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## **INFRASTRUCTURE DESIGN STANDARDS – FIGURES**

### **SECTION 4 – STORMWATER COLLECTION SYSTEM**

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- 4.1 Stormwater Collection System Design Chart
- 4.2a) Rainfall Intensity – Duration Curves for Storm Design
- 4.2b) 2 Year Rainfall Intensity Chart
- 4.3 Average Runoff Coefficient to Time of Concentration
- 4.4 Hydraulic Elements Graph for Circular Sewers
- 4.5 Insulation Standard for Shallow Mains and Offsets
- 4.6 Bedding Standard for Rigid and Flexible Pipe
- 4.7 Maximum Pipe Sizes for Pre-Cast Maintenance Holes
- 4.8 Maintenance Hole Drop Structure
- 4.9 Steps in Maintenance Hole Benching
- 4.10 Head Losses in Maintenance Holes
- 4.11 Standard Servicing Locations for Single Family and Semi-Detached Lots
- 4.12 Private Drain Connection (Residential)
- 4.13 Private Drain Connection Riser – Type 1 (Residential)
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- 4.15 Private Drain Connection Cleanout (Residential)
- 4.16 Private Drain Connection Marker (Residential)
- 4.17 Precast Concrete Curb Inlet Cast Basin 600 x 840
- 4.18 Precast Concrete Catch Basin Maintenance Hole
- 4.20a-b Typical Catchbasin Frame and Grate

**RUNOFF COEFFICIENT 'C'**

PARKS AND PLAYGROUNDS	- 0.20
RESIDENTIAL - SINGLE AND DUPLEX	- 0.50 and 0.55
- ROW HOUSING	- 0.65
- APARTMENTS	- 0.65 and 0.70
COMMERCIAL AND INDUSTRIAL	- 0.90 and 0.70
DENSELY BUILT, PAVED	- 0.90

**STORMWATER COLLECTION SYSTEM  
MIDDLESEX CENTRE**

FLOW  $Q = 2.78CIA$  where  $Q$  = PEAK FLOW IN LITRES PER SECOND (l/s)  
 $A$  = AREA IN HECTARES (ha)  
 $C$  = RUNOFF COEFFICIENT  
 $I$  = RAINFALL INTENSITY (mm/hr)  
 RETURN PERIOD  YEARS

DATE \_\_\_\_\_  
 DESIGN \_\_\_\_\_  
 CHECKED \_\_\_\_\_  
 PROJECT # \_\_\_\_\_

PROJECT NAME: \_\_\_\_\_

LOCATION				AREA		TOTAL (A X C)					RAINFALL INTENSITY			SEWER DESIGN						PROFILE									
AREA NO.	STREET	FROM	TO	DELTA	TOTAL	RUNOFF C	INCR.	TOTAL	TOTAL	TOTAL	DELTA	TIME ENTRY min	INTENSITY	Q	SIZE mm	n	SLOPE %	CAP. l/sec	VEL. m/sec	LENGTH m	TIME OF FLOW	DROP MH	FALL IN SEWER	INVERT ELEV.		Req'd H <sub>L</sub> m	K <sub>L</sub>	O <sub>u</sub> /O <sub>o</sub> or deg bend	
				HEC.	HEC.		AxC	AxC	AxC	AxC	AxC	AxC	SECTION											ACCUM.	mm/hr				l/sec

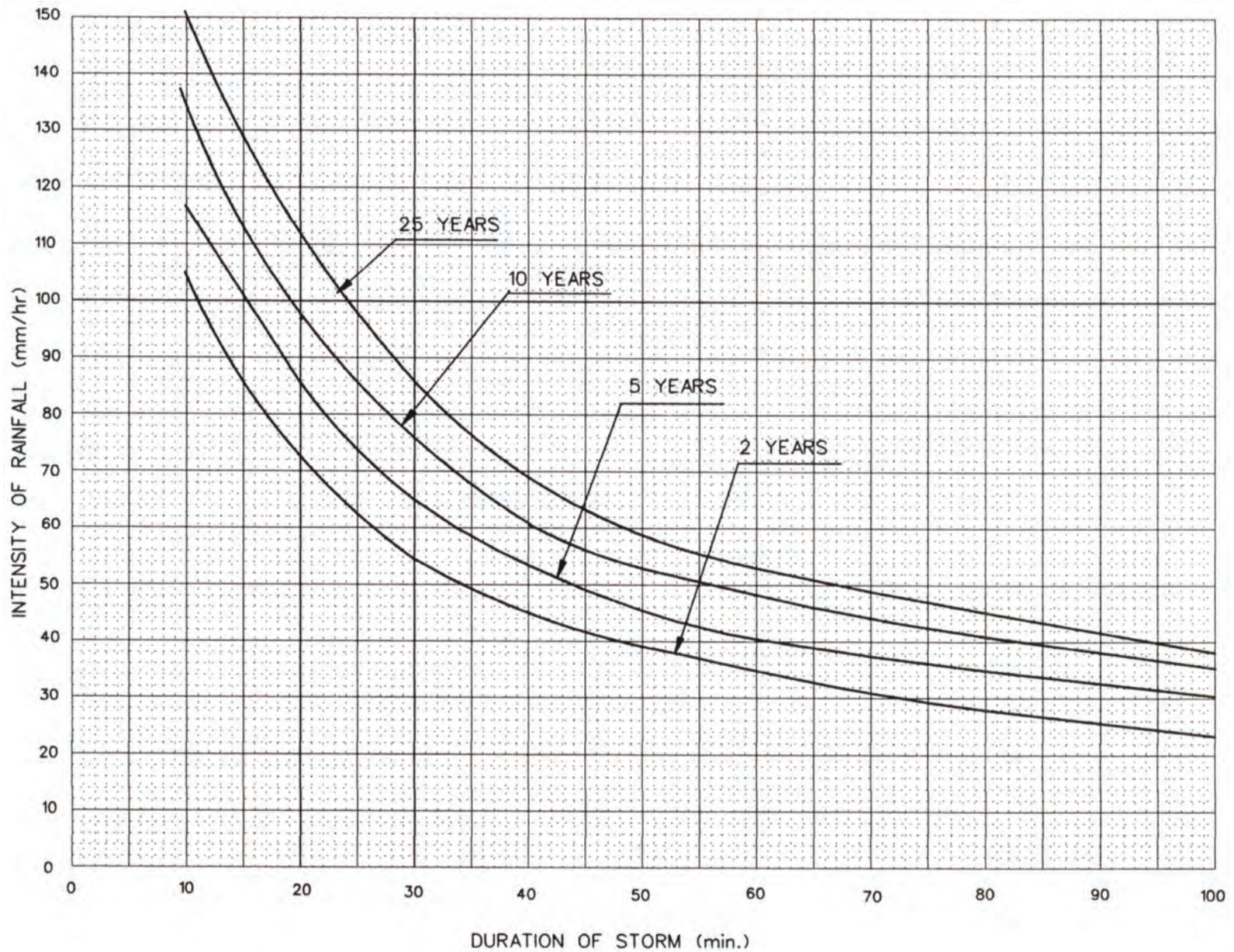


FIGURE 4.2a)

