HALDIMAND COUNTY

DESIGN CRITERIA

SECTION K

WASTEWATER COLLECTION SYSTEM

Reviewed/Revised August 2018

K 1.00 GENERAL

All sanitary sewer and appurtenances are to be designed and constructed in accordance with current Ministry of the Environment and Climate Change (MOECC) Guidelines for the Design of Sewage Works and Ontario Provincial Standards Drawings and Specifications.

Design computations for sanitary sewer systems must be completed on a standard calculation sheet in the format recommended by MOECC guidelines (attached at the end of this section).

Sanitary sewers are not permitted to accept foundation or weeping tile, sump pumps or roof drainage.

All sewers shall be designed for an embankment condition.

In cases of new subdivisions, the consulting Engineer is required to establish the geodetic invert elevations and ties of all sanitary sewer connections at street line and to make this information available on the as-built plans to Haldimand County.

K 2.00 DESIGN FLOW

K 2.01 AVERAGE DRY WEATHER FLOW

Type of Development	Equivalent Population Density (persons/hectare)	Unit Sewage Flow	
		m^3/capita/day	m^3/s/person
Residential			
Single Family	55	0.410	4.7×10^{-6}
Semi-detached, duplex & 4-plex	100	0.275	3.2×10^{-6}
Townhouse, maisonette, 6 story apartment or less	135	0.275	3.2×10^{-6}
Apartments (over 6 stories high)	285	0.275	3.2×10^{-6}

Industrial / Commercial / Institutional (ICI)			
Schools a) Boarding schools b) Day schools with cafeterias c) Day schools without cafeterias		0.3 0.08 0.06	3.5×10^{-6} 0.9×10^{-6} 0.7×10^{-6}
		m^3/day/ha	**m^3/s/ha**
Light Commercial Areas	90	40.5	4.688×10^{-4}
Community Services	40	18.0	2.083×10^{-4}
Light Industrial Areas	125	56.25	6.510×10^{-4}
Hospitals	4 persons/bed	1.8m^3/day/bed	2.080×10^{-5} m^3/s/bed

These population densities are guidelines only. Individual studies shall be made for special commercial establishments, major commercial areas and special industrial and major industrial areas.

For recommended maximum dwelling unit densities see K 11.0 (b).
The design of sanitary sewers should be based on the ultimate sewage flows.

K 2.02 PEAK SANITARY FLOW FACTOR

The peak sanitary flow will be derived by applying the ratio established by the Harmon formula to the average sanitary flow for residential and community services area as follows: Refer to peaking factor table at the end of this section.

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

$$2 \leq M \leq 5$$

Where M = ratio of peak flow to average flow
P = the tributary population in thousands

For commercial and industrial land uses, the peaking factor will be determined from a modified Harmon formula as follows:

$$Me = 0.8(1 + \frac{14}{4 + Pe^{0.5}})$$

Where Me = ratio of peak flow to average flow
Pe = equivalent tributary population in thousands

When tributary area consists of combined residential, industrial and commercial land uses, the peaking factor shall be calculated using the modified Harmon formula where Kav shall be determined as follows:

$$Mav = Kav(1 + \frac{14}{4 + (P + Pe)^{0.5}})$$

Where $Kav = AR + 0.8(AL + AC)$

AR = residential area
AL = industrial area
AC = commercial area

K 2.03 INFILTRATION ALLOWANCE

Except under unusual circumstances, infiltration allowance shall be determined at 2.3 x 10^{-4} $m^3/s/ha$ (19.872$m^3/day/ha$) for all land use types.

K 2.04 DESIGN FLOW

Design Flow **=** Av. Dry Weather Flow **x** Av. Peak Sanitary Flow Factor **+** Infiltration Allowance.

K 3.00 PIPE SIZE

To determine the pipe size and its capacity, Manning's Formula shall be used. Manning's Formula is expressed as:

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

Where Q = design flow (m^3/sec)
n = Manning Roughness coefficient factor (dimensionless)
R = hydraulic radius (m)
S = slope (m/m)
A = section area of flow (m^2)

For all smooth walled pipe, the coefficient of roughness shall be 0.013.

For Residential Areas, minimum diameter shall be 200 mm. The minimum grade on a 200 mm sanitary sewer is 0.40% if minimum 13 units are connected. Where there are only a few dwelling units connected to the upper section of a 200 mm sanitary sewer, the minimum grades shall be adjusted as follows:

1 to 5 units	0.65%
6 to 8 units	0.55%
9 to 12 units	0.45%

If the minimum flowing full velocity cannot be achieved on the uppermost run of sewer in a system using a 200mm pipe, then 150mm pipe at a minimum slope of 1% may be permitted.

For Commercial and Industrial Areas, minimum diameter shall be 300 mm at minimum grade of 0.25%.

K 4.00 FLOW VELOCITIES

The flow velocity may be determined from standard tables at the back of this section, or by V = Q/A

Where Q = design flow (m^3/sec)
A = cross-sectional area of flow (m^2)

The maximum velocity shall not be greater than 3m/sec with the pipe flowing full and the minimum velocity shall not be less than 0.60 m/sec. The actual velocity for a 200mm pipe (or greater) shall not be less than 0.5m/s.

K 5.00 SEWER PIPE

K 5.01 MATERIALS

Sanitary sewers shall be constructed of rigid or flexible pipe meeting OPSS and AWWA standards. The type and classification of all sanitary sewer pipe and the sewer bedding type shall be clearly indicated on all profile drawings for each sewer length.

K 5.02 PIPE BEDDING

The class of pipe and the type of bedding shall be selected to suit loading and proposed construction conditions. All pipes are to be designed assuming an embankment condition. Details of the types of bedding are to be as illustrated in the Ontario Provincial Standard Drawings. In general, Granular A compacted to 95% Proctor Density to

Springline with a minimum 300mm sand cover above the crown shall be used for sewers in new developments.

K 6.00 PIPE DEPTH

The top of the sewer pipe shall be a minimum of 2.75 m below the centerline of the road.

K 7.00 PIPE LOCATION

The sewer line shall be located in accordance with typical road section drawing (attached at the end of Section G). All trenches crossing the travelled portion of the roadway shall be backfilled as according to Section G – Roadways; Subsection G10.04.

K 8.00 TYPE OF PIPE AND JOINT ACCEPTABLE FOR SANITARY SEWER MAINS

K 8.01 CONCRETE PIPE

For Residential and Commercial areas, concrete pipe may be used for pipe sizes greater than or equal to 300mm diameter.

All concrete pipe and fittings shall conform in all respects to the requirements of the current standards of the American Society of Testing and Materials (ASTM) as follows:

a) Class 2 and Class 3 Non-Reinforced Concrete Pipe, CSA A257.1.
b) Reinforced Concrete Pipe, Classes 50-D to 140-D inclusive, CSA A257.2.

Gaskets for concrete pipe shall meet the requirements of current ASTM Designation C443.

Maximum allowable Joint Deflection is 66% of manufacturer's recommendations.

K 8.02 POLYVINYL CHLORIDE (P.V.C.) PIPE

P.V.C. pipe may be used, provided the requirements of OPSS, CSA and A.S.T.M. designation D-3034-77 are met for sizes up to and including 375mm diameter and A.S.T.M. designation F-679 for sizes 450mm to 675mm diameter.

For residential areas, P.V.C. pipe from 200mm to 675mm diameter may be used.

For commercial and industrial areas, P.V.C. pipe from 300mm to 675mm diameter may be used.

All joints using flexible Electrometric seals shall conform to current requirements of A.S.T.M. designation D-3212.

Maximum allowable Joint Deflection is 66% of manufacturer's recommendations.

K 9.00 CURVED SEWERS

Generally, curved sanitary sewers should be avoided. In case where suitability and efficiency of design suggest doing so, County will determine approval condition on a site-specific basis.

