

**SCHEDULE D**

**REGULATIONS, STANDARDS AND SPECIFICATIONS FOR THE  
DESIGN AND INSTALLATION OF WATER SYSTEMS**

This is Schedule D of the City of  
Vernon Subdivision and Development  
Servicing Bylaw No. 3843, 1992

*"Margaret Bailey"*

City Clerk

**SCHEDULE D – BYLAW NO. 3843**  
*(Bylaw 4515, June 21, 1999)*

**REGULATIONS, STANDARDS AND SPECIFICATIONS FOR THE DESIGN AND  
INSTALLATION OF WATER SYSTEMS**

**1.00 GENERAL DESIGN**

Water Distribution System to be Constructed by Applicant

- 1.01 Where the provisions of Schedule A of this Bylaw require the construction of a water distribution system, the Applicant shall provide a water distribution system and storage facilities including water mains, valves, hydrants, service connections, pump stations and reservoirs consistent with the regulations, standards and specifications set out in this Schedule. All standards not specifically described in this schedule shall be in accordance with appropriate American Water Works Association (AWWA) standards or as directed by the City Engineer.

Approval of Engineering Drawings Required prior to Construction  
*(Bylaw 4515, June 21, 1999)*

- 1.02 Engineering drawings showing detailed design of the necessary works shall be submitted to the City Engineer for approval. Engineering drawings shall also be submitted for approval to the regional Public Health Engineer of the Ministry of Health of the Province of British Columbia. The Ministry of Health's Final Certificate shall be submitted to the City Engineer prior to construction of any water system. No construction shall commence until the engineering drawings have been approved by the City Engineer and Ministry of Health. These drawings shall show alignment, size, *grade* and depths of pipes, pipe bedding requirements, existing ground line and proposed final ground line over the pipe, location, *elevation* and detail of all fittings, valves and hydrants, location of all service connections, location, access to, size and details of any pump stations and reservoirs, all easements and all such other details as may be required. Where a water system is not yet available, rights-of-way may be required to be provided by the Applicant to allow for the eventual installation of this facility. Such rights-of-way shall be registered in favor of the City of Vernon at the Applicant's expense.

Compliance with the Standards of Other Authorities *(Bylaw 4515, June 21, 1999)*

- 1.03 Where a subdivision is to be supplied by water from the *North Okanagan Water Authority* or other Water Authority, the Applicant shall comply with all of the specifications of the *Authority*, *in addition to providing a system equivalent to the City system and* provided that offsets and general layout for hydrants and valves shall comply with the minimum requirements this schedule.

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**2.00 DESIGN CRITERIA**

Capacity of System and Sizing of Water Mains (Bylaw 4515, June 21, 1999)

- 2.01 Water distribution systems shall be designed to deliver water in adequate quantities at adequate pressures for both domestic use under peak consumption conditions and fire flows. Mains shall be sized to carry the peak hourly flow rate or the maximum daily flow rate plus the fire flow rate, whichever is the greater. Mains shall be sized using the Hazen-William formula with  $C = 130$  for PVC mains and  $120$  for all other pipe material for new mains and maximum flow velocity for peak hourly demand rate of 2.0 m per second. For fire flow, plus the maximum day rate, the flow velocity shall not exceed 4.0 m per second.

Domestic Demand Criteria (Bylaw 4515, June 21, 1999)

- 2.02 For residential areas, the daily domestic demand criteria for purposes of designing water distribution systems shall be assumed to be:

Average day: 700 litres/day/capita

Maximum Day: 1800 liters/day/capita

Peak Hour/Maximum Day Consumption Ratio: 1.5

For other than residential areas, the demand criteria shall be selected to suit the particular circumstances subject to the approval of the City Engineer.

Fire Flow Requirements (Bylaw 4515, June 21, 1999)

- 2.03 Water distribution systems shall also be designed to ensure that fire flows as required by the Insurers' Advisory Organization (IAO) are available for required durations. The following fire flows must be met for the noted zones under maximum day flow conditions:

Single Family	60 litres/sec.
Low/Medium Density Residential, Light Industrial, Service Commercial	90 litres/sec.
High Density Residential, Urban Commercial, Institutional	150 litres/sec.
Industrial	200 litres/sec.

Interim fire flows, approved by the City Engineer, will be considered if the completed network will provide the ultimate fire flows.

Design Pressures (Bylaw 4515, June 21, 1999)

- 2.04 Water systems shall be designed for pressures in the range of 210 kPa to 1030 kPa, with 210 kPa measured under peak hourly conditions and 1030 kPa measured under static conditions. The minimum pressure shall be measured or calculated at the main

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floor elevation of the highest proposed house and an allowance made for pressure loss in the service line to the house wall. Minimum residual pressure at any hydrant shall not be less than 140 kPa under maximum day domestic consumption plus fire conditions. Reservoir level shall be assumed at mid point for calculation of minimum pressures and full for calculation of maximum static pressures. Design pressures different, but not less than the above, may be required if sprinkler systems are required. Such pressures must be designed and confirmed by the applicant's engineer.

Minimum Pipe Size (Bylaw 4515, June 21, 1999)

- 2.05 Watermain pipe size shall be determined by sizing to provide adequate fire protection.

The minimum pipe size for all water mains shall be 150 mm diameter *in low density residential areas and 200 mm in medium and high density residential, institutional, commercial and industrial areas.* For short dead end streets the minimum size may be reduced to 150 mm up to any required fire hydrants, provided such sizes meet fire flows, and 100 mm beyond. The City Engineer may require a hydraulic analysis design showing flows and pressures or may require lines to be oversized if on main distribution or transmission routes.

Location and Grade of Water Mains (Bylaw 4515, June 21, 1999)

- 2.06 Water mains shall be located in the road right-of-way as shown on Standard Drawings No. 100-1 to 100-6, unless otherwise approved by the City Engineer.

There shall be a minimum lineal horizontal clearance of 1 metre between a water main and other existing or proposed underground services, except sanitary and storm sewer mains. A minimum of 3 metre horizontal distance between a watermain and a sanitary or storm sewer main shall be maintained. In special cases such as installations in rock or hardpan, the horizontal clearance may be reduced, with the approval of the City Engineer and Ministry of Health, provided the invert of the water main is a minimum of 450 mm above the crown of the sanitary sewer and subject to any Provincial regulations. On side-hill streets, the main shall, where possible, be located on the cut side of the centre line of the street.

