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SECTION 2.4 – SANITARY SEWER SYSTEM

2.4.1 DESIGN FACTORS

The sanitary sewer system is to collect 100% of the sanitary sewerage generated in developed areas and convey it to a wastewater treatment facility for treatment. The pipe must be sized sufficiently to account for peak flows plus infiltration. The following design parameters apply to sanitary sewerage systems.

Residential

- Population Density: 40 persons/ha (minimum)
- Peak Sewage Flow: 4.0 x average flow
- Infiltration 6,000 L/ha/day

Where an existing water distribution system is to be used, sewage flows are to be 90% of the water consumption rate.

Commercial, Industrial and Institutional

- Peak Flow 3.0 x Average Flow
- Infiltration: 6,000 L/ha/day

Minimum velocity is to be 0.70 m/s or greater

Maximum velocity is to be 3.0 m/s or less

Average flow is to be calculated upon the worst expected building type, consistent with the zoning and building Bylaws. For Sanitary basins larger than 10 Ha. Apply a multiplier of 1.10 when calculated average flows to allow for potential future changes in zoning.

Pipe sizing is to be determined by utilizing Manning's Formula.

Gravity sewer mains are to run straight from manhole to manhole.

It is recommended that all sanitary sewers be designed with the following:

- No sanitary sewer are to have a slope of less than 0.1%;
- Start of the run on any main are to be 50% higher than minimum slope or 0.60%;
- Maximum slope will be based on limiting the maximum flow velocity to 3.0 m/s; and
- The minimum slopes permitted for various sewer sizes are as follows:

TABLE 2.4.1

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MINIMUM SLOPES FOR SANITARY SEWERS

SANITARY SEWER SIZE	MINIMUM SLOPE WITH A STRAIGHT ALIGNMENT	MINIMUM SLOPE WITH A CURVED ALIGNMENT
200 mm	0.40%	0.40%
250 mm	0.28%	0.31%
300 mm	0.22%	0.25%
375 mm	0.15%	0.18%
450 mm	0.12%	0.15%
525 mm	0.10%	0.13%
600 mm and larger	0.10%	0.10%

2.4.2 GENERAL LOCATION REQUIREMENTS

TABLE 2.4.2
REQUIRED CLEARANCES

FEATURE	MIN. HORIZONTAL CLEARANCE
SANITARY MAINS AND PROPERTY LINE OR CURB	1.5m
SANITARY MAIN OR SANITARY MANHOLE AND POWER MAIN OR TRANSFORMER	3.0m
SANITARY MAIN AND WATER MAIN	3.0m

2.4.3 SANITARY SEWER MAIN MATERIALS

TABLE 2.4.2
SANITARY SEWER PIPE

MATERIAL	CLASS
CONCRETE PIPE	ASTM C14, Class III, NON-REINFORCED.
	ASTM C76, ASTM C655-85a, Class III, REINFORCED
HDPE PIPE	ASTM D3350/F714, and D2837
	ASTM D1248, PE 3408 AWWA C-906-90
	Minimum Series 160,
	IPS, with a working stress of 5000 KPa

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DUCTILE IRON PIPE ASPHALTIC COATED	Min Pressure Class 350 to 300 mm Dia. Approved Pressure Class, larger than 300 mm Dia. ANSI / AWWA C150 A21.50
PVC PIPE	Class 100 DR 35 ASTM 1784 rubber gasket joints

The minimum size for sanitary sewer mains is to be 200 mm in diameter.

Pipe classes are to be determined to withstand subsequent superimposed loadings.

Various factors affecting the pipe class are to be taken into account, and pipe class are to be evaluated as per standard engineering practice.

2.4.4 INSULATION

Gravity sanitary sewers are to be insulated using a factory-applied rigid polyurethane foam, specified as follows:

TABLE 2.4.3A
SANITARY SEWER INSULATION

Density	35.2 kg/m ³ minimum, ASTM D1622, apparent core density.
Closed cell content	90% minimum ASTM D6226.
Water absorption	4.0% by Volume ASTM D2842-69
Thermal conductivity	0.023 W/m @ 22 degrees Celsius ASTM C518
System Compressive strength	Modified ASTM D 1621 with 50 mil (1.27 mm) Jacket. Approximately 414 to 552 KPa. *Note: Varies with pipe diameter.
Thickness	Minimum 50 mm

All gravity sanitary sewers are to have a UV stable high-density polyethylene jacket that is factory applied by continuous extrusion and specially formulated for superior cold weather performance (to -45°C) and below grade applications. Jacket thickness varies depending on pipe diameter.

TABLE 2.4.3B
INSULATION JACKET

Tape Jacket Material	Polyethylene UV inhibited, formulated for superior cold weather properties (to -45°C)
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Sealant	Butyl Rubber and resin
Tensile strength	21 MPa Minimum (ASTM D 1000) 8.93 kg/cm width
Thickness	1.14 mm minimum for extruded polyethylene or 2 cross raps for a total minimum thickness of 1.27 mm for the tape wrapped polyethylene application.

A pipe is to be located at the center of the insulation material. An allowable tolerance on this specification is as follows:

- Total diameter of insulation pipe structure is to in no instance be less than the pipe diameter plus 100 mm; and
- The minimum thickness of insulation on any side of the pipe at any location is to be 50 mm.