K 9.01 REINFORCED CONCRETE PIPE

Radius pipe (also referred to as beveled or mitered pipe) may be used for short radius bends. The pipe shall meet the requirements of CSA 257.2 or A.S.T.M C-76 for reinforced concrete radius pipe for sizes 525mm - 3050mm diameter.

NOTE: for flat curves (long radius), straight pipe with joint deflections is permissible. Maximum joint deflection shall be 13mm to conform to CSA 257.3 or A.S.T.M C-443.

K 9.02 P.V.C. PIPE

The allowable minimum curve radius recommended by the manufacturer shall not be exceeded. Deflection in the joint is not allowed.

Saddle type connections are not permitted. Tee connections are permitted, but the designer must take into consideration the tangent lengths of the tee connections when calculating the minimum achievable radius.

K 10.00 MANHOLE TYPES

Manholes may be constructed of pre-cast or poured concrete. O.P.S.D. details shall be used for manhole design where applicable. Although these Standard Drawings provide details for manholes up to certain maximum depths and sizes, the consulting Engineer shall analyse, individually, each application of the standards relative to soil conditions, loading and other pertinent factors to determine structural suitability. In all cases where the Standard Drawings are not applicable, the manholes shall be individually designed and detailed. Working drawings must be provided for poured-in-place structures.

A reference shall be made on all profile drawings to the type and size of all manholes. In the case of the standard 1,200mm pre-cast manhole, the size of the manhole may be omitted and reference need only be made to the standard O.P.S.D. number and complementing component numbers (OPSD 701.030, 701.031 & 701.032).

The corresponding O.P.S.D. reference number(s) can be included on the drawings for pre-cast manholes that are greater in diameter than the standard 1,200mm.

Pre-cast manholes shall conform to A.S.T.M. Specification C-478M latest revision.

K 10.01 MANHOLE DESIGN

(a) All manhole chamber openings shall be located on the side of the manhole parallel to the flow for straight run manholes, or on the upstream side of the manhole at all junctions.

(b) The direction of flow through any manhole shall not be permitted at acute interior angles.

(c) Safety gratings are required at the mid-point depth of manhole, when the depth is between 5.0 and 10.0m. Additional safety grates are required at third-point depths, when the manhole is equal to or greater than 10.0m to 15.0m deep. All in-coming pipes are to be below safety gratings, where possible.

(d) The obvert of the inlet pipe(s) shall not be lower than the obvert of the outlet pipe.

The minimum drop across manholes shall be as follows:

Change of Direction	Minimum Drop (mm)
0 degree to 15 degrees	15
16 degree to 45 degrees	30
46 degrees to 90 degrees	60

(e) Where the difference in elevation between the obvert of the inlet and outlet pipes exceeds 0.6m, a drop structure shall be placed on the inlet pipe, with the invert of the drop pipe located at the spring line of the outlet pipe. Design shall be in conformity with OPSD's.

(f) All sewer manholes shall be benched to the obvert of the outlet pipe on a vertical projection from the spring line of the sewer.

(g) The minimum width of benching in all manholes shall be 230mm.

(h) Manholes in boulevards shall be located, wherever possible, a minimum of 1.5m from the face of curb or other utilities or street furniture.

The maximum spacing between manholes shall be as follows:

Pipe Size	Maximum Manhole Spacing
200-300mm	95 metres
375mm to 750mm	100 metres
825mm to 1200mm	125 metres
1200mm and over	150 metres

(i) Manholes are required at all mainline pipe junctions, and at any changes in grade or alignment.

K 10.02 GRADES FOR MANHOLE FRAME AND COVERS

All manholes located within the travelled portion of roadway shall have the rim elevation set flush with the surface of the base course asphalt. The adjustment of the frame and cover shall be completed in accordance with the details provided in the Ontario Provincial Standard Drawings.
After final application of surface asphalt the manhole frame and grates shall be adjusted to surface elevation through a poured in place concrete ring. The concrete ring shall be constructed through coring through the full depth of the asphalt. The frame and grate shall be set to match the elevation and cross fall of the final asphalt grade. A sonotube form shall be installed as to match the manhole chimney opening. The concrete shall be placed neat to the edge of the asphalt core and shall be trowelled as to match the existing lines and grade of the asphalt surface. The surface of the concrete shall receive a brushed finish.

Alternatively a Mueller model "the Adjustable" or equivalent manhole frame and cover may be used. Installation of the manhole frame and grate shall be as per the manufacturers instructions. Units shall consist of three components, a cover, frame and guide.

Watertight manhole lids are required when sanitary maintenance holes are located within overland storm routes and/or under sanitary surcharge condition.

K 11.00 CONNECTIONS FROM SEWER TO STREET LINE

Only one (1) sanitary sewer connection per property shall be permitted, unless authorized by Haldimand County General Manager of Public Works.

Where an existing sanitary sewer main is to remain in place the connection of a sanitary service lateral may be made at an existing manhole, or directly to the sanitary sewer main if the size of the connection is less than or equal to half of the size of the sanitary sewer main.

If the sanitary service lateral connection size is greater than one half the size of the sanitary sewer main, the connection **must** be made to a manhole, existing or new. A direct connection to the sanitary sewer main may be accepted with the use of an approved manufactured tee. All connections to existing pipes or manholes shall be completed through coring the pipe or manhole. No intrusions shall be left in the pipe.

Where the sanitary service lateral is to tie into an existing wastewater collection system manhole, an exterior drop structure configuration is to be constructed. Reference OPSD 1003.020 – Cast-In-Place maintenance Hole Drop Structure Wye.

Where a new sanitary main is being constructed all connections shall be made by installation of manufactured tees at all service locations.

In all cases, the invert of the lateral pipe must be above the spring line of the main pipe.

P.V.C Pipe must be used for service connections. For P.V.C. service connections, minimum SDR28 shall be used.

If necessary, concrete encased risers shall be provided for connection with the main sewer.

Connection Requirements:

Development	**Minimum Sewer Lateral Size (mm)**	**Desirable Lateral Slope (%)**	**Minimum Lateral Slope (%)**	**Minimum Cover at Property Line (m)**
Residential • Single family • Semi-detatched	100	2.0	1.0	2.15

Multi-Residential	150	See subsection a) Multi-Residential below		2.15
Industrial Commercial Institutional	150	2.0	1.5	2.15

For all sanitary service laterals greater than thirty (30) meters in length, an approved property line cleanout is required and shall be shown on all design drawings.

Industrial, commercial and institutional developments require a property line monitoring manhole on the sewer lateral service as per the County's Sewer Use Bylaw.

Joints and bedding shall be equivalent to the joints and bedding specified for sewer pipe.

Until the sanitary sewer lateral pipe from the property line to the building has been installed, the location of the end of all lateral connections from the sanitary sewer main to the property line shall be marked by a 50mm x 100mm wooden stake, 2 meters long, projecting one meter above the ground with the top 300mm painted with fluorescent green colour conforming to Canadian General Standards Board (C.G.S.B.) 603-401.

(a) **Multi-Residential:** In multiple family blocks in residential areas, the connection shall meet the following requirements:

Diameter of Drain (mm)	**Slope of Drain**	
	2.0%	**4.0%**
(Max. No. of Fixture Units per conn.)		
150	840	1000
200	1920	2300
250	3500	4200
300	5600	6700
375	10000	12000

Maximum Dwelling Units Densities	
4-plex	25 units/hectare
Townhouse	37 units/hectare
Maisonette	45 units/hectare
Apartments	124 units/hectare

Loading – 20 fixtures units/dwelling unit

<u>To Use the Chart</u>

i) Determine dwelling density and total area of block

ii) Calculate total number of fixture units from:
Area x Dwelling units/hectare x 20

iii) Select connection size and grade from chart.

iv) The minimum requirement shall be 150mm diameter at 1.5% grade.