Water mains shall be normally designed to follow a straight alignment between intersections, at grades parallel to the road centreline.

Curved alignments may be accepted provided that the pipe alignment is at a parallel offset with an established boundary and the radius of curvature is not less than 60 m or the minimum radius of curvature recommended by the pipe manufacturer, whichever is the greater. The design drawings shall indicate the method for achieving the curvature. In no case shall curvature be established in PVC pipelines using joint deflection.

Water mains shall be designed with a rising grade wherever possible to minimize high points in the main. Where a high point is unavoidable, either a service or air release valve shall be installed at that point. Where the slope of the watermain exceeds 15% the design must provide proper pipe anchorage.

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Where the water main network is weak, installation of additional, interconnecting mains of a minimum of 200 mm diameter to existing mains may be required at the discretion of the City Engineer and may necessitate the provision of rights-of-way in favor of the City of Vernon. Supplementary mains shall be installed at the Applicant's cost. The maximum desirable length of any permanent non-interconnected watermain is 150 m. All mains exceeding 150 m must be looped, except with the approval of the City Engineer.

No gas main, electric or telephone duct or other utility line shall be installed in the same trench with water mains.

Where it is necessary for the water main to cross other underground services, the crossing shall be made at an angle greater than 20 degrees and the vertical clearance between services at the crossing point shall be not less than 300 mm except for sanitary sewers where the clearance shall be 450 mm between the exterior walls of the pipes.

The drawings shall indicate whether the water main passes over or under other underground services which it is crossing.

Spacing of Fire Hydrants *(Bylaw 4515, June 21, 1999)*

- 2.07 Fire hydrants shall be located, in general, at highway intersections and at maximum spacing of 150 metres in residential areas and 90 metres in high density commercial and industrial areas. Additional hydrants may be required by the City Engineer at schools, multiple family developments, commercial buildings or other major developments consistent with the current fire flow requirements of the Canadian Underwriters' Association. Whenever possible, hydrants shall be located near the lowest point of the water main. Additional fire hydrants, required to support new development, which are not required to meet the minimum spacing must be installed on private property and are to be considered private hydrants.

Where hydrants are located other than at intersections, they should be located on the projection of the property line dividing two lots. In selecting the location of a hydrant, the probable route of firefighting equipment shall be considered.

A hydrant shall not be located within 3 m of a utility pole or light standard, within 1.5 m horizontally of underground service pipes or open ditches, or within 1 m of the back of curb *nor can they protrude into the walkway.*

Line Valves *(Bylaw 4515, June 21, 1999)*

- 2.08 Line valves in residential areas shall be located at a maximum spacing of 300 m in a continuous line and shall generally be located so that not more than 2 hydrants or 50 dwelling units will be without adequate pressure in the event of any one water break.

In commercial and industrial areas, line valves shall have a maximum spacing of 120 m and be located so that not more than one hydrant will be out of service during water

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system repairs. Line valves on transmission mains with no services shall be located at a maximum spacing of 500 m.

In general a minimum of 3 valves are required at cross intersections and 2 valves at tee intersections. Valve locations should either be in a cluster at the intersection of the lines or at the projection of property lines.

A line valve may be required on a new pipe line near each point of connection to existing mains.

Blow Offs

- 2.09 Permanent blow offs shall be installed at all permanent dead-ends and an adapter will be required for connecting a standard 63 mm fire hose for flushing the main, as shown on the standard drawings.

Temporary blow offs (usually a corporation cock) may be installed to facilitate chlorination and flushing of any part of the system. After flushing, the temporary blow off shall be removed, plugged or capped as directed by the City Engineer.

Air Relief Valves (*Bylaw 4515, June 21, 1999*)

- 2.10 Double acting *combination*, air relief valves shall normally be installed at all summits in the mains. The applicant's engineer must provide a study of the proposed installation to determine the optimum type and placement of all air/vacuum valves.

Fittings and Appurtenances

- 2.11 Fittings and appurtenances with other than standard hub ends shall be so indicated on plan.

Where practical, all fittings shall be located in respect to each other so that flanges or standard pipe lengths can be used to connect them.

The centre-to-centre dimension between fittings near each other shall be shown on the final engineering drawing.

Services (*Bylaw 4515, June 21, 1999*)

- 2.12 The diameter of water services shall be determined by the City Engineer provided that in no case shall the diameter be less than 19 mm. If on-site sprinklering is to be installed the Design Engineer must determine the diameter of service required and show such on the drawings. No service connection sizes between 50 mm and 100 mm will be permitted.

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Water services shall be installed to the property line in accordance with Standard Drawings No. 300-1 and shall be installed, whenever possible, in a common trench with the sanitary sewer service.

A water service shall be installed where required to provide a connection to each lot created by the subdivision and to any other existing or possible future lot which can be serviced from mains installed by or for the subdivision.

In general, 19 mm diameter service connections may be tapped directly into mains 150 mm diameter and greater; and 25 mm diameter service connections may be tapped directly into mains 200 mm diameter and greater, except in the use of PVC water mains where all service connections must be made with double strap service saddles. 40 mm and 50 mm diameter service connections shall be made using double strap service saddles. Multiple corporation stops shall be staggered and not less than 600 mm apart.

No tappings shall be made at an angle of greater than 30 degrees above the horizontal centreline plan of the pipe.

Where it is necessary to install service connections at less than 1 m centres in a 100 mm diameter main, such lengths of pipe shall, in all cases, be ductile iron.

The curb stop at the end of each service pipe shall be located 0.3 m in front of the street/property boundary line, and at the centre of each lot. Where such location will conflict with other services, the location may be revised with the approval of the City Engineer.

Depth of Cover

- 2.13 The depth of the water main shall be sufficient to provide all services with a minimum cover of 1.5 m to the top of the service anywhere within the Right-of-Way. In no instance shall the minimum cover over the crown of the main be less than 1.5 m.

