

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies the requirements for construction water mains and service connections. Work includes supply, installation and testing of pipe, fittings and related appurtenances.

1.2 RELATED SECTIONS

- .1 Cast-in-Place Concrete: Section 03 30 00
- .2 Metal Fabrications: Section 05 50 00
- .3 Excavation, Trenching and Backfilling: Section 31 23 10

1.3 SYSTEM REQUIREMENTS

- .1 Maintain water service on Morris Drive throughout the duration of the Work.

1.4 APPROVALS

- .1 Approval of modifications to design requires approval of the Departmental Representative and Halifax Water (HW).

1.5 OPERATIONS PLAN

- .1 Submit a detailed Water System Operations Plan to the Departmental Representative for review and approval. This plan must incorporate the Commissioning Plan, refer to 3.7 of this Section. The Water System Operations Plan to include the following:
 - .1 A listing of all tenant services affected.
 - .2 A detailed schedule showing when the various sections of water main will be installed and when each of the various connections to the existing water system will be completed.
 - .3 A plan of which valves are to be utilized during the connections to the existing system.
 - .4 A list of any sections of the project for which water service will be interrupted and the anticipated duration of the interruption.
 - .5 A description of methods to be used to accomplish the maintenance of service.
 - .6 A description of contingency plans that can be implemented to provide water service to affected tenants should service be disrupted longer than anticipated.
 - .7 Certification that System Operations Plan has been coordinated with Halifax Water.
- .2 Deviation or amendment of the Water System Operations Plan requires approval by the Departmental Representative. Requests must be submitted in writing 72 hours prior to any change being authorized.

1.6 REFERENCES

- .1 ANSI/ASME B16.1-2010, Fittings, Flanges and Valves.
- .2 AWWA B300-2010, Hypochlorites.

- .3 AWWA B301-2010, Liquid Chlorine.
- .4 ANSI/AWWA C104/A21.4-2013, Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.
- .5 ANSI/AWWA C105/A21.5-2010, Polyethylene Encasement for Ductile Iron Pipe System.
- .6 ANSI/AWWA C110/A21.10-2012, Ductile Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm) for Water and Other Liquids.
- .7 ANSI/AWWA C111/A21.11-2012, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
- .8 ANSI/AWWA C151/A21.51-09, Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
- .9 ANSI/AWWA C153/A21.53-2011, Ductile Iron Compact Fittings 3 in. through 24 in. (76mm through 610mm) and 54 in through 64 in. (1,400mm through 1,600mm), for Water Service.
- .10 ANSI/AWWA C502-2014, Dry-Barrel Fire Hydrants.
- .11 ANSI/AWWA C504-2010, Rubber-Seated Butterfly Valves.
- .12 ANSI/AWWA C509-09, Resilient Seated Gate Valves, for Water and Sewerage Systems.
- .13 ANSI/AWWA C600-2010, Installation of Ductile Iron Water Mains and Their Appurtenances.
- .14 ANSI/AWWA C606-2011, Grooved and Shoulder Joints.
- .15 ANSI/AWWA C651-05, Disinfecting Water Mains.
- .16 ANSI/AWWA C800-2012, Underground Service Line Valves and Fittings.
- .17 ASSE 1060-2006, Performance Requirements for Outdoor Enclosures for Backflow Prevention Assemblies.
- .18 ASTM A183-03(R2009), Carbon Steel Track Bolts and Nuts.
- .19 ASTM A240-2010b, Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
- .20 ASTM A276-2013A, Stainless and Heat- Resisting Steel Bars and Shapes.
- .21 ASTM B62-2009, Composition Bronze or Ounce Metal Castings.
- .22 ASTM B88-2009, Seamless Copper Water Tube.
- .23 ASTM B418-2012, Cast and Wrought Galvanic Zinc Anodes.
- .24 AWWA C115-2011, Flanged Ductile Iron Pipe and Ductile Iron or Gray Iron Threaded Flanges.
- .25 AWWA C500-09, Gate Valves for Water and Sewage Systems.
- .26 CAN/CSA B64.10M-2011, Selection, Installation, Maintenance and Field Testing of Backflow Prevention Devices.
- .27 CAN/ULC S701-2011, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .28 Halifax Water Design and Construction Specification, latest edition.

1.7 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 for all pipe, fittings, valves and all other items necessary for a complete water main installation.

1.8 CERTIFICATES

- .1 Submit manufacturer's test data and certification that products and materials meet requirements of this Section in accordance with Section 01 33 00.

1.9 HANDLING AND STORAGE

- .1 Handle and store pipe, valves and fittings, in such manner as to avoid shock and damage. Do not use chains or cables passing through pipe bore. Do not damage coatings or linings.
- .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.
- .3 Store hydrants and valves to prevent retention of water and damage by freezing.

1.10 SCHEDULING OF WORK

- .1 Coordinate schedule in accordance with Water System Operations Plan.
- .2 Coordinate and organize work to minimize interruptions to existing services.
- .3 Notify the Departmental Representative, Halifax Water and building tenants and occupants a minimum of 48 hours in advance of any unavoidable interruptions in service.
- .4 Do not interrupt water service between 0800 hours and 1800 hours, unless otherwise authorized.
- .5 Notify Fire Department of any planned or accidental interruption to water service.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Diameter, material and strength class of pipe and fittings: as indicated.
- .2 All water main pipe to be Class 52 Ductile Iron pipe.
- .3 Provide lateral service extensions from old to new connection points in accordance with this section's requirements.

2.2 DUCTILE IRON PIPE AND FITTINGS

- .1 Pipe: Special Class 52, to AWWA C151.
- .2 Fittings: to AWWA C110 or C153, cement mortar lined, minimum pressure rating 1035 kPa for cast-iron, 1720 kPa for ductile-iron.

- .3 Hydrant Tee: to AWWA C153 and AWWA C111 c/w ductile-iron rotatable mechanical joint gland on plain end branch.
- .4 Pipe Coatings:
 - .1 Interior: cement mortar lining with asphaltic seal coat to AWWA C104.
 - .2 Exterior: manufacturer's standard coating.
- .5 Joints: mechanical or push-on to AWWA C111; flanged where indicated, to AWWA C110 or C153 with Class 125 flanged ends to ANSI B16.1 (grooved type coupling joint with malleable iron couplings and gaskets).

2.3 HYDRANTS

- .1 Dry barrel type: to AWWA C502 and as follows:
 - .1 Depth of bury: as per pipe specification.
- .2 Barrel: two-piece with safety break-away flange stem.
- .3 Main valve: compression type, 134 mm minimum diameter.
- .4 Inlet connection: mechanical joint, 150 mm diameter.
- .5 Nozzles: two hose and one pumper. Match nozzles to those currently installed at BIO. Note: For further clarification, refer to HW Standard Drawing No. 1110.
- .6 Direction of opening: counterclockwise.
- .7 Operating nut: 32 mm square.
- .8 Body colour: Safety Yellow
 - .1 Note: For further clarification, refer to Halifax Water Standard Drawing No. 1140. Confirm hydrant top colour requirements with HW prior to painting.
- .9 Acceptable products:
 - .1 Clow Brigadier "M67"
 - .2 Canada Valve "Century"
 - .3 Mueller "Centurion"

2.4 GATE VALVES

- .1 Standard buried type: to AWWA C509 up to and including 300 mm, minimum working pressure rating 1380 kPa and as follows:
 - .1 Body: cast-iron with mechanical joint ends.
 - .2 Mechanism: solid resilient wedge, epoxy coated, bonnet, S.S., packing gland nuts and bolts, non-rising spindle, and O-ring seals.
 - .3 Direction to close: clockwise.
 - .4 Operating nut: 50 mm square.
 - .5 Acceptable products:
 - .1 Clow McAvity F-6100 Resilient Seat Valve
 - .2 Mueller A2360-23 Resilient Wedge Valve
 - .3 AVK Series 25/00 Resilient Seat
- .2 Epoxy coat all gate valves with minimum 150 microns coating.

2.5 VALVE BOXES

- .1 To AWWA C500 and as follows:
 - .1 Cast iron, slide type, adjustable for depth of pipe below finished grade. Maintain minimum of 125mm between the top of the lower and flange of the upper.
 - .2 Covers marked "Water", "Sprinkler", "Service" or "Hydrant", as applicable.
 - .3 Lugged to prevent turning and rolling of cover, and cover notched to suit.
 - .4 Have clear opening of 135 mm.
 - .5 Bonnet on the bottom section which is capable of enclosing the packing gland section of the gate valve.
 - .6 Acceptable products:
 - .1 IMP Model V.1

2.6 BOLTS FOR BURIED SERVICE

- .1 T-head bolts and nuts:
 - .1 Low alloy Corten steel

2.7 COUPLINGS

- .1 Mechanical joint sleeve type: to AWWA C110; use on new ductile iron pipe. Provide spacer ring between pipe ends. Where gap between pipe ends is less than 10 mm, spacer not required.

2.8 THRUST RESTRAINT

- .1 Thrust blocks and anchors: Mix design to Section 03 30 00 - Cast-in-Place Concrete. Use 15 M Grade 400 reinforcing steel where indicated.
- .2 Joint restraint device: 100 mm to 600 mm joint restraint device to AWWA C111 and C153 for mechanical or push-on joints with multiple wedge or gripper ring restraining mechanism, minimum working pressure rating 2410 KPa and minimum safety factor of 2:1. No special tools will be required for installation.
 - .1 Acceptable products:
 - .1 Ebba Iron Megalug
 - .2 Ford
 - .3 Star
- .3 Mechanical joint restraint devices are to be used in combination with concrete thrust blocks. No pipe joints are permitted within the "minimum pipe length" as denoted in Standard Drawing No. 1090.
- .4 Thrust block design requirements are outlined in HW Standard Drawing No. 1070 for pipe up to 300mm diameter.

2.9 DISINFECTANT

- .1 Sodium hypochlorite or calcium hypochlorite: to AWWA B300.
- .2 Liquid chlorine: to AWWA B301.

2.10 REDUCING AGENT

- .1 Hydrogen peroxide, 35% by mass commercial grade.

2.11 INSULATION

- .1 To Section 07 20 00.

2.12 GEOSYNTHETIC

- .1 Synthetic fibre, rot proof, unaffected by action of oil or salt water and not subject to attack by insects or rodents. Non-woven construction, with minimum thickness of 2 mm and minimum density of 200 g/m2.

2.13 ANODE PACKS

- .1 Zinc anodes (ZN24-48), complete with clamps, as directed.

2.14 POLYETHYLENE ENCASEMENT

- .1 Encasement to be single application of 200 micron polyethylene tubes or sheets conforming to AWWA C105.

