

# REGION OF PEEL

## PUBLIC WORKS DESIGN, SPECIFICATIONS & PROCEDURES MANUAL

### LINEAR INFRASTRUCTURE

#### Sanitary Sewer Design Criteria

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**PUBLIC WORKS  
SANITARY SEWER DESIGN CRITERIA  
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## **1. INTRODUCTION**

The design of municipal services in the Region of Peel is to be based upon the current “Environment, Transportation and Planning Services Design, Specification & Procedures Manual”. All plans are to be reviewed by the Region prior to the construction of services. Such review shall not relieve the engineer from primary responsibility for the design to meet all Federal, Provincial, Regional, and local government requirements. Refer to the Environmental Assessment Process section of this manual for the steps required to fulfill the Class Environmental Assessment process.

### **1.1. Geotechnical Investigation**

The Consultant shall determine the need for soils investigation. However, if Regional staff requests a geotechnical investigation, the Consultant must supply one.

The purpose of a geotechnical investigation would be to determine the soil's composition, bearing strength, and type, and to verify that no contamination is present; which would be determined by the consultant. The consultant shall recommend the appropriate bedding requirements based on the findings of the geotechnical investigation and state them on the drawings.

Boreholes shall be taken to a minimum depth of one (1) metre below the anticipated depth of the sanitary sewer invert.

## **2. DESIGN FLOWS**

Design calculations for sanitary sewer systems shall be completed on Standard Drawing ~~2-5-4~~ **2-9-1** (appended hereto).

### **2.1. Population Equivalents based on Land Use**

#### Residential

Population equivalent densities are to be calculated based upon the following criteria:

<b>Density</b>	<b>Pop./Hectare</b>
Single family (greater than 10m frontage)	50 persons/hectare
Single family (less than 10m frontage)	70 persons/hectare
Semi-detached	70 persons/hectare
Row dwellings	175 persons/hectare
Apartments	475 persons/hectare

#### Apartments

If the proposed population equivalent is greater than 475 persons/hectare, based on a rate of 2.7 people per unit (ppu), then the calculated population equivalent shall be used for design.

$$\frac{2.7 \text{ ppu} \times (\# \text{ units})}{\text{area}} = \text{pop/hectare}$$

Standard Drawing ~~2-5-2~~ **2-9-2** (appended hereto) lists domestic sewage flows versus population including a peaking factor.

#### Industrial

For light industrial areas, use an equivalent population of 70 persons per hectare. Refer to Standard Drawing ~~2-5-2~~ **2-9-2** for sanitary sewage flows. Individual studies are to be made for special industries and major industrial areas.

### Commercial

For commercial areas, use an equivalent population of 50 persons per hectare. Refer to Standard Drawing 2-5-2 2-9-2 for sanitary sewage flows.

Individual studies are to be made for infill commercial development, redevelopment, land use intensification and areas where the equivalent population will be greater than 50 persons per hectare.

### Institutional

- Equivalent population per site as follows:
- Junior Public Schools  
1/3 x number of students (600 students minimum)
- Senior Public Schools  
½ x number of students (900 students minimum)
- Secondary Schools  
2/3 x number of students (1,500 students minimum)
- Hospitals  
Apply a population equivalent of 3 persons per bed.

## **2.2. Peak Sanitary Flow Factor**

The peak sanitary flows in Standard Drawing 2-5-2 2-9-2 were derived by applying the ratio established by the Harmon Formula to the average day sanitary flows as follows:

$$M = 1 + \frac{14}{4 + p^{0.5}}$$

where: M = ratio of peak flow to average flow  
P = the tributary equivalent population in thousands

### **2.3. Infiltration**

Except for unusual circumstances, the infiltration portion of sewage flow shall be  $0.0002 \text{ m}^3/\text{sec}/\text{ha}$  for all types of land use. This factor applies to the gross area of all lands.

When designing sewers that accept flows from an area developed more than twenty five (25) years ago, or where evidence indicates, an additional allowance shall be made for foundation drains equal to  $0.08 \text{ litres}/\text{sec}/\text{foundation drain}$  ( $0.00008 \text{ m}^3/\text{sec}/\text{drain}$ ).

Additional allowance for maintenance hole inflow:  $0.00028 \text{ m}^3/\text{sec}/\text{mh}$  or equivalent of  $0.000028 \text{ m}^3/\text{sec}/\text{m}$  of sewer length shall be included.

### **2.4. Design Flows**

- Design flows shall be based upon the equivalent population from Standard Drawing ~~2-5-2~~ **2-9-2** (peaking factor included). To this figure an infiltration allowance is added based upon the gross area. See section 2.3 above.
- Minimum sewer pipe grades to be as per Standard Drawing ~~2-5-4~~ **2-9-4**.

### 3. PIPE SIZE

To determine pipe size and its capacity, refer to Standard Drawing 2-5-3 2-9-3 (Circular Drain Nomograph), or use Manning's Formula, expressed as follows:

$$Q = \frac{A}{n} R^{2/3} S^{1/2}$$

where: Q = Design flow (m<sup>3</sup>/sec)

n = Coefficient of Roughness

R = Hydraulic Radius (m) ( $A_F/P_W$ )

$A_F$  = Area of Pipe Flowing Full  
 $P_W$  = Wetted Perimeter

S = Slope (m/m)

A = Cross-Sectional Area of Pipe (m<sup>2</sup>)

The coefficient of roughness for all pipes shall be: n = 0.013. The minimum pipe size shall be 250mm diameter.

Refer to Standard Drawing 2-5-4 2-9-4 (Discharge and Velocity) to select a pipe size vs. slope and to determine the resultant capacity and velocity.

#### 3.1 Pipe Classification

Primary Collection System – Major Trunk Sewers larger than 750mm diameter, dedicated to the conveyance of wastewater between local Trunk Sewers and Wastewater Treatment Plants.

Local Trunk Sewer Collection System – Large diameter pipes, 375mm diameter to 675mm diameter, used to transmit wastewater from local sanitary sewers within subdivisions to the Primary Collection System.

Local Collection System – Pipes 250mm diameter to 300mm diameter in size, used to collect wastewater within subdivisions.



See paragraph 8.4 for Connection Protocol.



#### **4. FLOW VELOCITIES**

The flow velocities shall be determined from Standard Drawing ~~2-5-4~~ **2-9-4** or by Manning's Formula:

$$V = \frac{Q}{A}$$

where: V = Flow velocity (m/sec)

Q = Design flow (m<sup>3</sup>/sec)

A = Cross sectional area of flow (m<sup>2</sup>)

The maximum flow velocity shall not be greater than 3.5 m/sec with the pipe flowing full and the minimum velocity shall not be less than 0.75 m/sec at actual flow.

To determine sewage velocities based upon actual flow refer to Standard Drawing ~~2-5-5~~ **2-9-5** "Values of Hydraulic Elements of a Circular Section for Various Depths of Flow".

Use a minimum grade of 0.50% for sewers servicing less than 500 persons, except for the last leg of sewer where a minimum grade of 1.00% is required.

Where depth is a problem, a 250mm diameter sewer at 0.40% grade can be used when servicing more than 500 persons up to the capacity of the sewer. Further, a 300mm diameter sewer at 0.35% grade can be used when servicing a minimum of 1,000 persons.

Concrete pipe larger than 450mm diameter (including maintenance holes) where velocities are greater than 2.0 m/sec and drops across maintenance hole is greater than 0.3m shall be reviewed for protection against sulphuric acid (H<sub>2</sub>SO<sub>4</sub>) and protected in a manner satisfactory to the Region of Peel.

## **5. PIPE SELECTION AND DESIGN**

### **5.1. Sewer Pipes and Appurtenances**

Sewer pipes and appurtenances shall be in accordance with the current Manufactures Approved Products List, Sanitary Sewer and Appurtenances section of this manual.

