Borrello Subdivision
Infrastructure Servicing Brief

Prepared For:

3428 Woodroffe Avenue
Mr. Antonino Borrello

Prepared By:

Robinson Land Development

Our Project No. 14057
Revised February 2017

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1.0 INTRODUCTION

Robinson Land Development (a division of Robinson Consultants Inc.) has been retained by Mr. Antonino Borrello to provide the detailed engineering design for the water, storm and sanitary servicing for a 30 lot subdivision at 3400-3428 Woodroffe Avenue. The development area is tributary to the existing Strandherd Stormwater Management Facility. The location of the development is shown on **Figure 1**.

This development has been designed in accordance with current City of Ottawa design standards and the recommendations/guidelines stated in the following reports:

South Nepean Urban Master Servicing Study Report, July 1997, revised 1998, prepared by J.L. Richards & Associates.

Cumming Cockburn Ltd. (CCL) detailed serviceability study in 1998 for the Area tributary to the Strandherd Stormwater Management Facility.

Serviceability Report for Draft Plan of Subdivision, April 2004, revised June 2004, prepared by Cecil D. Naraine Associates Limited.

2.0 WATERMAIN DISTRIBUTION

The lands will be serviced from the Barrhaven (BAR) high-pressure zone. Boundary conditions for the water distribution system were compared to existing models performed on the surrounding networks and confirmed with the City of Ottawa. Refer to the Watermain Hydraulic Analysis Report prepared by Robinson Land Development dated April 2015 for detailed analysis on the water supply network.

The existing water supply system in the vicinity of this development consists of a 305 mm diameter watermain along Woodroffe Avenue and a 203mm diameter on Stoneleigh Street.

It is proposed to service the site with a 203mm diameter watermain connecting to the existing City of Ottawa watermain infrastructure at the intersection of Woodroffe Avenue and Stoneleigh Street.

3.0 SANITARY SEWER DESIGN

Sanitary sewer flows for this proposed development have been calculated based on the current 2012 City of Ottawa's "Sewer Design Guidelines. The design criteria for this development are as follows:

- Average residential flow 350 Lcap/day
- Peaking factor for residential flow (Harmon formula) (1 + (14 / (4 + P1/2)))*k
- (max. = 4.0, min. = 2.0,k = 0.4 to 0.6, P = population in 1000's)
- Extraneous flow allowance 0.28 L/sec/ha
- Population density for single family units 3.4 persons/unit
- Population density for town-home units 2.7 persons/unit

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scale N.T.S.	CLIENT: BORRELLO SUBDIVISION	project no. 14057
date 22/05/15		
drawn by JHB	TITLE: KEY PLAN	FIG 1.0

• Undeveloped land persons/gross ha.	60
• Minimum full flow velocity	0.6 m/sec
• Maximum velocity	3.0 m/sec
• Minimum pipe size	200 mm
• If 10 or fewer units are tributary to a sewer, than a 200 mm diameter sewer at a minimum grade of 0.65% shall be used.	
• Manhole spacing	< 120 metres
• Minimum cover to pipe obvert	2.5 metres

The sanitary sewer network for the subdivision will be 200mm diameter. The maximum peak sanitary discharge from the development area is expected to be approximately 1.78 L/s. Sanitary and storm stubs to the subdivision were installed in 2014 when the main line sewers were being installed on Woodroffe Avenue. Refer to the as built drawing in Appendix A.

During the design of the Woodroffe Avenue and Stoneleigh Street sanitary sewers there was no allocation for the proposed Borrello Development Property. The majority of the sanitary flow from the development will be directed to the existing sanitary system on Stoneleigh Street. This will increase the flow on the existing sanitary sewer by 1.78 L/s. There are 8 new connections to the existing sanitary sewer on Woodroffe Avenue. The new connections will increase the sanitary flow 0.58 L/s. The existing sanitary sewer system has been analysed downstream of the proposed connections and illustrates that there is excess capacity to convey the increased flows. Refer to Appendix B for the sanitary design sheet and the Sanitary Drainage Area Plan.

4.0 STORM AND STORMWATER MANAGEMENT

This development has been designed using the dual drainage concept providing a storm sewer system (minor) and utilizing overland flow (major) routes. The minor system drains to the Strandherd Stormwater Management Facility on Prince of Wales Drive.

The minor system has been designed using the rational method, to convey frequent storm events up to the 1:5 year return period. Inflow into the minor system has been restricted using inlet control devices (ICD's) located in all catchbasins that are directly connected to the storm sewer system. The ICDs will restrict inflow to the system to a maximum of 70 L/sec/ha.

The existing minor system on Woodroffe Avenue was designed to accommodate this development. The Woodroffe Avenue minor system design accounted for a drainage area of 2.48 ha (which included the 2.36 ha Borrello Property) for pipe run 201 to 202 which resulted in a peak flow of 242.17 L/s. The detailed design of the Borrello Property will now attribute a 2.58 ha drainage area at a peak flow of 229.49 L/s. Therefore, the proposed flows from the Borrello Development are approximately 13 L/s less than what was assumed in the Woodroffe Avenue minor system design.

The existing Strandherd Stormwater Management Facility was originally not sized to include the minor drainage area flows from the Borrello property, however the overall drainage area used to design and construct the facility was 315 ha (refer to documentation obtained from the Strandherd Stormwater Facility Design Report by CG&S CH2M & Gore & Storrie Limited dated February 1998 in Appendix C). Since the construction of the pond, the former City of Nepean required a more detailed analysis of the drainage area based on future road patterns. The outcome of this study resulted in the reduction of the total drainage area contributing to the Strandherd Stormwater Management Facility to 300ha. As a result of the reduction of 15 ha in the total drainage there is sufficient capacity in the SWM pond to receive the minor flows from the Borrello lands of approximately 1.5 ha. Documentation from the Cecil D. Naraine Serviceability Report and Cumming Cockburn Ltd. (CCL) detailed serviceability study in 1998 for the Area tributary to the Strandherd Stormwater Management Facility has been included in Appendix C.

The Strandherd Stormwater Facility was also designed based on an imperviousness of 55% for the entire drainage area of 315 ha. The average percent imperviousness for the proposed Borrello property is 41% which therefore meets the requirements the stormwater pond was designed for.

Major overland flow has been routed to drain along the municipal roadways. The roadways have been designed to allow ponding in road sags to a maximum depth of 0.30 m on the local streets. Rear yard swales have been designed to allow ponding to a maximum depth of 0.30m. The drainage system for the proposed development was modelled using DDSWMM (v. 2.1) to determine the overland flow discharges from each sub-drainage area, and the total volume of runoff that will be directed along major overland routes.

4.1 Storm Sewer Hydraulic Grade Line

The local storm sewer system which outlets to the existing trunk storm sewers on Strandherd Drive have been designed to convey flows based on the City of Ottawa 5 year Intensity Frequency Duration curve. The hydraulic grade line will be contained within the local storm sewer system and will not be elevated above the storm obvert. The proposed development drains to the Strandherd SWM Facility and is not affected by the HGL elevation from the SWM Facility.

4.2 Allowable Direct Connection Catchbasins

The Borrello subdivision is approximately 2.36 hectares. The trunk storm sewer systems are designed to convey minor system flows to the Strandherd Stormwater Management Facility. The existing trunk storm sewer flows along Strandherd Drive, Crestway Drive, Hathaway Drive, Cresthaven Drive, Sunvale Drive, Fairpark Drive and then to the Strandherd Stormwater Management Facility for treatment prior to discharge to the Rideau River.

In accordance with the South Nepean Urban Area Study, storm drainage is to be controlled at the source to limit runoff rates to 70 L/s/ha.

$$70\ L/s/ha \times 2.36\ ha \approx 165.2 L/s$$

Table 1.0 summarizes the number of proposed catchbasins directly connected to the storm sewer system and release rate in the Borrello Subdivision:

Table 1.0
Number of Directly Connected Catchbasins and Release Rate

Location	100 Year Release Rate (L/s)	Max. Head 100 yr (m)	Orifice Diam. (mm)	Orifice Type
CB 1	20.0	1.21	93.3	Plug
CB 2	14.2	1.23	78.3	Plug
CB 3	31.0	1.23	115.7	Plug
DCB 4	20.0	1.10	95.6	Plug
DCB 5	20.0	1.23	92.9	Plug
CB 6	25.0	1.40	100.6	Plug
CB 7	15.0	0.98	85.3	Plug
CB 8	20.0	1.30	91.7	Plug

There are 8 catchbasin connections to the minor system proposed within this development with a total release rate to the minor system of 165.2 L/s.

4.3 Post-Development Average 'C' Value

The following runoff coefficients used to design the storm sewer system were calculated based on each individual storm area.

C = 0.20 for grassed areas
C = 0.90 for asphalt, sidewalk and roof areas

The runoff coefficient for each storm drainage area has been calculated individually. The runoff coefficient varies from 0.34 to 0.67. The overall average runoff coefficient for the entire site is 0.48. Refer to the storm sewer design sheet for individual runoff coefficients.

4.5 Storage Requirements

4.5.1 Overall Storage Requirements

The City of Ottawa has developed design standards for the South Nepean Area that determined an average storage volume of 130 m^3/ha was necessary to prevent individual sub-drainage areas from flowing overland up to the 100-year design storm. This was identified in the 1998 CCL serviceability study. Using the storage requirement of 130 m^3/ha, provided by the City of Ottawa for the South Nepean Area, (refer to Appendix C for documentation) the overall storage requirement to prevent major system overland flow from the Borrello Subdivision is:

$$\mathbf{2.36\ ha \times 130\ m^3/ha = 306.8\ m^3}$$

The storage requirement for certain drainage areas is greater than the available storage capacity. Therefore, some areas will flow overland. The development has been designed to provide an overland drainage flow route along the municipal road to the existing ditch on the west side of Woodroffe Avenue, which ultimately discharges into the Rideau River.

A total of 85.4 m^3 of storage is available within the subdivision roadway sags and rear yard subdrain system. Storage in rear yard swales has not been included in accordance with the City's Sewer Design Guidelines.

Flows in excess of the provided volume will overland flow to both Woodroffe Avenue and to the rear of Lots 12-15. The post development contributing area to the existing ditch and culverts on Woodroffe Avenue has been reduced by 0.94 ha from the pre-development conditions. Refer to the Storm Drainage Area Plan STM2 and the Woodroffe Culvert Capacities in Appendix C.

The post development contributing area to the rear of Lots 12-15 has been reduced from the pre-development conditions. Refer to Figure 2 and Figure 3 for the pre and post 5 and 100 year flows. The overland flow will be directed to the rear yard swales which will retain, via surface ponding, all flows up to and including the 100 year storm event. The 100 year storage requirement is 56.6cu.m. which has been calculated using the rational method. The storage provided in the rear yard swale is 57.0cu.m. Refer to the storage requirement in Appendix C. Storms in excess of the 100 year event will outlet at 3 different locations to the lot lines of the existing residential area to the west and directed into existing grass swales to the existing ditch on Newland Drive. Refer to Figure 4 for overland flow locations.

The drainage system has been modelled using City approved DDSWMM (ver. 2.1) software to determine the overland flow discharges from each sub-drainage area, and the total volume of runoff that will be directed along major overland routes. The Chicago 3 Hour – 100 Year storm has been used in the analysis. The main design parameters used in the DDSWMM modelling software (as derived from Section 5 of the Sewer Design Guidelines) are:

Depression storage:	1.57 mm for impervious areas 4.67 mm for pervious areas
Manning's roughness coefficient	0.013 (for impervious areas) 0.25 (for pervious areas)
Sub-area Width (width parameter)	2 x Street Segment Length
Infiltration Parameters	Max. Infiltration – 76.2 mm/hr Min. Infiltration – 13.2 mm/hr
Decay Coefficient (t-1)	0.00115 s-1

The following tables summarize the anticipated peak flows and depth of flow at the curb line for the 100 year storm event. Please refer to Appendix C for the DDSWM modelling output. The major drainage area I.D. numbers are referenced on drawing 14057-SWM1 in Appendix C.

Table 2 – DDSWMM Summary of Results

Drawing #	Drainage Area I.D.	100 Yr Peak Flow (cms)	100 Yr Static Depth (cm)	100 Yr Dynamic Depth (cm)	100 Yr Total Depth (cm)
SWM1	SWM13	0.02	11.0	7.72	18.72
	SWM11	0.03	11.0	8.95	19.95
	SWM8	0.06	13.0	11.36	24.36
	SWM3	0.10	13.0	14.05	27.05
	SWM7	0.08	0.0	4.57	4.57
	SWM1	0.14	13.0	15.73	28.73

Table 3 – DDSWMM Summary of Results with 20% Stress Test

Drawing #	Drainage Area I.D.	100 Yr Peak Flow (cms)	100 Yr Static Depth (cm)	100 Yr Dynamic Depth (cm)	100 Yr Total Depth (cm)
SWM1	SWM13	0.03	11.0	8.30	19.30
	SWM11	0.05	11.0	10.34	21.34
	SWM8	0.09	13.0	13.32	26.32
	SWM3	0.14	13.0	15.92	28.92
	SWM7	0.11	0.0	5.17	5.17
	SWM1	0.20	13.0	18.15	31.15

4.5.2 Analysis of Existing Downstream Culverts

The Borrello Subdivision outlets to an existing ditch system on the west side of the existing Woodroffe Avenue before flowing into the Rideau River on the south side of Prince of Wales Drive. As part of the supporting design analysis for the subdivision, the existing culverts were analysed to ensure that they would continue to provide the required (as per current City of Ottawa Guidelines, Table 6.4 Road Type vs. Culvert Design Storm) level of service (LOS) once the Borrello Subdivision is developed. The required level of service was based on the road type and design storm. All existing culverts will continue to meet the required LOS as per City of Ottawa design guidelines. All existing driveways were analysed based on a 5 year design storm even though driveways do not fall under the Table 6.4 classification. The road cross culverts at Bren Maur Road, Cortleigh Drive, Woodroffe Avenue and Lodge Road have been analysed based on a 25 year design storm and the culvert crossing Prince of Wales Drive has been analysed based on a 50 year design storm. The existing ditch on the west side of Woodroffe Avenue has been analysed for the 100 year post development flow at 3 locations for the impact on the existing residents downstream of the development. The 100 year flows indicated on the cross sections in Appendix C illustrate that the flows are contained within the roadside ditch on Woodroffe Avenue.

See summary Table 4 below and Appendix C for the culvert analyses supporting documentation and drawing #14057-STM2)

Table 4 – Level of Service (LOS) Analysis for existing Woodroffe Avenue Culverts

Culvert #	LOS required (year)	Min. Available freeboard (m)
1	5	0.67
2	5	0.45
3	5	0.67
4	25	0.47
5	5	0.44
6	5	0.38
7	5	0.60
8	5	0.43
9	25	0.40
10	25	0.57
11	50	2.03
12	50	1.10

5.0 EROSION AND SEDIMENT CONTROL

It will be necessary to implement the following sediment control measures, in accordance with current Ministry of Environment and Climate Change, Best Management Practice guidelines, in order to minimize the transport of sediment to adjacent lands and into the existing storm sewer system. (see Appendix A, 14057-ESC1 for details of the proposed control measures).

As a minimum, the following measures are proposed for this development:

- Installation of straw bale dams within existing drainage ditches
- Silt fence along property boundaries where construction is taking place
- Filter fabric installed between the frame and cover of adjacent manholes and catchbasins
- Minimization, wherever possible, of exposed soils and cleared areas
- Soil stockpiles to be located away from any existing drainage ways and stabilized as soon as possible

These measures will be installed prior to construction and maintained in good order until construction has been completed and vegetation has been re-established in all disturbed areas.

6.0 CONCLUSION

The Borrello Subdivision has been designed to direct the 1:100-year overland flow along the municipal roadway to the existing ditch on the west side of Woodroffe Avenue, ultimately to the Rideau River. The overland flow routes are shown on the drawings in Appendix A.

This report satisfactorily addresses the method by which this site will meet the overall stormwater management requirements of the City of Ottawa. Inlet control devices are to be placed in all direct connection catchbasins. Their release rates range from 14.2 to 31.0 L/s for a total release rate from the minor system of 165.2 L/s. The recommended inlet control device is the Tempest MHF (Plug Type), (see Appendix C). The ICD is to be installed in the outlet pipe of all catchbasins directly connected to the storm sewer system. Using 3.5 catchbasins/hectare, and considering the entire area encompassed by the Borrello Subdivision, a total drainage area of 2.36 hectares, there can be a maximum of 8 catchbasins directly connected to the storm sewer system. The proposed design requires 8 catchbasins directly connected to the storm sewer system.

All storm sewers have been designed for a post-development 1:5-year storm event, which meets the current level of service for urban residential development. The storm sewer system will provide the usual 5-year level of service if the City of Ottawa considers it appropriate to remove the inlet control devices at some point in the future.

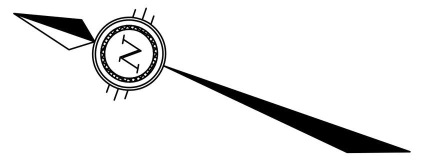
The design has incorporated current City of Ottawa design standards.

In conclusion, sufficient capacity within the existing water, sanitary and storm municipal infrastructure exists to support the proposed subdivision development.

Prepared By:	Reviewed By:
John Burns Senior Designer – Land Development	Sean M. Czaharynski, P.Eng. Manager – Land Development

Appendix A

General Plan of Services
(Drawing #14057-S1)
Grading and Drainage Plan
(Drawing #14057-GR1)
Erosion and Sediment Control Plan
(Drawing #14057-ESC1)
Sanitary and Storm Subdivision As Built Stubs

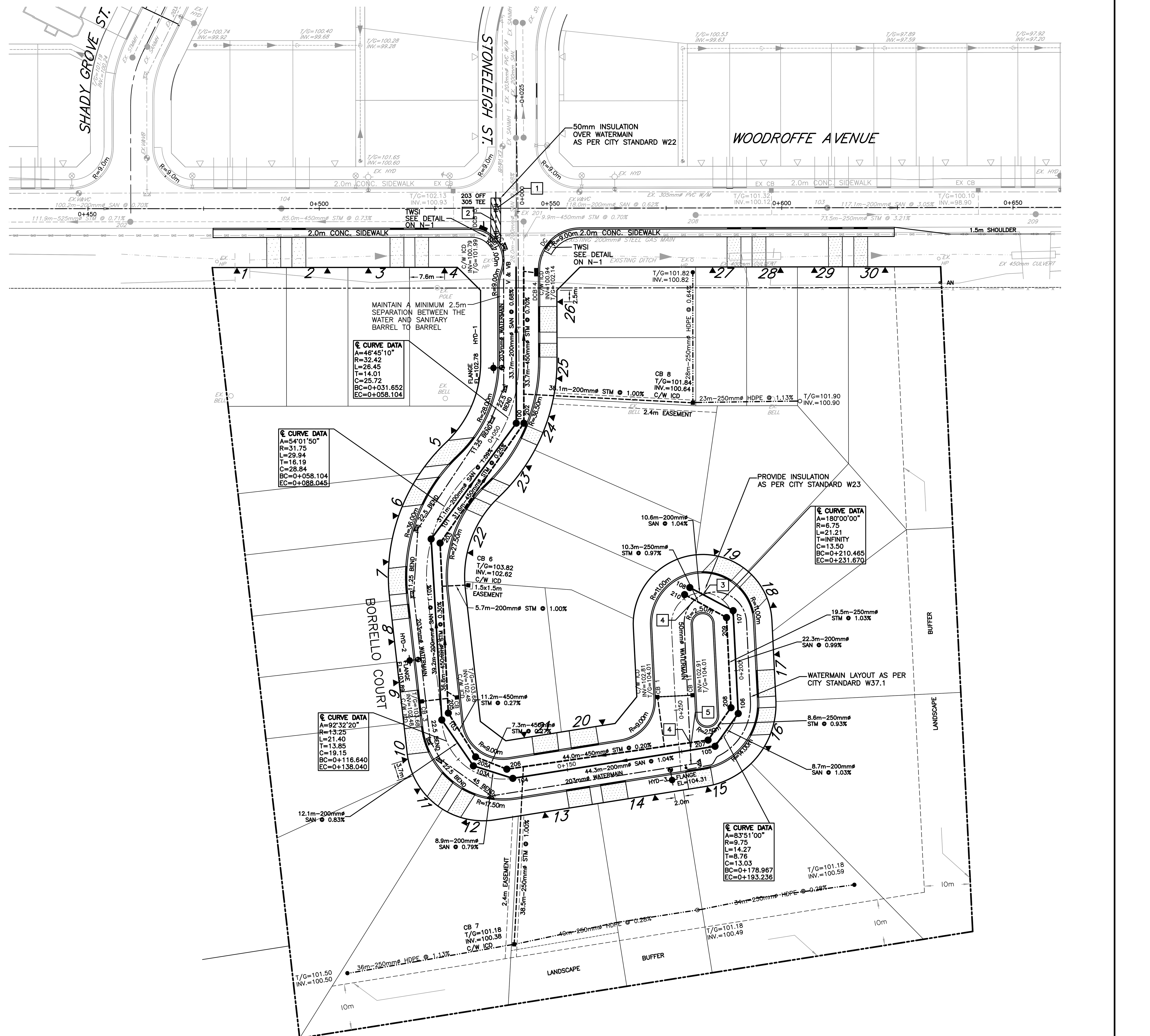


LEGEND

- PROPOSED SERVICE LATERAL LOCATION SINGLE SERVICE 135mm SANITARY 100mm STORM 19mm WATERMAIN
- PROPOSED HYDRANT WITH VALVE AND VALVE BOX
- THRUST BLOCK & RESTRAINING JOINTS
- MH 109 SANITARY SEWER WITH MANHOLE
- MH 209 STORM SEWER WITH MANHOLE
- WATERMAIN
- EX 109 EXISTING SANITARY SEWER WITH MANHOLE
- EX 209 EXISTING STORM SEWER WITH MANHOLE
- EXISTING WATERMAIN
- DRIVEWAY LOCATION
- STREET CATCHBASIN
- REAR YARD CATCHBASIN
- VALVE AND VALVE BOX
- CB T6 CATCHBASIN OUTLETTING TO ANOTHER CATCHBASIN
- CB 6 CATCHBASIN OUTLETTING DIRECTLY TO STORM SEWER SYSTEM
- SWALE c/w 250mmø HDPE SUBDRAIN
- SWALE w/o SUBDRAIN
- PROPOSED DITCH
- EXISTING DITCH
- EASEMENT
- REAR YARD ELBOW CATCHBASIN
- REAR YARD TEE CATCHBASIN

CATCHBASIN SUMMARY TABLE					
CB No.	ICD ORIFICE (L/s)	MAX. HEAD (m)	C/L ICD	ORIFICE DIAM. (mm)	ICD TYPE
CB 1	20	1.21	102.91	93.3	PLUG
CB 2	14.2	1.23	102.58	78.3	PLUG
CB 3	31	1.23	102.58	115.7	PLUG
DCB 4	20	1.10	101.05	95.6	PLUG
DCB 5	20	1.23	100.89	92.9	PLUG
CB 6	25	1.40	102.72	100.6	PLUG
CB 7	15	0.98	100.51	85.3	PLUG
CB 8	20	1.30	100.74	91.7	PLUG

CROSSING TABLE					
CROSSING No.	STATION	WATER	SANITARY	STORM	SEPARATION (m)
1	−0+000.7	INV.=99.70	OBV.=97.83	N/A	1.87
2	0+002.2	INV.=99.86	N/A	OBV.=99.52	0.34
3	0+220.6	INV.=102.06	OBV.=101.69	N/A	0.37
4	0+222.9	INV.=102.03	N/A	OBV.=101.17	0.86
4	0+257.4	INV.=101.83	N/A	OBV.=100.39	1.44
5	0+258.9	INV.=101.87	OBV.=101.07	N/A	0.80



NOTES

THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

NO.	REVISION DESCRIPTION	DATE	BY
4	REVISED PER CITY COMMENTS	28/09/16	SMC
3	REVISED PER CITY COMMENTS	17/06/16	SMC
2	REVISED PER CITY COMMENTS	10/12/15	SMC
1	ISSUED FOR REVIEW	25/05/15	SMC

SCALE
HORIZ. 1:500
0 5m 10m 20m

S. M. GIAMBRONE — LICENSED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO — SEPT 28/16

Robinson Land Development
350 PALLADIUM DRIVE
KANATA, ONTARIO K2V 1A8
TELEPHONE (613) 592-6060

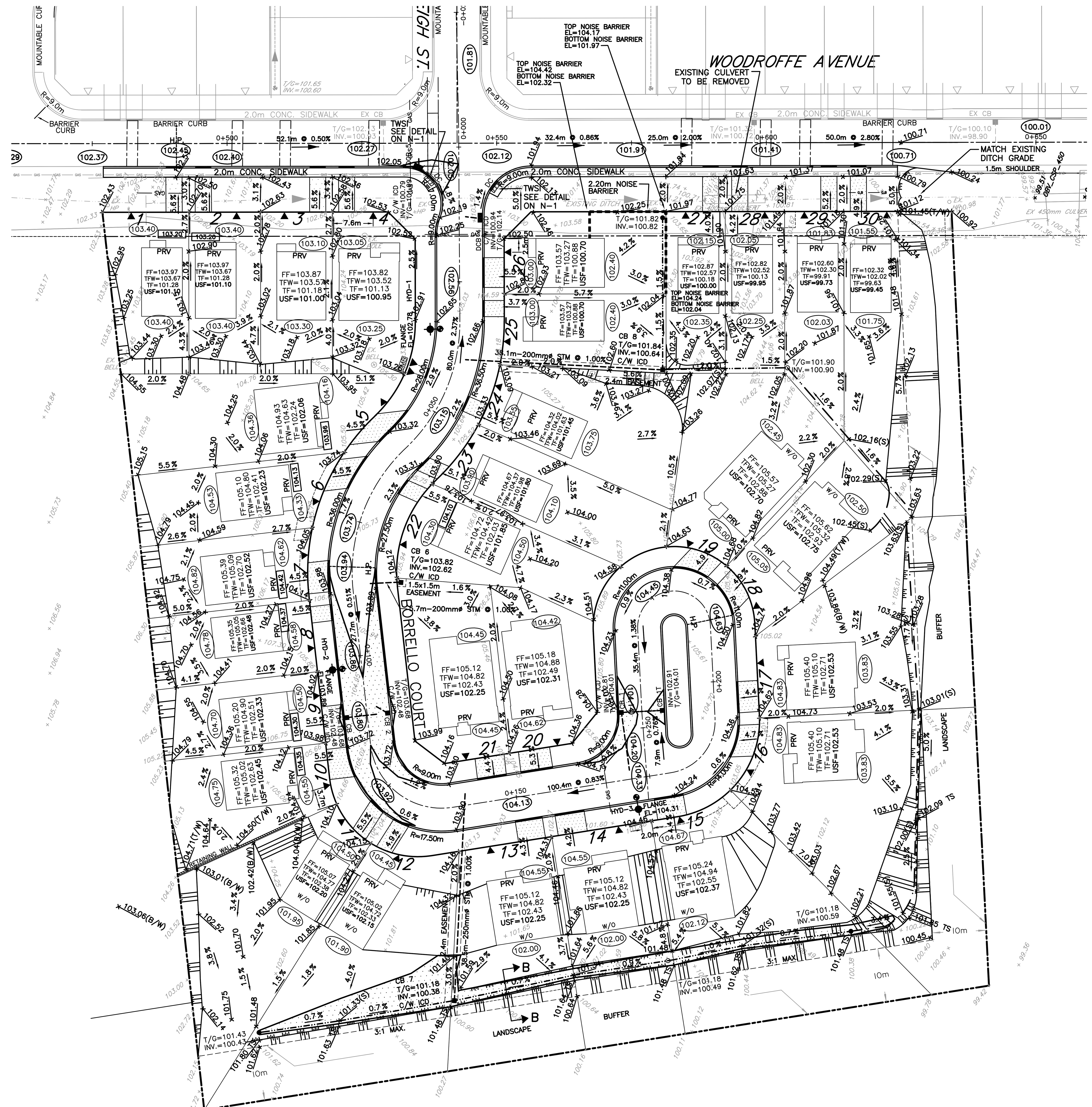
DESIGN	JHB
CHECKED	SMC
DRAWN	JHB
CHECKED	SMC
APPROVED	SMC

BORRELLO SUBDIVISION

514 KOCHAR DRIVE
OTTAWA, ON
K2C 4H3

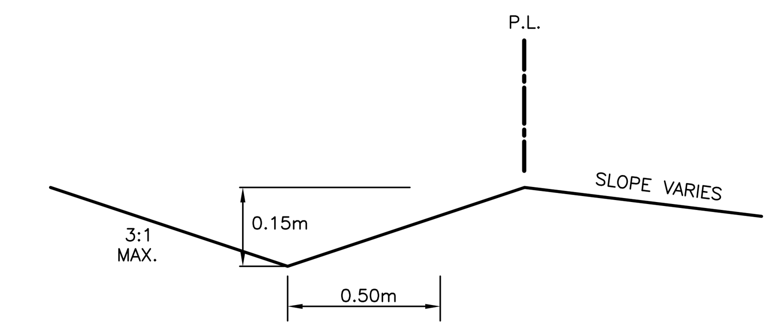
GENERAL PLAN OF SERVICES

PROJECT NO.	14057
SURVEY	RLD
DATED	MAY 2015
DWG. No:	14057-S1

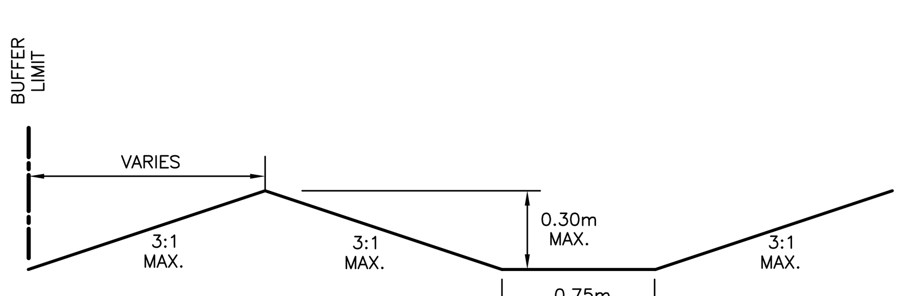


LEGEND

Symbol	Description
▲	PROPOSED SERVICE LATERAL LOCATION SINGLE SERVICE 135mm SANITARY 100mm STORM 19mm WATERMAIN
	DRIVEWAY LOCATION
■	STREET CATCHBASIN
■	REAR YARD CATCHBASIN
CB T6	CATCHBASIN OUTLETTING TO ANOTHER CATCHBASIN
CB 6	CATCHBASIN OUTLETTING DIRECTLY TO STORM SEWER SYSTEM
	SWALE c/w SUBDRAIN
	SWALE w/o SUBDRAIN
	PROPOSED DITCH
	EXISTING DITCH
	EASEMENT
	TERRACING
	REAR YARD ELBOW CATCHBASIN
○	REAR YARD TEE CATCHBASIN
91.90	PROPOSED TERRACE GRADE OR CENTRELINE ROAD GRADE
91.70	PROPOSED DRIVEWAY GRADE AT GARAGE
91.20	PROPOSED GRADE
91.76	EXISTING ELEVATION
2.5%	DRAINAGE DIRECTION AND SLOPE
PRV	PRESSURE REDUCING VALVE REQUIRED
	PONDING AREA



TYPICAL SWALE DETAIL



SECTION B–B

N.T.S.

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7	ISSUED FOR TENDER	15/09/17	SMC
6	ISSUED FOR ECA APPROVAL	23/06/17	SMC
5	REVISED PER CITY COMMENTS	21/02/17	SMC
4	REVISED PER CITY COMMENTS	28/09/16	SMC
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SCALE

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0 5m 10m 20m

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DESIGN	JHB
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DRAWN	JHB
CHECKED	SMC
APPROVED	SMC

BORRELLO SUBDIVISION

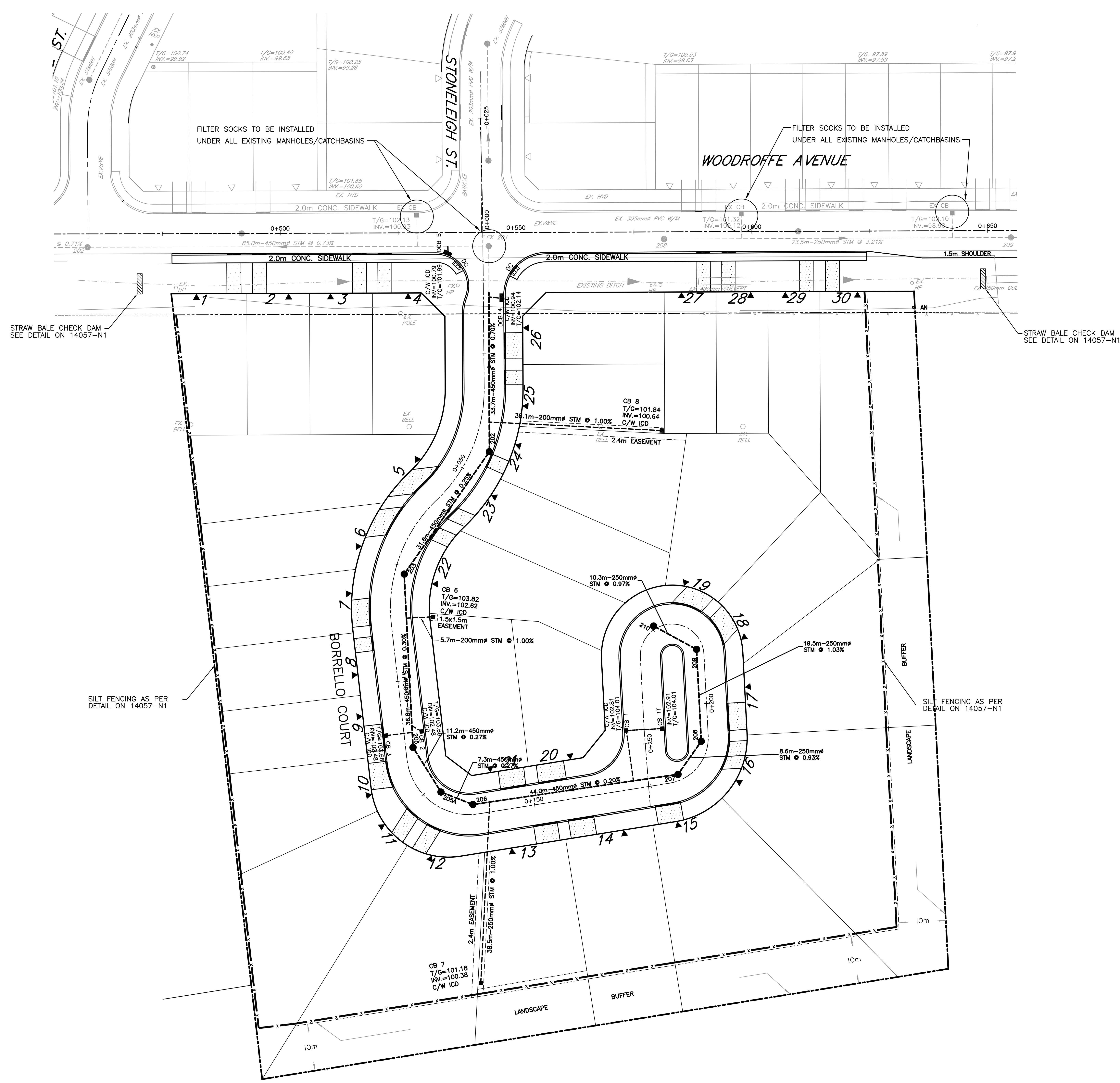
514 KOCHAR DRIVE
OTTAWA, ON
K2C 4H3

GRADING AND DRAINAGE PLAN

PROJECT NO.	14057
SURVEY	RLD
DATED	MAY 2015
DWG. No:	14057-GR1

LEGEND

- - - - - - -	EXISTING STORM SEWER
— · — · —	EXISTING DITCH
- - - - - - -	STORM SEWER
●	STORM MANHOLE
■	CB
— · — · —	SILT FENCE
▨	STRAW BALE CHECK DAM



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SCALE

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0 5m 10m 20m

LICENSED PROFESSIONAL ENGINEER S. M. CZARNYSKI SEPT 28 PROVINCE OF ONTARIO

Robinson Land Development

CONSULTING ENGINEERS

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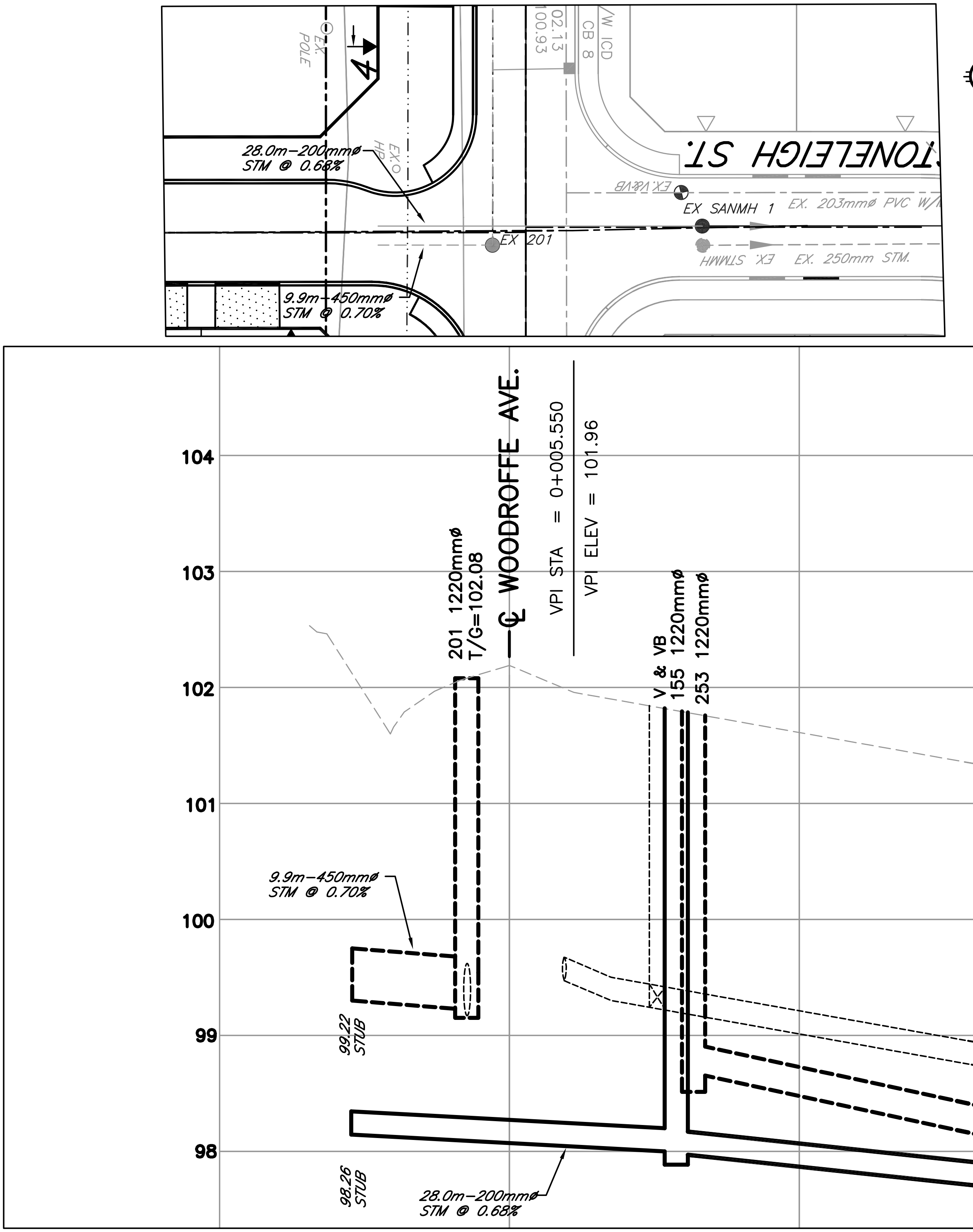
BORRELLO SUBDIVISION

514 KOCHAR DRIVE
OTTAWA, ON
K2C 4H3

EROSION AND SEDIMENT CONTROL PLAN

PROJECT NO.	14057
SURVEY	RLD
DATED	MAY 2015
DWG. No:	14057-EC1



Robinson Land Development

CONSULTING ENGINEERS

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scale 1:500	CLIENT:	BORRELLO PROPERTY	project no. 14057
date 13/11/14	TITLE:	SUBDIVISION SERVICES	P1
drawn by JHB			

Filename: p:\14\14057\drawings\borrello street profile.dwg
Last Saved: 11/13/2014 2:52:44 PM
Last Plotted:11/18/2015 10:34:38 AMPlotted by: jburns
Pen Table:: rld.ctb

Appendix B

Sanitary Sewer Design Sheet
Sanitary Drainage Area Plan
(Drawing #14057-SAN1)