2.15 PROTECTIVE COATING

- .1 Anti-corrosion petrolatum paste, tape and mastic.
 - .1 Acceptable products:
 - .1 Winn & Coates (Denso) Ltd.
 - .2 Trenton
 - .3 Petro
 - .4 Tapecoat
 - .5 STAC

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Carefully inspect products for defects and remove defective products from site.
- .2 Confirm that pipe, fittings, valves and hydrants are clean before installation.

3.2 TRENCHING, BEDDING AND BACKFILLING

- .1 Provide trenching, bedding and backfilling to Section 31 23 10.
- .2 Use Type 1 gravel for pipe bedding and protection unless otherwise specified.
- .3 Clear stone may be used in wet or freezing conditions only where specified or with the prior approval of the Departmental Representative.

- .4 Break rock 3m beyond end of watermain and lateral(s) for full trench width.

3.3 BURIED PIPE INSTALLATION

- .1 Lay and join pipe, fittings, and valves, as specified herein and according to manufacturer's published instructions.
- .2 Do not lay pipe and fittings when trench bottom is frozen, under water or when trench conditions or weather are unsuitable.
- .3 Lay pipe and fittings on prepared bed, true to line and grade indicated, within the following tolerances:
- .1 Horizontal Alignment: 150 mm
 - .2 Vertical Alignment: 75 mm
- .4 Face bell ends in direction of laying. On grades of 5% or greater, lay pipe up grade. For grades exceeding 16%, install appropriately designed gradient thrust restraint.
- .5 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary watertight bulkheads when pipe laying is not in progress.
- .6 Do not use excessive force to join pipe sections.
- .7 Install gaskets in accordance with manufacturers published instructions. Use only lubricant approved for potable water. During cold weather, store gaskets in heated area to assure that gaskets remain flexible.
- .8 Align pipes carefully before joining.
- .9 Support pipes as required to assure concentricity until joint is properly completed.
- .10 Keep pipe joints free from mud, silt, gravel or other foreign materials.
- .11 Avoid displacing gasket or contaminating with dirt, or other foreign material. Remove, clean, re-install and lubricate gaskets so disturbed. Do not reuse a gasket that has been contaminated with petroleum products.
- .12 Complete each joint before laying next length of pipe.
- .13 Restrain all joints with a mechanical joint restraint device.
- .14 Provide thrust blocks and joint restraint devices at all tees, bends and where indicated.
- .15 Where deflection at joints is permitted by the Departmental Representative, deflect only after spigot is fully inserted in bell. Do not exceed joint deflection recommended by manufacturer.
- .16 At structures, provide flexible joint not more than 300 mm from outside face of structure. Support pipe between structure wall and first joint with concrete.
- .17 Cut pipe as required for fittings or closure pieces, square to centerline, and as recommended by manufacturer. Do not damage pipe lining or coating. Leave smooth bevelled edge.
- .18 For corrosion protection, install polyethylene on ductile-iron pipe and fittings, as detailed on HW Standard Drawing No. 1020. Install zinc anodes on valves, hydrant bases, and copper service connections, as detailed on HW Standard Drawing No. 1040. Take care when handling poly wrapped pipe. Any damage to the polyethylene must be repaired to the Departmental Representative's satisfaction.

- .19 Give sufficient notice so that appropriate inspection and approval of pipe installation can be undertaken.

3.4 HYDRANT INSTALLATION

- .1 Install hydrants at locations indicated or where directed.
- .2 Install 150 mm gate valve and cast-iron valve box on hydrant anchor tee, or as indicated.
- .3 Set hydrant plumb, with hose outlets parallel to roadway, pumper connection facing roadway and breakaway flange, as indicated on HW Standard Drawing No. 1110
- .4 Provide mechanical joint restraint on all joints from the hydrant tee to the hydrant. In addition to joint restraint, provide concrete thrust blocks on all hydrants. Do not obstruct drain holes.
- .5 Provide drainage not less than 0.5 m³ in volume and backfill with clear stone to a level 150 mm above top of hydrant lead from hydrant to main.
- .6 Place geosynthetic over clear stone from hydrant to main.
- .7 Where water table is above drain holes, notify Departmental Representative. Where hydrant cannot be appropriately relocated, plug drain holes and advise Departmental Representative.
- .8 Set back hydrants a minimum of 700 mm from face of curb to center of hydrant on local streets, 850 mm on all other urban streets, as per HW Standard Drawing No. 1120.
- .9 Immediately upon installation of hydrants, place a 300 mm x 300 mm blue "hydrant out of service" marker on each hydrant pumper nozzle. Maintain markers on hydrants and remove when system is activated.

3.5 VALVES AND VALVE BOXES

- .1 Install valves at locations indicated. Joints and bedding as specified for pipe and fittings.
- .2 On direct buried valves, install valve boxes plumb and centered over operating nut, and true to line and grade.
- .3 Install zinc anodes on all valves as detailed on HW Standard Drawing No. 1040.
- .4 Place select backfill material, maximum size 50 mm around valve box to subgrade.
- .5 When valves are installed with cover in excess of 2.0 m, provide a valve stem extension in accordance with HW standards.
- .6 Where details of road construction do not dictate asphalt paving at valves an asphalt pad is required around the valve box as indicated on Standard Drawing No. 1050.

3.6 THRUST RESTRAINT

- .1 Provide formed thrust blocks to undisturbed ground on all tees, bends, plugs and caps. Keep joints and couplings free of concrete and construct, so as to avoid conflict with manholes in dual pipe trenches.
- .2 Backfill over thrust blocks when concrete has sufficient strength and can withstand earth pressure.

- .3 Mechanical joint restraint alone is permitted on 11, 22 and 45 Deg. horizontal bends of 300 mm diameter or smaller.
- .4 Where mechanical joint restraint is used alone, provide a single length of pipe within the "minimum pipe length" denoted in Standard Drawing No. 1090.
- .5 Reaction backing for plugs and caps shall be of timber blocking (hardwood sized to withstand thrust restraint against undisturbed earth or against a concrete thrust block). Install blocking to allow future removal without disturbing pipe, cap or bedding.
- .6 Place double polyethylene on bend before pouring concrete thrust block.

3.7 COMMISSIONING PLAN

- .1 Provide a Water System Commissioning Plan outlining the measures that will be taken for the hydrostatic testing, chlorination and disinfection of the water system. Coordinate plan with the Water Systems Operation Plan. This plan is to indicate the areas to be tested, the sequence of testing and the sample locations for bacteriological tests. Follow all requirements set forth in this specification and be provided to and approved by the Departmental Representative and HW's representative prior to any testing taking place. Unless otherwise approved, the maximum length of water main that can be tested will be limited to 450m.

3.8 HYDROSTATIC TESTING

- .1 Provide labour, equipment and materials required to perform hydrostatic test.
- .2 The operation of any existing valve not part of the new construction, shall be by Departmental Representative. 24 hours notice is required by HW for all filling, flushing or chlorination operations for new construction.
- .3 Include services, hydrants, mains and other appurtenances in the system test.
- .4 Do not carry out testing until the street base course (first lift of gravel) has been placed and compacted. Pipework located outside of the street right of way (R.O.W.) (ie easements) must be at finished grade prior to testing.
- .5 Perform tests in presence of the Departmental Representative and a representative of the HW. Provide HW representative with at least 24 hours notice prior to conducting any tests. Provide a ¼ inch NPT connection at an appropriate location for the HW's pressure gauge.
- .6 Pressure test valves, including hydrant valves.
- .7 Where hydrant extensions are required, install extensions prior to testing.
- .8 Open all valves in test section.
- .9 Expel air from main by slowly filling with potable water. Install corporation stops at high points where no air-vacuum release valves are installed.
- .10 Conduct test at a minimum pressure of the greater of 1035 kPa or one and one-half (1.5) times the operating pressure at the lowest point of elevation of the system being tested. In any case, the test pressure must not exceed 1205 kPa. Do pressure testing in sections where necessary to meet testing requirements. Testing to be in accordance to AWWA C600.

- .11 Conduct test over a full two (2) hour period, maintaining a constant test pressure. No leakage is permitted during the test period.
- .12 Locate and repair defects if test fails. Retest until results show remedial measures have been successful.
- .13 All water used for pipe testing including pressure testing, chlorination, flushing and dechlorination will be the responsibility of the Contractor, and will be chlorinated potable water.
- .14 Following acceptance of field tests, HW may order a second test. Cost of retesting will be paid by HW providing the test is satisfactory.

3.9 FLUSHING AND DISINFECTION

- .1 Chlorination of any water system can proceed only after system has been successfully pressure tested. Have chlorination test witnessed by the Departmental Representative and HW.
- .2 Flush and disinfect water mains to AWWA C651 and as herein specified. Notify HW 24 hours in advance of flushing and disinfection.
- .3 Flush water mains with potable water through available outlets until foreign materials have been removed and water is clear. The size and number of taps should conform to Table 3 of AWWA C651.

<u>Pipe Diameter</u>	<u>Flow Required to Produce 2.5 ft/s (approx.) Velocity in Main</u>		<u>Size of Tap, In. (mm)</u>			<u>Number of 2½" (64mm) Hydrant Outlets</u>
			<u>1(25)</u>	<u>1½(38)</u>	<u>2(51)</u>	
<u>In. (mm)</u>	<u>Gpm</u>	<u>(L/s)</u>	<u>Number of Taps on Pipe</u>			
4 (100)	100	(6.3)	1	-	-	1
6 (150)	200	(12.6)	-	1	-	1
8 (200)	400	(25.2)	-	2	1	1
10 (250)	600	(37.9)	-	3	2	1
12 (300)	900	(56.8)	-	-	2	2

- .4 Slowly open and close valves and hydrants to ensure thorough flushing.
- .5 If satisfactory results cannot be achieved by flushing, swab pipe by approved methods and re-flush.
- .6 Disinfect water main upon completion of flushing using chlorine solution distributed throughout entire system.
- .7 Inject 1% chlorine solution through a corporation stop in the top of newly laid pipe, at point close to where main is being filled and at rate proportioned to filling rate. Prepare stock chlorine with concentration of 1% free chlorine by volume as follows:

<u>Product</u>	<u>Amount Of Compound</u>	<u>Quantity of Water (litre)</u>
high test calcium hypochlorite (67-70%Cl)	1.0 kg	60 litres
liquid laundry bleach (5.25% Cl)	1.0 litre	3.5 litres
3.5 litres (10.5% Cl)	1.0 litre	7.0 litres

- .8 Calcium hypochlorite is not to be used when water temperature is less than 5 degrees C.
- .9 The following table indicates the quantity of 1% chlorine stock solution required per 100 metre length of pipe.