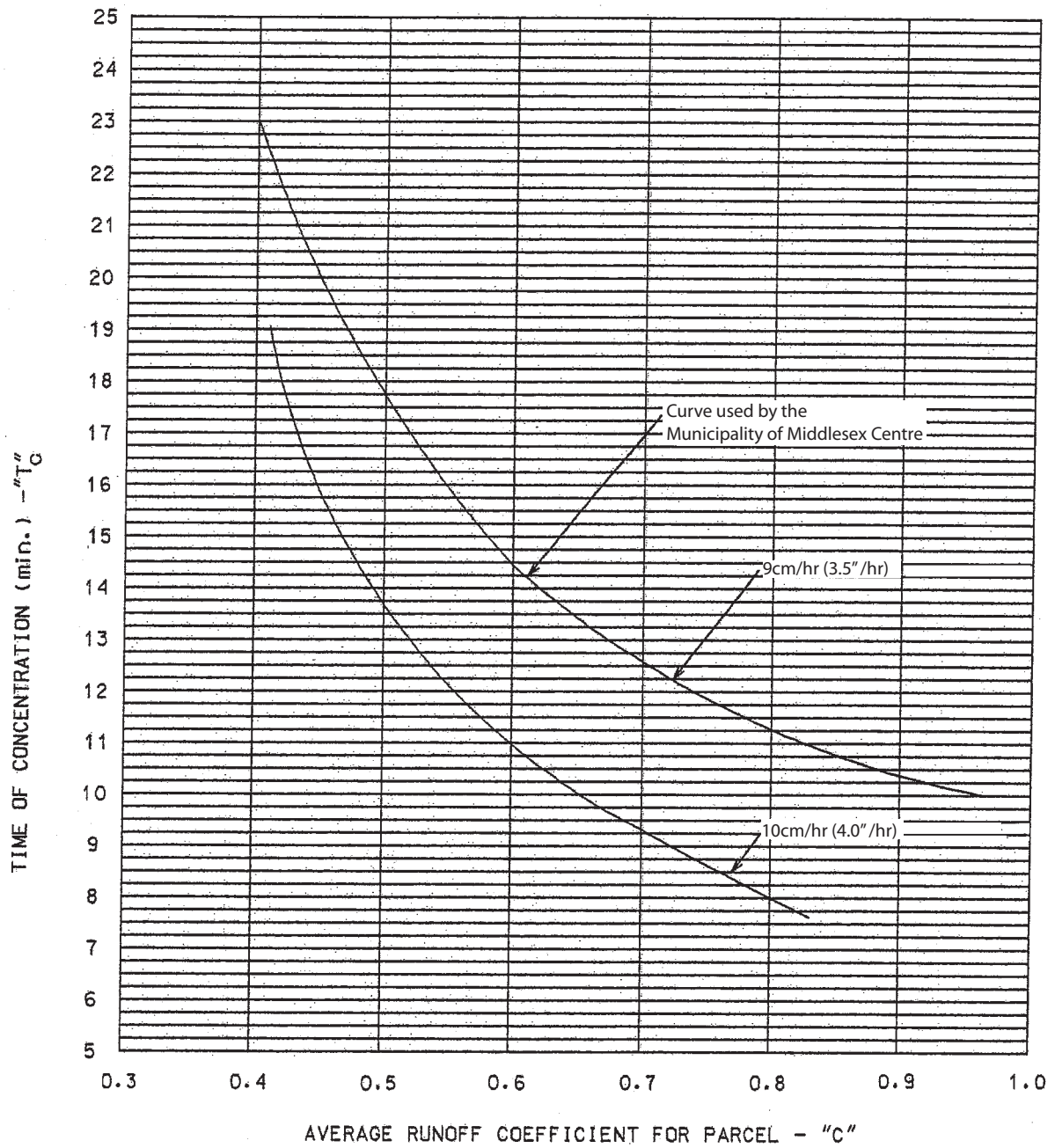


RAINFALL INTENSITY - DURATION CURVES  
FOR STORMWATER DESIGN

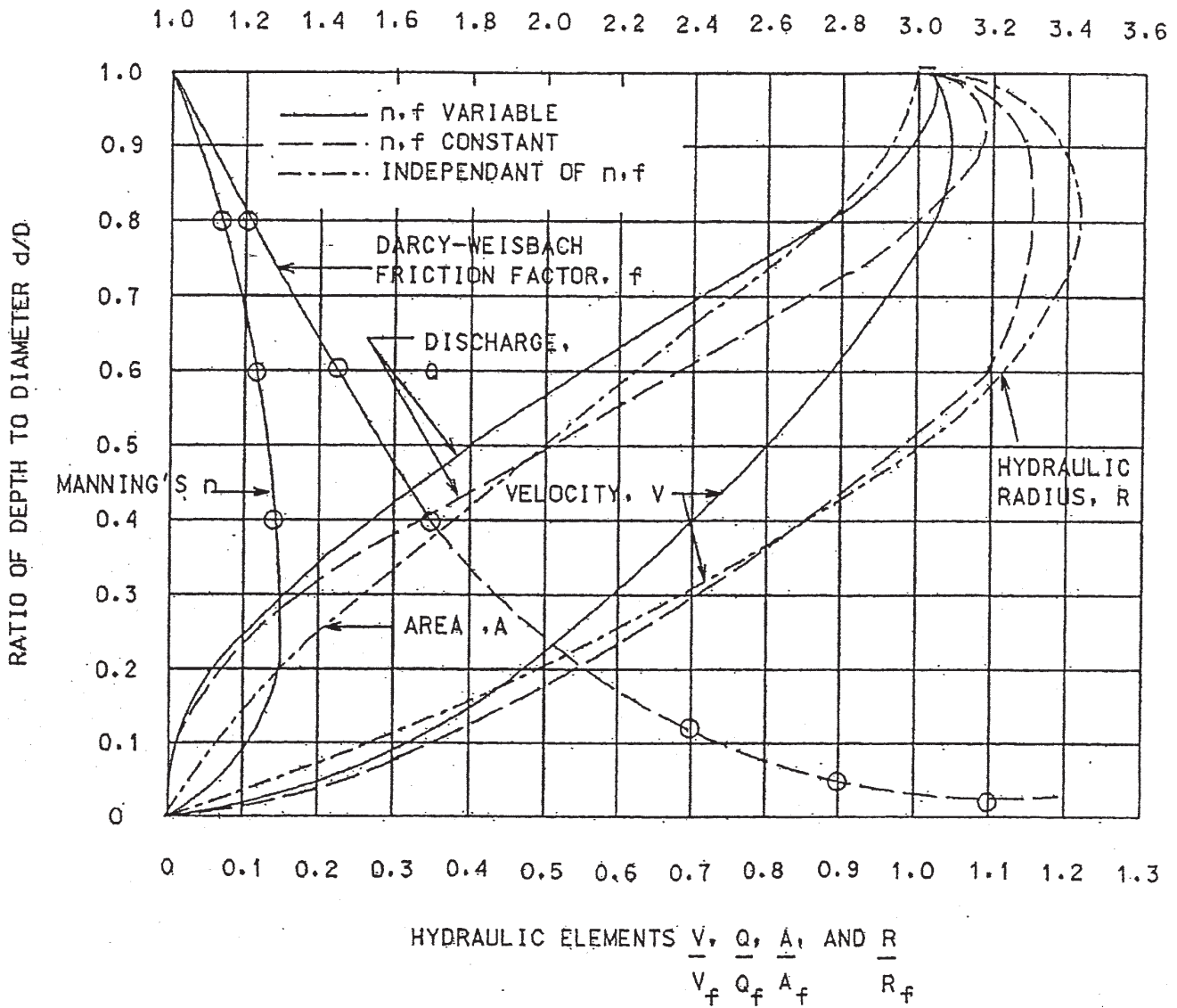
DATE: 2017-04

FIGURE 4.2a)

Time (min)	Metric (mm/hr.)	Time (min)	Metric (mm/hr.)	Time (min)	Metric (mm/hr.)	Time (min)	Metric (mm/hr.)	Time (min)	Metric (mm/hr.)
5.0	138.4	10.0	105.0	15.0	87.1	20.0	73.2	25.0	62.2
5.1	137.4	10.1	104.4	15.1	86.9	20.1	72.9	25.1	62.2
5.2	136.4	10.2	104.1	15.2	86.4	20.2	72.6	25.2	62.0
5.3	135.4	10.3	103.6	15.3	86.1	20.3	72.4	25.3	61.7
5.4	134.6	10.4	103.4	15.4	85.9	20.4	72.4	25.4	61.7
5.5	133.4	10.5	102.9	15.5	85.6	20.5	72.1	25.5	61.5
5.6	132.1	10.6	102.4	15.6	85.3	20.6	71.9	25.6	61.2
5.7	130.8	10.7	101.9	15.7	84.8	20.7	71.6	25.7	61.2
5.8	128.8	10.8	101.3	15.8	84.6	20.8	71.4	25.8	61.0
5.9	128.3	10.9	101.1	15.9	84.3	20.9	71.1	25.9	60.7
6.0	128.0	11.0	100.8	16.0	84.1	21.0	70.8	26.0	60.7
6.1	127.0	11.1	100.6	16.1	83.8	21.1	70.6	26.1	60.7
6.2	125.7	11.2	100.3	16.2	83.0	22.2	70.4	26.2	60.5
6.3	125.5	11.3	100.3	16.3	83.1	21.3	70.4	26.3	60.2
6.4	125.0	11.4	99.3	16.4	82.8	21.4	70.1	26.4	60.0
6.5	124.2	11.5	99.1	16.5	82.6	21.5	69.9	26.5	59.7
6.6	122.9	11.6	98.8	16.6	82.3	21.6	69.6	26.6	59.7
6.7	121.9	11.7	98.0	16.7	82.0	21.7	69.3	26.7	59.4
6.8	120.9	11.8	97.8	16.8	81.5	21.8	69.1	26.8	59.4
6.9	120.4	11.9	97.3	16.9	81.3	21.9	68.8	26.9	59.2
7.0	119.0	12.0	96.7	17.0	81.0	22.0	68.6	27.0	58.9
7.1	119.4	12.1	96.5	17.1	80.8	22.1	68.3	27.1	58.9
7.2	119.1	12.2	96.3	17.2	80.5	22.2	68.1	27.2	58.9
7.3	118.9	12.3	95.8	17.3	80.5	22.3	67.8	27.3	58.7
7.4	118.1	12.4	95.3	17.4	80.3	22.4	67.6	27.4	58.4
7.5	117.3	12.5	94.7	17.5	80.0	22.5	67.3	27.5	58.4
7.6	116.6	12.6	94.5	17.6	79.5	22.6	67.3	27.6	58.2
7.7	115.8	12.7	94.0	17.7	79.2	22.7	67.1	27.7	58.2
7.8	115.1	12.8	93.7	17.8	78.7	22.8	66.8	27.8	57.9
7.9	114.6	12.9	93.5	17.9	78.5	22.9	66.5	27.9	57.9
8.0	114.0	13.0	93.2	18.0	78.5	23.0	66.3	28.0	57.7
8.1	113.5	13.1	93.0	18.1	78.2	23.1	66.0	28.1	57.4
8.2	113.0	13.2	92.7	18.2	78.0	23.2	66.0	28.2	57.4
8.3	112.8	13.3	92.5	18.3	77.5	23.3	65.8	28.3	57.2
8.4	112.0	13.4	91.9	18.4	77.2	23.4	65.5	28.4	56.9
8.5	111.8	13.5	91.7	18.5	77.0	23.5	65.3	28.5	56.9
8.6	110.7	13.6	91.2	18.6	76.7	23.6	65.0	28.6	56.6
8.7	110.0	13.7	90.9	18.7	76.5	23.7	65.0	28.7	56.4
8.8	109.5	13.8	90.7	18.8	76.2	23.8	64.8	28.8	56.1
8.9	109.2	13.9	90.4	18.9	76.0	23.9	64.8	28.9	55.9
9.0	109.0	14.0	90.2	19.0	76.0	24.0	64.5		
9.1	108.7	14.1	90.0	19.1	75.7	24.1	64.3		
9.2	108.5	14.2	89.4	19.2	75.4	24.2	64.0		
9.3	108.2	14.3	88.9	19.3	75.2	24.3	63.8		
9.4	108.0	14.4	88.6	19.4	75.0	24.4	63.5		
9.5	107.4	14.5	88.4	19.5	74.7	24.5	63.5		
9.6	106.7	14.6	88.1	19.6	74.4	24.6	63.2		
9.7	106.0	14.7	87.9	19.7	74.0	24.7	62.7		
9.8	105.4	14.8	87.6	19.8	73.7	24.8	62.4		
9.9	105.2	14.9	87.4	19.9	73.4	24.9	62.4		

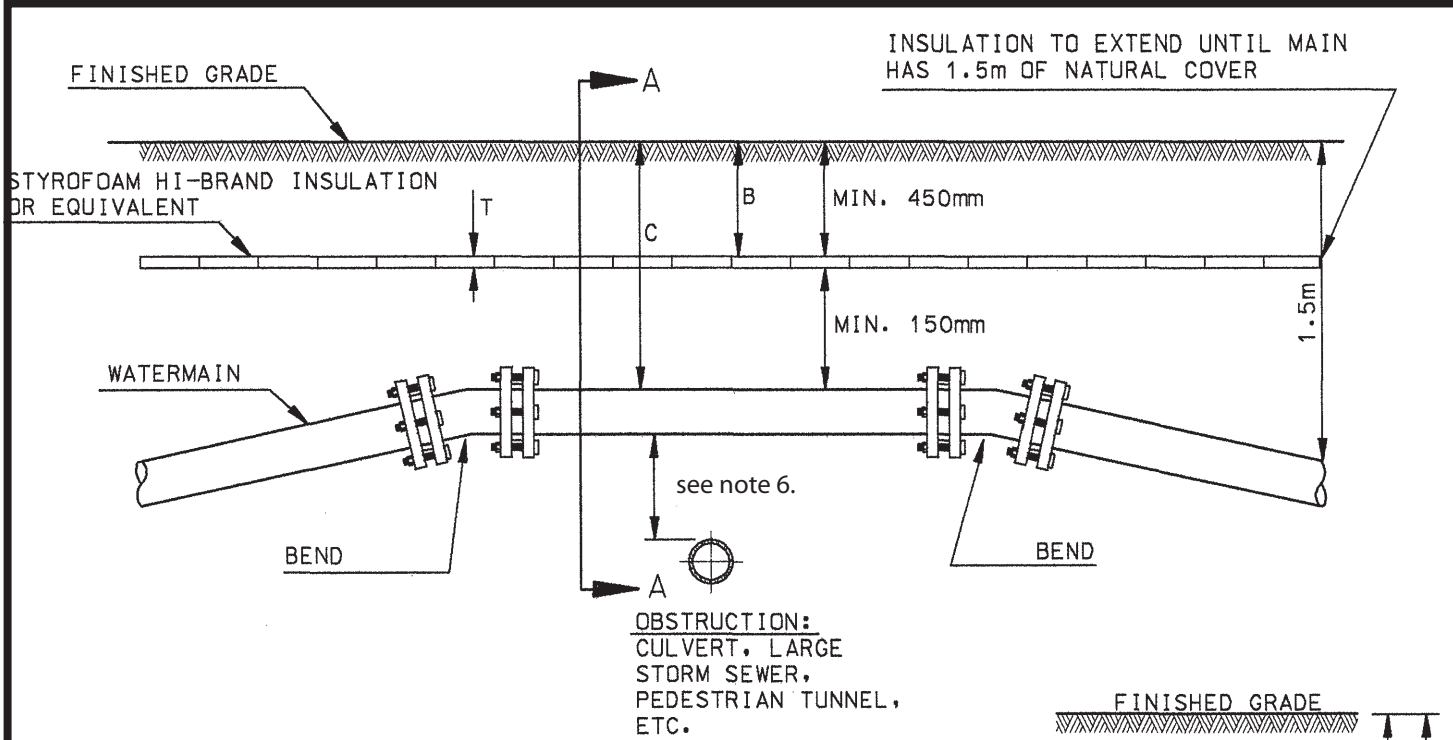


VALUES OF  $\frac{f}{f_f}$  AND  $\frac{n}{n_f}$

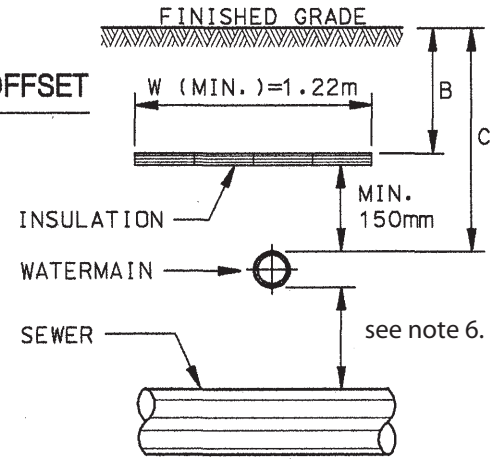


**NOTE:**

- Information taken from the American Society of Civil Engineers (ASCE) Manual



**ELEVATION OF JOINT DEFLECTION OFFSET**



**SECTION "A - A"**

**NOTES:**

1. Minimum compressive strength of insulation to be 690Kpa. Insulation shall be installed in thickness required in strict accordance with insulation manufacturer's directions. Insulation shall be installed over 150mm of fine granular fill screened soomth.
2. Butt insulation tightly together without gaps. Stagger end joints if more than one layer used.
3. To hold in place skewer insulation board to ground with 200mm hardwood skewers. Minimum 6mm dia., and 200mm long. 2 skewers per board.
4. If 2 layers of insulation are used skewer only the top layer through the first layer using a skewer 150mm longer than the combined thickness of the 2 layers of insulation. Insert skewers at approximately 30 degree angle.
5. Place at least 200mm of fine granular fill over insulation before using compaction equipment.
6. Minimum Clearance as per MOECC Procedure F-6-1.