SANITARY SEWER DESIGN SHEET
for
Borrello Subdivision

LOCATION			PROPOSED		EXISTING		CUMMULATIVE		PEAKING	PEAK	PEAK	PEAK	PROPOSED SEWER DATA					EXCESS
STREET	FROM MH	TO MH	POP.	AREA (ha)	POP.	AREA (ha)	POP.	AREA (ha)	FACTOR M	POP. FLOW (L/s)	EXTRAN. FLOW (L/s)	DESIGN FLOW (L/s)	LENGTH (m)	PIPE SIZE (mm)	GRADE (%)	CAPACITY (L/s)	VELOCITY (m/s)	CAPACITY (L/s)
Borrello Court	108	107	3.40	0.1			3.40	0.10	4.00	0.06	0.03	0.08	10.60	203.2	1.04	34.93	1.08	34.85
Borrello Court	107	106	6.80	0.23			10.20	0.33	4.00	0.17	0.09	0.26	22.30	203.2	0.99	34.08	1.05	33.82
Borrello Court	106	105	3.40	0.19			13.60	0.52	4.00	0.22	0.15	0.37	8.70	203.2	1.03	34.76	1.07	34.40
Borrello Court	105	104	17.00	0.47			30.60	0.99	4.00	0.50	0.28	0.77	44.30	203.2	1.04	34.93	1.08	34.16
Borrello Court	104	103A	3.40	0.15			34.00	1.14	4.00	0.55	0.32	0.87	11.50	203.2	0.61	26.75	0.82	25.88
Borrello Court	103A	103	6.80	0.16			40.80	1.30	4.00	0.66	0.36	1.03	9.60	203.2	1.04	34.93	1.08	33.90
Borrello Court	103	101	13.60	0.24			54.40	1.54	4.00	0.88	0.43	1.31	39.20	203.2	1.10	35.92	1.11	34.61
Borrello Court	101	100	10.20	0.22			64.60	1.76	4.00	1.05	0.49	1.54	31.10	203.2	1.09	35.76	1.10	34.22
Borrello Court	100	*EX 155*	10.20	0.26			74.80	2.02	4.00	1.21	0.57	1.78	61.70	203.2	0.68	28.24	0.87	26.47
Stoneleigh Street	*EX 155*	*EX 145*			*18.70*	*0.24*	*93.50*	*2.26*	*4.00*	*1.52*	*0.63*	*2.15*	*25.00*	*203.2*	*1.60*	*43.32*	*1.34*	*41.18*
Stoneleigh Street	*EX 145*	*EX 146*			*66.50*	*0.67*	*160.00*	*2.93*	*4.00*	*2.59*	*0.82*	*3.41*	*96.00*	*203.2*	*1.75*	*45.31*	*1.40*	*41.90*
Shady Grove Street	*EX 146*	*EX 148*			*143.50*	*1.45*	*303.50*	*4.38*	*4.00*	*4.92*	*1.23*	*6.14*	*72.30*	*203.2*	*0.89*	*32.31*	*1.00*	*26.17*
Marabrooke Street	*EX 148*	*EX 149*			*35.00*	*0.43*	*338.50*	*4.81*	*4.00*	*5.48*	*1.35*	*6.83*	*46.60*	*203.2*	*1.14*	*36.57*	*1.13*	*29.74*
Marabrooke Street	*EX 149*	*EX 150*			*10.50*	*0.25*	*349.00*	*5.06*	*4.00*	*5.66*	*1.42*	*7.07*	*11.80*	*203.2*	*1.44*	*41.10*	*1.27*	*34.03*
Marabrooke Street	*EX 150*	*EX 151*			*38.50*	*0.37*	*387.50*	*5.43*	*4.00*	*6.28*	*1.52*	*7.80*	*68.80*	*203.2*	*1.51*	*42.09*	*1.30*	*34.29*
Woodroffe Ave.	*EX 105*	*EX 104*	3.40	0.04	*23.80*	*0.49*	*27.20*	*0.53*	*4.00*	*0.44*	*0.15*	*0.59*	*100.20*	*203.2*	*0.70*	*28.66*	*0.88*	*28.07*
Woodroffe Ave.	*EX 104*	*EX 103*	20.40	0.36	*13.60*	*0.21*	*61.20*	*1.10*	*4.00*	*0.99*	*0.31*	*1.30*	*118.00*	*203.2*	*0.62*	*26.97*	*0.83*	*25.67*
Woodroffe Ave.	*EX 103*	*EX 141*	3.40	0.11	*27.20*	*0.50*	*91.80*	*1.71*	*4.00*	*1.49*	*0.48*	*1.97*	*117.10*	*203.2*	*3.05*	*59.82*	*1.84*	*57.85*
Whitewater Dr.	*EX 141*	*EX 151*			*15.20*	*0.26*	*107.00*	*1.97*	*4.00*	*1.73*	*0.55*	*2.29*	*71.30*	*203.2*	*1.11*	*36.09*	*1.11*	*33.80*
Whitewater Dr.	*EX 151*	*EX 152*			*8.10*	*0.14*	*502.60*	*7.54*	*3.97*	*8.09*	*2.11*	*10.20*	*56.40*	*203.2*	*0.55*	*25.40*	*0.78*	*15.20*

NOTES
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4	REVISED PER CITY COMMENTS	28/09/16	SMC
3	REVISED PER CITY COMMENTS	17/06/16	SMC
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1	ISSUED FOR REVIEW	25/05/15	SMC

SCALE
HORIZ. 1:500
0 5m 10m 20m

S. M. CJABARYNSKI
SEPT 28/16
PROVINCE OF ONTARIO

Robinson
Land Development

350 PALLADIUM DRIVE
KANATA, ONTARIO K2V 1A8
TELEPHONE (613) 592-6060

DESIGN JHB
CHECKED SMC
DRAWN JHB
CHECKED SMC
APPROVED SMC

BORRELLO SUBDIVISION

514 KOCHAR DRIVE
OTTAWA, ON
K2C 4H3

SANITARY DRAINAGE AREA PLAN

PROJECT NO. 14057
SURVEY RLD
DATED MAY 2015
DWG. No: 14057-SAN1

Appendix C

Storm Sewer Design Sheet
Woodroffe Avenue Approved Storm Sewer Design Sheet
Storm Drainage Area Plan (Drawing #14057-STM1,STM2)
Stormwater Management Plan (Drawing #14057-SWM1)
100 Year DDSWMM Computer Modelling – Input and Output
100 Year DDSWMM 20% Stress Test Computer Modelling – Input and Output
DDSWM 20% Stress Test Sketch
Tempest MHF
Storage Volume Requirements from CCL Report
Documentation from CG&S Strandherd Stormwater Facility Design Brief
South Nepean Urban Area Tributary to the Strandherd Stormwater Facility
Documentation from Cecil D. Naraine Report
Documentation from City of Ottawa Sewer Design Guidelines (Culvert Design)
Woodroffe Ave. Ditch Pre-Development
Woodroffe Ave. Ditch Post-Development
Woodroffe Ave. Culvert Capacities
Pre Development Drainage Area West
Post Development Drainage Area West
Lots 11-16 Overland Flow Direction

STORM SEWER DESIGN SHEET
for
Borrello Subdivision

LOCATION				AREA (ha)								TIME			PROPOSED SEWER						%FULL
STREET	FROM MH	TO MH	TOTAL AREA	R= 0.2	R= 0.9	R= 0.5	R= 0.52	R= 0.6	RUNOFF C	INDIV. 2.78AR	ACCUM. 2.78AR	OF CONC. (min.)	RAINFALL INTENSITY I	PEAK FLOW Q (L/s)	PIPE SIZE (mm)	GRADE (%)	LENGTH (m)	CAPACITY (L/s)	FULL FLOW VELOCITY (m/s)	TIME OF FLOW (min)	
Street A	210	209									0.00	10.00	104.19	0.00	254.0	0.97	10.3	61.16	1.21	0.14	0%
Street A	209	208									0.00	10.14	103.45	0.00	254.0	1.03	19.5	63.03	1.24	0.26	0%
Street A	208	207									0.00	10.40	102.11	0.00	254.0	0.93	8.6	59.89	1.18	0.12	0%
REARYARD	RYCB 7	MAIN	0.49	0.40	0.09				0.33	0.45	0.45	15.00	83.56	37.40	254.0	1.00	38.5	62.10	1.23	0.52	60%
Street A	207	206	0.21	0.09	0.12				0.60	0.35	0.80	10.52	101.50	80.98	457.2	0.20	44.0	133.15	0.81	0.90	61%
Street A	206	205A									0.80	11.43	97.21	77.56	457.2	0.27	7.3	154.71	0.94	0.13	50%
Street A	205A	205									0.80	11.56	96.63	77.09	457.2	0.27	11.2	154.71	0.94	0.20	50%
SIDE YARD	RYCB 6	MAIN	0.1	0.07	0.03				0.41	0.11	0.11	15.00	83.56	9.52	203.2	1.00	5.7	34.25	1.06	0.09	28%
Street A	205	203	0.36	0.19	0.17				0.53	0.53	1.44	11.76	95.75	138.15	457.2	0.30	36.8	163.08	0.99	0.62	85%
Street A	203	202									1.44	12.37	93.13	134.37	457.2	0.25	31.6	148.87	0.91	0.58	90%
REARYARD	RYCB 8	MAIN	0.22	0.16	0.06				0.39	0.24	0.24	15.00	83.56	19.98	203.2	1.00	38.1	34.25	1.06	0.60	58%
Street A	202	*EX201*	0.16	0.10	0.07				0.48	0.22	1.90	12.95	90.81	172.48	457.2	0.70	43.6	249.10	1.52	0.48	69%
Woodroffe Ave.	*EX 201*	*EX 202*	*0.47*				*0.47*			0.68	2.58	13.43	88.99	229.49	457.2	0.69	85.0	247.32	1.51	0.94	93%
Woodroffe Ave.	*EX 202*	*EX 203*	*1.17*			*1.17*				1.63	4.21	14.37	85.64	360.12	533.4	0.71	111.9	378.43	1.69	1.10	95%
Woodroffe Ave.	*EX 203*	*EX 204*								0.00	4.21	15.48	82.05	345.05	533.4	0.74	6.8	386.34	1.73	0.07	89%

Rainfall Intensity = $998.071 / (T + 6.053)^{0.814}$ T= time in minutes Peak Flow = Accummulated 2.78AR x Rainfall Intensity
(City of Ottawa, 5 year storm)

STORM SEWER CALCULATIONS for
Chapman Mills
Woodroffe Avenue

LOCATION										PROPOSED SEWER						%FULL
STREET	FROM MH	TO MH	R= 0.5	R= 0.6	INDIV. 2.78AR	ACCUM. 2.78AR	TIME OF CONC.	RAINFALL INTENSITY I	PEAK FLOW Q (l/s)	PIPE SIZE (mm)	GRADE (%)	LENGTH (m)	CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	TIME OF FLOW (min)	
Woodroffe Ave.	201	202	2.48		3.45	3.45	26.00	59.35	204.57	457.2	0.69	85.0	247.32	1.51	0.94	83%
Woodroffe Ave.	202	203	0.25	0.89	1.83	5.28	26.94	57.96	306.01	533.4	0.71	111.9	378.43	1.69	1.10	81%
Woodroffe Ave.	203	204		0.00	0.00	5.28	28.04	56.44	297.94	533.4	0.74	6.8	386.34	1.73	0.07	77%
Rear Yard Lead	EX CB	Main		0.18	0.30	0.30	15.00	83.56	25.09	203.2	1.00	18.0	34.25	1.06	0.28	73%
Woodroffe Ave.	204	205		0.15	0.25	5.83	28.11	56.35	328.49	609.6	0.69	39.0	532.63	1.82	0.36	62%
Woodroffe Ave.	205	206		0.43	0.72	6.55	28.46	55.87	365.80	685.8	0.61	71.0	685.60	1.86	0.64	53%
Rear Yard Lead	EX CB	Main		0.51	0.85	0.85	15.00	83.56	71.08	254.0	2.00	18.5	87.82	1.73	0.18	81%
Woodroffe Ave.	206	207		0.47	0.78	8.18	29.10	55.05	450.37	685.8	0.60	120.0	679.95	1.84	1.09	66%
Woodroffe Ave.	207	Ex. Stm MH 1			0.00	8.18	30.19	53.70	439.35	685.8	1.35	67.9	1019.93	2.76	0.41	43%
Woodroffe Ave.	Ex. Stm MH 1	Ex. Stm MH 2			0.00	17.57	30.60	53.21	935.04	762.0	0.89	32.1	1096.78	2.41	0.22	85%

Run-off Coefficient = 0.6 for all areas, with the following exceptions;
= 0.20 for Parkland

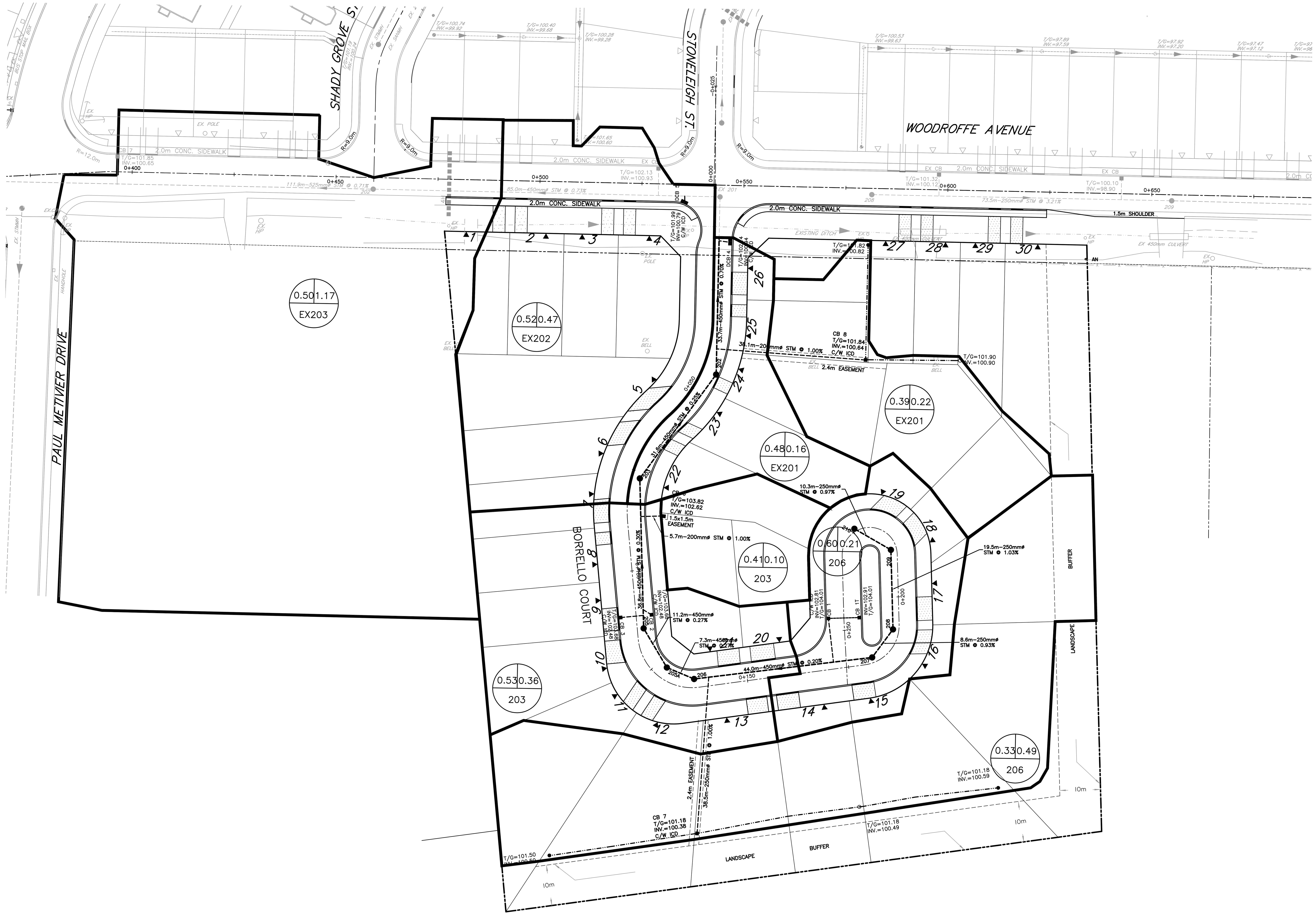
Peak Flow = Accummulated 2.78AR x Rainfall Intensity

Rainfall Intensity = 998.071 / (T + 6.053)$^{0.814}$ T= time in minutes
(City of Ottawa, 5 year storm)

LEGEND

RUNOFF COEFFICIENT — 0.50 | 0.28 — AREA (ha) — 201 — DOWNSTREAM MANHOLE

Symbol	Description
▼	SERVICE LOCATION
■	STREET CATCHBASIN
■	REAR YARD CATCHBASIN
○	REAR YARD TEE CATCHBASIN
●	REAR YARD ELBOW CATCHBASIN
CB 6	CATCHBASIN OUTLETTING DIRECTLY TO STORM SEWER SYSTEM
CB T6	CATCHBASIN OUTLETTING TO ANOTHER CATCHBASIN
▬	DRAINAGE AREA BOUNDARY



NOTES

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2	REVISED PER CITY COMMENTS	10/12/15	SMC
1	ISSUED FOR REVIEW	25/05/15	SMC

SCALE

HORIZ. 1:500

0 5m 10m 20m

LICENSED PROFESSIONAL ENGINEER S. M. GIABARYNSKI SEPT 28/16 PROVINCE OF ONTARIO

Robinson Land Development

350 PALLADIUM DRIVE
KANATA, ONTARIO K2V 1A8
TELEPHONE (613) 592-6060

DESIGN	JHB
CHECKED	SMC
DRAWN	JHB
CHECKED	SMC
APPROVED	SMC

BORRELLO SUBDIVISION

514 KOCHAR DRIVE
OTTAWA, ON
K2C 4H3

STORM DRAINAGE AREA PLAN

PROJECT NO.	14057
SURVEY	RLD
DATED	MAY 2015
DWG. No:	14057-STM1

NOTES

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NO.	REVISION DESCRIPTION	DATE	BY
3	REVISED PER CITY COMMENTS	21/09/16	SMC
2	REVISED PER CITY COMMENTS	17/06/16	SMC
1	ISSUED FOR REVIEW	10/12/15	SMC

SCALE
HORIZ. 1:1250
0 12.5m 25m 50m

S. M. CZABARYSKI — PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

Robinson
Land Development

CONSULTING ENGINEERS
350 PALLADIUM DRIVE
KANATA, ONTARIO K2V 1A8
TELEPHONE (613) 592-6060

DESIGN	JHB
CHECKED	SMC
DRAWN	JHB
CHECKED	SMC
APPROVED	SMC

BORRELLO SUBDIVISION

514 KOCHAR DRIVE
OTTAWA, ON
K2C 4H3

STORM DRAINAGE AREA

PROJECT NO.	14057
SURVEY	RLD
DATED	DECEMBER 2015
DWG. No:	14057-STM2

LEGEND

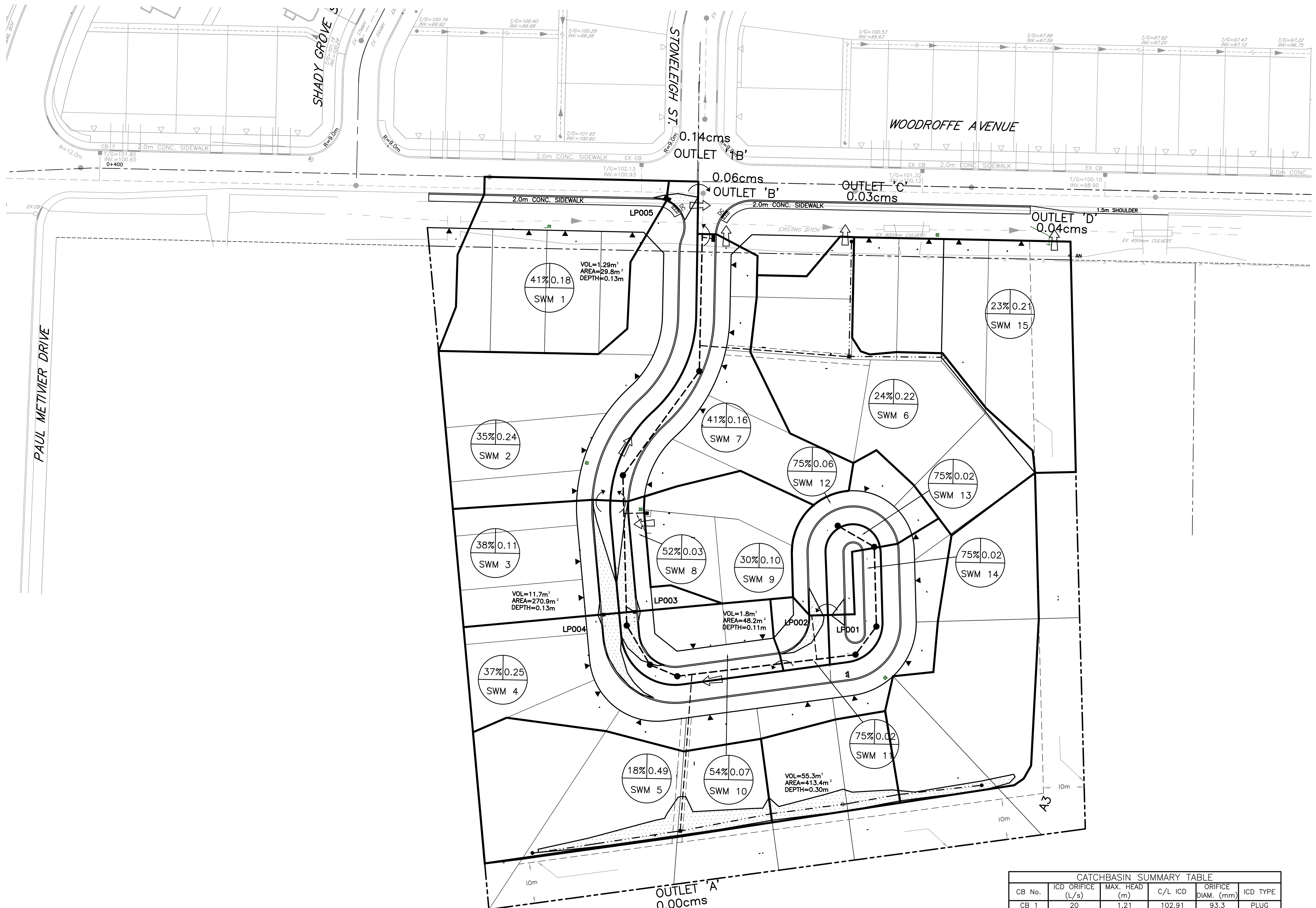
LP001 PONDING AREA ID

OVERLAND DRAINAGE DIRECTION

TOTAL IMPERVIOUSNESS

25% 0.28 SUB CATCHMENT AREA (ha)

201 SUB CATCHMENT ID



CATCHBASIN SUMMARY TABLE					
CB No.	ICD ORIFICE (L/s)	MAX. HEAD (m)	C/L ICD	ORIFICE DIAM. (mm)	ICD TYPE
CB 1	20	1.21	102.91	93.3	PLUG
CB 2	14.2	1.23	102.58	78.3	PLUG
CB 3	31	1.23	102.58	115.7	PLUG
DCB 4	20	1.10	101.05	95.6	PLUG
DCB 5	20	1.23	100.89	92.9	PLUG
CB 6	25	1.40	102.72	100.6	PLUG
CB 7	15	0.98	100.51	85.3	PLUG
CB 8	20	1.30	100.74	91.7	PLUG

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SCALE

HORIZ. 1:500

0 5m 10m 20m

LICENSED PROFESSIONAL ENGINEER S. M. CZARNYSKI SEPT 28/16 PROVINCE OF ONTARIO

Robinson Land Development

350 PALLADIUM DRIVE
KANATA, ONTARIO K2V 1A8
TELEPHONE (613) 592-6060

DESIGN JHB
CHECKED SMC
DRAWN JHB
CHECKED SMC
APPROVED SMC

BORRELLO SUBDIVISION

514 KOCHAR DRIVE
OTTAWA, ON
K2C 4H3

STORM WATER MANAGEMENT PLAN

PROJECT NO. 14057
SURVEY RLD
DATED MAY 2015
DWG. No: 14057-SWM1

```
' Borrello Subdivision                    '
' DDSWMM analysis, 3 hour 100 year Chicago Storm                         '
*******************************************************************
* DDSWMM Analysis by RLD - June 2016
* Bor100.txt
*******************************************************************
*
*   IUNIT   DELTC   NDELTC  IEVAL   QLIMIT  ISTEP
    1       5       72      3       20.0    1
* IUNIT =1 for metric
* DELTC = time increment for calculation (minutes)
* NDELTC = number of computational time steps (maximum = 300)
* IEVAL = 1 if pipe sizes are given and it is required to revise
* these sizes, if necessary, based on free surface flow
* QLIMIT = Default value of limiting capacity of inlets. Value can be overridden
* for individual inlets by the values assigned to (QLIM) on data group (7)
* ISTEP = Interval between print-out
*
*   RAINFALL DATA
*******************
*   JULDAY   TZERO
    02290    0.0
* JULDAY = Initial Julian calender
* TZERO = intial time [0hrs to 24hrs]
*   DELTR    NDELTR
    10.0       19
* 19 STEPS OF RAINFALL INTENSITIES AT 10 MINS INTERVAL
0 6.046 7.542 10.159 15.969 40.655 178.559 54.049 27.319 18.240 13.737
11.059 9.285 8.024 7.080 6.347 5.760 5.280 4.879
* DELTR = time increment for rainfall hyetograph (minutes)
* NDELTR = number of time increments for rainfall hyetograph
*
* MINOR SYSTEM CHARACTERISTICS
* IRTP  NP        NPD      XP        SP       CP      DP        QB   IPRTP
* IRTP=0, routing of minor system flow (for this pipe) will be performed
* NP = sewer identification number/name [node point]
* NPD = identification number/name of downstream sewer [node point downstream]
* XP = length of sewer (m)
* SP = invert slope (m/m)
* CP = Manning's roughness coefficient
* DP = pipe diameter (mm)
* QB = base flow (cubes)
* IPRTP = option for printing time history of pipe flow (1 or 0) (0=no print)
*
*
*       Street A
*       0       '210'   '209'   10.3    0.0097  0.013   254.0   0.0     0
*       0       '209'   '208'   19.5    0.0103  0.013   254.0   0.0     0
*       0       '208'   '207'   8.6     0.0093  0.013   254.0   0.0     0
*       0       '207'   '206'   44.4    0.0020  0.013   457.2   0.0     0
*       0       '206'   '205a'  7.3     0.0027  0.013   457.2   0.0     0
*       0       '205a'  '205'   11.2    0.0027  0.013   457.2   0.0     0
*       0       '205'   '203'   36.8    0.0030  0.013   457.2   0.0     0
*       0       '203'   '202'   31.6    0.0025  0.013   457.2   0.0     0
*       0       '202'   '201'   43.6    0.0070  0.013   457.2   0.0     0
*       0       '201'   '202a'  85.0    0.0073  0.013   457.2   0.0     0
* dummy pipe
*       0       'X'     '210'   85.0    0.0073  0.013   457.2   0.0     0
*
*ENDMNR
* to terminate minor system data entry
* if the drainage system has no storage for minor system, enter
* terminators as below.
```

```
*ENDMNRS1
* must be entered even if no storage is required
*ENDMNRS2
* must be entered even if no storage is required
*ENDMNRS3
* must be entered even if no storage is required
*   MAJOR SYSTEM CHARACTERISTICS
* maximum of 50 storage types
*   IS    W2     SX    YCURB  CNS   S0     SR0W   CNROW  YMAX
* IS = identification of street segment type
* W2 = segment width (m)
* SX = pavement cross slope (m/m)
* YCURB = height of curb (cm)
* CNS = Manning's roughness coefficient for pavement
* S0 = longitudinal slope
* SROW = cross slope of shoulder
* CNROW = Manning's roughness coefficient for shoulder
* YMAX = Maximum water depth (measured from bottom of curb)
* for calculation of street carrying capacity
*
*
* Maximum water depth assumed as 30 cm
* Street A
*
        1   4.25  0.030   15  0.013   0.0138   0.02    0.025  30
        2   4.25  0.030   15  0.013   0.0076   0.02    0.025  30
        3   4.25  0.030   15  0.013   0.0237   0.02    0.025  30
        4   4.25  0.030   15  0.013   0.0083   0.02    0.025  30
        5   4.25  0.030   15  0.013   0.0050   0.02    0.025  30
        6   4.25  0.030   15  0.013   0.0051   0.02    0.025  30
        7   4.25  0.030   15  0.013   0.0200   0.02    0.025  30
        8 118.00  0.010   30  0.025   0.0090   0.02    0.025  100
        9   4.25  0.030   15  0.013   0.0001   0.02    0.025  30
*
*
ENDSTR
* terminator for major system characteristics data set
*   INLET CAPTURE CHARACTERISTICS
*   IDCB   NJC
    1      8
*   QAPP   QCAP
    0.      0.
    10.     10.
    30.     30.
    60.     60.
    90.     90.
    130.    130.
    500.    500.
    1000.   1000.
ENDIN1
ENDIN2
* applicable for areas
*   IDCB   DET3   NPTS3
    2      55.0     2
*   QAPP   QCAP
     0.0    0.0
    55.0   15.0
* applicable for areas
*   IDCB   DET3   NPTS3
    3      1.8      2
*   QAPP   QCAP
     0.0    0.0
     1.8   20.0
```

```
* applicable for areas
*   IDCB   DET3   NPTS3
    4      5.7      2
*   QAPP   QCAP
     0.0    0.0
    17.9   14.2
* applicable for areas
*   IDCB   DET3   NPTS3
    5      1.3      2
*   QAPP   QCAP
     0.0    0.0
     1.3   20.0
* applicable for areas
*   IDCB   DET3   NPTS3
    6      5.7      2
*   QAPP   QCAP
     0.0    0.0
    17.9   31.0
* applicable for areas
*   IDCB   DET3   NPTS3
    7      20.0     3
*   QAPP   QCAP
     0.0    0.0
     1.0   18.0
    20.0   20.0
* applicable for areas
*   IDCB   DET3   NPTS3
    8      25.0     3
*   QAPP   QCAP
     0.0    0.0
     1.0   18.0
    25.0   20.0
* applicable for areas
*   IDCB   DET3   NPTS3
    9      30.0     3
*   QAPP   QCAP
     0.0    0.0
     1.0   18.0
    30.0   20.0
* applicable for areas
*   IDCB   DET3   NPTS3
    10     35.0     3
*   QAPP   QCAP
     0.0    0.0
     1.0   18.0
    35.0   20.0
* applicable for areas
*   IDCB   DET3   NPTS3
    11     50.0     3
*   QAPP   QCAP
     0.0    0.0
     1.0   18.0
    50.0   20.0
* applicable for areas
*   IDCB   DET3   NPTS3
    12      75.0     3
*   QAPP   QCAP
     0.0    0.0
     1.0   18.0
    75.0   20.0
* applicable for areas
*   IDCB   DET3   NPTS3
    13      1.0     2
```

```
*   QAPP   QCAP
     0.0    0.0
     1.0   58.4
* applicable for areas
*   IDCB   DET3   NPTS3
    14      3.0      3
*   QAPP   QCAP
     0.0    0.0
     1.0   11.4
     3.0   13.4
* applicable for areas
*   IDCB   DET3   NPTS3
    15      5.0      3
*   QAPP   QCAP
     0.0    0.0
     1.0   11.4
     5.0   13.4
* applicable for areas
*   IDCB   DET3   NPTS3
    16      33.0     3
*   QAPP   QCAP
     0.0    0.0
     1.0    7.0
     33.0   9.0
* applicable for areas
*   IDCB   DET3   NPTS3
    17      32.0     3
*   QAPP   QCAP
     0.0    0.0
     1.0    4.8
     32.0   6.8
* applicable for areas
*   IDCB   DET3   NPTS3
    18      15.5     3
*   QAPP   QCAP
     0.0    0.0
     1.0    6.5
     15.5   8.5
* applicable for areas
*   IDCB   DET3   NPTS3
    19      19.0     3
*   QAPP   QCAP
     0.0    0.0
     1.0    1.0
     19.0   3.3
* applicable for areas
*   IDCB   DET3   NPTS3
    20      15.5     3
*   QAPP   QCAP
     0.0    0.0
     1.0    7.4
     15.5   9.4
*
**
ENDIN3
*  MAJOR SYSTEM SEGMENT DATA
**---------------------------------------------------------------------------------
--------------
* IRTS = Option for major system flow routing
* NS = identification number/name of major system segment
* NSD = identification number/name of major system segment downstream
* XS = length of segment
* IDSS = segment type (as per segment data list)
```

```
* NUMCB = number of storm inlets within street segment
* IINC = inlet type (as per segment data list)
* QLIM = maximum allowable inlet capture
* NPD = pipe receiving inlet flow
* IPRTS = option for printing time history of segment (=o, no printing)
* routing is performed (for this segment)
**------------------------------------------------------------------------------------
----------------
*       IRTS    NS      NSD     XS      IDSS    NUMCB   IINC    QLIM    NPD
IPRTS
* Road Drainage Areas
        0       'SWM14' 'LP001' 40      4       0       1       0.      'X'     0
        0       'SWM13' 'LP001' 29      1       0       1       0.      'X'     0
        1       'LP001' 'D001'  10      7       0       1       0.      'X'     0
        0       'SWM12' 'LP002' 41      1       0       1       0.      'X'     0
        0       'SWM11' 'LP002' 16      4       0       1       0.      'X'     0
        1       'LP002' 'D002'  10      4       1       3       20.     '207'   0
        0       'SWM10' 'LP003' 48      4       0       1       0.      'X'     0
        0       'SWM8'  'LP003' 27      6       0       1       0.      'X'     0
        1       'LP003' 'D003'  10      6       1       4       14.2    '205'   0
        0       'SWM3'  'LP004' 28      6       0       1       0.      'X'     0
        0       'SWM4'  'LP004' 107     4       0       1       0.      'X'     0
        1       'LP004' 'D004'  10      6       1       6       31.     '205'   0
        0       'SWM2'  'LP005' 81      3       0       1       0.      'X'     0
        0       'SWM1'  'LP005' 45      5       0       1       0.      'X'     0
        1       'LP005' 'D005'  10      7       1       5       20.     '202'   0
        0       'SWM7'  'OUTB'  71      3       1       1       20.     '202'   0
* Rear Yard Drainage
        0       'SWM9'  'SWM8'  37      8       1       1       25.     '205'   0
        0       'SWM5'  'OUTA'  157     8       1       2       15.     '207'   0
        0       'SWM6'  'OUTC'  88      8       1       1       20.     '202'   0
        0       'SWM15' 'OUTD'  40      8       0       1       0.      'X'     0
*Dummy Segments
        0       'D001'  'LP002'  7      9       0       1       0.      'X'     1
        0       'D002'  'SWM10' 20      9       0       1       0.      'X'     1
        0       'D003'  'SWM7'  50      9       0       1       0.      'X'     1
        0       'D004'  'SWM2'  65      9       0       1       0.      'X'     1
        0       'D005'  'OUT1B'  8      9       0       1       0.      'X'     1
ENDMJR
*  MAJOR SYSTEM STORAGE UNITS
*   IDSTS      NUSS  NSTOR
    'Out1'    1     'OUTA'
    'Out2'    1     'OUTB'
    'Out3'    1     'OUTC'
    'Out4'    1     'OUT1B'
    'Out5'    1     'OUTD'
*
ENDMJRS
*   INFILTRATION PARAMETERS FOR RUNOFF CALCULATIONS
*   MAX   MIN   DECAY
    76.2  13.2  .00115
ENDUAH
* SUBAREA DATA FOR SWMM RUNOFF
* NW        NSDW      ASW     PIMP    CNIMP     CNP     S           WLAT
DETIMP   DETP   IPRTW
  'SWM1'   'SWM1'     0.18    41.     0.013     0.25    0.02        45          1.57
    4.67   0
  'SWM2'   'SWM2'     0.24    35.     0.013     0.25    0.02        81          1.57
    4.67   0
  'SWM3'   'SWM3'     0.11    38.     0.013     0.25    0.02        28          1.57
    4.67   0
  'SWM4'   'SWM4'     0.25    37.     0.013     0.25    0.02        107         1.57
    4.67   0
```

```
  'SWM5'   'SWM5'     0.49    18.     0.013    0.25    0.02        157        1.57
    4.67   0
  'SWM6'   'SWM6'     0.22    24.     0.013    0.25    0.02        88         1.57
    4.67   0
  'SWM7'   'SWM7'     0.16    41.     0.013    0.25    0.02        71         1.57
    4.67   0
  'SWM8'   'SWM8'     0.03    52.     0.013    0.25    0.02        27         1.57
    4.67   0
  'SWM9'   'SWM9'     0.10    30.     0.013    0.25    0.02        37         1.57
    4.67   0
  'SWM10'  'SWM10'    0.07    54.     0.013    0.25    0.02        48         1.57
    4.67   0
  'SWM11'  'SWM11'    0.02    51.     0.013    0.25    0.02        16         1.57
    4.67   0
  'SWM12'  'SWM12'    0.06    41.     0.013    0.25    0.02        41         1.57
    4.67   0
  'SWM13'  'SWM13'    0.02    73.     0.013    0.25    0.02        29         1.57
    4.67   0
  'SWM14'  'SWM14'    0.02    70.     0.013    0.25    0.02        40         1.57
    4.67   0
  'SWM15'  'SWM15'    0.21    23.     0.013    0.25    0.02        40         1.57
    4.67   0
* NW = identification number/name of subarea
* NSDW = identification number/name of major segment receiving surface runoff
* ASW  area of subarea (ha.)
* PIMP = percentage imperious
* CNIMP = Manning's roughness coefficient for impervious area
* CNP = Manning's roughness coefficient for pervious area
* s = average slope
* WLAT = subarea width
* DETIMP = detention storage for impervious area
* DETP = detention storage for pervious area
* IRTW = option for printing and plotting of surface runoff hydrograph (=0, no
printing)
ENDSUB1
ENDSUB2
ENDSUB3
```

```
                   bor 100 year out sept 28-16
          ***************************************************
          *             D D S W M M (release 2.1)           *
          *  The Dual Drainage Storm Water Management Model *
          *                      Copyright                  *
          *                      ---------                  *
          *         AMK Associates International Ltd.       *
          ***************************************************
```

This release of DDSWMM will run with a maximum of

```
  500 minor system segments (pipes), including outlets
  500 major system (street) segments, including outlets
  500 subcatchments
   30 storage units for the minor system
   30 storage units for the major system
  300 computational time steps
  300 increments for rainfall hyetograph
   50 storm inlet types
   20 points describing the inlet capture curve
   50 major system segment types
    5 street segments discharging into a street junction
    5 pipes discharging into a pipe junction
    5 subcatchments discharging into a major system segment
    5 inlet groups discharging into a pipe
   30 unit area hydrographs
```

For other program constraints, please refer to the users manual

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

RUN CONTROL PARAMETERS

Measuring units		Metric
Time increment for calculation	5.00	minutes
Number of computational steps	72	
Default limiting capacity of inlets	20.00	l/s
Total simulation time	5:55	(hrs:mins)
Interval between printout	1	

Calculation for the minor system is not included in this simulation

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

```
           RAINFALL DATA                                         Initial Julian Date
02290
                                                                 Initial Time
 0.00 hours
         Time      Rainfall                                      Rainfall intensity
(mm/hr)
       (hr:min)    (mm/hr)
                                                    0.00E+00  0.36E+02  0.71E+02
0.11E+03  0.14E+03   0.18E+03

I---------I---------I---------I---------I----------I
          0: 0       0.00                           I*
                 I
          0:10       6.05                           I**
                 I
          0:20       7.54                           I***
                 I
          0:30      10.16                           I***
                 I
          0:40      15.97                           I*****
                 I
          0:50      40.65                           I************
                 I
          1: 0     178.56
I**************************************************I
          1:10      54.05                           I****************
                 I
          1:20      27.32                           I********
                 I
          1:30      18.24                           I******
                 I
          1:40      13.74                           I****
                 I
          1:50      11.06                           I****
                 I
          2: 0       9.28                           I***
                 I
          2:10       8.02                           I***
                 I
          2:20       7.08                           I**
                 I
          2:30       6.35                           I**
                 I
          2:40       5.76                           I**
                 I
          2:50       5.28                           I**
                 I
          3: 0       4.88                           I**
                 I

I---------I---------I---------I---------I----------I
                                                    0.00E+00  0.36E+02  0.71E+02
0.11E+03  0.14E+03   0.18E+03
```

Rainfall duration   3:10 (hrs:mins.)