<u>1% Hydrogen Peroxide</u>	
<u>Pipe Diameter (mm)</u>	<u>Solution (litres)</u>
100	4.9
150	10.9
200	19.4
250	30.4
300	42.9

- .10 Operate valves, hydrants, and appurtenances while main contains chlorine solution.
- .11 Take water samples at all hydrants and termination points, in suitable sequence, to test chlorine residual. When tests indicate minimum chlorine residual of 50 mg/L, leave system charged with disinfectant solution for 24 hours. At the end of this 24-hour period, the treated water in all portions of the main must have a residual of not less than 25 mg/L. Rechlorinate if the residual has fallen below 25 mg/L the system.
- .12 Flush disinfectant solution from line after 24 hours. Under no circumstances shall disinfectant solution remain in the line longer than 48 hours. Add 1.0% hydrogen peroxide reducing agent to the disinfectant solution at point of discharge or within a retention facility such that the solution is disposed to the environment with a total chlorine residual no greater than 0.0 mg/L in accordance with the requirements of Nova Scotia Environment. Check chlorine residuals before disposal and at regular intervals during disposal to ensure compliance. This de-chlorination requirement can only be excluded with the written consent of Nova Scotia Environment.
- .13 Dispose of de-chlorinated disinfectant solution. Where disposing to the environment, disposal of the de-chlorinated solution must be at least 100 meters from the nearest watercourse.
- .14 Where disinfectant solution is de-chlorinated at point of discharge, inject stock reducing agent at a rate proportioned to discharge rate. Injection and discharge rates must be monitored continuously to ensure proper proportioning.
- .15 Prepare stock reducing agent with concentration of 1% Hydrogen Peroxide (H₂O₂) by volume, as follows:

<u>Liquid Reducing Agent</u>	<u>Amount of Agent (litres)</u>	<u>Quantity of Water (litres)</u>
Hydrogen Peroxide (35% H ₂ O ₂ by mass)	1.0	34.0
34.0		

- .16 The following table indicates quantity of 1% Hydrogen Peroxide required to reduce total chlorine residual of disinfectant solution contained per 100 metre length of pipe, from 50 mg/L to 0.0 mg/L.

1% Hydrogen Peroxide	
Pipe Diameter (mm)	Stock Solution (litres)
100	4.5
150	10.2
200	18.1
250	28.2
300	40.6

- .17 Where total chlorine residual of disinfectant solution exceeds 50 mg/L, quantity of stock reducing agent for de-chlorination can be increased in direct proportion to the quantity indicated in the above table.
- .18 After disinfectant solution is flushed from water main, assist HW representative in obtaining two (2) water samples on each of two consecutive days (at least 24 hours apart) for bacteriological tests. Hydrants shall not be used as sampling points. Repeat disinfection procedure if bacteriological tests fail.
- .19 Obtain bacteriological samples from a test sampling tap or a copper service lateral if available. Take samples from every 366m (1200 ft) of new water main, plus one set from the end of the line and from every branch (See AWWA C651, Section 5.1). If service laterals are not available, a hydrant lead may be tapped to provide the required sampling location.
- .20 Collect samples in accordance with Appendix A of Nova Scotia Environment "Guidelines for Monitoring Public Drinking Water Supplies". Have analysis done by an independent lab in accordance with Section 410 of the Guidelines.
- .21 Should any of the test results be positive, repeat disinfection, flushing, sampling and analysis.
- .22 After testing, submit the results to the Departmental Representative showing the passing of the bacteriological tests. Remove corporation stops and install plugs. Check visually for leakage after plugs are installed with water main under normal operating pressure.

3.10 CONNECTIONS TO EXISTING MAIN

- .1 Connect new mains to existing mains as indicated.
- .2 Do not make a connection to an existing main within 1.0 m of a fitting, pipe joint or another service.
- .3 Departmental Representative and HW do not guarantee leak tight operation of existing valves.
- .4 No Work will be performed on existing main until all items required to complete the connection are on site and the outside diameter and type of pipe have been confirmed.
- .5 Departmental Representative will operate valves in the exiting system.
- .6 When a connection is made to an exiting main (ie. inserting a new tee) an inspection of the joints for leakage must be made by the HW, while the main is under operating pressure, prior to backfilling.

3.11 PROTECTIVE COATING

- .1 Apply where alternative corrosion protection measures (polywrap, epoxy coating, cathodic protection) are not

employed unless otherwise directed by the Departmental Representative.

- .2 Protective coating:
 - .1 Coat all valves, steel flanges, couplings and make-up pieces, restrained joint mechanisms, and other areas indicated on Drawings and specified with protective coating, in accordance with manufacturer's instruction.
 - .2 Transport and store coating materials at temperatures between 5°C and 30°C.
 - .3 Confirm surfaces to be coated are free of loose coating, soil and other foreign matter.
 - .4 Apply priming paste to all areas after surface preparation is completed.
 - .5 Apply mastic to all irregular surfaces to ensure smooth surfaces and no air pockets.
 - .6 Apply tape spirally to all areas receiving paste or mastic using a 25% overlap wrapping technique.
 - .7 Wrap protected area with 150 micron polyethylene sheet prior to backfilling.
- .3 Utilize primer, mastic and tape in accordance with manufacturer's instructions.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

- .1 Excavating, Trenching, and Backfilling: Section 31 23 10

1.2 REFERENCES

- .1 CAN/CSA-B1800-2011, Thermoplastic Non-pressure Piping Compendium.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit shop drawings for all pipe, fittings, valves, and all other items necessary for a complete installation. Include details showing dimensions and tolerance of pipe and joint proposed.

1.4 MATERIAL CERTIFICATIONS

- .1 Submit manufacturer's test data and certification that products and materials meet requirements of this Section.
- .2 Confirm certification is marked on pipe.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Handle and store pipe in such a manner as to avoid shock and damage and as per manufacturer's recommendations. Do not use chains or cables passed through pipe bore.
- .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.

1.6 SCHEDULING OF WORK

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

PART 2 - PRODUCTS

2.1 SEWER PIPE

- .1 Gravity PVC pipe and fittings: type PSM polyvinyl chloride, to CAN/CSA-B1800, DR35, complete with bell and spigot joints with locked in rubber gaskets.

2.2 PIPE BEDDING MATERIAL

- .1 Granular bedding material: as specified in Section 31 23 10.

2.3 GROUT

- .1 Shrinkage compensating to Section 03 30 00.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Clean pipes and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.
- .2 Obtain Departmental Representative's approval of pipes and fittings prior to installation.
- .3 Provide proper implements, tools and facilities approved by the Departmental Representative, for the safe and convenient prosecution of the Work.
- .4 Take every precaution to prevent foreign material from entering the pipe.

3.2 TRENCHING AND BACKFILLING

- .1 Provide trenching, excavating and backfilling to Section 31 23 10.

3.3 GRANULAR BEDDING

- .1 Provide granular bedding to Section 31 23 10.

3.4 PIPE LAYING

- .1 Carefully lower pipe into the trench. Do not drop or dump materials into the trench.
- .2 Lay and join pipes as specified herein and according to manufacturer's published instructions.
- .3 Lay pipe and fittings on prepared bed, true to line and grade indicated.
- .4 Commence laying at outlet and proceed in upstream direction with bell ends of pipe facing upgrade.
- .5 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary water-tight bulkheads when pipe laying is not in progress.
- .6 Do not lay pipe when the trench bottom is frozen, underwater or when trench conditions or weather are unsuitable.

3.5 PIPE JOINTING

- .1 Install gaskets in accordance with manufacturers published instructions. During cold weather store gaskets in heated area to assure flexibility.
- .2 Align pipe carefully before joining. Do not use excessive force to join pipe sections.
- .3 Support pipes as required to assure concentricity until joint is properly completed.
- .4 Keep pipe joints free from mud, silt, gravel or other foreign material.
- .5 Avoid displacing gasket or contaminating with dirt, petroleum products, or other foreign material. Remove, clean, reinstall and lubricate gaskets so disturbed.
- .6 Cut pipe as required for fittings or closure pieces, square to centreline, and as recommended by manufacturer.
- .7 Make watertight connections to manholes and structures.
- .8 At structures provide flexible joint not more than 300 mm from outside face of structure, or as otherwise indicated.

3.6 PIPE BACKFILL

- .1 As specified in Section 31 23 10.

3.7 PIPE CLEANING

- .1 Prior to testing, clean gravity sewer to remove foreign materials.

3.8 LOW PRESSURE AIR TEST

- .1 Notify the Departmental Representative at least 24 hours in advance of all proposed tests. Perform tests in presence of the Departmental Representative.
- .2 Provide labour, equipment and materials required to perform testing.
- .3 **CAUTION:**
FOR SAFETY OF PERSONNEL AND PUBLIC, OBSERVE PROPER PRECAUTIONS DURING AIR TESTING. USE TEST EQUIPMENT DESIGNED TO OPERATE ABOVE GROUND. DO NOT PERMIT PERSONNEL IN TRENCH DURING TESTING. DO NOT AIR TEST PIPE WITH DIAMETER GREATER THAN 600mm.
 - .1 Provide air testing equipment meeting the following requirements:
 - .1 Air Blower: 14 litres/sec, maximum pressure 70 kPa continuous.
 - .2 Pressure Relief Valve: Sized to relieve full blower capacity at maximum blower pressure. Range 20 - 70 kPa, adjustable.
 - .3 Pressure Gauges: Range 0 to 70 kPa with accuracy +/- 0.25 kPa.
 - .2 Provide plugs at each end of section, with one plug equipped for air inlet connection.
 - .3 Fill test section slowly until a constant pressure of 28 kPa is reached. If ground water is above section being tested, Engineer may recommend increase in air pressure.

- .4 Allow minimum 2 minutes for air temperature to stabilize, adding only amount of air required to maintain pressure.
- .5 After 2 minute period, shut off air supply.
- .6 Decrease pressure to 24 kPa. Measure time required for pressure to reach 17kPa. Minimum time allowed for pressure drop is as follows:

<u>Pipe Diameter (mm)</u>	<u>Minimum Time Min:Sec</u>
100	1:53
150	2:50
200	3:47
250	4:43
300	5:40
375	7:05
450	8:30
525	9:55
600	11:20

- .7 Locate and repair defects if test fails. Retest.
- .8 Repair visible leaks regardless of test

3.9 DEFLECTION TESTING - PVC PIPE

- .1 Measure deflection by pulling a deflection gauge through each pipe from manhole to manhole after backfilling.
- .2 Provide deflection gauges to measure a 5% and 7-1/2% deflection. Gauges to be a "Go-No-Go" device.
- .3 Thirty days after installation, pull a deflection gauge measuring 5% deflection through the installed section of pipeline. If this test fails proceed with 7-1/2% deflection test.
- .4 Thirty days prior to completion of Warranty Period Maintenance, pull a deflection gauge measuring 7-1/2% deflection through the installed section of pipeline.
- .5 If 7-1/2% deflection test fails, locate defect and repair. Retest to satisfaction of Departmental Representative.

