

1 General

1.1 RELATED SECTIONS

- .1 Section 01 10 01 - General Requirements.
- .2 Section 31 05 17 - Aggregate Materials.
- .3 Section 31 23 33 - Excavating, Trenching and Backfilling.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM International).
 - .1 ASTM A48/A48M-00, Standard Specification for Gray Iron Castings.
 - .2 ASTM C478M-97, Specification for Precast Reinforced Concrete Manhole Sections (Metric).
 - .3 ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³)).
 - .4 ASTM C139-73, Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
- .2 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-A3000-98 (April 2001), Cementitious Materials Compendium.
Includes:
 - .1 CAN/CSA-A5-98, Portland Cement.
 - .2 CAN/CSA-A8-98, Masonry Cement.
 - .3 CAN/CSA-A23.5-98, Supplementary Cementing Materials.
 - .2 CSA-A23.1/A23.2-14 (June 2001), Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .3 CAN/CSA-G30.18-M92 (R1998), Billet Steel Bars for Concrete Reinforcement.
 - .4 CAN/CSA-G164-M92 (R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .5 CAN3-A165 Series-M85, CSA Standards on Concrete Masonry Units.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 10 01 – General Requirements.
- .2 Submit manufacturer's test data and certification at least one (1) week prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Dispose of waste materials in accordance with Section 01 35 43 - Environmental Procedures.

2 Products

2.1 MATERIALS

- .1 Precast manhole units: to ASTM C478M, circular. Top sections eccentric cone or flat slab top type with opening offset.
- .2 Joints: to be made watertight using rubber rings, bituminous compound, epoxy resin cement.

- .3 Mortar:
 - .1 Aggregate: 20 mm.
 - .2 Masonry cement: to CAN/CSA-A3000-A8.
 - .4 Adjusting rings: to ASTM C478M.
 - .5 Drop manhole pipe: to be same as sewer pipe.
 - .6 Galvanized iron sheet: to be approximately 2 mm thick.
 - .7 Steel gratings, I-beams and fasteners: as indicated.
 - .8 Frames, gratings, covers to dimensions as indicated and as per the following requirements:
 - .1 Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
 - .2 Gray iron castings: to ASTM A48/A48M, strength class 30B.
 - .3 Castings: coated with two applications of asphalt varnish, sand blasted or cleaned and ground to eliminate surface imperfections.
 - .4 Storm manhole frames and covers: heavy duty municipal type for road service to NBDTI Standards. Granular bedding and backfill: in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- 3 Execution
- 3.1 EXCAVATION AND BACKFILL
- .1 Excavate and backfill in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling and as indicated.
 - .2 Obtain approval of Departmental Representative before installing manholes.
- 3.2 INSTALLATION
- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
 - .2 Complete units as pipe laying progresses. Maximum of three units behind point of pipe laying will be allowed.
 - .3 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.
 - .4 Set precast concrete base on 150 mm minimum of granular bedding compacted to 98% maximum density to ASTM D698.
 - .5 Precast units:
 - .1 Set bottom section of precast unit in bed of levelled and compacted coarse bedding slab or base. Make each successive joint watertight with manufacturer's recommended rubber ring gaskets.
 - .2 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
 - .3 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.

- .6 For sewers:
 - .1 Place stub outlets and bulkheads at elevations and in positions indicated.
 - .2 Storm sewer manholes to be installed with a sump.
 - .7 Compact granular backfill to 95% maximum density to ASTM D698.
 - .8 Place frame and cover on top section to elevation as indicated. If adjustment required, use concrete rings.
 - .9 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.
- 4 Supplementary Specifications
- .1 All work and materials are to comply with the Department of Transportation and Infrastructure Standard Specifications for Highway Construction, January 2015.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 23 33 - Excavating, Trenching and Backfilling.

1.2 MEASUREMENT PROCEDURES

- .1 Measure trenching and backfilling, other than granular bedding and surround in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Measure water main including trenching and backfilling, in metres of each size of pipe installed.
 - .1 Horizontal measurement will be made over surface, through valves and fittings, after work has been completed.
- .3 Measure lateral connections from water main to hydrants as water main and include curb valve and adjustable valve box.
- .4 Measure hydrants including excavation and backfilling, in units installed.
- .5 Measure service connections including trenching and backfilling, in metres of each size of pipe installed.
- .6 Measure valves in units installed including, valves and valve boxes.
- .7 Measure valve chambers, in units installed.
- .8 Measure granular bedding and surround material in cubic metres compacted in place.
- .9 Measure concrete for bedding, encasement of pipes, supports and thrust blocks in cubic metres.

1.3 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA).
 - .1 ANSI/AWWA B300-10, Standard for Hypochlorites.
 - .2 ANSI/AWWA B301-10, Standard for Liquid Chlorine.
 - .3 ANSI/AWWA B303-10, Standard for Sodium Chlorite.
 - .4 ANSI/AWWA C104/A21.4-08, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - .5 ANSI/AWWA C105/A21.5-10, Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - .6 ANSI/AWWA C111/A21.11-07, American National Standard for Rubber-Gasket Joints for Ductile-Iron and Fittings.
 - .7 ANSI/AWWA C110/A21.10-08, American National Standard for Ductile-Iron and Gray Iron Fittings for Water.
 - .8 ANSI/AWWA C150/A21.50-08, Standard for Thickness Design of Ductile-Iron Pipe.
 - .9 ANSI/AWWA C151/A21.51-09, Standard for Ductile-Iron Pipe, Centrifugally Cast.
 - .10 ANSI/AWWA C153/A21.53-11, Standard for Ductile-Iron Compact Fittings.
 - .11 ANSI/AWWA C500-09, Standard for Metal-Seated Gate Valves for Water Supply Service.