Tie-ins to Existing Water Mains

- 2.14 Connection of a new pipe to an existing water main shall be done by the City unless the existing main has an acceptable provision for a direct extension. The Applicant shall pay for the supply of all materials required and shall pay the full cost of making the tie-in. This portion of the work, including details of materials required, shall be clearly indicated on the design drawings. Only the City may operate valves and curb stops on the existing water mains. Application for tie-in shall be made one week in advance of the proposed work.

Reservoirs *(Bylaw 4515, June 21, 1999)*

- 2.15 Reservoirs, where required, shall be designed to suit the particular circumstances. In general, reservoir capacity shall be not less than:

Total Storage Requirement = A + B + C

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where A = Fire Storage

B = Equalization Storage (25% of maximum day demand)

C = Emergency Storage (25% of A + B)

Reservoir design shall incorporate, *but not be limited to* the following features:

- must be built to current Ministry of Health standards;
- structures to be below ground and covered, unless specifically approved otherwise;
- material - reinforced concrete;
- 2 cells, each containing one-half of total required volume and capable of being drained and filled independently;
- suitable anchors for fall arrest devices;
- one access opening in roof for cleaning and maintenance - minimum dimension 1 m x 1 m each, to be located between overflow pipe and wall;
- lockable hatches, using Master 21KZ-15 padlocks;
- hatches must not drain into reservoir, and have a weather proof seal to prevent contamination;
- extendible post extending 0.6 metres above sill level for all ladders;
- vacuum relief pipe;
- ventilation pipes or openings complete with bird screens;
- slope floor to sump;
- roof must slope to sides to provide drainage;
- sub-drain under floor to collect and drain any leakage;
- interior wall ladders from roof accesses to floor (no exterior ladder required); above ground reservoirs require ground level manway;
- exposed surfaces of any above ground reservoir must be finished to be aesthetically pleasing; form concrete not acceptable;
- guard rail required on exposed side(s) of any above ground reservoirs;
- landscaping plan;
- separate inlet and outlet pipes at diagonally opposite ends of reservoir cell designed to encourage circulation and reduce dead spots;
- overflow drain to be provided and sized to transmit the maximum pump discharge. The overflow drain shall be connected to an acceptable point of discharge;
- air break in overflow/drainage line prior to first service connection to this line;
- access road must have a 4.5 m wide, 75 mm thick asphalt surface, 100 mm base and 150 mm sub-base with 1.0 m wide gravel shoulders. The road should be crossfalled to the ditch at 3% with centreline grades not to exceed 15%. Minimum centreline radius, with no expanded corner, is 12.0 m. Temporary access roads may be permitted but must have the design approved by the City Engineer;
- gate required on access road c/w Master 21 KZ-15 padlock;
- ultrasonic level transmitter, three wire style;
- level transmitter must be moveable from cell to cell;
- high and low level floats;
- cable communications shall include at least 2 spare pair;
- equipment and operations manuals.



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Reservoir Disinfection and testing:

- Disinfection procedure must be in accordance with the latest version of AWWA Standard C652. Two or more successive sets of samples, taken at 24-hour intervals indicating acceptable levels of organic and bacteriological background are to be provided to the City Engineer prior to acceptance of the reservoir for filling. Heavily chlorinated water must be disposed of in accordance with current Ministry of Health standards.

Reservoir valve chamber design shall incorporate:

- sump in valve chamber floor, connected to overflow pipe;
- 50 mm valved outlet off supply line within valve chamber for water supply for cleaning reservoir;

Pump Stations *(Bylaw 4515, June 21, 1999)*

- 2.16 Pump stations, where required, shall be designed to suit the particular circumstances. In general, pump stations shall be designed to meet maximum daily demands with the largest pump out of service with balanced storage on line. A pre-design report providing pumpstation site plan, layouts and design calculations are required prior to detailed design. Upon approval of the pre-design report by the City Engineer, the applicant can commence detailed design addressing the following requirements.

A building permit is required prior to construction.

Pump station design shall incorporate the following features:

- reinforced concrete, all exposed walls to be constructed of ledger block or alternate as approved by City Engineer, construction, aesthetically pleasing;
- free standing buildings require a safety device system complete with fall restraint from roof area where roof access is required;
- if building is partially buried a mansard style roof, to act as a hand rail. The material must match that used in adjacent areas;
- address and pumpstation number as specified by City;
- exterior lights;
- removable, insulated winter covers on all louvers;
- a 1.8 m, 50 mm #9 chainlink fence, topped with 3 strand barbed wire, angled in with acceptable hedging c/w a drip irrigation system;
- there must be eaves over all doors with access doorways sized so that the largest single piece of equipment may be safely removed and replaced. Lifting hooks or rails with pulley blocks as required;
- all exterior doors must be connected to an alarm system, connected to the PLC;

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- all exterior doors to be vandal resistant with Schlage door locks, auto closers, hooks, and a stainless steel jimmy plate. Hatches to be locked with a pad lock. Pad locks to be Master #21 KZ-15;
- a wall mounted fire extinguisher must be provided in the pump room;
- interior must be painted with a light earth tone shade and well lit;
- emergency lights;
- separate rooms are required for the chlorination and electrical rooms, each with a window to the pump room;
  
- sites greater than 10 driving kilometres from existing City buildings, containing a year round toilet, may be required to provide washroom facilities;
- where rechlorination is not required a sub-surface pump station may be permitted provided it has a stair well for operator access;
- pumps to start and stop individually. Start and stop to be based on water levels in control reservoir. Automatic alternation of pump sequence;
- power failure protection with manual reset;
- high water override start plus alarm;
- high pressure (discharge) override start;
- low pressure (discharge) override start plus alarm;
- low pressure/no flow (suction) override start;
- Alarm acknowledge button;
- Un-acknowledged alarm light;
- Alarm reset button;
- Active alarm light;
- alarm bypass switch, c/w bypass light;
- Reset switches for all equipment to be accessible from exterior of control panels;
- the Programmable Logic Controller shall be a Control Microsystems Telesafe SCADA Pack and complete modules or equivalent approved by City Engineer;
- The modem shall be a US Robotic Sportster Modem with minimum 16 k baud rate or equivalent approved by City Engineer;
- Two phone lines, one must be an Information Systems Access, BC Tel ISA line, the other a standard voice phone line complete with hand set;
- Stations to include the following output data:
  - intrusion alarm, door and window switches required;
  - low building temperature alarm, thermostat switch required in each room;
  - pump status (on or off);
  - pump selector status (hand, off or auto);
  - pump overload draw alarm;
  - pump over heat alarm;
  - metered flow rate;
  - chlorination speed rate;
  - pump running low flow alarm;
  - high flow alarm;
  - low pump suction pressure alarm;
  - discharge pressure;
  - high pressure discharge alarm;
  - suction pressure;