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
1	4.25	0.030	15.0	0.0130	0.014	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.02	1.00
4.50	0.06	1.50
6.00	0.12	2.00
7.50	0.23	2.50
9.00	0.37	3.00
10.50	0.55	3.50
12.00	0.79	4.00
13.50	1.08	4.25
15.00	1.43	4.25
16.50	1.82	5.00
18.00	2.26	5.75
19.50	2.76	6.50
21.00	3.32	7.25
22.50	3.95	8.00
24.00	4.64	8.75
25.50	5.41	9.50
27.00	6.24	10.25
28.50	7.15	11.00
30.00	8.14	11.75

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM RATING CURVE

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Type Maximum Flow Depth (cm)	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)
2 30.0	4.25	0.030	15.0	0.0130	0.008	0.020	0.0250

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.01	1.00
4.50	0.04	1.50
6.00	0.09	2.00
7.50	0.17	2.50
9.00	0.27	3.00
10.50	0.41	3.50
12.00	0.59	4.00
13.50	0.80	4.25
15.00	1.06	4.25
16.50	1.35	5.00
18.00	1.68	5.75
19.50	2.05	6.50
21.00	2.47	7.25
22.50	2.93	8.00
24.00	3.45	8.75
25.50	4.01	9.50
27.00	4.63	10.25
28.50	5.31	11.00
30.00	6.04	11.75

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM RATING CURVE

Type Maximum Flow Depth	Pavement Width (m)	Pavement Cross Slope	Height of Curb	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope	Shoulder Roughness (n)

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
3	4.25	0.030	15.0	0.0130	0.024	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.03	1.00
4.50	0.08	1.50
6.00	0.16	2.00
7.50	0.30	2.50
9.00	0.48	3.00
10.50	0.73	3.50
12.00	1.04	4.00
13.50	1.42	4.25
15.00	1.87	4.25
16.50	2.38	5.00
18.00	2.96	5.75
19.50	3.62	6.50
21.00	4.36	7.25
22.50	5.18	8.00
24.00	6.09	8.75
25.50	7.09	9.50
27.00	8.18	10.25
28.50	9.38	11.00
30.00	10.67	11.75

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
4	4.25	0.030	15.0	0.0130	0.008	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.02	1.00
4.50	0.04	1.50
6.00	0.10	2.00
7.50	0.18	2.50
9.00	0.28	3.00
10.50	0.43	3.50
12.00	0.61	4.00
13.50	0.84	4.25
15.00	1.11	4.25
16.50	1.41	5.00
18.00	1.75	5.75
19.50	2.14	6.50
21.00	2.58	7.25
22.50	3.06	8.00
24.00	3.60	8.75
25.50	4.19	9.50
27.00	4.84	10.25
28.50	5.55	11.00
30.00	6.32	11.75

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
5	4.25	0.030	15.0	0.0130	0.005	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50

3.00	0.01	1.00
4.50	0.03	1.50
6.00	0.07	2.00
7.50	0.14	2.50
9.00	0.22	3.00
10.50	0.33	3.50
12.00	0.48	4.00
13.50	0.65	4.25
15.00	0.86	4.25
16.50	1.09	5.00
18.00	1.36	5.75
19.50	1.66	6.50
21.00	2.00	7.25
22.50	2.38	8.00
24.00	2.80	8.75
25.50	3.25	9.50
27.00	3.76	10.25
28.50	4.31	11.00
30.00	4.90	11.75

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM RATING CURVE

Type	Maximum Flow Depth (cm)	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)
6	30.0	4.25	0.030	15.0	0.0130	0.005	0.020	0.0250

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.01	1.00
4.50	0.04	1.50
6.00	0.08	2.00
7.50	0.14	2.50
9.00	0.22	3.00
10.50	0.34	3.50
12.00	0.48	4.00
13.50	0.66	4.25

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15.00	0.87	4.25
16.50	1.10	5.00
18.00	1.37	5.75
19.50	1.68	6.50
21.00	2.02	7.25
22.50	2.40	8.00
24.00	2.82	8.75
25.50	3.29	9.50
27.00	3.80	10.25
28.50	4.35	11.00
30.00	4.95	11.75

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
7	4.25	0.030	15.0	0.0130	0.020	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.02	1.00
4.50	0.07	1.50
6.00	0.15	2.00
7.50	0.27	2.50
9.00	0.44	3.00
10.50	0.67	3.50
12.00	0.95	4.00
13.50	1.30	4.25
15.00	1.72	4.25
16.50	2.19	5.00
18.00	2.72	5.75
19.50	3.33	6.50
21.00	4.00	7.25
22.50	4.76	8.00
24.00	5.59	8.75
25.50	6.51	9.50

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27.00	7.52	10.25
28.50	8.61	11.00
30.00	9.80	11.75

♀
Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
8	118.00	0.010	30.0	0.0250	0.009	0.020	0.0250	100.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
5.00	0.10	5.00
10.00	0.61	10.00
15.00	1.81	15.00
20.00	3.89	20.00
25.00	7.06	25.00
30.00	11.47	30.00
35.00	17.31	35.00
40.00	24.71	40.00
45.00	33.83	45.00
50.00	44.80	50.00
55.00	57.77	55.00
60.00	72.86	60.00
65.00	90.19	65.00
70.00	109.90	70.00
75.00	132.10	75.00
80.00	156.91	80.00
85.00	184.44	85.00
90.00	214.81	90.00
95.00	248.12	95.00
100.00	284.49	100.00

♀
Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
9	4.25	0.030	15.0	0.0130	0.000	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.00	1.00
4.50	0.00	1.50
6.00	0.01	2.00
7.50	0.02	2.50
9.00	0.03	3.00
10.50	0.05	3.50
12.00	0.07	4.00
13.50	0.09	4.25
15.00	0.12	4.25
16.50	0.15	5.00
18.00	0.19	5.75
19.50	0.24	6.50
21.00	0.28	7.25
22.50	0.34	8.00
24.00	0.40	8.75
25.50	0.46	9.50
27.00	0.53	10.25
28.50	0.61	11.00
30.00	0.69	11.75

♀
Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

STORM INLET DATA

1 Normal Inlet

Inlet Identification No. 1

No. of Points on Capture Curve 8

Inlet Capture Relationship

Approach Flow (l/s)	Inlet Flow (l/s)
0.00	0.00
10.00	10.00
30.00	30.00
60.00	60.00
90.00	90.00
130.00	130.00
500.00	500.00
1000.00	1000.00

2 Storage Inlet

Inlet Identification No. 2

Maximum Storage 55.00 cu.m.

No. of Points on Storage-Capture Curve 2

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
55.00	15.00

3 Storage Inlet

Inlet Identification No. 3

Maximum Storage 1.80 cu.m.

No. of Points on Storage-Capture Curve 2

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.80	20.00

4 Storage Inlet

Inlet Identification No. 4

Maximum Storage 5.70 cu.m.

No. of Points on Storage-Capture Curve 2

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
17.90	14.20

5 Storage Inlet

Inlet Identification No. 5

Maximum Storage 1.30 cu.m.

No. of Points on Storage-Capture Curve 2

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.30	20.00

6 Storage Inlet

Inlet Identification No. 6

Maximum Storage 5.70 cu.m.

No. of Points on Storage-Capture Curve 2

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
17.90	31.00

7 Storage Inlet

Inlet Identification No. 7

Maximum Storage 20.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	18.00
20.00	20.00

8 Storage Inlet

Inlet Identification No. 8

Maximum Storage 25.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	18.00
25.00	20.00

9 Storage Inlet

Inlet Identification No. 9

Maximum Storage 30.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	18.00
30.00	20.00

10 Storage Inlet

Inlet Identification No. 10

Maximum Storage 35.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	18.00
35.00	20.00

11 Storage Inlet

Inlet Identification No. 11

Maximum Storage 50.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	18.00
50.00	20.00

12 Storage Inlet

Inlet Identification No. 12

Maximum Storage 75.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	18.00
75.00	20.00

13 Storage Inlet

Inlet Identification No. 13

Maximum Storage 1.00 cu.m.

No. of Points on Storage-Capture Curve 2

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	58.40

14 Storage Inlet

Inlet Identification No. 14

Maximum Storage 3.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	11.40
3.00	13.40

15 Storage Inlet

Inlet Identification No. 15

Maximum Storage 5.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	11.40
5.00	13.40

16 Storage Inlet

Inlet Identification No. 16

Maximum Storage 33.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	7.00
33.00	9.00

17 Storage Inlet

Inlet Identification No. 17

Maximum Storage 32.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	4.80
32.00	6.80

18 Storage Inlet

Inlet Identification No. 18

Maximum Storage 15.50 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	6.50
15.50	8.50

19 Storage Inlet

Inlet Identification No. 19

Maximum Storage 19.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	1.00
19.00	3.30

20 Storage Inlet

Inlet Identification No. 20

Maximum Storage 15.50 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	7.40
15.50	9.40

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM DATA

	Street Segment	D/S Segment	Length (m)	Type	No. of C.B.	Inlet Type	Limiting Inlet Capture (l/s)	Connecting Pipe/EXTRAN Inlet	Flow History (?)
1	SWM14	LP001	40.0	4	0	1 *	0.00	X	NO
2	SWM13	LP001	29.0	1	0	1 *	0.00	X	NO

3	LP001	D001	10.0	7	0	1	*	0.00	X	NO "No Routing"
4	SWM12	LP002	41.0	1	0	1	*	0.00	X	NO
5	SWM11	LP002	16.0	4	0	1	*	0.00	X	NO
6	LP002	D002	10.0	4	1	3	***	20.00	207	NO "No Routing"
7	SWM10	LP003	48.0	4	0	1	*	0.00	X	NO
8	SWM8	LP003	27.0	6	0	1	*	0.00	X	NO
9	LP003	D003	10.0	6	1	4	***	4.52	205	NO "No Routing"
10	SWM3	LP004	28.0	6	0	1	*	0.00	X	NO
11	SWM4	LP004	107.0	4	0	1	*	0.00	X	NO
12	LP004	D004	10.0	6	1	6	***	9.87	205	NO "No Routing"
13	SWM2	LP005	81.0	3	0	1	*	0.00	X	NO
14	SWM1	LP005	45.0	5	0	1	*	0.00	X	NO
15	LP005	D005	10.0	7	1	5	***	20.00	202	NO "No Routing"
16	SWM7	OUTB	71.0	3	1	1	*	20.00	202	NO
17	SWM9	SWM8	37.0	8	1	1	*	25.00	205	NO
18	SWM5	OUTA	157.0	8	1	2	***	15.00	207	NO
19	SWM6	OUTC	88.0	8	1	1	*	20.00	202	NO
20	SWM15	OUTD	40.0	8	0	1	*	0.00	X	NO
21	D001	LP002	7.0	9	0	1	*	0.00	X	YES
22	D002	SWM10	20.0	9	0	1	*	0.00	X	YES
23	D003	SWM7	50.0	9	0	1	*	0.00	X	YES
24	D004	SWM2	65.0	9	0	1	*	0.00	X	YES
25	D005	OUT1B	8.0	9	0	1	*	0.00	X	YES

*   Normal Inlet.
**   Storage Inlet with linear relationship between Storage and Inlet Capture.
*** Storage Inlet with user-specified relationship between Storage and Inlet Capture.

Total Number of Street segments	25	
Total Length of Major System	1055.00	m
Total Number of Inlet C.B.	8	
Average Distance Between Inlets	263.75	m

Outlets From Major System

Outlet I.D.

OUTB
OUTA
OUTC
OUTD
OUT1B

Total Number of Outlets from Major System = 5

DATA FOR MAJOR SYSTEM STORAGE

No.	Storage Unit	No. of Inflow Points	I.D. Nos. of Inflow Points
1	Out1	1	OUTA
2	Out2	1	OUTB
3	Out3	1	OUTC
4	Out4	1	OUT1B
5	Out5	1	OUTD

No. of Detention Structures 5

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

SUB-CATCHMENT/SURFACE RUNOFF DATA

Infiltration Parameters

Max. Infiltration Rate	76.20	mm/hr
Min. Infiltration Rate	13.20	mm/hr
Decay Rate	0.001150	1/sec.

Unit Area Hydrograph (UAH) Data

No Unit Area Hydrograph Data

SUB-CATCHMENT DATA

No.	Subarea	Street Segment	Area (Ha.)	Imp. (%)	Manning (N) (Imp.)	Manning (N) (Perv.)	Slope (m/m)	Width (m)	Dep. Storage Imp. (mm)	Dep. Storage Perv. (mm)	Flow History (?)
1	SWM1	SWM1	0.18	41.	0.0130	0.2500	0.020	45.	1.570	4.670	NO
2	SWM2	SWM2	0.24	35.	0.0130	0.2500	0.020	81.	1.570	4.670	NO
3	SWM3	SWM3	0.11	38.	0.0130	0.2500	0.020	28.	1.570	4.670	NO
4	SWM4	SWM4	0.25	37.	0.0130	0.2500	0.020	107.	1.570	4.670	NO
5	SWM5	SWM5	0.49	18.	0.0130	0.2500	0.020	157.	1.570	4.670	NO
6	SWM6	SWM6	0.22	24.	0.0130	0.2500	0.020	88.	1.570	4.670	NO
7	SWM7	SWM7	0.16	41.	0.0130	0.2500	0.020	71.	1.570	4.670	NO
8	SWM8	SWM8	0.03	52.	0.0130	0.2500	0.020	27.	1.570	4.670	NO
9	SWM9	SWM9	0.10	30.	0.0130	0.2500	0.020	37.	1.570	4.670	NO
10	SWM10	SWM10	0.07	54.	0.0130	0.2500	0.020	48.	1.570	4.670	NO
11	SWM11	SWM11	0.02	51.	0.0130	0.2500	0.020	16.	1.570	4.670	NO
12	SWM12	SWM12	0.06	41.	0.0130	0.2500	0.020	41.	1.570	4.670	NO
13	SWM13	SWM13	0.02	73.	0.0130	0.2500	0.020	29.	1.570	4.670	NO
14	SWM14	SWM14	0.02	70.	0.0130	0.2500	0.020	40.	1.570	4.670	NO
15	SWM15	SWM15	0.21	23.	0.0130	0.2500	0.020	40.	1.570	4.670	NO

* Inflow Hydrograph Input Directly
** Inflow hydrograph Input in terms of flow per unit area

Total Drainage Area 2.18 Hectares

Number of Subcatchments 15

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

Simulation Details - Surface Runoff - 15 Subareas

count	Subarea
1	SWM1
2	SWM2
3	SWM3
4	SWM4
5	SWM5
6	SWM6
7	SWM7
8	SWM8
9	SWM9
10	SWM10
11	SWM11
12	SWM12
13	SWM13
14	SWM14
15	SWM15

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

Simulation Details - Major System - 30 Segments/Outlets

count	order	segment	time step (min.)	No. of time steps	Max. flow (cms)	Max. depth (cm)
1	2	SWM13	0.69	512	0.01	2.19
2	1	SWM14	1.13	314	0.01	2.48
3	3	LP001			0.02	2.80
4	21	D001	0.84	424	0.02	7.72
5	5	SWM11	0.48	735	0.01	2.25
6	4	SWM12	0.76	467	0.02	3.15
7	11	SWM4	1.74	204	0.08	5.60
8	10	SWM3	0.69	516	0.03	4.35
9	6	LP002			0.05	4.67
10	12	LP004			0.11	6.90
11	17	SWM9	4.07	87	0.03	1.47
12	22	D002	2.17	164	0.03	8.95
13	24	D004	4.83	73	0.10	14.05

14	8	SWM8	0.77	459	0.02	3.47
15	7	SWM10	0.90	395	0.05	4.52
16	14	SWM1	0.98	363	0.06	5.31
17	13	SWM2	0.82	433	0.12	5.19
18	9	LP003			0.06	5.54
19	15	LP005			0.16	6.09
20	23	D003	4.62	77	0.06	11.36
21	25	D005	0.55	641	0.14	15.73
22	20	SWM15	2.97	119	0.04	2.18
23	19	SWM6	4.81	74	0.06	2.96
24	18	SWM5	5.00	72	0.10	5.06
25	16	SWM7	0.78	454	0.08	4.57
26	30	OUT1B			0.14	
27	29	OUTD			0.04	
28	28	OUTC			0.03	
29	27	OUTA			0.06	
30	26	OUTB			0.06	

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

EXTRAN Interface File Information
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Inlet flows are stored at the following 4 inlets (EXTRAN nodes):

X 207 205 202

DDSWMM-EXTRAN Connectivity

EXTRAN Inlet	DDSWMM Inlets (Major System Segments)			
X	SWM14	SWM13	LP001	SWM12
	SWM11			
207	LP002	SWM5		
205	LP003	LP004	SWM9	
202	LP005	SWM7	SWM6	

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM DETAILED SIMULATION RESULTS

Major System Segment D001

Time (hr:min)	U/S Inflow (cms)	Catchment Inflow (cms)	Total Inflow (cms)	Inlet Capture (cms)	Outflow (cms)	Depth at Curb (cm)	Storage (cu.m)
0: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:30	0.000	0.000	0.000	0.000	0.000	0.6	0.00
0:35	0.001	0.000	0.001	0.000	0.000	1.8	0.00
0:40	0.001	0.000	0.001	0.000	0.001	2.0	0.00
0:45	0.001	0.000	0.001	0.000	0.001	2.3	0.00
0:50	0.002	0.000	0.002	0.000	0.002	3.1	0.00
0:55	0.003	0.000	0.003	0.000	0.003	3.7	0.00
1: 0	0.011	0.000	0.011	0.000	0.009	6.0	0.00
1: 5	0.020	0.000	0.020	0.000	0.018	7.6	0.00
1:10	0.010	0.000	0.010	0.000	0.012	5.8	0.00
1:15	0.005	0.000	0.005	0.000	0.006	4.6	0.00
1:20	0.004	0.000	0.004	0.000	0.004	4.0	0.00
1:25	0.003	0.000	0.003	0.000	0.003	3.5	0.00
1:30	0.002	0.000	0.002	0.000	0.002	3.2	0.00
1:35	0.002	0.000	0.002	0.000	0.002	3.1	0.00
1:40	0.001	0.000	0.001	0.000	0.002	2.8	0.00
1:45	0.001	0.000	0.001	0.000	0.001	2.6	0.00
1:50	0.001	0.000	0.001	0.000	0.001	2.4	0.00
1:55	0.001	0.000	0.001	0.000	0.001	2.3	0.00
2: 0	0.001	0.000	0.001	0.000	0.001	2.2	0.00
2: 5	0.001	0.000	0.001	0.000	0.001	2.1	0.00
2:10	0.001	0.000	0.001	0.000	0.001	2.0	0.00
2:15	0.001	0.000	0.001	0.000	0.001	2.0	0.00
2:20	0.001	0.000	0.001	0.000	0.001	1.9	0.00
2:25	0.001	0.000	0.001	0.000	0.001	1.9	0.00
2:30	0.001	0.000	0.001	0.000	0.001	1.9	0.00
2:35	0.001	0.000	0.001	0.000	0.001	1.8	0.00
2:40	0.001	0.000	0.001	0.000	0.001	1.8	0.00
2:45	0.001	0.000	0.001	0.000	0.001	1.8	0.00
2:50	0.000	0.000	0.000	0.000	0.001	1.7	0.00
2:55	0.000	0.000	0.000	0.000	0.000	1.7	0.00
3: 0	0.000	0.000	0.000	0.000	0.000	1.7	0.00
3: 5	0.000	0.000	0.000	0.000	0.000	1.7	0.00
3:10	0.000	0.000	0.000	0.000	0.000	1.7	0.00
3:15	0.000	0.000	0.000	0.000	0.000	1.7	0.00
3:20	0.000	0.000	0.000	0.000	0.000	1.6	0.00
3:25	0.000	0.000	0.000	0.000	0.000	1.6	0.00
3:30	0.000	0.000	0.000	0.000	0.000	1.6	0.00
3:35	0.000	0.000	0.000	0.000	0.000	1.5	0.00
3:40	0.000	0.000	0.000	0.000	0.000	1.5	0.00
3:45	0.000	0.000	0.000	0.000	0.000	1.5	0.00

3:50	0.000	0.000	0.000	0.000	0.000	1.4	0.00
3:55	0.000	0.000	0.000	0.000	0.000	1.3	0.00
4: 0	0.000	0.000	0.000	0.000	0.000	1.2	0.00
4: 5	0.000	0.000	0.000	0.000	0.000	1.2	0.00
4:10	0.000	0.000	0.000	0.000	0.000	1.1	0.00
4:15	0.000	0.000	0.000	0.000	0.000	1.0	0.00
4:20	0.000	0.000	0.000	0.000	0.000	1.0	0.00
4:25	0.000	0.000	0.000	0.000	0.000	1.0	0.00
4:30	0.000	0.000	0.000	0.000	0.000	0.9	0.00
4:35	0.000	0.000	0.000	0.000	0.000	0.9	0.00
4:40	0.000	0.000	0.000	0.000	0.000	0.8	0.00
4:45	0.000	0.000	0.000	0.000	0.000	0.8	0.00
4:50	0.000	0.000	0.000	0.000	0.000	0.8	0.00
4:55	0.000	0.000	0.000	0.000	0.000	0.8	0.00
5: 0	0.000	0.000	0.000	0.000	0.000	0.7	0.00
5: 5	0.000	0.000	0.000	0.000	0.000	0.7	0.00
5:10	0.000	0.000	0.000	0.000	0.000	0.7	0.00
5:15	0.000	0.000	0.000	0.000	0.000	0.7	0.00
5:20	0.000	0.000	0.000	0.000	0.000	0.6	0.00
5:25	0.000	0.000	0.000	0.000	0.000	0.6	0.00
5:30	0.000	0.000	0.000	0.000	0.000	0.6	0.00
5:35	0.000	0.000	0.000	0.000	0.000	0.6	0.00
5:40	0.000	0.000	0.000	0.000	0.000	0.6	0.00
5:45	0.000	0.000	0.000	0.000	0.000	0.6	0.00
5:50	0.000	0.000	0.000	0.000	0.000	0.6	0.00
5:55	0.000	0.000	0.000	0.000	0.000	0.5	0.00
Maximum	0.021		0.021	0.000	0.020	7.7	0.00
Time (h:min)	1: 6		1: 6	0: 0	1: 7		

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM DETAILED SIMULATION RESULTS

Major System Segment D002

Time (hr:min)	U/S Inflow (cms)	Catchment Inflow (cms)	Total Inflow (cms)	Inlet Capture (cms)	Outflow (cms)	Depth at Curb (cm)	Storage (cu.m)
0: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00

1: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
1: 5	0.028	0.000	0.028	0.000	0.015	8.6	0.00
1:10	0.012	0.000	0.012	0.000	0.019	6.2	0.00
1:15	0.000	0.000	0.000	0.000	0.008	0.0	0.00
1:20	0.000	0.000	0.000	0.000	0.004	0.0	0.00
1:25	0.000	0.000	0.000	0.000	0.003	0.0	0.00
1:30	0.000	0.000	0.000	0.000	0.002	0.0	0.00
1:35	0.000	0.000	0.000	0.000	0.001	0.0	0.00
1:40	0.000	0.000	0.000	0.000	0.001	0.0	0.00
1:45	0.000	0.000	0.000	0.000	0.001	0.0	0.00
1:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
1:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
Maximum	0.031		0.031	0.000	0.023	8.9	0.00

Time (h:min) 1: 6 1: 6 0: 0 1: 8
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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM DETAILED SIMULATION RESULTS

Major System Segment D003

Time (hr:min)	U/S Inflow (cms)	Catchment Inflow (cms)	Total Inflow (cms)	Inlet Capture (cms)	Outflow (cms)	Depth at Curb (cm)	Storage (cu.m)
0: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
1: 0	0.016	0.000	0.016	0.000	0.005	7.0	0.00
1: 5	0.053	0.000	0.053	0.000	0.023	10.9	0.00
1:10	0.051	0.000	0.051	0.000	0.042	10.8	0.00
1:15	0.031	0.000	0.031	0.000	0.041	9.0	0.00
1:20	0.019	0.000	0.019	0.000	0.031	7.5	0.00
1:25	0.012	0.000	0.012	0.000	0.022	6.3	0.00
1:30	0.008	0.000	0.008	0.000	0.016	5.4	0.00
1:35	0.005	0.000	0.005	0.000	0.011	4.6	0.00
1:40	0.004	0.000	0.004	0.000	0.008	3.9	0.00
1:45	0.002	0.000	0.002	0.000	0.006	3.3	0.00
1:50	0.001	0.000	0.001	0.000	0.004	2.7	0.00
1:55	0.001	0.000	0.001	0.000	0.003	1.9	0.00
2: 0	0.000	0.000	0.000	0.000	0.002	0.4	0.00
2: 5	0.000	0.000	0.000	0.000	0.002	0.0	0.00
2:10	0.000	0.000	0.000	0.000	0.002	0.0	0.00
2:15	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:20	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:25	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:30	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:35	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:40	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:45	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00

3:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
Maximum	0.059		0.059	0.000	0.044	11.4	0.00
Time (h:min)	1: 6		1: 6	0: 0	1:11		

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM DETAILED SIMULATION RESULTS

Major System Segment D004

Time (hr:min)	U/S Inflow (cms)	Catchment Inflow (cms)	Total Inflow (cms)	Inlet Capture (cms)	Outflow (cms)	Depth at Curb (cm)	Storage (cu.m)
0: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00

0:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:55	0.000	0.000	0.000	0.000	0.001	0.0	0.00
1: 0	0.031	0.000	0.031	0.000	0.009	9.0	0.00
1: 5	0.088	0.000	0.088	0.000	0.037	13.2	0.00
1:10	0.078	0.000	0.078	0.000	0.065	12.6	0.00
1:15	0.049	0.000	0.049	0.000	0.066	10.7	0.00
1:20	0.032	0.000	0.032	0.000	0.052	9.1	0.00
1:25	0.019	0.000	0.019	0.000	0.039	7.5	0.00
1:30	0.011	0.000	0.011	0.000	0.028	6.2	0.00
1:35	0.007	0.000	0.007	0.000	0.019	4.9	0.00
1:40	0.003	0.000	0.003	0.000	0.014	3.5	0.00
1:45	0.000	0.000	0.000	0.000	0.010	1.4	0.00
1:50	0.000	0.000	0.000	0.000	0.008	0.0	0.00
1:55	0.000	0.000	0.000	0.000	0.006	0.0	0.00
2: 0	0.000	0.000	0.000	0.000	0.005	0.0	0.00
2: 5	0.000	0.000	0.000	0.000	0.004	0.0	0.00
2:10	0.000	0.000	0.000	0.000	0.004	0.0	0.00
2:15	0.000	0.000	0.000	0.000	0.003	0.0	0.00
2:20	0.000	0.000	0.000	0.000	0.003	0.0	0.00
2:25	0.000	0.000	0.000	0.000	0.002	0.0	0.00
2:30	0.000	0.000	0.000	0.000	0.002	0.0	0.00
2:35	0.000	0.000	0.000	0.000	0.002	0.0	0.00
2:40	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:45	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:50	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:55	0.000	0.000	0.000	0.000	0.001	0.0	0.00
3: 0	0.000	0.000	0.000	0.000	0.001	0.0	0.00
3: 5	0.000	0.000	0.000	0.000	0.001	0.0	0.00
3:10	0.000	0.000	0.000	0.000	0.001	0.0	0.00
3:15	0.000	0.000	0.000	0.000	0.001	0.0	0.00
3:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00

5:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
Maximum	0.103		0.103	0.000	0.072	14.1	0.00
Time (h:min)	1: 7		1: 7	0: 0	1:12		

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM DETAILED SIMULATION RESULTS

Major System Segment D005

Time (hr:min)	U/S Inflow (cms)	Catchment Inflow (cms)	Total Inflow (cms)	Inlet Capture (cms)	Outflow (cms)	Depth at Curb (cm)	Storage (cu.m)
0: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
1: 0	0.041	0.000	0.041	0.000	0.034	10.0	0.00
1: 5	0.130	0.000	0.130	0.000	0.119	15.4	0.00
1:10	0.134	0.000	0.134	0.000	0.134	15.5	0.00
1:15	0.112	0.000	0.112	0.000	0.114	14.5	0.00
1:20	0.082	0.000	0.082	0.000	0.086	12.9	0.00
1:25	0.054	0.000	0.054	0.000	0.058	11.0	0.00
1:30	0.035	0.000	0.035	0.000	0.038	9.3	0.00
1:35	0.020	0.000	0.020	0.000	0.023	7.6	0.00
1:40	0.010	0.000	0.010	0.000	0.012	5.8	0.00
1:45	0.003	0.000	0.003	0.000	0.005	3.4	0.00
1:50	0.000	0.000	0.000	0.000	0.001	0.0	0.00
1:55	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00

3: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
Maximum	0.138		0.138	0.000	0.136	15.7	0.00
Time (h:min)	1: 6		1: 6	0: 0	1: 7		

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

RESULTS OF SIMULATION FOR MAJOR SYSTEM STORAGE

Storage Unit Out1
Number of Inflow Points 1

Discharge Point	Peak Inflow (cms)	Peak Time (hr:min.)
OUTA	0.062	1:20

```
                                     bor 100 year out sept 28-16
         Time       Flow       Storage                                              Flow (cms)
       (hr:min)    (cms)      (cu.m)

                                                            0.00E+00  0.12E-01  0.25E-01
0.37E-01  0.49E-01   0.62E-01

I---------I---------I---------I---------I----------I
         0: 0        0.000        0.00              I*
                  I
         0: 5        0.000        0.00              I*
                  I
         0:10        0.000        0.00              I*
                  I
         0:15        0.000        0.00              I*
                  I
         0:20        0.000        0.00              I*
                  I
         0:25        0.000        0.00              I*
                  I
         0:30        0.000        0.00              I*
                  I
         0:35        0.000        0.00              I*
                  I
         0:40        0.000        0.00              I*
                  I
         0:45        0.000        0.00              I*
                  I
         0:50        0.000        0.00              I*
                  I
         0:55        0.000        0.00              I*
                  I
         1: 0        0.000        0.00              I*
                  I
         1: 5        0.000        0.00              I*
                  I
         1:10        0.000        0.00              I*
                  I
         1:15        0.000        0.00              I*
                  I
         1:20        0.062        9.26
I**************************************************I
         1:25        0.048       25.74
I***************************************            I
         1:30        0.035       38.28              I*****************************
                  I
         1:35        0.028       47.79              I***********************
                  I
         1:40        0.021       55.14              I******************
                  I
         1:45        0.016       60.76              I**************
                  I
         1:50        0.012       65.10              I***********
                  I
         1:55        0.010       68.40              I********
                  I
         2: 0        0.007       70.89              I******
                  I
         2: 5        0.005       72.71              I*****
                  I
         2:10        0.003       73.97              I***
                  I
         2:15        0.002       74.77              I**
                  I
```

```
2:20        0.001      75.17            I*
        I
2:25        0.000      75.28            I*
        I
2:30        0.000      75.28            I*
        I
2:35        0.000      75.28            I*
        I
2:40        0.000      75.28            I*
        I
2:45        0.000      75.28            I*
        I
2:50        0.000      75.28            I*
        I
2:55        0.000      75.28            I*
        I
3: 0        0.000      75.28            I*
        I
3: 5        0.000      75.28            I*
        I
3:10        0.000      75.28            I*
        I
3:15        0.000      75.28            I*
        I
3:20        0.000      75.28            I*
        I
3:25        0.000      75.28            I*
        I
3:30        0.000      75.28            I*
        I
3:35        0.000      75.28            I*
        I
3:40        0.000      75.28            I*
        I
3:45        0.000      75.28            I*
        I
3:50        0.000      75.28            I*
        I
3:55        0.000      75.28            I*
        I
4: 0        0.000      75.28            I*
        I
4: 5        0.000      75.28            I*
        I
4:10        0.000      75.28            I*
        I
4:15        0.000      75.28            I*
        I
4:20        0.000      75.28            I*
        I
4:25        0.000      75.28            I*
        I
4:30        0.000      75.28            I*
        I
4:35        0.000      75.28            I*
        I
4:40        0.000      75.28            I*
        I
4:45        0.000      75.28            I*
        I
4:50        0.000      75.28            I*
        I
4:55        0.000      75.28            I*
```

```
                I
      5: 0         0.000       75.28            I*
                I
      5: 5         0.000       75.28            I*
                I
      5:10         0.000       75.28            I*
                I
      5:15         0.000       75.28            I*
                I
      5:20         0.000       75.28            I*
                I
      5:25         0.000       75.28            I*
                I
      5:30         0.000       75.28            I*
                I
      5:35         0.000       75.28            I*
                I
      5:40         0.000       75.28            I*
                I
      5:45         0.000       75.28            I*
                I
      5:50         0.000       75.28            I*
                I
      5:55         0.000       75.28            I*
                I

I---------I---------I---------I---------I----------I
                                                  0.00E+00  0.12E-01  0.25E-01
0.37E-01  0.49E-01   0.62E-01
  Peak   1:20       0.062
```

Required Detention Volume   75.28 cu.m.

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

RESULTS OF SIMULATION FOR MAJOR SYSTEM STORAGE

Storage Unit   Out2
Number of Inflow Points   1

Discharge Point	Peak Inflow (cms)	Peak Time (hr:min.)
OUTB	0.060	1: 6

```
        Time      Flow      Storage                                 Flow (cms)
      (hr:min)    (cms)     (cu.m)

                                                  0.00E+00  0.11E-01  0.23E-01
0.34E-01  0.46E-01   0.57E-01

I---------I---------I---------I---------I----------I
```

```
          0: 0       0.000        0.00            I*
                 I
          0: 5       0.000        0.00            I*
                 I
          0:10       0.000        0.00            I*
                 I
          0:15       0.000        0.00            I*
                 I
          0:20       0.000        0.00            I*
                 I
          0:25       0.000        0.00            I*
                 I
          0:30       0.000        0.04            I*
                 I
          0:35       0.001        0.20            I*
                 I
          0:40       0.001        0.49            I*
                 I
          0:45       0.001        0.85            I**
                 I
          0:50       0.003        1.44            I***
                 I
          0:55       0.004        2.38            I****
                 I
          1: 0       0.014        5.03            I*************
                 I
          1: 5       0.052       14.93
I**********************************************    I
          1:10       0.057       32.30
I**************************************************I
          1:15       0.046       47.75
I*****************************************         I
          1:20       0.030       59.17            I***************************
                 I
          1:25       0.018       66.34            I****************
                 I
          1:30       0.013       70.92            I************
                 I
          1:35       0.009       74.27            I*********
                 I
          1:40       0.007       76.74            I*******
                 I
          1:45       0.005       78.60            I*****
                 I
          1:50       0.004       80.01            I****
                 I
          1:55       0.003       81.08            I***
                 I
          2: 0       0.002       81.91            I***
                 I
          2: 5       0.002       82.57            I**
                 I
          2:10       0.002       83.12            I**
                 I
          2:15       0.001       83.60            I**
                 I
          2:20       0.001       84.02            I**
                 I
          2:25       0.001       84.40            I**
                 I
          2:30       0.001       84.74            I*
                 I
          2:35       0.001       85.04            I*
```

	I			
2:40		0.001	85.33	I*
	I			
2:45		0.001	85.59	I*
	I			
2:50		0.001	85.82	I*
	I			
2:55		0.001	86.05	I*
	I			
3: 0		0.001	86.25	I*
	I			
3: 5		0.001	86.45	I*
	I			
3:10		0.001	86.63	I*
	I			
3:15		0.000	86.79	I*
	I			
3:20		0.000	86.91	I*
	I			
3:25		0.000	87.00	I*
	I			
3:30		0.000	87.07	I*
	I			
3:35		0.000	87.13	I*
	I			
3:40		0.000	87.18	I*
	I			
3:45		0.000	87.23	I*
	I			
3:50		0.000	87.26	I*
	I			
3:55		0.000	87.30	I*
	I			
4: 0		0.000	87.33	I*
	I			
4: 5		0.000	87.36	I*
	I			
4:10		0.000	87.39	I*
	I			
4:15		0.000	87.42	I*
	I			
4:20		0.000	87.44	I*
	I			
4:25		0.000	87.47	I*
	I			
4:30		0.000	87.49	I*
	I			
4:35		0.000	87.51	I*
	I			
4:40		0.000	87.53	I*
	I			
4:45		0.000	87.55	I*
	I			
4:50		0.000	87.57	I*
	I			
4:55		0.000	87.59	I*
	I			
5: 0		0.000	87.61	I*
	I			
5: 5		0.000	87.62	I*
	I			
5:10		0.000	87.64	I*
	I			

```
        5:15        0.000       87.65             I*
                I
        5:20        0.000       87.67             I*
                I
        5:25        0.000       87.68             I*
                I
        5:30        0.000       87.70             I*
                I
        5:35        0.000       87.71             I*
                I
        5:40        0.000       87.73             I*
                I
        5:45        0.000       87.74             I*
                I
        5:50        0.000       87.75             I*
                I
        5:55        0.000       87.77             I*
                I

I---------I---------I---------I---------I----------I
                                                  0.00E+00  0.11E-01  0.23E-01
0.34E-01  0.46E-01   0.57E-01
  Peak   1: 6       0.060
```

Required Detention Volume   87.77 cu.m.

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

RESULTS OF SIMULATION FOR MAJOR SYSTEM STORAGE

Storage Unit   Out3
Number of Inflow Points   1

Discharge Point	Peak Inflow (cms)	Peak Time (hr:min.)
OUTC	0.027	1:15

```
          Time      Flow      Storage                               Flow (cms)
       (hr:min)    (cms)     (cu.m)

                                                  0.00E+00  0.55E-02  0.11E-01
0.16E-01  0.22E-01   0.27E-01

I---------I---------I---------I---------I----------I
        0: 0        0.000        0.00             I*
                I
        0: 5        0.000        0.00             I*
                I
        0:10        0.000        0.00             I*
                I
        0:15        0.000        0.00             I*
```

```
                  I
        0:20         0.000        0.00            I*
                  I
        0:25         0.000        0.00            I*
                  I
        0:30         0.000        0.00            I*
                  I
        0:35         0.000        0.00            I*
                  I
        0:40         0.000        0.01            I*
                  I
        0:45         0.000        0.03            I*
                  I
        0:50         0.000        0.06            I*
                  I
        0:55         0.000        0.15            I*
                  I
        1: 0         0.002        0.46            I****
                  I
        1: 5         0.006        1.55            I***********
                  I
        1:10         0.027        6.50
I**************************************************I
        1:15         0.027       14.72
I************************************************* I
        1:20         0.019       21.59
I***********************************               I
        1:25         0.016       26.77            I*****************************
                  I
        1:30         0.013       30.98            I***********************
                  I
        1:35         0.011       34.46            I********************
                  I
        1:40         0.009       37.41            I*****************
                  I
        1:45         0.008       39.96            I***************
                  I
        1:50         0.007       42.21            I*************
                  I
        1:55         0.006       44.23            I************
                  I
        2: 0         0.006       46.05            I***********
                  I
        2: 5         0.005       47.73            I**********
                  I
        2:10         0.005       49.28            I**********
                  I
        2:15         0.005       50.72            I*********
                  I
        2:20         0.004       52.08            I********
                  I
        2:25         0.004       53.36            I********
                  I
        2:30         0.004       54.57            I********
                  I
        2:35         0.004       55.72            I*******
                  I
        2:40         0.004       56.81            I*******
                  I
        2:45         0.003       57.85            I*******
                  I
        2:50         0.003       58.84            I******
                  I
```

2:55 0.003 59.79 I******
I
3: 0 0.003 60.70 I******
I
3: 5 0.003 61.57 I******
I
3:10 0.003 62.42 I******
I
3:15 0.003 63.23 I*****
I
3:20 0.003 64.02 I*****
I
3:25 0.002 64.78 I*****
I
3:30 0.002 65.52 I*****
I
3:35 0.002 66.23 I*****
I
3:40 0.002 66.93 I*****
I
3:45 0.002 67.61 I*****
I
3:50 0.002 68.27 I****
I
3:55 0.002 68.91 I****
I
4: 0 0.002 69.53 I****
I
4: 5 0.002 70.14 I****
I
4:10 0.002 70.74 I****
I
4:15 0.002 71.32 I****
I
4:20 0.002 71.88 I****
I
4:25 0.002 72.44 I****
I
4:30 0.002 72.98 I****
I
4:35 0.002 73.51 I****
I
4:40 0.002 74.03 I****
I
4:45 0.002 74.54 I****
I
4:50 0.002 75.03 I***
I
4:55 0.002 75.52 I***
I
5: 0 0.002 76.00 I***
I
5: 5 0.002 76.47 I***
I
5:10 0.002 76.93 I***
I
5:15 0.001 77.38 I***
I
5:20 0.001 77.83 I***
I
5:25 0.001 78.26 I***
I
5:30 0.001 78.69 I***

```
                 I
         5:35       0.001       79.11            I***
                 I
         5:40       0.001       79.53            I***
                 I
         5:45       0.001       79.93            I***
                 I
         5:50       0.001       80.33            I***
                 I
         5:55       0.001       80.73            I***
                 I

I---------I---------I---------I---------I----------I
                                                 0.00E+00  0.55E-02  0.11E-01
0.16E-01  0.22E-01   0.27E-01
  Peak   1:15       0.027
```

Required Detention Volume   80.73 cu.m.