- .12 ANSI/AWWA C600-10, Standard for Installation of Ductile-Iron Water Mains, and Their Appurtenances.
- .13 ANSI/AWWA C602-11, Standard for Cement-Mortar Lining of Water Pipelines - 4 Inch (100 mm) and Larger.
- .14 ANSI/AWWA C651-05, Standard for Disinfecting Water Mains.
- .15 ANSI/AWWA C900-07, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.
- .2 ASTM International.
 - .1 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
 - .2 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - .4 ASTM C117-04, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .5 ASTM C136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .6 ASTM C478M-11, Standard Specification for Precast Reinforced Concrete Manhole Sections Metric.
 - .7 ASTM C618-08a, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- .3 American Water Works Association (AWWA)/Manual of Practice.
 - .1 AWWA M17-2006, Installation, Field Testing, and Maintenance of Fire Hydrants.
- .4 Canada Green Building Council (CaGBC).
- .5 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .6 CSA International.
 - .1 CAN/CSA-A257 Series-09, Standards for Concrete Pipe (Consists of A257.0, A257.1, A257.2, A257.3 and A257.4).
 - .2 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .3 CAN/CSA-B137 Series-09, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
 - .1 CAN/CSA-B137.3-09, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
 - .4 CSA-G30.18-09, Carbon and Steel Bars for Concrete Reinforcement.
- .7 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC-S520-07, Standard for Fire Hydrants.
 - .2 CAN/ULC-S543-09, Standard for Internal-Lug, Quick Connect Couplings for Fire Hose.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 01 - General Requirements.
- .2 Product Data.
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Pipe certification to be on pipe.
- .3 Shop Drawings.
 - .1 Submit complete drawings and construction schedule for water mains 150 mm diameter and larger. Include method for installation of water main.
- .4 Samples.
 - .1 Submit manufacturer's test data and certification that pipe materials meet requirements of this section 4 weeks minimum prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 10 01 - General Requirements.
- .2 Submit record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details.
 - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.
- .3 Operation and Maintenance Data: submit operation and maintenance data for pipe, valves, valve boxes, valve chambers and hydrants for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements.
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect water distribution piping from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.7 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Departmental Representative.
- .3 Notify Departmental Representative minimum of 48 hours in advance of interruption in service.

- .4 Do not interrupt water service for more than 3 hours and confine this period between 1000 and 1600 hours local time unless otherwise authorized.
- .5 Notify fire department of planned or accidental interruption of water supply to hydrants.
- .6 Provide and post "Out of Service" sign on hydrant not in use.
- .7 Advise local police department of anticipated interference with movement of traffic.

1.8 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction Waste Management Plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
- .2 Recycled Content.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements: Construction for "List of products requiring recycled content".
 - .2 If products within this section are indicated on the "List of products requiring recycled content", only products with recycled content will be acceptable.
 - .3 For products not identified on list, source products with highest recycled content available when practical.
 - .4 Include following information with product data submission.
 - .1 Percentage of pre-consumer and post-consumer recycled content for each product.
- .3 Regional Materials.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements: Construction for "List of products required to be locally sourced".
 - .2 If products within this section are indicated on the "List of products required to be locally sourced", include following information with Product Data submission:
 - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
- .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer's certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California's SCAQMD #1168.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 10 01 - General Requirements.
- .2 Tools: provide tools as follows:
 - .1 1 (one) service post wrenches for curb stops.
 - .2 1 (one) hydrant wrenches.
 - .3 1 (one) tee-handle operating keys for valves.

2 Products

2.1 PIPE, JOINTS AND FITTINGS

- .1 Ductile iron pipe: to ANSI/AWWA C151/A21.51, pressure class 52 for 1000 kPa cement mortar lined to ANSI/AWWA C104/A21.4.
- .2 Joints and fittings for ductile iron pipe.
 - .1 Joints.
 - .1 Push-on joints: to ANSI/AWWA C111/A21.11.
 - .2 Rubber gasket for mechanical pipe joints: to ANSI/AWWA C111/A21.11.
 - .3 Rubber gasket for flange pipe joints 1.6 mm thick: to ANSI/AWWA C111/A21.11.
 - .4 Bolts, nuts, hex head with washers: to ASTM A307, heavy series.
 - .5 Ensure electrical conductivity across joints.
 - .2 Fittings.
 - .1 Mechanical joint cast iron and ductile iron fittings NPS 3 and larger: to ANSI/AWWA C110/A21.10.
 - .2 Flanged cast iron fittings NPS 3 and larger: to ANSI/AWWA C110/A21.10.
 - .3 Compact Fittings to ANSI/AWWA C153/A21.53.
- .3 Polyvinyl chloride pressure pipe: to ANSI/AWWA C900, pressure class 150, DR 18, 1 MPa gasket bell end, cast iron outside diameter.
 - .1 CAN/CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket.
 - .2 Composite epoxy impregnated fibreglass PVC pipe to ASTM D2996, class H. Unplasticized PVC core over wrapped with bonded fibreglass reinforced epoxy resin. Pressure class 300, 2.4 MPa with cast iron outside diameter and integral bell gasketed joints to ANSI/ASTM D2992. Material to ASTM D2310, classification RTRP-11HZ-5001-PVC-13223.
 - .3 Cast iron fittings: to ANSI/AWWA C110/A21.10, and for pipe diameters larger than NPS 4 cement mortar lined to ANSI/AWWA C104/A21.4.

2.2 PIPE PROTECTION

- .1 Provide means of protection for iron pipe in corrosive soils in accordance with local practices.

