

1. GENERAL

1.1 RELATED WORK

- .1 Section 31 23 00 – Excavation, Trenching and Backfilling.
- .2 Section 31 32 19 – Geosynthetics.
- .3 Section 33 14 17 – Building Services.
- .4 Section 33 05 13 – Miscellaneous removals and Adjustments.

1.2 DEFINITIONS

- .1 Class A Bedding:
 - .1 The sewer pipe shall be bedded and cradled in concrete to the depths shown on the standard drawing.
 - .2 The concrete shall be placed around and under the pipe. The pipe must not be laid on hardened concrete unless a layer of fresh concrete a minimum of 25mm thick is placed between the pipe, and bells if any, and the hardened concrete. The pipe may be temporarily supported on concrete blocking. The concrete shall extend half (½) of the outside diameter up the side of the pipe barrel.
- .2 Class B Bedding:
 - .1 The pipe shall be bedded in compacted granular material which shall have a thickness as specified on the Standard Drawing.
 - .2 The granular material shall be hand placed and compacted to a density of 95% Standard Proctor Density in 150mm layers when compacted for the full width of the trench up to 300mm above the crown of the pipe.

1.3 SAMPLES

- .1 At least two (2) weeks prior to commencing work, inform the Engineer of the proposed source of bedding and pipe zone materials.
- .2 Provide a sieve analysis of the bedding and pipe zone materials, performed by a qualified materials testing laboratory, for the Engineer's review.
- .3 Bedding materials shall be submitted to the Engineer before being used.

1.4 MATERIAL CERTIFICATION

- .1 At least two (2) weeks prior to commencing work, submit the manufacturer's test data and certification that the pipe materials, manholes and all other materials meet the requirements of this section.

1.5 SCHEDULING OF WORK

- .1 Schedule work to minimize interruptions to existing services.
- .2 Maintain existing flow during construction.

- .3 Submit a schedule of expected interruptions for approval and adhere to the approved schedule.

1.6 MEASUREMENT AND PAYMENT

- .1 The supply and installation of sewer main (PVC or other) will be measured in lineal meters along the centerline of each type, size, and depth of pipe installed, as specified within the Bid Forms. Horizontal measurement will be made over the surface and will be from the centerline of manhole to centerline of manhole or to a specified termination point. The unit price shall include the supply of the pipe, fittings, gaskets, lubricants, and all related materials, tools, equipment, labour and supervision, laying and jointing the pipes, excavation, trenching, backfilling and compaction of native backfill, dewatering, pipe zone bedding material, disposal of all waste/excess material, provision of a sieve analysis for bedding and pipe zone material, the flushing and testing of the system including the Closed Circuit Television (CCTV) camera inspection and testing, and all other incidentals deemed necessary for the satisfactory completion of the work.
- .2 The supply and installation of manholes will be measured in vertical metres from the top of the frame and cover to the lowest invert or sump, if any, as specified within the Bid Forms. The unit price shall include the supply and installation of the concrete base, concrete barrels, concrete top, tools, materials, equipment, labour and supervision, adjusting grade rings, bedding material, benching, grouting, and all other incidental deemed necessary for the satisfactory installation of manholes.
- .3 The supply and installation of drop manholes will be paid for at the unit price for manholes except that the drop section of the manhole shall be paid for separately. The drop section of the manhole shall be measured in lineal metres between the low invert and the high invert of the drop piping, as specified in the Bid Forms. Payment shall be compensation in full for the supply and installation of all material exclusive of the manhole, including piping, fittings, and all other related appurtenances, tools, equipment, labour and supervision, cutting into the manhole, grouting, benching the manhole floor, excavation, trenching, backfill, and compaction of native backfill, and all other incidentals deemed necessary for the satisfactory completion of the work.
- .4 Connections to existing manholes will be measured in units completed, as specified in the Bid Forms. Payment shall be compensation in full for excavation, concrete coring/cutting into the manhole or catch basin, supply and installation of all concrete, pipe, adaptors, connections and bedding, tools, materials, equipment, labour and supervision, grouting the junction area, benching and rechannelling the manhole floor, sealing off connections to be abandoned, excavation, backfill and compaction of native backfill, and all other incidentals deemed necessary for the satisfactory completion of the work.
- .5 Supply and installation of frames and covers and storm gratings will be measured in units installed, as specified in the Bid Forms. The unit price shall include the supply, tools, materials equipment, labour and supervision, installation and adjustment to design grade, and all other incidentals deemed necessary for the satisfactory completion of the work, unless otherwise identified in the Bid Forms.
- .6 Ties or connections to existing sewer mains will be measured in tie-in or connection units completed, as specified in the Bid Forms. Payment shall be compensation in full for all excavation, tools, materials equipment, labour and supervision, cutting, removal and

disposal of existing pipe (if required), tapping and connections, gaskets, grouting, supply and installation of pipe and fittings, supply and placement of bedding materials and washed rock (if required), laying and jointing of pipe, backfill and compaction of native backfill, and all other incidentals deemed necessary for the work related to the tie or connection.