### **5.2. Rigid Pipe Design**

Refer to Standard Drawings 2-5-6 **2-9-6** for pipe class requirements for rigid pipe. Special designs shall be completed in accordance with the following guidelines:

#### Live Load

For calculating transmitted live loads on sewer pipes, use Marston's Formula:

$$W_t = \frac{1.0}{L} \times I_c \times C_t \times T$$

where:	$W_t$	=	Average load per unit length of pipe (kg/linear metre)
	$L$	=	Length of pipe (metres) on which the load is computed
	$I_c$	=	Impact factor for a moving load
	$C_t$	=	Load Coefficient
	$T$	=	A concentrated surface load (kg)

For vehicular traffic, use loading in accordance with the Ontario Highways Bridge Design Code (OHBDC).

For railroad traffic, use E-80 loading (1.75) or additional requirements per the respective rail road company.

### Dead Load

For calculating backfill loading on sewer pipes, use Marston's Formula:

$$W_d = C_d \times W \times B_d^2$$

*\*For trench conditions (Standard Drawing 2-5-8)*

$$W_c = C_c \times W \times B_c^2$$

*\*For embankment conditions (Standard Drawing 2-5-9)*

where:	$W_d$	=	The soil backfill load in kg/linear metre
	$W_c$	=	The soil backfill load in kg/linear metre
	$C_d$	=	The load coefficient for trench condition
	$C_c$	=	Coefficient (dimensionless) for positive projecting embankment condition (Standard Drawing 2-5-9)
	$W$	=	Unit weight of the backfill material in kg per metre <sup>3</sup>
	$B_d$	=	Width of trench in metres, measured in a horizontal plane at the extreme top of the pipe Min. O.D. of the pipe + .45 m Max. O.D. of the pipe + .75 m
	$B_c$	=	The O.D. of the pipe in metres

For non-reinforced pipe, multiply the above loading by a factor of safety of 1.25.

The width of a trench at which a transition occurs between the trench condition and embankment condition can be determined by referring to Standard Drawing ~~2-5-9~~ **2-9-9**.

To determine the value of  $C_c$  on Standard Drawing ~~2-5-9~~ **2-9-9**, the  $r_{sdP}$  value is to be established. The term  $r_{sdP}$  is made up of the projection ratio (P) and the settlement ratio ( $r_{sd}$ ). These ratios form the shear component of the total load on a sewer under embankment conditions. If no other data are available, an  $r_{sdP}$  ratio of 0.35 may be used.

Establish H/B<sub>c</sub>. Enter Standard Drawing 2-5-9 **2-9-9** to determine the ratio of B<sub>d</sub>/B<sub>c</sub>. Apply this ratio to the OD of the pipe (B<sub>c</sub>) to determine the installation conditions.

The minimum A.S.T.M. 0.01 crack, three edge bearing strength requirements for reinforced concrete pipe and minimum A.S.T.M. three edge bearing crushing strength requirements for non-reinforced concrete pipe are to be used in determining pipe strength.

Refer to Standard Drawing 2-3-1 for standard pipe beddings and resultant load factors to determine field supporting strength.

### **5.3. Flexible Pipe Design**

#### Dead Load

$$P = WH \times \frac{1}{10,000cm^2}$$

Where:

P	=	Prism Load (kg/cm <sup>2</sup> )
W	=	Unit weight of the backfill soil (kg/m <sup>3</sup> )
H	=	Depth of cover (m)

#### Live Load

Live loads are calculated in the same manner as with rigid pipe (see section 5.2.).

#### 5.4. Deflection Calculations

The maximum allowable deflection of PVC pipe under loadings shall be equal to 5% (five percent) of the nominal internal diameter, or as per 50% manufacturer's specifications.

This percent deflection may be calculated using the following formula:

$$\text{Percent Deflection: } \frac{\% \Delta Y}{D} = \frac{D_L \cdot K \cdot P \cdot 100}{(0.149 F / \Delta Y) + (0.061 E^1)}$$

- Where:
- $E^1$  = Modulus of soil reaction (kPa)  
           For main sewer line           - 6900 kPa  
           For sanitary connections   - 1379 kPa
  - $D_L$  = Deflection lag factor (1.50)
  - $K$  = Bedding constant (0.11)
  - $P$  = Prism Load   WH   x    $\frac{1}{10,000} \text{ cm}^2$
  - $H$  = Depth of cover (m)
  - $W$  = Unit weight of backfill material  
           (Min. 2,080 kg/m<sup>3</sup>)
  - $F / \Delta Y$  = Min. 1.83 kg/cm/cm

## **6. PIPE DEPTH, LOCATION AND BEDDING**

### **6.1. Pipe Depth**

The obvert of the sewer shall be a minimum of 2.5 m below the centre line of the road allowance. Where this is not possible, minimum basement elevations of 1.0 m above the sanitary pipe obvert are to be shown on the profile drawing, lot grading plans, and general underground servicing plan. These elevations are to be included in the Servicing Agreement. In commercial areas, the sewer obvert shall be a minimum of 3.5 m below the centre line of the road allowance where possible. In valleys, the sewer obvert shall be a minimum 1.4 m below the creek bottom. A permit from the Conservation Authority is required for creek crossing.

In all cases the proposed sanitary sewers shall be installed at sufficient depth to service lands external to the site as determined by the Region of Peel. Special design consideration for water tight joints is to be applied when pipe is buried to a depth where significant hydrostatic pressures are anticipated.

The Consulting Engineer shall support the selection of the type of pipe to be used with detailed design calculations, when requested.

### **6.2. Location**

The sanitary sewer shall be located 1.50 m north or east of the centreline of the road allowance unless conflicts with other utilities require a revised location. Curvilinear sewer alignments may be permitted for large diameter sewers only, provided it is parallel to the road centreline and compensation is provided for head losses due to curvature.

A 2.0 m horizontal separation between the sanitary sewer and storm sewer (barrel to barrel) will be permitted to allow for common trench construction as long as the inverts of both sewers are at the same relative elevation. Should the sewer inverts vary by more than 1.0 m, a 3.0 m horizontal separation shall be maintained.

Note: Allowance to be made for minimum basement elevation where storm sewers obvert impacts the serviceability of adjacent lands.

### **6.3. Bedding**

Sanitary sewers shall be installed with bedding as per Standard Drawing 2-3-1. The sieve analysis for granular bedding materials can be seen in the standard drawings.

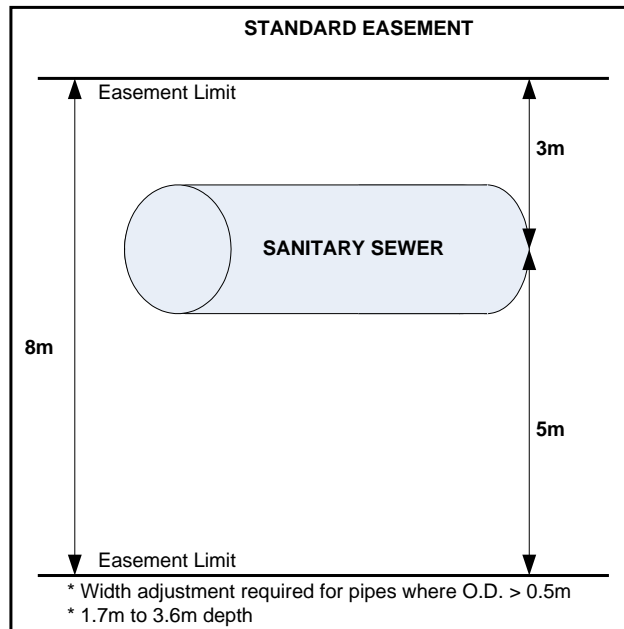
In rock and shale excavation, the Consultant shall determine the required thickness of compressible material (minimum 50mm layer) between the trench walls and any concrete encasement.