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- PLC failure;
- power failure;
- ground fault;
- loss of phase;
- low PLC battery failure (low battery or analogue input failure);
- high motor control centre temperature;
- chlorine residuals;
- high chlorine residual alarm (if re-chlorination is installed);
- low chlorine residual alarm;
- reservoir entry alarm, contact switches required;
- reservoir level signal;
- low reservoir alarm, via a float switch, Flygt type;
- high reservoir alarm, via float switch, Flygt type;
  
- A Human Machine Interface (HMI), connected to the PLC. The HMI must be 50 I/O Runtime Lookout Software for Windows 98, resident on a computer capable of operating Windows 98, the above noted software and have a minimum of the following:
  - Intel Pentium 200, or approved equal;
  - 16 mb ram;
  - 300 mb hard drive;
  - 14" nominal SVGA (640 X 480) NI monitor & compatible video display controller;
  - two serial ports, one parallel port;
  - 3.5" floppy drive;
  - 4X CD ROM drive;
  - 200 watt power supply;
  - keyboard and Microsoft mouse or approved equal;
  - Windows 98;
  - Microsoft Works;
  - shelf or desk for monitor, keyboard, keyboard cover and mouse pad;
  - sufficient cabling to connect to PLC;
  
- Stations to have an un-interruptable power supply (UPS) sized for a power supply of twenty minutes. Typically UPS powers the following equipment, if it is present:
  - PLC;
  - modem;
  - HMI (not including the monitor);
  - solenoid valves for fire flow valves;
  - level transmitters;
  - Liebert GXT-700 MT-120, for Gen. Set. applications, a Liebert PS 700 MT-120 otherwise, or approved equal UPS;
  
- A suitable transient voltage suppresser, for the UPS, and all telephone, or telemetry lines connected to the PLC or modem;

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- Where rechlorination is required it must be provided by means of sodium hypochloride pumping from two suitable plastic drums. Each must be a minimum of 200 litres and have a lid and drains complete with a valve. A hose bib must be located within 4 m of the drums;
- Chlorine solution pump is a Wallace and Tiernan Model Premia 75 Micro P75MP19XAVCBXX, or similar from this model line or a ProMinent Concept, or similar from this model line;
- Residual chlorine is measured by a EIT model 8450 –1-1-1-1 or equivalent approved by City Engineer;
- The flow meter must be wired to the PLC. Leads from the PLC go to the chlorinator;
- Chlorination room must have suitable sump preventing drainage of spilled chlorine. Sump to be larger than chlorine mixing barrel;
- All pump station discharge to be metered. Meters to be Sparling Tigermag or ABB Kent-Taylor MagMaster or equivalent approved by City Engineer;
- Piping subject to corrosion shall be interior and exterior coated. Potable water pipe shall be exterior coated blue. All pipe labelled complete with directional arrows;
- Piping shall include sufficient unions, or similar devices to provide easy removal of all equipment. Piping in parallel systems to have joints that provide slack permitting easy removal of equipment. The City prefers Victaulic couplings on pipes 50 mm and over;
- House-keeping pads to be set with pipes in thrust blocking, and supports;
- A minimum of 700 mm space on one side, and 200 mm on the other shall be maintained from the outside of all appurtenances to adjacent appurtenances or parallel walls. Rotary equipment shall have a minimum of 1000 mm space all around;
- Valves shall be placed so the entire station may be isolated;
- Hose bibs shall be placed upstream and downstream of the pump; they should also be upstream and downstream of rechlorination;
- A 8 m garden house, hose hanger and nozzle;
- Where rechlorination of the main may be required, provision for future chlorine injection piping must be installed;
- Pressure gauges and transmitters to be ranged so that the standard operating pressure is no less than half the instrument's peak. Gauges and transmitters to have an isolation valve, a tee and plug;
- Impellers must be Zincless Bronze;
- Safety screen must be used to enclose moving parts;
- Pilot valves to be Stainless Steel, Singer model 160 SST or equivalent approved by the City Engineer. Pilot valve tubing to be stainless steel. Y strainers shall be placed ahead of all pilot valves;
- alarms to be audible and visible;
- control valves to minimize starting and stopping surges;
- duplicate control cables (without splices) between pump stations and reservoirs;
- power factor correction as required by Power Authority;
- hour meters on each pump;
- automatic heating, ventilating and dehumidifying systems;
- drainage to be provided for all areas of the pump station;

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- chlorine alert detection where gaseous chlorine is used;
- chlorine weight scale where gaseous chlorine is used;
- electrical phase loss protection;
- electrical drawing schematics for control panels;
- duplex strainers on control valves;
- paved access roads to rural standards, minimum;
- pump electrical, equipment and operations manual.

For each design submission to the City, an extra set of drawings and manuals pertaining to the design of the pump station, keyplan, and a location plan shall be submitted for the maintenance department to review.

Before commencement of construction, the Applicant shall provide five sealed sets of mechanical shop drawings and five sealed sets of electrical line diagrams for review by the City Engineer and the application for a building permit (two additional sets).

Two sealed copies of design calculations shall be provided for documentation. Before acceptance of the completed station, by the City, the Applicant shall provide one copy of the as-built electrical/electronic plans for the facilities, which shall be sized for metric A1, and 3 copies of an Operation and Maintenance Manual to the City. The manual shall contain:

- As constructed shop drawings.
- Equipment layout drawings.
- Electrical, control, and alarm wiring diagrams.
- Operating instructions for the station and for all equipment.
- Maintenance instructions for all equipment, including frequency of maintenance tasks.
- Equipment data sheets.
- Certified head/capacity curves for pumps.
- Equipment part lists.
- Emergency operating procedures.