2.3 VALVES AND VALVE BOXES

- .1 Valves to open counter clockwise.
- .2 Gate valves: to ANSI/AWWA C500, standard iron body, brass mounted resilient wedge valves with non-rising stems, suitable for 1 Pa with push-on joints.
- .3 Underground type indicator valve where indicated. Indicator post to accurately indicate valve open or closed.
- .4 Cast iron valve boxes: bituminous coated screw type adjustable over minimum of 450 mm complete with valve operating extension rod, 30 mm 25 X 25, 150 mm below cover.
 - .1 Base to be large round type with minimum diameter of 300 mm.
 - .2 Top of box to be marked "WATER"/"EAU".

2.4 TAPPING SLEEVES AND VALVES

- .1 Valves to open counter clockwise.
- .2 Tapping sleeves shall be stainless steel with full circle sealing capability. All bolts and nuts to be stainless steel. The following stainless steel tapping sleeves with ductile iron outlet flanges will be acceptable:
 - .1 Ford Fast.
 - .2 Smith-Blair/Rockwell #662.
 - .3 Romac "SST".
 - .4 Mueller Model H304.
 - .5 Robar 6606 Lifter Bar.
- .3 Tapping valves are to be true tapping configuration with mechanical joint outlet, resilient seat, open counter clockwise and have a municipal 50mm square operating nut on a non-rising stem. Mixed end valves are not acceptable. All valves to be epoxy coated. The following valves are acceptable:
 - .1 Mueller T2360-19.
 - .2 Clow F-6114.
 - .3 AVK Series 25/30081.

2.5 VALVE CHAMBERS

- .1 Concrete and reinforcing steel: to Section 03 30 00 - Cast-in-Place Concrete and Section 03 20 00 - Concrete Reinforcing.
- .2 Precast concrete sections to ASTM C478M.
- .3 Valve chamber frames and covers: gray iron castings, minimum tensile strength 200 MPa, with two coats, shop applied, approved asphalt coating with a mass of approximately 215 kg per set.
 - .1 Design and dimensions as indicated.
 - .2 Cover to be marked "WATER/EAU".
- .4 Jointing materials:
 - .1 Manufacturer's rubber ring gaskets.
 - .2 Mastic joint filler.
 - .3 Cement mortar.
 - .4 Combination of above types.
- .5 Mortar:
 - .1 Aggregate in accordance with Section 04 05 12 - Mortar and Masonry Grout.
 - .2 Masonry cement to CAN/CSA-A3000.

2.6 SERVICE CONNECTIONS

- .1 Copper tubing: to ASTM B88M type K, annealed.
- .2 Ductile iron pipe: to ANSI/AWWA C151/A21.51 pressure class 52 for 1000 kPa cement mortar lined to ANSI/AWWA C104/A21.4.
- .3 Polyvinyl chloride pressure pipe: to CAN/CSA-B137.3, type 1120 series 160 1.1 MPa.
- .4 Copper tubing joints: compression type suitable for 1 MPa working pressure.

- .5 Joints for ductile iron pipe: push-on joints to ANSI/AWWA C111/A21.11. Rubber gaskets to ANSI/AWWA C111/A21.11. Verify requirement to maintain electrical conductivity between pipes.
- .6 Brass corporation stops: compression type having threads to ANSI/AWWA C800.
- .7 Brass inverted key-type curb stops: red brass to ASTM B62, compression type without drains.
 - .1 Curb stops to have adjustable bituminous coated cast iron service box with stem to suit depth of bury.
 - .2 Top of cast iron box marked "WATER/EAU".
- .8 Service connections for PVC pipe:
 - .1 Service connections less than 100 mm: corporation stop, tapped to main using AWWA threads, complete with stainless service saddle. Service saddle to consist of circumferential band type complete with side bars and fingers, keeper bar, stud bolts, nuts, washers and gaskets.
 - .2 Service connections 100 mm and over: use tee fitting or tapping valve and sleeve.
- .9 Bronze type service clamps: for PVC pipe service connections.
 - .1 Service clamps to be of strap-type, with confined "O" ring seal cemented in place.
 - .2 Clamps to be tapped with threads to ANSI/AWWA C800.
- .10 Tee connections: for services above NPS 1. Tee connections to be fabricated of same material and to same standards as specified pipe fittings and to have ends matching pipe to which they are joined.

2.7 HYDRANTS

- .1 Post type hydrants: compression type hydrant, to CAN/ULC-S520, designed for working pressure of 1000 kPa with two 65 mm threaded hose outlets, one Storz pumper connection, 150 mm riser barrel, 125 mm bottom valve and 150 mm connection for main.
 - .1 Hydrants to open counter clockwise, threads to local standard, fittings to be Provide metal caps and chains.
 - .2 Provide key operated gate valve located 1 m from hydrant.
 - .3 Depth of bury 2.0 m.
 - .4 Manufacturer: M67 Brigadier; Canada Valve 'Century'; Mueller Super Centurion 250.
- .2 Hydrant paint: exterior enamel to MPI #96.
- .3 Hydrant must be supplied with the lower barrel plugged.

2.8 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material to: Section 31 05 17 - Aggregate Materials and following requirements:
 - .1 Crushed or screened stone, gravel or sand.

- .2 Gradations to be within limits specified when tested to ASTM C136 ASTM C117. Sieve sizes to CAN/CGSB-8.1.

Sieve Designation (mm)	% Passing	
	Stone/Gravel	Gravel/Sand
200	-	-
75	-	-
50	-	-
38.1	-	-
25	100	-
19	-	-
12.5	65 - 90	100
9.5	-	-
4.75	35 - 55	80 - 100
2.00	-	50 - 90
0.425	10 - 25	10 - 50
0.180	-	-
0.075	0 - 8	0 - 10

- .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00 - Cast-in-Place Concrete.