#### **6.4. Easements**

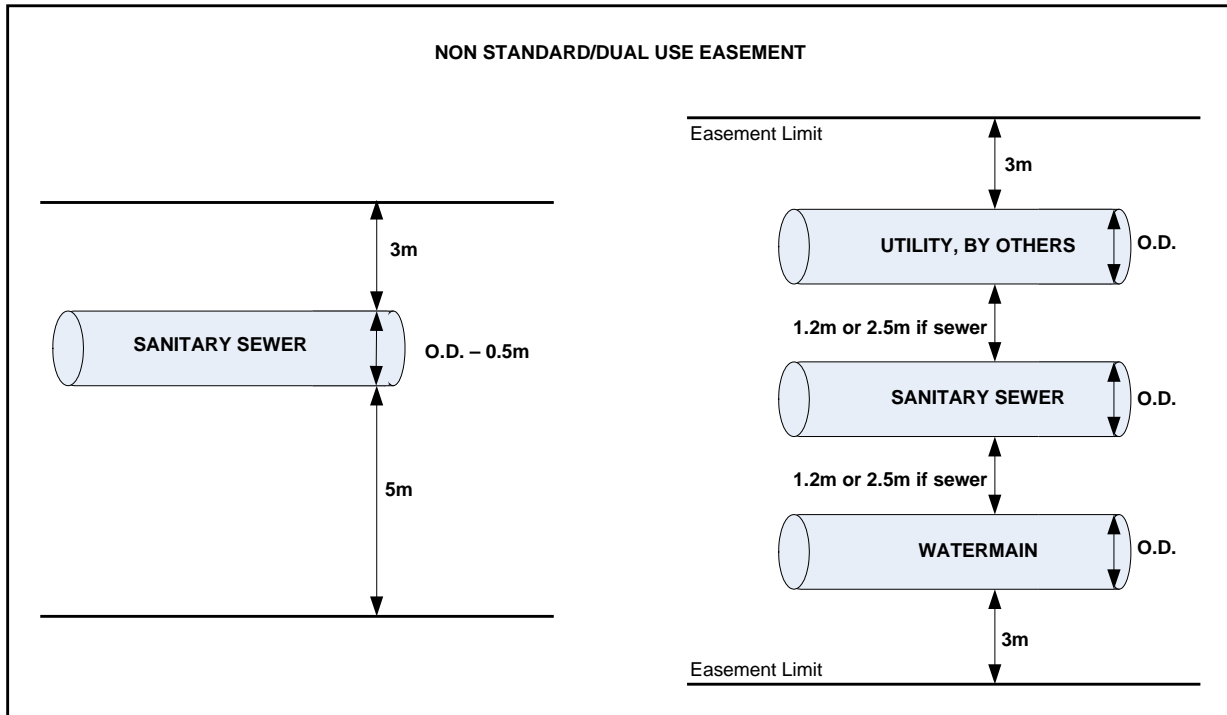
No Regional infrastructure shall be installed in a trench whose lines of influence encroach on the foundation of any present or proposed permanent structure.

Line of influence – An imaginary line at a slope of 1:1 taken from the deepest point of the permanent structure towards the easement in question. The zone of influence would therefore be all areas underneath the lines(s) of influence.

Easements for Region of Peel sanitary sewers with a pipe invert between 2.5m to 3.6 m depth require a total easement width of 8.0 m. The sanitary sewer should be offset within the easement as illustrated.



Certain restrictions apply with respect to easements as per the documents registered on title. The applicant must keep the easement clear of buildings, structures, or obstructions. The permitted use for the easement lands are restricted to lawn, flowerbed, roadway, driveway or parking area which can not be paved with a hard concrete surface. Maintenance vehicles and equipment must be able to easily access infrastructure in the easement.



A width adjustment is required for infrastructure with an outside diameter (O.D.) greater than 500 mm. Required easement width is directly related to pipes outside diameter. Example: for pipe with an outside diameter of 800mm, assuming standard depth of bury, the minimum easement width shall be 8.3m (3m + 5m + (800mm – 500mm))

For Region of Peel infrastructure with a pipe depth greater than 3.6 m, the easement width shall be designed such that the infrastructure can be installed by conventional excavation methods with the operation totally contained within the easement limits. Furthermore, the pipe location within the easement should not be within the zone of influence of any existing or proposed permanent structure. Considerations need to be made to accommodate 1:1 slope above the shoring box (3.6m). For each metre of depth below 3.6m, the width of the easement will need to increase by 2m.



## **7. MAINTENANCE HOLES**

All maintenance holes shall conform to the current Manufacturer's Approved Products List, Sanitary Sewer and Appurtenances, Standard Drawings ~~2-1-4~~ **2-3-1** to ~~2-2-4~~ **2-9-9** and designed according to the following criteria:

- a) The maximum spacing shall be 120 m between maintenance holes for sewers up to 600mm diameter. For sewers greater than 600mm diameter spacing up to 170 metres may be used. Large trunk sewers may use greater spacing at the Region's approval.
- b) Drops through sanitary maintenance holes shall be calculated using the following formula:

$$\text{Velocity Head} = \frac{V^2}{2g}$$

$$90^\circ \text{ bends} = \frac{1}{2} \text{ Velocity Head}$$

$$45^\circ \text{ bends} = \frac{1}{4} \text{ Velocity Head}$$

$$\text{Where: } g = 9.8 \text{ m/sec}^2$$

On 250 mm to 300 mm diameter pipes:

$$\text{minimum drop} = 0.030 \text{ m}$$

$$\text{maximum drop} = 0.20 \text{ m}$$

On larger pipes, drops to be calculated as per the above.

- c) At maintenance holes where pipe sizes change, the above criteria shall be altered such that the obverts of the pipe are matched.
- d) Where depth from the invert to top of a maintenance hole exceeds 5.0 m, a safety platform is to be provided as per Regional Standard ~~2-2-4~~ **2-6-13 to 2-6-15**. The platform shall be located to allow ~~2.0~~ **2.4m** below manhole cover and ~~2.6~~ **0.3m** above ~~benching~~ **obvert of pipe**.
- e) Drop maintenance holes shall be provided where the difference in invert elevation is greater than 0.90 m. The drop pipe shall be one size smaller than the sewer line (minimum 250mm diameter). The economic feasibility of providing a deeper sanitary sewer instead of a drop maintenance hole shall be explored. The use of 45° bends and Y's for drops is acceptable. No drops will be accepted between 0.9 m and the requirements in 7(b) above. See Standard Drawings ~~2-1-5~~ **2-5-26** and ~~2-1-6~~ **2-5-27**.

- f) Watertight bolt down covers shall be provided on maintenance holes located in all easements and in areas where maintenance holes are susceptible to flooding and/or vandalism. Where significant sections of sanitary sewers are provided with watertight covers, extended vents will be required at every third maintenance hole as per STD DWG 2-4-7 **2-5-22**. The elevation of the vents shall be above Regional flood lines as determined by the appropriate Conservation Authority and illustrated on the plan and profile drawings. Where possible, maintenance holes shall be accessible to maintenance vehicles and equipment and be positioned in a suitable location to allow for venting.
- g) When a PVC sewer is installed into a maintenance hole, one of the following methods is to be used:
  - i) Couplings providing an elastomeric gasket seal are to be grouted into the maintenance hole wall.
  - ii) A manufactured length of PVC that has been softened with solvent and covered with sand for adherence to grout in the wall of the maintenance hole.
- h) Even when an elastomeric gasket is used at the maintenance hole wall, the maximum distance to the first joint from the maintenance hole wall when using PVC pipe shall be 0.60 m. Special care shall be taken in compacting the over-excavated area at the maintenance hole wall. As an alternative, concrete fill may be used to 100 mm below the sanitary invert. Standard bedding is then used for the remaining depth.
- i) 90° changes of flow direction should be eliminated, where possible, by utilizing 2 x 45° bends within maintenance holes.