INSULATION THICKNESS		INSULATION WIDTH	
C (m)	T (mm)	B (m)	W (m)
0.60	75	0.45	2.44
0.75	75	0.60	1.83
0.90	50	0.75	1.54
1.09	50	0.90	1.22
1.20	25		
1.35	25		

**All dimensions are in millimetres unless shown otherwise.**

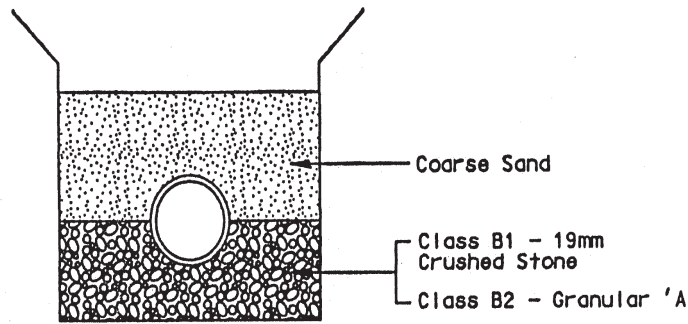


**INSULATION STANDARD FOR SHALLOW MAINS AND OFFSETS**

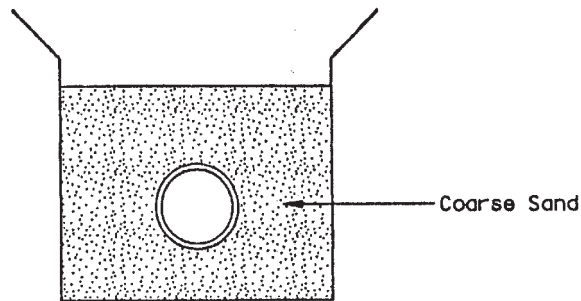
DATE: 2017-04

FIGURE 4.5

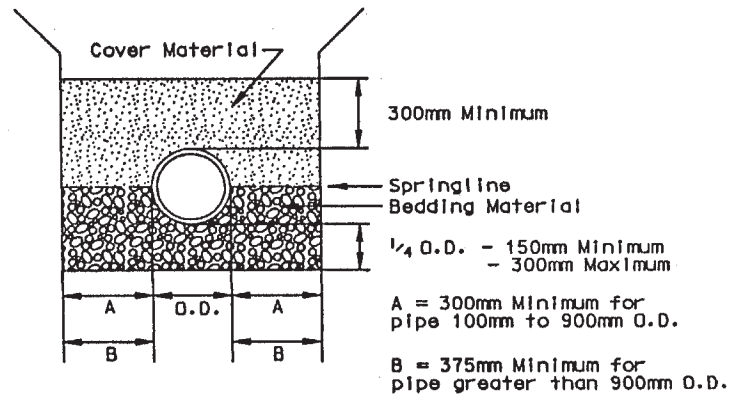
### RIGID PIPE - CLASS B



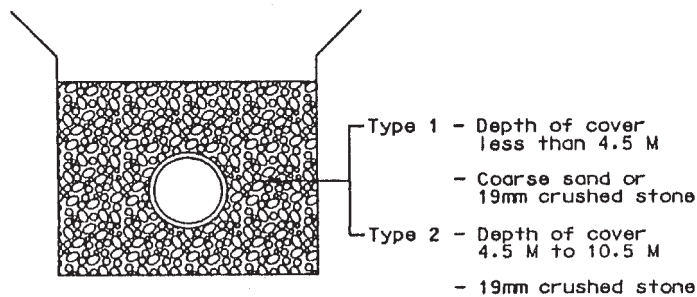
### RIGID PIPE - CLASS C



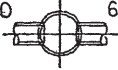

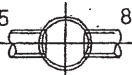
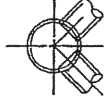
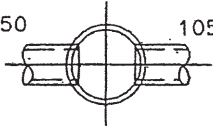
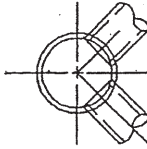
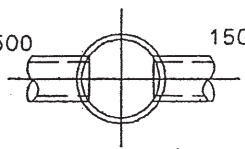
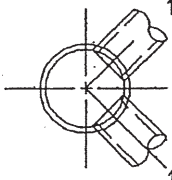
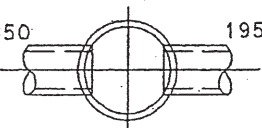
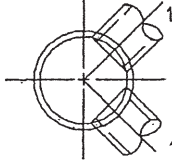
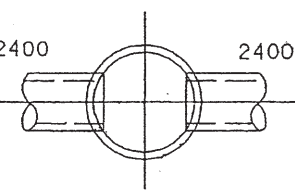
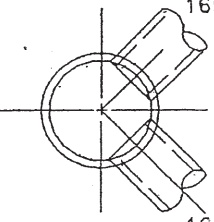
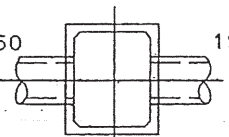
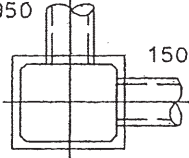
### TRENCH DIMENSIONS FOR ALL PIPE SEWERS



### FLEXIBLE PIPE



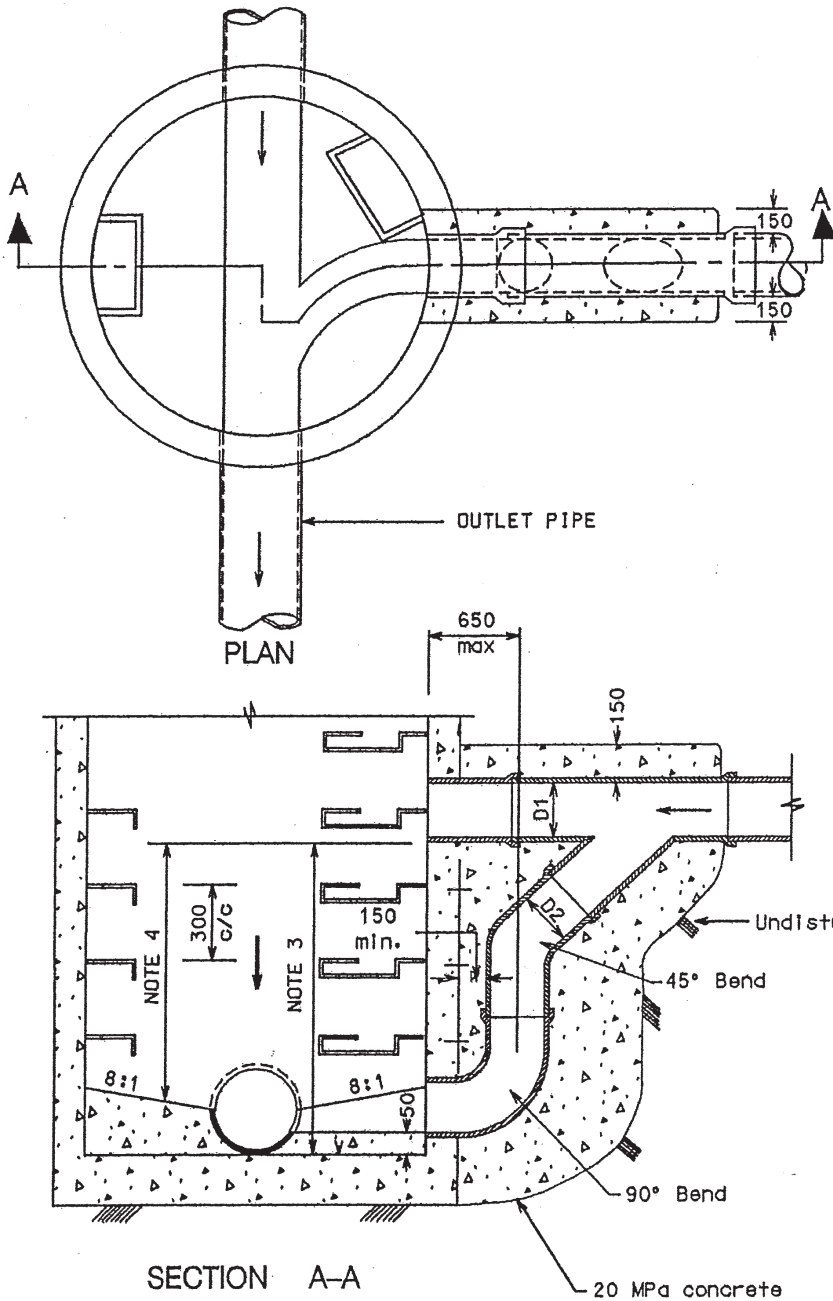


MAINTENANCE HOLE INSIDE DIAMETER (mm)	MAX. PIPE SIZE FOR STRAIGHT THROUGH INSTALLATION (mm)	MAX. PIPE SIZE FOR RIGHT ANGLE INSTALLATION (mm)
1200	600 	 450
1500	825 	 600
1800	1050 	 825
2400	1500 	 1050
3000	1950 	 1500
3600	2400 	 1650
3000 x 2400	1950 	 1500