2.9 BACKFILL MATERIAL

- .1 Common material unless otherwise directed by Departmental Representative.

2.10 PIPE DISINFECTION

- .1 Sodium hypochlorite or Calcium hypochlorite or Liquid chlorine to ANSI/AWWA B300, ANSI/AWWA B301, ANSI/AWWA B303 to disinfect water mains.
- .2 Disinfect water mains in accordance with ANSI/AWWA C651.

3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
- .2 Inspect materials for defects to approval of Departmental Representative.
- .3 Remove defective materials from site as directed by Departmental Representative.

3.3 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- .2 Ensure trench depth allows coverage over pipe of 2.1 m minimum from finished grade.
- .3 Trench alignment and depth require Departmental Representative's approval prior to placing bedding material and pipe.

3.4 CONCRETE BEDDING AND ENCASEMENT

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .1 Place concrete to details as indicated as directed by Departmental Representative.
- .2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Do not backfill over concrete within 24 hours after placing.

3.5 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 300 mm below bottom of pipe.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to 95% minimum of corrected maximum dry density.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling with compacted bedding material.

3.6 PIPE INSTALLATION

- .1 Terminate building water service at property line, 1 m outside building wall opposite point of connection to main.
 - .1 Install coupling necessary for connection to building plumbing.
 - .2 If plumbing is already installed, make connection; otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Lay pipes to ANSI/AWWA C600 manufacturer's standard instructions and specifications.
 - .1 Do not use blocks except as specified.
- .3 Join pipes in accordance with ANSI/AWWA C600 manufacturer's recommendations.

- .4 Bevel or taper ends of PVC pipe to match fittings.
- .5 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .6 Lay pipes on prepared bed, true to line and grade.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - .2 Take up and replace defective pipe.
 - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
- .7 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .8 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .9 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .10 Position and join pipes with equipment and methods approved by Departmental Representative.
- .11 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .12 Align pipes before jointing.
- .13 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .14 Avoid displacing gasket or contaminating with dirt or other foreign material.
 - .1 Remove disturbed or contaminated gaskets.
 - .2 Clean, lubricate and replace before jointing is attempted again.
- .15 Complete each joint before laying next length of pipe.
- .16 Minimize deflection after joint has been made.
- .17 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .18 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Departmental Representative.
- .19 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .20 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .21 Do not lay pipe on frozen bedding.
- .22 Do hydrostatic and leakage test and have results approved by Departmental Representative before surrounding and covering joints and fittings with granular material.

- .23 Backfill remainder of trench.

3.7 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of concrete located between valve and solid ground. Bedding same as adjacent pipe. Minimum length of pipe on each end of valve shall be 5.5 m. Valves not to be supported by pipe.
- .3 Install underground post-type indicator valves as indicated.

3.8 VALVE CHAMBERS

- .1 Use precast units as approved by Departmental Representative.
- .2 Construct units as indicated, plumb and centred over valve nut, true to alignment and grade, and not resting on pipe.
- .3 Place reinforcing steel and miscellaneous metals required to be embedded in concrete to details indicated and in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .4 Cast bottom slabs for precast units directly on undisturbed ground when permitted by Departmental Representative on 150 mm minimum of compacted granular bedding.
- .5 Set bottom section of precast unit in bed of cement mortar and bond to bottom slab.
 - .1 Make each successive joint watertight with approved rubber ring gaskets, mastic joint filler, cement mortar, or combination thereof.
- .6 Clean surplus mortar and joint compounds from interior surface of valve chamber as work progresses.
- .7 Plug lifting holes with precast concrete plugs set in cement mortar.
- .8 Set frame and cover to required elevation.
 - .1 Concrete ring with preformed bituminous gasket.
- .9 Place frame and cover on top section to elevation indicated. If adjustment is required use concrete ring. One ring permitted with maximum height of 300 mm.
- .10 Clean valve chambers of debris and foreign materials; remove fins and sharp projections.

3.9 SERVICE CONNECTIONS

- .1 Terminate building water service at property line, inside building wall opposite point of connection to main.
 - .1 Install coupling necessary for connection to building plumbing.
 - .2 If plumbing is already installed, make connection, otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.
- .3 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops 300 mm inside right-of-way.

- .4 Tappings on ductile iron, or PVC-C900 pipe, may be threaded without service clamps.
- .1 Double strap service connections with galvanized malleable iron body and neoprene gasket cemented in place may be used.
- .2 Tappings for asbestos cement or PVC-C900 pipe to conform to following:

Pipe Diameter (mm)	Maximum Tap Without Clamp (mm)	Maximum Tap With Clamp (mm)
100	20	25
150	20	40
200	25	50
250	25	50
300	40	75

- .3 Maximum dried direct tappings (mm) for ductile iron pipe to conform to:

Nominal Pipe Size (mm)	Pressure Class/Max.				
150	200	250	300	350	
75	-	-	-	-	19
102	-	-	-	-	19
152	-	-	-	-	25
203	-	-	-	-	25
254	-	-	-	-	25
305	-	-	-	-	32
356	-	-	32	38	38
406	-	-	38	50	50
457	-	-	50	50	50
508	-	-	50	50	50
610	-	50	50	50	50
762	50	50	50	50	50

- .5 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.
- .6 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .7 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
- .8 Install multiple corporation stops, 30 degrees apart around circumference of pipe and minimum of 300 mm apart along pipe.
- .9 Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m minimum, whichever is greater.
- .10 Leave corporation stop valves fully open.