- .7 The supply and installation of sewer mains and catch basin leads installed in auger holes will be measured in lineal metres from shaft face to shaft face, as specified in the Bid Forms. Payment shall be compensation in full for excavation of shafts, tools, materials equipment, labour and supervision, boring, supply and installation of the pipe, testing, backfill, compaction and disposal of surplus excavated material, and all other incidentals deemed necessary for the satisfactory completion of the work.
- .8 The supply and installation of catch basins will be measured in catch basin units installed, as specified in the Bid Forms. Payment shall be compensation in full for all excavation, backfill and compaction of native backfill, tools, materials, equipment, labour and supervision, the supply and installation of the concrete base, concrete barrel, concrete top, adjusting grade rings, bedding material, benching, grouting, and all other incidentals deemed necessary for the satisfactory installation of catch basins.
- .9 The supply and installation of catch basin leads will be measured in lineal metres along the top of the pipe from the centre of the catch basin to the centre of the storm sewer main or manhole at the point of connection, as specified in the Bid Forms. The unit price shall include the supply of the pipe, gaskets, couplings, and all related materials, bedding materials, tools, equipment, labour and supervision, laying and jointing the pipes, trenching, backfilling and compaction of native backfill, dewatering, pipe zone bedding material, disposal of all waste/excess material, provision of a sieve analysis for bedding and pipe zone material, the flushing of the lines, and all other incidentals deemed necessary for the satisfactory completion of the work.
- .10 The supply and installation of geotextile material used for wrapping trench stabilizing gravel will be measured in square metres in place, as specified in the Bid Forms. Payment shall be compensation in full for supply and hauling the material to the Site, tools, materials, equipment, labour and supervision, placing, sewing, welding, cutting and all other incidentals deemed necessary to complete the Work prescribed.
- .11 The supply and installation of safety platforms will be measured in units installed, as specified in the Bid Forms. Payment shall be compensation in full for the supply of all materials, fabrication, tools, equipment, labour and supervision, installation, and all other incidentals deemed necessary for the satisfactory completion of the work.
- .12 If installing/replacing sewer mains or catch basin leads within the same alignment as existing sewer mains or catch basin leads, the unit price provided within the Bid Forms associated with the supply and installation of sewer mains or catch basin leads, shall include all costs associated with the removal and disposal of the existing sewer main or catch basin lead pipes, couplers, the excavation, loading, hauling, and disposal of waste/excess material including existing bedding material and all other incidentals necessary to complete the Work prescribed. As such no additional payment will be made due for removing and disposing of the existing main(s) along the proposed alignments.

- .13 All temporary flow control of sanitary or storm sewer flows shall be provided by the means of by-pass pumping while installing/replacing sewer mains or catch basin leads within the same alignments as existing sewer mains or catch basin leads. Temporary flow control of sewer flows is deemed incidental to the Work and shall be included in the applicable unit prices provided in the Bid Forms. As such no additional payment will be made due for to control the flow within the sewer mains during construction.

2. PRODUCTS

2.1 CONCRETE PIPE

- .1 Reinforced concrete pipe conforming to CAN A257 and ASTM C655, using flexible rubber gaskets meeting CAN A257 and ASTM C443. Use Type HS, high sulphate-resistant, cement in the manufacture of reinforced concrete pipe and fittings. Class of pipe strength as specified.
- .2 Lifting Holes
 - .1 Required for pipe greater than 900mm in diameter; lift holes are not to exceed two in a piece of pipe.
 - .2 Provide pre-fabricated plugs to effectively seal the lift holes after the installation of the pipe.