**NOTES:**

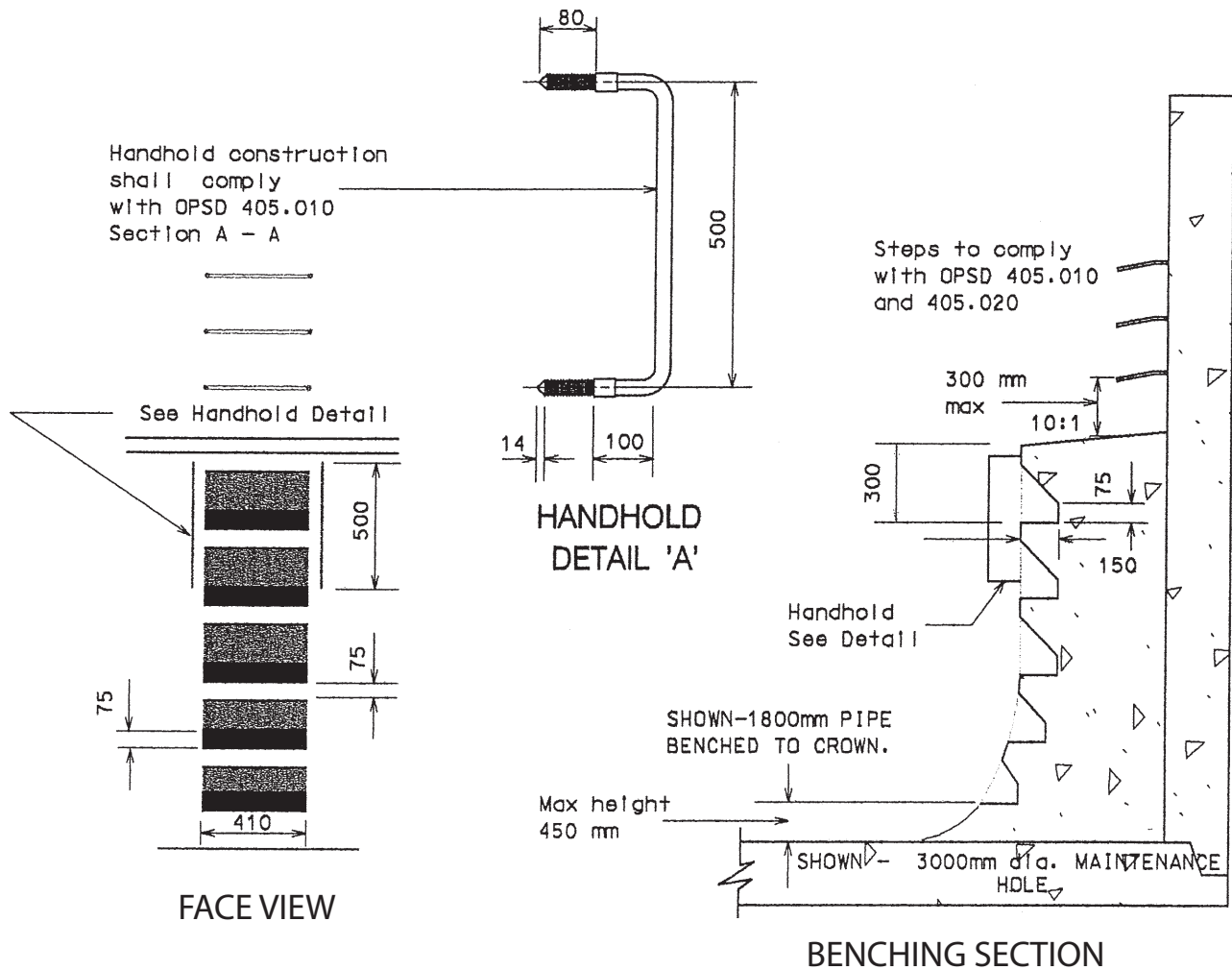
1. All dimensions are for concrete pipe
2. All dimensions are in millimeters
3. Knockouts for small diameter catch basins lead sizes 300mm or less could be provided in addition to what is shown.
4. Information taken from the Ontario Concrete Pipe Association (O.C.P.A.)

A. ALL DIMENSIONS ARE IN MILLIMETERS  
UNLESS OTHERWISE SHOWN



### NOTES:

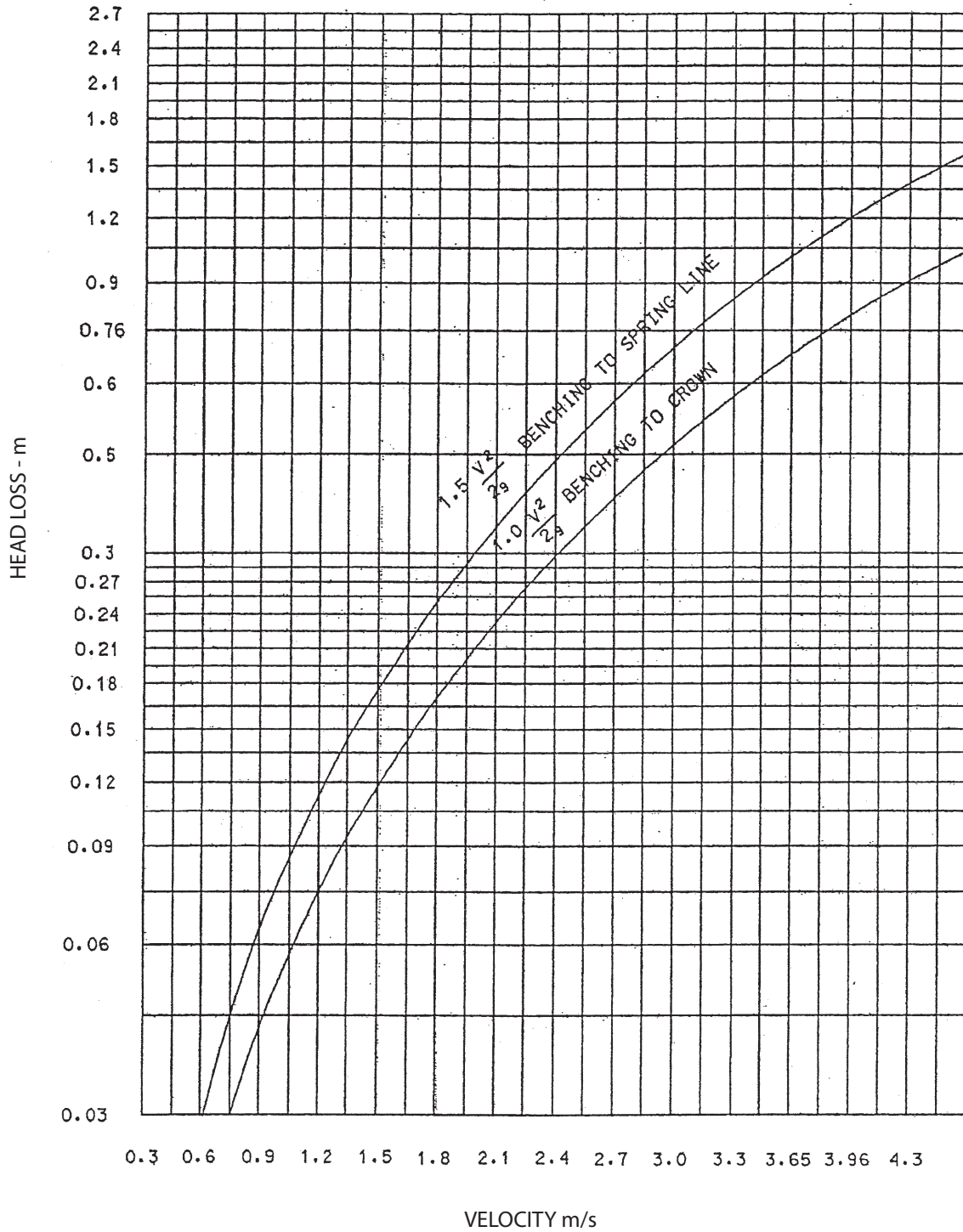
1. Drop structure to be completely encased in a minimum 150mm of 20MPa concrete and secured to the maintenance hole with 450mm long, 13mm dia., threaded rods and drilled expansion anchors down both sides of the drop pipe at 300mm c/c.
2. For pipe sewer sizes 200mm to 450mm (inside pipe diameter)  $D1=D2$ . For pipe sewer sizes equal to or greater than 525mm dia.,  $D2=450$ mm dia.
3. Drop structures shall be constructed when the differences upstream and outlet sewers in the maintenance hole is equal or greater than 600mm for sanitary sewers and 900mm for storm sewers.
4. When the difference in elevation between the upstream invert and the top of the benching exceeds 1.50m, an additional set of steps are required adjacent to the overflow pipe for maintenance operations.
5. Maintenance hole steps shall be located to avoid conflict with an inletting or outletting sewer pipe. Access to maintenance hole must be above the benching platform.

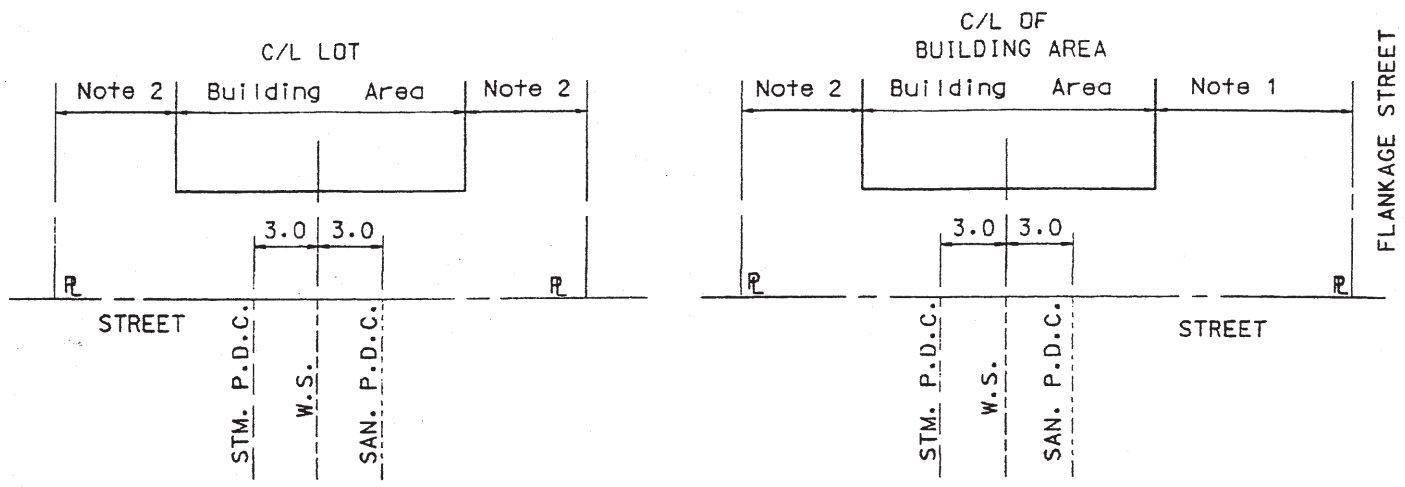


**NOTES:**

1. Steps are required in benching for pipe diameters:
  - a) Greater than 900mm - benching to springline;
  - b) Greater than or equal to 450mm - benching to crown.
2. Handholds shall be constructed in accordance with DETAIL 'A'.
3. Handholds are required for pipe diameters greater than or equal to 1500mm dia when benching to crown.
4. Additional handholds may be required for pipe diameters greater than 1950mm - benching to crown.
5. Step dimensions are typical.
6. Maintenance hole steps shall be located to avoid conflict with an inletting or out letting sewer pipe. Access to maintenance hole must be above benching platform.

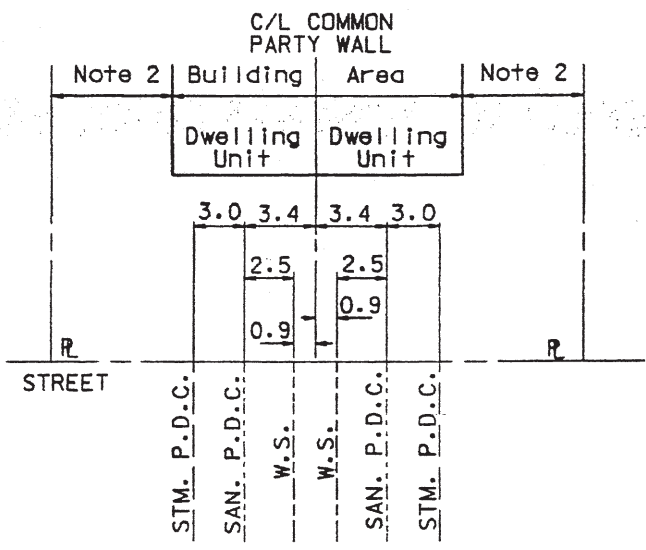
All dimensions are in millimetres unless otherwise shown.