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

RESULTS OF SIMULATION FOR MAJOR SYSTEM STORAGE

Storage Unit   Out4
Number of Inflow Points   1

Discharge Point	Peak Inflow (cms)	Peak Time (hr:min.)
OUT1B	0.136	1: 7

```
         Time      Flow      Storage                               Flow (cms)
       (hr:min)    (cms)     (cu.m)

                                                 0.00E+00  0.27E-01  0.54E-01
0.80E-01  0.11E+00   0.13E+00

I---------I---------I---------I---------I----------I
         0: 0       0.000        0.00            I*
                 I
         0: 5       0.000        0.00            I*
                 I
         0:10       0.000        0.00            I*
                 I
         0:15       0.000        0.00            I*
                 I
         0:20       0.000        0.00            I*
                 I
         0:25       0.000        0.00            I*
                 I
         0:30       0.000        0.00            I*
                 I
```

```
        0:35        0.000        0.00             I*
                 I
        0:40        0.000        0.00             I*
                 I
        0:45        0.000        0.00             I*
                 I
        0:50        0.000        0.00             I*
                 I
        0:55        0.000        0.01             I*
                 I
        1: 0        0.034        5.16             I*************
                 I
        1: 5        0.119       28.22
I*********************************************     I
        1:10        0.134       67.86
I**************************************************I
        1:15        0.114      105.06
I*******************************************       I
        1:20        0.086      135.06
I*********************************                 I
        1:25        0.058      156.71             I**********************
                 I
        1:30        0.038      171.17             I***************
                 I
        1:35        0.023      180.32             I*********
                 I
        1:40        0.012      185.57             I*****
                 I
        1:45        0.005      188.08             I**
                 I
        1:50        0.001      188.96             I*
                 I
        1:55        0.001      189.22             I*
                 I
        2: 0        0.000      189.33             I*
                 I
        2: 5        0.000      189.39             I*
                 I
        2:10        0.000      189.43             I*
                 I
        2:15        0.000      189.45             I*
                 I
        2:20        0.000      189.47             I*
                 I
        2:25        0.000      189.48             I*
                 I
        2:30        0.000      189.50             I*
                 I
        2:35        0.000      189.51             I*
                 I
        2:40        0.000      189.51             I*
                 I
        2:45        0.000      189.52             I*
                 I
        2:50        0.000      189.52             I*
                 I
        2:55        0.000      189.53             I*
                 I
        3: 0        0.000      189.53             I*
                 I
        3: 5        0.000      189.54             I*
                 I
        3:10        0.000      189.54             I*
```

	I			
3:15		0.000	189.54	I*
	I			
3:20		0.000	189.54	I*
	I			
3:25		0.000	189.55	I*
	I			
3:30		0.000	189.55	I*
	I			
3:35		0.000	189.55	I*
	I			
3:40		0.000	189.55	I*
	I			
3:45		0.000	189.55	I*
	I			
3:50		0.000	189.55	I*
	I			
3:55		0.000	189.55	I*
	I			
4: 0		0.000	189.55	I*
	I			
4: 5		0.000	189.56	I*
	I			
4:10		0.000	189.56	I*
	I			
4:15		0.000	189.56	I*
	I			
4:20		0.000	189.56	I*
	I			
4:25		0.000	189.56	I*
	I			
4:30		0.000	189.56	I*
	I			
4:35		0.000	189.56	I*
	I			
4:40		0.000	189.56	I*
	I			
4:45		0.000	189.56	I*
	I			
4:50		0.000	189.56	I*
	I			
4:55		0.000	189.56	I*
	I			
5: 0		0.000	189.56	I*
	I			
5: 5		0.000	189.56	I*
	I			
5:10		0.000	189.56	I*
	I			
5:15		0.000	189.56	I*
	I			
5:20		0.000	189.56	I*
	I			
5:25		0.000	189.56	I*
	I			
5:30		0.000	189.56	I*
	I			
5:35		0.000	189.56	I*
	I			
5:40		0.000	189.56	I*
	I			
5:45		0.000	189.56	I*
	I			

```
         5:50        0.000      189.56            I*
                I
         5:55        0.000      189.56            I*
                I

I---------I---------I---------I---------I----------I
                                                   0.00E+00  0.27E-01  0.54E-01
0.80E-01  0.11E+00   0.13E+00
  Peak   1: 7        0.136
```

Required Detention Volume   189.56 cu.m.

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

RESULTS OF SIMULATION FOR MAJOR SYSTEM STORAGE

```
Storage Unit              Out5
Number of Inflow Points       1

  Discharge    Peak       Peak
    Point     Inflow      Time
               (cms)    (hr:min.)

  OUTD         0.038      1: 8


    Time      Flow      Storage                                  Flow (cms)
  (hr:min)    (cms)     (cu.m)

                                                   0.00E+00  0.75E-02  0.15E-01
0.22E-01  0.30E-01   0.37E-01

I---------I---------I---------I---------I----------I
         0: 0        0.000        0.00            I*
                I
         0: 5        0.000        0.00            I*
                I
         0:10        0.000        0.00            I*
                I
         0:15        0.000        0.00            I*
                I
         0:20        0.000        0.00            I*
                I
         0:25        0.000        0.00            I*
                I
         0:30        0.000        0.00            I*
                I
         0:35        0.000        0.02            I*
                I
         0:40        0.000        0.05            I*
                I
         0:45        0.000        0.10            I*
                I
         0:50        0.001        0.22            I*
```

```
                 I
         0:55      0.001        0.49            I**
                 I
         1: 0      0.006        1.52            I********
                 I
         1: 5      0.022        5.59            I*****************************
                 I
         1:10      0.037       15.55
I**************************************************I
         1:15      0.032       25.98
I*******************************************       I
         1:20      0.027       34.83
I*************************************             I
         1:25      0.023       42.28            I*******************************
                 I
         1:30      0.018       48.45            I*************************
                 I
         1:35      0.016       53.57            I*********************
                 I
         1:40      0.013       57.89            I******************
                 I
         1:45      0.011       61.57            I****************
                 I
         1:50      0.010       64.76            I**************
                 I
         1:55      0.009       67.56            I************
                 I
         2: 0      0.008       70.03            I***********
                 I
         2: 5      0.007       72.25            I**********
                 I
         2:10      0.006       74.24            I*********
                 I
         2:15      0.006       76.06            I********
                 I
         2:20      0.005       77.72            I********
                 I
         2:25      0.005       79.25            I*******
                 I
         2:30      0.005       80.67            I*******
                 I
         2:35      0.004       82.00            I******
                 I
         2:40      0.004       83.24            I******
                 I
         2:45      0.004       84.41            I******
                 I
         2:50      0.004       85.52            I*****
                 I
         2:55      0.003       86.56            I*****
                 I
         3: 0      0.003       87.56            I*****
                 I
         3: 5      0.003       88.50            I*****
                 I
         3:10      0.003       89.41            I****
                 I
         3:15      0.003       90.27            I****
                 I
         3:20      0.003       91.10            I****
                 I
         3:25      0.003       91.90            I****
                 I
```

```
      3:30        0.003       92.68             I****
              I
      3:35        0.002       93.42             I****
              I
      3:40        0.002       94.15             I****
              I
      3:45        0.002       94.85             I****
              I
      3:50        0.002       95.53             I***
              I
      3:55        0.002       96.18             I***
              I
      4: 0        0.002       96.82             I***
              I
      4: 5        0.002       97.45             I***
              I
      4:10        0.002       98.05             I***
              I
      4:15        0.002       98.64             I***
              I
      4:20        0.002       99.21             I***
              I
      4:25        0.002       99.77             I***
              I
      4:30        0.002      100.32             I***
              I
      4:35        0.002      100.85             I***
              I
      4:40        0.002      101.37             I***
              I
      4:45        0.002      101.88             I***
              I
      4:50        0.002      102.38             I***
              I
      4:55        0.002      102.86             I***
              I
      5: 0        0.002      103.34             I***
              I
      5: 5        0.002      103.81             I***
              I
      5:10        0.002      104.26             I***
              I
      5:15        0.001      104.71             I**
              I
      5:20        0.001      105.15             I**
              I
      5:25        0.001      105.58             I**
              I
      5:30        0.001      106.00             I**
              I
      5:35        0.001      106.41             I**
              I
      5:40        0.001      106.82             I**
              I
      5:45        0.001      107.22             I**
              I
      5:50        0.001      107.61             I**
              I
      5:55        0.001      108.00             I**
              I

I---------I---------I---------I---------I----------I
                                                    0.00E+00  0.75E-02  0.15E-01
```

0.22E-01 0.30E-01 0.37E-01
Peak 1: 8 0.038

Required Detention Volume 108.00 cu.m.

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm

MAJOR SYSTEM

SUMMARY OF SIMULATION RESULTS

No.	Segment	Peak Flow (cms)	Peak Time (hr:min.)	Max. Depth (cm)	Max. Capture (l/s)	Inlet Restriction (?)	D/S Pipe	Max. Storage (cu.m.)
1	SWM14	0.011	1: 5	2.48	0.00	-	X	0.00
2	SWM13	0.011	1: 5	2.19	0.00	-	X	0.00
3	LP001	0.021	1: 6	2.80	0.00	-	X	0.00
4	SWM12	0.023	1: 5	3.15	0.00	-	X	0.00
5	SWM11	0.009	1: 5	2.25	0.00	-	X	0.00
6	LP002	0.051	1: 6	4.67	20.00	N/A	207	1.80
7	SWM10	0.046	1: 5	4.52	0.00	-	X	0.00
8	SWM8	0.019	1: 9	3.47	0.00	-	X	0.00
9	LP003	0.063	1: 6	5.54	4.52	N/A	205	5.70
10	SWM3	0.033	1: 5	4.35	0.00	-	X	0.00
11	SWM4	0.083	1: 5	5.60	0.00	-	X	0.00
12	LP004	0.113	1: 7	6.90	9.87	N/A	205	5.70
13	SWM2	0.116	1:12	5.19	0.00	-	X	0.00
14	SWM1	0.056	1: 5	5.31	0.00	-	X	0.00
15	LP005	0.158	1: 6	6.09	20.00	N/A	202	1.30
16	SWM7	0.080	1: 5	4.57	20.00	YES	202	0.00
17	SWM9	0.028	1: 5	1.47	11.64	NO	205	0.00
18	SWM5	0.103	1: 5	5.06	15.00	N/A	207	55.00
19	SWM6	0.057	1: 5	2.96	20.00	YES	202	0.00

```
20 SWM15         0.042    1: 5       2.18       0.00       -        X
0.00
21 D001          0.021    1: 6       7.72       0.00       -        X
0.00
22 D002          0.031    1: 6       8.95       0.00       -        X
0.00
23 D003          0.059    1: 6      11.36       0.00       -        X
0.00
24 D004          0.103    1: 7      14.05       0.00       -        X
0.00
25 D005          0.138    1: 6      15.73       0.00       -        X
0.00
```

```
*** SIMULATION ENDED NORMALLY ***
♀
   ***********************************************************
   *                                                         *
   *    Simulation Starting Date      September 08, 16       *
   *                        Time      08:45:39.13            *
   *                                                         *
   *    Simulation Ending   Date      September 08, 16       *
   *                        Time      08:45:40.21            *
   *                                                         *
   *    Duration of Simulation          0.02 Minutes         *
   *                                                         *
   ***********************************************************
```

Data Files

Input Data File Name bor100.txt

Ouput File Name sept8

```
' Borrello Subdivision                          '
' DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST
      '
*****************************************************************
* DDSWMM Analysis by RLD - September 2016
* Bor100+20%.txt
*****************************************************************
*
*   IUNIT   DELTC   NDELTC  IEVAL   QLIMIT  ISTEP
    1       5       72      3       20.0    1
* IUNIT =1 for metric
* DELTC = time increment for calculation (minutes)
* NDELTC = number of computational time steps (maximum = 300)
* IEVAL = 1 if pipe sizes are given and it is required to revise
* these sizes, if necessary, based on free surface flow
* QLIMIT = Default value of limiting capacity of inlets. Value can be overridden
* for individual inlets by the values assigned to (QLIM) on data group (7)
* ISTEP = Interval between print-out
*
*   RAINFALL DATA
******************
*   JULDAY   TZERO
    02290    0.0
* JULDAY = Initial Julian calender
* TZERO = intial time [0hrs to 24hrs]
*   DELTR    NDELTR
    10.0       19
* 19 STEPS OF RAINFALL INTENSITIES AT 10 MINS INTERVAL
0 7.255 9.05 12.191 19.163 48.786 214.271 64.859 32.783 21.888 16.484
13.271 11.142 9.629 8.496 7.616 6.912 6.336 5.855
* DELTR = time increment for rainfall hyetograph (minutes)
* NDELTR = number of time increments for rainfall hyetograph
*
* MINOR SYSTEM CHARACTERISTICS
* IRTP  NP        NPD      XP        SP       CP      DP        QB   IPRTP
* IRTP=0, routing of minor system flow (for this pipe) will be performed
* NP = sewer identification number/name [node point]
* NPD = identification number/name of downstream sewer [node point downstream]
* XP = length of sewer (m)
* SP = invert slope (m/m)
* CP = Manning's roughness coefficient
* DP = pipe diameter (mm)
* QB = base flow (cubes)
* IPRTP = option for printing time history of pipe flow (1 or 0) (0=no print)
*
*
*       Street A
*       0       '210'   '209'   10.3    0.0097  0.013   254.0   0.0     0
*       0       '209'   '208'   19.5    0.0103  0.013   254.0   0.0     0
*       0       '208'   '207'   8.6     0.0093  0.013   254.0   0.0     0
*       0       '207'   '206'   44.4    0.0020  0.013   457.2   0.0     0
*       0       '206'   '205a'  7.3     0.0027  0.013   457.2   0.0     0
*       0       '205a'  '205'   11.2    0.0027  0.013   457.2   0.0     0
*       0       '205'   '203'   36.8    0.0030  0.013   457.2   0.0     0
*       0       '203'   '202'   31.6    0.0025  0.013   457.2   0.0     0
*       0       '202'   '201'   43.6    0.0070  0.013   457.2   0.0     0
*       0       '201'   '202a'  85.0    0.0073  0.013   457.2   0.0     0
* dummy pipe
*       0       'X'     '210'   85.0    0.0073  0.013   457.2   0.0     0
*
*ENDMNR
* to terminate minor system data entry
* if the drainage system has no storage for minor system, enter
```

```
* terminators as below.
*ENDMNRS1
* must be entered even if no storage is required
*ENDMNRS2
* must be entered even if no storage is required
*ENDMNRS3
* must be entered even if no storage is required
*   MAJOR SYSTEM CHARACTERISTICS
* maximum of 50 storage types
*   IS    W2     SX    YCURB  CNS   S0     SR0W   CNROW  YMAX
* IS = identification of street segment type
* W2 = segment width (m)
* SX = pavement cross slope (m/m)
* YCURB = height of curb (cm)
* CNS = Manning's roughness coefficient for pavement
* S0 = longitudinal slope
* SROW = cross slope of shoulder
* CNROW = Manning's roughness coefficient for shoulder
* YMAX = Maximum water depth (measured from bottom of curb)
* for calculation of street carrying capacity
*
*
* Maximum water depth assumed as 30 cm
* Street A
*
        1   4.25  0.030   15  0.013   0.0138   0.02    0.025  30
        2   4.25  0.030   15  0.013   0.0076   0.02    0.025  30
        3   4.25  0.030   15  0.013   0.0237   0.02    0.025  30
        4   4.25  0.030   15  0.013   0.0083   0.02    0.025  30
        5   4.25  0.030   15  0.013   0.0050   0.02    0.025  30
        6   4.25  0.030   15  0.013   0.0051   0.02    0.025  30
        7   4.25  0.030   15  0.013   0.0200   0.02    0.025  30
        8 118.00  0.010   30  0.025   0.0090   0.02    0.025  100
        9   4.25  0.030   15  0.013   0.0001   0.02    0.025  30
*
*
ENDSTR
* terminator for major system characteristics data set
*   INLET CAPTURE CHARACTERISTICS
*   IDCB   NJC
    1      8
*   QAPP   QCAP
    0.      0.
    10.     10.
    30.     30.
    60.     60.
    90.     90.
    130.    130.
    500.    500.
    1000.   1000.
ENDIN1
ENDIN2
* applicable for areas
*   IDCB   DET3   NPTS3
    2      55.0     2
*   QAPP   QCAP
     0.0    0.0
    55.0   15.0
* applicable for areas
*   IDCB   DET3   NPTS3
    3      1.8      2
*   QAPP   QCAP
     0.0    0.0
```

```
      1.8   20.0
* applicable for areas
*    IDCB   DET3   NPTS3
     4      5.7      2
*    QAPP   QCAP
      0.0    0.0
     17.9   14.2
* applicable for areas
*    IDCB   DET3   NPTS3
     5      1.3      2
*    QAPP   QCAP
      0.0    0.0
      1.3   20.0
* applicable for areas
*    IDCB   DET3   NPTS3
     6      5.7      2
*    QAPP   QCAP
      0.0    0.0
     17.9   31.0
* applicable for areas
*    IDCB   DET3   NPTS3
     7      20.0     3
*    QAPP   QCAP
      0.0    0.0
      1.0   18.0
     20.0   20.0
* applicable for areas
*    IDCB   DET3   NPTS3
     8      25.0     3
*    QAPP   QCAP
      0.0    0.0
      1.0   18.0
     25.0   20.0
* applicable for areas
*    IDCB   DET3   NPTS3
     9      30.0     3
*    QAPP   QCAP
      0.0    0.0
      1.0   18.0
     30.0   20.0
* applicable for areas
*    IDCB   DET3   NPTS3
     10     35.0     3
*    QAPP   QCAP
      0.0    0.0
      1.0   18.0
     35.0   20.0
* applicable for areas
*    IDCB   DET3   NPTS3
     11     50.0     3
*    QAPP   QCAP
      0.0    0.0
      1.0   18.0
     50.0   20.0
* applicable for areas
*    IDCB   DET3   NPTS3
     12      75.0     3
*    QAPP   QCAP
      0.0    0.0
      1.0   18.0
     75.0   20.0
* applicable for areas
*    IDCB   DET3   NPTS3
```

```
    13      1.0     2
*   QAPP   QCAP
     0.0    0.0
     1.0   58.4
* applicable for areas
*   IDCB   DET3   NPTS3
    14      3.0      3
*   QAPP   QCAP
     0.0    0.0
     1.0   11.4
     3.0   13.4
* applicable for areas
*   IDCB   DET3   NPTS3
    15      5.0      3
*   QAPP   QCAP
     0.0    0.0
     1.0   11.4
     5.0   13.4
* applicable for areas
*   IDCB   DET3   NPTS3
    16      33.0     3
*   QAPP   QCAP
     0.0    0.0
     1.0    7.0
     33.0   9.0
* applicable for areas
*   IDCB   DET3   NPTS3
    17      32.0     3
*   QAPP   QCAP
     0.0    0.0
     1.0    4.8
     32.0   6.8
* applicable for areas
*   IDCB   DET3   NPTS3
    18      15.5     3
*   QAPP   QCAP
     0.0    0.0
     1.0    6.5
     15.5   8.5
* applicable for areas
*   IDCB   DET3   NPTS3
    19      19.0     3
*   QAPP   QCAP
     0.0    0.0
     1.0    1.0
     19.0   3.3
* applicable for areas
*   IDCB   DET3   NPTS3
    20      15.5     3
*   QAPP   QCAP
     0.0    0.0
     1.0    7.4
     15.5   9.4
*
**
ENDIN3
*  MAJOR SYSTEM SEGMENT DATA
**-----------------------------------------------------------------------------------
--------------
* IRTS = Option for major system flow routing
* NS = identification number/name of major system segment
* NSD = identification number/name of major system segment downstream
* XS = length of segment
```

```
* IDSS = segment type (as per segment data list)
* NUMCB = number of storm inlets within street segment
* IINC = inlet type (as per segment data list)
* QLIM = maximum allowable inlet capture
* NPD = pipe receiving inlet flow
* IPRTS = option for printing time history of segment (=o, no printing)
* routing is performed (for this segment)
**-------------------------------------------------------------------------------------
----------------
*       IRTS    NS      NSD     XS      IDSS    NUMCB   IINC    QLIM    NPD
IPRTS
* Road Drainage Areas
        0       'SWM14' 'LP001' 40      4       0       1       0.      'X'     0
        0       'SWM13' 'LP001' 29      1       0       1       0.      'X'     0
        1       'LP001' 'D001'  10      7       0       1       0.      'X'     0
        0       'SWM12' 'LP002' 41      1       0       1       0.      'X'     0
        0       'SWM11' 'LP002' 16      4       0       1       0.      'X'     0
        1       'LP002' 'D002'  10      4       1       3       20.     '207'   0
        0       'SWM10' 'LP003' 48      4       0       1       0.      'X'     0
        0       'SWM8'  'LP003' 27      6       0       1       0.      'X'     0
        1       'LP003' 'D003'  10      6       1       4       14.2    '205'   0
        0       'SWM3'  'LP004' 28      6       0       1       0.      'X'     0
        0       'SWM4'  'LP004' 107     4       0       1       0.      'X'     0
        1       'LP004' 'D004'  10      6       1       6       31.     '205'   0
        0       'SWM2'  'LP005' 81      3       0       1       0.      'X'     0
        0       'SWM1'  'LP005' 45      5       0       1       0.      'X'     0
        1       'LP005' 'D005'  10      7       1       5       20.     '202'   0
        0       'SWM7'  'OUTB'  71      3       1       1       20.     '202'   0
* Rear Yard Drainage
        0       'SWM9'  'SWM8'  37      8       1       1       25.     '205'   0
        0       'SWM5'  'OUTA'  157     8       1       2       15.     '207'   0
        0       'SWM6'  'OUTC'  88      8       1       1       20.     '202'   0
        0       'SWM15' 'OUTD'  40      8       0       1       0.      'X'     0
*Dummy Segments
        0       'D001'  'LP002'  7      9       0       1       0.      'X'     1
        0       'D002'  'SWM10' 20      9       0       1       0.      'X'     1
        0       'D003'  'SWM7'  50      9       0       1       0.      'X'     1
        0       'D004'  'SWM2'  65      9       0       1       0.      'X'     1
        0       'D005'  'OUT1B'  8      9       0       1       0.      'X'     1
ENDMJR
*  MAJOR SYSTEM STORAGE UNITS
*   IDSTS      NUSS  NSTOR
    'Out1'    1     'OUTA'
    'Out2'    1     'OUTB'
    'Out3'    1     'OUTC'
    'Out4'    1     'OUT1B'
    'Out5'    1     'OUTD'
*
ENDMJRS
*   INFILTRATION PARAMETERS FOR RUNOFF CALCULATIONS
*   MAX   MIN   DECAY
    76.2  13.2  .00115
ENDUAH
* SUBAREA DATA FOR SWMM RUNOFF
* NW        NSDW      ASW     PIMP    CNIMP     CNP     S           WLAT
DETIMP   DETP   IPRTW
  'SWM1'   'SWM1'     0.18    41.     0.013     0.25    0.02        45          1.57
    4.67   0
  'SWM2'   'SWM2'     0.24    35.     0.013     0.25    0.02        81          1.57
    4.67   0
  'SWM3'   'SWM3'     0.11    38.     0.013     0.25    0.02        28          1.57
    4.67   0
  'SWM4'   'SWM4'     0.25    37.     0.013     0.25    0.02        107         1.57
```

```
    4.67   0
  'SWM5'   'SWM5'     0.49    18.     0.013     0.25    0.02        157         1.57
    4.67   0
  'SWM6'   'SWM6'     0.22    24.     0.013     0.25    0.02        88          1.57
    4.67   0
  'SWM7'   'SWM7'     0.16    41.     0.013     0.25    0.02        71          1.57
    4.67   0
  'SWM8'   'SWM8'     0.03    52.     0.013     0.25    0.02        27          1.57
    4.67   0
  'SWM9'   'SWM9'     0.10    30.     0.013     0.25    0.02        37          1.57
    4.67   0
  'SWM10'  'SWM10'    0.07    54.     0.013     0.25    0.02        48          1.57
    4.67   0
  'SWM11'  'SWM11'    0.02    51.     0.013     0.25    0.02        16          1.57
    4.67   0
  'SWM12'  'SWM12'    0.06    41.     0.013     0.25    0.02        41          1.57
    4.67   0
  'SWM13'  'SWM13'    0.02    73.     0.013     0.25    0.02        29          1.57
    4.67   0
  'SWM14'  'SWM14'    0.02    70.     0.013     0.25    0.02        40          1.57
    4.67   0
  'SWM15'  'SWM15'    0.21    23.     0.013     0.25    0.02        40          1.57
    4.67   0
* NW = identification number/name of subarea
* NSDW = identification number/name of major segment receiving surface runoff
* ASW  area of subarea (ha.)
* PIMP = percentage imperious
* CNIMP = Manning's roughness coefficient for impervious area
* CNP = Manning's roughness coefficient for pervious area
* s = average slope
* WLAT = subarea width
* DETIMP = detention storage for impervious area
* DETP = detention storage for pervious area
* IRTW = option for printing and plotting of surface runoff hydrograph (=0, no
printing)
ENDSUB1
ENDSUB2
ENDSUB3
```

```
*************************************************
*           D D S W M M (release 2.1)           *
*  The Dual Drainage Storm Water Management Model *
*                   Copyright                   *
*                   ---------                   *
*        AMK Associates International Ltd.      *
*************************************************
```

This release of DDSWMM will run with a maximum of

```
  500 minor system segments (pipes), including outlets
  500 major system (street) segments, including outlets
  500 subcatchments
   30 storage units for the minor system
   30 storage units for the major system
  300 computational time steps
  300 increments for rainfall hyetograph
   50 storm inlet types
   20 points describing the inlet capture curve
   50 major system segment types
    5 street segments discharging into a street junction
    5 pipes discharging into a pipe junction
    5 subcatchments discharging into a major system segment
    5 inlet groups discharging into a pipe
   30 unit area hydrographs
```

For other program constraints, please refer to the users manual

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

RUN CONTROL PARAMETERS

Measuring units		Metric
Time increment for calculation	5.00	minutes
Number of computational steps	72	
Default limiting capacity of inlets	20.00	l/s
Total simulation time	5:55	(hrs:mins)
Interval between printout	1	

Calculation for the minor system is not included in this simulation

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

```
           RAINFALL DATA                                          Initial Julian Date
02290
                                                                  Initial Time
 0.00 hours

         Time      Rainfall                                       Rainfall intensity
(mm/hr)
       (hr:min)    (mm/hr)
                                                      0.00E+00  0.43E+02  0.86E+02
0.13E+03  0.17E+03   0.21E+03

I---------I---------I---------I---------I----------I
          0: 0       0.00                           I*
                 I
          0:10       7.26                           I**
                 I
          0:20       9.05                           I***
                 I
          0:30      12.19                           I***
                 I
          0:40      19.16                           I*****
                 I
          0:50      48.79                           I************
                 I
          1: 0     214.27
I**************************************************I
          1:10      64.86                           I****************
                 I
          1:20      32.78                           I********
                 I
          1:30      21.89                           I******
                 I
          1:40      16.48                           I****
                 I
          1:50      13.27                           I****
                 I
          2: 0      11.14                           I***
                 I
          2:10       9.63                           I***
                 I
          2:20       8.50                           I**
                 I
          2:30       7.62                           I**
                 I
          2:40       6.91                           I**
                 I
          2:50       6.34                           I**
                 I
          3: 0       5.86                           I**
                 I

I---------I---------I---------I---------I----------I
                                                      0.00E+00  0.43E+02  0.86E+02
0.13E+03  0.17E+03   0.21E+03
```

Rainfall duration   3:10 (hrs:mins.)

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
1	4.25	0.030	15.0	0.0130	0.014	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.02	1.00
4.50	0.06	1.50
6.00	0.12	2.00
7.50	0.23	2.50
9.00	0.37	3.00
10.50	0.55	3.50
12.00	0.79	4.00
13.50	1.08	4.25
15.00	1.43	4.25
16.50	1.82	5.00
18.00	2.26	5.75
19.50	2.76	6.50
21.00	3.32	7.25
22.50	3.95	8.00
24.00	4.64	8.75
25.50	5.41	9.50
27.00	6.24	10.25
28.50	7.15	11.00
30.00	8.14	11.75

♀
Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM RATING CURVE

Type	Maximum Flow Depth (cm)	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)
2	30.0	4.25	0.030	15.0	0.0130	0.008	0.020	0.0250

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.01	1.00
4.50	0.04	1.50
6.00	0.09	2.00
7.50	0.17	2.50
9.00	0.27	3.00
10.50	0.41	3.50
12.00	0.59	4.00
13.50	0.80	4.25
15.00	1.06	4.25
16.50	1.35	5.00
18.00	1.68	5.75
19.50	2.05	6.50
21.00	2.47	7.25
22.50	2.93	8.00
24.00	3.45	8.75
25.50	4.01	9.50
27.00	4.63	10.25
28.50	5.31	11.00
30.00	6.04	11.75

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM RATING CURVE

Type	Maximum Flow Depth	Pavement Width (m)	Pavement Cross Slope	Height of Curb	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope	Shoulder Roughness (n)

		(m/m)	(cm)			(m/m)		(cm)
3	4.25	0.030	15.0	0.0130	0.024	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.03	1.00
4.50	0.08	1.50
6.00	0.16	2.00
7.50	0.30	2.50
9.00	0.48	3.00
10.50	0.73	3.50
12.00	1.04	4.00
13.50	1.42	4.25
15.00	1.87	4.25
16.50	2.38	5.00
18.00	2.96	5.75
19.50	3.62	6.50
21.00	4.36	7.25
22.50	5.18	8.00
24.00	6.09	8.75
25.50	7.09	9.50
27.00	8.18	10.25
28.50	9.38	11.00
30.00	10.67	11.75

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
4	4.25	0.030	15.0	0.0130	0.008	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.02	1.00
4.50	0.04	1.50
6.00	0.10	2.00
7.50	0.18	2.50
9.00	0.28	3.00
10.50	0.43	3.50
12.00	0.61	4.00
13.50	0.84	4.25
15.00	1.11	4.25
16.50	1.41	5.00
18.00	1.75	5.75
19.50	2.14	6.50
21.00	2.58	7.25
22.50	3.06	8.00
24.00	3.60	8.75
25.50	4.19	9.50
27.00	4.84	10.25
28.50	5.55	11.00
30.00	6.32	11.75

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
5	4.25	0.030	15.0	0.0130	0.005	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50

3.00	0.01	1.00
4.50	0.03	1.50
6.00	0.07	2.00
7.50	0.14	2.50
9.00	0.22	3.00
10.50	0.33	3.50
12.00	0.48	4.00
13.50	0.65	4.25
15.00	0.86	4.25
16.50	1.09	5.00
18.00	1.36	5.75
19.50	1.66	6.50
21.00	2.00	7.25
22.50	2.38	8.00
24.00	2.80	8.75
25.50	3.25	9.50
27.00	3.76	10.25
28.50	4.31	11.00
30.00	4.90	11.75

♀
Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
6	4.25	0.030	15.0	0.0130	0.005	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.01	1.00
4.50	0.04	1.50
6.00	0.08	2.00
7.50	0.14	2.50
9.00	0.22	3.00
10.50	0.34	3.50
12.00	0.48	4.00
13.50	0.66	4.25

15.00	0.87	4.25
16.50	1.10	5.00
18.00	1.37	5.75
19.50	1.68	6.50
21.00	2.02	7.25
22.50	2.40	8.00
24.00	2.82	8.75
25.50	3.29	9.50
27.00	3.80	10.25
28.50	4.35	11.00
30.00	4.95	11.75

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
7	4.25	0.030	15.0	0.0130	0.020	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.02	1.00
4.50	0.07	1.50
6.00	0.15	2.00
7.50	0.27	2.50
9.00	0.44	3.00
10.50	0.67	3.50
12.00	0.95	4.00
13.50	1.30	4.25
15.00	1.72	4.25
16.50	2.19	5.00
18.00	2.72	5.75
19.50	3.33	6.50
21.00	4.00	7.25
22.50	4.76	8.00
24.00	5.59	8.75
25.50	6.51	9.50

27.00	7.52	10.25
28.50	8.61	11.00
30.00	9.80	11.75

♀
Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
8	118.00	0.010	30.0	0.0250	0.009	0.020	0.0250	100.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
5.00	0.10	5.00
10.00	0.61	10.00
15.00	1.81	15.00
20.00	3.89	20.00
25.00	7.06	25.00
30.00	11.47	30.00
35.00	17.31	35.00
40.00	24.71	40.00
45.00	33.83	45.00
50.00	44.80	50.00
55.00	57.77	55.00
60.00	72.86	60.00
65.00	90.19	65.00
70.00	109.90	70.00
75.00	132.10	75.00
80.00	156.91	80.00
85.00	184.44	85.00
90.00	214.81	90.00
95.00	248.12	95.00
100.00	284.49	100.00

♀
Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM RATING CURVE

Type	Pavement Width (m)	Pavement Cross Slope (m/m)	Height of Curb (cm)	Manning (n)	Long. Slope (m/m)	Shoulder Cross Slope (m/m)	Shoulder Roughness (n)	Maximum Flow Depth (cm)
9	4.25	0.030	15.0	0.0130	0.000	0.020	0.0250	30.0

RATING CURVE

Depth (cm)	Flow (cms)	Spread (m)
0.00	0.00	0.00
1.50	0.00	0.50
3.00	0.00	1.00
4.50	0.00	1.50
6.00	0.01	2.00
7.50	0.02	2.50
9.00	0.03	3.00
10.50	0.05	3.50
12.00	0.07	4.00
13.50	0.09	4.25
15.00	0.12	4.25
16.50	0.15	5.00
18.00	0.19	5.75
19.50	0.24	6.50
21.00	0.28	7.25
22.50	0.34	8.00
24.00	0.40	8.75
25.50	0.46	9.50
27.00	0.53	10.25
28.50	0.61	11.00
30.00	0.69	11.75

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

STORM INLET DATA

1 Normal Inlet

Inlet Identification No. 1

No. of Points on Capture Curve 8

Inlet Capture Relationship

Approach Flow (l/s)	Inlet Flow (l/s)
0.00	0.00
10.00	10.00
30.00	30.00
60.00	60.00
90.00	90.00
130.00	130.00
500.00	500.00
1000.00	1000.00

2 Storage Inlet

Inlet Identification No. 2

Maximum Storage 55.00 cu.m.

No. of Points on Storage-Capture Curve 2

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
55.00	15.00

3 Storage Inlet

Inlet Identification No. 3

Maximum Storage 1.80 cu.m.

No. of Points on Storage-Capture Curve 2

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.80	20.00

4 Storage Inlet

Inlet Identification No. 4

Maximum Storage 5.70 cu.m.

No. of Points on Storage-Capture Curve 2

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
17.90	14.20

5 Storage Inlet

Inlet Identification No. 5

Maximum Storage 1.30 cu.m.

No. of Points on Storage-Capture Curve 2

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.30	20.00

6 Storage Inlet

Inlet Identification No. 6

Maximum Storage 5.70 cu.m.

No. of Points on Storage-Capture Curve 2

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
17.90	31.00

7 Storage Inlet

Inlet Identification No. 7

Maximum Storage 20.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	18.00
20.00	20.00

8 Storage Inlet

Inlet Identification No. 8

Maximum Storage 25.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	18.00
25.00	20.00

9 Storage Inlet

Inlet Identification No. 9

Maximum Storage 30.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	18.00
30.00	20.00

10 Storage Inlet

Inlet Identification No. 10

Maximum Storage 35.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	18.00
35.00	20.00

11 Storage Inlet

Inlet Identification No. 11

Maximum Storage 50.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	18.00
50.00	20.00

12 Storage Inlet

Inlet Identification No. 12

Maximum Storage 75.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	18.00
75.00	20.00

13 Storage Inlet

Inlet Identification No. 13

Maximum Storage 1.00 cu.m.

No. of Points on Storage-Capture Curve 2

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	58.40

14 Storage Inlet

Inlet Identification No. 14

Maximum Storage 3.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	11.40
3.00	13.40

15 Storage Inlet

Inlet Identification No. 15

Maximum Storage 5.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	11.40
5.00	13.40

16 Storage Inlet

Inlet Identification No. 16

Maximum Storage 33.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	7.00
33.00	9.00

17 Storage Inlet

Inlet Identification No. 17

Maximum Storage 32.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	4.80
32.00	6.80

18 Storage Inlet

Inlet Identification No. 18

Maximum Storage 15.50 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	6.50
15.50	8.50

19 Storage Inlet

Inlet Identification No. 19

Maximum Storage 19.00 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	1.00
19.00	3.30

20 Storage Inlet

Inlet Identification No. 20

Maximum Storage 15.50 cu.m.

No. of Points on Storage-Capture Curve 3

Storage-Inlet Capture Relationship

Storage Volume (cu.m)	Inlet Flow (l/s)
0.00	0.00
1.00	7.40
15.50	9.40

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM DATA

	Street Segment	D/S Segment	Length (m)	Type	No. of C.B.	Inlet Type	Limiting Inlet Capture (l/s)	Connecting Pipe/EXTRAN Inlet	Flow History (?)
1	SWM14	LP001	40.0	4	0	1 *	0.00	X	NO
2	SWM13	LP001	29.0	1	0	1 *	0.00	X	NO

3	LP001	D001	10.0	7	0	1	*	0.00	X	NO	"No Routing"
4	SWM12	LP002	41.0	1	0	1	*	0.00	X	NO	
5	SWM11	LP002	16.0	4	0	1	*	0.00	X	NO	
6	LP002	D002	10.0	4	1	3	***	20.00	207	NO	"No Routing"
7	SWM10	LP003	48.0	4	0	1	*	0.00	X	NO	
8	SWM8	LP003	27.0	6	0	1	*	0.00	X	NO	
9	LP003	D003	10.0	6	1	4	***	4.52	205	NO	"No Routing"
10	SWM3	LP004	28.0	6	0	1	*	0.00	X	NO	
11	SWM4	LP004	107.0	4	0	1	*	0.00	X	NO	
12	LP004	D004	10.0	6	1	6	***	9.87	205	NO	"No Routing"
13	SWM2	LP005	81.0	3	0	1	*	0.00	X	NO	
14	SWM1	LP005	45.0	5	0	1	*	0.00	X	NO	
15	LP005	D005	10.0	7	1	5	***	20.00	202	NO	"No Routing"
16	SWM7	OUTB	71.0	3	1	1	*	20.00	202	NO	
17	SWM9	SWM8	37.0	8	1	1	*	25.00	205	NO	
18	SWM5	OUTA	157.0	8	1	2	***	15.00	207	NO	
19	SWM6	OUTC	88.0	8	1	1	*	20.00	202	NO	
20	SWM15	OUTD	40.0	8	0	1	*	0.00	X	NO	
21	D001	LP002	7.0	9	0	1	*	0.00	X	YES	
22	D002	SWM10	20.0	9	0	1	*	0.00	X	YES	
23	D003	SWM7	50.0	9	0	1	*	0.00	X	YES	
24	D004	SWM2	65.0	9	0	1	*	0.00	X	YES	
25	D005	OUT1B	8.0	9	0	1	*	0.00	X	YES	

* Normal Inlet.
** Storage Inlet with linear relationship between Storage and Inlet Capture.
*** Storage Inlet with user-specified relationship between Storage and Inlet Capture.

Total Number of Street segments	25	
Total Length of Major System	1055.00	m
Total Number of Inlet C.B.	8	
Average Distance Between Inlets	263.75	m

Outlets From Major System

Outlet I.D.

OUTB
OUTA
OUTC
OUTD
OUT1B

Total Number of Outlets from Major System = 5

DATA FOR MAJOR SYSTEM STORAGE

No.	Storage Unit	No. of Inflow Points	I.D. Nos. of Inflow Points
1	Out1	1	OUTA
2	Out2	1	OUTB
3	Out3	1	OUTC
4	Out4	1	OUT1B
5	Out5	1	OUTD

No. of Detention Structures 5

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

SUB-CATCHMENT/SURFACE RUNOFF DATA

Infiltration Parameters

Max. Infiltration Rate	76.20	mm/hr
Min. Infiltration Rate	13.20	mm/hr
Decay Rate	0.001150	1/sec.