2.2 POLYVINYL CHLORIDE (PVC) PIPE

- .1 Pipe age is not to exceed two (2) years at the time of installation.
- .2 Type Polyvinyl Chloride (PVC): to ASTM D3034, ASTM F679, CSA B182.2.
 - .1 Dimension ratio of DR35 for diameters less than or equal to 900mm.
 - .2 Locked-in gasket and integral bell system.
 - .3 Nominal lengths: 4m.
 - .4 Watertight plugs to be used on PVC pipe.
- .3 Type Open Profile Polyvinyl Chloride (PVC): to CSA B182.4.
 - .1 Minimum pipe stiffness of 320kPa.
 - .2 Locked-in gasket and integral bell system.
 - .3 Nominal lengths: 4m.
 - .4 Watertight plugs to be used on PVC pipe.

2.3 CATCH BASIN LEADS

- .1 Catch basin leads shall be 300mm Ultra-Rib PVC or open profile PVC SDR35 or approved equivalent. The pipe shall be manufactured from Polyvinyl Chloride (PVC) compounds conforming to ASTM D1784. Joints shall be rubber rings conforming to ASTM D1869 pre-set in the bell groove.
- .2 Pipe age is not to exceed two (2) years at the time of installation.

2.4 MANHOLE AND CATCH BASIN SECTIONS

- .1 Manhole and catch basin sections shall be precast reinforced concrete conforming to ASTM C478 and CSA A257.4, circular. All manhole sections shall have confined rubber gasket joints meeting the requirements of ASTM C443. Both the inside and outside of each joint

shall be finished smooth with non-shrink grout. Top sections shall be an eccentric cone or flat slab type with an opening offset for vertical ladder installation. Ladder rungs are to be 20mm diameter aluminium forged manhole steps as per the Standard Drawings. All manhole bases shall be pre-benched bases with all incoming and outgoing pipe penetrations factory installed, unless otherwise specified. If required due to site conditions and approved of by the Engineer, poured in place manholes and catch basins shall have a minimum 200mm thick base and shall rest on undisturbed soil.

- .2 Manhole sections shall be minimum 1200mm diameter. The top manhole section shall be an eccentric cone, or a slab top for manholes as directed by the Engineer.
- .3 Catch Basin barrels with pre-cast bases and pre-cast slab top shall be a minimum 900mm inside diameter conforming to ASTM C478, or as described in the Drawings.
- .4 Safety Platforms shall consist of two (2) piece removable aluminum grates supported on aluminum frames designed to fit in the standard manhole joint in accordance with the Standard Drawing.

2.5 FRAME AND COVER

- .1 Frames, gratings, and covers conforming to the dimensions on the Drawings and the following requirements:
 - .1 Metal gratings and covers are to bear evenly on frames. A frame with a grating or cover is to constitute one unit. Assemble and mark unit components before shipment.
 - .2 Gray iron castings are to conform to ASTM A48 strength class 30B.
 - .3 Castings are to be sand blasted or cleaned and ground to eliminate surface imperfections.
- .2 Sanitary manholes located in roadway sags or grassed areas, or as directed to on the Drawings shall be furnished with a watertight manhole frame and cover.
 - .1 Watertight manhole frame and covers shall be a Lifespan System complete with a Lifespan Frame and Locking Manhole Cover system.
 - .2 A frame with a cover, and associated gaskets and hardware is to constitute one unit. Assemble and mark unit components before shipment.

2.6 CONCRETE

- .1 Concrete for bedding, manholes, catch basins, concrete pipe and other appurtenances shall be to ASTM A3000 Type HS, high sulphate-resistant, Portland cement. Cast-in-place concrete shall develop a compressive strength of not less than 32MPa in 28 Days.
- .2 Concrete for bedding, manholes, catch basins, concrete pipe and other appurtenances shall also be in accordance with Section 32 16 13 – Concrete Walks, Curbs and Gutters, as well as the latest version of CSA Standard CAN3-A23.1, Concrete Materials and Methods of Concrete Construction.

2.7 PLUGS AND ADAPTORS

- .1 Plugs and adaptors shall be manufactured using Type HS, high sulphate-resistant, cement or PVC conforming to Clause 2.2 of this section.

2.8 JOINT GROUT

- .1 Portland Cement: to CSA A3000 Type HS, high sulphate-resistant, cement.
- .2 Grout to consist of one-part Portland cement to two-parts clean sharp sand mixed with the minimum amount of water to obtain optimum consistency for the use intended. Do not use additives.