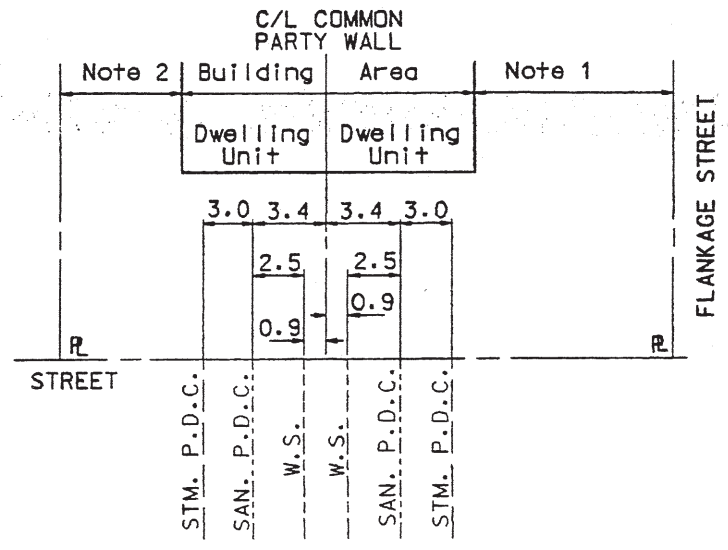


SINGLE

SINGLE CORNER LOT



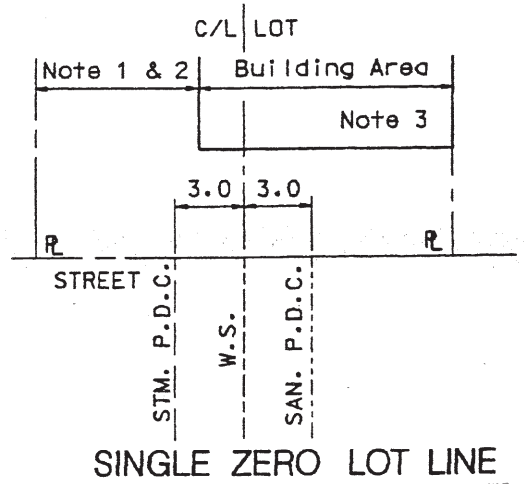
SEMI-DETACHED



SEMI-DETACHED CORNER LOT

**NOTES:**

1. External building setbacks to reflect current applicable zoning by-laws.
2. Internal building setbacks to reflect current applicable zoning by-laws.
3. If the building area is located on the opposite side of zero lot line lot, then show the services in reversed location (i.e. Sanitary and Storm).
4. Storm PDCs are required except where exempt by the drainage by-law.
5. STM. PDC - Storm Private Drain Connection  
SAN PDC - Sanitary Private Drain Connection  
WS - Water Service



SINGLE ZERO LOT LINE

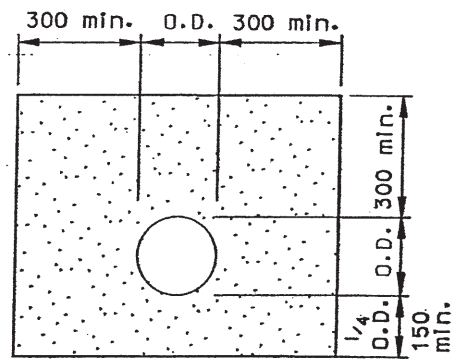
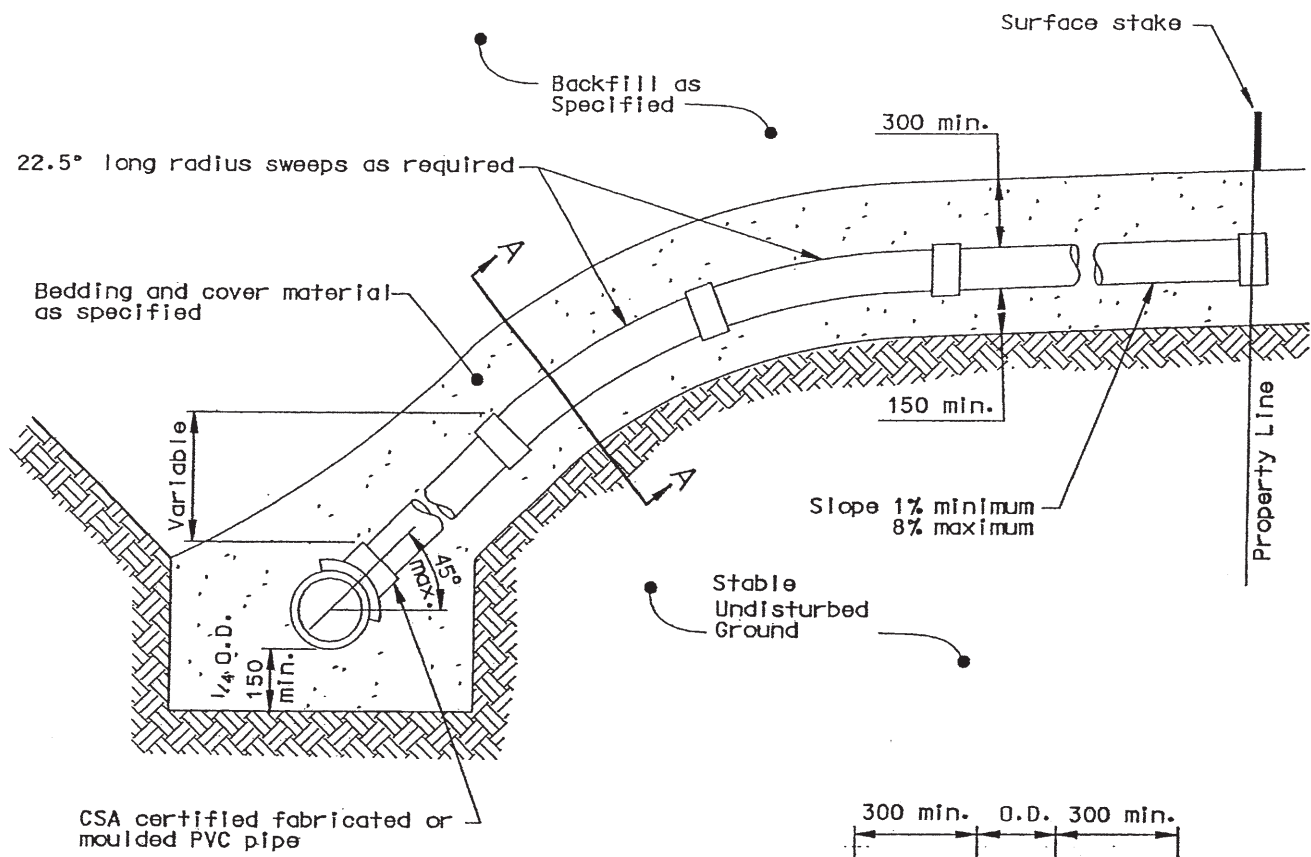
All dimensions are in metres unless otherwise shown.



STANDARD SERVICING LOCATIONS FOR SINGLE FAMILY AND SEMI-DETACHED LOTS

DATE: 2017-04

FIGURE 4.11



SECTION A - A

**NOTES:**

1. PDC risers are required for sewer depths greater than or equal to 4.5m
2. The minimum inside diameter for Sanitary and Storm PDCs is 100mm.
3. The minimum clearance between a PDC and a sewer or watermain (outside wall to outside wall) is 0.5 m as per MOECC Procedure F-6-1.
4. Pre-fabricated tees shall be used for all service sewer mains for new subdivisions prior to assumption.
5. Saddle connections may be used when connecting new services to an existing sewer main.
6. No sanitary PDC connections to maintenance holes are permitted.
7. Where horizontal or vertical bends are required long radius sweeps shall be used. Short bends are not acceptable.

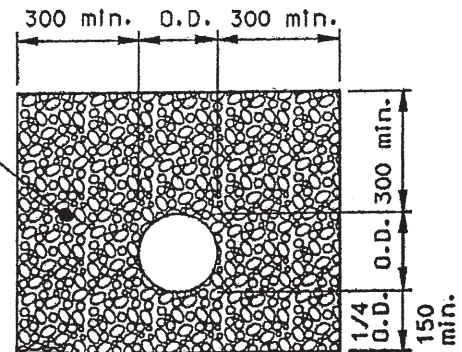
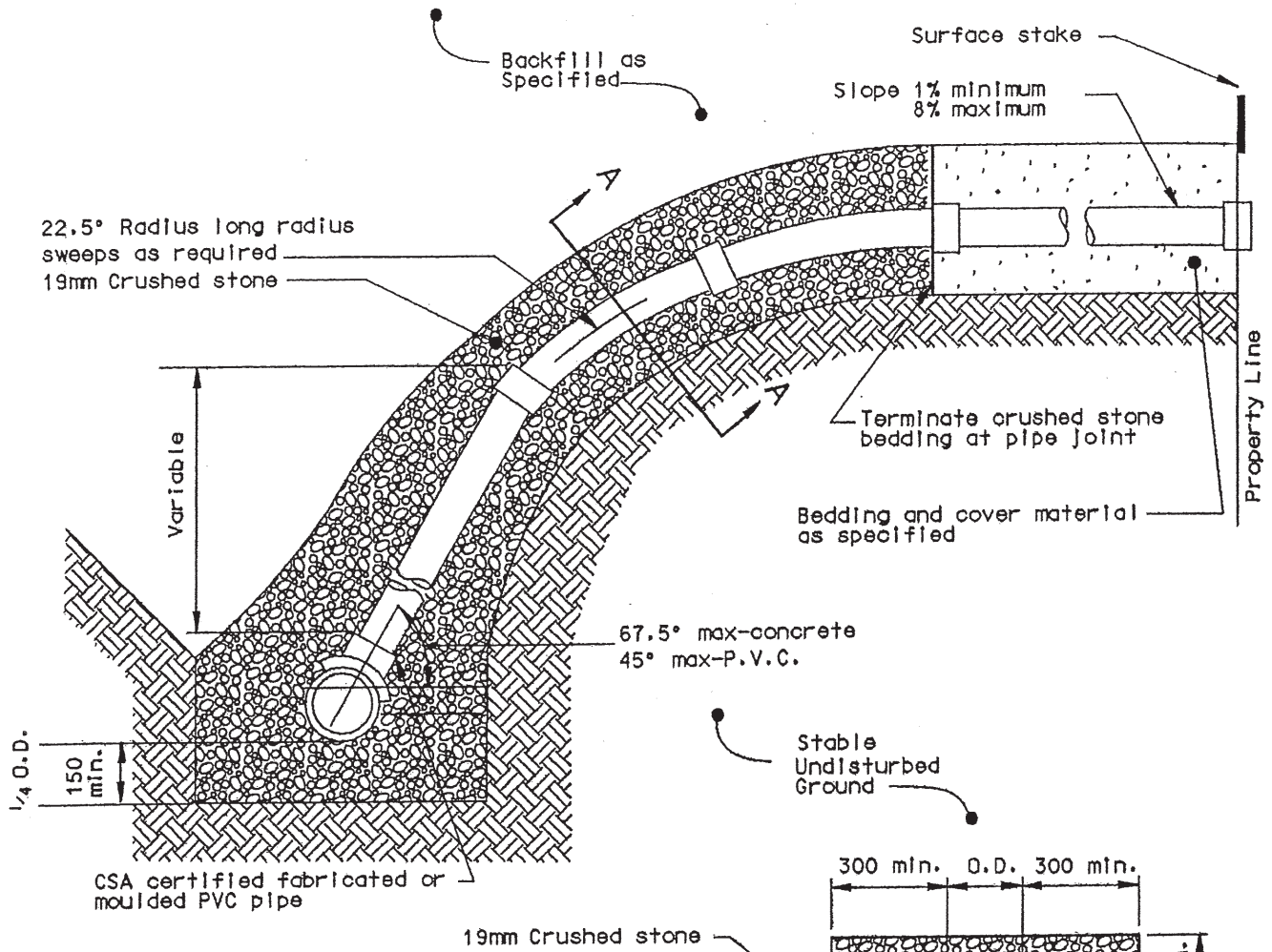
All dimensions are in millimetres unless otherwise shown.



PRIVATE DRAIN CONNECTION (RESIDENTIAL)

DATE: 2017-04

FIGURE 4.12



SECTION A-A

**NOTES:**

1. A Type 1 PDC riser is required for sewer depths greater than or equal to 4.5m and for excavations in stable bank conditions.
2. The minimum inside diameter for Sanitary and Storm PDC is 100mm.
3. Prefabricated tees shall be used for all service connections on new sewer main construction, including sewer mains for new subdivisions prior to assumption.  
  