The maintenance manuals shall be hardbacked bound documents with the name of the facility embossed on the cover.

The station must meet all WCB requirements. All stations with rechlorination to include a tepid water eye wash and shower in accordance with WCB requirements.

Pressure Reducing Stations (Bylaw 4515, June 21, 1999)

2.17 *Where a PRV is required to provide water at an adequate reduced pressure to an area it must be designed to meet maximum daily demand as well as fire flow requirements for the service area and shall incorporate the following features:*

- *below the finished grade with the access hatch at least 200 mm above the surface;*
- *insulated on the ceiling;*
- *located in a City ROW but not under any permanent road structures;*

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- *Each pressure zone created, containing more than 50 service connections, must have a minimum of one pressure transmitter connected to the SCADA system;*
- *The PRV used is at the discretion of the project engineer subject to approval by the City Engineer however in areas with less than 50 service connections a Roll seal type valve will not be permitted;*
- *Piping, valves, pilot valves, gauges, pressure transmitters, access hatches and ladders the same as pump stations;*
- *Each pressure zone to have a minimum of two pressure reducing valves supplying the zone. This allows for the maintenance of one of the valves. The second supply may be contained in a common PRV station;*
- *Venting must be in accordance with WCB regulations;*
- *Lighting must be provided;*
- *the maximum distance from the access hatch lid to the PRV floor must not exceed 3.0 m;*
- *the floor must be sloped to a sump which must drain to a community storm system or drywell. An air break is required on this drain.*

### **3.00 MATERIALS**

#### Pipe (Bylaw 4515, June 21, 1999)

#### 3.01 Pipe for water mains shall either be ductile iron or polyvinyl chloride (PVC).

- *Ductile iron pipe shall be AWWA C151 Standard in minimum Pressure Class 350 for sizes 100 mm through 300 mm, minimum Pressure Class 250 for sizes 350 mm through 500 mm. Sizes larger than 500 mm must have the pressure class specified and approved by the City Engineer. Pipe shall be supplied with push-on joints to AWWA C111 Standard. The pipe shall be cement mortar lined to AWWA C104. All pipe shall be polyethylene encased to AWWA C105 Standard, unless otherwise approved by the City Engineer based upon a comprehensive soil analysis submitted by the applicant which demonstrates that encasement is not required.*
- *PVC pipe shall be pigmented blue and conform with AWWA C-900-81 and have CSA certification, CAN3- B1373M-86 for mains 100 - 300 mm diameter and with AWWA C-905 CSA CAN3-B137.3-M86 for mains 350 mm to 600 mm diameter. Joints shall be wall thickened and sleeve reinforced bell and spigot ends with formed groove for elastomeric gasket seal conforming to ASTM D2122.*

#### Fittings (Bylaw 4515, June 21, 1999)

#### 3.02 Fittings shall be ductile iron for use with ductile iron or PVC pipes conforming to AWWA C110/A21.10 and shall be designed for a minimum pressure of 1720 kPa unless specified otherwise by the City Engineer.

Compact Ductile Iron AWWA C153/A21.53 are also acceptable.

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Buried Valves (Bylaw 4515, June 21, 1999)

- 3.03 Buried valves between 100 mm and 300 mm shall be gate valves and shall conform to:

AWWA C-509 iron body, resilient seated valves with non-rising stem, O-ring stem seal, suitable for 1 MPa minimum and have tie-lugs.

Buried valves 350 mm and over are to be butterfly valves and shall conform to:

AWWA C504, Valve body shall be cast iron ASTM A 126/126B, (for pressures over 150 psi), Class B, with an epoxy coating meeting AWWA C550. Valve shaft must conform to stainless steel ASTM A-276 Type 304. Valve actuators must be fully grease packed with stops in the open and closed position which can withstand an input torque of 450 ft. lbs. Mueller Linesal III/XP or approved equivalent. Butterfly valves must be flange type unless otherwise specified by the City Engineer.

Both types of valves shall be equipped with a 50 mm square AWWA operating nut and open counterclockwise.

Valve Boxes (Bylaw 4515, June 21, 1999)

- 3.04 Valve boxes shall be Nelson type with anchored flanges approximately 100 mm from the top of the box. *The box must be flush with the finished surface, no risers are permitted.*

Hydrants (Bylaw 4515, June 21, 1999)

- 3.05 All hydrants shall be Terminal City Iron Works Number C-71P compression, CLOW-Brigadier M93 or Canada Valve/Mueller-Century B-50-B24 complete with 2 - 63.5 mm ports and be equipped with a 100 mm Storz Port. Threads shall conform to the British Columbia Fire Hose Thread specifications. Inlet connection shall be 150 mm diameter. Hydrants shall be painted yellow above the ground line. Drain outlets shall be provided. Depth of bury shall be a minimum of 1.5 metres.

Joint Restraints (Bylaw 4515, June 21, 1999)

- 3.06 Joint restraints must be Uni-Flange or equivalent as approved by City Engineer and be manufactured of high strength ductile iron in accordance with ASTM A536. Restraints for use on PVC pipe must meet ASTM F1674. If joint restraints are proposed to be used as an alternative to concrete thrust blocks the applicant must provide detailed design information for each application, from the restraint manufacturer, endorsed by the pipe manufacturer.

Service Connection Pipe, Saddles, and Joints (Bylaw 4515, June 21, 1999)

- 3.07 All pipe for underground services 50 mm diameter and smaller shall be Type K annealed copper conforming to ASTM B88. The use of alternate Water Service tubing, rather than copper, in corrosive soil areas, may be permitted by the City Engineer provided compatible fittings are also used. Pipe for services 100 mm and 150 mm diameter shall

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be as specified for the watermain pipe. No services between 50 mm and 100 mm are permitted.

Service connections to PVC pipe shall be made using bronze saddles with either bronze or stainless steel (*Type 304*) fasteners tapped for AWWA thread. Saddles shall provide full support around the circumference of the pipe and shall provide a minimum bearing width of 50 mm measured along the axis of the pipe. Saddles must have at least two bolts.