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## **8. SEWER LATERALS**

### **8.1. Residential**

All residential connections shall be in accordance with the current “Manufacturer’s Approved Products list, Sanitary Sewer/Forcemains”. The minimum diameter within the road allowance shall be 125 mm. The minimum and maximum cover at street line shall be 2.30 m and 2.75 m respectively, unless circumstances require otherwise. If necessary, risers shall be provided for connection with the main sewer as per STD DWG. 2-4-1 to ~~2-4-3~~, **2-4-2 and 2-4-4**. These risers are to be shown on the profile portion of the drawings. Grades of 1% minimum and 2% maximum shall be used for laterals. Connections directly into maintenance holes shall be minimized and reviewed on an individual basis.

### **8.2. Commercial**

In commercial areas, the minimum connection size shall be 150 mm in diameter, installed with a minimum grade of 1% and a maximum grade of 2%. The minimum cover at property line shall be 2.30 m, unless circumstances require otherwise. The maximum drop across the property line manhole shall be 0.03 m. The maximum depth is as required by design. A maintenance hole will be required if the lateral diameter is equal to or greater than half the diameter on the main line sewer, except for a 150 mm diameter pipe connecting to a 250 mm diameter mainline or a 200mm diameter pipe connecting to a 375 mm diameter (see matrix below). If necessary, risers shall be provided at the main sewer and shown on the profile drawings as per STD DWG. 2-4-1 to 2-4-3. Connection numbers are to be established prior to construction of the lateral. Pipe materials shall be in accordance with the current Manufacturer’s Approved Products List, Sanitary Sewer and Appurtenances.

### **8.3. Industrial**

The minimum connection size shall be 150 mm diameter, installed on a minimum grade of 1% and a maximum grade of 2%. The minimum and maximum cover at property line shall be 2.00 m and 2.75 m respectively, unless circumstances require otherwise. The maximum drop across the property line manhole shall be 0.03 m. A maintenance hole will be required if the lateral diameter is equal to or greater than half the diameter on the main line sewer, except for a 150mm diameter pipe connecting to a 250mm diameter mainline or a 200mm diameter pipe connecting to a 375mm diameter mainline (see matrix below). If necessary, risers shall be provided at the main sewer and shown on the profile drawings as per STD DWG. 2-4-1 to 2-4-3. Connection numbers are to be established prior to construction

of the lateral. Pipe materials shall be in accordance with the current Manufacturers Approved Products List, Sanitary Sewer and Appurtenances.

Sampling manholes are required for industrial sites. Refer to STD DWG 1-8-6 for industrial buildings and 1-8-9 servicing for multiple building industrial sites (no frontage).

Maintenance Hole Requirements Matrix

MH required = Y MH not required = N		Lateral		
		150 mm ø	200 mm ø	250 mm ø
Mainline Sewer	250 mm ø	N	Y	Y
	300 mm ø	N	Y	Y
	375 mm ø	N	N	Y
	450 mm ø	N	N	Y

**8.4. Connection Protocol**



See paragraph 3.1. for Pipe Classification definitions

Primary Collection System, larger than or equal to 750mm diameter:

- Connections with other Major Trunk Sewers and Local Sub-Trunk Sewers permitted
- No service connections are permitted

Local Sub-Trunk Sewer Collection System, 375mm – 675mm diameter:

- Connections with other Sub-Trunk Sewers and Local Sewers permitted
- Non-residential and residential connections may be permitted on an individual basis.

Local Collection System, 250mm – 300mm diameter:


- All types of service connections permitted.

**9. NON-PERMITTED USES**

**New construction**

Connections from foundation, weeping tile drainage, roof drainage or any other storm source are not permitted to discharge into the sanitary sewer system.

This STD DWG is now referred to as 2-9-1

LOCATION	FROM M.H.	TO M.H.	AREA (ha)	DENSITY (ppha)	POPULATION	CUMULATIVE AREA (ha)	CUMULATIVE POPULATION	SEWAGE FLOW 1 (l <sup>3</sup> /sec)	INFILTRATION FLOW 2 (m <sup>3</sup> /sec)	FOUNDATION DRAIN 3 (m <sup>3</sup> /sec)	TOTAL FLOW 1+2+3 (m <sup>3</sup> /sec)	LENGTH (m)	PIPE DIAMETER (mm)	GRADIENT (%)	CAPACITY (m <sup>3</sup> /sec)	VELOCITY (m/sec)	DROP IN LOWER M.H. (m)
 <b>Region of Peel</b> <i>Working for you</i>																	
<b>STD. DWG. 2-5-1</b> <small>Sewer Flow Numbers Taken From STD. DWG. 2-5-2</small>																	
Drainage Area Plan No. _____ Consultant _____ Subdivision _____ of _____ Sheet _____ of _____ Project No. _____																	
Approved _____ Date _____ _____ Date _____																	

Population	Peak Flow (m <sup>3</sup> /sec)	Population	Peak Flow (m <sup>3</sup> /sec)	Population	Peak Flow (m <sup>3</sup> /sec)
1000	0.0130	4750	0.0542	13000	0.1292
1050	0.0139	5000	0.0569	14000	0.1376
1100	0.0145	5250	0.0594	15000	0.1459
1150	0.0151	5500	0.0618	16000	0.1540
1200	0.0157	5750	0.0640	17000	0.1620
1300	0.0169	6000	0.0666	18000	0.1700
1400	0.0181	6250	0.0691	19000	0.1779
1500	0.0193	6500	0.0710	20000	0.1857
1600	0.0204	6750	0.0737	25000	0.2236
1700	0.0217	7000	0.0762	30000	0.2601
1800	0.0228	7250	0.0784	35000	0.2955
1900	0.0239	7500	0.0809	40000	0.3298
2000	0.0251	7750	0.0830	45000	0.3634
2200	0.0273	8000	0.0854	50000	0.3963
2400	0.0296	8250	0.0878	55000	0.4286
2600	0.0318	8500	0.0898	60000	0.4603
2800	0.0340	8750	0.0922	65000	0.4915
3000	0.0361	9000	0.0945	70000	0.5224
3250	0.0387	9250	0.0968	75000	0.5528
3500	0.0415	9500	0.0981	80000	0.5828
3750	0.0441	9750	0.1010	85000	0.6126
4000	0.0467	10000	0.1033	90000	0.6420
4250	0.0492	11000	0.1120	95000	0.6711
4500	0.0518	12000	0.1210	100000	0.7000

Notes:

1. Domestic sewage flows are based upon a unit sewage flow of 302.8 Lpcd.
2. The flows in the above table include the Harmon Peaking Factor.
3. Domestic sewage flow for less than 1000 persons shall be 0.013m<sup>3</sup>/sec.
4. Domestic sewage flow for greater than 100,000 persons shall be 7.0 x 10<sup>-6</sup> m<sup>3</sup>/sec per capita.
5. Lpcd = Litres per capita per day      1 Litre = 0.001 metre<sup>3</sup>