Saddle connections may be used when connecting new services to an existing sewer main.
4. No stormPDC connection to maintenance holes are permitted.
5. Where horizontal or vertical bends are required long radius sweeps shall be used. Short bends are not acceptable.

All dimensions are in millimeters unless otherwise shown.



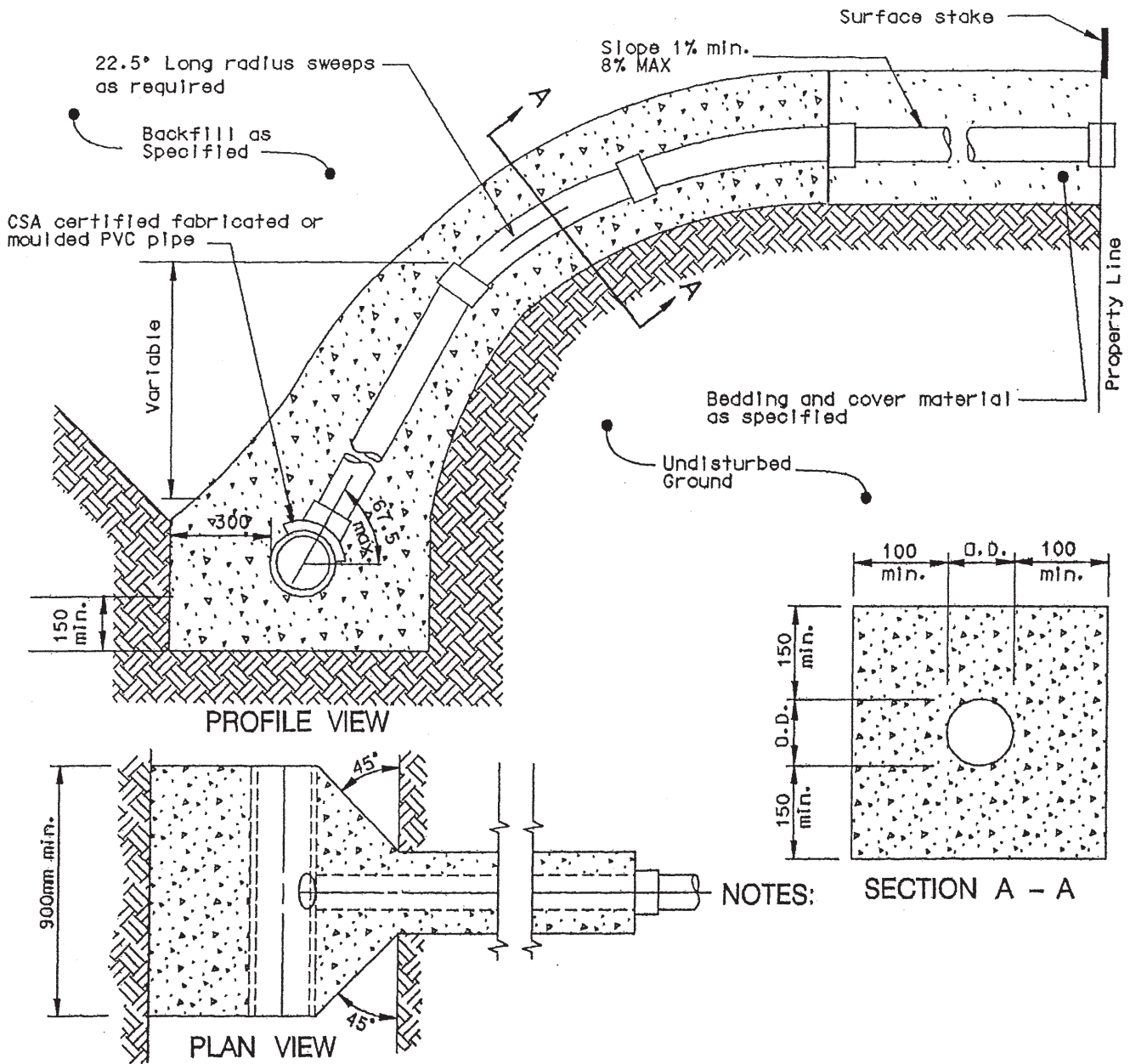
**PRIVATE DRAIN CONNECTION RISER - TYPE 1 (RESIDENTIAL)**

67.5° MAXIMUM CONCRETE PIPE,

45° MAXIMUM PVC - STABLE BANK CONDITIONS

DATE: 2017-04

FIGURE 4-13



**NOTES:**

1. A Type 2 PDC riser is required for sewer depths greater than or equal to 4.5m and for excavations in bank conditions.
2. The minimum inside diameter for Sanitary and Storm PDC is 100mm.
3. Prefabricated tees shall be used for all service connections on new sewer main construction, including sewer mains for new subdivisions prior to assumption.
4. Saddle connections may be used when connecting new services to an existing sewer main subject to municipal approval.
5. Concrete strength shall be 20 MPA.
6. Where horizontal and vertical bends are required, long radius sweeps shall be used. Short bends are not acceptable.
7. No storm PDC connections to maintenance holes are permitted.

**All dimensions are in millimetres unless otherwise shown.**



**PRIVATE DRAIN CONNECTION RISER - TYPE 2 (RESIDENTIAL)**

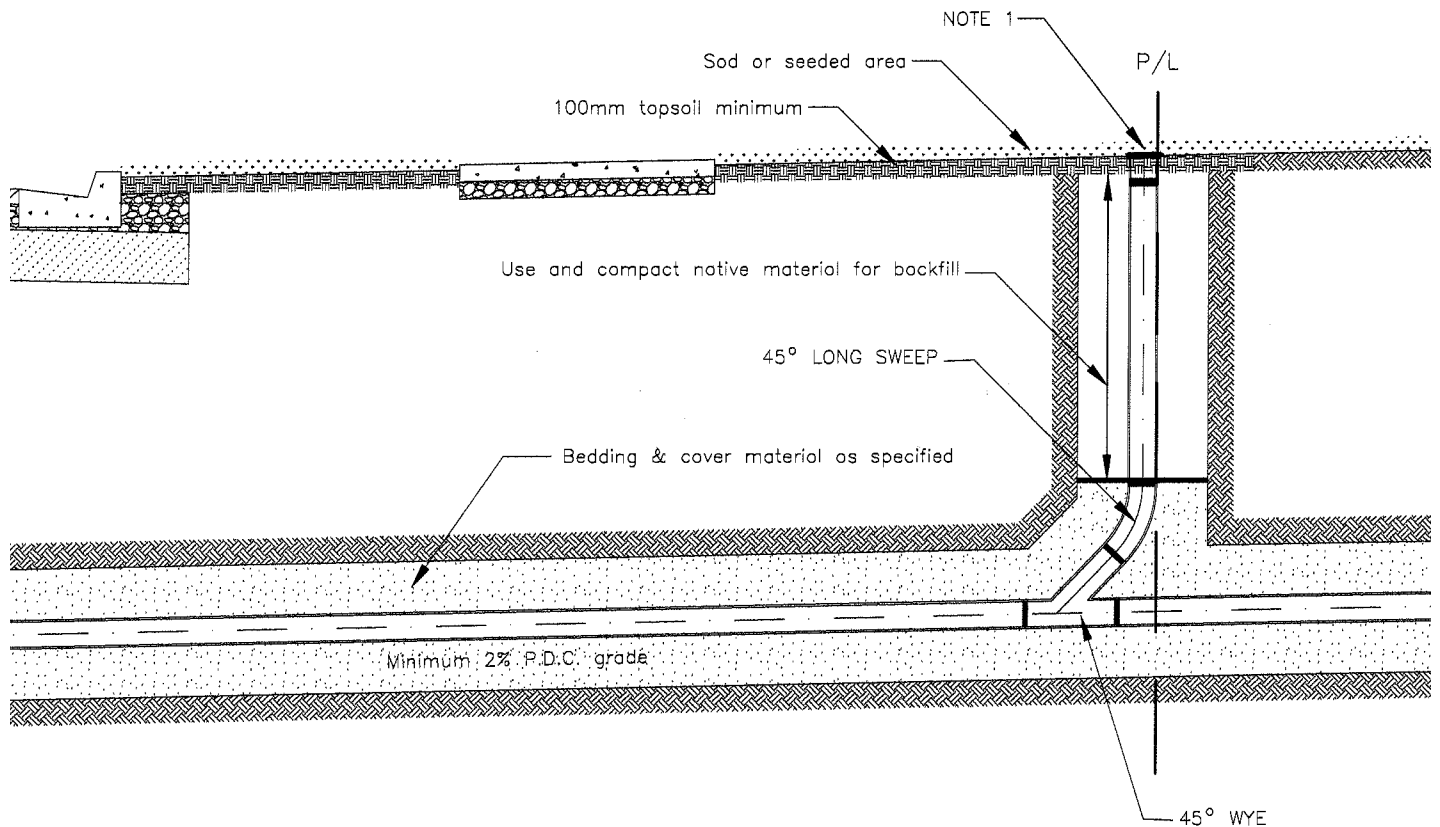
67.5° MAXIMUM - UNSTABLE BANK CONNECTIONS

DATE: 2017-04

FIGURE 4.14

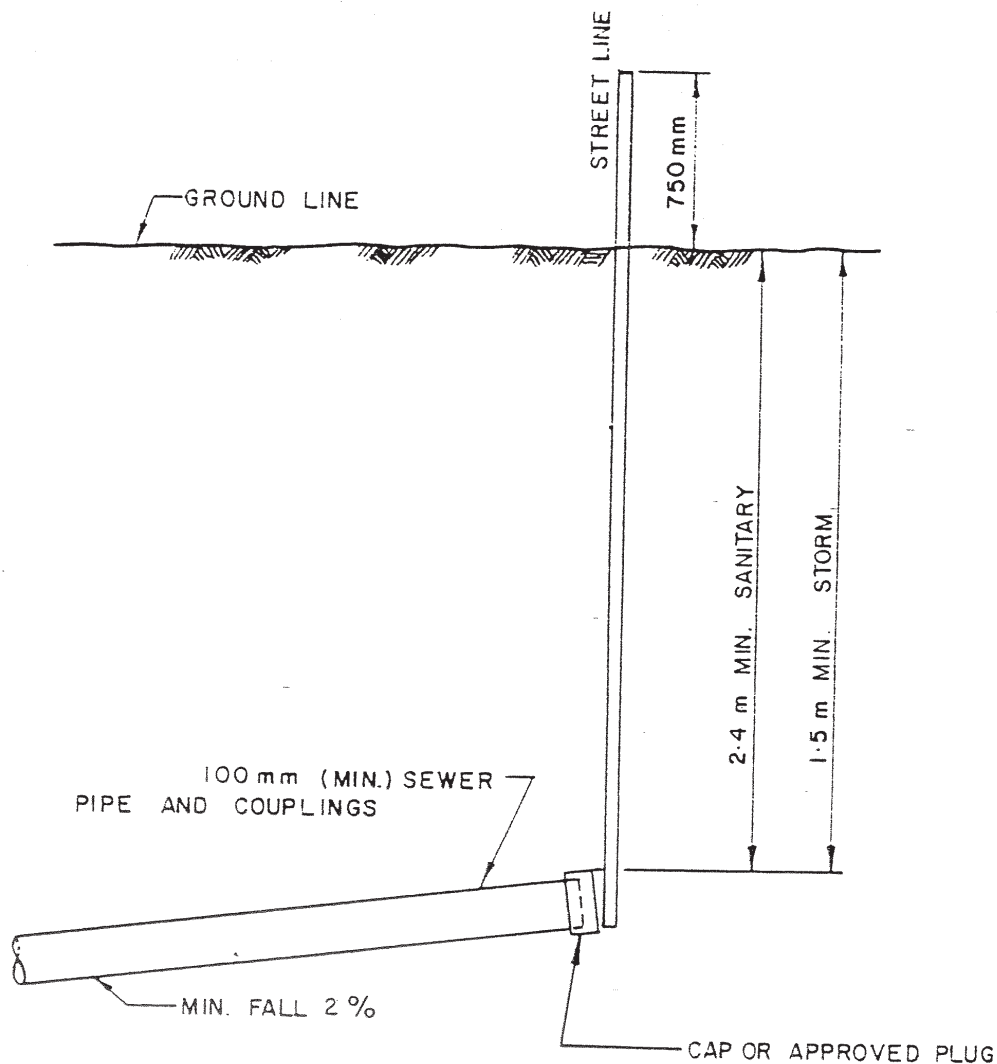


1. The pipe diameter of the cleanout pipe shall equal the pipe diameter of the P.D.C.
2. The minimum inside diameter for sanitary P.D.C. cleanout is 100mm.
3. Approved prefabricated wyes and long radius sweeps shall be used for all P.D.C. cleanout connections.
4. Where applicable, approved end caps are required at property line to complete the P.D.C. installation. They shall be braced to withstand pressure testing when required.