2.9 PIPE BEDDING MATERIAL

- .1 Granular material:
 - .1 Gradation is to be within specified limits when tested to ASTM C136 and ASTM C117 (AASHTO T11 and T27) and giving a smooth curve without sharp breaks when plotted on a semi log grading chart.
 - .2 Bedding Sand:
 - .1 Natural sand or crushed rock screenings to follow grading requirements:

Sieve Designation	% Passing
10.0mm	100
5.0mm	50-100
2.5mm	30-90
0.315mm	10-50
0.08mm	0-10

- .1 Liquid limit: ASTM D4318 (AASHTO T89), maximum 25.
- .2 Plasticity index: ASTM D4318 (AASHTO T90), maximum 6.
- .3 Bedding Stone: crushed stone or crushed gravel to following grading requirements:

Sieve Designation	% Passing
20.0mm	100
16.0mm	75-100
12.5mm	65-90
5.0mm	35-55
2.5mm	0

- .4 Washed Rock

Sieve Designation	% Passing
25mm	100
10mm	30-55
2.5mm	5-25
0.315mm	0-5

- .2 Geotextile material shall be non-woven in accordance with Section 31 32 19 – Geosynthetics.

3. EXECUTION

3.1 PREPARATION

- .1 Clean the pipes and fittings of debris and water before installation. Carefully inspect materials for defects before installing. Remove any defective materials from Site.

3.2 TRENCHING

- .1 Trenching and backfill work is to be in accordance with Section 31 23 00 – Excavation, Trenching and Backfilling.
- .2 Do not allow the contents of any sewer or sewer connection to flow into the trench, unless otherwise approved of by the Engineer.
- .3 Trench line and depth require approval prior to placing bedding material and pipe.
- .4 Do not backfill trenches until the pipe grade and alignment have been checked and accepted by the Engineer.

3.3 PIPE BEDDING MATERIAL

- .1 Pipe bedding shall be Class A, B or as defined in Section 1.2 - Definitions. Bedding material shall be as specified in Section 2.9 – Bedding Material.
- .2 Granular Bedding:
 - .1 Hand place granular bedding material in uniform layers not exceeding 150mm compacted thickness for the full width of the trench up to a level of 300 mm above the crown of the pipe to at least 95% Standard Proctor Density.
 - .2 Shape the bed true to grade and to provide a continuous, uniform bearing surface for the barrel of the pipe. Do not use blocks when bedding pipe.
 - .3 Shape transverse depressions as required to receive the bell if bell and spigot pipe is used.
- .3 Concrete Bedding:
 - .1 Class A concrete bedding shall be for rigid pipe only.
 - .2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent floatation when concrete is placed.
 - .3 Do not backfill over concrete within twenty-four (24) hours after placing.
- .4 When field test results associated with the pipe bedding material are acceptable to the Engineer, place surrounding material at pipe joints.

3.4 PIPE INSTALLATION

- .1 Lay and join pipe in accordance with the manufacturer's recommendations and these Specifications. Installation of PVC pipe, fittings, and couplings shall conform to CSA-B182.11.
- .2 The horizontal alignment of the centreline of the pipe shall not be more than 50mm off the given line.
- .3 The vertical grade of the sewer main shall not deviate from the given grade by an amount greater than 5mm, in excess of 5mm it will be deemed a sag and recorded as such.
- .4 Sags:
 - .1 < 4.99% of the nominal inside diameter of the pipe will be deemed acceptable.

- .2 5% - 9.99% of the nominal inside diameter of the pipe will be reviewed by the Engineer, and a determination made regarding the removal and replacement of the pipe provided to the Contractor.
- .3 > 10% of the nominal inside diameter of the pipe will require immediate removal and replacement, unless otherwise specified by the Engineer.
- .4 In the event a sag is determined by the Engineer to require removal and replacement, the costs to complete such Work including, but not limited to, excavation, trenching, backfill, materials testing, and surface work rehabilitation is deemed to the sole responsibility of the Contractor.
- .5 The percent sag shall be determined from the sewer inspection by camera (i.e., closed circuit television (CCTV)), results of the deepest point of the sag and recorded in millimetres.
- .5 Handle pipe by approved methods. Do not use chains or cables passed through rigid pipe bore so that the weight of the pipe bears upon the pipe ends.
- .6 Lay pipes on the prepared bed, true to line and grade with the pipe inverts smooth and free of sags or high points. Ensure the barrel of each pipe is in contact with the shaped bed throughout its full length. No pipe shall be laid in water, on frozen bedding, or where the trench conditions are unsuitable.
- .7 Commence laying at the outlet and proceed in the upstream direction with the socket ends of the pipe facing upgrade.
- .8 Do not exceed the maximum joint deflection recommended by the pipe manufacturer.
- .9 Do not allow water to flow through the pipes during construction except as may be permitted by the Engineer.
- .10 Whenever work is suspended, install a removable water-tight bulkhead at the open end of the last pipe laid to prevent entry of foreign materials.
- .11 Position and join pipes by approved methods. Do not use excavating equipment to force pipe sections together.
- .12 Install PVC pipe and fittings in accordance with CSA B182.11.
- .13 Joints:
 - .1 Install gaskets as recommended by the manufacturer.
 - .2 Support pipes with hand slings or a crane as required, minimizing lateral pressure on the gasket and maintaining concentricity until the gasket is properly positioned.
 - .3 Align pipes carefully before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
 - .5 Avoid displacing the gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
 - .6 Complete each joint before laying the next length of pipe.
 - .7 Minimize joint deflection after the joint has been made to avoid joint damage.
 - .8 Apply sufficient pressure in making joints to ensure that the joint is complete as outlined in the manufacturer's recommendations.