K 11.01 PRIVATE SIDE SEWER LATERALS

The following requirements apply to all private side laterals connecting a building drain to a municipal sanitary sewer in Haldimand County.

MATERIALS
When these materials are used they must be installed as per the OBC and this Design Criteria.

a) PVC SDR 28 with Gasket Fittings conforming to CAN/CSA-B182.2 is the preferred choice of sewer lateral pipe (as a minimum)

b) PVC SDR 26 with Gasket Fittings conforming to CAN/CSA-B182.2 is acceptable as well.

As per 7.2.5.10.(2) all plastic pipe used underground shall have a stiffness equal or greater than 320 kPa.

INSTALLATION
All piping when installed for a sewer lateral must be installed as per manufacturers instructions. Manufactures requirements must be followed for foundation, bedding, haunching, initial and final backfill of piping installed for sewer laterals. Any installation that is performed in a manner that does not meet manufacturers installation requirements will be deemed for the purpose of this design criteria not to meet the Ontario Building Code.

MINIMUM TESTING REQUIREMENTS
All sewer laterals will be pressure tested as per OBC 7.3.6.4.(1)(2)(a)(b) Water Test or 7.3.6.5.(1)(a)(b) Air Test. A flow test will be conducted as well to ensure grade and to confirm there are no blockages in the lateral or lateral extension. A test "T" or "Y" fitting will be required to be installed in the sewer lateral immediately upstream of the lateral extension. After the test has passed the required test fitting shall be

capped by an approved fitting and will seen by the inspector before backfill has been completed.

INSPECTIONS

Inspections by the Haldimand County Building Department shall be conducted and will consist of two separate inspections. The first required inspection shall be to confirm there is proper bedding for the lateral, the correct pipe has been installed, the approved method of joining has been adhered to and that the pipe has the correct grade as per O.B.C requirements. The second required inspection will be to view the pressure test, flow test, an initial backfill of 300 mm of carefully placed clean fill or gravel (to ensure there are no large chunks and/or frozen earth, rocks, boulders etc. over the pipe), and to witness the permanent capping of the test fitting. It will be accepted that both inspections may be the same day and within a short period of time if required.

K 12.00 SEWAGE FORCEMAINS

K 12.01 TYPE OF PIPE AND JOINT ACCEPTABLE FOR SEWAGE FORCEMAINS

a) **Ductile Iron Cement Lined Pipe**

Ductile iron cement lined pipe with Tyton joints or equivalent may be used. The current requirement of AWWA C150 and AWWA C104 shall apply to all classes of ductile iron pipe.

b) **Poly-vinyl Chloride (P.V.C.) Pipe**

For sizes up to 600mm, P.V.C. pipe with gasketed joints may be used. The current requirements of CSA B137.3 shall apply to all classes of P.V.C. pipe.

c) **Polyethylene (P.E.) Pressure Pipe**

Polyethylene pressure pipe with joints made by thermal fusion or by mechanical means may be used. The polyethylene resin compound used in the pipe shall conform to current ASTM Designation D1248. The pipe shall be manufactured to CGSB 41-GP-25M specifications.

d) **Reinforced Concrete Pressure Pipe**

For sizes 400mm and over, reinforced concrete pressure pipe with gasketed joints may be used as indicated below:

Pre-tensioned concrete cylinder pipe conforming to AWWA C-303.

Pre-stressed concrete lined cylinder pipe conforming to AWWA C-301.

K 12.02 PIPE SIZE

The forcemain shall be sized to have flow velocity in the range of 0.8 to 2.5 m/s with the lower limit being preferred for the initial phase. However, the minimum size shall not be less than 100mm.

K 12.03 PIPE DEPTH

The top of the forcemain shall have a minimum of 1.7m cover. On open ditch or unimproved road, increased cover shall be provided to allow for future road improvement or lowering when urbanization takes place.

K 12.04 SYSTEM DESIGN

a) Haldimand County's preference is to avoid thrust blocks if possible, giving preference to appropriate mechanical restraint. All forcemains and thrust blocks shall be designed to withstand the maximum operating pressure plus the transient pressure to which they will be subjected.

b) All forcemains shall be equipped with a suitably valved connection to permit connection of a portable pump should pumping stations need to be by-passed during emergencies or major modifications.

c) Air release valves suitable for use with sewage shall be positioned at all forcemain high points. The valves shall be of low-pressure double acting type.

d) All plugs, tees, and bends will have approved thrust blocks (at Haldimand County discretion) or suitable alternatives i.e. non-corrosive clamps and bell bolt joints, restraining type glands rings.

e) The bedding requirements for the forcemains will depend upon the type and class of pipe used. As a minimum requirement, forcemain pipe shall be laid on 150mm of selected native material bedding. However, each installation shall be reviewed on a site specific basis.

f) The type of backfill material will usually be determined from the location of mains within the R.O.W. Under road pavement, granular backfill will be provided.

K 12.05 PRIVATE FORCEMAINS

It is the preference of the County that all structures be connected to the County's sanitary sewer system by means of gravity connections.

There are situations where gravity access to existing County sanitary sewers is not feasible. Where these instances arise, an application must be made to the Water and Wastewater Operations Division requesting the installation of a private sanitary forcemain. Each application will be reviewed on a site-specific basis. A permit for the installation of a private forcemain will only be allowed with the written approval of the Manager of Water and Wastewater Operations.

SANITARY SEWERS -PREFERRED DESIGN RANGE

		Concrete Pipe	P.V.C. Pipe	Truss Pipe	Polyethylene (P.E.) Pipe	Ductile Iron Pipe
RESIDENTIAL MAINS	**Dia.**	>300mm	200mm to 675mm	200 to 375mm		
	Joint	Bell & Spigot	Gasket joint	Solvent Weld		
COMMERCIAL MAINS	**Dia.**	>300mm	300-675	Not Allowed		
	Joint	Bell & Spigot	Gasket joint	Not Allowed		
INDUSTRIAL MAINS	**Dia.**	>600mm	375-675	Not Allowed		
	Joint	Bell & Spigot	Gasket joint	Not Allowed		
SERVICE LATERALS	**Dia.**	Not Allowed	>100mm Res. Only >150mm I/C/I	Not Allowed		
	Joint	Not Allowed	Gasket joint	Not Allowed		
FORCEMAINS	**Dia.**	>400mm pressured	<600mm	Not Allowed	<600mm	
	Joint	Bell & Spigot with gasket	Plas-tyton gasket joint	Not Allowed	Butt fusion	

LIST OF APPROVED MANUFACTURERS AND PRODUCTS FOR WASTEWATER SYSTEMS

PRODUCT	MANUFACTURER	APPROVED DATE	DESC-MAKE-MODEL
FITTINGS CONCRETE	Centennial		Reinforced and non
	Con-Cast		Reinforced and non
	Hanson	06/09/1998	Reinforced and non
	Munro Concrete Fittings	09/15/1999	300mm to 1800mm wastewater and storm
FITTINGS PVC	Rehau Industries Inc.		
	Royal Flex-lox Pipe	06/13/1990	
	IPEX		
	Le Ron Plastics	06/12/1996	Gasketed and ribbed fittings
	Plastic Trend	08/14/1996	Plastic Trend Sewer Fittings 150 and 200mm
	Preper	08/18/1997	Rubber Coupling for Sewer Pipe
	Mission	09/15/1999	Rubber Adjustable Sewer Repair Couplings
FITTINGS VC	Logan Vitrified Clay		
FITTINGS POLYETHELYNE	KWH Pipe Canada Ltd.		
	Ken Taylor Ind.	06/09/1998	Polyethylene Adjustment Shims
CASTINGS	Domestic Foundry Ltd.	04/17/1991	Municipal Castings All Models except #DF307
MH ADJUSTERS	Brooklin Concrete	11/04/1992	Multi-Loc adj ring
	Centennial		Bricking & Precast
	Turner Co.	11/04/1992	Rubber MH riser ring
	W.E. Wilkinson Ltd.		Bricking & Precast
	Domal Envirotech		Rubber Riser Rings
	Hanson	06/09/1998	Precast
	IPEX	11/02/2000	Lifesaver Manhole Adjustment Ring 24" and 27" dia.
MH FRAME AND COVER	Bibby Foundry		
	Mueller	06/11/2013	The Adjustable
	McCoy Foundry	04/12/1995	OPSD 401.01