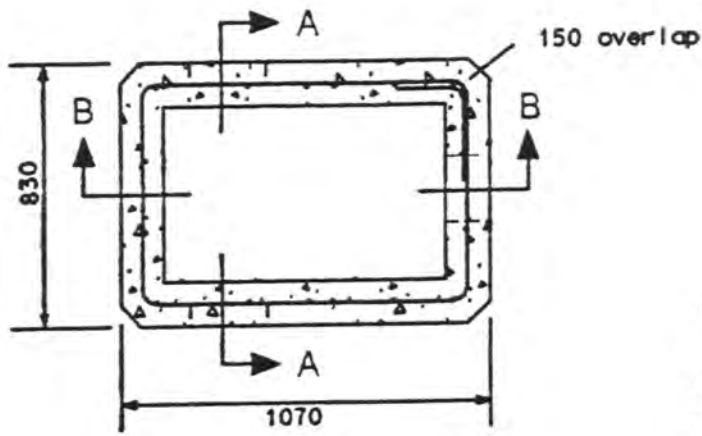
Note 1

- a) Cleanout Hard (Rigid) Surface Installation: Use cast iron cap and install flush with surface.  
 Cleanout 4" – EMCO#DF44 – SKU 6463049  
 Cleanout 6" – EMCO#DF66 – SKU 6463052
- b) Cleanout Soft Surface (Grass) Installation: Use standard plastic cap, with peak flush with grass surface.  
 4" bds threaded adapter EMCO#SKU 6012213  
 4" bds threaded plug EMCO#SKU 6015263  
 6" bds threaded adapter EMCO#SKU 6010059  
 6" bds threaded plug EMCO#SKU 6010084

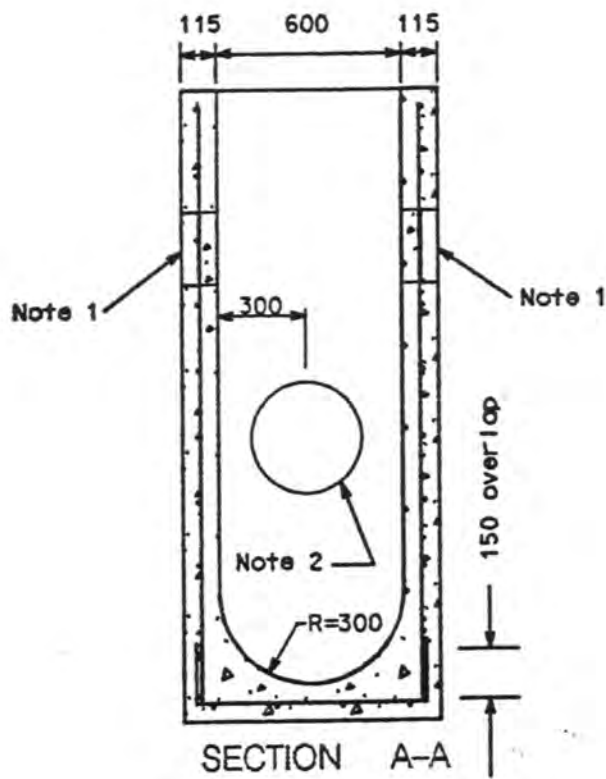


**NOTES:**

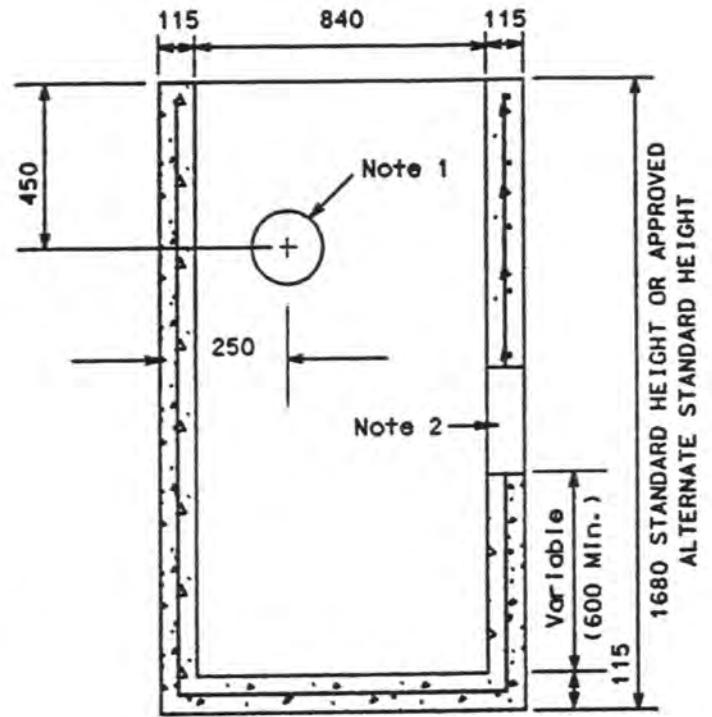
1. The pipe diameter of the cleanout pipe equals the pipe diameter of the PDC.
2. The minimum inside diameter for sanitary PDC cleanout is 100mm.
3. Approved prefabricated tees shall be used for all PDC cleanout connections.
4. Where applicable, approved and plugs are required at property line to complete the PDC installations. They shall be braced to withstand pressure testing when required.
5. When cleanout is required to service the PDC between property line and the sewer main it shall be constructed as a 'reverse image' of the drawing above.



PLAN



SECTION A-A

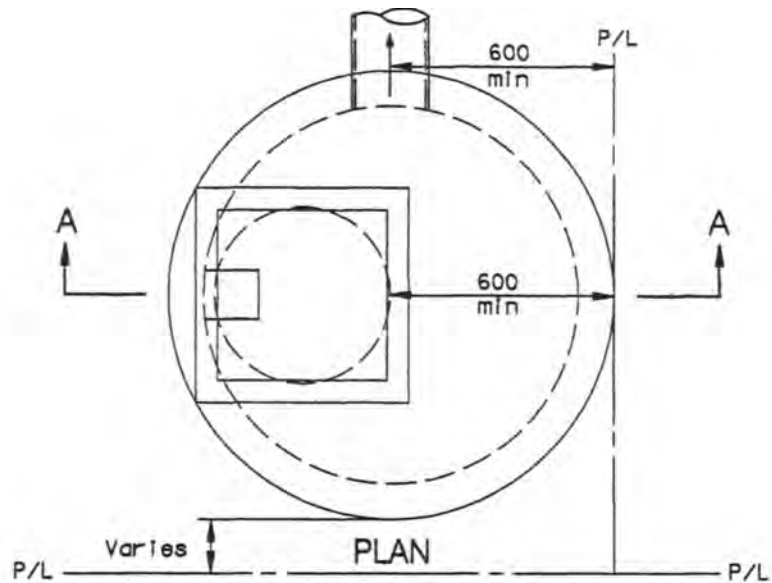


SECTION B-B

**NOTES:**

1. 200mm dia. knockout to accommodate subdrain. Knockout to be half wall thickness from the outside.
2. Outlet hole size 400mm dia. location as required.
3. All reinforcing steel bars to be 15. Reinforcing steel shall have 50mm cover.
4. Granular backfill to be placed and compacted to a minimum thickness of 300mm all around
5. Adjustment units shall be installed as per OPSD-704.010
6. Class of concrete: 30 MPa at 28 days
7. Refer to OPSD-400.09 for catch basin cast iron curb inlet overflow plate details.

**All dimensions are in millimeters unless otherwise shown.**

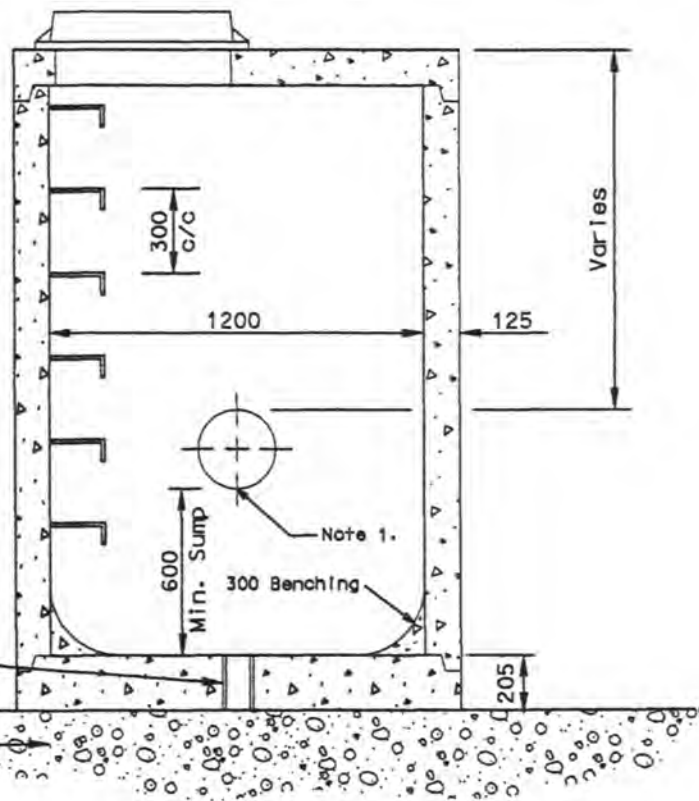


**NOTES:**

- Outlet hole diameter = 400mm, located as required.
- 2. Adjustment units and components shall be installed as per OPSD 701.030
- 3. Class of concrete 30 MPA at 28 days
- 4. Refer to OPSD 400.02 to catchbasin cast iron frame and flat square grate
- 5. All catch basin maintenance hold leads and grates are to be located a minimum of 0.6m from the P/L.