- .11 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .12 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- .13 Install curb stop with corporation box on services NPS 2 or less in diameter.
 - .1 Equip larger services with gate valve and cast iron box.
 - .2 Set box plumb over stop and adjust top flush with final grade elevation.
 - .3 Leave curb stop valves fully closed.
- .14 Place temporary location marker at ends of plugged or capped unconnected water lines.
 - .1 Each marker to consist of 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade.
 - .2 Paint exposed portion of stake red with designation "WATER SERVICE EAU" in black.

3.10 HYDRANTS

- .1 Install hydrants at locations as indicated.
- .2 Install hydrants in accordance with AWWA M17.
- .3 Install 150 mm gate valve and cast iron valve box on hydrant service leads as indicated.
- .4 Set hydrants plumb, with hose outlets parallel with edge of pavement or curb line, with pumper connection facing roadway and with body flange set at elevation of 50 mm above final grade.
- .5 Place concrete thrust blocks as indicated and specified ensuring that drain holes are plugged.
- .6 To provide proper draining for each hydrant, excavate pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to level 150 mm above drain holes.
- .7 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.
- .8 Place sign and post 0.3 m from installed hydrants as indicated on drawings.

3.11 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by Departmental Representative.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 For restrained joints: only use restrained joints approved by Departmental Representative.

3.12 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with ANSI/AWWA C600.

- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Departmental Representative at least 24 hours in advance of proposed tests.
 - .1 Perform tests in presence of Departmental Representative.
- .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .5 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by Departmental Representative.
- .6 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated as directed by Departmental Representative.
- .7 Leave hydrants, valves, joints and fittings exposed.
- .8 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
- .9 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .10 Open valves.
- .11 Expel air from main by slowly filling main with potable water.
 - .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
 - .2 Remove stops after satisfactory completion of test and seal holes with plugs.
- .12 Thoroughly examine exposed parts and correct for leakage as necessary.
- .13 Apply hydrostatic test pressure of 1000 kPa minimum based on elevation of lowest point in main and corrected to elevation of test gauge, for period of 1 hour.
- .14 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .15 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .16 Repeat hydrostatic test until defects have been corrected.
- .17 Apply leakage test pressure of 1500 kPa minimum after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 hours.
- .18 Define leakage as amount of water supplied from municipality in order to maintain test pressure for 2 hours.
- .19 Do not exceed allowable leakage of pipe, including lateral connections.
- .20 Locate and repair defects if leakage is greater than amount specified.
- .21 Repeat test until leakage is within specified allowance for full length of water main.

3.13 PIPE SURROUND

- .1 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes as indicated.

- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .1 Do not dump material within 5 m of pipe.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95 % of corrected maximum dry density.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 90 % of corrected maximum dry density 90.

3.14 BACKFILL

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under paving and walks, compact backfill to at least 95% maximum density to ASTM D698.
 - .1 In other areas, compact to at least 90% corrected maximum dry density.

3.15 HYDRANT FLOW TESTS

- .1 Conduct flow tests on every hydrant to determine fire flows prior to painting hydrant caps and ports.

3.16 PAINTING OF HYDRANTS

- .1 After installation, paint hydrants red.
- .2 After hydrant flow tests, paint caps and ports to meet colour selections approved by authority having jurisdiction.

3.17 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: witnessed by Departmental Representative carried out by contractor.
 - .1 Notify Departmental Representative at least 4 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.
- .3 Flushing flows as follows:

<u>Pipe Size NPS</u>	<u>Flow (L/s) Minimum</u>
6 and below	38
8	75
10	115
12	150

- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, hydrants and service connections to ensure thorough flushing.
- .6 When flushing has been completed to Departmental Representative approval, introduce strong solution of chlorine as approved by Departmental Representative into water main and ensure that it is distributed throughout entire system.
- .7 Disinfect water mains to the requirements of local authority.
- .8 Rate of chlorine application to be proportional to rate of water entering pipe.
- .9 Chlorine application to be close to point of filling water main and to occur at same time.
- .10 Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .11 Flush line to remove chlorine solution after 24 hours.
- .12 Measure chlorine residuals at extreme end of pipeline being tested.
- .13 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
 - .1 Take samples daily for minimum of 2 days.
 - .2 Should contamination remain or recur during this period, repeat disinfecting procedure.
 - .3 Submit certified copy of test results.
- .14 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.
- .15 After adequate chlorine residual not less than 50 ppm has been obtained leave system charged with chlorine solution for 24 hours.
 - .1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.

3.18 SURFACE RESTORATION

- .1 After installing and backfilling over water mains, restore surface to original condition as directed by Departmental Representative.

3.19 CLEANING

- .1 Progress Cleaning:
 - .1 Leave work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 23 33 – Excavating, Trenching and Backfill.

1.2 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA).
 - .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .2 ASTM International.
 - .1 ASTM D3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - .2 ASTM D3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - .3 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
 - .4 CSA International.
 - .1 CSA-B182.1-11, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA-B182.2-11, PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling.
 - .1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction.
 - .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
 - .3 Notify Departmental Representative and building occupants 24 hours minimum in advance of any interruption in service.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data.
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings.
 - .1 Submit drawings stamped and signed.
- .3 Certificates.
 - .1 Certification to be marked on pipe.
- .4 Test and Evaluation Reports.
 - .1 Submit manufacturer's test data and certification two (2) weeks minimum before beginning Work.

- .5 Sustainable Design Submittals.
 - .1 Regional Materials: submit evidence that project incorporates regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements.
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.