3.10 CLOSED CIRCUIT TELEVISION INSPECTIONS

- .1 Arrange and pay for television camera inspection of installed pipeline.
- .2 Scheduling:
 - .1 Perform first video inspection when the sanitary sewer has been cleaned and all manhole adjustments and street reinstatement have been completed.
 - .2 The entire system must also be video inspected a second time eleven months after substantial completion.
- .3 Equipment:
 - 1 Provide equipment meeting following requirements:
 - .1 Self-contained monitoring unit and camera with remotely controlled lighting system capable of varying the illumination.
 - .2 Picture quality shall produce continuous 600-line resolution picture, showing entire periphery of pipe.

- .3 A meter device with readings above ground or marking on cable to clearly identify exact location of camera.
- .4 Definition of fault:
 - .1 Any pipe joint which displays a gap or spread, offset, gasket, or signs of infiltration.
 - .2 Any section of pipeline which is crushed, broken or displays cracks.
 - .3 Any variance in grade of pipeline.
 - .4 Any gravel, roots, or foreign material which may impede flow.
 - .5 Any deformation in shape of pipe.
- .5 Inspection:
 - .1 Perform inspection of pipe by passing TV camera through pipeline in direction of flow.
- .6 Records:
 - .1 Maintain inspection record in log form, during television inspection.
 - .2 Log to include location of each fault.
 - .3 Photograph fault from the television screen using a digital camera or provide hard copy stills directly from system if possible. All photographs to be clear and precise with distinct definition of fault.
 - .4 Include detailed technical description with photographs as supporting data for each fault.
 - .5 Provide all photos and videos in colour.
- .7 Reports:
 - .1 Provide a composite report of TV inspection. Enclose report in binder on letter size paper. Include following pages and information:
 - .1 Title page identifying project, camera operator and dates of inspection.
 - .2 Index page identifying pipeline, page number or numbers where information for section is contained.
 - .2 Report on each pipeline to contain:
 - .1 Heading:
 - .1 Street name.
 - .2 Manhole numbers applicable to section.
 - .3 Reference drawing number, if applicable.
 - .4 Weather on the day of inspection.
 - .5 Statement of soil condition in area of inspection, i.e., dry, damp, wet, frozen.
 - .6 Date of inspection.
 - .2 Key Plan showing magnetic north, horizontal distance, pipe and material and direction of flow.
 - .3 Inspection findings for each pipeline to include:
 - .1 Location of all faults.
 - .2 One photograph each of typical joint and flanged connection.
 - .4 Mount photographs on left-hand page and place corresponding description on right-hand page. Number all photographs in order. Number beside photograph to correspond with description number.
 - .5 Enclose all pages of report in transparent sheet protector.
 - .6 Provide copy of DVD to Departmental Representative.

3.11 TESTS TO BE REPEATED

- .1 Should testing or inspection disclose non-conformance, locate and repair defective pipe or joint to the approval of the Departmental Representative.
- .2 Re-test to determine success or otherwise of remedial measures applied to pipework. These re-tests are to be repeated at no extra cost to Contract until results show that remedial measures have been successful.

- .3 In the event the Departmental Representative suspects the sanitary gravity sewer no longer complies with requirement of the test, the Departmental Representative may order additional testing. Should the length of pipeline prove defective, repair or make good the defect at no extra cost to Contract.
- .4 Cover the cost of additional testing at no extra cost to Contract if test proves a defect. However, if this testing shows pipe to be satisfactory, cost of second test will be borne by the Departmental Representative.

3.12 CLEANUP

- .1 Upon completion of testing of each section remove all ancillary equipment and plug holes. Do not backfill around test plugs until inspected by Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for constructing a Grinder type sewage lift station. Work generally includes supply and installation of pumping equipment, pump controller, valves, metal fabrications, and related pipe and electrical work.

1.2 RELATED SECTIONS

- .1 Concrete: Section 03 30 00
- .2 Excavating, Trenching and Backfilling: Section 31 23 10
- .3 Sanitary Sewers: Section 33 31 00
- .4 Pressure Sewers: Section 33 34 00
- .5 Pre-cast Manholes, Catch Basins and Structures: Section 33 39 00

1.3 REFERENCE STANDARDS

- .1 ANSI/ASME B-16.1-2010, Class 125, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ANSI/AWWA C104/A21.4-2013, Cement Mortar Lining for Ductile-Iron Pipe and Fittings.
- .3 ANSI/AWWA C110/A21.10-2012, Ductile-Iron and Gray Iron Fittings for Water.
- .4 ANSI/AWWA C151/A21.51-2009, Ductile-Iron Pipe, Centrifugally Cast, for Water.
- .5 ASTM A36M-2012, Carbon Structural Steel.
- .6 ASTM A181M-2013, Carbon Steel Forgings for General-Purpose Piping.
- .7 CAN/CSA-C22.1-2012, Canadian Electrical Code.
- .8 CAN/CSA-C22.2 No. 108-01(R2010), Liquid Pumps.
- .9 CSA Bulletin S2619-1998, Information and Documentation.
- .10 ANSI/ASTM D2564-04e1, Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
- .11 ANSI/ASTM D1785-12, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- .12 ANSI/ASTM D2467-13A, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- .13 CSA B137 Series-13, Thermoplastic Pressure Piping Compendium.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate details of piping, valves, supports, pumps, metal fabrications, access hatches, electrical connections and appurtenances.

1.5 OPERATING AND MAINTENANCE DATA

- .1 Provide operating and maintenance data in accordance with Section 01 78 00 and as follows:
 - .1 System description.
 - .2 Performance curves for the pumps, layout, and wiring diagrams, control system schematic, level control system schematic.
 - .3 Related civil, mechanical, and electrical drawings.
 - .4 Manufacturer's operation instructions.
 - .5 Name, address, and telephone number of equipment suppliers.
 - .6 Information on guarantees and warranties.

1.6 HANDLING AND STORAGE

- .1 Handle and store pumps, pipe, valves, and fittings in such a manner as to avoid shock and damage. Do not use chains or cables passed through pipe or equipment. Do not damage coatings or linings.

1.7 MAINTENANCE MATERIAL

- .1 Provide manufacturer's recommended spare parts list.
- .2 Parts to be available for use on site within 24 hours notice.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Pump characteristics: 3.15 l/s (50 USgpm) at 18.3 (60 ft.) 208 V, 3 Phase, 60 Hz.

2.2 PUMPS

- .1 Submersible, grinder pumps.
 - .1 Equip each pump with submersible, electric motor and power supply and monitoring snow composite cable(s). Cables to be suitable for submerged use and CSA approved.
 - .2 Cable Entry:
 - .1 Confirm cable entry design has an impermeable seal.
- .2 Combine power, temperature sensing and moisture sensor conductors into a single cord. Entry into the pump can be accomplished in two (2) ways:
 - .1 Furnish a plug-in power cable to allow easy changes of both voltage and cable length without motor entry.

- .2 Cable enters through a double grommet and internal strain relief to a terminal strip for conductor attachment.
- .3 Cable entry design must be capable of continuous submergence underwater without loss of watertight integrity to a depth of 20 m.
- .4 Pump unit to be capable of delivering flow and TDH, as indicated per level B of Hydraulic Institute Standard for Centrifugal Pumps. Size pumps such that no point on the operating curve shall overload the motor.
- .5 Supply each unit complete with a mating, discharge connection and hot-dip galvanized lifting chain or stainless steel cable, approved for overhead lifting and of adequate strength to permit raising and lowering of the pump. Supply a cast-in davit socket, davit and chain fall or cable winch for pump retrieval.
- .6 Pump and motor close-coupled, integral design capable of handling raw, unscreened sewage. Permanently install discharge connection elbow in wet well, together with the discharge piping.
- .7 Pump to be automatically connected to discharge connection elbow when lowered into place, and easily removed for inspection and service.
- .8 Major pump components: grey cast iron, with smooth surfaces, devoid of blowholes and other irregularities.
- .9 All exposed nuts and bolts to be 316 series stainless steel construction.
- .10 Protect all surfaces coming into contact with sewage, other than stainless steel or brass, by an approved, sewage-resistant coating.
- .11 Machine all mating surfaces where watertight sealing is required and fitted with nitrile or neoprene rubber O-rings. Accomplish sealing by metal-to-metal contact between machined surfaces.
- .12 Control compression of nitrile rubber or neoprene O-rings without the requirement of a specific torque limit. Do not use secondary sealing components, rectangular gaskets, elliptical O-rings, grease or other devices or materials.
- .13 Volute: single port, non-concentric design with smooth fluid passages, large enough at all points on the volute to pass any size solids which can pass through impeller.
- .14 Impeller ductile iron or grey cast iron, Class 30 or better, dynamically balanced, non-clog or recessed design having a long throughlet without acute turns.
 - .1 Impeller: capable of handling solids, fibrous material, heavy sludge, and other matter found in normal sewage applications.
 - .2 Impeller complete with an integral grinding assembly.
 - .3 Pump out vanes in the back of impeller shroud to be large enough to sufficiently expel solids away from seal area.
- .15 Grinder pumps to have hardened stainless shredding ring and grinder to reduce sewage to a small size for discharge through small diameter piping.
- .16 Pumps to be rated for operation in Class 1, Zone 1 Hazardous areas..
- .17 Electric Motor:
 - .1 The pump motor: squirrel-cage induction, inverter duty rated type design, housed in a watertight or dielectric oil-filled chamber of maximum efficiency and durability. Design motor for continuous duty capable of sustaining a minimum of fifteen (15) starts per hour. Motor speed and electrical characteristics as indicated in Project Documents.
 - .2 Motor stator: directly shrink-fitted into the stator housing. Insulate stator winding and leads with

moisture-resistant varnish capable of withstanding a temperature of 155°C or the motors maximum temperature rise, whichever is greater. Insulation rating to Class F or higher.

.3 Rotor bars and short-circuit rings to be made of aluminum. Use thermal sensors to monitor stator temperatures on all pumps. Equip stator with not less than two (2) thermal switches embedded in the end coils of the stator windings (one switch per phase to protect the motor against surcharges and high temperature). Use these in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel.

.4 Seal junction box chamber containing the terminal board from the motor by an elastomer compression grommet for pumps of 3 kW (4 hp) or more. Alternately, use of triple-sealed cable entry system does not require a seal junction box chamber.

.5 Equip air-filled motor housing with a moisture detector to detect any leakage of water or pumpage into the stator housing. The signals from the thermal switches and the moisture detector to be wired to the control panel.