Corporation Stops (*Bylaw 4515, June 21, 1999*)

- 3.08 Corporation stops shall be a ball valve type conforming to AWWA C-800 and rated to withstand 300 psi. Approved models are: Mueller 300 Ball valves, Ford B Series Ball valve, Cambridge Brass Century 2000 Ball valve, EMCO Ball valve or McDonald Ball valve.

Curb Stop and Boxes (*Bylaw 4515, June 21, 1999*)

- 3.09 Curb stops shall be a ball valve type conforming to AWWA C-800 and rated to withstand 300 psi. Approved models are: Mueller 300 Ball valves, Ford B Series Ball valve or Cambridge Brass Century 2000 Ball valve for 19-50 mm.

Service boxes shall be Mueller A726 or Trojan VSB1 for 19 mm diameter to 40 mm diameter and Mueller A728 or Trojan VSB2 for 40 mm diameter through 50 mm diameter. Curb box rods must be either Mueller or Trojan.

Air Valves (*Bylaw 4515, June 21, 1999*)

- 3.10 Air valves shall be at least a 50 mm Terminal City, Apco or Crispin double acting air valves or as approved by the City Engineer. Combined valves will also be permitted. All air/vacuum valves must be installed in a standard 1050 mm manhole as per standard DWG 300-5.

Stops and Drains (*Bylaw 4515, June 21, 1999*)

- 3.11 Stops and drains shall be minimum 50 mm ball valve type, conforming to AWWA C-800 and rated to withstand 300 psi. Approved models are: Mueller 300 Ball valves, Ford B Series Ball valve or Cambridge Brass Century 2000 Ball valve.

Meters



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3.12 Meters shall be installed indoors or in an outdoor enclosure at the Applicant's expense. Location shall be as approved by the City Engineer. All meters shall be easily accessible to the City. Outdoor meter chambers, vaults or enclosures shall include:

- underground structures shall be watertight
- drainage and ventilation
- protection from freezing
- adequate access and interior space for maintenance and equipment removal
- minimum headroom of 2.0 m
- permanent ladder to WCB standards
- piping primed and painted with a rust-inhibiting paint
- metering and readout devices as required by the City of Vernon Waterworks Bylaw
- meter bypass

Concrete

3.13 All concrete shall conform to CSA A23.1 with a minimum 28-day compressive strength of 14 MPa for unshrinkable fill and thrust blocks, and 20 MPa for all other purposes. Concrete slump shall be in the range of 50 mm to 100 mm.

Cement shall be Portland cement conforming to CSA A.5, and shall be normal type unless specified by the City Engineer or dictated otherwise by soil conditions.

Admixtures shall not be included in the concrete mix without the approval of the City Engineer.

Bedding Material

3.14 Bedding shall for all pipe bedding shall be sand or crushed rock free of clay lumps, organic and other deleterious material. Gradation shall conform to the gradation limits set out on Standard Drawings No. 100-14 and 100-15.

Backfill Material in Pipe Zone

3.15 Backfill material in the pipe zone shall be sand or crushed rock free of clay lumps, organic and deleterious material. Gradation shall conform to the gradation limits set out or Standard Drawings No. 100-14 and 100-15.

Backfill Material Above Pipe Zone

3.16 In Traveled Areas

- Backfill material below the pavement structure for trenches in road areas shall be pitrun gravel with gradation limits as shown on Standard Drawings No. 100-12.

In Non-Traveled Areas:

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- Backfill material for trenches and easements or other non- road areas may be native material excavated from the trench providing it is sufficiently free of frozen soil, roots or other objectionable material so as not to cause undue settlement. Maximum particle size of backfill material not to exceed 200 mm.

**4.00 WORKMANSHIP**

Trench Excavation

- 4.01 Trenches shall be excavated to suit the cross-section shown on the Standard Drawings No. 400-7. Open trenches through existing paved surfaces will be allowed only with the prior express consent of the City Engineer. When trenches through existing pavement are allowed, the pavement shall first be saw-cut by mechanical means in straight continuous lines parallel to the trench centreline.

If trenches are excavated wider than the specified widths, a higher class of pipe or special bedding may be required.

Rock excavation in trenches shall provide a minimum clearance of 150 mm below the pipe for pipes 600 mm in diameter or less, and 250 mm for pipes larger than 600 mm in diameter.

The top of the trench at ground level shall be kept to the minimum width consistent with the depth, natural angle of repose of the material and the regulations of the Workers' Compensation Board.

Excavation for manholes, fittings and other appurtenances, shall be to the lines which will permit the assembly of these sections. Concrete for bases may be cast against the walls of the excavation, if the soil conditions are suitable.

Where an existing structure or underground installation may be affected by the works, it is the responsibility of the Applicant to inform the owner of such facility sufficiently in advance that the owner may make an inspection and specify the protective measures to be undertaken.

Where an unforeseen or other obstruction is encountered which interferes with the designed alignment or grade, the construction shall cease until such time as revised proposals are approved by the City Engineer.

The attention of the Applicant is directed to the provisions of the Workers' Compensation Board safety regulations. All municipal employees have been instructed not to enter excavations which are not properly braced or which otherwise do not conform with the requirement of the Board. It follows, therefore, that approvals cannot be given to installations not inspected because of unsafe working conditions.

Any over-excavation of the trench subgrade beyond the specified depth shall be backfilled with select material and compacted to 100% Standard Proctor Density.

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In rock excavation the depth of compacted bedding material below the pipe shall be a minimum of 150 mm for pipe of 600 mm diameter or less and 250 mm for pipe in excess of 600 mm diameter. This depth shall exist for the full wall-to-wall width of the trench.

Where the bottom of any excavation as uncovered is soft and is in the Developer's Engineer's opinion unfit to support the pipes or structures, a further depth shall be excavated and refilled to the correct shape, grade and elevation as directed by the Developer's Engineer.

When the bottom of a trench is found to consist of unstable material which, in the opinion of the Developer's Engineer, cannot be removed and replaced with bedding material, a pile foundation or other structural support in accordance with plans prepared by the Developer's Engineer shall be constructed.

In areas of clay or other impermeable soils, where overexcavation of the trench subgrade is required, the overexcavation shall continue to a point where ponding of water in the trench bottom will be avoided.