- .9 At rigid structures, install pipe joints not more than 1.2m from the side of the structure.
- .14 When any stoppage of work occurs, block pipes to prevent "creep" during down time and to prevent foreign matter from entering the pipe.
- .15 Plug lifting holes with approved prefabricated plugs set in non-shrink grout.
- .16 Cut pipes as required for special inserts, fittings or closure pieces in a neat manner, as recommended by the pipe manufacturer, without damaging the pipe and to leave a smooth end at right angles to the axis of the pipe.
- .17 Make watertight connections to manholes and catch basins. Use non-shrink grout when suitable gaskets are not available.

3.5 MANHOLE AND CATCH BASIN INSTALLATION

- .1 Construct units to the details indicated, plumb and true to alignment and grade.
- .2 Complete units as pipe laying progresses. A maximum of three (3) units behind the point of pipe laying will be allowed.
- .3 Pump the excavation free of standing water and remove soft and foreign material before placing the concrete base.
- .4 Cast bottom slabs directly on undisturbed ground, or when permitted by the Engineer, set the precast concrete base on a minimum of 150mm thickness of granular material, compacted to a minimum of 95% Standard Proctor Density.
- .5 For Precast Units:
 - .1 Set the bottom section of the precast unit in a bed of cement grout and bond to the concrete slab or base. Set the bottom section and each successive section using "O" ring joints and rubber gaskets to produce a watertight joint. Both the inside and outside of each joint shall be finished smooth with non-shrink grout. Clean surplus grout from the interior surface of the unit as work progresses.
 - .2 Plug lifting holes with concrete plugs set in cement grout or mastic compound.
 - .3 All manholes over 5.0m in depth, measured from the top of the frame and cover to the lowest invert, shall have an aluminum safety platform located 2.0m above the invert of the lowest pipe. Where multiple safety platforms are required, the safety platforms shall be spaced a minimum of 3.0m apart.
- .6 For all sewers:
 - .1 Place all stub outlets and bulkheads at the elevations and in the positions indicated.
 - .2 Bench to provide a smooth U-shaped channel. Side height of the channel is to be 0.75 times the full diameter of the sewer. Slope adjacent to the floor at 10 horizontal to 1 vertical (1.0%). Curve channels smoothly. Slope the invert to establish sewer grade.
- .7 Installing units in existing sewer systems:
 - .1 Where a new unit is to be installed in an existing run of pipe, ensure full support of the existing pipe to the dimensions required and install the new unit as specified.

- .2 Make joints watertight between the new unit and the existing pipe.
- .3 Where it is deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready to be put in operation, complete the installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.

- .8 Set the frame and cover to the required elevation using no more than three concrete rings. Make joints smooth and watertight by an approved mastic compound.

- .9 Recess the catch basin frame and cover 30mm below the concrete gutter elevation and 10mm behind the concrete face of curb.

- .10 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering the system.

3.6 TIE-IN TO EXISTING SEWERS

- .1 Tie-ins to existing sewers shall be made at the location shown on the Drawings. Caution shall be exercised in uncovering existing pipe to ensure that no damage occurs.

- .2 All openings shall be made watertight with non-shrinking grout.

3.7 SERVICE CONNECTIONS

- .1 Service connections shall be installed as per Section 33 14 17 – Building Services.