PRODUCT	MANUFACTURER	APPROVED DATE	DESC-MAKE-MODEL
MH SAFETY STEPS	MSU Mississauga Ltd.		
	Centennial	10/26/2000	
	W.E. Wilkinson Ltd.		
	M.A. Industries	09/15/1999	PE Manhole Steps
MH SAFETY GRATES	Centennial		
	MSU Mississauga Ltd.		
MH PRECAST SECTIONS	W.E. Wilkinson Ltd.		
	Centennial		
	Con-Cast		
	Monroe Concrete		
	Hanson	06/09/1998	
MH APPURTENANCES	Aqua Spec Ltd.	01/03/2000	Inside drop MH system for retrofit or special applications Modular MH invert flume
CB PRECAST SECTIONS	Centennial		
	W.E. Wilkinson Ltd.		
	Con-Cast		
	Monroe Concrete		
	Hanson	06/09/1998	
CB FRAME & GRATE	Bibby Foundry		
	McCoy Foundry Co.		
PIPE CONCRETE	Centennial		Reinforced & non
	Hanson	06/03/1998	Reinforced & non
	Con-Cast		Reinforced & non
	Munro Concrete Pipe	09/15/1999	300-1800mm Wastewater and storm
	Price Brothers	11/02/2000	Prestressed Concrete Pressure Pipe Sizes 400mm to 1200mm
PIPE POLYETHYLENE	Philips	12/15/1993	Poly-tite 200 to 600mm Series 1000 & 8600
	KWH Pipe Canada Ltd.		Forcemain Pipe
	Big “O”	04/12/1995	Gasketed sewer pipe 100 to 600mm
	Soleno	06/03/1998	Storm Sewer Pipe up to 900mm

PRODUCT	MANUFACTURER	APPROVED DATE	DESC-MAKE-MODEL
PIPE VC SADDLES	Logan Vitrified Clay		
	Clow Canada Ltd.		D-50 125mm & 150mm
	Crowle Fittings		Cast Iron Saddles
	Mission	09/15/1999	Rubber Flexible Saddles
SEALENTS	Presfab Inc.		Ring-O-Pave Safe Match
	Rehau Industries Inc.		Bond-Loc-joint
	Centennial	12/12/1990	Kor-N-Seal
COUPLINGS	Mission	08/31/2000	Rubber adjustable sewer repair couplings
	Fernco	1980	

PEAKING FACTORS FOR SANITARY SEWERS

POPULATION	M	POP.	M	POP.	M	POP.	M	POP.	M	POP.	M
25	4.37	475	3.99	925	3.82	2600	3.50	6200	3.16	9800	2.96
50	4.31	500	3.97	950	3.81	2800	3.47	6400	3.14	10000	2.95
75	4.28	525	3.96	975	3.81	3000	3.44	6600	3.13	10200	2.95
100	4.24	550	3.95	1000	3.80	3200	3.42	6800	3.12	10400	2.94
125	4.22	575	3.94	1050	3.79	3400	3.40	7000	3.11	10600	2.93
150	4.19	600	3.93	1100	3.77	3600	3.37	7200	3.09	10800	2.92
175	4.17	625	3.92	1150	3.76	3800	3.35	7400	3.08	11000	2.91
200	4.15	650	3.91	1200	3.75	4000	3.33	7600	3.07	11200	2.91
225	4.13	675	3.90	1300	3.72	4200	3.31	7800	3.06	11400	2.90
250	4.11	700	3.89	1400	3.70	4400	3.30	8000	3.05	11600	2.89
275	4.09	725	3.89	1500	3.68	4600	3.28	8200	3.04	11800	2.88
300	4.08	750	3.88	1600	3.66	4800	3.26	8400	3.03	12000	2.88
325	4.06	775	3.87	1700	3.64	5000	3.25	8600	3.02	12200	2.87
350	4.05	800	3.86	1800	3.62	5200	3.23	8800	3.01	12400	2.86
375	4.04	825	3.85	1900	3.60	5400	3.21	9000	3.00	12600	2.85
400	4.02	850	3.84	2000	3.59	5600	3.20	9200	2.99	12800	2.85
425	4.01	875	3.84	2200	3.55	5800	3.18	9400	2.98	13000	2.84
450	4.00	900	3.83	2400	3.52	6000	3.17	9600	2.97		

HARMON FORMULA $M = 1 + (14 / 4+P^{0.5})$; $2 \leq M \leq 5$

M = Ratio of the peak rate of flow to the average rate of flow.

P = Tributary population in thousand

FOR PIPE FLOWING FULL

GRADE %	150mm		200mm		250mm		300mm		375mm	
	V	Q	V	Q	V	Q	V	Q	V	Q
6.00	2.134	.039	2.585	.084	2.999	.152	3.387	.247	3.930	.448
5.00	1.948	.036	2.359	.077	2.738	.139	3.092	.226	3.587	.409
4.00	1.742	.032	2.100	.068	2.449	.124	2.765	.202	3.209	.366
3.50	1.630	.030	1.974	.064	2.291	.116	2.587	.189	3.002	.342
3.00	1.509	.028	1.828	.059	2.121	.108	2.395	.175	2.779	.317
2.50	1.377	.025	1.668	.054	1.936	.098	2.186	.160	2.537	.289
2.00	1.232	.023	1.492	.048	1.732	.088	1.955	.143	2.269	.259
1.80	1.169	.021	1.416	.046	1.643	.083	1.855	.136	2.153	.246
1.60	1.102	.020	1.335	.043	1.549	.079	1.749	.128	2.029	.231
1.50	1.067	.020	1.292	.042	1.500	.076	1.693	.124	1.965	.224
1.40	1.031	.019	1.248	.041	1.449	.073	1.636	.119	1.898	.216
1.30	.993	.018	1.203	.039	1.396	.071	1.579	.115	1.829	.209
1.20	.954	.017	1.156	.038	1.341	.068	1.515	.111	1.758	.200
1.10	.914	.017	1.107	.036	1.284	.065	1.450	.106	1.683	.192
1.00	.871	.016	1.056	.034	1.224	.062	1.383	.101	1.604	.183
0.98	.862	.016	1.045	.034	1.212	.061	1.369	.100	1.588	.181
0.96	.853	.016	1.034	.034	1.200	.061	1.355	.099	1.572	.179
0.94	.844	.015	1.023	.033	1.187	.060	1.341	.098	1.554	.177
0.92	.835	.015	1.012	.033	1.174	.060	1.326	.097	1.539	.176
0.90	.826	.015	1.001	.033	1.162	.059	1.312	.096	1.522	.174
0.88	.817	.015	0.990	.032	1.149	.058	1.297	.095	1.505	.172
0.86	.808	.015	.979	.032	1.135	.058	1.282	.094	1.488	.170
0.84	.798	.015	.967	.031	1.122	.057	1.267	.093	1.470	.168
0.82	.798	.014	.623	.031	1.09	.56	1.252	.091	1.453	.166