Open cut trenches shall be sheeted and braced as required by the Workers' Compensation Act, as may be necessary to protect life, property, or the work, unless the trench excavation is sufficiently wide at the top to be naturally stable. When close sheeting is required, it shall be driven so as to prevent the soil from entering the trench either from below or through such sheeting. A minimum distance of 150 mm from the closest point of the pipe to the sheeting shall be maintained.

When possible, vertical trench timber or sheeting shall be placed so that it does not extend below the level of the bottom of the excavation. Sheeting driven below the pipe grade shall not be removed unless the sheeting can be removed without causing settlement or lateral displacement of the pipe.

Sheeting thus left in shall be cut off 100 mm above the top of the pipe.

Unless otherwise indicated in the drawings or specifications, or unless approval to leave it in place is received from the City Engineer, trench sheeting and bracing shall be removed when backfilling has been completed or has reached a level which will permit its safe removal without causing injury to persons or damage to the works. When sheeting and bracing is left in place, it shall be cut such that no sheeting remains closer than one metre to the established sub-base road grade or the existing ground surface, whichever is the lower.

Particular caution will be taken to ensure that pipe bedding is not disturbed such that settlement of the pipe results.

Timber supports or sheeting shall be left in place when its removal would endanger adjacent structures or result in a shifting of pipe bedding material and a displacement of the pipe. The City Engineer may require the pipe to be bedded in concrete (Class A Bedding) when, in his opinion, the removal of sheeting would disturb the pipe bedding.

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Discharge from trench pumps, well points, or other dewatering aids, shall be located and controlled in such a manner as to not cause loss or damage to public or private property, nuisance on roads or walks, or injury to the public.

Pipe Class and Bedding Class

- 4.02 Notwithstanding other provisions of this Bylaw, the quality of the pipe and bedding shall be so selected such that the installation will adequately support the loads to be placed on it during construction and in operation. For ductile iron pipe, the calculations shall follow the method shown in CSA B131.12, latest edition. For PVC pipe, the calculations shall follow the methods outlined in the Uni-Bell Plastic Pipe Association publication "Handbook of PVC Pipe - Design and Construction", latest edition.

For all pipe, a minimum Class B bedding, as defined by Standard Drawings No. 400-8, is required. Pipe class and bedding class must be identified on all engineering drawings.

Pipe Alignment and Depth of Cover

- 4.03 Pipe shall be installed true to the alignment shown on the approved construction drawings and to a depth sufficient to provide a minimum cover of 1.5 m measured from the top of the installed pipe to the finished grade elevation over the pipe.

Pipe Installation

- 4.04 Prior to installing pipe, all standing water shall be drained or pumped from the trench. Pipe shall be carefully offloaded and lowered into the trench in a manner that will prevent damage to the pipe. The pipe shall be jointed in strict accordance with the manufacturer's recommended practice.

Service connection pipe shall be connected to the Corporation stop and a gooseneck formed as shown on Standard Drawings No. 300-1. Pipe shall be installed in a straight line between the gooseneck and the terminus of the service.

Compression joints shall be required for connecting service piping. Service tapping shall be spaced along the length of pipe and staggered around the circumference to avoid cracking of pipe between tappings. Minimum distance between two tappings and between the end of a pipe and the tapping shall be 600 mm. A marker stake shall be set with bottom flush with the end of the service and the top projecting above the ground. Marker stakes shall be cut to an even 200 mm length, and depth from top of marker to water service shall be clearly marked on the stake. Marker stake tops shall be painted blue with yellow painted stencilled numbers and letters.

Service boxes shall be set flush with ground or road surface. A blue marker stake with appropriate identification shall be installed to identify the curb stop. A length of copper flattened on one end shall be installed on the private property side of the curb stop to prevent entrance of foreign material and this pipe shall extend 1500 mm into private property.

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Thrust Blocking (Bylaw 4515, June 21, 1999)

- 4.05 Concrete thrust blocking shall be provided at fittings as shown on Standard Drawings No. 300-2 and on hydrants as shown on Standard Drawings No. 300-3. Concrete shall be placed between undisturbed ground and the fitting to be anchored such that the pipe and the fitting joints are accessible for repair. Bolts on flanged fittings shall be left free. The area of thrust block bearing on pipe and on ground shall be no less than that shown on Standard Drawings No. 300-2. Joint restraints used on PVC mains must be two directional to prevent compression of the joints.

Temporary blocking or support of valves and fittings shall be with concrete, fabricated steel, durable rock, sand or gravel and in no case shall temporary or permanent wood blocking be used.

Valves, Fittings and Hydrants

- 4.06 Valves, fittings and hydrants shall be set plumb and directly on the centerline of the pipe. A valve box shall be provided for every valve. The valve box shall not transmit shock or strain to the valve and shall be centered and plumb over the nut of the valve. The 150 mm riser pipe must be placed in such a manner as to permit the use of long-handled angle wrenches through the box to tighten packing gland nuts. On valves 200 mm and over, a cast bell bottom fitting shall be used over the valve.

Hydrants shall be plumb and shall have their nozzles parallel with or at right angles to the curb. Hydrants shall be set with ground flange above the ground at the elevation directed by the City Engineer generally at 150 mm above finished curb grade. When set in a permanent sidewalk or other solid structure, a suitable expansion joint material shall be placed around the hydrant to allow for movement between hydrant and structure. All hydrants shall be supplied with drains. Sufficient drain gravel shall be placed to allow for proper hydrant drainage, generally a minimum of 0.50 cubic metres.

Blow-Offs

- 4.07 Blow-offs shall be installed as shown on Standard Drawings No. 300-4.

Backfill Above Pipe Zone

- 4.08 In Traveled Areas

- In road areas trench backfill material shall be placed in layers not exceeding 300 mm in thickness and compacted by mechanical means to a minimum of 95% Standard Proctor Density.

The water content of the material shall be controlled to achieve the required density. When the natural water content of the material is less than the required value, water shall be added during the placing of the fill materials. When the

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water content of the material is greater than the required value, all compaction and placement operations shall cease and the material aerated until the required water content is obtained.

In Non-Traveled Areas

- In easements and other non-roads areas, native trench material may be used for trench backfill above the pipe zone. Backfill shall be placed and compacted to 90% Standard Proctor Density except, where structures or walkways are located over the pipe, compact to 95% Standard Proctor Density.