3.8 APPURTENANCES

- .1 Install all manholes, drop inlets, junctions, risers, catch basins and other appurtenances at the locations shown on the construction Drawings and/or as directed by the Engineer. Installation shall be in accordance with the standard or special drawing for each appurtenance.

- .2 Maximum allowable tolerances for installed manholes and catch basins are:
 - .1 Horizontal (plumb): 10mm horizontal in 1.5m vertical.
 - .2 Vertical: \pm 10mm for any elevation shown.

- .3 A maximum of three (3) grade rings may be used immediately beneath the manhole cover to allow for a minimum adjustment of 100mm and maximum adjustment of 450mm.

- .4 Confined rubber gasket joints conforming to ASTM C443 shall be used between barrels and all joints between barrels. All joints shall be finished smoothly with non-shrinking grout.

- .5 The channelled floor of the manholes shall be smooth and true to line and grade and shall be constructed of concrete shaped to provide a smooth, unobstructed flow. The benching shall be trowelled to a smooth finish. Branch lines entering the manhole shall be channelled to join the main line at an acute angle.

- .6 Sewer pipe installed into existing manholes must be grouted in. Since concrete will not bond to PVC pipes, it will be necessary to coat the PVC pipe with an approved cementing

agent to which sand has been added to form a suitable surface to which the concrete will bond. All PVC pipe shall be connected in accordance with the ASTM Standard.

- .7 Openings into existing manholes, catch basins or sewers shall be cored or saw cut as shown on the construction Drawings. Existing manhole floors shall be rechannelled and properly benched, the junction area shall be grouted to form a smooth joint, all debris including concrete and excavated material shall be removed and the vicinity of the connection shall be left in a tidy condition acceptable to the Engineer.

3.9 BACKFILL

- .1 Minimize the placement of frozen backfill material.
- .2 Place backfill material above the pipe in uniform layers not exceeding 150mm compacted thickness up to the indicated grades.
- .3 Compact backfill in accordance with Section 31 23 00 – Excavation, Trenching and Backfilling.
- .4 Do not use heavy vibratory equipment for compaction until at least one (1) metre of backfill has been placed above the elevation of the top of the pipe.

3.10 FIELD TESTING AND INSPECTION

- .1 Sewer inspection by camera:
 - .1 All sewers up to 900mm shall be inspected by camera after backfilling of the trench to the finished grade. For pipes larger than 900mm, the pipe must be visually inspected by a certified operator, and have observations recorded during a walk-through. Camera inspections of these larger pipes may be authorized by the Engineer, provided it can be demonstrated acceptable data quality will be obtained.
 - .1 Sewers to be inspected by camera after backfilling of the trench to finished grade shall include sanitary mains, storm sewer main, catch basin leads over 8m in length.
 - .2 The inspection shall be made by employing closed circuit television (CCTV) equipment which shall be provided by the Contractor. The Contractor shall employ a qualified closed-circuit television contractor, acceptable to the Engineer, to carry out the inspection.
 - .3 All CCTV inspection shall be carried out in the presence of the Engineer, who shall be given at least forty-eight (48) hours advance notice of any testing to be carried out. CCTV inspection shall be performed by the Contractor on all sewers unless otherwise directed by the Engineer.
 - .4 The CCTV Contractor shall provide all equipment and materials necessary to conduct the inspection as specified herein.
 - .5 The television equipment shall be a self-contained camera and monitoring unit connected by cable. It must be waterproof and be capable of lighting the entire pipe. Picture capabilities must be of quality to show the entire pipe periphery. There must be the capability of providing measurement within the line to an accuracy of one third of a metre per kilometre. Picture quality must be such to produce a continuous 600-line resolution picture showing the entire periphery of the pipe.
 - .6 The following capabilities and items must be available.
 - .1 A direct voice communication.