Unit Area Hydrograph (UAH) Data

No Unit Area Hydrograph Data

SUB-CATCHMENT DATA

No.	Subarea	Street Segment	Area (Ha.)	Imp. (%)	Manning (N) (Imp.)	Manning (N) (Perv.)	Slope (m/m)	Width (m)	Dep. Storage Imp. (mm)	Dep. Storage Perv. (mm)	Flow History (?)
1	SWM1	SWM1	0.18	41.	0.0130	0.2500	0.020	45.	1.570	4.670	NO
2	SWM2	SWM2	0.24	35.	0.0130	0.2500	0.020	81.	1.570	4.670	NO
3	SWM3	SWM3	0.11	38.	0.0130	0.2500	0.020	28.	1.570	4.670	NO
4	SWM4	SWM4	0.25	37.	0.0130	0.2500	0.020	107.	1.570	4.670	NO
5	SWM5	SWM5	0.49	18.	0.0130	0.2500	0.020	157.	1.570	4.670	NO
6	SWM6	SWM6	0.22	24.	0.0130	0.2500	0.020	88.	1.570	4.670	NO
7	SWM7	SWM7	0.16	41.	0.0130	0.2500	0.020	71.	1.570	4.670	NO
8	SWM8	SWM8	0.03	52.	0.0130	0.2500	0.020	27.	1.570	4.670	NO
9	SWM9	SWM9	0.10	30.	0.0130	0.2500	0.020	37.	1.570	4.670	NO
10	SWM10	SWM10	0.07	54.	0.0130	0.2500	0.020	48.	1.570	4.670	NO
11	SWM11	SWM11	0.02	51.	0.0130	0.2500	0.020	16.	1.570	4.670	NO
12	SWM12	SWM12	0.06	41.	0.0130	0.2500	0.020	41.	1.570	4.670	NO
13	SWM13	SWM13	0.02	73.	0.0130	0.2500	0.020	29.	1.570	4.670	NO
14	SWM14	SWM14	0.02	70.	0.0130	0.2500	0.020	40.	1.570	4.670	NO
15	SWM15	SWM15	0.21	23.	0.0130	0.2500	0.020	40.	1.570	4.670	NO

*   Inflow Hydrograph Input Directly
** Inflow hydrograph Input in terms of flow per unit area

Total Drainage Area 2.18 Hectares

Number of Subcatchments 15

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

Simulation Details - Surface Runoff - 15 Subareas

count	Subarea
1	SWM1
2	SWM2
3	SWM3
4	SWM4
5	SWM5
6	SWM6
7	SWM7
8	SWM8
9	SWM9
10	SWM10
11	SWM11
12	SWM12
13	SWM13
14	SWM14
15	SWM15

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

Simulation Details - Major System - 30 Segments/Outlets

count	order	segment	time step (min.)	No. of time steps	Max. flow (cms)	Max. depth (cm)
1	2	SWM13	0.65	546	0.01	2.40
2	1	SWM14	1.05	337	0.01	2.75
3	3	LP001			0.03	3.07
4	21	D001	0.80	445	0.03	8.30
5	5	SWM11	0.44	801	0.01	2.56
6	4	SWM12	0.72	495	0.03	3.45
7	11	SWM4	1.61	220	0.11	6.28
8	10	SWM3	0.64	553	0.04	4.82
9	6	LP002			0.07	5.10
10	12	LP004			0.15	7.75
11	17	SWM9	2.96	119	0.04	2.02
12	22	D002	1.97	180	0.05	10.34
13	24	D004	4.52	78	0.14	15.92

14	8	SWM8	0.69	514	0.03	4.11
15	7	SWM10	0.82	430	0.07	5.17
16	14	SWM1	0.90	394	0.07	5.98
17	13	SWM2	0.75	476	0.16	5.99
18	9	LP003			0.09	6.44
19	15	LP005			0.22	6.82
20	23	D003	3.98	89	0.09	13.32
21	25	D005	0.57	621	0.20	18.15
22	20	SWM15	2.15	165	0.06	3.01
23	19	SWM6	3.42	104	0.08	4.17
24	18	SWM5	4.80	74	0.15	5.50
25	16	SWM7	0.72	491	0.11	5.17
26	30	OUT1B			0.20	
27	29	OUTD			0.06	
28	28	OUTC			0.05	
29	27	OUTA			0.11	
30	26	OUTB			0.09	

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

EXTRAN Interface File Information
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Inlet flows are stored at the following 4 inlets (EXTRAN nodes):

X 207 205 202

DDSWMM-EXTRAN Connectivity

EXTRAN Inlet	DDSWMM Inlets (Major System Segments)			
X	SWM14	SWM13	LP001	SWM12
	SWM11			
207	LP002	SWM5		
205	LP003	LP004	SWM9	
202	LP005	SWM7	SWM6	

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM DETAILED SIMULATION RESULTS

Major System Segment D001

Time (hr:min)	U/S Inflow (cms)	Catchment Inflow (cms)	Total Inflow (cms)	Inlet Capture (cms)	Outflow (cms)	Depth at Curb (cm)	Storage (cu.m)
0: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:25	0.000	0.000	0.000	0.000	0.000	0.6	0.00
0:30	0.001	0.000	0.001	0.000	0.000	1.8	0.00
0:35	0.001	0.000	0.001	0.000	0.001	2.0	0.00
0:40	0.001	0.000	0.001	0.000	0.001	2.3	0.00
0:45	0.001	0.000	0.001	0.000	0.001	2.7	0.00
0:50	0.003	0.000	0.003	0.000	0.002	3.4	0.00
0:55	0.004	0.000	0.004	0.000	0.004	4.0	0.00
1: 0	0.014	0.000	0.014	0.000	0.012	6.6	0.00
1: 5	0.024	0.000	0.024	0.000	0.023	8.2	0.00
1:10	0.012	0.000	0.012	0.000	0.015	6.2	0.00
1:15	0.007	0.000	0.007	0.000	0.008	4.9	0.00
1:20	0.005	0.000	0.005	0.000	0.005	4.4	0.00
1:25	0.003	0.000	0.003	0.000	0.004	3.7	0.00
1:30	0.003	0.000	0.003	0.000	0.003	3.4	0.00
1:35	0.002	0.000	0.002	0.000	0.002	3.2	0.00
1:40	0.002	0.000	0.002	0.000	0.002	3.1	0.00
1:45	0.002	0.000	0.002	0.000	0.002	2.9	0.00
1:50	0.001	0.000	0.001	0.000	0.001	2.6	0.00
1:55	0.001	0.000	0.001	0.000	0.001	2.5	0.00
2: 0	0.001	0.000	0.001	0.000	0.001	2.4	0.00
2: 5	0.001	0.000	0.001	0.000	0.001	2.3	0.00
2:10	0.001	0.000	0.001	0.000	0.001	2.2	0.00
2:15	0.001	0.000	0.001	0.000	0.001	2.1	0.00
2:20	0.001	0.000	0.001	0.000	0.001	2.1	0.00
2:25	0.001	0.000	0.001	0.000	0.001	2.0	0.00
2:30	0.001	0.000	0.001	0.000	0.001	2.0	0.00
2:35	0.001	0.000	0.001	0.000	0.001	1.9	0.00
2:40	0.001	0.000	0.001	0.000	0.001	1.9	0.00
2:45	0.001	0.000	0.001	0.000	0.001	1.9	0.00
2:50	0.001	0.000	0.001	0.000	0.001	1.8	0.00
2:55	0.001	0.000	0.001	0.000	0.001	1.8	0.00
3: 0	0.001	0.000	0.001	0.000	0.001	1.8	0.00
3: 5	0.001	0.000	0.001	0.000	0.001	1.8	0.00
3:10	0.001	0.000	0.001	0.000	0.001	1.8	0.00
3:15	0.001	0.000	0.001	0.000	0.001	1.8	0.00
3:20	0.000	0.000	0.000	0.000	0.000	1.7	0.00
3:25	0.000	0.000	0.000	0.000	0.000	1.6	0.00
3:30	0.000	0.000	0.000	0.000	0.000	1.6	0.00
3:35	0.000	0.000	0.000	0.000	0.000	1.6	0.00
3:40	0.000	0.000	0.000	0.000	0.000	1.5	0.00
3:45	0.000	0.000	0.000	0.000	0.000	1.5	0.00

3:50	0.000	0.000	0.000	0.000	0.000	1.5	0.00
3:55	0.000	0.000	0.000	0.000	0.000	1.4	0.00
4: 0	0.000	0.000	0.000	0.000	0.000	1.3	0.00
4: 5	0.000	0.000	0.000	0.000	0.000	1.2	0.00
4:10	0.000	0.000	0.000	0.000	0.000	1.2	0.00
4:15	0.000	0.000	0.000	0.000	0.000	1.1	0.00
4:20	0.000	0.000	0.000	0.000	0.000	1.1	0.00
4:25	0.000	0.000	0.000	0.000	0.000	1.0	0.00
4:30	0.000	0.000	0.000	0.000	0.000	1.0	0.00
4:35	0.000	0.000	0.000	0.000	0.000	0.9	0.00
4:40	0.000	0.000	0.000	0.000	0.000	0.9	0.00
4:45	0.000	0.000	0.000	0.000	0.000	0.9	0.00
4:50	0.000	0.000	0.000	0.000	0.000	0.8	0.00
4:55	0.000	0.000	0.000	0.000	0.000	0.8	0.00
5: 0	0.000	0.000	0.000	0.000	0.000	0.8	0.00
5: 5	0.000	0.000	0.000	0.000	0.000	0.7	0.00
5:10	0.000	0.000	0.000	0.000	0.000	0.7	0.00
5:15	0.000	0.000	0.000	0.000	0.000	0.7	0.00
5:20	0.000	0.000	0.000	0.000	0.000	0.7	0.00
5:25	0.000	0.000	0.000	0.000	0.000	0.7	0.00
5:30	0.000	0.000	0.000	0.000	0.000	0.6	0.00
5:35	0.000	0.000	0.000	0.000	0.000	0.6	0.00
5:40	0.000	0.000	0.000	0.000	0.000	0.6	0.00
5:45	0.000	0.000	0.000	0.000	0.000	0.6	0.00
5:50	0.000	0.000	0.000	0.000	0.000	0.6	0.00
5:55	0.000	0.000	0.000	0.000	0.000	0.6	0.00
Maximum	0.026		0.026	0.000	0.024	8.3	0.00
Time (h:min)	1: 6		1: 6	0: 0	1: 6		

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM DETAILED SIMULATION RESULTS

Major System Segment D002

Time (hr:min)	U/S Inflow (cms)	Catchment Inflow (cms)	Total Inflow (cms)	Inlet Capture (cms)	Outflow (cms)	Depth at Curb (cm)	Storage (cu.m)
0: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00

1: 0	0.010	0.000	0.010	0.000	0.005	5.9	0.00
1: 5	0.042	0.000	0.042	0.000	0.028	10.0	0.00
1:10	0.019	0.000	0.019	0.000	0.030	7.5	0.00
1:15	0.002	0.000	0.002	0.000	0.012	3.3	0.00
1:20	0.000	0.000	0.000	0.000	0.005	0.0	0.00
1:25	0.000	0.000	0.000	0.000	0.003	0.0	0.00
1:30	0.000	0.000	0.000	0.000	0.002	0.0	0.00
1:35	0.000	0.000	0.000	0.000	0.001	0.0	0.00
1:40	0.000	0.000	0.000	0.000	0.001	0.0	0.00
1:45	0.000	0.000	0.000	0.000	0.001	0.0	0.00
1:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
1:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
Maximum	0.045		0.045	0.000	0.037	10.3	0.00

Time (h:min) 1: 6 1: 6 0: 0 1: 8
♀
Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM DETAILED SIMULATION RESULTS

Major System Segment D003

Time (hr:min)	U/S Inflow (cms)	Catchment Inflow (cms)	Total Inflow (cms)	Inlet Capture (cms)	Outflow (cms)	Depth at Curb (cm)	Storage (cu.m)
0: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
1: 0	0.027	0.000	0.027	0.000	0.009	8.4	0.00
1: 5	0.081	0.000	0.081	0.000	0.039	12.8	0.00
1:10	0.073	0.000	0.073	0.000	0.068	12.3	0.00
1:15	0.043	0.000	0.043	0.000	0.060	10.1	0.00
1:20	0.025	0.000	0.025	0.000	0.044	8.2	0.00
1:25	0.015	0.000	0.015	0.000	0.030	6.8	0.00
1:30	0.011	0.000	0.011	0.000	0.020	6.0	0.00
1:35	0.007	0.000	0.007	0.000	0.014	5.1	0.00
1:40	0.005	0.000	0.005	0.000	0.010	4.6	0.00
1:45	0.004	0.000	0.004	0.000	0.008	3.9	0.00
1:50	0.002	0.000	0.002	0.000	0.006	3.3	0.00
1:55	0.001	0.000	0.001	0.000	0.004	2.8	0.00
2: 0	0.001	0.000	0.001	0.000	0.003	2.0	0.00
2: 5	0.000	0.000	0.000	0.000	0.002	1.1	0.00
2:10	0.000	0.000	0.000	0.000	0.002	0.0	0.00
2:15	0.000	0.000	0.000	0.000	0.002	0.0	0.00
2:20	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:25	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:30	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:35	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:40	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:45	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00

3:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
Maximum	0.089		0.089	0.000	0.068	13.3	0.00
Time (h:min)	1: 6		1: 6	0: 0	1:10		

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM DETAILED SIMULATION RESULTS

Major System Segment D004

Time (hr:min)	U/S Inflow (cms)	Catchment Inflow (cms)	Total Inflow (cms)	Inlet Capture (cms)	Outflow (cms)	Depth at Curb (cm)	Storage (cu.m)
0: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00

0:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:55	0.000	0.000	0.000	0.000	0.001	0.0	0.00
1: 0	0.045	0.000	0.045	0.000	0.014	10.3	0.00
1: 5	0.122	0.000	0.122	0.000	0.056	15.0	0.00
1:10	0.105	0.000	0.105	0.000	0.095	14.2	0.00
1:15	0.066	0.000	0.066	0.000	0.090	11.9	0.00
1:20	0.043	0.000	0.043	0.000	0.069	10.1	0.00
1:25	0.027	0.000	0.027	0.000	0.050	8.4	0.00
1:30	0.017	0.000	0.017	0.000	0.036	7.1	0.00
1:35	0.011	0.000	0.011	0.000	0.026	6.0	0.00
1:40	0.006	0.000	0.006	0.000	0.018	4.9	0.00
1:45	0.003	0.000	0.003	0.000	0.013	3.8	0.00
1:50	0.001	0.000	0.001	0.000	0.009	2.1	0.00
1:55	0.000	0.000	0.000	0.000	0.007	0.0	0.00
2: 0	0.000	0.000	0.000	0.000	0.006	0.0	0.00
2: 5	0.000	0.000	0.000	0.000	0.005	0.0	0.00
2:10	0.000	0.000	0.000	0.000	0.004	0.0	0.00
2:15	0.000	0.000	0.000	0.000	0.003	0.0	0.00
2:20	0.000	0.000	0.000	0.000	0.003	0.0	0.00
2:25	0.000	0.000	0.000	0.000	0.002	0.0	0.00
2:30	0.000	0.000	0.000	0.000	0.002	0.0	0.00
2:35	0.000	0.000	0.000	0.000	0.002	0.0	0.00
2:40	0.000	0.000	0.000	0.000	0.002	0.0	0.00
2:45	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:50	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2:55	0.000	0.000	0.000	0.000	0.001	0.0	0.00
3: 0	0.000	0.000	0.000	0.000	0.001	0.0	0.00
3: 5	0.000	0.000	0.000	0.000	0.001	0.0	0.00
3:10	0.000	0.000	0.000	0.000	0.001	0.0	0.00
3:15	0.000	0.000	0.000	0.000	0.001	0.0	0.00
3:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00

5:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
Maximum	0.142		0.142	0.000	0.102	15.9	0.00
Time (h:min)	1: 7		1: 7	0: 0	1:11		

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM DETAILED SIMULATION RESULTS

Major System Segment D005

Time (hr:min)	U/S Inflow (cms)	Catchment Inflow (cms)	Total Inflow (cms)	Inlet Capture (cms)	Outflow (cms)	Depth at Curb (cm)	Storage (cu.m)
0: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
0:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
1: 0	0.062	0.000	0.062	0.000	0.053	11.6	0.00
1: 5	0.187	0.000	0.187	0.000	0.172	17.8	0.00
1:10	0.192	0.000	0.192	0.000	0.193	18.0	0.00
1:15	0.156	0.000	0.156	0.000	0.160	16.6	0.00
1:20	0.113	0.000	0.113	0.000	0.118	14.6	0.00
1:25	0.075	0.000	0.075	0.000	0.080	12.5	0.00
1:30	0.050	0.000	0.050	0.000	0.054	10.7	0.00
1:35	0.032	0.000	0.032	0.000	0.035	9.1	0.00
1:40	0.019	0.000	0.019	0.000	0.022	7.5	0.00
1:45	0.010	0.000	0.010	0.000	0.012	5.8	0.00
1:50	0.003	0.000	0.003	0.000	0.005	3.6	0.00
1:55	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2: 0	0.000	0.000	0.000	0.000	0.001	0.0	0.00
2: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
2:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00

3: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
3:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
4:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 0	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5: 5	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:10	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:15	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:20	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:25	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:30	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:35	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:40	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:45	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:50	0.000	0.000	0.000	0.000	0.000	0.0	0.00
5:55	0.000	0.000	0.000	0.000	0.000	0.0	0.00
Maximum	0.197		0.197	0.000	0.195	18.2	0.00
Time (h:min)	1: 6		1: 6	0: 0	1: 7		

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Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

RESULTS OF SIMULATION FOR MAJOR SYSTEM STORAGE

Storage Unit Out1
Number of Inflow Points 1

Discharge Point	Peak Inflow (cms)	Peak Time (hr:min.)
OUTA	0.113	1:15

```
                               bor100-20% out sept 28-16
         Time       Flow       Storage                                       Flow (cms)
       (hr:min)     (cms)      (cu.m)

                                                     0.00E+00  0.23E-01  0.45E-01
0.68E-01  0.90E-01   0.11E+00

I---------I---------I---------I---------I----------I
         0: 0        0.000        0.00             I*
                 I
         0: 5        0.000        0.00             I*
                 I
         0:10        0.000        0.00             I*
                 I
         0:15        0.000        0.00             I*
                 I
         0:20        0.000        0.00             I*
                 I
         0:25        0.000        0.00             I*
                 I
         0:30        0.000        0.00             I*
                 I
         0:35        0.000        0.00             I*
                 I
         0:40        0.000        0.00             I*
                 I
         0:45        0.000        0.00             I*
                 I
         0:50        0.000        0.00             I*
                 I
         0:55        0.000        0.00             I*
                 I
         1: 0        0.000        0.00             I*
                 I
         1: 5        0.000        0.00             I*
                 I
         1:10        0.000        0.00             I*
                 I
         1:15        0.113       16.92
I**************************************************I
         1:20        0.084       46.37
I*************************************             I
         1:25        0.062       68.16             I****************************
                 I
         1:30        0.046       84.25             I*********************
                 I
         1:35        0.035       96.35             I****************
                 I
         1:40        0.027      105.66             I************
                 I
         1:45        0.021      112.84             I**********
                 I
         1:50        0.016      118.42             I********
                 I
         1:55        0.013      122.75             I******
                 I
         2: 0        0.010      126.07             I*****
                 I
         2: 5        0.007      128.59             I****
                 I
         2:10        0.005      130.44             I***
                 I
         2:15        0.003      131.74             I**
                 I
```

2:20	0.002	132.57	I*
I			
2:25	0.001	133.01	I*
I			
2:30	0.000	133.13	I*
I			
2:35	0.000	133.13	I*
I			
2:40	0.000	133.13	I*
I			
2:45	0.000	133.13	I*
I			
2:50	0.000	133.13	I*
I			
2:55	0.000	133.13	I*
I			
3: 0	0.000	133.13	I*
I			
3: 5	0.000	133.13	I*
I			
3:10	0.000	133.13	I*
I			
3:15	0.000	133.13	I*
I			
3:20	0.000	133.13	I*
I			
3:25	0.000	133.13	I*
I			
3:30	0.000	133.13	I*
I			
3:35	0.000	133.13	I*
I			
3:40	0.000	133.13	I*
I			
3:45	0.000	133.13	I*
I			
3:50	0.000	133.13	I*
I			
3:55	0.000	133.13	I*
I			
4: 0	0.000	133.13	I*
I			
4: 5	0.000	133.13	I*
I			
4:10	0.000	133.13	I*
I			
4:15	0.000	133.13	I*
I			
4:20	0.000	133.13	I*
I			
4:25	0.000	133.13	I*
I			
4:30	0.000	133.13	I*
I			
4:35	0.000	133.13	I*
I			
4:40	0.000	133.13	I*
I			
4:45	0.000	133.13	I*
I			
4:50	0.000	133.13	I*
I			
4:55	0.000	133.13	I*

```
                I
     5: 0          0.000      133.13             I*
                I
     5: 5          0.000      133.13             I*
                I
     5:10          0.000      133.13             I*
                I
     5:15          0.000      133.13             I*
                I
     5:20          0.000      133.13             I*
                I
     5:25          0.000      133.13             I*
                I
     5:30          0.000      133.13             I*
                I
     5:35          0.000      133.13             I*
                I
     5:40          0.000      133.13             I*
                I
     5:45          0.000      133.13             I*
                I
     5:50          0.000      133.13             I*
                I
     5:55          0.000      133.13             I*
                I
I---------I---------I---------I---------I----------I
                                                 0.00E+00  0.23E-01  0.45E-01
0.68E-01  0.90E-01   0.11E+00
  Peak   1:15       0.113
```

Required Detention Volume   133.13 cu.m.

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

RESULTS OF SIMULATION FOR MAJOR SYSTEM STORAGE

Storage Unit   Out2
Number of Inflow Points   1

Discharge Point	Peak Inflow (cms)	Peak Time (hr:min.)
OUTB	0.095	1: 6

```
     Time      Flow      Storage                              Flow (cms)
   (hr:min)    (cms)     (cu.m)

                                                 0.00E+00  0.19E-01  0.37E-01
0.56E-01  0.74E-01   0.93E-01

I---------I---------I---------I---------I----------I
```

```
        0: 0       0.000       0.00            I*
                I
        0: 5       0.000       0.00            I*
                I
        0:10       0.000       0.00            I*
                I
        0:15       0.000       0.00            I*
                I
        0:20       0.000       0.00            I*
                I
        0:25       0.000       0.01            I*
                I
        0:30       0.001       0.14            I*
                I
        0:35       0.001       0.41            I*
                I
        0:40       0.001       0.77            I*
                I
        0:45       0.002       1.22            I*
                I
        0:50       0.003       1.94            I**
                I
        0:55       0.005       3.09            I***
                I
        1: 0       0.019       6.67            I***********
                I
        1: 5       0.084      22.23
I**********************************************    I
        1:10       0.093      50.14
I**************************************************I
        1:15       0.072      74.86
I***************************************           I
        1:20       0.047      92.79            I**************************
                I
        1:25       0.026     103.81            I***************
                I
        1:30       0.016     110.19            I*********
                I
        1:35       0.012     114.42            I*******
                I
        1:40       0.009     117.53            I*****
                I
        1:45       0.007     119.89            I****
                I
        1:50       0.005     121.70            I***
                I
        1:55       0.004     123.10            I***
                I
        2: 0       0.003     124.20            I**
                I
        2: 5       0.003     125.07            I**
                I
        2:10       0.002     125.76            I**
                I
        2:15       0.002     126.34            I*
                I
        2:20       0.002     126.84            I*
                I
        2:25       0.001     127.28            I*
                I
        2:30       0.001     127.68            I*
                I
        2:35       0.001     128.03            I*
```

I
2:40 0.001 128.36 I*
I
2:45 0.001 128.66 I*
I
2:50 0.001 128.94 I*
I
2:55 0.001 129.20 I*
I
3: 0 0.001 129.44 I*
I
3: 5 0.001 129.66 I*
I
3:10 0.001 129.88 I*
I
3:15 0.001 130.06 I*
I
3:20 0.000 130.19 I*
I
3:25 0.000 130.28 I*
I
3:30 0.000 130.36 I*
I
3:35 0.000 130.42 I*
I
3:40 0.000 130.47 I*
I
3:45 0.000 130.51 I*
I
3:50 0.000 130.56 I*
I
3:55 0.000 130.59 I*
I
4: 0 0.000 130.63 I*
I
4: 5 0.000 130.66 I*
I
4:10 0.000 130.69 I*
I
4:15 0.000 130.71 I*
I
4:20 0.000 130.74 I*
I
4:25 0.000 130.76 I*
I
4:30 0.000 130.79 I*
I
4:35 0.000 130.81 I*
I
4:40 0.000 130.83 I*
I
4:45 0.000 130.85 I*
I
4:50 0.000 130.87 I*
I
4:55 0.000 130.89 I*
I
5: 0 0.000 130.91 I*
I
5: 5 0.000 130.92 I*
I
5:10 0.000 130.94 I*
I

```
        5:15        0.000      130.95           I*
                I
        5:20        0.000      130.97           I*
                I
        5:25        0.000      130.99           I*
                I
        5:30        0.000      131.00           I*
                I
        5:35        0.000      131.01           I*
                I
        5:40        0.000      131.03           I*
                I
        5:45        0.000      131.04           I*
                I
        5:50        0.000      131.05           I*
                I
        5:55        0.000      131.07           I*
                I

I---------I---------I---------I---------I----------I
                                                  0.00E+00  0.19E-01  0.37E-01
0.56E-01  0.74E-01   0.93E-01
  Peak   1: 6       0.095
```

Required Detention Volume   131.07 cu.m.

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

RESULTS OF SIMULATION FOR MAJOR SYSTEM STORAGE

Storage Unit   Out3
Number of Inflow Points   1

Discharge Point	Peak Inflow (cms)	Peak Time (hr:min.)
OUTC	0.052	1: 8

```
          Time      Flow      Storage                                Flow (cms)
       (hr:min)    (cms)     (cu.m)

                                                  0.00E+00  0.10E-01  0.20E-01
0.31E-01  0.41E-01   0.51E-01

I---------I---------I---------I---------I----------I
        0: 0        0.000        0.00           I*
                I
        0: 5        0.000        0.00           I*
                I
        0:10        0.000        0.00           I*
                I
        0:15        0.000        0.00           I*
```

```
                 I
        0:20          0.000        0.00             I*
                 I
        0:25          0.000        0.00             I*
                 I
        0:30          0.000        0.00             I*
                 I
        0:35          0.000        0.01             I*
                 I
        0:40          0.000        0.03             I*
                 I
        0:45          0.000        0.05             I*
                 I
        0:50          0.000        0.10             I*
                 I
        0:55          0.001        0.22             I*
                 I
        1: 0          0.002        0.59             I**
                 I
        1: 5          0.014        2.93             I**************
                 I
        1:10          0.051       14.62
I**************************************************I
        1:15          0.040       28.31
I****************************************          I
        1:20          0.026       38.27             I**************************
                 I
        1:25          0.018       44.95             I******************
                 I
        1:30          0.014       49.86             I***************
                 I
        1:35          0.012       53.84             I************
                 I
        1:40          0.010       57.17             I**********
                 I
        1:45          0.009       60.02             I*********
                 I
        1:50          0.008       62.50             I********
                 I
        1:55          0.007       64.70             I*******
                 I
        2: 0          0.006       66.68             I*******
                 I
        2: 5          0.006       68.48             I******
                 I
        2:10          0.005       70.13             I******
                 I
        2:15          0.005       71.65             I*****
                 I
        2:20          0.005       73.08             I*****
                 I
        2:25          0.004       74.41             I*****
                 I
        2:30          0.004       75.67             I*****
                 I
        2:35          0.004       76.87             I****
                 I
        2:40          0.004       78.00             I****
                 I
        2:45          0.004       79.08             I****
                 I
        2:50          0.003       80.10             I****
                 I
```

2:55	0.003	81.08	I****
I			
3: 0	0.003	82.02	I****
I			
3: 5	0.003	82.93	I***
I			
3:10	0.003	83.79	I***
I			
3:15	0.003	84.63	I***
I			
3:20	0.003	85.44	I***
I			
3:25	0.003	86.22	I***
I			
3:30	0.002	86.97	I***
I			
3:35	0.002	87.71	I***
I			
3:40	0.002	88.42	I***
I			
3:45	0.002	89.11	I***
I			
3:50	0.002	89.79	I***
I			
3:55	0.002	90.44	I***
I			
4: 0	0.002	91.08	I***
I			
4: 5	0.002	91.71	I***
I			
4:10	0.002	92.31	I**
I			
4:15	0.002	92.91	I**
I			
4:20	0.002	93.48	I**
I			
4:25	0.002	94.05	I**
I			
4:30	0.002	94.60	I**
I			
4:35	0.002	95.14	I**
I			
4:40	0.002	95.67	I**
I			
4:45	0.002	96.19	I**
I			
4:50	0.002	96.69	I**
I			
4:55	0.002	97.19	I**
I			
5: 0	0.002	97.68	I**
I			
5: 5	0.002	98.16	I**
I			
5:10	0.002	98.62	I**
I			
5:15	0.002	99.08	I**
I			
5:20	0.001	99.53	I**
I			
5:25	0.001	99.98	I**
I			
5:30	0.001	100.41	I**

```
                 I
         5:35       0.001      100.84            I**
                 I
         5:40       0.001      101.26            I**
                 I
         5:45       0.001      101.67            I**
                 I
         5:50       0.001      102.08            I**
                 I
         5:55       0.001      102.48            I**
                 I

I---------I---------I---------I---------I----------I
                                                  0.00E+00  0.10E-01  0.20E-01
0.31E-01  0.41E-01   0.51E-01
  Peak   1: 8       0.052
```

Required Detention Volume   102.48 cu.m.

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

RESULTS OF SIMULATION FOR MAJOR SYSTEM STORAGE

Storage Unit   Out4
Number of Inflow Points   1

Discharge Point	Peak Inflow (cms)	Peak Time (hr:min.)
OUT1B	0.195	1: 7

```
   Time      Flow      Storage                                  Flow (cms)
  (hr:min)    (cms)     (cu.m)

                                                  0.00E+00  0.39E-01  0.77E-01
0.12E+00  0.15E+00   0.19E+00

I---------I---------I---------I---------I----------I
         0: 0       0.000        0.00            I*
                 I
         0: 5       0.000        0.00            I*
                 I
         0:10       0.000        0.00            I*
                 I
         0:15       0.000        0.00            I*
                 I
         0:20       0.000        0.00            I*
                 I
         0:25       0.000        0.00            I*
                 I
         0:30       0.000        0.00            I*
                 I
```

0:35 0.000 0.00 I*
I
0:40 0.000 0.00 I*
I
0:45 0.000 0.00 I*
I
0:50 0.000 0.00 I*
I
0:55 0.000 0.00 I*
I
1: 0 0.053 7.93 I**************
I
1: 5 0.172 41.66
I*** I
1:10 0.193 98.56
I**I
1:15 0.160 151.51
I** I
1:20 0.118 193.24 I*******************************
I
1:25 0.080 222.95 I*********************
I
1:30 0.054 243.08 I***************
I
1:35 0.035 256.45 I**********
I
1:40 0.022 264.94 I******
I
1:45 0.012 269.95 I****
I
1:50 0.005 272.46 I**
I
1:55 0.001 273.39 I*
I
2: 0 0.001 273.67 I*
I
2: 5 0.000 273.79 I*
I
2:10 0.000 273.85 I*
I
2:15 0.000 273.89 I*
I
2:20 0.000 273.92 I*
I
2:25 0.000 273.94 I*
I
2:30 0.000 273.95 I*
I
2:35 0.000 273.96 I*
I
2:40 0.000 273.97 I*
I
2:45 0.000 273.98 I*
I
2:50 0.000 273.99 I*
I
2:55 0.000 273.99 I*
I
3: 0 0.000 274.00 I*
I
3: 5 0.000 274.00 I*
I
3:10 0.000 274.00 I*

```
               I
3:15              0.000       274.01             I*
               I
3:20              0.000       274.01             I*
               I
3:25              0.000       274.01             I*
               I
3:30              0.000       274.01             I*
               I
3:35              0.000       274.02             I*
               I
3:40              0.000       274.02             I*
               I
3:45              0.000       274.02             I*
               I
3:50              0.000       274.02             I*
               I
3:55              0.000       274.02             I*
               I
4: 0              0.000       274.02             I*
               I
4: 5              0.000       274.02             I*
               I
4:10              0.000       274.02             I*
               I
4:15              0.000       274.02             I*
               I
4:20              0.000       274.02             I*
               I
4:25              0.000       274.02             I*
               I
4:30              0.000       274.02             I*
               I
4:35              0.000       274.03             I*
               I
4:40              0.000       274.03             I*
               I
4:45              0.000       274.03             I*
               I
4:50              0.000       274.03             I*
               I
4:55              0.000       274.03             I*
               I
5: 0              0.000       274.03             I*
               I
5: 5              0.000       274.03             I*
               I
5:10              0.000       274.03             I*
               I
5:15              0.000       274.03             I*
               I
5:20              0.000       274.03             I*
               I
5:25              0.000       274.03             I*
               I
5:30              0.000       274.03             I*
               I
5:35              0.000       274.03             I*
               I
5:40              0.000       274.03             I*
               I
5:45              0.000       274.03             I*
               I
```

```
         5:50       0.000      274.03            I*
                I
         5:55       0.000      274.03            I*
                I

I---------I---------I---------I---------I----------I
                                                 0.00E+00  0.39E-01  0.77E-01
0.12E+00  0.15E+00   0.19E+00
  Peak   1: 7       0.195
```

Required Detention Volume   274.03 cu.m.

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

RESULTS OF SIMULATION FOR MAJOR SYSTEM STORAGE

Storage Unit   Out5
Number of Inflow Points   1

Discharge Point	Peak Inflow (cms)	Peak Time (hr:min.)
OUTD	0.056	1: 7

```
   Time      Flow      Storage                               Flow (cms)
 (hr:min)    (cms)     (cu.m)

                                                 0.00E+00  0.10E-01  0.21E-01
0.31E-01  0.42E-01   0.52E-01

I---------I---------I---------I---------I----------I
         0: 0       0.000        0.00            I*
                I
         0: 5       0.000        0.00            I*
                I
         0:10       0.000        0.00            I*
                I
         0:15       0.000        0.00            I*
                I
         0:20       0.000        0.00            I*
                I
         0:25       0.000        0.00            I*
                I
         0:30       0.000        0.01            I*
                I
         0:35       0.000        0.04            I*
                I
         0:40       0.000        0.09            I*
                I
         0:45       0.000        0.17            I*
                I
         0:50       0.001        0.34            I*
```

```
                 I
         0:55        0.002        0.73             I**
                 I
         1: 0        0.008        2.18             I********
                 I
         1: 5        0.037        8.93
I************************************              I
         1:10        0.052       24.12
I**************************************************I
         1:15        0.043       38.46
I******************************************        I
         1:20        0.035       50.26
I**********************************                I
         1:25        0.029       59.90             I****************************
                 I
         1:30        0.023       67.66             I**********************
                 I
         1:35        0.019       73.99             I*******************
                 I
         1:40        0.016       79.26             I****************
                 I
         1:45        0.014       83.70             I**************
                 I
         1:50        0.012       87.50             I************
                 I
         1:55        0.010       90.81             I**********
                 I
         2: 0        0.009       93.71             I*********
                 I
         2: 5        0.008       96.28             I********
                 I
         2:10        0.007       98.58             I*******
                 I
         2:15        0.007      100.66             I*******
                 I
         2:20        0.006      102.54             I******
                 I
         2:25        0.006      104.27             I******
                 I
         2:30        0.005      105.86             I*****
                 I
         2:35        0.005      107.33             I*****
                 I
         2:40        0.004      108.69             I*****
                 I
         2:45        0.004      109.97             I****
                 I
         2:50        0.004      111.18             I****
                 I
         2:55        0.004      112.31             I****
                 I
         3: 0        0.003      113.38             I****
                 I
         3: 5        0.003      114.40             I****
                 I
         3:10        0.003      115.37             I****
                 I
         3:15        0.003      116.29             I***
                 I
         3:20        0.003      117.18             I***
                 I
         3:25        0.003      118.03             I***
                 I
```

```
  3:30        0.003      118.85              I***
        I
  3:35        0.003      119.64              I***
        I
  3:40        0.003      120.40              I***
        I
  3:45        0.002      121.14              I***
        I
  3:50        0.002      121.86              I***
        I
  3:55        0.002      122.55              I***
        I
  4: 0        0.002      123.22              I***
        I
  4: 5        0.002      123.87              I***
        I
  4:10        0.002      124.51              I**
        I
  4:15        0.002      125.12              I**
        I
  4:20        0.002      125.72              I**
        I
  4:25        0.002      126.30              I**
        I
  4:30        0.002      126.87              I**
        I
  4:35        0.002      127.43              I**
        I
  4:40        0.002      127.97              I**
        I
  4:45        0.002      128.50              I**
        I
  4:50        0.002      129.02              I**
        I
  4:55        0.002      129.52              I**
        I
  5: 0        0.002      130.01              I**
        I
  5: 5        0.002      130.50              I**
        I
  5:10        0.002      130.97              I**
        I
  5:15        0.002      131.43              I**
        I
  5:20        0.001      131.89              I**
        I
  5:25        0.001      132.33              I**
        I
  5:30        0.001      132.77              I**
        I
  5:35        0.001      133.19              I**
        I
  5:40        0.001      133.61              I**
        I
  5:45        0.001      134.03              I**
        I
  5:50        0.001      134.43              I**
        I
  5:55        0.001      134.83              I**
        I

I---------I---------I---------I---------I---------I
                                                   0.00E+00  0.10E-01  0.21E-01
```

0.31E-01 0.42E-01   0.52E-01
Peak   1: 7   0.056

Required Detention Volume   134.83 cu.m.

♀

Dual Drainage Storm Water Management Model (DDSWMM 2.1)