.6 Accomplish control of the moisture detector and the winding thermal switches by using a control/indicator relay(s) which will be installed and wired inside the control panel to stop the pump unit upon a fault signal.

.7 Motors to be air cooled or oil cooled to manufacturer's standard.

.8 Motor to be able to operate dry without damage while pumping under load.

.18 Shaft and Seals

.1 Pump shaft: AISI 400 series stainless steel. Provide each pump with a tandem mechanical shaft seal system.

.2 Tandem mechanical shaft seal to be of single spring design operating in cooling medium.

.3 Seals must be silicone carbide, tungsten carbide or carbon ceramic.

2.3 GUIDE BARS

.1 Provide corrosion resistant vertical guide bar(s) with each pump to ensure correct alignment of pump with automatic discharge connection.

.2 For each pump, guide bar(s) securely fixed at lower end to the discharge connection by means of corrosion proof bosses, provided.

.3 Extend guide bar(s) from discharge connection toward ground level to be securely fixed by corrosion proof brackets (mid and upper guide bar holders).

.4 Provide bracket with special inserts to position the guide bars rigidly, where shown on the drawings.

2.4 DISCHARGE CONNECTIONS

.1 Provide cast iron, automatic discharge connection for each pump to connect pump to discharge piping.

.2 Discharge connection to be permanently fixed in position by anchor bolts attached to the bottom of the pump chamber.

.3 Discharge connections to permit rapid and precise installation or removal of the pumps without entering pump chamber.

.4 Connection to ensure zero leakage between the pump and its discharge connection.

.5 No part of the pump to bear directly on the floor of the wet well.

2.5 PIPING, FITTINGS AND VALVES

- .1 Pipe: all interior station piping to be ductile Schedule 80 PVC pipe and fittings.
- .2 Plug valves: Non-lubricated eccentric plug type, cast iron body to ASTM A126, Class B, with exterior epoxy finish and Bunn-N interior coating, full round port, 125 lb flanges, wrench operated with stem extensions to access covers.
- .3 Check valves: Ball check type, non-clog for unobstructed free flow.
- .4 Wall penetrations: All wall penetrations to have Linkseal, Pen-Seal or approved equivalent.

2.6 MISCELLANEOUS ITEMS

- .1 Splash plate: fabricated from stainless steel.

2.7 ACCESS FRAME AND COVER

- .1 Fabricate aluminum access frame using an extrusion of 6351 aluminum. Fabricate cover using a plate of 5086 aluminum designed to withstand shear and deflect not more than 1/79 of the maximum span for minimum specified loads of 7.2 kPa uniform load or 1100 kg point load. Cover to rest on a rubber gasket to be hinged along one side with a heavy duty aluminum hinge.
- .2 Top of the access frame to be flush, the handle recessed. Install padlock within the recess to lock the cover in the closed position.
- .3 Provide cover stay to allow the cover to be locked in the open position.
- .4 Each access frame to be capable of supporting the full weight of any submersible pump which can be installed through its opening.
- .5 Design access frames for embedding into the concrete top of a sewer station, extrusion to be shaped such as to provide good anchoring to the concrete. All surfaces in contact with the concrete to be bitumastic coated.
- .6 Frames to be capable of being installed side-by-side by bolting them together using standardized bolting kits.
- .7 Provide aluminum rail nuts within the extrusions, permitting an upper guide holder, a level regulator hanger and a chain hook to be attached without any modifications required to the frame.
- .8 Clearly display a bilingual confined space warning label on the underside of the cover.
- .9 Provide a safety grate for fall through protection. When installed in pairs, install safety grates so that they open outward.

2.8 LIQUID CONTROL

- .1 Provide liquid level regulation to control the operation of the pumps in accordance with variations of sewage

levels in the pump chamber.

- .2 Level control by mechanical switches (floats). Mercury liquid level switches are not permitted.
- .3 Cables with sufficient lengths to run directly to the junction boxes and pull through conduits.
- .4 Acceptable Products: Flygt ENM-10, Conery B6 or approved equivalent.

2.9 PUMP CONTROL PANEL

- .1 Provide duplex control panel complete with:
 - .1 NEMA 4X insulated enclosure.
 - .2 Provide control panel complete with a fused main disconnect switch and associated controls, rated to suite loads. Minimum 14 KAIC.
 - .3 Provide enclosures complete with an inner swing door for mounting controls (selector switches, run-timers, pilot lights, etc.). Provide outer door complete with provision for pad locking.
 - .4 Main disconnect and pump starter disconnect to be moulded case circuit breakers or fused disconnect switches, complete with Class J fuses. Disconnects.
 - .5 Provide an integral manual transfer switch complete with a weather resistant generator receptacle. Field install receptacle to suit panel installation. Provide matching plug for the Owner's generator.
 - .6 NEMA design motor starters with overload relays, ground fault protection and external reset buttons.
 - .7 Pump over-temperature and seal failure protection installation as supplied by pump manufacturer.
 - .8 Inner door mounted hand-off-auto selector switch for each pump starter.
 - .9 120V fused control circuits, NEMA design pilot lights for power available, pump run indication, pump fault and high level alarm.
 - .10 Automatic control to be provided by float switches.
 - .11 Intrinsically safe barriers for wiring float switches in a Class 1, Zone 1 hazardous area.
 - .12 Specification grade, ground fault type convenience receptacle (15A, 125V, duplex, 5-15 configuration).
 - .13 Individually protected 120V control circuits for pump control, instruments, heating and receptacle.
 - .14 Provide enclosure heater with thermostat control.
 - .15 Provide logic for duplex operation:
 - .1 On a rising liquid level in the sump, the lead pump must turn on when the liquid reaches the "pump on" level.
 - .2 If liquid level continues to rise, the lag pump will be started by "lag pump on" float.
 - .3 Both pumps will continue to pump until the liquid level is lowered to the "pump off" level. Normal operation is to alternate the lead pump position when the "pump off" level is reached.
 - .4 If the liquid level continues to rise the high level alarm will be activated by the "high level" float.
 - .5 Each pump is equipped with a hand off auto selector.
 - .6 The pumps are manually turned on and off by HOA.
 - .7 When in auto, each pump is controlled by the pump control system.
 - .16 The fault status of each pump (failure, overheating and leak detection) and high level shall feed back to the controller as one general system fault. A red vandal-resistant, weatherproof flashing light will be triggered as indication of alarm, provide acknowledge switch.
 - .17 Provide auto dialer to communicate Pump 1 fault, Pump 2 fault high level alarm and power failure. Unit complete with battery back-up.
 - .1 Acceptable Product: Sensaphone 400 or approved equivalent.
 - .18 Provide panel general arrangement layouts, schematic drawings, wiring termination schedules and a bill of materials with shop drawing submission.
 - .19 Acceptable Products: TEKK Controls, The Panel Shop, Surflin or approved equivalent.

2.10 ELECTRICAL WIRING

- .1 Install only equipment essential for the operation of the pump station inside the wet well.
- .2 Locate, where possible, all fans, heaters, switches and junction boxes, etc., outside the wet well to avoid corrosion or flood damage.
- .3 All electrical wiring of the pump station to be designed and supplied by the manufacturer in accordance with the Canadian Electrical Code and CSA bulletin S2619.
- .4 Provide pump power and level regulator cables in sufficient length to run directly to the control panel via an external conduit. Provide conduit fittings and strain relief connectors in sufficient number and size to permit installation of the conduit to the pumping station. All external conduits to enter the control panel enclosure only through the bottom. Seal conduits with an approved gastight barrier, preventing entry of vapour or gas from the wet well into the control panel. Locate seal to enable motor removal complete with electrical disconnect without disturbing the seal. Where EYS seals are used, a rated junction box is to be employed to allow for pump removal.
- .5 Code all wiring in the pump station either by colour or a numbering system.
- .6 Provide pump power and level regulator (and automatic flush valve-optional) cables with sufficient length to run directly to the junction boxes and pull through external conduits.
- .7 All conductors in power wiring to be no less than No. 14 AWG. Control wiring conductors may be smaller in size, in accordance with the current requirements of the circuit involved and all applicable standards.
- .8 Provide separate conduit(s) for intrinsically safe devices.

2.11 LABELS

- .1 Permanently affix suitable nameplates onto the pumps, motors, control enclosure components, and other operating components to indicate the purpose of the component or operating routine and parameters applying to the component. Confirm lift station pumps and control equipment are CSA approved and the CSA logo appears on the nameplates of these components.
- .2 Provide a second complete set of pump data and serial number labels for the Owner's reference.

PART 3 – EXECUTION

3.1 MANUFACTURER'S INSPECTION, TESTING AND SHIPMENT

- 1 Inspection and Testing:
 - .1 Test pump proper operation at rated power supply values and for electrical and mechanical integrity prior to shipment. Pump supplier to have adequate test facilities to at least provide a single-point performance test or a complete performance curve at an accuracy of $\pm 1\%$.
 - .2 Pump/motor assembly to be CSA approved as one, integral unit, as per CSA standard CAN/CSA-C22.2. No. 108. Proof of this approval to be submitted by the pump manufacturer together with the approval drawings. An approval of the motor unit only will not be acceptable. Cable to be CSA approved, SOW type, neoprene-jacketed, with a 90°C rating.
 - .3 The supplier grants the right of inspection of the pumping equipment to any authorized representative of the Departmental Representative before shipment from factory. If inspection is requested

- give 48 hours notice in advance of the time when the equipment will be ready for inspection at the factory.
- .4 Have any equipment in the pumping station that may have been provided by another supplier tested by the original supplier.
 - .5 Pump manufacturer to perform the following inspections and tests on each pump before shipment:
 - .1 Check impeller, motor rating, and electrical connections for compliance to the customer's purchase order.
 - .2 A motor and cable insulation test for moisture content and/or insulation defects.
 - .3 Prior to submergence, run the pump dry to establish mechanical integrity and free rotation.
 - .4 Run pump submerged, 2 m minimum depth.
 - .5 Repeat after operational test number 4, the insulation test, number 2.
 - .6 Check oil housing for any leakage of water by the lower seal.
 - .7 Inspect motor housing and junction box for any water leakage.
 - .8 Supply upon request, a written report stating that the above tests have been performed with each pump at the time of shipment.
 - .9 Seal pump cable end with a high quality protective covering to make it impervious to moisture and/or water seepage, prior to shipping to job site and electrical installation.
 - .6 Provide successful test results prior to shipment.
- .2 Shipment: ship equipment assembled to the greatest extent possible to reduce installation and start-up costs.