1.6 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction Waste Management Plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
- .2 Recycled Content.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements: Construction for "List of products requiring recycled content".
 - .2 If products within this section are indicated on the "List of products requiring recycled content", only products with recycled content will be acceptable.
 - .3 For products not identified on list, source products with highest recycled content available when practical.
 - .4 Include following information with product data submission.
 - .1 Percentage of pre-consumer and post-consumer recycled content for each product.
- .3 Regional Materials.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements: Construction for "List of products required to be locally sourced".
 - .2 If products within this section are indicated on the "List of products required to be locally sourced", include following information with Product Data submission:
 - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
- .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer's certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California's SCAQMD #1168.

2 Products

2.1 PLASTIC PIPE

- .1 Type PSM Polyvinyl Chloride (PVC) for Gravity Pipe: to ASTM D3034.
 - .1 Standard Dimensional Ratio (SDR): 35.
 - .2 Nominal lengths: 6 m.
- .2 Type PSM Polyvinyl Chloride (PVC) for Gravity Laterals: to ASTM D3034.
 - .1 Standard Dimensional Ratio (SDR): 28.
 - .2 Nominal lengths: 6 m.

2.2 SERVICE CONNECTIONS

- .1 Type PSM Poly (Vinyl) Chloride: to CSA-B182.2.

2.3 PIPE BEDDING AND SURROUND MATERIALS

- .1 Granular material to Section 31 23 33 - Excavation, Trenching and Backfill.

2.4 BACKFILL MATERIAL

- .1 As indicated.

3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sewer pipe installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control.
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative. Clean and dry pipes and fittings before installation.
- .3 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

3.3 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- .2 Protect trench from contents of sewer or sewer connection.
- .3 Trench alignment and depth require approval of Departmental Representative prior to placing bedding material and pipe.

3.4 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe and lift station.
 - .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% corrected maximum dry density.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.

3.5 INSTALLATION

- .1 Lay and join pipes to: ASTM C12.
- .2 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .3 Handle pipe using methods approved by Manufacturer.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .6 Joint deflection permitted within limits recommended by pipe manufacturer.
- .7 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA-B182.11.
- .9 Pipe jointing.
 - .1 Install gaskets in accordance with manufacturer's written recommendations.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.

- .4 Maintain pipe joints free from mud, silt, gravel and foreign material.
- .5 Avoid displacing gasket or contaminating with dirt or foreign material. Gaskets so disturbed to be removed, cleaned and lubricated and replaced before joining is attempted.
- .6 Complete each joint before laying next length of pipe.
- .7 Minimize joint deflection after joint has been made to avoid joint damage.
- .8 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
- .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .10 When stoppage of Work occurs, block pipes to prevent creep during down time.
- .11 Plug lifting holes with pre-fabricated plugs approved by Manufacturer set in shrinkage compensating grout.
- .12 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .13 Make watertight connections to manholes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .14 Install pumping station per manufacturer's installation instructions.
- .15 Pumping station alarm panel to be mounted at interior of building. See electrical/mechanical drawings for exact location.
- .16 Alarm panel to be wired to building systems – see electrical/mechanical specifications and drawings for details.

3.6 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipelaying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% corrected maximum dry density.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 95% corrected maximum dry density.
- .7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.7 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.

- .3 Under paving and walks, compact backfill to at least 95% corrected maximum dry density
 - .1 In other areas, compact to at least 90% corrected maximum dry density.

3.8 FIELD TESTING

- .1 Field Testing as per Municipality.
- .2 Repair or replace pipe, pipe joint or bedding found defective.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
- .5 Do infiltration and exfiltration test per Municipality.
- .6 Carry out tests on each section of sewer between successive manholes including service connections.
- .7 Repair and retest sewer line as required, until test results are within limits specified.
- .8 Repair visible leaks regardless of test results.
- .9 Television and photographic inspections.
 - .1 Carry out inspection of installed sewers by video camera, digital camera or by other related means.
 - .2 Provide means of access to permit Departmental Representative to do inspections.

END OF SECTION

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1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 23 33- Excavating Trenching and Backfill.

1.2 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA).
 - .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .2 ASTM International.
 - .1 ASTM D3034-15, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - .3 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
 - .4 CSA International.
 - .1 CSA-B182.1-11, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA-B182.2-11, PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling.
 - .1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction.
 - .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
 - .3 Notify Departmental Representative and building occupants 24 hours minimum in advance of any interruption in service.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data.
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings.
 - .1 Submit drawings stamped and signed.
- .3 Certificates.
 - .1 Certification to be marked on pipe.
- .4 Test and Evaluation Reports.
 - .1 Submit manufacturer's test data and certification two (2) weeks minimum before beginning Work.

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- .5 Sustainable Design Submittals.
 - .1 Regional Materials: submit evidence that project incorporates regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements.
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.

1.6 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction Waste Management Plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the Contractor's waste management final report.
- .2 Recycled Content.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements: Construction for "List of products requiring recycled content".
 - .2 If products within this section are indicated on the "List of products requiring recycled content", only products with recycled content will be acceptable.
 - .3 For products not identified on list, source products with highest recycled content available when practical.
 - .4 Include following information with product data submission.
 - .1 Percentage of pre-consumer and post-consumer recycled content for each product.
- .3 Regional Materials.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements: Construction for "List of products required to be locally sourced".
 - .2 If products within this section are indicated on the "List of products required to be locally sourced", include following information with Product Data submission:
 - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
- .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer's certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California's SCAQMD #1168.

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2 Products

2.1 PLASTIC PIPE

- .1 Type PSM Polyvinyl Chloride (PVC) for Gravity Pipe: to ASTM D3034.
 - .1 Standard Dimensional Ratio (SDR): 35.
 - .2 Nominal lengths: 6 m.
- .2 Type PSM Polyvinyl Chloride (PVC) for Gravity Laterals: to ASTM D3034.
 - .1 Standard Dimensional Ratio (SDR): 28.
 - .2 Nominal lengths: 6 m.
- .3 Elbows - Long Radius to ANSI B16.
 - .1 Standard Dimensional Ratio (SDR): 28.
 - .2 Nominal lengths: 6 m.