Borrello Subdivision

DDSWMM analysis, 3 hour 100 year Chicago Storm + 20% STRESS TEST

MAJOR SYSTEM

SUMMARY OF SIMULATION RESULTS

No.	Segment	Peak Flow (cms)	Peak Time (hr:min.)	Max. Depth (cm)	Max. Capture (l/s)	Inlet Restriction (?)	D/S Pipe	Max. Storage (cu.m.)
1	SWM14	0.013	1: 5	2.75	0.00	-	X	0.00
2	SWM13	0.013	1: 5	2.40	0.00	-	X	0.00
3	LP001	0.026	1: 6	3.07	0.00	-	X	0.00
4	SWM12	0.031	1: 5	3.45	0.00	-	X	0.00
5	SWM11	0.011	1: 5	2.56	0.00	-	X	0.00
6	LP002	0.065	1: 6	5.10	20.00	N/A	207	1.80
7	SWM10	0.068	1: 5	5.17	0.00	-	X	0.00
8	SWM8	0.029	1: 8	4.11	0.00	-	X	0.00
9	LP003	0.094	1: 6	6.44	4.52	N/A	205	5.70
10	SWM3	0.044	1: 5	4.82	0.00	-	X	0.00
11	SWM4	0.112	1: 5	6.28	0.00	-	X	0.00
12	LP004	0.152	1: 7	7.75	9.87	N/A	205	5.70
13	SWM2	0.163	1:11	5.99	0.00	-	X	0.00
14	SWM1	0.075	1: 5	5.98	0.00	-	X	0.00
15	LP005	0.217	1: 6	6.82	20.00	N/A	202	1.30
16	SWM7	0.115	1: 5	5.17	20.00	YES	202	0.00
17	SWM9	0.039	1: 5	2.02	17.47	NO	205	0.00
18	SWM5	0.148	1: 5	5.50	15.00	N/A	207	55.00
19	SWM6	0.081	1: 5	4.17	20.00	YES	202	0.00

```
20 SWM15        0.058    1: 5       3.01       0.00       -        X
0.00
21 D001         0.026    1: 6       8.30       0.00       -        X
0.00
22 D002         0.045    1: 6      10.34       0.00       -        X
0.00
23 D003         0.089    1: 6      13.32       0.00       -        X
0.00
24 D004         0.142    1: 7      15.92       0.00       -        X
0.00
25 D005         0.197    1: 6      18.15       0.00       -        X
0.00
```

```
*** SIMULATION ENDED NORMALLY ***
♀
   ***********************************************************
   *                                                         *
   *    Simulation Starting Date      September 13, 16       *
   *                        Time      08:25:25.57            *
   *                                                         *
   *    Simulation Ending   Date      September 13, 16       *
   *                        Time      08:25:28.26            *
   *                                                         *
   *    Duration of Simulation          0.04 Minutes         *
   *                                                         *
   ***********************************************************
```

```
   Data Files
   ----------

   Input Data File Name                 bor100+20%.txt

   Ouput File Name                      bor100-20

   EXTRAN Interface (ASCII) File Name   ssdgsa
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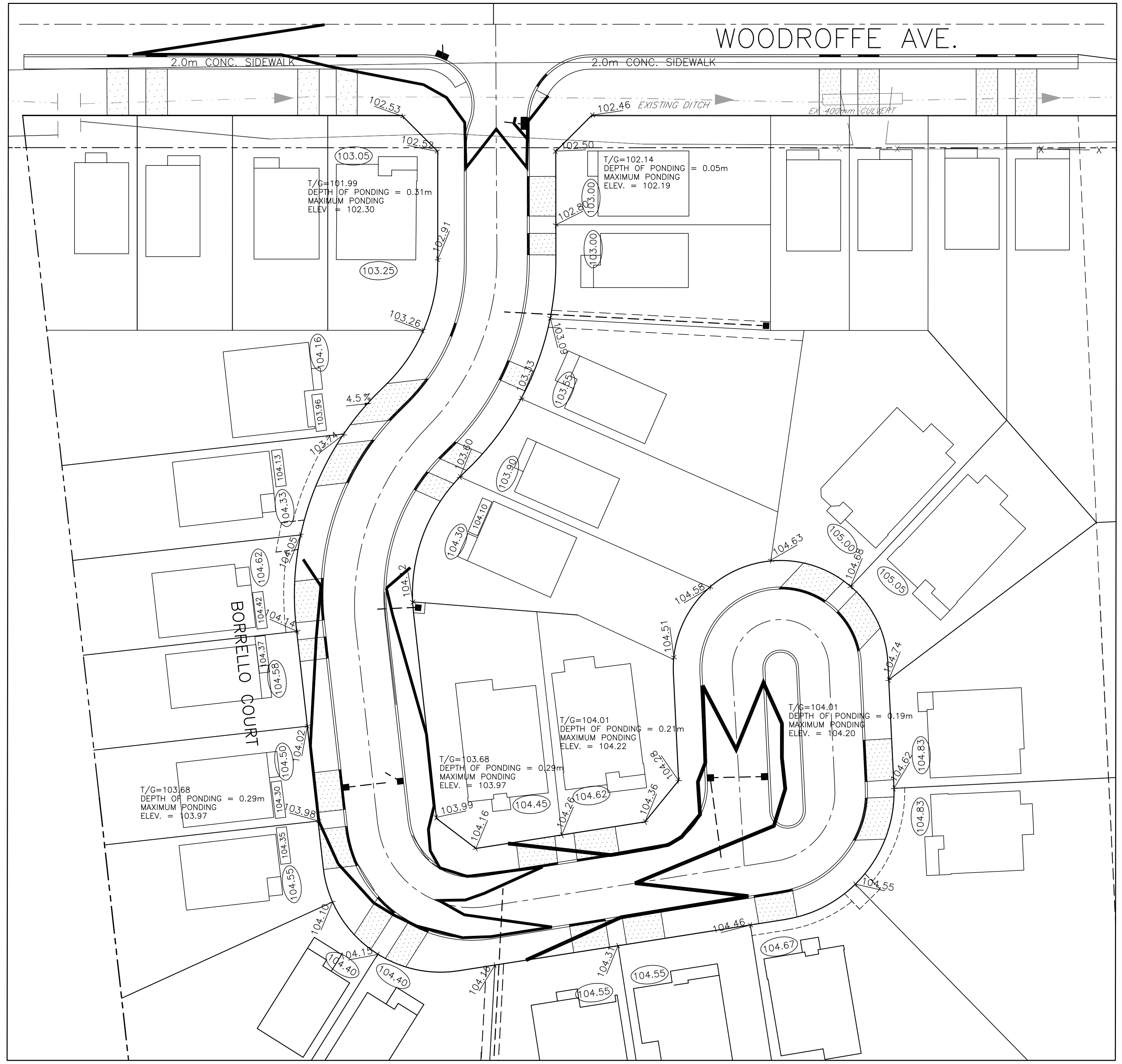
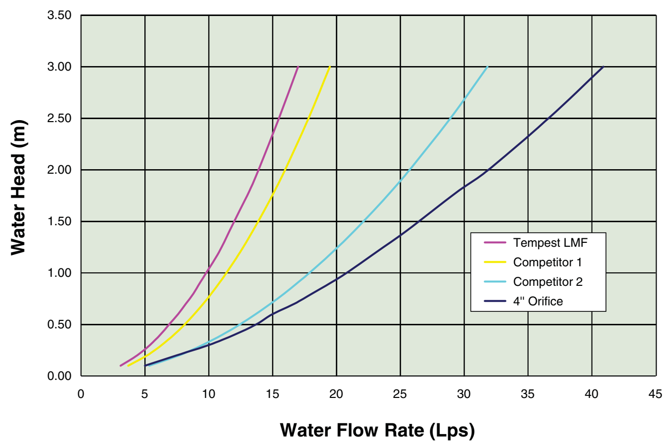


Robinson
Land Development

scale N.T.S.	BORRELLO SUBDIVISION	project no. 14057
date 15/09/16		
drawn by JHB	20% STRESS TEST	SWM-2

Tempest Inlet Control Devices restrict flow to a narrower range than traditional methods regardless of head



THE TEMPEST FAMILY OF SYSTEMS

TEMPEST LMF

Restricts:

✓ Flow
✓ Odours
✓ Floatables

LOW to MODERATE FLOW RATES

2 L/s (32 GPM) – 17 L/s (270 GPM) **14 pre-set flow rates**

The Tempest LMF system features a vortex inlet design that allows a low flow rate to be set and eliminates the passage of odours and floatables and allows for debris and sediment to collect in the structure.

TEMPEST HF & HF SUMP

Restricts:

✓ Flow
✓ Odours
✓ Floatables

HIGH FLOW RATES

15L/s (240 GPM) or greater **5 pre-set flow rates**

The standard Tempest HF system allows a near constant discharge rate to be set and eliminates the passage of odours and floatables and allows for debris and sediment to collect in the structure.

The Tempest HF SUMP system is designed for catch basins & manholes in which there is no sump or the outlet pipe is too low to install standard Tempest device.

TEMPEST MHF

Restricts:

✓ Flow

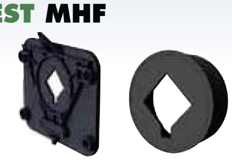


Plate Plug

MEDIUM TO HIGH FLOW RATES

9L/s (143 GPM) or greater **Specified pre-set flow rates**

The Tempest MHF is a standard orifice plate or plug device designed to allow a specified flow volume through the outlet pipe at a specified head.

5.3 Levels of Service

5.3.1. Minor System

I. **Lateral sewer system** to be designed using the Rational Method and the 5-year Intensity Duration Frequency Curve - Nepean DWG IDF-93 (See **Appendix E**).

- I-a Inlet time in typical residential areas = 20 min
- I-b Average runoff coefficient for residential areas does not exceed $C_{max}=0.55$ (asphalt=0.9, grass=0.2)
- I-c Calculation of the hydraulic grade line to be conducted only for the surcharged lateral sewers that are connected to the trunk sewer at surcharged sections.
- I-d Surcharge calculations to be based on the steady state Darcy-Weisbach formula using maximum water level in the trunk junction as the starting hydraulic grade line elevation.
- I-e Maximum permitted hydraulic grade line elevation to be 0.30m below the underside of building foundations.

II. Density of inlets connected to the minor system to be restricted to a maximum of 3.5 inlets per hectare with the equivalent capacity of Inlet Control Device SCEPTOR type "A" – 20.0 l/s or the equivalent of 70 l/s/ha.

III. **Trunk storm sewers** to be designed based on the results of hydrological/hydrodynamic modeling using XP-SWMM.

- III-a Modeling to be based on the 5 and 100 year Chicago design storm of 12 hour duration and 20 minutes time step, derived from the Nepean IDF-93 curves (see Appendix E).
- III-b Modeling to be based on the inlet densities and restrictions specified in paragraph II above.
- III-c Hydraulic grade line modeling to be based on the hydrodynamic fluctuation of the water levels in the Strandherd SWM facility.
- III-d Maximum permitted hydraulic grade line elevation to be 0.30m below the underside of basement floor slab (top of footing).

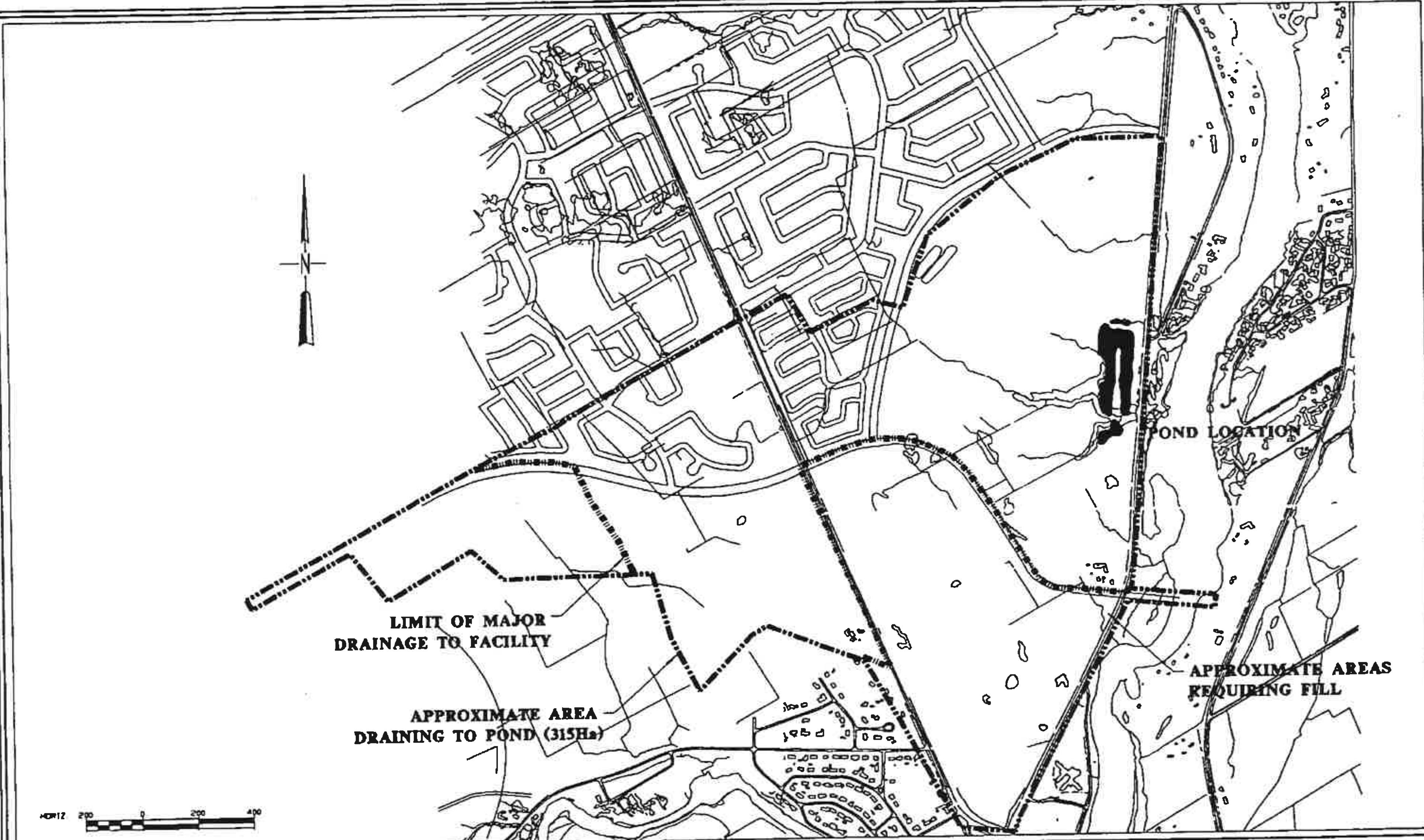
5.3.2 Major system

I Major flow to be accommodated by a combination of on-site detention and overland flow conveyance with no-ponding

II The storage versus conveyance requirements for areas of average runoff coefficient less than c=0.55 to be determined using the chart enclosed in **Appendix F**.

III **Residential Development:**
Modeling is not required for densities with the average runoff coefficient lower than C=0.55. The maximum on-site detention storage requirement during the 100 year storm is 130 m^3/ha assuming no-overflow and that the average runoff coefficient does not exceed 0.55.

- III-a On-site detention storage may be provided by:
  - low laying park surfaces, and/or,
  - fairly evenly distributed road/rear yard sawtoothing design, and/or,
  - combination of both sawtoothing design and park storage
- III-b Maximum hydrostatic depth in roadways sags = 0.25m



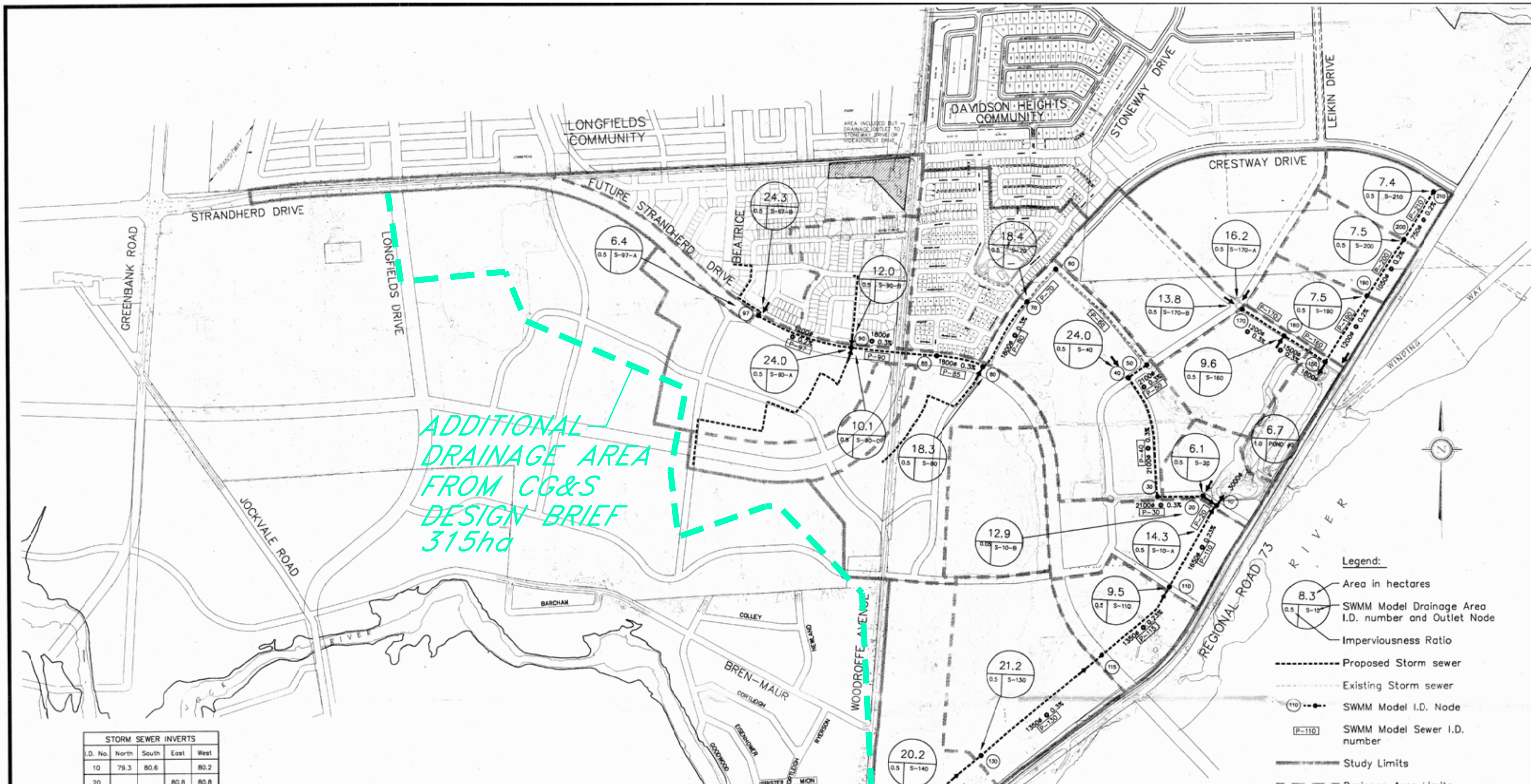
CITY OF NEPEAN
PUBLIC WORKS DEPARTMENT

CG&S
CH2M Gore & Storrie Limited

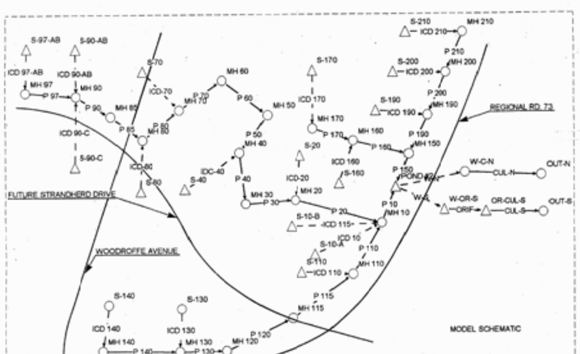
Title:

FACILITY DRAINAGE BOUNDARIES

FIGURE DBB



STORM SEWER INVERTS				
I.D. No.	North	South	East	West
10	79.3	80.6		80.2
20			80.8	80.8
30	82.1		81.3	
40		83.4	83.4	
50			83.6	83.6
70	85.4	85.7		
80	86.4			86.5
85			86.9	86.9
90			87.7	88.3
97			88.9	
110	81.3	81.6		
115	82.3	82.3		
130	83.7	84.0		
140	84.8			
150		79.5	81.1	80.2
190	81.7	81.5		
200	82.4	82.1		
210		82.8		
160			80.6	82.85
170			83.25	



THIS DRAWING TO BE READ IN CONJUNCTION WITH REPORT TITLED "AREA TRIBUTARY TO THE STRANDHERD STORMWATER FACILITY"

0 100 200 300 400 500

SOUTH NEPEAN URBAN AREA
AREA TRIBUTARY TO THE STRANDHERD STORMWATER FACILITY
STORM DRAINAGE AREAS AND SWMM MODEL SCHEMATIC

CONTOUR INTERVAL	SCALE
1.0m	1:5000
DWG. NO. WB-168-2	DATE JULY 1998

NEPEAN
PUBLIC WORKS DEPARTMENT

DME Ltd.
David McManus
Engineering Ltd.

June 2/04
Smc

June 2, 2004

Cecil D. Naraine Associates Limited
Consulting Engineers
1097 Lena Avenue
Manotick, Ontario
K4M 1E7

Attn: Mr. D. Cecil Naraine, P.Eng.

Dear Sir:

Re: Borrello's Property, Woodroffe Avenue - Our File 2420

We have received your letter of April 13, 2004 requesting that capacity for the Borrello property be provided in the future storm sewer system that will be constructed on Woodroffe Avenue. We have discussed this request with Minto Developments Inc. and they have agreed to provide capacity for Borrello, subject to Borrello cost sharing on applicable works. Your client must negotiate with Minto directly on cost sharing.

As you know, the storm sewer system in this area outlets to the Strandherd SWM facility on Prince of Wales Drive. CH2M Gore & Storrie Limited prepared the *South Nepean Strandherd Stormwater Facility Design Brief (February 1998)* for the stormwater management facility on Prince of Wales Drive. This report indicates that the Strandherd SWM facility has capacity to accommodate minor system flows from 315 ha of developed area. The drainage area from Minto's lands and the Borrello property is a total of 300 ha. Therefore there is capacity in the Strandherd SWM facility. We have attached information from the CH2M Gore & Storrie Design Brief for your information.

Please call if you have any questions or concerns.

Regards,

Sean Czaharynski, P.Eng.
Senior Project Manager

cc Mr. Marcel Denomme, Minto Developments Inc.

400 - 30 Camelot Drive, Nepean, Ontario K2G 5X8
Tel: 613-225-1929 Fax: 613-225-7330 E-mail: mcmanus@dmel.on.ca
Municipal and Land Development Consultants

1.0 TREATMENT FACILITY OVERVIEW

1.1 General

The Strandherd Stormwater Facility will receive stormwater flow from developments in South Nepean. The purpose of the proposed works is to provide treatment for influent stormwater prior to discharge into the Rideau River in order to achieve water quality targets for the Rideau River and to meet provincial water quality standards. Figure DB 'A' shows the location of the facility with respect to other areas in South Nepean. The following sections outline the general shape and configuration, operating water levels and hydraulic operation of the facility.

Inflow to the facility will be routed first into either the north or south forebay prior to discharge into the main cell. A constant outflow rate will be maintained from the facility during discharge events, with a typical water level fluctuation of approximately 1.1 m during these events. This constant outflow is an operational requirement for the potential future UV facility, but in the interim (prior to installation of UV) the flow control will help enhance the water quality of facility effluent by increasing facility mean retention times.

Storm events up to 5-year return period which exceed the treatment level in the facility will be discharged via the main southern outlet from the facility through the existing culvert on Strandherd Creek. This outlet will be designed to pass 2.3 m^3/s at 5-year pond water levels. Flows from storms beyond this 5-year return period in excess of the capacity of the main outlet will be bypassed via the high level overflow spillway for the facility located near the south entrance to Winding Way. This outlet will ensure that water levels in the facility do not exceed an elevation of 82.5 m under storms equal to the 100-year design storm event. It is expected that the discharge from this outlet will be approximately 7 m^3/s in this event.

Flow measurement and water quality monitoring equipment will be required at each of the inlets and at the main (south) facility outlet. This equipment will be used to monitor the performance of the facility with respect to water quality parameters of concern.

1.2 Facility Sizing

Sizing of the stormwater facility was performed as part of the pre-design process. This sizing was based on several criteria; the level of protection required based on fisheries habitat in receiving waters, the size of the contributing area, and the imperviousness of this contributing area all affect the facility size required. The portion of the major flows from the development to be directed through the facility as well as the outlet configuration and operation were also considered in the design.

1.2.1 Drainage Area

The facility is designed to accommodate minor system flows from 315 ha of developed area with an average runoff coefficient of 0.47. The facility provides enough storage to meet MOEE (1994) Level 1 protection sizing guidelines for a 55% impervious area, which is based on a reduction in the incoming suspended solids load by an average of 80%.

6.4.2 Culvert Design