3.2 PRE-INSTALLATION

- .1 Verify all layouts, dimensions, elevations and other pertinent data prior to proceeding with the work.
- .2 Back-prime all metal surfaces being mounted directly against concrete surfaces with bitumastic paint with the exception of surfaces that will be grouted in.
- .3 Examine all components to be incorporated into the Work for cracks, pits, blow holes, finishes, and any other defects. Do not incorporate any defective materials into the Work. Remove any defective materials from the site immediately and replace defective materials with new materials. Inspect all materials and remove all dirt and other debris.
- .4 Install all components in strict accordance with each manufacturer's instructions, recommendations and the approved shop drawings for the various materials to be incorporated in the Work.
- .5 Install pumps, pipe, fittings, valves, accessories and appurtenances using skilled workers experienced in the tasks required.
- .6 Handle all components carefully taking care not to damage the surface finish on these components. Make good any damage or supply new components as appropriate.
- .7 Install isolation bushings between stainless steel anchors and other dissimilar materials.
- .8 Install stainless steel washers when installing anchors for pump discharge base elbows. Washers to have a stick-on plastic film on the side contacting the base elbows. Use stainless steel shims similarly protected when shimming base elbows.
- .9 Arrange for start-up, testing and commissioning by the equipment manufacturers' representatives in presence of the Owner's representatives after the installation has been completed and is ready for start-up and commissioning.
- .10 All electrical installations to be completed to meet or exceed all applicable codes.

3.3 PIPING

- .1 Cut piping to length using equipment designed for the cutting of pipe within the maximum allowable tolerance from square cut ends in accordance with type.
- .2 Install piping straight, parallel to walls and in such a manner so as to prevent straining during jointing procedures. Install galvanized pipe supports where shown or required.
- .3 Prior to assembling flanged joints, thoroughly clean flanges. Use a gasket lubricant to ease gasket installation. Tighten diametrically opposed bolts simultaneously.
- .4 Do not correct misalignment using fasteners or other means to pull flanges into alignment. Correct so that no eccentric loads are placed on flanges.

3.4 VALVES

- .1 Install valves in the proper orientation with respect to flow direction. Install isolation valves with the seat side toward pump.

3.5 PUMPS AND APPURTENANCES

- .1 Locate, align, level, adjust and install pump discharge base elbows. Locate pumps and discharge base elbows so that the pumps can be easily removed through the openings in the lift station without requiring the removal of any station equipment.
- .2 Install guide bar holders and guide bar(s) in accordance with the pump and anchor manufacturer's instructions, so that the guide bars are true, plumb and in the proper location and alignment so that the pumps can be easily removed through the openings in the lift station cover.
- .3 Take care to protect the finish on the pumps, pipe, fittings, valves and appurtenances from scratches and other damage. Repair any damage to the surface finishes.

3.6 ACCESSORIES

- .1 Construct level regulator hanger of stainless steel and mount in the position indicated or as directed by the Departmental Representative. The level regulator hanger(s) will otherwise be mounted in a location where it will not be affected by flow from the inlet piping or prevent removal of the pumps, all in accordance with the pump and anchor manufacturer's instructions.
- .2 Back-prime and mount each galvanized chain hook or cable in the area shown and located so that the chain can be reached conveniently and such that the hook does not interfere with pump removal from the lift station. Install isolation bushings between galvanized steel and stainless steel anchors. Install hooks in accordance with pump and anchor manufacturer's instructions.
- .3 Supply and install back-primed galvanized pipe supports and install with medium duty, stainless steel, anchors using isolation bushings all in accordance with the anchor manufacturer's instructions.
- .4 Following installation of the stainless steel anchors that use studs instead of bolts, cut the studs off with four (4) threads showing above the top of the nut.

3.7 TESTING

- .1 Test interior pipework: water inside pipework to be gradually increased until it reaches a minimum of 690 kPa and maintain test pressure for one hour. No leakage will be allowed.
- .2 Prior to starting the pumps, remove the plug or cap from the forcemain in the manhole.
- .3 After pumps and piping have been installed, test pumps with the material they are to pump, or with water, operate and pump for a duration of time sufficient to satisfy that the complete installation has been properly installed and aligned and that the pumps run free from heating, rubbing or vibration and meet the requirements of these Specifications, and that the pumps and piping are free and clear of debris and obstructions.
- .4 Demonstrate that each pump can be easily removed from the lift station without obstruction or removal of any station equipment. Make any adjustments necessary to carry out pump removal in this manner.
- .5 Demonstrate the operation of all valves and make any adjustments necessary to permit the valves to be operated smoothly without obstruction and allow the pumps to be removed with the valves in an open or closed position.
- .6 Demonstrate integrity of pump discharge connection seal to pump by pumping down wet well sufficiently to detect leakage.
- .7 Observe wet well and valve chamber piping during pump operation for leaks and/or loose connections. Repair any leaks identified.
- .8 Test station piping in accordance with Section 33 34 00.

3.8 COMMISSIONING

- .1 Perform commissioning activities in accordance with Section 01 91 13.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for constructing pressure sewers and appurtenances. Work includes supply, installation and testing of pipe, fittings and service connections.

1.2 RELATED SECTIONS

- .1 Concrete: Section 03 30 00
- .2 Metal Fabrications: Section 05 50 00
- .3 Excavating, Trenching and Backfilling: Section 31 23 10
- .4 Precast Manholes, Catch Basins and Structures: Section 33 39 00

1.3 REFERENCE STANDARDS

- .1 ANSI/ASME B16.1-2010, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
- .2 ANSI/AWWA C104/A21.4-2013, Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.
- .3 ANSI/AWWA C110/A21.10-2012, Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., (75mm Through 1200mm) for Water and Other Liquids.
- .4 ANSI/AWWA C111/A21.11-2012, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .5 ANSI/AWWA C153/A21.53-2012, Ductile Iron Compact Fittings, 3 Inch Through 16 Inch, for Water and Other Liquids.
- .6 ANSI/AWWA C301-07, Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids.
- .7 ANSI/AWWA C509-2009, Resilient-Seated Gate Valves for Water and Sewerage Systems.
- .8 ANSI/AWWA C901-08, Polyethylene (PE) Pressure Pipe and Tubing, ½ in. (13mm) Through 3 in. (76mm), for Water Service.
- .9 ANSI/AWWA C906-07, Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100mm) Through 63 in. (1,600mm), for Water Distribution and Transmission.
- .10 CAN/CSA B137 Series-2013, Thermoplastic Pressure Piping Compendium.
- .11 CAN/ULC S701-2011, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.

1.5 CERTIFICATES

- .1 Submit manufacturer's test data and certification that products and materials meet requirements of this Section in accordance with Section 01 33 00.
- .2 For fusion butt jointing for polyethylene pipe provide certification that personnel are trained by manufacturer in current methods and use of equipment.

1.6 HANDLING AND STORAGE

- .1 Handle and store pipe, valves, fittings, in such a manner as to avoid shock and damage. Do not use chains or cables passed through pipe bore. Do not damage coatings or linings.
- .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.

PART 2 - PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

- .1 Pipe:
 - .1 13 to 76mm diameter: to AWWA C901.
 - .2 100mm diameter and larger: to AWWA C906.
- .2 Joints:
 - .1 Thermal Butt Fusion
 - .2 Mechanical Connections: polyethylene flange end with metal back-up ring.
 - .3 Electrofusion.
- .3 Fittings:
 - .1 Polyethylene: to AWWA C901 and AWWA C906.
 - .2 Flanged cast-iron: to AWWA C110.

2.2 INSULATION

- .1 Insulation: to CAN/ULC S701, Type 4, extruded polystyrene.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Carefully inspect material for defects and remove defective materials from site.
- .2 Immediately before installation, remove any water, debris, and foreign material from interior of pipe, fittings and valves.

3.2 TRENCHING BEDDING, AND BACKFILLING

- .1 Do excavating, trenching and backfilling to Section 31 23 10.
- .2 Provide type 1 bedding as shown on the Project Drawings and as specified in Section 32 11 16.

3.3 PIPE INSTALLATION

- .1 Lay and join pipe, fittings, and valves as specified herein and according to manufacturer's published instructions.
- .2 Lay pipe and fittings on prepared bed, true to line and grade indicated.
- .4 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary watertight bulkheads when pipe laying is not in progress.
- .5 Join pipes in accordance with manufacturers published instructions. Do not use excessive force to join pipe sections.
- .6 Keep pipe joints free from soil or other foreign materials.
- .7 Join polyethylene pipe in accordance with manufacturer's published instructions.
- .8 Cut pipe as required for specials, fittings or closure pieces, square to centerline, and as recommended by manufacturer. Do not damage pipe lining or coating and leave smooth beveled edge.

3.4 HYDROSTATIC AND LEAKAGE TESTING

- .1 Conduct pressure test as specified in Section 33 11 00.

3.5 FLUSHING

- .1 If water used for flushing or testing is obtained from a potable water supply, the supply is to be continuously separated from the service being flushed or tested by an air gap or a level of protection equal to or greater than that provided by a double check valve backflow prevention device.
- .2 Notify the Departmental Representative 24 hours in advance of flushing.
- .3 Flush mains with water through available outlets with sufficient flow to produce minimum velocity in main of 1.5 m/s, for 10 minutes. Flush until foreign materials have been removed and water is clear.
- .4 Slowly open and close valves to confirm thorough flushing.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

- .1 Cast-in-Place Concrete: Section 03 30 00
- .2 Excavating, Trenching and Backfilling: Section 31 23 10

1.2 REFERENCES

- .1 ASTM A48/A48M-2003 (R2012), Specification for Gray Iron Castings.
- .2 ASTM A123-2012, Standard Specification for Zinc-Dipped (Hot-Dipped Galvanized) coatings on Iron and Steel Products.
- .3 ASTM C478M-2014, Specification for Precast Reinforced Concrete Manhole Sections.
- .4 ASTM C858-2010, Standard Specification for Underground Precast Concrete Utility Structures.
- .5 CAN/CGSB 51.34-M86, Vapour Barrier, Polyethylene Sheet for use in Building construction.
- .6 CAN/CSA-A23.1-04/A23.2-2014, Concrete Materials and Methods for Concrete Construction.
- .7 CAN/CSA-A257 Series - 2014, Standards for Concrete Pipe.
- .8 CAN/CSA-A3000-2013, Cementitious Materials.
- .9 CAN/ULC S701-2011, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .10 CSA G40.20/G40.21-2013, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit manufacturer's test data and certification that materials meet requirements of this section. Include manufacturer's drawings, information, size of components, dimensions and details where pertinent.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Precast manhole and catch basin sections: to ASTM C478M, circular. Manhole top sections flat slab top type with opening offset for vertical ladder installation. Precast concrete bases to be approved by Departmental Representative.
- .2 Joints: to be made watertight using rubber O-rings.