Diameters shown in table are nominal. Q & V are base on imperial I.D.s

$1 m^3/s$ = 1000 liters per second

V = Meter per second

Q = $Meter^3$ per second

n = 0.013

HALDIMAND COUNTY
Velocity & Discharge For 150mm to 375mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	150mm		200mm		250mm		300mm		375mm	
	V	Q	V	Q	V	Q	V	Q	V	Q
0.80	0.779	.014	0.944	.031	1.095	.056	1.237	.090	1.435	.164
0.78	0.769	.014	0.932	.030	1.081	.055	1.221	.089	1.417	.162
0.76	0.759	.014	0.920	.030	1.067	.054	1.205	.088	1.399	.160
0.74	0.749	.014	0.908	.030	1.053	.053	1.189	.087	1.380	.157
0.72	0.739	.014	0.895	.029	1.039	.053	1.173	.086	1.361	.155
0.70	0.729	.013	0.883	.029	1.024	.052	1.157	.084	1.342	.153
0.68	0.718	.013	0.870	.028	1.010	.051	1.140	.083	1.323	.151
0.66	0.706	.013	0.857	.028	0.995	.050	1.123	.082	1.303	.149
0.64	0.697	.013	0.844	.027	0.980	.050	1.106	.081	1.284	.146
0.62	0.686	.013	0.831	.027	0.964	.049	1.089	.080	1.263	.144
0.60	0.675	.012	0.817	.027	0.948	.048	1.071	.078	1.243	.142
0.58	0.663	.012	0.804	.026	0.932	.047	1.053	.077	1.222	.139
0.56	0.652	.012	0.790	.026	0.916	.046	1.035	.076	1.201	.137
0.54	0.640	.012	0.775	.025	0.900	.046	1.016	.074	1.179	.134
0.52	0.628	.012	0.761	.025	0.883	.045	0.997	.073	1.157	.132
0.50	0.616	.011	0.746	.024	0.866	.044	0.978	.071	1.135	.129
0.48	0.603	.011	0.731	.024	0.848	.043	0.958	.070	1.112	.127
0.46	0.591	.011	0.716	.023	0.830	.042	0.938	.068	1.088	.124
0.44	0.578	.011	0.700	.023	0.812	.041	0.917	.067	1.064	.121
0.42	0.565	.010	0.684	.022	0.794	.040	0.896	.055	1.040	.119
0.40	0.551	.010	0.667	.022	0.774	0.39	0.874	.064	1.015	.116
0.35	0.515	.009	0.624	.020	0.724	.037	0.818	.060	0.949	.108
0.30	0.477	.009	0.578	.019	0.671	.034	0.757	.055	0.879	.100
0.25	0.436	.008	0.528	.017	0.612	.031	0.691	.050	0.802	.091
0.20	0.390	.007	0.472	.015	0.548	.028	0.618	.045	0.718	.082

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

1m³/s = 1000 liters per second

V = Meter per second

Q = Meter³ per second

n = 0.013

HALDIMAND COUNTY
Velocity and Discharge for 150mm to 375mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

Grade %	450MM		525MM		600MM		675MM	
	V	Q	V	Q	V	Q	V	Q
6.00	4.438	.729	4.92	1.099	5.38	1.569	5.82	2.148
5.00	4.051	.665	4.49	1.003	4.91	1.432	5.31	1.961
4.00	3.623	.595	4.02	.897	4.39	1.281	4.75	1.754
3.50	3.389	.556	3.76	.839	4.11	1.198	4.44	1.641
3.00	3.138	.515	3.48	.777	3.80	1.109	4.11	1.519
2.50	2.865	.470	3.17	.709	3.47	1.013	3.75	1.387
2.00	2.562	.421	2.84	.635	3.10	.906	3.36	1.240
1.80	2.431	.399	2.69	.602	2.94	.859	3.19	1.177
1.60	2.292	.376	2.54	.568	2.78	.810	3.00	1.109
1.50	2.219	.364	2.46	.550	2.69	.785	2.91	1.074
1.40	2.144	.352	2.38	.531	2.60	.758	2.81	1.038
1.30	2.066	.339	2.29	.512	2.50	.730	2.71	1.000
1.20	1.985	.326	2.20	.491	2.40	.702	2.60	.961
1.10	1.900	.312	2.11	.471	2.30	.672	2.49	.920
1.00	1.812	.298	2.01	.449	2.19	.641	2.37	.877
0.98	1.794	.295	1.99	.444	2.17	.634	2.35	.868
0.96	1.775	.291	1.97	.440	2.15	.628	2.33	.859
0.94	1.757	.289	1.95	.435	2.13	.621	2.30	.850
0.92	1.738	.285	1.93	.430	2.11	.614	2.28	.841
.90	1.719	.282	1.91	.426	2.08	.608	2.25	.832
0.88	1.700	.279	1.88	.421	2.06	.601	2.23	.823
0.86	1.680	.276	1.86	.416	2.04	.594	2.20	.813
0.84	1.661	.273	1.84	.411	2.01	.587	2.18	.804
0.82	1.641	.269	1.82	.406	1.99	.580	2.15	.794

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

$1m^3/s$ = 1000 liters per second

V = Meter per second

Q = $Meter^3$ per second

n= 0.013

HALDIMAND COUNTY

Velocity and Discharge for 450mm to 675mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	450mm V	Q	525mm V	Q	600mm V	Q	675mm V	Q
0.80	1.620	.266	1.80	.401	1.96	.573	2.12	.784
0.78	1.600	.263	1.77	.396	1.94	.566	2.10	.775
0.76	1.579	.259	1.75	.391	1.91	.558	2.07	.754
0.74	1.559	.256	1.73	.386	1.89	.551	2.04	.749
0.72	1.537	.252	1.70	.381	1.86	.543	2.01	.744
0.70	1.516	.249	1.68	.375	1.84	.536	1.99	.734
0.68	1.494	.245	1.66	.370	1.81	.528	1.96	.723
0.66	1.472	.242	1.63	.364	1.78	.520	1.93	.712
0.64	1.449	.238	1.61	.359	1.76	.512	1.90	.702
0.62	1.427	.234	1.58	.353	1.73	.504	1.87	.691
0.60	1.403	.230	1.56	.348	1.70	.496	1.84	.679
0.58	1.380	.227	1.53	.342	1.67	.488	1.81	.668
0.56	1.356	.223	1.50	.336	1.64	.479	1.78	.656
0.54	1.331	.219	1.48	.330	1.61	.471	1.74	.644
0.52	1.306	.214	1.45	.324	1.58	.462	1.71	.632
0.50	1.281	.210	1.42	.317	1.55	.453	1.68	.620
0.48	1.255	.206	1.39	.311	1.52	.444	1.64	.608
0.46	1.229	.202	1.36	.304	1.49	.434	1.61	.595
0.44	1.202	.197	1.33	.298	1.46	.425	1.57	.582
0.42	1.174	.193	1.30	.291	1.42	.415	1.54	.568
0.40	1.146	.188	1.27	.284	1.39	.405	1.50	.555
0.35	1.072	.176	1.19	.265	1.30	.379	1.41	.519
0.30	0.992	.163	1.10	.246	1.20	.351	1.30	.480
0.25	0.906	.149	1.00	.224	1.10	.320	1.19	.439
0.20	0.810	.133	0.90	.201	0.98	.286	1.06	.392