Hydraulic analysis must consider the presence of culverts for roadway and driveway crossings since these facilities usually provide the most significant head loss. Culverts shall be sized/designed using the methodology outlined in Chapter 5 of the MTO Drainage Manual.

The designer shall submit hydraulic design calculations to identify design flow conditions and inlet head requirements for culverts. The need for energy dissipation, erosion control measures, and grates shall be considered for each design.

The minimum culvert diameter (including private entrances/driveways) shall be 500 mm to allow for reliability and ease of maintenance. The culvert length shall be sufficient to keep fill from obstructing the waterway. Lengths should be minimized to avoid fish passage problems or uplift pressures that may lead to failure. Normal stream velocities should also be low enough to allow for the passage of native fish species. If extra length is required to accommodate future road-widening potential, uplift pressures should also be checked under these future conditions. Depth of cover will affect the required material thickness. Refer to the OPSD 800 series for material minimum thickness. Check the Standard for detail drawings, approved materials, and special provisions to the OPS construction specifications.

When designing a culvert under a roadway, the designer must also check first to see if the waterway falls under the authority of one of the conservation authorities that will likely have their own return frequency requirements.

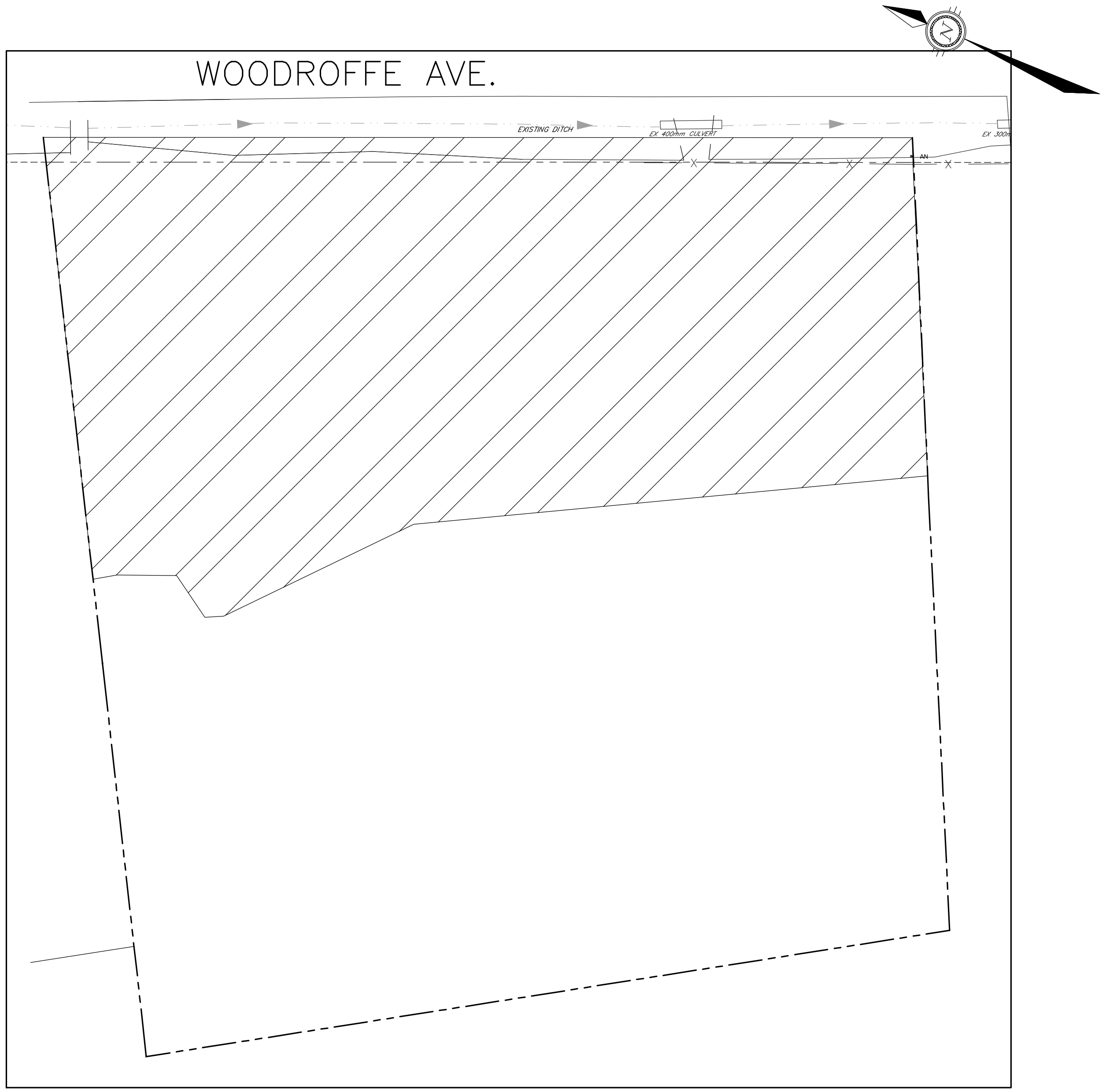
For all other road culverts the following applies. Ensure that the roadway will not be overtopped for at least the following return frequencies:

Table 6.4 Road Type vs. Culvert Design Storm

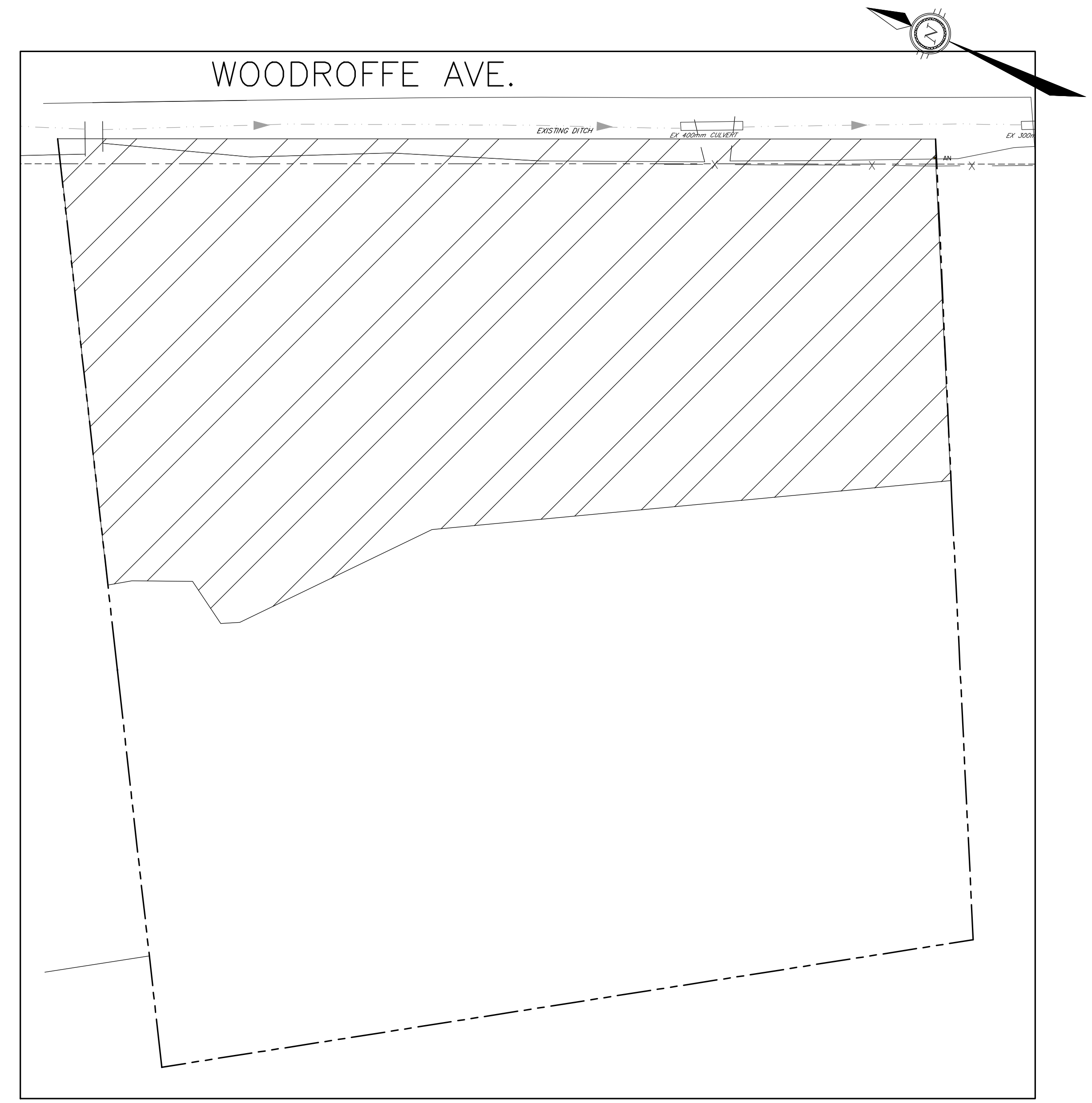
ROAD CLASSIFICATION	UNDER 6M SPAN	OVER 6M SPAN
Local Rural Road	10 Years	25 Years
Local Urban Road	25 Years	50 Years
Collector	25 Years	50 Years
Rural arterial	25 Year	50 Years
Urban Arterial	50 Years	100 Years

6.4.3 Water Table Considerations

All development shall ensure that each foundation footing is above the average water table elevation.



5 YEAR PRE-DEVELOPMENT DRAINAGE BOUNDARY

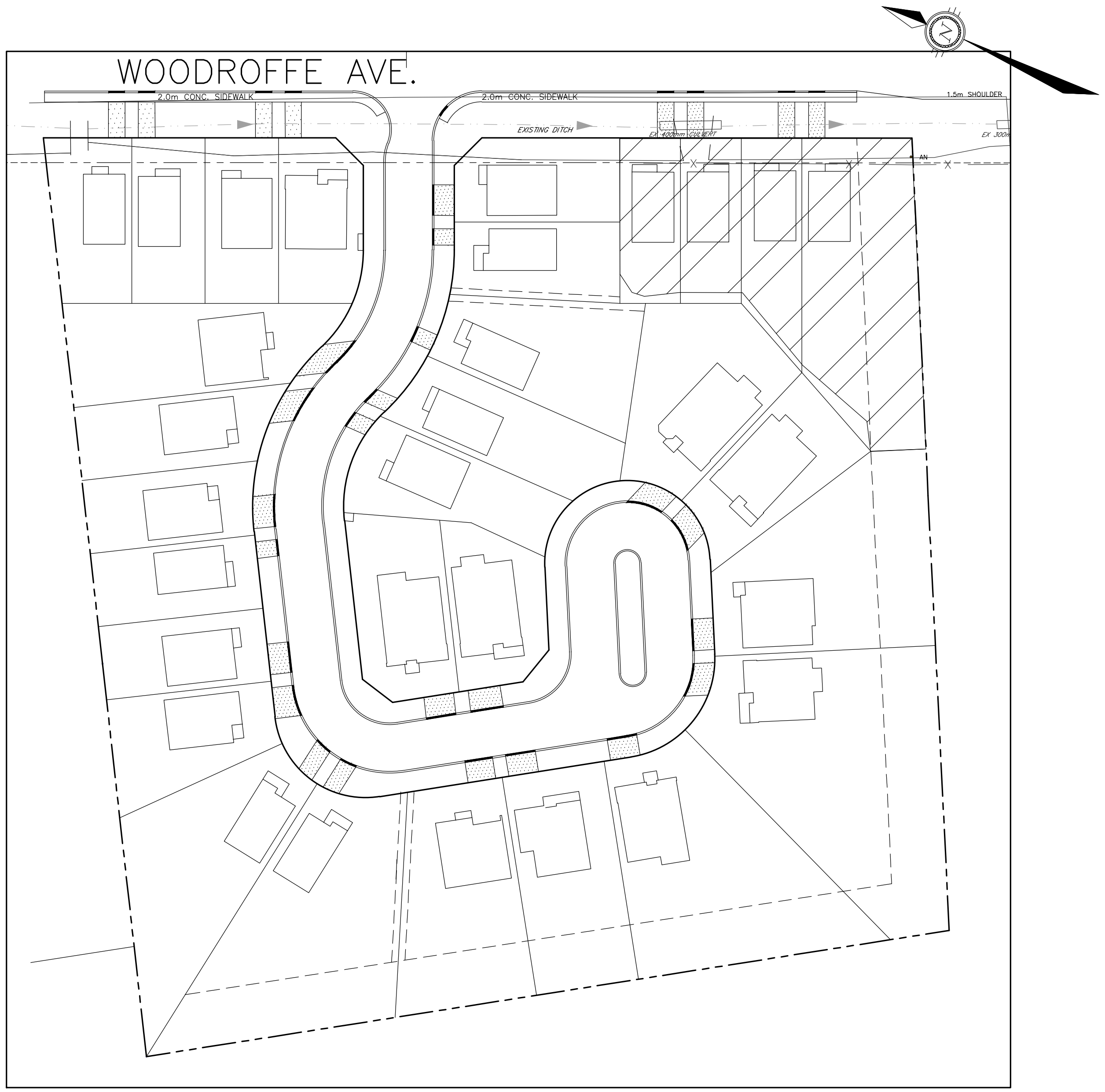


100 YEAR PRE-DEVELOPMENT DRAINAGE BOUNDARY

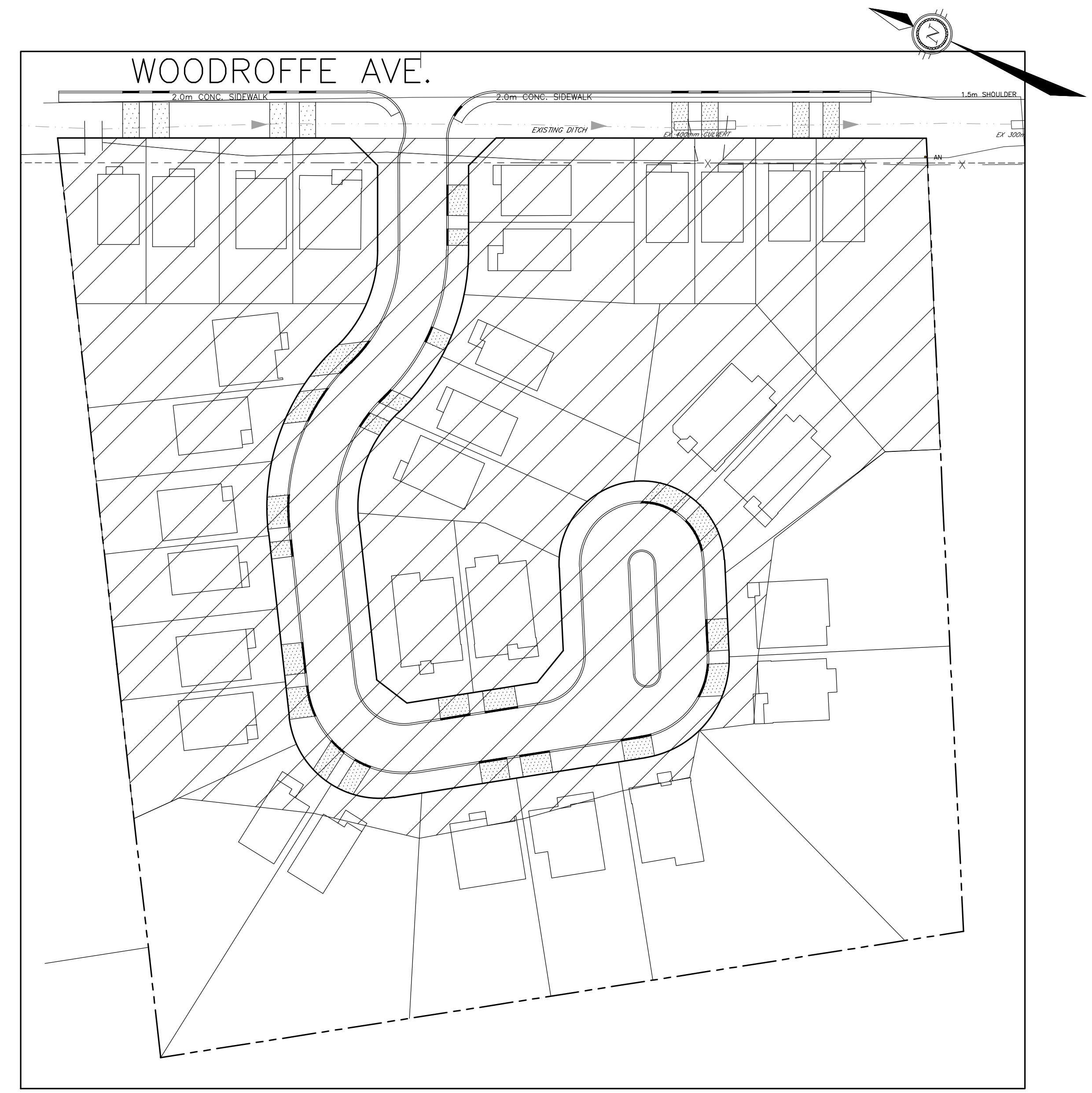
PRE-DEVELOPMENT RUNOFF			
RETURN PERIOD	T_C (min.)	C VALUE	FLOW (L/s)
5 YEAR	14.8	0.20	51.40
100 YEAR	14.8	0.25	110.10

Robinson Land Development

scale N.T.S.	BORRELLO SUBDIVISION	project no. 14057
date 02/05/16	PRE-DEVELOPMENT DRAINAGE TO WOODROFFE DITCH	PRE-SOUTH
drawn by BLM		



5 YEAR POST–DEVELOPMENT DRAINAGE BOUNDARY



100 YEAR POST–DEVELOPMENT DRAINAGE BOUNDARY

POST–DEVELOPMENT RUNOFF			
RETURN PERIOD	T_C (min.)	C VALUE	FLOW (L/s)
5 YEAR	14.5	0.36	93.80
100 YEAR	31.5	0.53	144.00

Robinson Land Development

scale N.T.S.	BORRELLO SUBDIVISION	project no. 14057
date 02/05/16	POST–DEVELOPMENT DRAINAGE TO WOODROFFE DITCH	POST–SOUTH
drawn by BLM		

Drainage Area Characteristics
5 Year Storm Event

Drainage Area ID			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
Area (ha)		A	0.47	0.18	0.53	1.89	0.64	0.21	0.22	0.56	0.18	0.36	8.13	1.23
Runoff Coefficient	5 year	C_{5yr}	0.46	0.39	0.34	0.32	0.33	0.33	0.28	0.28	0.28	0.34	0.25	0.55
Sub-Watershed Length (m)		L	112	26	79	139	43	21	38	86	29	106	375	250
Sub-Watershed Slope (%)		S_w	1.35	2.80	1.90	3.75	0.20	0.20	0.20	0.20	0.20	2.00	2.00	1.00
		Total A	13.57											

Time of Concentration, t_c

5 Year Storm Event

Method	Equation	A1	A2	A3	A4	A5	A6
		t_c (min)	t_c (min)	t_c (min)	t_c (min)	t_c (min)	t_c (min)
		5 year	5 year	5 year	5 year	5 year	5 year
Airport (FAA)	$t_c = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S_w{}^{0.33}}$	20.0	8.4	17.8	19.4	28.0	19.6

Method	Equation	A7	A8	A9	A10	A11	A12
		t_c (min)	t_c (min)	t_c (min)	t_c (min)	t_c (min)	t_c (min)
		5 year	5 year	5 year	5 year	5 year	5 year
Airport (FAA)	$t_c = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S_w{}^{0.33}}$	28.0	42.2	24.5	20.3	42.7	28.3

Table B.1
Rational Method Calculation Sheet
5 Year Storm Event

Drainage Area ID	Area (ha)	Runoff Coefficient, C	Time Conc.5yr	Rainfall Intensity	Peak Design Flow (m^3/s)	Cumulative Peak Design Flow (m^3/s)
		C_{5yr}	(min.)	5 year	5 year	5 year
A1	0.47	0.46	20.0	70.25	0.042	0.042
A2	0.18	0.39	8.4	113.47	0.022	0.064
A3	0.53	0.34	17.8	75.44	0.038	0.102
A4	1.89	0.32	19.4	71.64	0.120	0.223
A5	0.64	0.33	28.0	56.50	0.033	0.256
A6	0.21	0.33	19.6	71.22	0.014	0.270
A7	0.22	0.28	28.0	56.45	0.010	0.279
A8	0.56	0.28	42.2	42.56	0.019	0.298
A9	0.18	0.28	24.5	61.73	0.009	0.306
A10	0.36	0.34	20.3	69.61	0.024	0.330
A11	8.13	0.25	42.7	42.19	0.238	0.568
A12	1.23	0.55	28.3	56.02	0.105	0.674

$Q = 0.00278\ A \times I \times C$ (m^3/s), Where:

5 yr
998.071
6.053
0.814

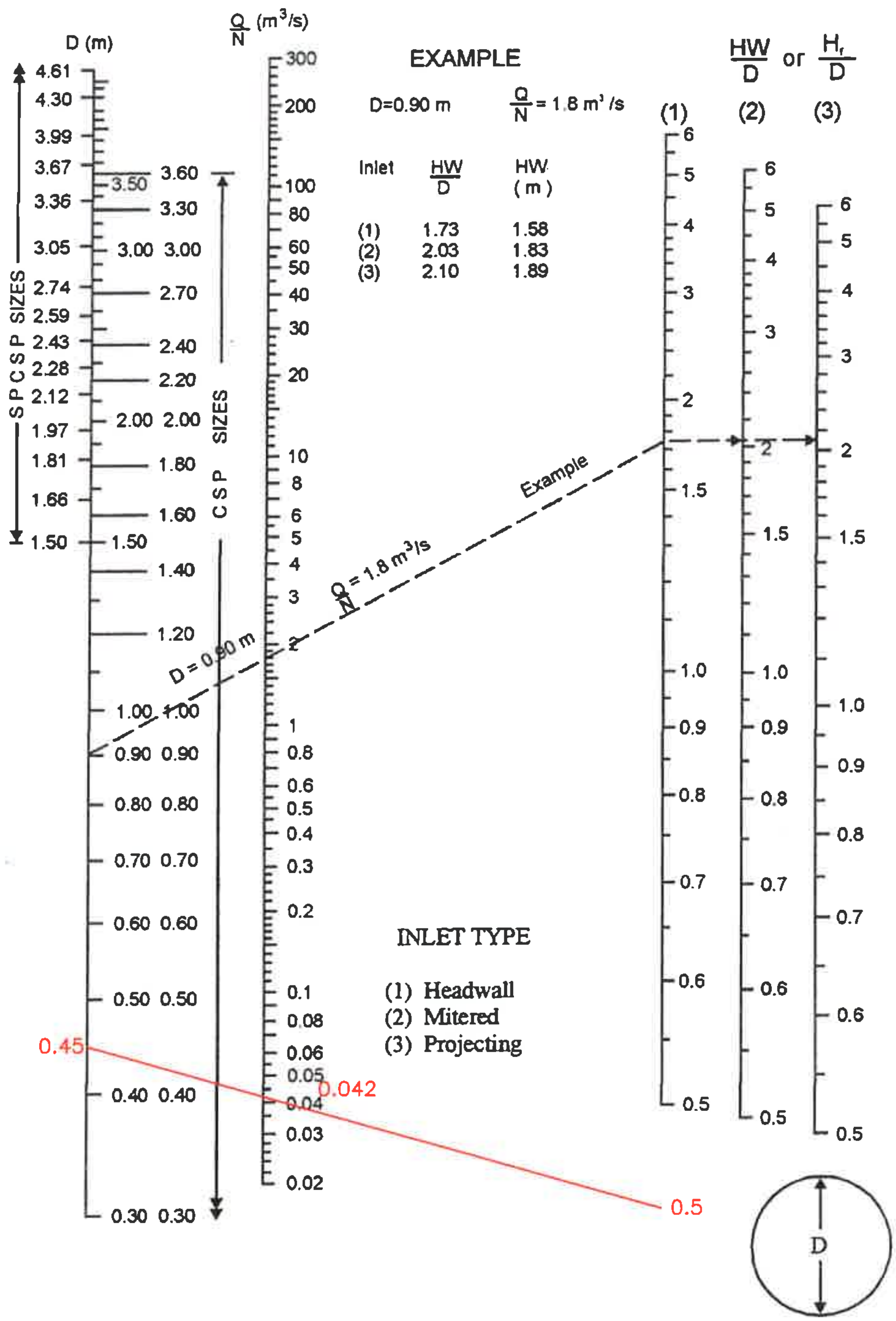
Culvert Sizing Calculation Sheet

Location: Woodroffe Avenue
Watercourse: Roadside Ditch to Jock River
Road Classification: Various
Design Flow: 5 Year
Existing Structure: Various CSP culverts

STRUCTURE	DESIGN DATA								CULVERT DATA														INLET CONTROL		OUTLET CONTROL										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
	Return Year	Q_{peak}	Type	Length	Slope	Top of Road	U/S invert	D/S invert	B	D	t	B/D	TW	N	Q/N	Q/NB	A	V	P	R	n	ke	HW/D	HW	H	dc	(dc+D)/2	H_0	LS	HW	Gov'g HW	Water Surface	Obvert	Cover	Free board
Existing Culvert #1 450mm CSP	5	0.042	CSP	9.4	0.032	99.95	99.06	98.76	--	0.45	0.02	--		1	0.042	--	0.159	0.27	--	--	0.024	0.9	1.45	0.65	0.42	0.31	0.38	0.38	0.30	0.50	0.65	99.71	99.51	0.44	0.24
Existing Culvert #2 450mm CSP	5	0.064	CSP	12.3	0.046	98.99	98.28	97.72	--	0.45	0.02	--		1	0.064	--	0.159	0.40	--	--	0.024	0.9	1.45	0.65	0.55	0.31	0.38	0.38	0.56	0.37	0.65	98.93	98.73	0.26	0.06
Existing Culvert #3 500mm CSP	5	0.102	CSP	9.2	0.032	95.72	94.72	94.43	--	0.5	0.02	--		1	0.102	--	0.196	0.52	--	--	0.024	0.9	1.08	0.54	0.27	0.31	0.41	0.41	0.29	0.39	0.54	95.26	95.22	0.50	0.46
Existing Culvert #5 500mm CSP	5	0.256	CSP	12.5	0.002	93.85	92.70	92.67	--	0.5	0.02	--		1	0.256	--	0.196	1.30	--	--	0.024	0.9	1.11	0.56	0.29	0.31	0.41	0.41	0.03	0.66	0.66	93.37	93.20	0.65	0.48
Existing Culvert #6 500mm CSP	5	0.270	CSP	13	0.002	93.80	92.64	92.61	--	0.5	0.02	--		1	0.270	--	0.196	1.37	--	--	0.024	0.9	1.11	0.56	0.32	0.31	0.41	0.41	0.03	0.69	0.69	93.34	93.14	0.66	0.47
Existing Culvert #7 500mm CSP	5	0.279	CSP	14.5	0.002	94.00	92.57	92.54	--	0.5	0.02	--		1	0.279	--	0.196	1.42	--	--	0.024	0.9	1.2	0.60	0.38	0.31	0.41	0.41	0.03	0.76	0.76	93.33	93.07	0.93	0.67
Existing Culvert #8 500mm CSP	5	0.298	CSP	10	0.002	93.25	92.00	91.98	--	0.5	0.02	--		1	0.298	--	0.196	1.52	--	--	0.024	0.9	1.2	0.60	0.32	0.31	0.41	0.41	0.02	0.71	0.71	92.71	92.50	0.75	0.55

EXISTING CULVERT #1
450mmø CSP

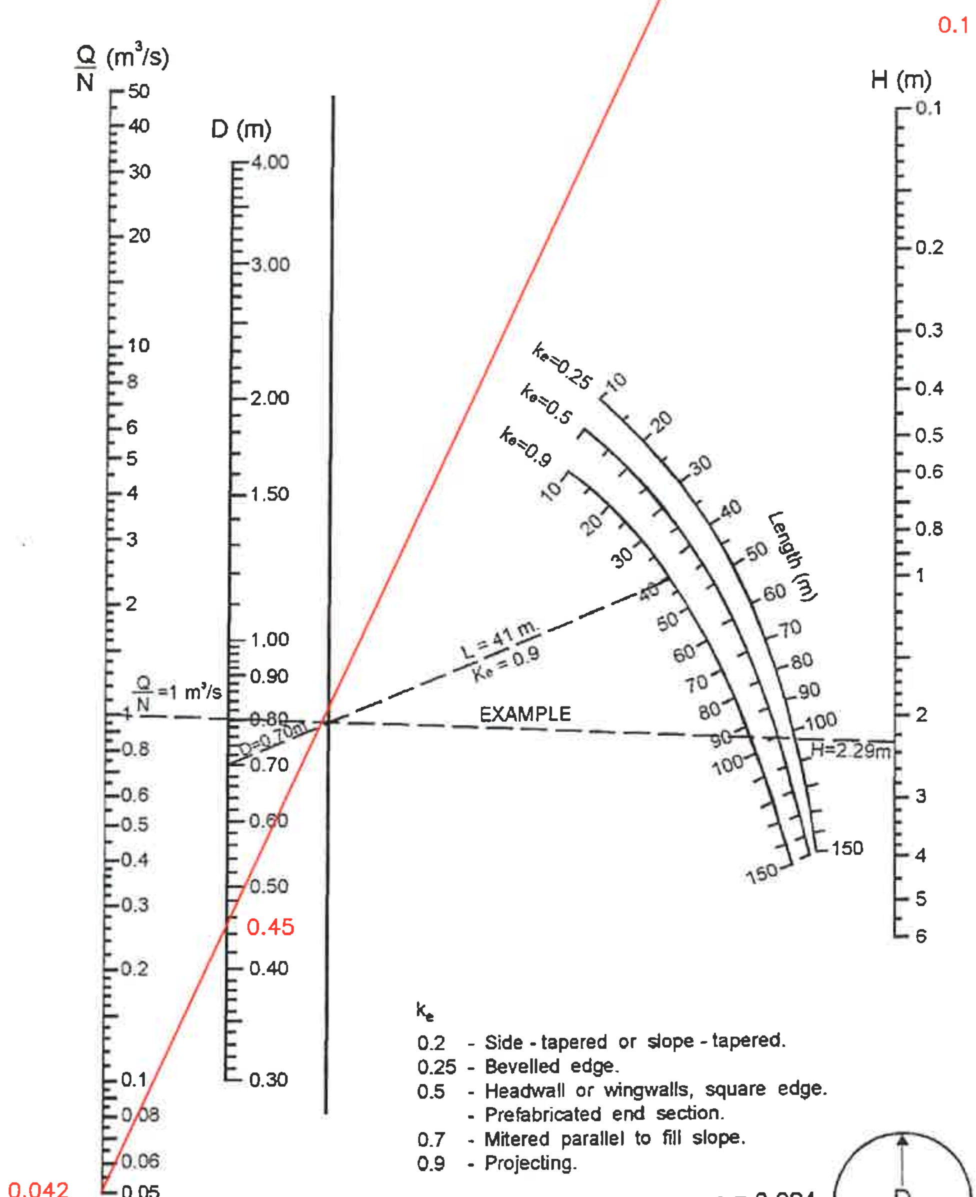
Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

EXISTING CULVERT #1
450mmø CSP

Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



k_e

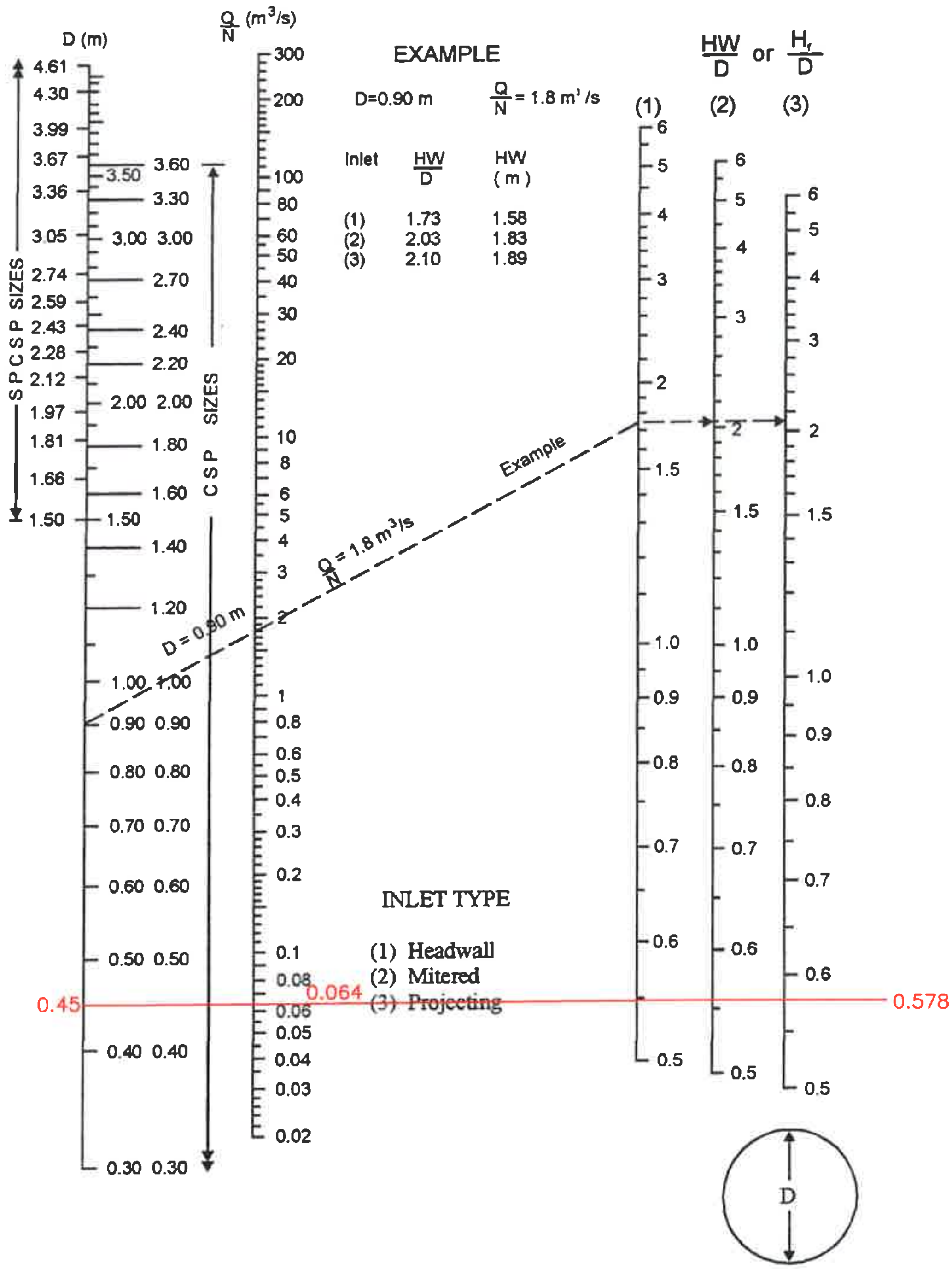
0.2 - Side - tapered or slope - tapered.
0.25 - Bevelled edge.
0.5 - Headwall or wingwalls, square edge.
- Prefabricated end section.
0.7 - Mitered parallel to fill slope.
0.9 - Projecting.

n = 0.024

Source: Herr (1977)

EXISTING CULVERT #2
450mmØ CSP

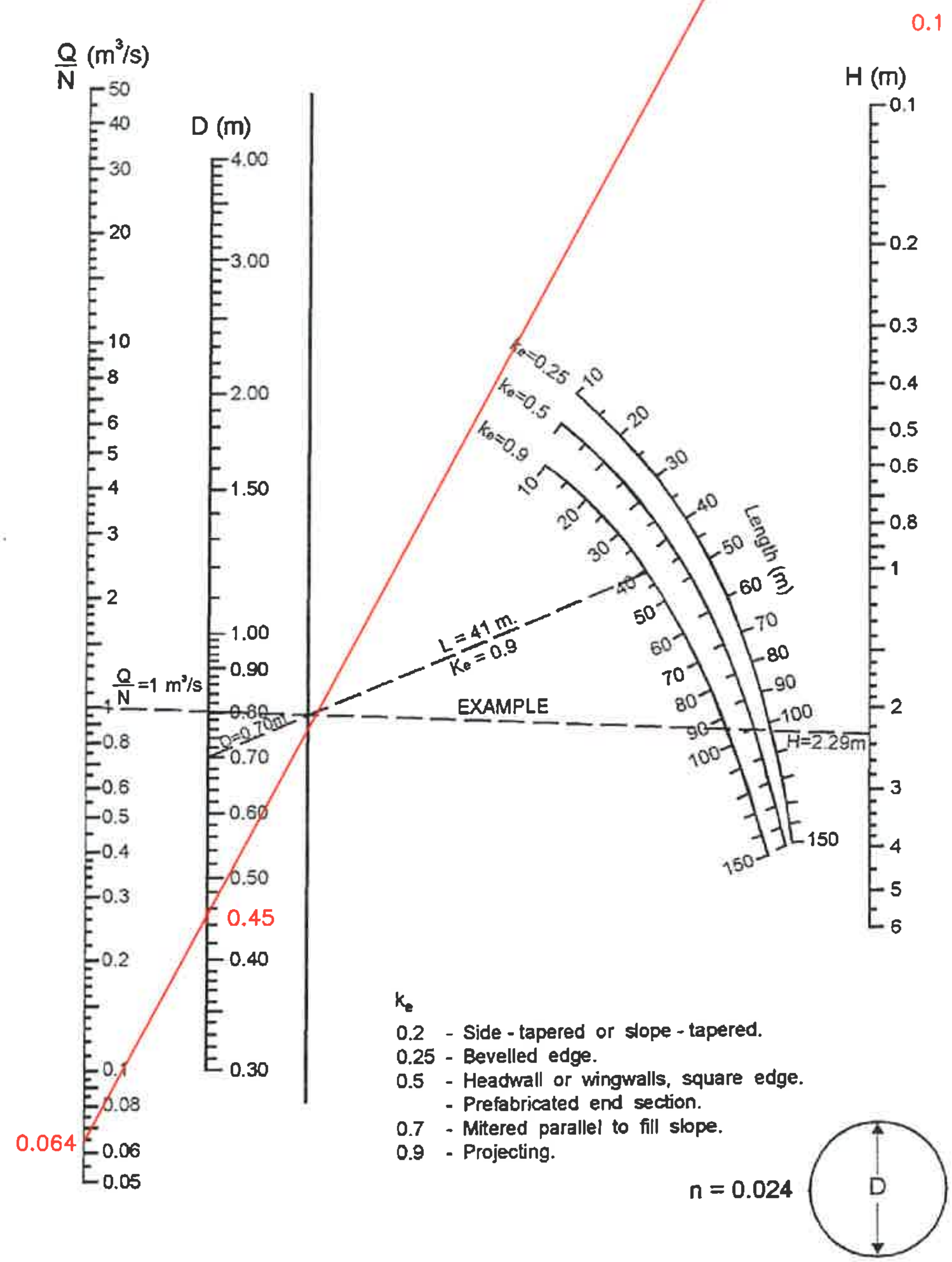
Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

EXISTING CULVERT #2
450mmø CSP

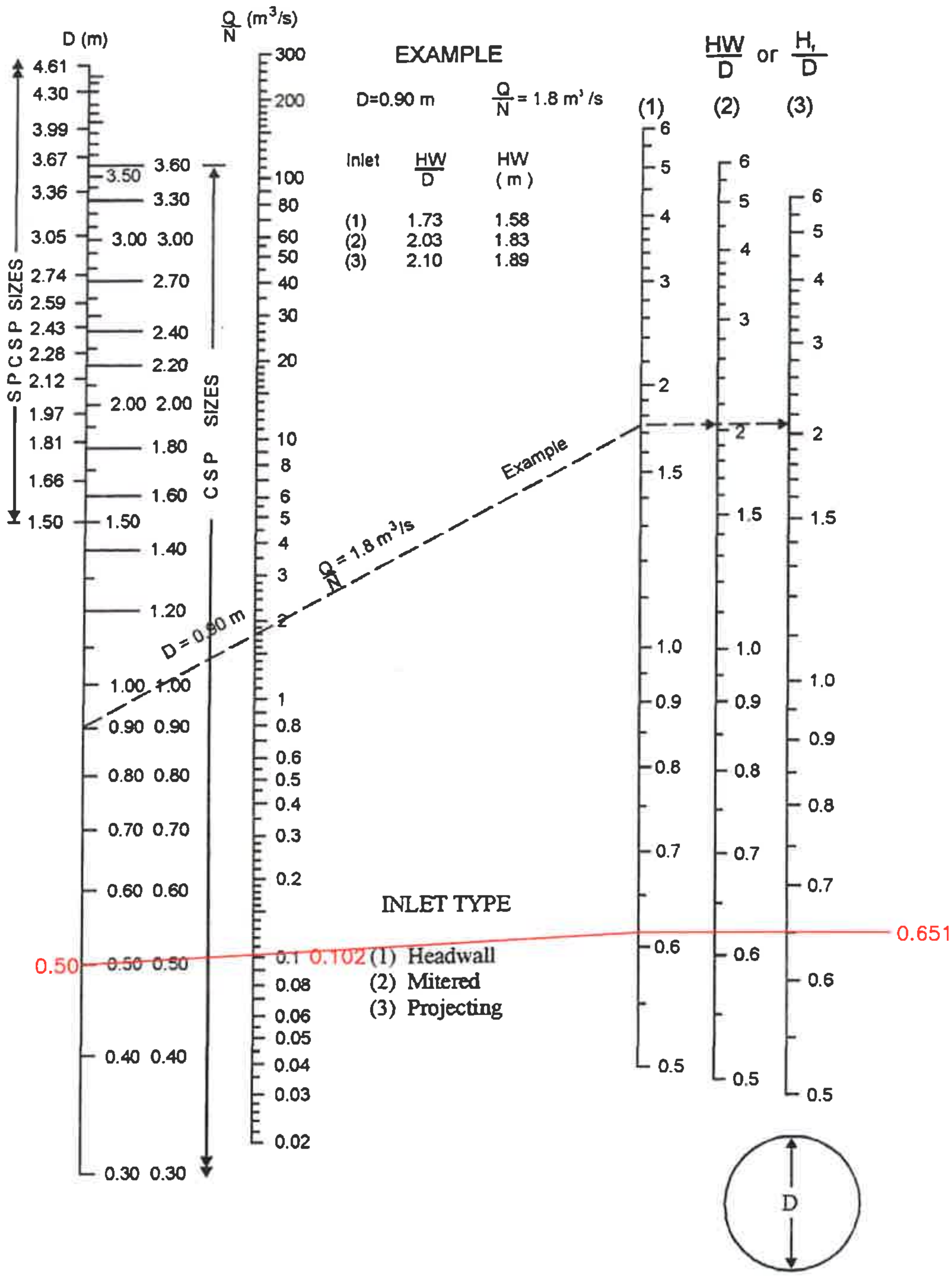
Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



Source: Herr (1977)

EXISTING CULVERT #3
500mmØ CSP

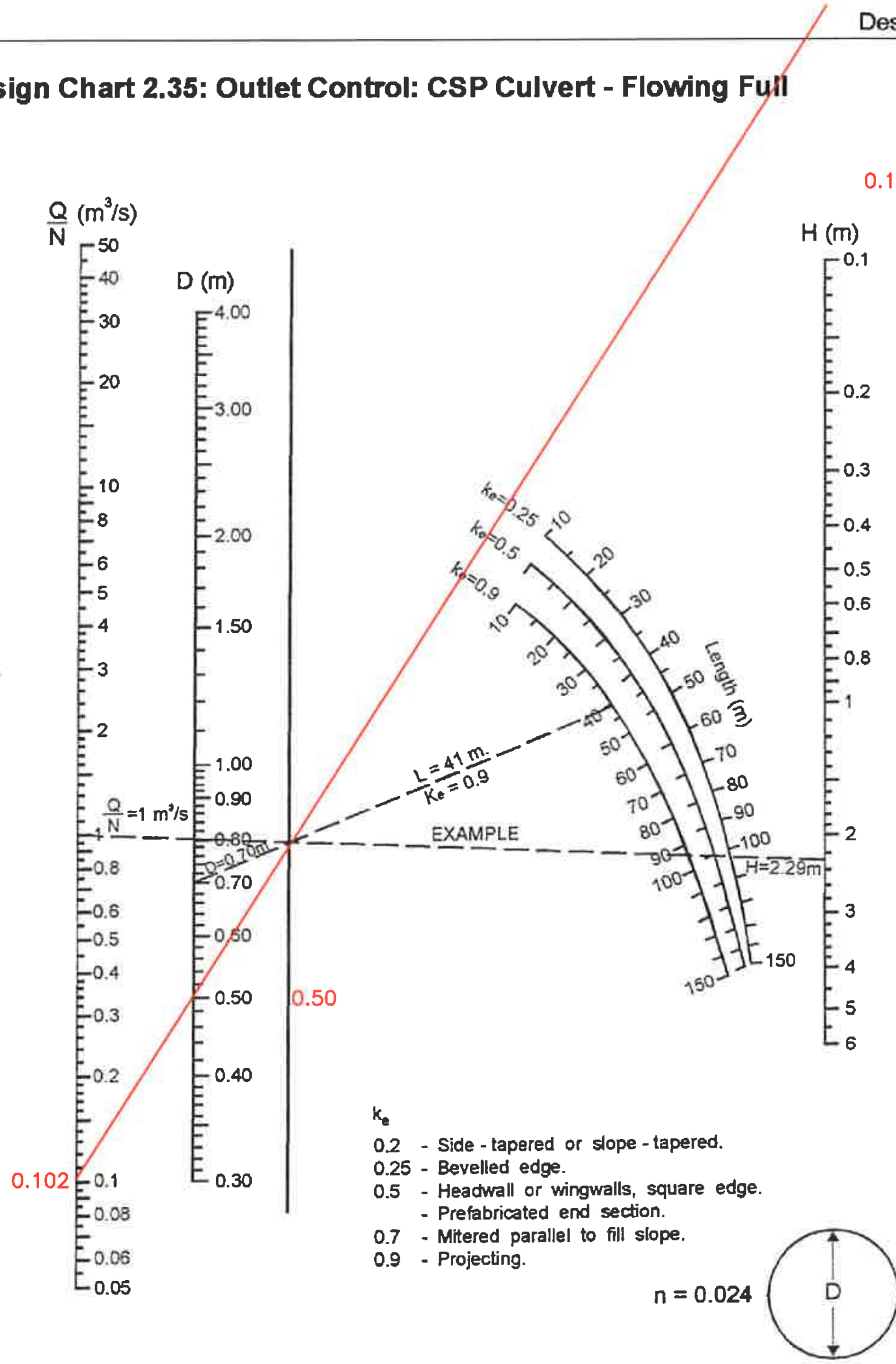
Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

EXISTING CULVERT #3
500mmø CSP

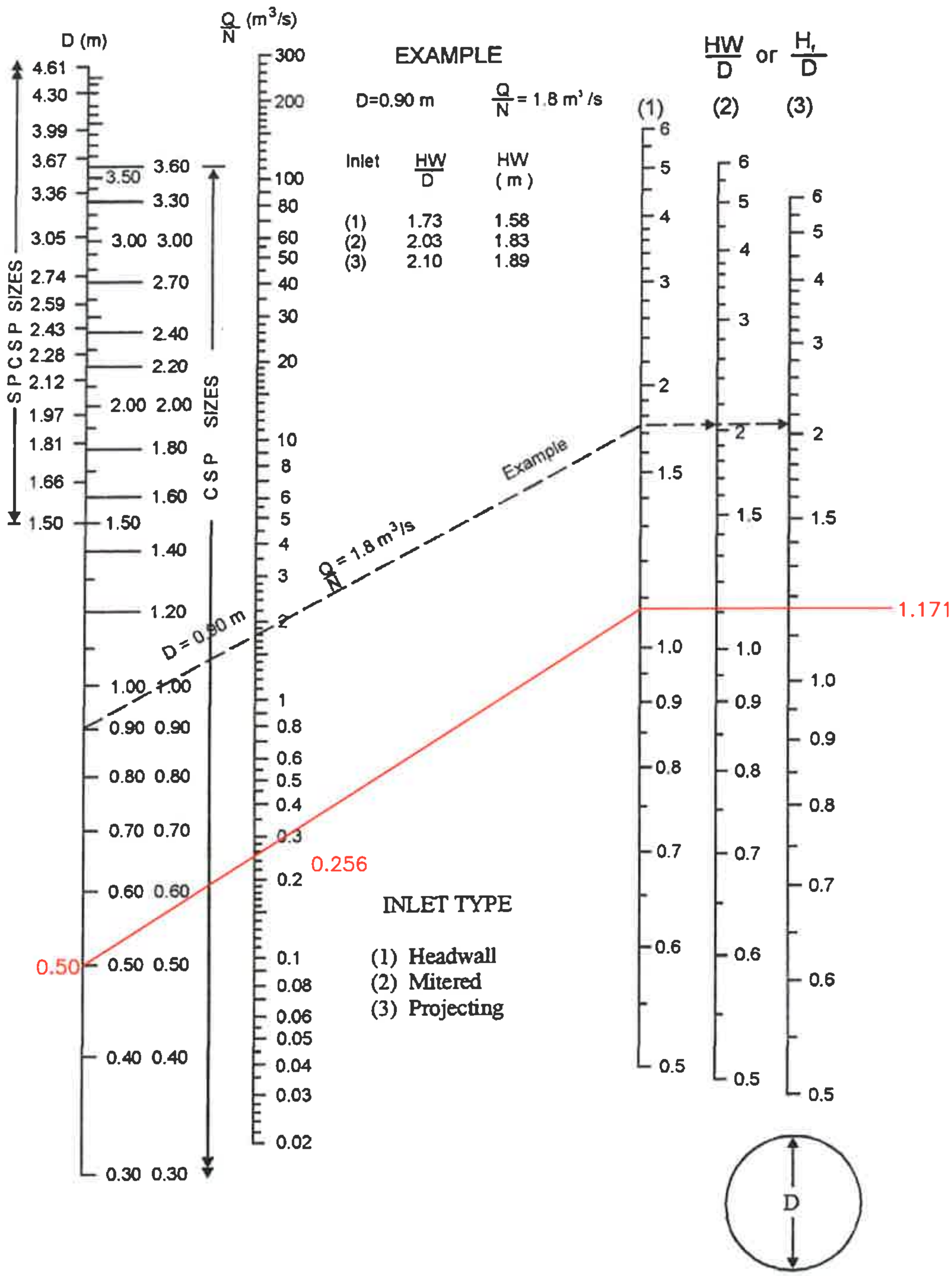
Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



Source: Herr (1977)

EXISTING CULVERT #5
500mmø CSP

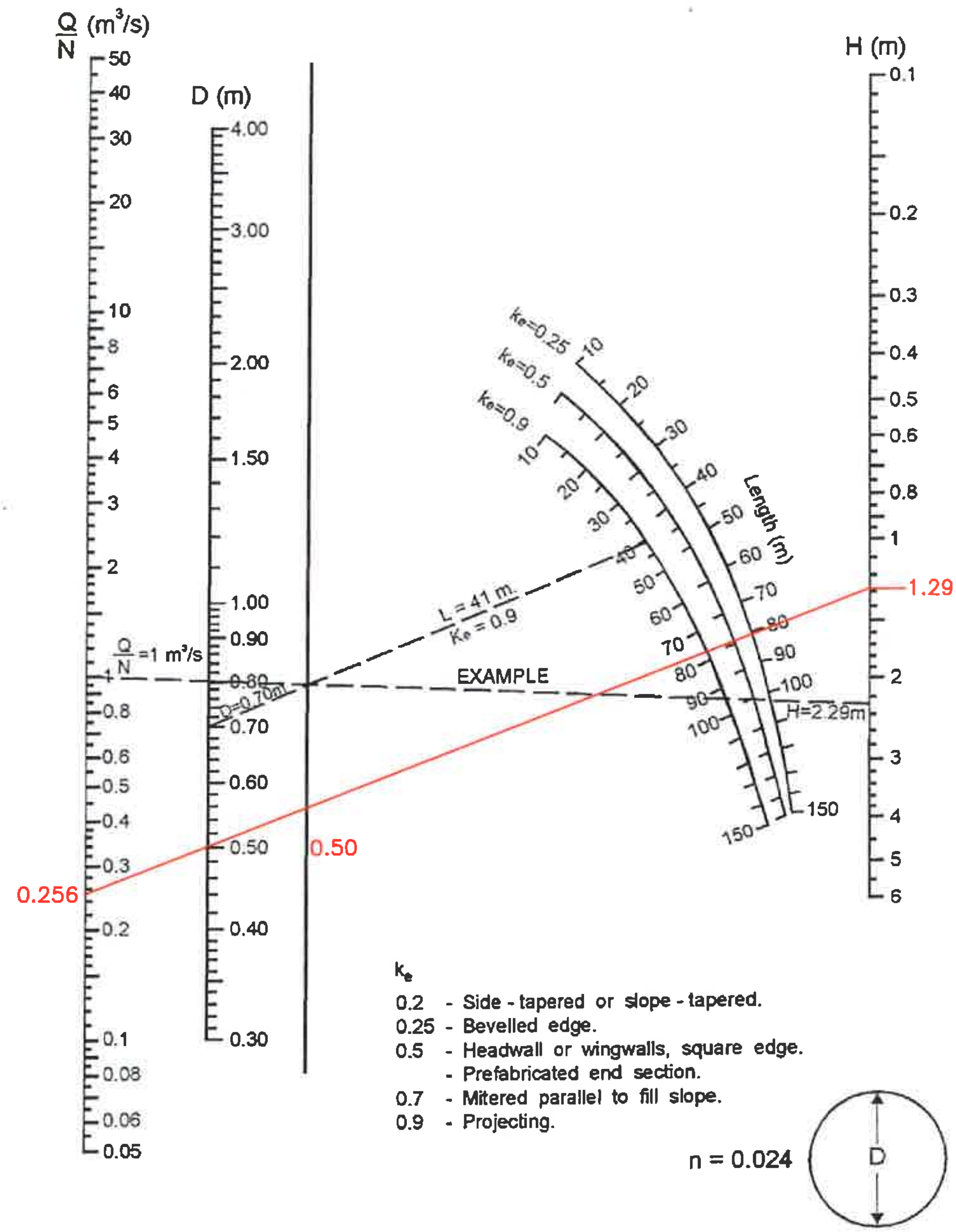
Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

EXISTING CULVERT #5
500mmø CSP

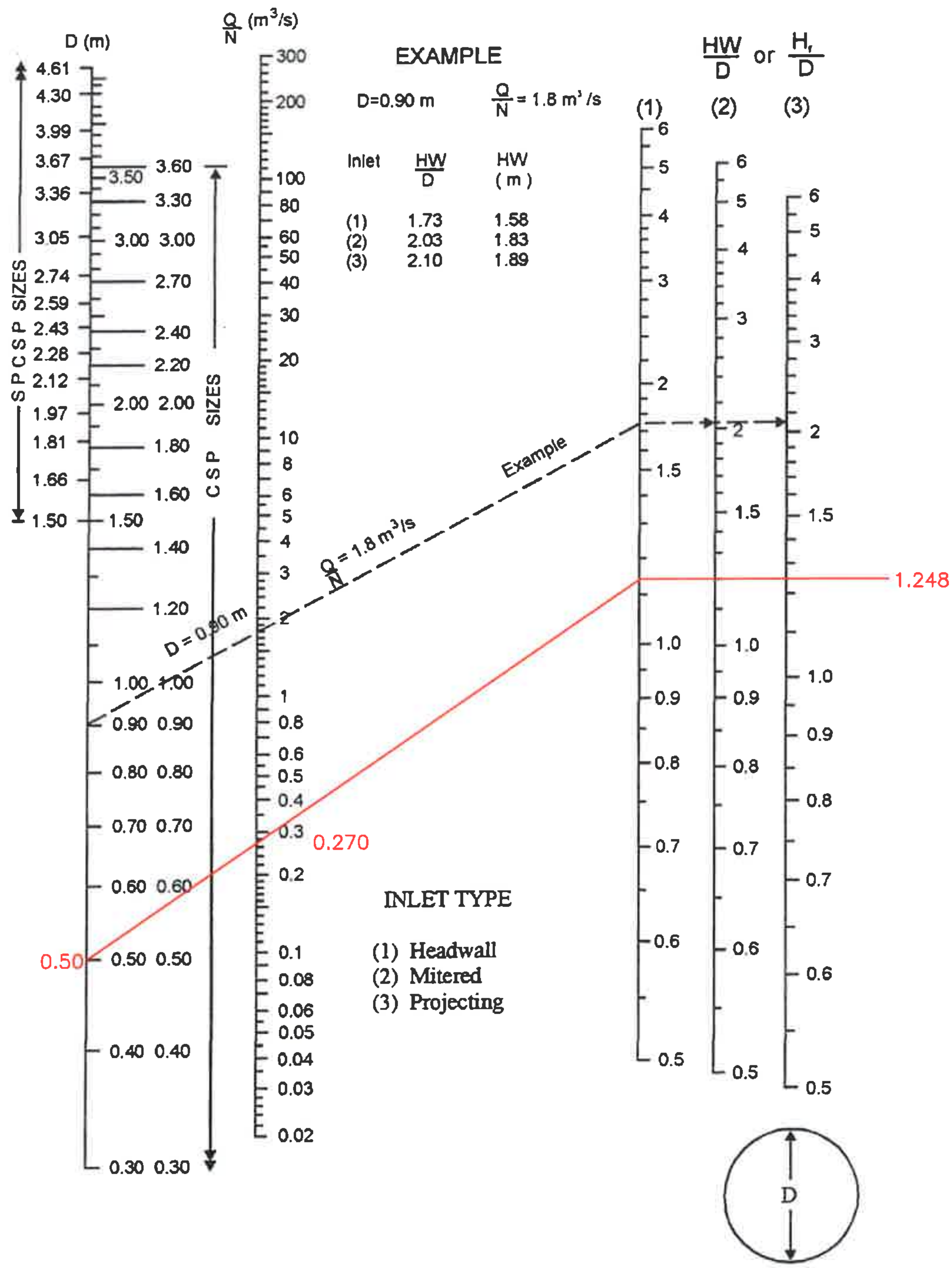
Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



Source: Herr (1977)

EXISTING CULVERT #6
500mmø CSP

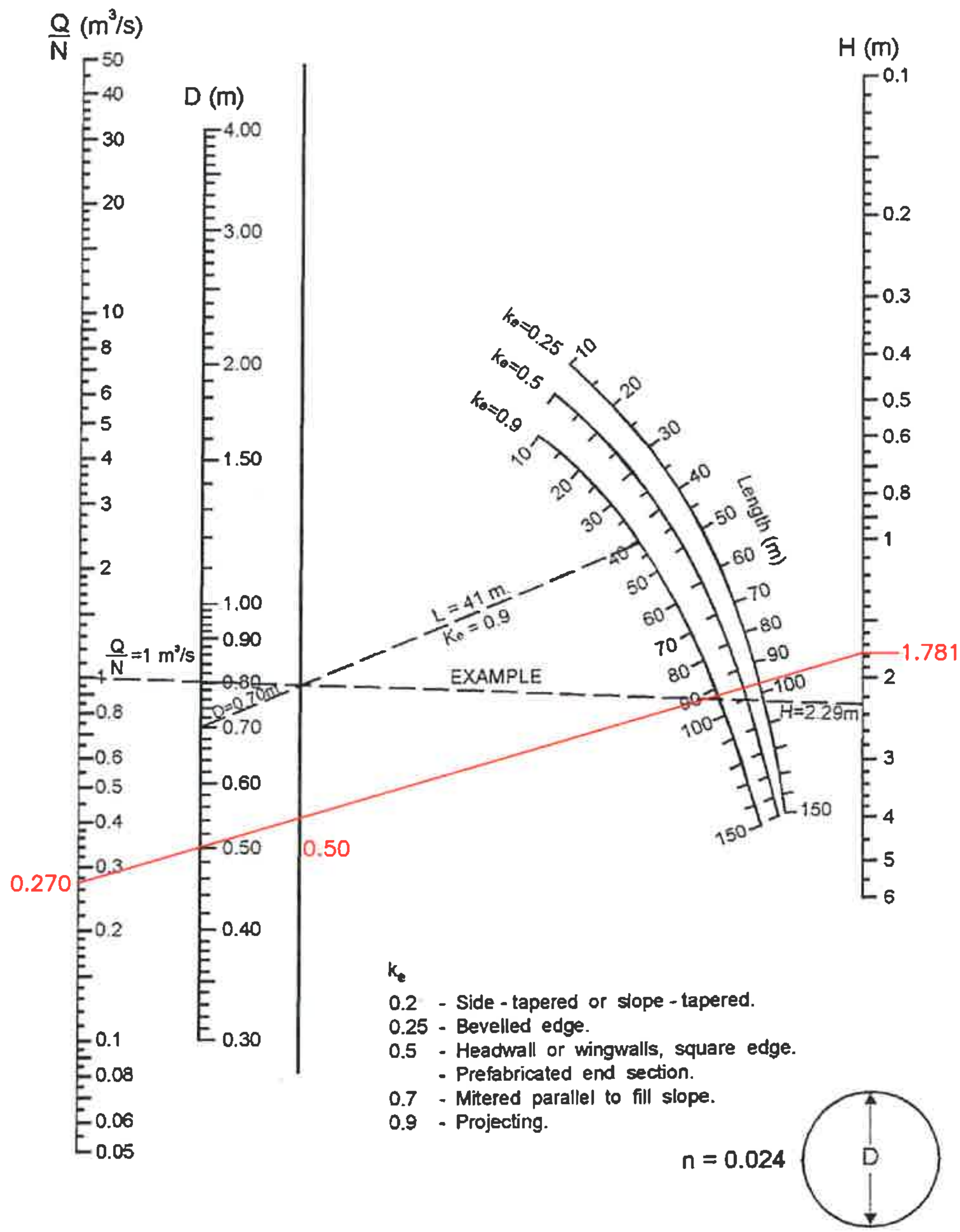
Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

EXISTING CULVERT #6
500mmø CSP

Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



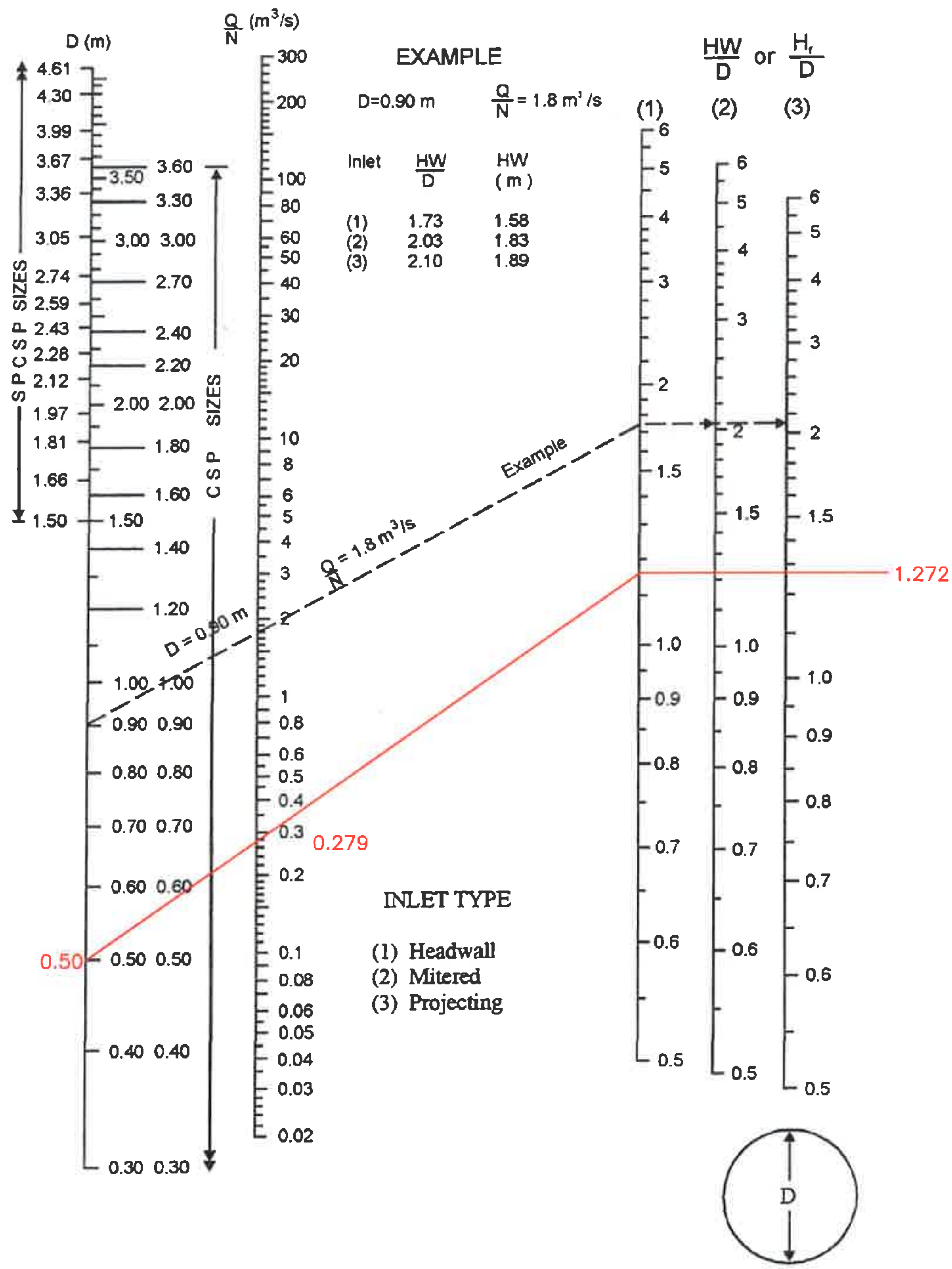
k_e

0.2 - Side - tapered or slope - tapered.
0.25 - Bevelled edge.
0.5 - Headwall or wingwalls, square edge.
- Prefabricated end section.
0.7 - Mitered parallel to fill slope.
0.9 - Projecting.

Source: Herr (1977)

EXISTING CULVERT #7
500mmø CSP

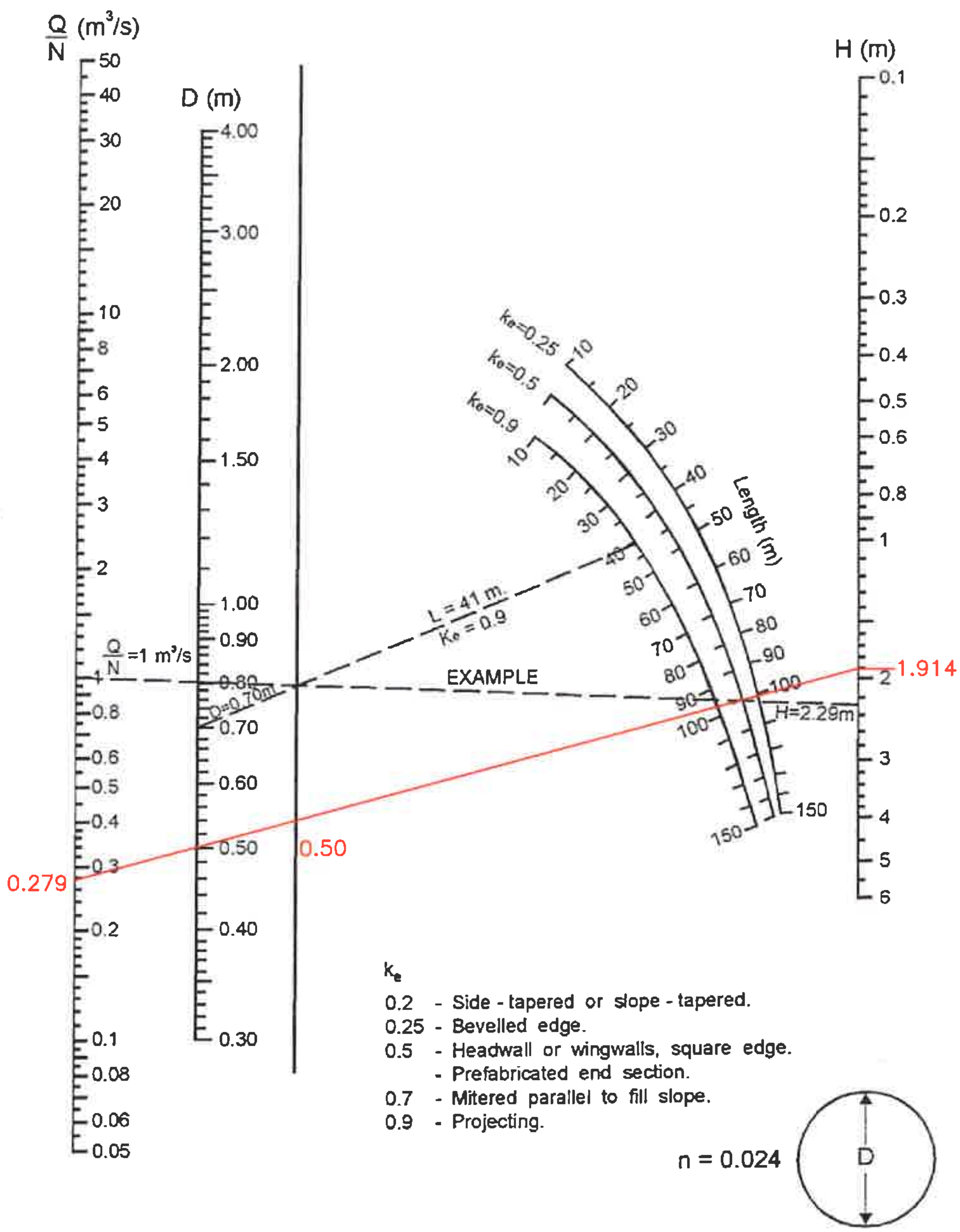
Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

EXISTING CULVERT #7
500mmØ CSP

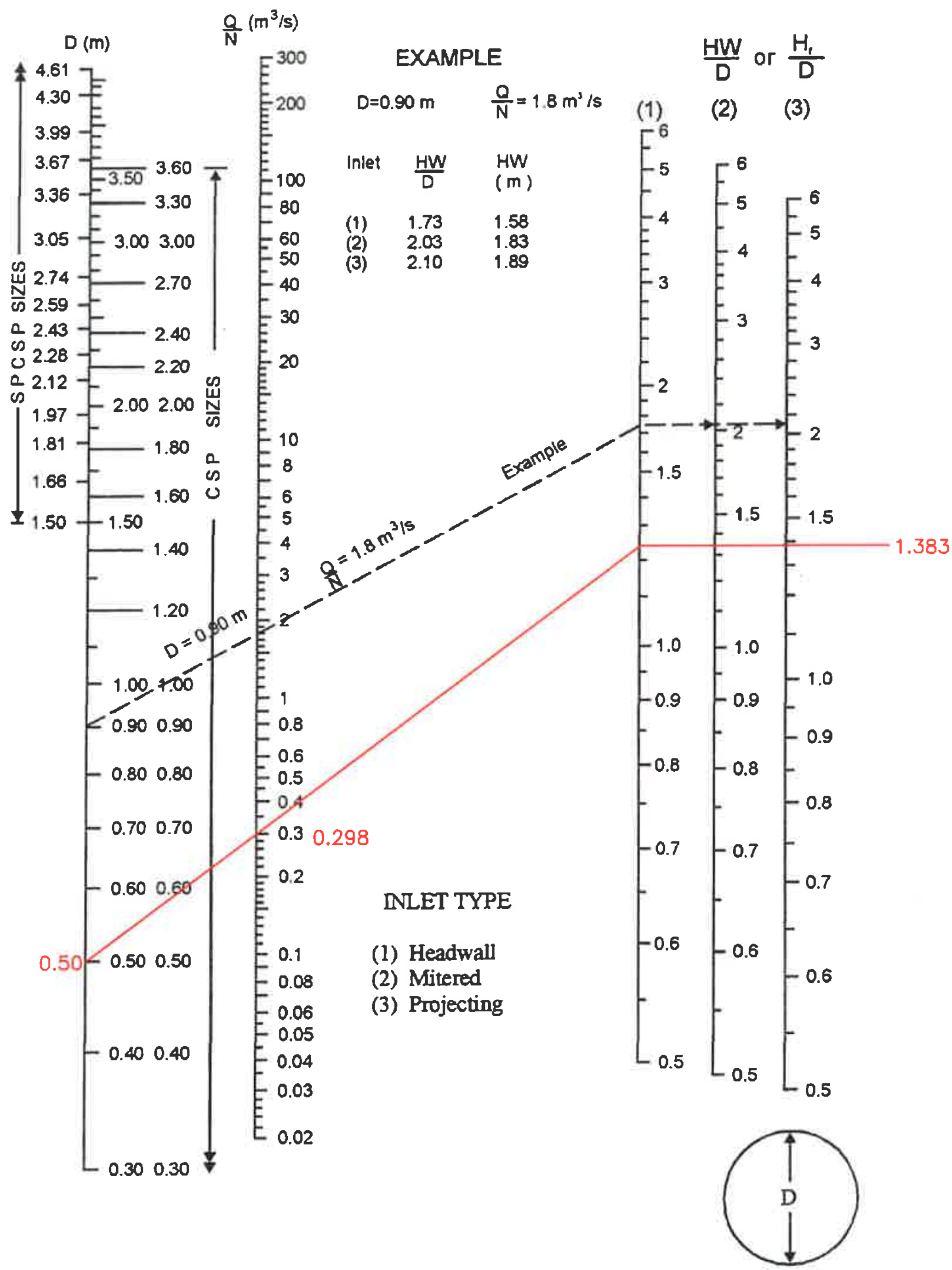
Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



Source: Herr (1977)

EXISTING CULVERT #8
500mmø CSP

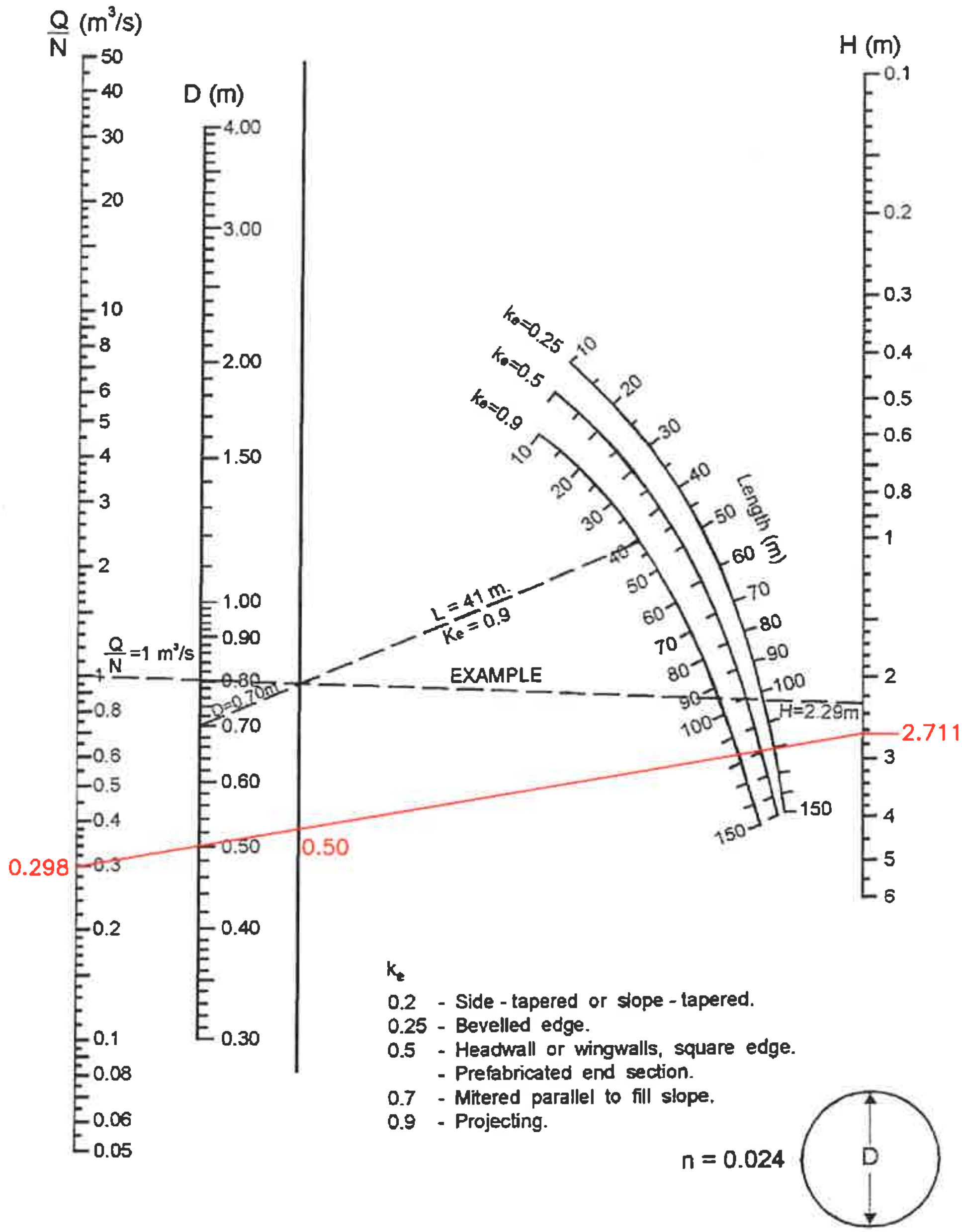
Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

EXISTING CULVERT #8
500mmØ CSP

Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



Source: Herr (1977)

Drainage Area Characteristics
25, 50 Year Storm Event

Drainage Area ID			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
Area (ha)		A	1.94	0.18	0.53	1.89	0.64	0.21	0.22	0.56	0.18	0.36	8.13	1.23
Runoff Coefficient	25 year	C_{25yr}	0.51	0.43	0.37	0.35	0.36	0.36	0.31	0.31	0.31	0.37	0.28	0.61
	50 year	C_{50yr}	0.53	0.45	0.39	0.37	0.38	0.38	0.32	0.32	0.32	0.39	0.29	0.63
Sub-Watershed Length (m)		L	112	26	79	139	43	21	38	86	29	106	375	250
Sub-Watershed Slope (%)		S_w	1.35	2.80	1.90	3.75	0.20	0.20	0.20	0.20	0.20	2.00	2.00	1.00
		Total A	16.07											

Return Frequency	A	B	C
2 yr	732.951	0.810	6.199
5 yr	998.071	0.814	6.053
10 yr	1174.184	0.816	6.014
25 yr	1402.884	0.819	6.018
50 yr	1569.580	0.820	6.014
100 yr	1735.688	0.820	6.014

$Q = 2.78 CIA$
$I = (A / T_c + C)^B$

Where Q = peak flow (L/s)
A = area (ha)
I = rainfall intensity (mm/hr)
C = runoff coefficient
T_c = time of concentration (min)

Table 1
SWM DESIGN SHEET
PROPOSED CONDITIONS (25 yr)

IDF - Macdonald-Cartier Airport, 1967-1997

RCI_STM v1.02 (130204)

Project Information			
Project Name	Borrello Subdivison SWM		
File No.	14057	**Contract No.**	
	Name	**Company**	**Date**
Design	CN	RCI	20/10/2016
Check	BSA	RCI	21/10/2016

Robinson Consultants

LOCATION					CATCHMENT AREA			FLOW DATA				SEWER DATA									
					10-Yr Design Storm				Rainfall Intensity	Peak Flow		PHYSICAL PROPERTIES						FLOW & VELOCITY DATA			
DRAINAGE AREA	LOCATION	EX. PIPE ID / PROPOSED	Start	End	Area A (ha)	C	Individual 2.78 AC	Time of Concentration T_c (min)	25-Yr I_{25yr} (mm/hr)	25-Yr Q_{25yr} (m³/s)	Total Peak Flow Q_{total} (m³/s)	Material Type	Roughness Coefficient (n)	Slope (%)	Water Depth (m)	Flow Area (m²)	Length (m)	Capacity Q (m³/s)	Full Flow Velocity (m/s)	Time of Flow (min)	Q/Q_{full}
Woodroffe Ave. (Stoneleigh St. to Prince of Wales Dr.)																					
SD	Woodroffe	Ditch	SD Outlet	End A1				125.00 *(1)	25.88	0.16 *(2)	0.16	Grass	0.035	0.0667	0.0443	0.12	105.00		1.42	1.23	
A1	Woodroffe	Ditch	SD Outlet	End A1	0.47	0.51	0.66	126.23	25.68	0.17	0.17	Grass	0.035	0.0320	0.0443	0.12	105.00		1.42	1.23	
A2	Woodroffe	Ditch	End A1	End A2	0.18	0.43	0.21	127.46	25.49	0.18	0.18	Grass	0.035	0.0385	0.0429	0.12	25.60		1.52	0.28	
A3	Woodroffe	Ditch	End A2	End A3	0.53	0.37	0.55	127.74	25.44	0.19	0.19	Grass	0.035	0.0390	0.0393	0.11	79.40		1.82	0.73	
A4	Woodroffe	Ditch	End A3	End A4	1.89	0.35	1.85	128.47	25.33	0.24	0.24	Grass	0.035	0.0168	0.0368	0.18	136.25		1.33	1.71	
A5	Woodroffe	Ditch	End A4	End A5	0.64	0.36	0.65	130.18	25.07	0.25	0.25	Grass	0.035	0.0015	0.3555	0.38	53.75		0.66	1.36	
A6	Woodroffe	Ditch	End A5	End A6	0.21	0.36	0.21	131.54	24.87	0.26	0.26	Grass	0.035	0.0024	0.3335	0.34	26.25		0.76	0.58	
A7	Woodroffe	Ditch	End A6	End A7	0.22	0.31	0.19	132.11	24.78	0.26	0.26	Grass	0.035	0.0022	0.3384	0.35	37.50		0.75	0.84	
A8	Woodroffe	Ditch	End A7	End A8	0.56	0.31	0.48	132.95	24.66	0.27	0.27	Grass	0.035	0.0021	0.3461	0.36	108.10		0.74	2.42	
A9	Woodroffe	Ditch	End A8	End A9	0.18	0.31	0.15	135.38	24.31	0.27	0.27	Grass	0.035	0.0070	0.2876	0.25	35.60		1.07	0.55	
A10	Woodroffe	Ditch	End A9	End A10	0.36	0.37	0.37	135.93	24.23	0.28	0.28	Grass	0.035	0.0105	0.2732	0.23	68.10		1.23	0.93	
Prince of Wales Dr. (Wodroffe Ave. to Lodge Rd.)																					
A11	Prince of Wales	Ditch	End A10	End A11	8.13	0.28	6.22	136.85	24.11	0.43	0.43	Grass	0.035	0.0092	0.3171	0.30	340.00		1.40	4.05	