- .3 Mortar:
 - .1 Cement: to CAN/CSA-A3000.
- .4 Adjusting rings: precast concrete, to ASTM C478.
- .5 Frames and covers: to dimensions as indicated and following requirements:
 - .1 Bear metal gratings and covers 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.
 - .3 Grind down bearing surfaces to eliminate surface imperfections.
 - .4 Manhole frames and covers: heavy duty municipal type for road service and as indicated on the drawings. Cover cast with perforations for storm sewer application. Cover cast without perforations and complete with single 25mm square lifting hole for sanitary sewer and other applications.
 - .1 Acceptable product: IMP Group Ltd. Slotted (Perforated) Type R91, IMP Group Ltd. Vented (Non-perforated) Type R90 - single hole.
- .6 Granular bedding material: as specified in Section 31 23 10.
- .7 Concrete: for adjustment and benching, as specified in Section 03 30 00.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILLING

- .1 Provide excavating and backfilling in accordance with Section 31 23 10.
- .2 Obtain approval of Departmental Representative before installing, manholes or catch basins.

3.2 CONCRETE WORK

- .1 Do concrete work in accordance with Section 03 30 00.
- .2 Position metal inserts in accordance with dimensions and details as indicated.

3.3 INSTALLATION

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Complete manholes and catch basins as pipe laying progresses.
- .3 Dewater excavation as directed by 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 in accordance with Section 31 23 10.
- .5 Set riser sections on precast base and make joint watertight with O-ring gaskets. Grout joints inside and out with non-shrink grout.
- .6 Plug lifting holes with non-shrink grout.

- .7 Place stub outlets at elevations and in position indicated. Provide type of gasket connection as indicated.
- .8 Install manhole benching where shown on the Drawings in accordance with Section 03 30 00.
- .9 Install frames and covers on applicable top sections to elevation shown on Drawings or as directed. Use cast-in-place concrete (min. 150 mm thickness) or cast-in-place concrete with 15 M reinforcing bar in centre (for adjustments between 75 mm and 150 mm) or "Rapid-Set" or "Set-45" epoxy mortar (between 20 mm and 75 mm). Cast-in-place concrete must not exceed the outside edge of the capping ring.
- .10 Install frames and covers integrally with concrete structures as indicated on drawings.
- .11 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.
- .12 Apply waterproofing for sanitary manholes as indicated and in accordance with Section 07 11 00.

3.4 SYSTEM CLEANLINESS

- .1 Upon manhole adjustment, removal of catchment device and all works associated with restoration around the manhole, the contractor shall provide all testing equipment, labour, incidentals, traffic control, etc., required to undertake an inspection of the system to verify its cleanliness. This inspection must be done in the presence of the Departmental Representative.

3.5 VACUUM TEST (LIFT STATION MANHOLE ONLY)

- .1 Notify the Departmental Representative 24 hours in advance of proposed test. Do test in presence of the Departmental Representative.
- .2 Provide labour, equipment and materials required to perform testing.
- .3 Plug all inlet and outlet pipes. Restrain plugs.
- .4 Place and seal vacuum tester head on the manhole frame.
- .5 Draw vacuum of 250mm Hg on the manhole and measure the time for the vacuum to drop to 225mm Hg.
- .6 Time to be not less than 45, 50, 65, and 80 seconds for manhole diameters of 1050mm, 1200mm, 1500mm, and 1800mm respectively.
- .7 For manholes deeper than 6 meters, increase test times by 2 seconds per 300mm of additional manhole depth.
- .8 Locate and repair defects if test fails. Retest using same methodology.
- .9 Repair leaks regardless of test results.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

- .1 Excavating, Trenching, and Backfilling: Section 31 23 10
- .2 Manholes, Catch Basins and Structures: Section 33 39 00

1.2 REFERENCES

- .1 ASTM C1433-2014, Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers.
- .2 CAN/CSA A257 Series-2014, Concrete Pipe and Manhole Sections.

PART 2 - PRODUCTS

2.1 CONCRETE PIPE

- .1 Reinforced concrete pipe to CAN/CSA-A257, diameter as indicated, minimum strength classification as follows:
 - .1 Up to 750mm nominal diameter: 65D
 - .2 Greater than 750mm nominal diameter: 100D

2.2 PLASTIC PIPE

- .1 PVC pipe and fittings: type DSM polyvinyl chloride, to CAN/CSA 121000, DR35, complete with bell and spigot joints and locked-in rubber gaskets.

2.3 INLET CONTROL DEVICE

- .1 Framed inlet control device, PVC, bolted into position where shown on the Project Drawings.

2.4 PIPE BEDDING MATERIAL

- .1 Granular bedding material: as specified in Section 31 23 10.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Clean pipes and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.
- .2 Provide proper implements, tools and facilities approved by the Departmental Representative for the safe

and convenient prosecution of the Work. Take every precaution to prevent foreign material from entering pipe.

3.2 TRENCHING AND BACKFILLING

- .1 Provide trenching, excavating and backfilling to Section 31 23 10.

3.3 GRANULAR BEDDING

- .1 Provide granular bedding to Section 31 23 10.

3.4 PIPE LAYING

- .1 Carefully lower pipe into the trench. Do not drop or dump materials into the trench.
- .2 Firmly and accurately set pipe to line and elevation on bedding material to the depth shown on the Drawings.
- .3 Check profiles at the commencement of Work. Confirm grades and depths. Any variation will be made only at the order of the Departmental Representative. Set line of pipe and set elevation by a method approved by the Departmental Representative.
- .4 Start laying of the pipe at the lowest pipe and lay upgrade unless approved otherwise by the Departmental Representative.
- .5 Do not lay pipe when the trench bottom is frozen or underwater or when trench conditions or weather are unsuitable.
- .6 Temporarily support all pipe during assembly and install fittings in a manner to ensure pipe is not strained during jointing procedure. Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .7 Whenever it is necessary to cut pipe to fit into pipeline, do this work and provide materials at no extra cost to the Contract. No extra compensation will be considered for cutting of pipe or for placing cut pipe in the pipeline.

3.5 INLET CONTROL DEVICE

- .1 Install inlet control device as instructed by the manufacturer's written instructions.

3.6 PIPE JOINTING

- .1 Align pipes carefully before jointing.
- .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gaskets and maintain concentricity until gaskets are properly positioned.
- .3 Maintain pipe joints clean and free from foreign materials.
- .4 Complete each joint before laying next length of pipe.

- .5 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations. Minimize deflection after joint has been made to avoid damage.
- .6 Connections to manholes, catch basins and structures to be watertight and structurally sound, all as specified in Section 33 39 00.

3.7 PIPE CLEANING

- .1 Leave internal parts of storm sewer in clean condition.
- .2 Remove debris by scraping, dragging, brushing, picking or flushing as required.

3.8 CLOSED CIRCUIT TELEVISION INSPECTION

- .1 Arrange and pay for television camera inspection of installed pipeline.
- .2 Scheduling:
 - .1 Perform first video inspection when the storm sewer has been cleaned and all manhole adjustments and street reinstatement have been completed.
 - .2 The entire system must also be video inspected a second time eleven months after substantial completion.
- .3 Equipment:
 - .1 Provide equipment meeting following requirements:
 - .1 Self-contained monitoring unit and camera with remotely controlled lighting system capable of varying the illumination.
 - .2 Picture quality shall produce continuous 600-line resolution picture, showing entire periphery of pipe.
 - .3 A meter device with readings above ground or marking on cable to clearly identify exact location of camera.
- .4 Definition of fault:
 - .1 Any sewer pipe joint which displays a gap or spread, offset, gasket, or signs of infiltration.
 - .2 Any service lateral which displays water infiltrating around service connection, or a steady flow through service lateral.
 - .3 Any service lateral exhibiting pronounced protrusion into the sewer main.
 - .4 Any section of sewer which is crushed, broken or displays cracks.
 - .5 Any variance in grade of sewer main section.
 - .6 Any gravel, roots, or foreign material which may impede flow.
 - .7 Any deformation in shape of pipe.
 - .8 Any ponding of water in pipe.
- .5 Inspection:
 - .1 Perform inspection of pipe from manhole to manhole by passing TV camera through sewer in direction of flow.
- .6 Records:
 - .1 Maintain inspection record in log form, during television inspection.
 - .2 Log to include location of each fault and service lateral distance measured from centreline of reference manhole and position referenced to axis of pipe.
 - .3 Photograph fault from the television screen using a digital camera or provide hard copy stills directly

- from TV system if possible. All photographs to be clear and precise with distinct definition of fault.
- .4 Include detailed technical description with photographs as supporting data for each fault.
 - .5 Provide minimum of two photographs for each sewer main section televised, detailing typical joint, and typical building service lateral.
 - .6 All photos and videos to be in colour.
- .7 Reports:
- .1 Provide a composite report of TV inspection. Enclose report in binder on letter size paper. Include following pages and information.
 - .1 Title page identifying project, camera operator and dates of inspection.
 - .2 Index page identifying street name, section from manhole to manhole, page number or numbers where information for section is contained.
 - .2 Organize inspection records in sequence from upstream manhole to downstream manhole.
 - .3 Report on each sewer main section to contain:
 - .1 Heading:
 - .1 Project name.
 - .2 Manhole numbers applicable to section.
 - .3 Reference drawing number, if applicable.
 - .4 Weather on the day of inspection.
 - .5 Statement of soil condition in area of inspection, i.e., dry, damp, wet, frozen.
 - .6 Date of inspection.
 - .2 Key Plan, showing corresponding manhole numbers, magnetic north, horizontal distance, pipe and material between manholes, and direction of flow.
 - .3 Inspection findings for each sewer main section to include:
 - .1 Location of all faults.
 - .2 Photographs of all faults.
 - .3 Location of all service laterals.
 - .4 One photograph each of typical joint and typical when service laterals faults are not found.
 - .4 Mount photographs on left-hand page and place corresponding description on right-hand page. Number all photographs in order. Number beside photograph to correspond with description number.
 - .5 Enclose all pages of report in transparent sheet protector.
- .8 Accuracy:
- .1 Maximum permissible error in accuracy to be within following limits of fault location:
 - .1 Up to 375mm pipe: $\pm 75\text{mm}$ per 100m of length.
 - .2 450mm - 600mm pipe: $\pm 150\text{mm}$ per 100 m of length.
 - .3 750mm and greater pipe: $\pm 225\text{mm}$ per 100m of length.
- .9 Video Records:
- .1 Supply a complete record of all inspections on DVD format.
 - .2 Index all DVD's, listing sections of inspections.
 - .3 Submit DVD's with written reports to Departmental Representative.
- .10 Repeat Inspection:
- .1 Repair faults detected during television inspection. Repeat television inspection at no cost to the Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with requirements of Division 1.