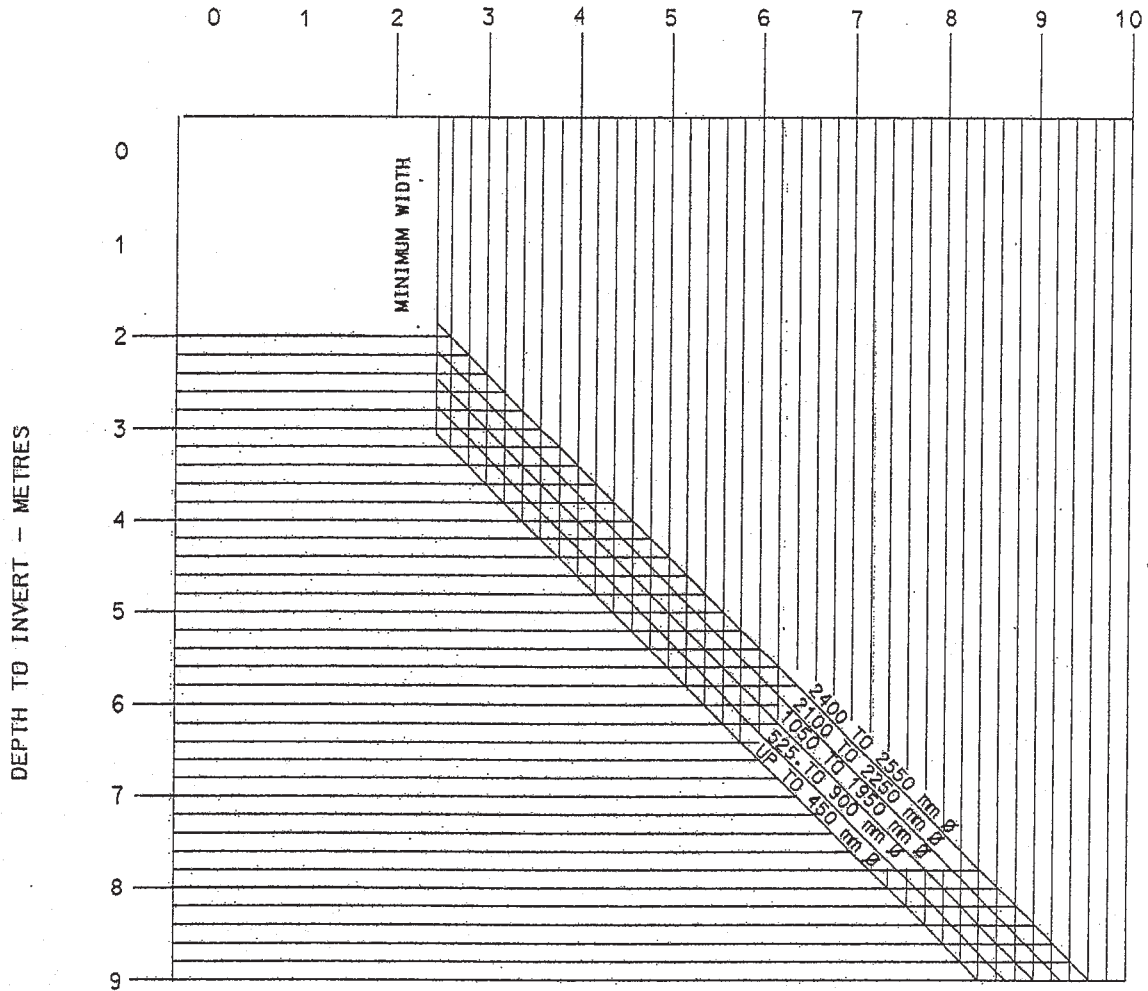
100mm dia. drain tile to be used in permeable soil

19mm crushed stone bedding  
150mm minimum depth



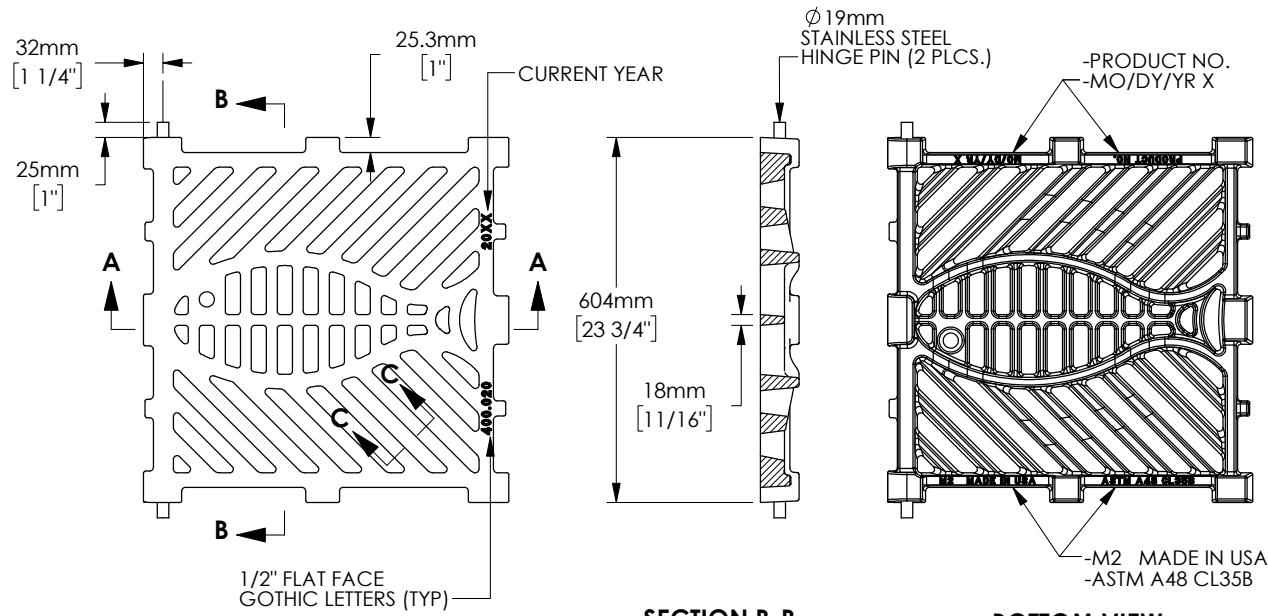
SECTION A-A

MINIMUM WIDTH OF EASEMENT - FROM C/L OF SEWER - METERS



**NOTES:**

1. Minimum easement width measured from C/L of sewer pipe e.g.: 675mm dia., sewer with invert 3.9m below finished surface elevation - width of easement required = 3.6m each side or a total width of 7.2m.
2. Through fields, open space, etc., 9.1m minimum - 3.0m on one side of sewer C/L and 6.1m on the other side, or at least 3.0m wider than the minimum width obtained from this chart. As required by Municipal Engineer.



- Design Features**
- Materials  
Gray Iron (CL35B)
  - Design Load  
Heavy Duty
  - Open Area  
239 sq. in
  - Coating  
Undipped
  - √ Designates Machined Surface

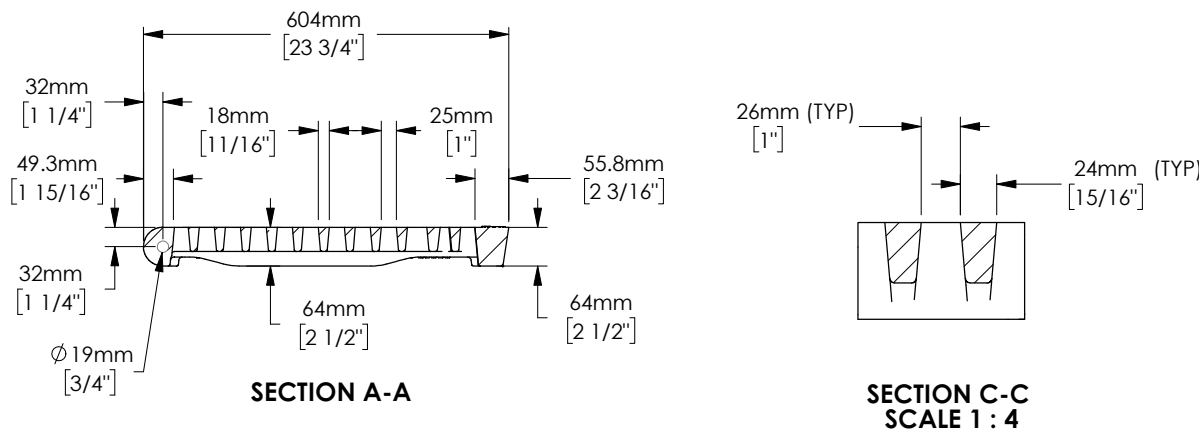


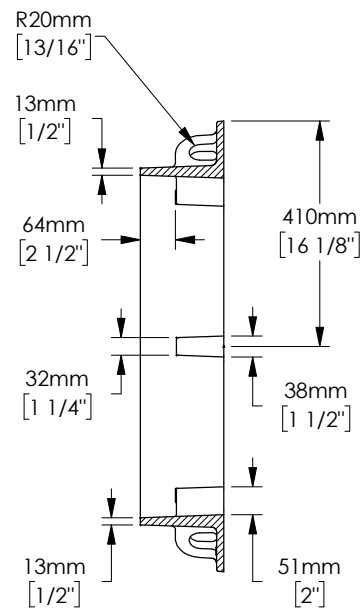
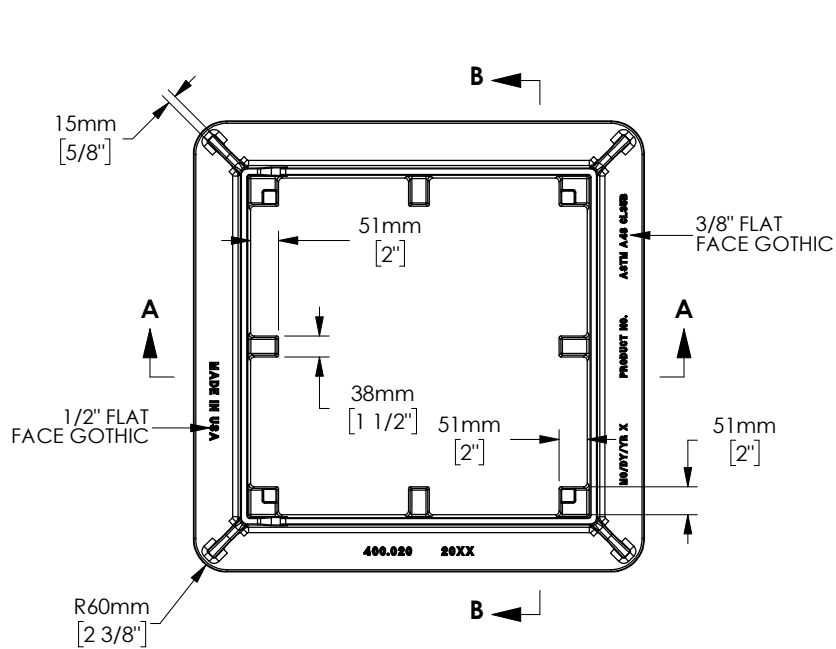
FIGURE 4.20a



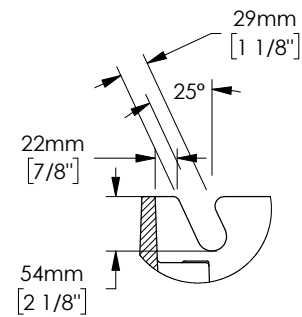
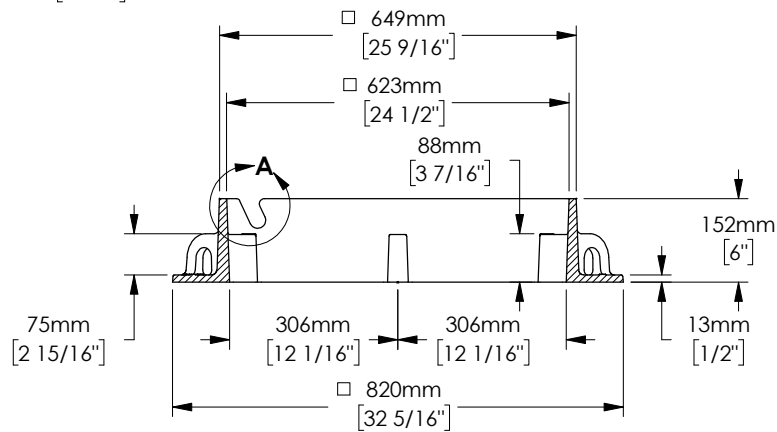
TYPICAL CATCHBASIN FRAME AND GRATE

DATE: 2018-01

FIGURE 4.20a



- Design Features**
- Materials
    - Gray Iron (CL35B)
  - Design Load
    - Heavy Duty
  - Open Area
    - n/a
  - Coating
    - Undipped
  - √ Designates Machined Surface



SECTION B-B

DETAIL A  
SCALE 1 : 6

SECTION A-A

TYPICAL CATCHBASIN FRAME AND GRATE