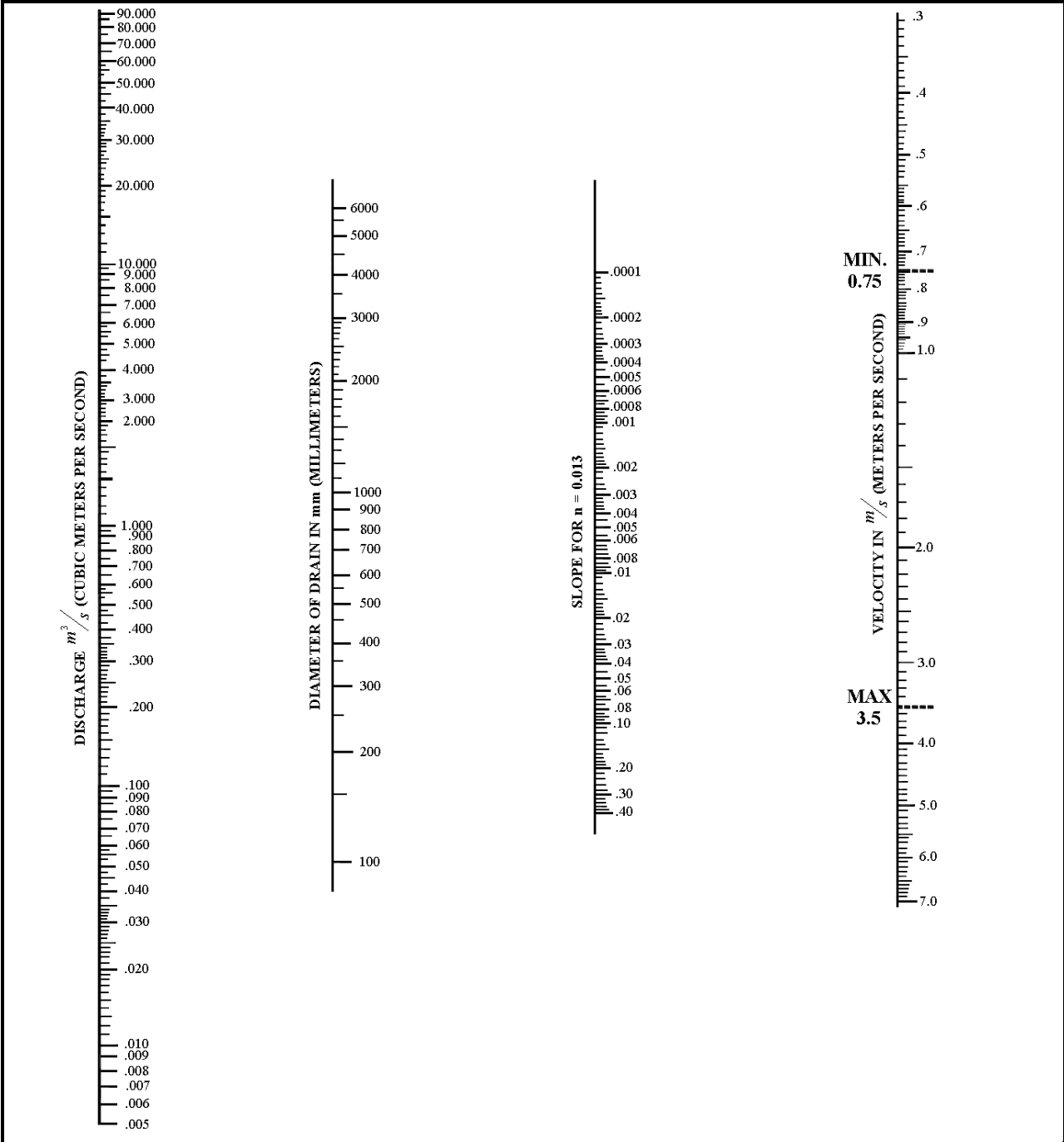


Date: June 2005      Rev: 1

Approved:

**SEWAGE FLOWS**  
(EXCLUDING INFILTRATION)

**STD. DWG. 2-5-2**  
**2-9-2**



 **Region of Peel**  
*Working for you*

Date: June 2005      Rev: 1

Approved:

**CIRCULAR DRAIN NOMOGRAPH**  
 Flowing Full

**STD. DWG. 2-5-3**  
**2-9-3**





% Grade	250		300		375		450		525		600		675		750		825		900		1050		1200		1350		1500		% Grade
	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	
0.20					0.082	0.72	0.132	0.81	0.200	0.90	0.286	0.98	0.391	1.06	0.519	1.14	0.668	1.21	0.841	1.23	1.276	1.43	1.918	1.56	2.491	1.69	3.239	1.81	0.20
0.25			0.049	0.69	0.091	0.80	0.148	0.91	0.223	1.00	0.320	1.10	0.438	1.19	0.581	1.27	0.747	1.36	0.941	1.44	1.427	1.59	2.033	1.74	2.786	1.98	3.800	2.02	0.25
0.30			0.054	0.76	0.100	0.88	0.162	0.99	0.245	1.10	0.351	1.20	0.480	1.30	0.636	1.39	0.818	1.49	1.032	1.58	1.564	1.75	2.229	1.91	3.054	2.06	4.045	2.21	0.30
0.35			0.058	0.82	0.108	0.95	0.175	1.07	0.264	1.19	0.379	1.30	0.518	1.40	0.687	1.51	0.883	1.61	1.114	1.70	1.689	1.89	2.406	2.06	3.296	2.23	4.366	2.39	0.35
0.40			0.062	0.87	0.115	1.01	0.187	1.15	0.282	1.27	0.405	1.39	0.553	1.50	0.734	1.61	0.944	1.72	1.190	1.82	1.804	2.02	2.570	2.20	3.522	2.38	4.665	2.56	0.40
0.45			0.066	0.93	0.122	1.07	0.198	1.22	0.299	1.34	0.430	1.47	0.587	1.59	0.779	1.71	1.001	1.82	1.262	1.93	1.914	2.13	2.727	2.33	3.796	2.53	4.949	2.71	0.45
0.50	0.044	0.87	0.070	0.98	0.129	1.13	0.209	1.28	0.316	1.42	0.453	1.55	0.619	1.68	0.821	1.80	1.056	1.92	1.331	2.03	2.018	2.25	2.875	2.46	3.940	2.66	5.218	2.86	0.50
0.55	0.046	0.91	0.073	1.02	0.135	1.19	0.219	1.34	0.331	1.59	0.475	1.62	0.649	1.77	0.860	1.89	1.107	2.01	1.386	2.13	2.117	2.36	3.016	2.58	4.132	2.79	5.473	3.00	0.55
0.60	0.048	0.95	0.076	1.07	0.141	1.24	0.229	1.40	0.346	1.56	0.487	1.70	0.679	1.84	0.900	1.97	1.157	2.10	1.459	2.23	2.121	2.47	3.152	2.70	4.319	2.92	5.720	3.13	0.60
0.65	0.050	0.98	0.079	1.11	0.147	1.29	0.238	1.46	0.360	1.62	0.516	1.77	0.706	1.92	0.936	2.05	1.203	2.18	1.517	2.32	2.300	2.57	3.278	2.81	4.491	3.03	5.949	3.25	0.65
0.70	0.052	1.02	0.082	1.16	0.153	1.34	0.247	1.52	0.374	1.68	0.536	1.84	0.433	1.99	0.972	2.13	1.250	2.27	1.594	2.41	2.389	2.69	3.404	2.91	4.664	3.15	6.178	3.38	0.70
0.75	0.053	1.06	0.085	1.20	0.158	1.39	0.256	1.57	0.387	1.74	0.554	1.90	0.758	2.05	1.005	2.20	1.292	2.35	1.629	2.49	2.471	2.76	3.520	3.02	4.823	3.26	6.388	3.50	0.75
0.80	0.055	1.10	0.088	1.24	0.163	1.44	0.264	1.62	0.399	1.80	0.573	1.96	0.783	2.12	1.038	2.28	1.335	2.43	1.683	2.57	2.552	2.85	3.636	3.12	4.982	3.37	6.598	3.62	0.80
0.85	0.057	1.13	0.091	1.27	0.168	1.48	0.272	1.67	0.412	1.85	0.590	2.02	0.807	2.19	1.070	2.34	1.376	2.50	1.735	2.65	2.630	2.94	3.748	3.21	5.135	3.47	6.805	3.73	0.85
0.90	0.058	1.16	0.094	1.31	0.173	1.52	0.280	1.72	0.424	1.90	0.608	2.08	0.831	2.25	1.102	2.42	1.417	2.57	1.787	2.73	2.709	3.02	3.869	3.31	5.288	3.59	7.004	3.84	0.90
0.95	0.060	1.19	0.096	1.34	0.178	1.56	0.287	1.77	0.435	1.96	0.625	2.15	0.853	2.31	1.131	2.48	1.455	2.64	1.835	2.80	2.983	3.10	3.983	3.39	5.430	3.67	7.196	3.94	0.95
1.00	0.062	1.22	0.098	1.38	0.182	1.60	0.295	1.81	0.446	2.01	0.641	2.19	0.876	2.37	1.161	2.55	1.493	2.71	1.883	2.855	3.19	4.067	3.48	5.573	3.77	7.381	4.04	1.00	
1.10	0.065	1.28	0.103	1.45	0.191	1.68	0.310	1.90	0.468	2.11	0.672	2.30	0.919	2.49	1.218	2.67	1.567	2.85	1.975	3.02	2.994	3.34	4.266	3.65	5.846	3.95	7.743	4.24	1.10
1.20	0.067	1.34	0.108	1.51	0.200	1.76	0.323	1.98	0.489	2.20	0.702	2.40	0.959	2.60	1.272	2.79	1.635	2.97	2.061	3.15	3.126	3.49	4.453	3.82	6.102	4.13	8.092	4.43	1.20
1.30	0.070	1.40	0.112	1.58	0.208	1.83	0.337	2.07	0.509	2.29	0.730	2.50	0.998	2.71	1.324	2.90	1.703	3.08	2.146	3.28	3.254	3.63	4.636	3.97	6.353	4.30	8.414	4.61	1.30
1.40	0.073	1.45	0.117	1.64	0.216	1.90	0.349	2.14	0.523	2.38	0.758	2.60	1.060	2.82	1.374	3.01	1.767	3.21	2.227	3.40	3.377	3.77	4.811	4.12	6.592	4.46	8.732	4.78	1.40
1.50	0.075	1.50	0.121	1.69	0.224	1.96	0.362	2.22	0.547	2.46	0.785	2.69	1.073	2.91	1.422	3.12	1.829	3.32	2.306	3.52	3.497	3.90	4.982	4.27	6.826	4.62	9.042	4.95	1.50
1.60	0.078	1.55	0.125	1.75	0.231	2.03	0.374	2.29	0.565	2.54	0.811	2.78	1.108	3.00	1.468	3.22	1.888	3.43	2.381	3.64	3.611	4.03	5.145	4.41	7.047	4.77	9.337	5.11	1.60
1.70	0.080	1.60	0.128	1.80	0.238	2.09	0.385	2.36	0.582	2.62	0.835	2.86	1.141	3.10	1.514	3.32	1.946	3.54	2.464	3.75	3.721	4.16	5.301	4.54	7.267	4.91	9.625	5.27	1.70
1.80	0.083	1.64	0.132	1.86	0.245	2.15	0.396	2.43	0.599	2.69	0.860	2.94	1.175	3.19	1.558	3.42	2.004	3.64	2.526	3.831	4.28	5.456	4.67	7.478	5.06	9.905	5.42	1.80	
1.90	0.085	1.69	0.136	1.91	0.251	2.21	0.407	2.50	0.616	2.77	0.883	3.03	1.206	3.27	1.600	3.51	2.058	3.74	2.594	3.96	3.933	4.39	5.604	4.80	7.679	5.19	10.170	5.57	1.90
2.00	0.087	1.73	0.139	1.96	0.256	2.27	0.418	2.56	0.631	2.84	0.906	3.10	1.238	3.36	1.642	3.60	2.112	3.84	2.662	4.07	4.036	4.51	5.751	4.93	7.880	5.33	10.436	5.72	2.00
2.20	0.091	1.82	0.146	2.05	0.270	2.38	0.437	2.69	0.659	2.98	0.947	3.26	1.294	3.52	1.716	3.78	2.207	4.03	2.768	4.27									2.20
2.40	0.095	1.90	0.152	2.14	0.281	2.49	0.455	2.81	0.688	3.11	0.988	3.40	1.350	3.68	1.790	3.95	2.302	4.20	2.913	4.46									2.40
2.60	0.099	1.97	0.158	2.23	0.283	2.59	0.474	2.92	0.716	3.24	1.028	3.54	1.405	3.83	1.863	4.11	2.397	4.38											2.60
2.80	0.103	2.05	0.164	2.31	0.304	2.68	0.492	3.03	0.745	3.36	1.069	3.67	1.461	3.97	1.937	4.26	2.482	4.54											2.80
3.00	0.107	2.12	0.171	2.39	0.316	2.78	0.511	3.14	0.773	3.48	1.110	3.90	1.519	4.11	2.011	4.41													3.00
3.50	0.115	2.29	0.184	2.56	0.341	3.00	0.552	3.40	0.835	3.75	1.199	4.10	1.638	4.44															3.50
4.00	0.123	2.45	0.197	2.77	0.365	3.21	0.581	3.62	0.893	4.02	1.281	4.38																	4.00