1.2 RELATED SECTIONS

- .1 Section 31 23 10: Excavating, Trenching, and Backfilling.
- .2 Section 32 91 19.13: Topsoil Placement and Finish Grading.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM C 136, Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .2 ASTM D 698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m³).
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-8.1, Sieves Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA).
 - .1 CAN/CSA-A182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CAN3-G401, Corrugated Steel Pipe Products.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Bedding gravel or crushed stone: hard, durable particles graded evenly in size from 8 to 18 mm or 19 mm clear stone
- .2 Granular filter material: screened stone or gravel, gradations to be within limits specified when tested to ASTM C136. Sieve sizes to CAN/CGSB-8.1.
- .3 Perimeter drainage tile: Flexible plastic tubing and fittings: to CGSB 41-GP-29Ma, Type 1 and 2, perforated and non-perforated nominal inside diameter 150 mm.
- .4 Geotextile filter mat: to CAN/CGSB-148.1, nonwoven synthetic fibre fabric, non-clogging type, supplied in rolls 3000 mm wide, composed of minimum 85% by mass of polyester with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure for 60 days. Acceptable products:
 - .1 Terrafix 200 R by Terrafix Erosion Control Products.
 - .2 Mirafi P230 by Dominion Textile Inc.
 - .3 Amoco 4553 by Amoco Fabrics and Fibers Company
 - .4 Armtec 150 by Armtec Construction Products
 - .5 or approved equal.

- .5 Preformed drainage sheet: three dimensional, formed high-impact polypropylene sheet, 12 mm thick with fully bonded, non-woven, needle punched geotextile filter fabric, 1800 mm wide rolls. Acceptable products:
 - .1 Delta-Drain 2000 by Cosella Dorken (distributed by Atlantic Enviro Supply, Moncton, N.B. (506) 852-1198.
 - .2 or approved equal.

2.2 BACKFILL MATERIAL

- .1 Type 1 or 2, in accordance with Section 31 23 10: Excavating, Trenching, and Backfilling.

PART 3 - EXECUTION

3.1 LAYOUT

- .1 Establish grades and inverts from appropriate bench marks. Lay out lines as shown on Drawings.
- .2 Slope drainage pipes at least 0.1%. Pipe grade shall not vary more than 10% of internal diameter of drain pipe within a given run. Such deviation shall be gradual and over a distance of not less than 10 m.
- .3 Lay pipe in straight lines; turn corners using 45 degree bends.

3.2 INSPECTION

- .1 Ensure graded base conforms with required drainage pattern before placing bedding material.
- .2 Ensure improper slopes, unstable areas, areas requiring additional compaction or other unsatisfactory conditions are corrected to approval of Departmental Representative.
- .3 Ensure foundation wall has been installed and approved by Departmental Representative before placing bedding material.

3.3 TRENCHING

- .1 Do excavating, trenching and backfilling in accordance with Section 31 23 10: Excavating, Trenching, and Backfilling.

3.4 BEDDING PREPARATION

- .1 Place bedding material after approval of excavation and trenches by Departmental Representative.
- .2 Place 100 mm layer of bedding material to full trench width and compact to 95% of corrected maximum modified dry density to ASTM D 557. Do not place pipe in direct contact with rigid materials such as rock, brick or wood. Do not use grade stakes, stones, masonry, concrete fragments or any type of shim under pipe.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for drainage pipe.

3.5 PERIMETER DRAINAGE TILE INSTALLATION

- .1 Provide perimeter drainage tile at outside of external foundation walls and where indicated on tender documents. Lay pipe drains on prepared bed, true to line and grade with inverts smooth and free of sags or high points. Ensure barrel of each pipe is in contact with bed throughout full length.
- .2 Commence laying drainage tile at outlet and proceed in upstream direction.
- .3 Place filter fabric into prepared excavation. Size filter fabric to completely wrap perimeter drainage course, lapping at joints minimum 300 mm.
- .4 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases. Overlap each successive strip of geotextile 300mm over previously laid strip.
- .5 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
- .6 Place minimum 100 mm drainage course aggregate on filter fabric and consolidate.
- .7 Aggregate materials shall be damp when placed. If necessary, spray with water using fog nozzle to assist hydraulic consolidation.
- .8 Ensure drainage tile interior and coupling surfaces are clean before laying.
- .9 Lay perforated drainage tile on top of 100 mm drainage bottom course to minimum to slope of 1:100. Face perforations and coupling slots downward.
- .10 Lay drainage tile in straight lines, turn corners using 45° degree bends.
- .11 Join drainage tile sections by means of couplings and make joints watertight. Provide fittings such as elbows, bends, tees, adapters, reducers as required to form a complete drainage system.
- .12 Supply rigid non-corrosive sleeves for insertion into foundation walls and other building elements where pipe penetrates such elements. Sleeve diameter shall be 50 mm larger than pipe diameter. Pack joint between pipe and sleeve with moisture resistant compressible pre-moulded filler.
- .13 Install end plugs at ends of collector drains to protect tubing ends from damage and ingress of foreign material.
- .14 Make watertight connections to existing drains, new or existing manholes and catch basins where indicated.
- .15 Protect sub-drains against flotation during installation.
- .16 Install "Y" connections to surface as indicated, for flushing.

3.6 PERIMETER DRAINAGE TILE SURROUND MATERIAL

- .1 Do not cover pipes until reviewed and accepted by Departmental Representative.

- .2 Upon completion of drainage tile laying place filter aggregate materials by hand around and above pipe in successive 150 mm lifts. Do not drop material on top of tubing. Consolidate each lift by tamping moderately; prevent damage to pipes.
- .3 Place layers uniformly and simultaneously on each side and top of drainage tile.
- .4 Do not place bedding surround and backfill materials in frozen condition.
- .5 Compact each layer from mid-height of drainage tile to underside of backfill to at least 95% of corrected maximum modified dry density to ASTM D 698.
- .6 Close filter fabric over top of drainage course and secure lap in place. Lap filter fabric minimum 300 mm.

3.7 PREFORMED DRAINAGE SHEET

- .1 Install preformed drainage sheet in accordance with manufacturers recommended installation procedures and as indicated herein.
- .2 Place chalkline at grade level for positioning top edge of preformed drainage sheet. Apply bead of sealant 25 mm below.
- .3 Starting at corner, mechanically fasten along top of sheet in a staggered pattern spaced 100 mm vertically and 200 mm horizontally. At the top edge of the sheet apply termination bar in line with the sealant and fasten every 200 mm.
- .4 Fit sheet snug at corners and vertically fasten at 200 mm o.c. maximum, 100 mm from the corner.
- .5 At vertical joints pull back geotextile fabric 150 mm from drainage sheet and overlap the dimples from the adjacent sheet to interlock with the first sheet. Pull back geotextile fabric 100 mm from top sheet and fasten both sheets to wall every 200 mm. Reposition geotextile fabric.

3.8 BACKFILL MATERIAL

- .1 Place backfill material above filter fabric wrapped drainage tile surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Under paving and walks, compact backfill to at least 95% of corrected maximum modified dry density to ASTM D 1557. In other areas, compact to at least 95% of corrected maximum modified dry density to ASTM D 1557.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Cast-in-Place Concrete: Section 03 30 00
- .2 Excavating, Trenching and Backfilling: Section 31 23 10

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.

1.3 REFERENCES

- .1 CSA C22.2 No. 211.1-06(R2011), Rigid Types EB1 and DB2/ES2 PVC Conduit.
- .2 CSA C22.3 No. 7-2010, Underground Systems.

PART 2 - PRODUCTS

2.1 PVC DUCTS

- .1 PVC ducts, type DB2, encased in reinforced concrete. Concrete to Section 03 30 00.

2.2 PVC DUCT FITTINGS

- .1 Rigid PVC solvent welded and pushfit type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.
- .2 Expansion joints.
- .3 Rigid PVC 5° angle couplings.
- .4 PVC long radius bends, 5 ft. radius: 90° and 45°.

2.3 CABLE PULLING EQUIPMENT

- .1 Pull rope: 6mm stranded polypropylene, tensile strength 5 kN, continuous throughout each duct run with 3m spare rope at each end.

2.4 MARKERS

- .1 Concrete type cable markers: 600mm x 600mm x 100mm, with words: "cable", "joint" or "conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install underground duct banks including formwork.
- .2 Build duct bank on undisturbed soil or on well compacted Type 1 bedding not less than 150mm thick, compacted to 95% to ASTM D1557.
- .3 Open trench completely before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.
- .4 Where unstable soil (clay) is encountered, construct "mud slab" not less than 75mm thick prior to laying ducts.
- .5 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400 away from building or manholes.
- .6 Install spacers to provide duct spacing indicated, at maximum intervals of 1.5m levelled to grades indicated for bottom layer of ducts.
- .7 Lay PVC ducts with configuration and reinforcing as indicated with intermediate spacers to maintain spacing between ducts as indicated. Stagger joints in adjacent layers at least 150mm and make joints watertight. Encase duct bank with concrete cover as indicated. Use galvanized steel conduit for sections extending above finished grade level unless otherwise indicated.
- .8 Make transpositions, offsets and changes in direction using 5° bend sections, do not exceed a total of 20° with duct offset.
- .9 Use bell ends at duct terminations in buildings and manholes. Comply with utility requirement for termination at poles.
- .10 Use conduit to duct adapters when connecting to conduits.
- .11 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension, where indicated.
- .12 Cut, ream and taper end of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.
- .13 Allow concrete to attain 50% of its specified strength before backfilling.
- .14 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.
- .15 Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .16 Immediately after placing of concrete, pull through each duct a steel or wooden mandrel not less than 300mm long and of a diameter 8mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely.

Pull stiff bristle brush through each duct immediately before pulling-in cables.

- .17 In each duct install pull rope continuous throughout each duct run with 3m spare rope at each end.

3.2 MARKERS

- .1 Mark location of duct runs under hard surfaced areas not terminating in manhole with railway spike driven flush in edge of pavement, directly over run. Place concrete duct marker at ends of such duct runs. Construct markers and install flush with grade.
- .2 Mark ducts every 90m along straight runs and at all changes in direction.
- .3 Where markers are removed to permit installation of additional duct, reinstall existing markers.
- .4 Lay concrete markers flat and centered over duct with top 25mm above earth surface.
- .5 Provide drawings showing locations of markers.

3.3 INSPECTIONS

- .1 Inspection of duct will be carried out by Departmental Representative prior to placing. Placement of concrete and duct cleanout to be done when Departmental Representative present.

3.4 CABLE INSTALLATION

- .1 Supply and installation of cables in utility company ducts will be provided by the respective utilities.

END OF SECTION