Service Connections

- 4.09 Service connections shall be installed as shown on Standard Drawings No. 300-1.

Service connections shall be tested with mains where main testing is required.

A 50 X 100 mm marker stake shall be set with the bottom of the service connection with the top projecting 1.0 m above the ground surface. Marker stakes shall be painted "blue", be cut to an even 200 mm length and the depth from top of stake to the service pipe shall be clearly marked on the stake with yellow, painted stencilled letters and numbers.

Information as to size of service pipe and type of service shall also be indicated on the stake.

Pipe Casings

- 4.10 Pipe casings shall be installed as shown on the engineering drawings. The water pipe shall be blocked at each joint to ensure line and grade is maintained and the casing is to be sealed at both ends with joint filler with proper care taken to ensure that the pipe remains on line and grade and does not float. The annular space between the water pipe and the casing pipe may be filled with sand or otherwise secured from floating and movement.

A length of 6 mm polypropylene rope shall be laid alongside the carrier pipe inside the casing to assist future retrieval.

Pavement Restoration

- 4.11 If the edges of the cut pavement become ragged as a result of the construction operation, the pavement shall be re-cut to form a straight line prior to placing new pavement. The edges of the existing pavement shall be thoroughly clean and coated with an approved bituminous bonding agent prior to placing the hot asphalt mix. The finished grade of the asphalt surface shall conform with that of the existing surface such that no rises, depressions or ridges result from the repaving process.

TESTING

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Leakage Tests

- 4.12 Following final trench backfilling, leakage tests shall be performed on all installed piping according to AWWA Standard C600. Tests shall be conducted in the presence of the City Engineer with 24 hour notice provided to the City in advance of the test. A leakage test shall be conducted after all mains and service connections have been completely installed and backfilled. The Applicant shall furnish all necessary apparatus, test water and labour to conduct test. Leakage tests shall be performed in the following manner:

The section to be tested shall be filled with water and all air expelled from the piping. It is recommended that the test section be filled with water for at least 24 hours prior to testing. By pumping water into the test section, the pressure within the piping shall be increased to the pressure rating of the main or 1 1/2 times the operating pressure, whichever is greater. This pressure shall be maintained constantly in the pipe throughout the duration of the test by the addition of make-up water. The duration of the test shall be a minimum of 2 hours. Hydrant leads shall be shut off at the hydrant such that the hydrant is placed under test. The quantity of water pumped into the test section to maintain the specified pressure over the period of the test shall be considered to be the leakage. Piping will not be accepted until the leakage is less than the maximum allowable leakage determined from the following formula:

$$L = ND \_P$$

in which      L = the allowable leakage in L/hr.  
                  N = the number of joints in the test section.  
                  D = the nominal diameter of the pipe in mm.  
                  P = the average test pressure during the leakage test in kPa.

Should any test disclose leakage greater than that specified above, the source of the leakage shall be located and the defect repaired or the necessary replacement made and the section retested until a satisfactory test is obtained. All repairs to the work shall be made with new material equivalent to that requiring repair or replacement. The use of repair and maintenance aids such as clamps will not be permitted.

Leakage tests shall be carried out between valved sections of the installation such that every valve in the system is tested for leakage in the shut-off position.

Flushing

- 4.13 The pipe shall be cleaned of dirt and other foreign materials. The pipe shall be flushed at water velocities of 1 m/s or as high a velocity as can be obtained from the available water source. Flushing time shall be at least five times the time required to travel the main at 1.5 m/s velocity. Flushing shall continue for the required time or until 10 minutes after the water has cleared, whichever is greater.

The Developer's Engineer shall submit a report to the City Engineer indicating that flushing was performed in conformance with this section.

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Chlorination

- 4.14 On completion of the flushing operation, main pipes and services shall be chlorinated. Chlorination procedures shall conform to AWWA C601. No pills, powders or solids shall be placed in the main during installation or for chlorination purposes. Chlorination shall be applied by the continuous feed method.

After preliminary flushing, the chlorine solution shall be injected at a measured rate such as to fill the main with a 50 mg/L available chlorine solution.

All appurtenances shall be operated in this solution to disinfect them. All measures shall be taken to prevent the disinfectant solution from flowing into existing water supply system. The disinfecting solution shall remain in the main for 24 hours and shall have no less residual than 25 mg/l at the end of that period. Following disinfection of lines to the required standard, the line shall have a final flushing to completely purge all disinfecting solution. Any water with residual greater than 2.5 mg/L shall be diluted prior to discharging to an open ditch. Flushing shall continue for 15 minutes after a concentration of 1 mg/L is reached. Water with a chlorine concentration greater than 1 mg/L shall not be discharged to a recognized water course without the approval of the Ministry of Environment.

Bacteriological samples must be submitted to a qualified testing laboratory and indicate that satisfactory disinfection has been achieved prior to putting the main into service.

A log of all test results and disinfection procedures and bacteriological tests shall be submitted to the City Engineer. On completion of chlorination, the entire piping system shall be thoroughly flushed, filled with water and left in a condition ready for use.

Compaction Test

- 4.15 The City shall be provided with copies of all sieve and compaction test results pertaining to bedding backfill and road restoration.

Compaction tests shall be taken at a frequency of one test per lift for every 75 m of trench length and one test per lift for any trench less than 75 m.

**5.00 STANDARD DRAWINGS**

- 5.01 The following City of Vernon Standard Drawings shall form part of this schedule.

<u>Drawing No.</u>	<u>Drawing Description</u>
100-12	Gradation Limits - 150 mm Minus Gravel
100-14	Gradation Limits - 25 mm Minus Crushed Gravel
100-15	Gradation Limits - Sand Bedding Material
300-1	Typical Service Connection Detail



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300-2	Standard Thrust Block Details
300-3	Standard Hydrant Detail
300-4	Standard Blow Off Detail
300-5	Standard Air Release Assembly
300-6	Standard Valve Box Assembly
300-7	Standard Sprinkler System Outlet from Water Main
400-7	Typical Trench Section for Underground Utility Installation
400-8	Standard Pipe Bedding Classification