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

$1m^3/s$ = 1000 liters per second

V = Meter per second

Q = $Meter^3$ per second

n = 0.013

HALDIMAND COUNTY
Velocity and Discharge for 450mm to 675mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	750MM		825MM		900MM		975MM	
	V	Q	V	Q	V	Q	V	Q
6.00	6.24	2.845	6.65	3.665	7.05	4.626	7.43	5.727
5.00	5.69	2.597	6.07	3.349	6.43	4.223	6.78	5.228
4.00	5.09	2.323	5.43	2.995	5.75	3.777	6.07	4.676
3.50	4.77	2.173	5.08	2.802	5.38	3.533	5.68	4.374
3.00	4.41	2.012	4.70	2.594	4.98	3.271	5.25	4.050
2.50	4.03	1.836	4.29	2.368	4.55	2.986	4.80	3.697
2.00	3.60	1.643	3.84	2.118	4.07	2.671	4.29	3.306
1.80	3.42	1.558	3.64	2.009	3.86	2.534	4.07	3.137
1.60	3.22	1.469	3.43	1.894	3.64	2.389	3.84	2.957
1.50	3.12	1.422	3.32	1.834	3.52	2.313	3.72	2.863
1.40	3.01	1.374	3.21	1.772	3.40	2.235	3.59	2.766
1.30	2.90	1.324	3.09	1.707	3.28	2.153	3.46	2.666
1.20	2.79	1.272	2.97	1.640	3.15	2.069	3.32	2.561
1.10	2.67	1.218	2.85	1.571	3.02	1.981	3.18	2.452
1.00	2.55	1.161	2.71	1.498	2.88	1.889	3.03	2.338
0.98	2.52	1.150	2.69	1.482	2.85	1.870	3.00	2.315
0.96	2.50	1.138	2.66	1.467	2.82	1.850	2.97	2.291
0.94	2.47	1.126	2.63	1.452	2.79	1.831	2.94	2.267
0.92	2.44	1.114	2.60	1.436	2.76	1.811	2.981	2.243
0.90	2.42	1.102	2.57	1.421	2.73	1.792	2.88	2.218
0.88	2.39	1.090	2.55	1.405	2.70	1.772	2.84	2.193
0.86	2.36	1.077	2.52	1.389	2.67	1.751	2.81	2.168
0.84	2.33	1.064	2.49	1.372	2.64	1.731	2.78	2.143
0.82	2.31	1.052	2.46	1.356	2.60	1.710	2.75	2.117

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

$1 m^3/s$ = 1000 liters per second

V = Meter per second

Q = $Meter^3$ per second

n = 0.013

HALDIMAND COUNTY
Velocity and Discharge for 750mm to 975mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	750mm		825mm		900mm		975mm	
	V	Q	V	Q	V	Q	V	Q
0.80	2.28	1.039	2.43	1.339	2.57	1.689	2.71	2.091
0.78	2.25	1.026	2.40	1.323	2.54	1.668	2.68	2.065
0.76	2.22	1.013	2.37	1.306	2.51	1.646	2.64	2.038
0.74	2.19	.999	2.33	1.288	2.47	1.625	2.61	2.011
0.72	2.16	.986	2.30	1.271	2.44	1.603	2.57	1.983
0.70	2.13	.972	2.27	1.253	2.41	1.580	2.54	1.956
0.68	2.10	.958	2.24	1.234	2.37	1.557	2.50	1.928
0.66	2.07	.944	2.20	1.217	2.34	1.534	2.46	1.899
0.64	2.04	.929	2.17	1.198	2.30	1.511	2.43	1.870
0.62	2.01	.915	2.14	1.179	2.26	1.487	2.39	1.841
0.58	1.94	.885	2.07	1.140	2.19	1.438	2.31	1.781
0.56	1.91	.869	2.03	1.121	2.15	1.413	2.27	1.750
0.54	1.87	.854	1.99	1.100	2.11	1.388	2.23	1.718
0.52	1.84	.838	1.96	1.080	2.07	1.362	2.19	1.686
0.50	1.80	.821	1.92	1.059	2.03	1.334	2.15	1.653
0.48	1.76	.805	1.88	1.038	1.99	1.308	2.10	1.620
0.46	1.73	.788	1.84	1.016	1.95	1.281	2.06	1.586
0.44	1.69	.770	1.80	.993	1.91	1.253	2.01	1.551
0.42	1.65	.753	1.76	.971	1.86	1.224	1.97	1.515
0.40	1.61	.735	1.72	.947	1.82	1.194	1.92	1.479
0.35	1.51	.687	1.61	.886	1.70	1.117	1.80	1.383
.30	1.39	.636	1.49	.820	1.58	1.034	1.66	1.281
0.25	1.27	.581	1.36	.749	1.44	.944	1.52	1.169
0.20	1.14	.519	1.21	.670	1.29	.845	1.36	1.046

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

$1 m^3/s$ = 1000 liters per second

V = Meter per second

Q = $Meter^3$ per second

n = 0.013

HALDIMAND COUNTY
Velocity and Discharge for 750mm to 975mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	1050mm		1200mm		1350mm		1500mm	
	V	Q	V	Q	V	Q	V	Q
6.00	7.81	6.978	8.53	9.963	9.23	13.639	9.90	18.064
5.00	7.13	6.370	7.79	9.095	8.43	12.451	9.04	16.490
4.00	6.37	5.698	6.97	8.135	7.54	11.136	8.09	14.749
3.50	5.96	5.330	6.52	7.609	7.05	10.417	7.54	13.796
3.00	5.50	4.934	6.03	7.045	6.53	9.644	7.00	12.773
2.50	5.02	4.504	5.51	6.431	5.96	8.804	6.39	11.660
2.00	4.49	4.029	4.93	5.752	5.33	7.875	5.72	10.429
1.80	4.26	3.822	4.67	5.457	5.06	7.471	5.42	9.894
1.60	4.02	3.604	4.41	5.145	4.77	7.043	5.11	9.328
1.50	3.89	3.489	4.27	4.981	4.62	6.820	4.95	9.032
1.40	3.76	3.371	4.12	4.813	4.46	6.588	4.78	8.726
1.30	3.62	3.248	3.97	4.637	4.30	6.349	4.61	8.408
1.20	3.48	3.121	3.82	4.456	4.13	6.100	4.43	8.078
1.10	3.33	2.988	3.65	4.266	3.95	5.840	4.24	7.735
1.00	3.18	2.849	3.48	4.057	3.77	5.568	4.04	7.375
0.98	3.15	2.820	3.45	4.026	3.73	5.512	4.00	7.300
0.96	3.11	2.791	3.41	3.985	3.69	5.456	3.96	7.226
0.94	3.08	2.762	3.38	3.943	3.65	5.399	3.92	7.150
0.92	3.05	2.732	3.34	3.901	3.61	5.341	3.88	7.073
0.90	3.02	2.703	3.31	3.859	3.58	5.283	3.84	6.996
0.88	2.98	2.672	3.27	3.815	3.54	5.224	3.79	6.918
0.86	2.95	2.642	3.23	3.772	3.50	5.164	3.75	6.839
0.84	2.91	2.611	3.19	3.728	3.45	5.103	3.71	6.759
0.82	2.89	2.580	3.15	3.683	3.41	5.042	3.66	6.678