$$Q = V \times A \text{ (m}^3\text{/sec)}$$

$$V = 1.0 / n \times R^{2/3} \times S^{1/2} \text{ (m/sec)}$$

$$\text{Manning Formula (Metric Units) } n = 0.013$$



Date: June 2005

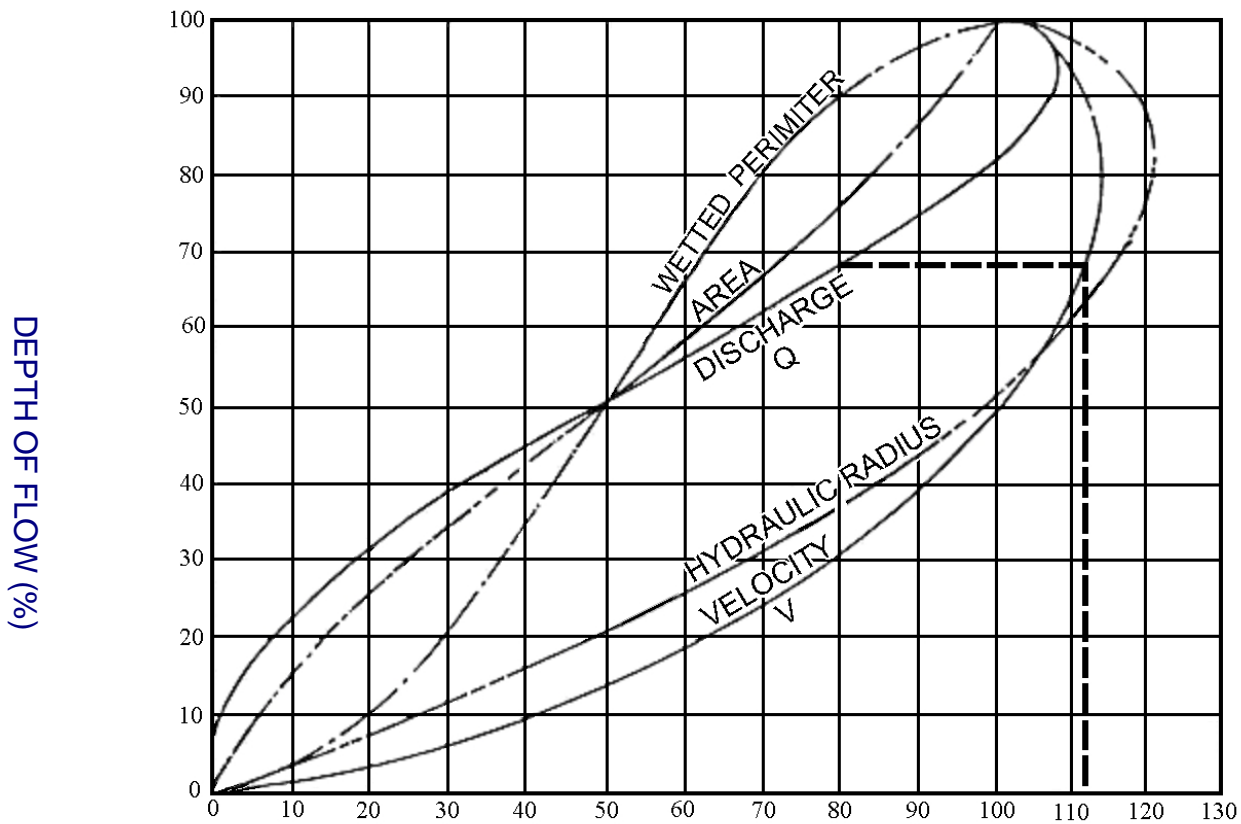
Rev: 1

Approved:

**DISCHARGE AND VELOCITY**  
(FOR CIRCULAR PIPE n=0.013)

**STD. DWG. 2-5-4**  
**2-9-4**





**HYDRAULIC ELEMENTS**  
Percent of Value for Full Pipe (Approx.)

**EXAMPLE :**

**GIVEN:** Discharge = 0.341 m<sup>3</sup>/sec through a pipe which has capacity flowing full of 0.426 m<sup>3</sup>/sec at velocity of 2.13m/sec

**FIND:** V for Q = 0.341 m<sup>3</sup>/sec  
 Since percentage of full discharge = 0.341/0.426 = 80%, enter chart at 80% of value for full section of hydraulic elements  
 Find V = 112.5% x 2.13m/sec = 2.4m/sec



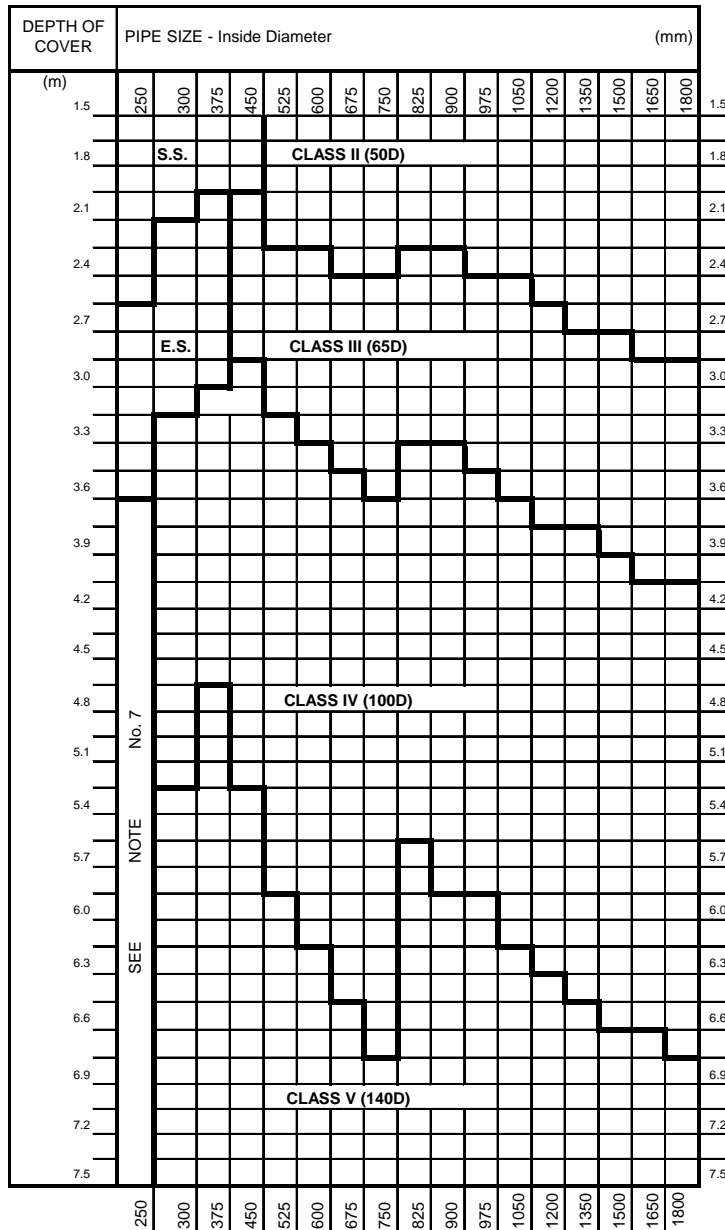
Date: June 2005

Rev: 1

Approved:

**VALUES OF HYDRAULIC ELEMENTS OF CIRCULAR SECTION FOR VARIOUS DEPTHS OF FLOW**

**STD. DWG. 2-5-5**  
**2-9-5**



## NOTES

### 1. DESIGN CRITERIA

- The table is based on a backfill weight of 2242 kg/m and a KU value of 0.130
- Safety factors:  
ASTM C14(250 – 450) – 1.50,  
ASTM C76(525 – 1800) – 1.0
- Bedding factors:  
Class "B" = 1.9  
Class "A" = 2.8  
Class "AA" = 4.5

### 2. MAXIMUM TRENCH WIDTH AT TOP OF PIPE:

- 250 - 300 = O.D. + 450mm
- 375 – 750 = O.D. + 600mm
- 825 – 1800 = O.D. + 750mm

### 3. TYPE "B" BEDDING UNLESS OTHERWISE NOTED.

### 4. PIPE MANUFACTURED TO CURRENT C.S.A STANDARD SPECIFICATION.

### 5. SPECIAL DESIGNS ARE REQUIRED BEYOND THE DEPTH LIMIT OF THE CHART AND WHEN TRENCH WIDTH AT TOP OF PIPE EXCEEDS THAT SPECIFIED BY NOTE 2.

### 6. AT DEPTHS > 3.7m, USE EITHER 250mm E.S. WITH "A" OR "AA" BEDDING, OR INVESTIGATE ASBESTOS CEMENT OR VIT. CLAY PIPE WITH "B" BEDDING