Remove insulation from pipe where pipes connect to manholes. Any exposed pipe outside of the manhole is to be reinsulated.

2.4.5 MANHOLES

Manholes are to be reinforced concrete, manufactured as follows:

- Bases are to be either precast reinforced concrete or poured in place.
- Barrels are to be min. 1200 mm diameter, precast according to ASTM C478.
- Tops are to be conical precast tops. Slab tops are to be constructed to ensure a minimum of 300 mm from the top of the slab to the bottom of asphalt or surface course gravel.
- Slab tops are to be used where the distance from the bottom of the rings to the manhole base is less than 2.2 m.
- Where depth of the manhole from the lowest invert to the top of the frame exceeds 6.0 meters, safety platforms are to be provided and installed at mid-depth according to the manufacturer's recommendations and as noted on the standard drawings in Section 4.
- Ladder rungs are to be galvanized steel or polypropylene plastic (steel reinforced) precast into the barrels at maximum 400 mm spacing.
- All barrel joints are to be mortared on the outside.
- An O-ring rubber gasket or butyl rubber sealant (or respective approved alternate) is to be installed at each barrel joint in accordance with manufacturer's recommendations.
- Cement mortar for pipe joints, manhole and catch basin construction are to be made of 1 part Portland cement, 1.5 parts clean, sharp sand, and clean water to provide workability.

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Manhole frames and covers are to be in accordance with the Standard Details included in Section 4 of this manual.

Typical manhole covers include:

- Standard manhole frame and cover for non-asphalt roadway surfaces. Standard of acceptance:
 - Norwood Foundry F-39 ;
 - Dobney Foundry C-39; or
 - Titan Foundry TF-39.
- Standard manhole frame and cover for asphalt roadway surfaces (floating manhole frame and cover). Standard of acceptance:
 - Norwood Foundry NF-80; or
 - Titan Foundry TF-80.

Where manholes are located in gravel, holes in the lid are to be plugged.

Frost covers are to be manufactured in four sections according to the standard drawings in Section 4 of this manual and are to be installed in manholes less than 2.5m deep and low flow conditions and at the top end of the distribution system unless otherwise directed by the Engineer. Frost covers are to be installed in all manholes where insulated pipe is used.

Concrete for Manholes and Appurtenances:

- Cement Type 50
- Maximum Slump 75 mm
- Class 27.5 MPa

Floating manhole frames are to be used in all paved roadways.

2.4.6 SANITARY SEWER MAIN INSTALLATION AND LOCATION

Mains are to be installed to provide adequate sewer service connection depth at the property line.

Uninsulated mains are to be installed to provide a minimum depth of cover of 2.8 m from obvert of the main to the gutter line or lowest surface cross-section point, or as thermal analysis and design dictates.

Where the depth to invert of sanitary main is greater than 5 m measure from the lip of gutter, sanitary risers are to be installed at service locations.

Mains are to be located within the road right-of-way in accordance with the standard drawings in Section 4 of this manual.

Crossings are to be installed in accordance with Standard Details in Section 4 of this manual.

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Pipe bedding is to be provided for all mains in accordance with the Standard Details included in Section 4 of this manual.

2.4.7 MANHOLE INSTALLATION AND LOCATION

Manholes are to be located at the end of each line and at all changes in pipe size, material, grade, and alignment and are to be installed in accordance with Standard Details included in Section 4 of this manual.

The maximum distance between manholes is not to exceed 125 m unless approved by the Engineer.

Inverts in manholes at changes in direction are to have at least 50 mm fall across manhole.

Floating manhole frames and covers are to be used in all roadways.

Where possible, manholes are not to be located in bike lanes.

Trench walls are to be in accordance with the Yukon Occupational Health and Safety Regulations. Pipe zone widths are to be as shown on the Standard Details in Section 4 of this manual.

Where the inlet of a pipe is 1 m or greater above the outlet, use a drop structure in accordance with Standard Detail in Section 4 of this manual.

2.4.8 TRENCHING AND BACKFILLING

Backfilling is to be carried out with selected native or imported material in 300 mm lifts to a minimum of 95% Standard Proctor Density. Backfill 1.0 m below the top of Subgrade is to be compacted to 98% Standard Proctor Density. Trenches that do not extend beneath the road surface are to be compacted to 95% Standard Proctor Density.

Backfill around manholes is to be compacted with mechanical tampers to a minimum of 95% Standard Proctor Density at optimum moisture content in 300 mm lifts. The top meter of backfill is to be compacted to 98% Standard Proctor Density.

Sand bedding or other approved granular material in the pipe zone is to be compacted to a minimum of 95% Standard Proctor Density in maximum lifts of 150 mm.

2.4.9 INSPECTION AND TESTING

Prior to acceptance, a video camera inspection is to be carried out for all sewer lines up to and including 750 mm diameter. A manual visual inspection is to be carried out for sewer lines with diameters greater than 750 mm.

Sanitary mains and manholes are subject to an infiltration and exfiltration test. The maximum allowable infiltration and exfiltration is 1.0 L/hour per 10 mm of pipe diameter /100m length of pipe

Sanitary mains are to be tested for alignment by means of a light test. The illuminated interior of the pipe is not to show any substantial misalignment or displacement. 75% of the full inside diameter must be visible from manhole to manhole.