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

$1 m^3/s$ = 1000 liters per second

V = Meter per second

Q = $Meter^3$ per second

n = 0.013

HALDIMAND COUNTY
Velocity and Discharge for 1050mm to 1500mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	1050mm		1200mm		1350mm		1500mm	
	V	Q	V	Q	V	Q	V	Q
0.80	2.85	2.548	3.12	3.638	3.37	4.980	3.62	6.596
0.78	2.81	2.516	3.08	3.592	3.33	4.918	3.57	6.513
0.76	2.78	2.484	3.04	3.546	3.29	4.854	3.52	6.429
0.74	2.74	2.451	3.00	3.499	3.24	4.790	3.48	6.344
0.72	2.70	2.417	2.96	3.451	3.20	4.725	3.43	6.258
0.70	2.67	2.383	2.91	3.403	3.15	4.659	3.38	6.170
0.68	2.63	2.349	2.87	3.354	3.11	4.592	3.33	6.081
0.66	2.59	2.314	2.83	3.304	3.06	4.524	3.28	5.991
0.64	2.55	2.279	2.79	3.254	3.01	4.455	3.23	5.900
0.62	2.51	2.243	2.74	3.203	2.97	4.384	3.18	5.807
0.60	2.47	2.207	2.70	3.151	2.92	4.313	3.13	5.712
0.58	2.43	2.170	2.65	3.098	2.87	4.241	3.08	5.616
0.56	2.39	2.32	2.61	3.044	2.82	4.167	3.03	5.519
0.54	2.34	2.093	2.56	2.989	2.77	4.092	2.97	5.419
0.52	2.30	2.054	2.51	2.933	2.72	4.015	2.92	5.318
0.50	2.25	2.014	2.46	2.876	2.66	3.937	2.86	5.215
0.48	2.20	1.974	2.41	2.818	2.61	3.858	2.80	5.109
0.46	2.16	1.932	2.36	2.759	2.56	2.777	2.74	5.002
0.44	2.11	1.890	2.31	2.698	2.50	3.694	2.68	4.892
0.42	2.07	1.846	2.26	2.636	2.44	3.609	2.62	4.779
0.40	2.02	1.802	2.20	2.572	2.38	3.522	2.56	4.664
0.35	1.89	1.685	2.06	2.406	2.23	3.294	2.39	4.363
0.30	1.75	1.560	1.91	2.228	2.06	3.050	2.21	4.039
0.25	1.59	1.424	1.74	2.034	1.88	2.784	2.02	3.687
0.20	1.43	1.274	1.56	1.819	1.69	2.490	1.81	3.298

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

$1m^3/s$ = 1000 liters per second

V = Meter per second

Q = Meter^3 per second

n = 0.013

HALDIMAND COUNTY
Velocity and Discharge for 1050mm to 1500mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	1650mm		1800mm		1950mm	
	V	Q	V	Q	V	Q
6.00	10.55	23.291	11.18	29.374	11.795	36.362
5.00	9.63	21.262	10.21	26.814	10.768	33.196
4.00	8.62	19.017	9.13	23.984	9.631	29.691
3.50	8.06	17.789	8.54	22.435	9.009	27.773
3.00	7.46	16.469	7.91	20.770	8.341	25.714
2.50	6.81	15.034	7.22	18.961	7.614	23.473
2.00	6.09	13.447	6.46	16.959	6.810	20.994
1.80	5.78	12.757	6.13	16.089	6.461	19.918
1.60	5.45	12.028	5.78	15.169	6.091	18.777
1.50	5.28	11.646	5.59	14.687	5.898	18.182
1.40	5.10	11.251	5.40	14.189	5.698	17.566
1.30	4.91	10.841	5.21	13.673	5.490	16.925
1.20	4.72	10.416	5.00	13.138	5.275	16.262
1.10	4.52	9.973	4.79	12.577	5.050	15.568
1.00	4.30	9.509	4.57	11.992	4.815	14.844
0.98	4.26	9.413	4.52	11.871	4.767	14.696
0.96	4.22	9.316	4.47	11.750	4.718	14.545
0.94	4.18	9.219	4.43	11.627	4.669	14.394
0.92	4.13	9.120	4.38	11.502	4.619	14.240
0.90	4.09	9.021	4.33	11.377	4.568	14.082
0.88	4.04	8.920	4.28	11.249	4.517	13.925
0.86	4.00	8.818	4.23	11.121	4.466	13.768
0.84	3.95	8.715	4.18	10.991	4.413	13.604
0.82	3.90	8.610	4.13	10.859	4.361	13.444

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

$1m^3/s$ = 1000 liters per second

V = Meter per second

Q = $Meter^3$ per second

n = 0.013

HALDIMAND COUNTY
Velocity and Discharge for 1650mm to 1950mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	1650mm		1800mm		1950mm	
	V	Q	V	Q	V	Q
0.80	3.85	8.505	4.08	10.726	4.307	13.278
0.78	3.80	8.398	4.03	10.591	4.253	13.111
0.76	3.76	8.289	3.98	10.454	4.198	12.942
0.74	3.71	8.180	3.93	10.316	4.142	12.769
0.72	3.66	8.068	3.87	10.175	4.086	12.596
0.70	3.60	7.955	3.82	10.033	4.029	12.421
0.68	3.55	7.841	3.76	9.889	3.971	12.242
0.66	3.50	7.725	3.71	9.742	3.912	12.060
0.64	3.45	7.607	3.65	9.593	3.852	11.875
0.62	3.39	7.487	3.59	9.442	3.792	11.690
0.60	3.34	7.365	3.54	9.289	3.730	11.499
0.58	3.28	7.242	3.48	9.135	3.667	11.305
0.56	3.22	7.116	3.42	8.974	3.604	11.110
0.54	3.17	6.987	3.35	8.912	3.539	10.910
0.52	3.11	6.857	3.29	8.647	3.472	10.704
0.50	3.05	6.724	3.23	8.480	3.405	10.497
0.48	2.98	6.588	3.16	8.308	3.336	10.284
0.46	2.92	6.449	3.10	8.133	3.266	10.069
0.44	2.86	6.307	3.03	7.955	3.194	9.847
0.42	2.79	6.162	2.96	7.772	3.121	9.621
0.40	2.72	6.014	2.89	7.584	3.046	9.390
0.35	2.55	5.625	2.70	7.094	2.849	8.783
0.30	2.36	5.208	2.50	6.568	2.638	8.133
0.25	2.15	4.754	2.28	5.996	2.408	4.723
0.20	1.93	4.252	2.04	5.363	2.154	6.640

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

$1 m^3/s$ = 1000 liters per second

V = Meter per second

Q = $Meter^3$ per second

n = 0.013

HALDIMAND COUNTY
Velocity and Discharge for 1650mm to 1950mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	2100mm		2250mm		2400mm	
	V	Q	V	Q	V	Q
6.00	12.393	44.309	12.976	53.258	13.547	63.262
5.00	11.313	40.448	11.846	48.620	12.366	57.747
4.00	10.119	36.179	10.595	43.485	11.061	51.653
3.50	9.465	33.841	9.911	40.678	10.346	48.314
3.00	8.763	31.331	9.176	37.661	9.579	44.732
2.50	8.000	28.603	8.376	34.378	8.744	40.833
2.00	7.155	25.582	7.492	30.750	7.821	35.523
1.80	6.788	24.269	7.107	29.170	7.420	34.650
1.60	6.400	22.882	6.701	27.503	6.995	32.665
1.50	6.196	22.153	6.488	26.629	6.773	31.629
1.40	5.986	21.402	6.268	25.726	6.544	30.559
1.30	5.769	20.626	6.040	24.790	6.306	29.448
1.20	5.542	19.815	5.803	23.817	6.058	28.290
1.10	5.306	18.971	5.556	22.804	5.800	27.085
1.00	5.059	18.088	5.298	27.745	5.530	25.824
0.98	5.009	17.909	5.244	21.523	5.475	25.567
0.96	4.957	17.723	5.190	21.302	5.419	25.306
0.94	4.905	17.537	5.136	21.080	5.362	25.040
0.92	4.853	17.351	5.081	20.854	5.305	24.773
0.90	4.800	17.162	5.026	20.628	5.247	24.503
0.88	4.746	16.969	4.970	20.399	5.188	24.227
0.86	4.692	16.775	4.913	20.165	5.129	23.952
0.84	4.637	16.579	4.855	19.927	5.069	23.671
0.82	4.581	16.379	4.797	19.689	5.008	23.386