- .2 A camera towing service.
- .3 Self-contained electrical power.
- .4 Proper safety equipment to protect employees and the general public.
- .7 The camera's rate of progress shall be uniform during the inspection and shall not exceed 6m/min.
 - .1 A CCTV log shall be maintained during the inspection showing the location of any leak, fault, open joint, break, crack, collapse, settlement, obstruction, infiltration, pooled water along with the depth of water in millimetres, or any other defect affecting the overall performance of the sewer line. The location of the defect shall be referenced from the nearest manhole.
 - .2 A separate log shall be kept of service connections with comments of condition.
 - .3 Photographs shall be taken as directed by the Engineer or at the discretion of the television scanning operator. A minimum of one (1) photo per manhole reach is required plus one of every deficiency.
 - .4 Manhole identity shall be noted clearly as indicated on the Drawings.
- .8 A final written report with corresponding photographs referenced to the text along with a copy of the video shall be submitted within two (2) Weeks after the completion of the inspection.
- .9 The Contractor shall be responsible for all works performed by the subcontractor, for traffic control and any other related work incidental to the completion of the television inspection.
- .2 Sewer inspection by walkthrough:
 - .1 For pipes larger than 900 mm, the pipe must be visually inspected by a certified operator, and have observations recorded during a walk-through.
 - .2 The operator must have means of measurement within the line.
 - .3 All noted defects shall be documented by marking the interior of the pipe with the measured location and photographed.
 - .4 The operator shall provide a final written report with corresponding photographs referenced to the text shall be submitted within two (2) Weeks after completion of inspection.
 - .5 A second inspection will be performed, with photographs required to verify the satisfactory completion of the repairs.
- .3 Exfiltration test – low pressure air:
 - .1 If required by the Engineer, the Contractor shall conduct an exfiltration test.
 - .2 Standard practice for testing, equipment used, and other specifications shall follow ASTM F1417, and as noted herein.
 - .3 The Contractor is responsible for ensuring that the test is conducted in a safe manner and that all applicable safety procedures are followed. The Contractor shall not allow anyone to enter the manhole during testing.
 - .4 Tests shall be conducted between two consecutive manholes or to a stub end where the sewer does not terminate at a manhole. The test section shall be plugged at each end. Air shall be supplied slowly to the test section until the internal pressure reaches 24KPa.
 - .5 If the groundwater is above the pipe being tested, the air pressure shall be increased by 3.0kPa for each 300mm that the groundwater level is above the interior invert of the pipe.
 - .6 Where the groundwater table cannot be visually monitored in terms of elevation from the pipe, the Engineer may request that groundwater level be measured prior to testing as per Clause 3.10.6.

- .7 The air pressure shall be allowed to stabilize for at least five (5) minutes. When the pressure has stabilized and is at or above 20.5kPa plus any allowance made for groundwater, the air supply shall be disconnected, and timing shall begin. The time taken for a pressure drop of 3.5kPa shall be recorded.
- .8 The time taken for a pressure drop of 3.5kPa shall not be less than the times shown in the table below (Column B) for lengths equal to or less than the length shown (Column C). If the length of the test section is greater than the length shown in Column C, the testing time shall be the product of the length of the test section multiplied by the value in Column D (i.e. Minimum time = test length x Column D).

Column A Nominal Pipe Size (mm)	Column B Minimum Time (min:sec)	Column C Length of Pipe for Minimum Time (m)	Column D Time Per Unit for Longer Lengths of Pipe (sec/m)
100	1:53	182	0.623
150	2:50	121	1.140
200	3:47	91	2.493
250	4:43	73	3.893
300	5:40	61	5.606
375	7:05	48	8.761
450	8:30	41	12.615
525	9:55	35	17.171
600	11:20	30	22.425
675	12:45	27	28.382
750	14:10	24	30.040
825	15:35	22	42.397
900	17:00	20	50.450

- .9 Determination of Acceptance:
 - .1 If the time shown in the table above for the designated pipe size and length elapses before the air pressure drops by 3.5kPa, the section undergoing the test shall have passed and shall be presumed to be free of all defects. The test may be discontinued once the prescribed time has elapsed even though the 3.5kPa pressure drop has not occurred.
- .10 Determination of Failure:
 - .1 If the pressure drops by 3.5kPa before the appropriate time shown in the table above has elapsed, the air loss shall be considered excessive and the section of pipe shall be deemed to have failed the test.
 - .2 In the event that air exfiltration testing on the sanitary sewer system or any section thereof fails, and/or any leak repair is unsuccessful, the use of other test methodology at the discretion of the Engineer may be permitted. The Engineer shall request air exfiltration testing again once the repair is complete.
 - .3 If the air test on the sewer system or any section thereof fails, but the water infiltration or exfiltration test on the sanitary sewer system or section thereof is successful, the sewer system, or section thereof, shall be deemed acceptable. The Contractor shall be responsible for repairing all visible leaks regardless of the ability of the sanitary sewer system or section thereof to pass any established test criteria specified in these Specifications.