2.2 CONCRETE PIPE

- .1 CAN/CSA-A257.2 Series M92 Standards for Concrete Pipe. ; standard diameter concrete sizes as shown on drawings; bell and spigot joints; complete with o-ring gasket and lubricant; subject to joint acceptance test as outlined in ASTM C1103. Joints to CSA A257.3.

2.3 PIPE BEDDING AND SURROUND MATERIALS

- .1 Granular material to Section 31 23 33 - Excavation, Trenching and Backfill.

2.4 BACKFILL MATERIAL

- .1 As indicated.

3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sewer pipe installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control.
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

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- .2 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative. Clean and dry pipes and fittings before installation.
- .3 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

3.3 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- .2 Protect trench from contents of sewer or sewer connection.
- .3 Trench alignment and depth require approval of Departmental Representative prior to placing bedding material and pipe.

3.4 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe and lift station.
 - .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% corrected maximum dry density.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.

3.5 INSTALLATION

- .1 Lay and join pipes to: ASTM C12.
- .2 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .3 Handle pipe using methods approved by Manufacturer.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .6 Joint deflection permitted within limits recommended by pipe manufacturer.
- .7 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA-B182.11.

- .9 Pipe jointing.
 - .1 Install gaskets in accordance with manufacturer's written recommendations.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or foreign material. Gaskets so disturbed to be removed, cleaned and lubricated and replaced before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.
 - .8 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
 - .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .10 When stoppage of Work occurs, block pipes to prevent creep during down time.
- .11 Plug lifting holes with pre-fabricated plugs approved by Manufacturer set in shrinkage compensating grout.
- .12 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .13 Make watertight connections to manholes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .14 Install pumping station per manufacturer's installation instructions.
- .15 Pumping station alarm panel to be mounted at interior of building. See electrical/mechanical drawings for exact location.
- .16 Alarm panel to be wired to building systems – see electrical/mechanical specifications and drawings for details.

3.6 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% corrected maximum dry density.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 95% corrected maximum dry density.
- .7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.7 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .3 Under paving and walks, compact backfill to at least 95% corrected maximum dry density
 - .1 In other areas, compact to at least 90% corrected maximum dry density.

3.8 FIELD TESTING

- .1 Field Testing as per Municipality.
- .2 Repair or replace pipe, pipe joint or bedding found defective.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
- .5 Do infiltration and exfiltration test per Municipality.
- .6 Carry out tests on each section of sewer between successive manholes including service connections.
- .7 Repair and retest sewer line as required, until test results are within limits specified.
- .8 Repair visible leaks regardless of test results.
- .9 Television and photographic inspections.
 - .1 Carry out inspection of installed sewers by video camera, digital camera or by other related means.
 - .2 Provide means of access to permit Departmental Representative to do inspections.

END OF SECTION

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1 General

1.1 WORK INCLUDED

- .1 The Work to be done under this Section consists of furnishing all labour, tools, and equipment and performing all operations necessary to complete the installation of the perimeter foundation sub-drain system shown on the drawings. This Section includes, but is not necessarily limited to, the following:
 - .1 Preparation for excavation.
 - .2 Excavation.
 - .3 Trench excavation.
 - .4 Preparation of foundation bed.
 - .5 Supply and installation of filter aggregates.
 - .6 Supply and installation of perforated and non-perforated rigid plastic pipe and fittings.
 - .7 Geotextile fabric.
 - .8 Sand fill.
 - .9 Connection to storm sewer system.
 - .10 Backfill and compaction.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA).
 - .1 CSA A23.1, Concrete Materials and Methods of Concrete Construction.
 - .2 CSA B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

1.3 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction Waste Management Plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the Contractor's waste management final report.
- .2 Recycled Content.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements: Construction for "List of products requiring recycled content".
 - .2 If products within this section are indicated on the "List of products requiring recycled content", only products with recycled content will be acceptable.
 - .3 For products not identified on list, source products with highest recycled content available when practical.
 - .4 Include following information with product data submission.
 - .1 Percentage of pre-consumer and post-consumer recycled content for each product.
- .3 Regional Materials.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements: Construction for "List of products required to be locally sourced".
 - .2 If products within this section are indicated on the "List of products required to be locally sourced", include following information with Product Data submission:
 - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.

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- .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer's certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California's SCAQMD #1168.
- 2 Products
- 2.1 MATERIALS
 - .1 Coarse filter aggregate to be used next to pipe and for bedding shall conform to CSA A23.1, Table 3, Group 1, 19 mm to 4.8 mm (0.75 inch to 0.187 inch).
 - .2 Perforated and non-perforated rigid plastic pipe and fittings shall conform to CSA B182.1, 150 mm (6 inch) diameter complete with fittings.
 - .3 Filter fabric: NBDTI Type W2 Geotextile.
- 3 Execution
- 3.1 INSPECTION
 - .1 Ensure graded subgrade conforms to required drainage pattern and slope before placing filter bed material. Begin installation of foundation drainage after deficiencies have been corrected.
- 3.2 INSTALLATION
 - .1 Place filter fabric of sufficient width to wrap around filter bed and overlap.
 - .2 Place and compact minimum 100 mm (4 inch) thickness of coarse filter aggregate.
 - .3 Ensure pipe interior and coupling surfaces are clean before laying pipe.
 - .4 Lay perforated pipe to minimum slope of 0.5% or as shown. Face perforations and coupling slots downward.
 - .5 Lay non-perforated pipe to minimum slope of 1.0% or as shown. Make joints watertight.
 - .6 Do not use shims to establish pipe slope.
 - .7 Use fittings recommended by manufacturer.
 - .8 Protect pipe ends from damage and ingress of foreign material.
 - .9 Connect pipe to nearest catch basin or manhole, where indicated on the drawings.
 - .10 Place filter bed backfill after pipe installation is performed. Place minimum of 150 mm (6 inch) thickness coarse filter aggregate on each side of perforated pipe and minimum of 300 mm (12 inch) thickness coarse filter aggregate over perforated pipe.
 - .11 Place minimum of 150 mm (6 inch) granular bedding on each side and over non-perforated pipe.
 - .12 Place filter bed by hand, in 150 mm (6 inch) lifts. Consolidate by tamping lightly and take precautions to prevent displacement of pipe.