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

$1m^3/s$ = 1000 liters per second

V = Meter per second

Q = $Meter^3$ per second

n = 0.013

HALDIMAND COUNTY
Velocity and Discharge for 2100mm to 2400mm CIRCULAR PIPE

FOR PIPE FLOWING FULL

GRADE %	2100mm		2250mm		2400mm	
	V	Q	V	Q	V	Q
0.80	4.525	16.178	4.738	19.446	4.947	23.102
0.78	4.468	15.975	4.679	19.204	4.884	22.807
0.76	4.411	15.771	4.618	18.954	4.821	22.513
0.74	4.352	15.560	4.557	18.703	4.757	22.214
0.72	4.293	15.349	4.495	18.449	4.693	21.916
0.70	4.233	15.134	4.432	18.190	4.627	21.607
0.63	4.172	14.916	4.368	17.928	4.561	21.299
0.66	4.110	14.695	4.304	17.665	4.493	20.982
0.64	4.048	14.473	4.238	17.394	4.424	20.659
0.62	3.984	14.244	4.171	17.119	4.355	20.337
0.60	3.919	14.012	4.103	16.840	4.284	20.006
0.58	3.853	13.776	4.034	16.557	4.212	19.669
0.56	3.786	13.536	3.964	16.270	4.139	19.328
0.54	3.718	13.293	3.893	15.978	4.064	18.978
0.52	3.648	13.043	3.820	15.679	3.988	18.623
0.50	3.578	12.793	3.746	15.375	3.911	18.264
0.48	3.505	12.532	3.6700	15.063	3.832	17.895
0.46	3.431	12.267	3.593	14.747	3.751	17.517
0.44	3.356	11.999	3.514	14.423	3.668	17.129
0.42	3.279	11.724	3.433	14.090	3.584	16.737
0.40	3.200	11.441	3.350	13.750	3.498	16.335
0.35	2.993	10.701	3.134	12.863	3.272	15.280
0.30	2.771	9.907	2.902	11.911	3.029	14.145
0.25	2.530	9.046	2.649	10.872	2.765	12.912
0.20	2.263	8.091	2.369	9.723	2.473	11.549

Diameters shown in table are nominal. Q & V are based on imperial I.D.s

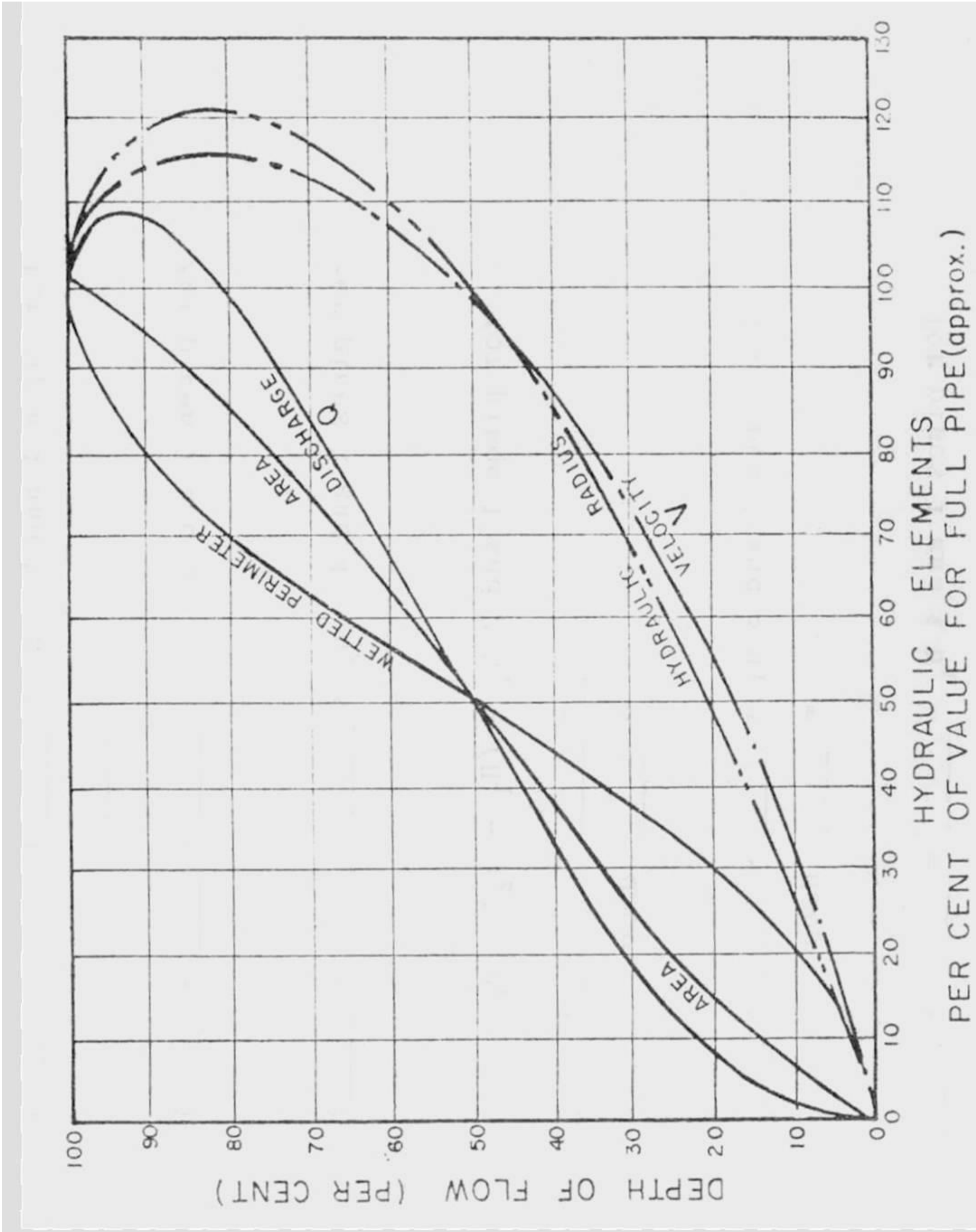
$1m^3/s$ = 1000 liters per second

V = Meter per second

Q = Meter^3 per second

n = 0.013

HALDIMAND COUNTY
Velocity and Discharge for 2100mm to 2400mm CIRCULAR PIPE


HYDRAULIC ELEMENTS
PER CENT OF VALUE FOR FULL PIPE (approx.)
DEPTH OF FLOW (PER CENT)
DISCHARGE
Q
AREA
WETTED PERIMETER
HYDRAULIC RADIUS
VELOCITY
V
AREA
0
10
20
30
40
50
60
70
80
90
100
110
120
130

SANITARY SEWER DESIGN SHEET

q = average daily per capita flow (___L/cap. d)
I = unit of peak extraneous flow (___L/ha. s)
M = peaking factor
Q (p) = peak population flow (L/s)
Q (i) = peak extraneous flow (L/s)
Q (d) = peak design flow

$M = 1 + \frac{14}{4 + \sqrt{P}}$ where P population in 1000's

$Q(p) = \frac{PqM}{86.4}$ (L/s)

Q(i) = IA (L/s) where A = area in hectares
Q(d) = Q(p) + Q(i) (L/s)

LOCATION			INDIVIDUAL		CUMULATIVE		Peaking factor M	Pop. flow Q(p) (L/s)	Peak extraneous flow Q(i) (L/s)	Peak design flow Q(d) (L/s)	PROPOSED SEWER						
STREET	FROM	TO	Pop.	Area A (hectares)	Pop.	Area A (hectares)					Length (m)	Pipe size (mm)	Type of pipe	Grade %	Capacity (L/s) n = ___	Full flow velocity (m/s)	Actual velocity at Q(d)

	DESIGN	PROJECT	SHEET No.
	CHECKED		___ of ___
	DATE		