- .4 Exfiltration test – water:
 - .1 If required by the Engineer, the Contractor shall conduct an exfiltration test. The length of the test section shall be determined by CSA B1800, in conjunction with CSA B182, or as per the City of Lloydminster’s Sewer Exfiltration Test procedures.
 - .2 Standard practice for testing, equipment used, and other specifications shall follow the City of Lloydminster’s Sewer Exfiltration Test procedures, and as noted herein.
 - .3 Exfiltration tests utilizing water shall be conducted on a minimum of 10% of all new sewer line construction, on any lines where there is visible infiltration, and when specified by the Engineer.
 - .4 Water shall be added to the pipeline prior to testing until there is a head in the upstream manhole of 1000mm over the crown of the pipe or 600 mm above the groundwater level (refer to Clause 3.10.6 for groundwater measurement).
 - .5 The leakage at the end of the two (2) hour test period shall not be in excess of 4.6 litres/millimetre internal pipe diameter/1 kilometre of pipe/hour. An allowance for each manhole can be included in the test section.

- .5 Infiltration test:
 - .1 If required by the Engineer, the Contractor shall conduct an infiltration test.
 - .2 Standard practice for testing, equipment used, and other specifications shall follow CSA B1800 and as noted herein.
 - .3 The rate of infiltration into the sanitary sewer system shall not be in excess of 4.6 litres/millimetre diameter/1 kilometre of pipe/hour.
 - .4 Infiltration test shall be conducted only where the ground water level at the time of testing is 600 mm or more above the crown of the pipe for the entire length of the test section, otherwise infiltration will be considered an invalid water tightness test.
 - .5 Prior to testing, discontinue dewatering operations at least three (3) days before conducting the test and allow the groundwater level to stabilize. Measure groundwater levels in accordance with Section on groundwater measurement.
 - .6 V-notch weir or other suitable measuring device shall be installed at the downstream end of the test section. Infiltrating water shall be allowed to build up behind the weir until the flow through the V-notch has stabilized. Several tests (minimum three) at 15-30 minutes intervals shall be performed to ensure that the flow through the weir is steady and not changing. The rate of flow shall then be measured and shall not exceed the maximum allowable infiltration calculated for the test section

- .6 Groundwater measurement:
 - .1 Where the groundwater table cannot be visually monitored in terms of elevation from the pipe, the Engineer may request that groundwater level be measured with piezometers placed in representative locations throughout the length of sanitary sewers under construction.
 - .2 The contractor shall provide all materials and equipment necessary for the construction of piezometers for measuring groundwater level and equipment to measure the water level within the piezometer.
 - .3 Piezometers shall be placed in the excavation alongside the sewer at approved locations.
 - .1 Piezometers shall be constructed of 19mm PVC pipe and shall be equipped with 1.0m well screens or sections of a slotted PVC pipe at the end with gravel pack filled in around the screen to approximately 0.5m - 1m above and below the screen.

- .4 All casing and screen material shall be assembled and installed with sufficient care to prevent damage to the sections and joints.
- .5 Prior to installation an end cap must be placed at the bottom of the PVC piping. During installation, a cap shall be placed on top of the casing to avoid materials from entering the PVC piping.
- .6 A completed monitoring piezometer shall be sufficiently straight to allow passage of measuring devices.
- .7 Provide a water level indicator, featuring a cable reel device, designed to measure groundwater levels in small diameter tubes and piezometers.
- .8 The cable reel device shall be equipped with a probe that on entry to water completes an electrical circuit and sends a signal back to the reel where a light and audible buzzer are activated. The water level is then determined by taking a reading directly from the cable at the top of the piezometer casing. Prior, during and after testing of the sewer, the static water level shall be recorded.

1.1 ACCEPTANCE

- .1 The location of all deficient work will be recorded and the Contractor will be required to repair, relay, restore or otherwise make good, to the satisfaction of the Engineer, any deficient work including the repair of alignment problems, sags, cracked or broken pipe, deformed pipe, leaks or any other faults not conforming with these Specifications or the pipe manufacturer's which any inspection or test revealed.
- .2 After the deficiencies are repaired and corrected and before Final Acceptance, the Owner reserves the right to have the faulty areas re-inspected at the Contractor's expense.

END OF SECTION

REVISION LOG		
DATE	REVISION	COMMENTS
12/15/2020	Addition to Clause 3.10 Field Testing and Inspection, Paragraph .1.1	Clarification of sewers to be included as part of the camera inspection.