- .13 Wrap filter fabric around filter bed.
- .14 Place filter fabric to prevent surface infiltration of fine materials into coarse filter material, thereby blocking groundwater infiltration.

END OF SECTION

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1 General

1.1 DESCRIPTION

- .1 This section specifies the requirements for supply and installation of subdrains as indicated by the Contract Documents or as established by the Departmental Representative.

1.2 RELATED SECTIONS

- .1 Section 01 10 01 - General Requirements.
- .2 Section 31 32 19 - Geotextiles.
- .3 Section 31 23 33 - Excavating, Trenching and Backfilling.

1.3 REFERENCES

- .1 All references to these Specifications, Standards, or Methods shall be understood to refer to the latest adopted revision, including all amendments.
- .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM C4, Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile.
 - .2 ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM C444M, Standard Specification for Perforated Concrete Pipe Metric.
 - .4 ASTM C654M, Standard Specification for Porous Concrete Pipe Metric.
 - .5 ASTM D698-00ae1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .3 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B1800-02, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
 - .1 CSA B182.1-02, Plastic Drain and Sewer Pipe and Pipe Fittings.
- .5 DOT 601 – Geotextile.

1.4 SUBMITTALS

- .1 Inform the Departmental Representative of proposed source of bedding and filter materials and provide access for sampling at least four (4) weeks prior to commencing work.
- .2 Submit manufacturer's test data and certification that drain pipe materials meet requirements of this Section at least four (4) weeks prior to beginning Work.
- .3 Certification to be marked on pipe.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

- .2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins.
- .3 Separate for reuse and recycling and place in designated containers Steel, Metal, and Plastic waste.
- .4 Divert unused metal materials from landfill to metal recycling facility for disposal approved by the Departmental Representative.
- .5 Divert unused concrete materials from landfill to local facility as approved by the Departmental Representative.
- .6 Divert unused aggregate materials from landfill to facility for reuse as approved by the Departmental Representative.
- .7 Fold up metal banding, flatten and place in designated area for recycling.

1.6 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction Waste Management Plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
- .2 Recycled Content.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements: Construction for "List of products requiring recycled content".
 - .2 If products within this section are indicated on the "List of products requiring recycled content", only products with recycled content will be acceptable.
 - .3 For products not identified on list, source products with highest recycled content available when practical.
 - .4 Include following information with product data submission.
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- .3 Regional Materials.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements: Construction for "List of products required to be locally sourced".
 - .2 If products within this section are indicated on the "List of products required to be locally sourced", include following information with Product Data submission:
 - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
- .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer's certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California's SCAQMD #1168.

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2 Products

2.1 MATERIALS

- .1 Perforated PVC Pipe.
 - .1 PVC SDR 35 to CAN/CSA-B182.1.
 - .2 Perforations shall be a minimum two (2) rows of holes positioned at 120 degrees radially on the pipe, sized and space to provide a minimum total cross sectional hole area of 3,000 mm² per metre of length.
 - .3 Fittings shall be integral bell system with separate gasket.
 - .4 Diameters as indicated on drawings.
 - .5 Length: nominal 6 m lengths for PVC pipe.
- .2 Geotextile.
 - .1 Geotextile to Section 31 32 19 - Geotextiles.
- .3 Granular Material.
 - .1 Drain rock material shall be as indicated.

3 Execution

3.1 TRENCHING

- .1 Do trenching and backfilling in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- .2 Do not place geotextile and drain rock material prior to approval of trench by the Departmental Representative.
- .3 Place drain rock material to details indicated.
- .4 Install geotextile in accordance with Section 31 32 19 - Geotextiles.

3.2 INSTALLATION OF PIPE SUBDRAINS

- .1 Lay pipe drains on prepared bed, true to line and grade with inverts smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with bed throughout full length.
- .2 Begin laying at outlet and proceed in upstream direction.
- .3 Lay perforated pipes with perforations at 4 o'clock and 8 o'clock positions.
- .4 Lay bell and spigot pipe with bell ends facing upstream.
 - .1 Do not mortar joints.
- .5 Make joints tight in accordance with manufacturer's instructions.
- .6 Make watertight connections to existing drains, new or existing manholes and catch basins where indicated or as directed by the Departmental Representative.
- .7 Plug open upstream ends of pipes with watertight concrete, steel or wood bulkheads.
- .8 Surround and cover drain with drain rock material in uniform 150 mm layers to depths as indicated and compact to at least 95% of corrected maximum dry density.
- .9 Backfill remainder of trench to Section 31 23 33 - Excavating, Trenching and Backfilling as indicated or as directed by the Departmental Representative.
- .10 Wrap or sleeve perforated pipe with geotextile filter as indicated.

- .11 Do not place bedding surround and backfill materials in frozen condition.
- .12 Protect subdrains against flotation during installation.

END OF SECTION