### 7. CLASS 5 (140D) ADEQUATE TO 12m DEPTH (DEPENDING ON EXISTING SOIL CONDITIONS)

 **Region of Peel**  
*Working for you*

Date: June 2005

Rev: 1

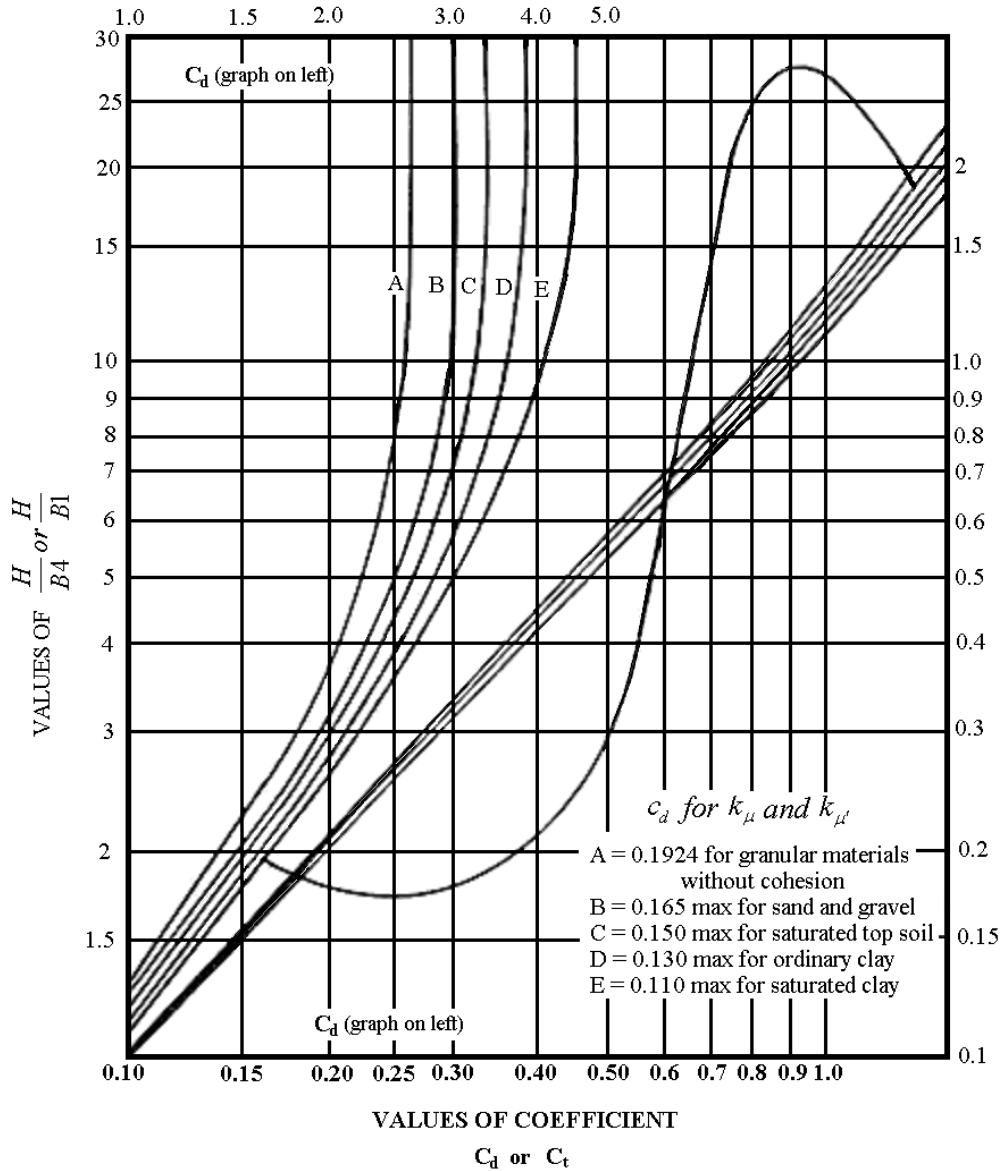
Approved:

**PIPE CLASS  
REQUIREMENTS**

**STD. DWG. 2-5-6**

**2-9-6**

# For Concrete Pipe



**Region of Peel**  
Working for you

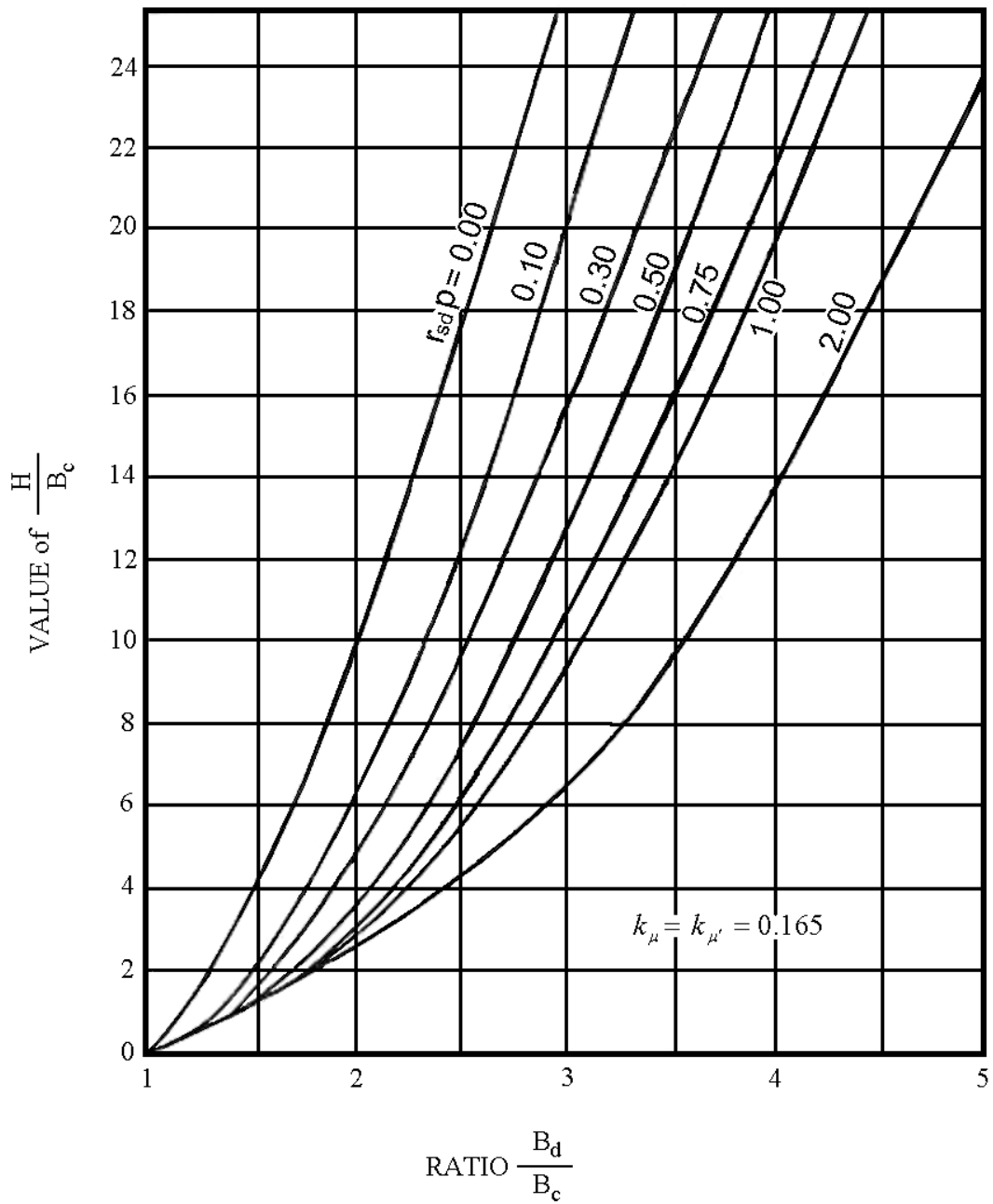
Date: June 2005

Rev: 1

Approved:

**COMPUTATION DIAGRAM  
FOR SOIL LOADS ON TRENCH INSTALLATIONS  
(PIPE COMPLETELY BURIED IN TRENCHES)**

**STD. DWG. 2-5-8  
2-9-8**



**Region of Peel**  
Working for you

Date: June 2005 | Rev: 1

Approved:

**VALUES OF  $B_d / B_c$**   
AT WHICH PIPE IN TRENCH AND PROJECTING PIPE  
LOAD FORMULAE GIVE EQUAL LOADS

**STD. DWG. 2-5-9**  
**2-9-9**