A12	Prince of Wales	Ditch	End A11	End A12	1.23	0.61	2.07	140.91	23.56	0.47	0.47	Grass	0.035	0.0128	0.3097	0.29	57.50		1.60	0.60	

Note 1: Time of Concentration for Subdivision (SD) calculated from Time of Peak for peak outlet flows from Subdivision. Equation used is TP/0.6 (From SWMHYMO Manual)   Tc = TP/0.6 = 75/0.6 = 125
Note 2: Total Peak Flow for Subdivision (SD) calculated from DDSWMM Output table.

Return Frequency	A	B	C
2 yr	732.951	0.810	6.199
5 yr	998.071	0.814	6.053
10 yr	1174.184	0.816	6.014
25 yr	1402.884	0.819	6.018
50 yr	1569.580	0.820	6.014
100 yr	1735.688	0.820	6.014

$Q = 2.78\,CIA$

$I = (A / T_c + C)^B$

Where Q = peak flow (L/s)
A = area (ha)
I = rainfall intensity (mm/hr)
C = runoff coefficient
T_c = time of concentration (min)

Table 2
SWM DESIGN SHEET
PROPOSED CONDITIONS (50 yr)

IDF - Macdonald-Cartier Airport, 1967-1997

RCI_STM v1.02 (130204)

Robinson Consultants

Project Information			
Project Name	Borrello Subdivison SWM		
File No.	14057	**Contract No.**	
	Name	**Company**	**Date**
Design	CN	RCI	20/10/2016
Check	BSA	RCI	21/10/2016

LOCATION					CATCHMENT AREA			FLOW DATA				SEWER DATA									
					10-Yr Design Storm				Rainfall Intensity	Peak Flow		PHYSICAL PROPERTIES						FLOW & VELOCITY DATA			
DRAINAGE AREA	LOCATION	EX. PIPE ID / PROPOSED	Start	End	Area A (ha)	C	Individual 2.78 AC	Time of Concentration T_c (min)	50-Yr I_{50yr} (mm/hr)	50-Yr Q_{50yr} (m³/s)	Total Peak Flow Q_{total} (m³/s)	Material Type	Roughness Coefficient (n)	Slope (%)	Water Depth (m)	Flow Area (m²)	Length (m)	Capacity Q (m³/s)	Full Flow Velocity (m/s)	Time of Flow (min)	Q/Q_{full}
Woodroffe Ave. (Stoneleigh St. to Prince of Wales Dr.)																					
SD	Woodroffe	Ditch	SD Outlet	End A1				125.00 *(1)	28.81	0.20 *(2)	0.20	Grass	0.035	0.0667	0.0491	0.14	105.00		1.55	1.13	
A1	Woodroffe	Ditch	SD Outlet	End A1	0.47	0.55	0.72	126.13	28.61	0.22	0.22	Grass	0.035	0.0320	0.0475	0.13	105.00		1.65	1.06	
A2	Woodroffe	Ditch	End A1	End A2	0.18	0.47	0.23	127.19	28.42	0.22	0.22	Grass	0.035	0.0385	0.0436	0.12	25.60		1.98	0.22	
A3	Woodroffe	Ditch	End A2	End A3	0.53	0.41	0.60	127.40	28.39	0.24	0.24	Grass	0.035	0.0390	0.0414	0.20	79.40		1.44	0.92	
A4	Woodroffe	Ditch	End A3	End A4	1.89	0.38	2.02	128.32	28.23	0.29	0.29	Grass	0.035	0.0168	0.3775	0.43	136.25		0.71	3.18	
A5	Woodroffe	Ditch	End A4	End A5	0.64	0.40	0.70	131.50	27.69	0.31	0.31	Grass	0.035	0.0015	0.3543	0.38	53.75		0.82	1.09	
A6	Woodroffe	Ditch	End A5	End A6	0.21	0.40	0.23	132.59	27.51	0.31	0.31	Grass	0.035	0.0024	0.3594	0.39	26.25		0.81	0.54	
A7	Woodroffe	Ditch	End A6	End A7	0.22	0.34	0.21	133.14	27.42	0.32	0.32	Grass	0.035	0.0022	0.3676	0.41	37.50		0.80	0.78	
A8	Woodroffe	Ditch	End A7	End A8	0.56	0.34	0.52	133.91	27.30	0.33	0.33	Grass	0.035	0.0021	0.3060	0.28	108.10		1.17	1.55	
A9	Woodroffe	Ditch	End A8	End A9	0.18	0.34	0.17	135.46	27.05	0.33	0.33	Grass	0.035	0.0070	0.2907	0.26	35.60		1.33	0.45	
A10	Woodroffe	Ditch	End A9	End A10	0.36	0.41	0.41	135.90	26.98	0.34	0.34	Grass	0.035	0.0105	0.3371	0.34	68.10		1.52	0.75	
Prince of Wales Dr. (Wodroffe Ave. to Lodge Rd.)																					
A11	Prince of Wales	Ditch	End A10	End A11	8.13	0.30	6.78	136.65	26.87	0.52	0.52	Grass	0.035	0.0092	0.3371	0.34	340.00		1.52	3.74	
A12	Prince of Wales	Ditch	End A11	End A12	1.23	0.66	2.26	140.39	26.30	0.57	0.57	Grass	0.035	0.0128	0.3294	0.33	57.50		1.73	0.55	

Note 1: Time of Concentration for Subdivision (SD) calculated from Time of Peak for peak outlet flows from DDSWMM. Equation used is TP/0.6 (From SWMHYMO Manual) Tc = TP/0.6 = 75/0.6 = 125
Note 2: Total Peak Flow for Subdivision (SD) calculated from DDSWMM Output table.

Return Frequency	A	B	C
2 yr	732.951	0.810	6.199
5 yr	998.071	0.814	6.053
10 yr	1174.184	0.816	6.014
25 yr	1402.884	0.819	6.018
50 yr	1569.580	0.820	6.014
100 yr	1735.688	0.820	6.014

$Q = 2.78\,CIA$
$I = (A / T_c + C)^B$

Where Q = peak flow (L/s)
A = area (ha)
I = rainfall intensity (mm/hr)
C = runoff coefficient
T_c = time of concentration (min)

Table 3
SWM DESIGN SHEET
PROPOSED CONDITIONS (100 yr)

IDF - Macdonald-Cartier Airport, 1967-1997

RCI_STM v1.02 (130204)

Project Information			
Project Name	Borrello Subdivison SWM		
File No.	14057	Contract No.	
	Name	Company	Date
Design	CN	RCI	20/10/2016
Check	BSA	RCI	21/10/2016

Robinson Consultants

LOCATION					CATCHMENT AREA			FLOW DATA				SEWER DATA									
					10-Yr Design Storm				Rainfall Intensity	Peak Flow		PHYSICAL PROPERTIES						FLOW & VELOCITY DATA			
DRAINAGE AREA	LOCATION	EX. PIPE ID / PROPOSED	Start	End	Area A (ha)	C	Individual 2.78 AC	Time of Concentration T_c (min)	100-Yr I_{100yr} (mm/hr)	100-Yr Q_{100yr} (m³/s)	Total Peak Flow Q_{total} (m³/s)	Material Type	Roughness Coefficient (n)	Slope (%)	Water Depth (m)	Flow Area (m²)	Length (m)	Capacity Q (m³/s)	Full Flow Velocity (m/s)	Time of Flow (min)	Q/Q_{full}
Woodroffe Ave. (Stoneleigh St. to Prince of Wales Dr.)																					
SD	Woodroffe	Ditch	SD Outlet	End A1				125.00 *(1)	31.86	0.23 *(2)	0.23	Grass	0.035	0.0667	0.0524	0.15	105.00		1.64	1.07	
A1	Woodroffe	Ditch	SD Outlet	End A1	0.47	0.58	0.75	126.07	31.65	0.25	0.25	Grass	0.035	0.0320	0.0507	0.15	105.00		1.75	1.00	
A2	Woodroffe	Ditch	End A1	End A2	0.18	0.49	0.24	127.07	31.45	0.25	0.25	Grass	0.035	0.0385	0.0466	0.13	25.60		2.10	0.20	
A3	Woodroffe	Ditch	End A2	End A3	0.53	0.43	0.63	127.27	31.42	0.27	0.27	Grass	0.035	0.0390	0.0446	0.22	79.40		1.53	0.87	
A4	Woodroffe	Ditch	End A3	End A4	1.89	0.40	2.10	128.14	31.25	0.34	0.34	Grass	0.035	0.0168	0.3937	0.47	136.25		0.75	3.01	
A5	Woodroffe	Ditch	End A4	End A5	0.64	0.41	0.73	131.15	30.69	0.35	0.35	Grass	0.035	0.0015	0.3696	0.41	53.75		0.87	1.03	
A6	Woodroffe	Ditch	End A5	End A6	0.21	0.41	0.24	132.18	30.50	0.36	0.36	Grass	0.035	0.0024	0.3750	0.43	26.25		0.86	0.51	
A7	Woodroffe	Ditch	End A6	End A7	0.22	0.35	0.21	132.69	30.41	0.36	0.36	Grass	0.035	0.0022	0.3836	0.45	37.50		0.85	0.73	
A8	Woodroffe	Ditch	End A7	End A8	0.56	0.35	0.54	133.43	30.27	0.38	0.38	Grass	0.035	0.0021	0.3193	0.31	108.10		1.23	1.46	
A9	Woodroffe	Ditch	End A8	End A9	0.18	0.35	0.18	134.89	30.02	0.38	0.38	Grass	0.035	0.0070	0.3034	0.28	35.60		1.41	0.42	
A10	Woodroffe	Ditch	End A9	End A10	0.36	0.43	0.43	135.31	29.94	0.39	0.39	Grass	0.035	0.0105	0.3520	0.38	68.10		1.61	0.71	
Prince of Wales Dr. (Wodroffe Ave. to Lodge Rd.)																					
A11	Prince of Wales	Ditch	End A10	End A11	8.13	0.31	7.06	136.02	29.82	0.60	0.60	Grass	0.035	0.0092	0.3520	0.38	340.00		1.61	3.53	
A12	Prince of Wales	Ditch	End A11	End A12	1.23	0.69	2.35	139.55	29.23	0.66	0.66	Grass	0.035	0.0128	0.3440	0.36	57.50		1.84	0.52	

Note 1: Time of Concentration for Subdivision (SD) calculated from Time of Peak for peak outlet flows from DDSWMM. Equation used is TP/0.6 (From SWMHYMO Manual) Tc = TP/0.6 = 75/0.6 = 125
Note 2: Total Peak Flow for Subdivision (SD) calculated from DDSWMM Output table.

Table 4
Culvert Sizing Design Sheet

Location:	Woodroffe Ave. (Stoneleigh St. to Prince of Wales Dr.) & Prince of Wales Drive
Watercourse:	Roadside Ditch to Jock River
Road Classification:	Urban Local, Arterial
Design Flow:	25, 50 year
Existing Structure:	Various CSP Culverts

Project Information			
Project Name	Borrello Subdivison SWM		
File No.	14057	**Contract No.**	
	Name	**Company**	**Date**
Design	CN	RCI	20/10/2016
Check	BSA	RCI	21/10/2016

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Page 1 of 1

STRUCTURE	**DESIGN DATA**													**INLET CONTROL**		**OUTLET CONTROL**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
	Return Year	**Length (m)**	**Slope (m/m)**	**Top of Road**	**U/S invert**	**D/S invert**	**D (m)**	**t (m)**	**Q (m^3/s)**	**A (m^2)**	**V (m/s)**	**n**	**ke**	**HW/D**	**HW**	**H**	**dc**	**(dc+D)/2**	**H_0**	**LS**	**HW**	**Gov'g HW**	**Water Surface**	**Obvert**	**Cover**	**Free board**
Culvert #4	**25**	**16.70**	**0.0006**	**93.85**	**92.74**	**92.73**	**0.6**	**0.02**	**0.238**	**0.283**	**0.84**	**0.024**	**0.9**	**0.82**	**0.49**	**0.16**	**0.30**	**0.49**	**0.49**	**0.01**	**0.64**	**0.64**	**93.38**	**93.34**	**0.51**	**0.47**
600mm CSP	50	16.70	0.0006	93.85	92.74	92.73	0.6	0.02	0.337	0.283	1.19	0.024	0.9	0.93	0.56	0.24	0.34	0.49	0.49	0.01	0.72	0.72	93.46	93.34	0.51	0.39
Culvert #9	**25**	**20.00**	**0.0120**	**92.73**	**91.80**	**91.56**	**0.6**	**0.02**	**0.270**	**0.283**	**0.95**	**0.024**	**0.9**	**0.87**	**0.52**	**0.21**	**0.32**	**0.54**	**0.54**	**0.24**	**0.51**	**0.52**	**92.32**	**92.40**	**0.33**	**0.40**
600mm CSP	50	20.00	0.0120	92.73	91.80	91.56	0.6	0.02	0.381	0.283	1.35	0.024	0.9	0.99	0.59	0.32	0.38	0.54	0.54	0.24	0.62	0.62	92.42	92.40	0.33	0.30
Culvert #10	**25**	**34.80**	**0.0089**	**92.35**	**91.18**	**90.87**	**0.6**	**0.02**	**0.278**	**0.283**	**0.98**	**0.024**	**0.9**	**0.89**	**0.53**	**0.33**	**0.32**	**0.56**	**0.56**	**0.31**	**0.58**	**0.58**	**91.76**	**91.78**	**0.57**	**0.59**
600mm CSP	50	34.80	0.0089	92.35	91.18	90.87	0.6	0.02	0.393	0.283	1.39	0.024	0.9	1.02	0.61	0.48	0.38	0.56	0.56	0.31	0.73	0.73	91.91	91.78	0.57	0.44
Culvert #11	25	31.90	0.0094	89.34	86.75	86.45	1.2	0.02	0.426	1.131	0.38	0.024	0.9	0.41	0.49	0.00	0.33	0.64	0.64	0.30	0.34	0.49	87.24	87.95	1.39	2.10
1200mm CSP	**50**	**31.90**	**0.0094**	**89.34**	**86.75**	**86.45**	**1.2**	**0.02**	**0.602**	**1.131**	**0.53**	**0.024**	**0.9**	**0.47**	**0.56**	**0.01**	**0.38**	**0.64**	**0.64**	**0.30**	**0.35**	**0.56**	**87.31**	**87.95**	**1.39**	**2.03**
Culvert #12	25	26.50	0.0162	87.50	85.81	85.38	1.2	0.02	0.465	1.131	0.41	0.024	0.9	0.44	0.53	0.00	0.34	0.62	0.62	0.43	0.19	0.53	86.34	87.01	0.49	1.16
1200mm CSP	**50**	**26.50**	**0.0162**	**87.50**	**85.81**	**85.38**	**1.2**	**0.02**	**0.659**	**1.131**	**0.58**	**0.024**	**0.9**	**0.49**	**0.59**	**0.02**	**0.39**	**0.62**	**0.62**	**0.43**	**0.21**	**0.59**	**86.40**	**87.01**	**0.49**	**1.10**

***Bold indicates required design return period**

Return Frequency	A	B	C
2 yr	732.951	0.810	6.199
5 yr	998.071	0.814	6.053
10 yr	1174.184	0.816	6.014
25 yr	1402.884	0.819	6.018
50 yr	1569.580	0.820	6.014
100 yr	1735.688	0.820	6.014

$Q = 2.78 CIA$
$I = (A / T_c + C)^B$

Where Q = peak flow (L/s)
A = area (ha)
I = rainfall intensity (mm/hr)
C = runoff coefficient
T_c = time of concentration (min)

Table 5
SWM DESIGN SHEET
PROPOSED CONDITIONS
(100 yr Pre-Development)

IDF - Macdonald-Cartier Airport, 1967-1997

RCI_STM v1.02 (130204)

Project Information			
Project Name	Borrello Subdivison SWM		
File No.	14057	**Contract No.**	
	Name	**Company**	**Date**
Design	CN	RCI	20/10/2016
Check	BSA	RCI	21/10/2016

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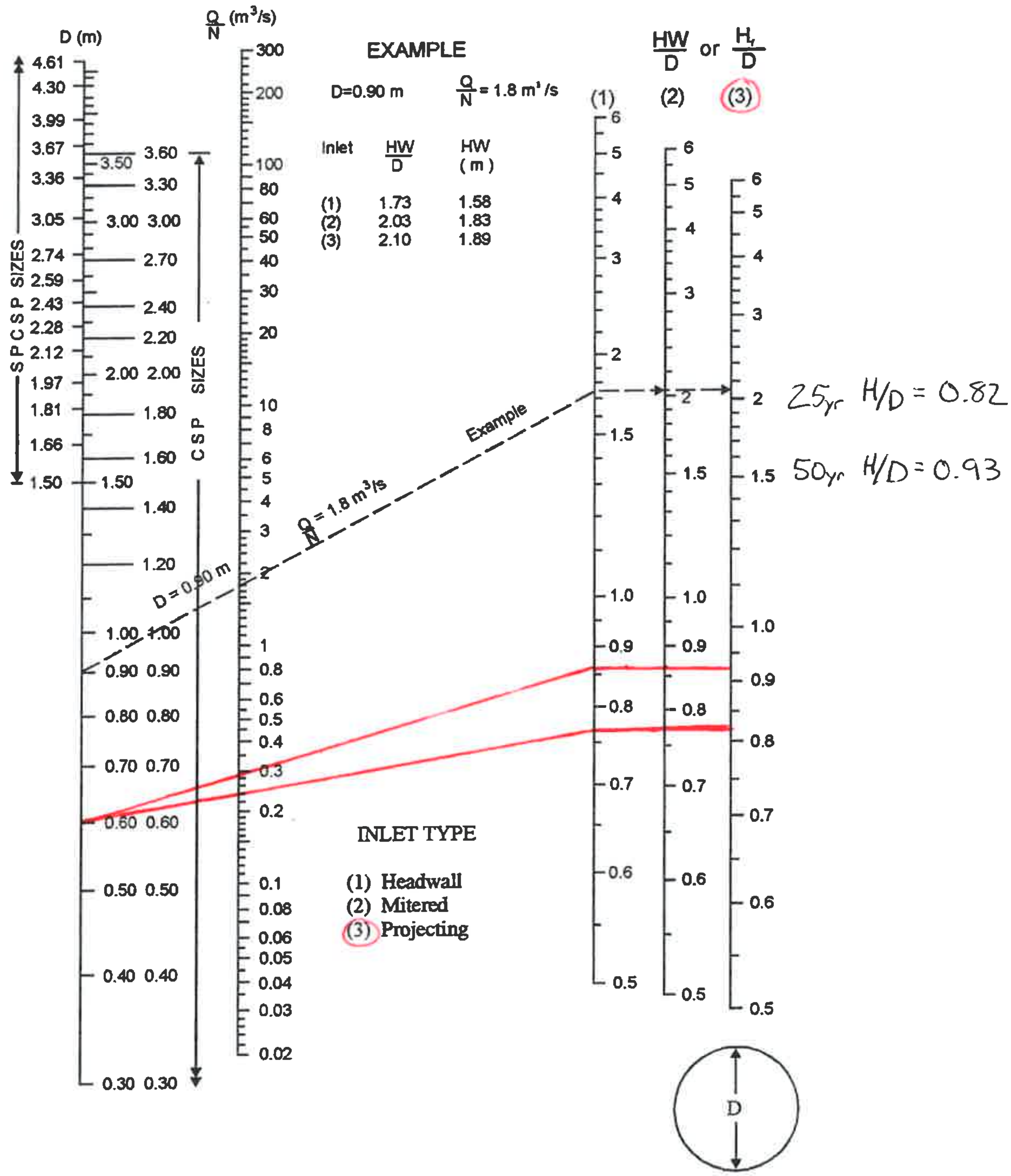
LOCATION					CATCHMENT AREA			FLOW DATA				SEWER DATA									
					10-Yr Design Storm				Rainfall Intensity	Peak Flow		PHYSICAL PROPERTIES						FLOW & VELOCITY DATA			
DRAINAGE AREA	LOCATION	EX. PIPE ID / PROPOSED	Start	End	Area A (ha)	C	Individual 2.78 AC	Time of Concentration T_c (min)	100-Yr I_{100yr} (mm/hr)	100-Yr Q_{100yr} (m³/s)	Total Peak Flow Q_{total} (m³/s)	Material Type	Roughness Coefficient (n)	Slope (%)	Water Depth (m)	Flow Area (m²)	Length (m)	Capacity Q (m³/s)	Full Flow Velocity (m/s)	Time of Flow (min)	Q/Q_{full}
Woodroffe Ave. (Stoneleigh St. to Prince of Wales Dr.)																					
SD	Woodroffe	Ditch	SD Outlet	End A1	2.18	0.55	3.33	125.00 *(1)	31.86	0.11	0.11	Grass	0.035	0.0667	0.0383	0.10	105.00		1.26	1.39	
A1	Woodroffe	Ditch	SD Outlet	End A1	0.47	0.58	0.75	126.39	31.59	0.13	0.13	Grass	0.035	0.0320	0.0375	0.10	105.00		1.36	1.29	
A2	Woodroffe	Ditch	End A1	End A2	0.18	0.49	0.24	127.67	31.34	0.14	0.14	Grass	0.035	0.0385	0.0353	0.09	25.60		1.67	0.26	
A3	Woodroffe	Ditch	End A2	End A3	0.53	0.43	0.63	127.93	31.29	0.16	0.16	Grass	0.035	0.0390	0.0351	0.17	79.40		1.28	1.03	
A4	Woodroffe	Ditch	End A3	End A4	1.89	0.40	2.10	128.96	31.09	0.22	0.22	Grass	0.035	0.0168	0.3487	0.37	136.25		0.64	3.54	
A5	Woodroffe	Ditch	End A4	End A5	0.64	0.41	0.73	132.50	30.44	0.24	0.24	Grass	0.035	0.0015	0.3282	0.33	53.75		0.74	1.21	
A6	Woodroffe	Ditch	End A5	End A6	0.21	0.41	0.24	133.71	30.22	0.24	0.24	Grass	0.035	0.0024	0.3338	0.34	26.25		0.73	0.60	
A7	Woodroffe	Ditch	End A6	End A7	0.22	0.35	0.21	134.30	30.12	0.25	0.25	Grass	0.035	0.0022	0.3434	0.36	37.50		0.74	0.85	
A8	Woodroffe	Ditch	End A7	End A8	0.56	0.35	0.54	135.15	29.97	0.26	0.26	Grass	0.035	0.0021	0.2863	0.25	108.10		1.07	1.69	
A9	Woodroffe	Ditch	End A8	End A9	0.18	0.35	0.18	136.84	29.68	0.27	0.27	Grass	0.035	0.0070	0.2730	0.23	35.60		1.22	0.48	
A10	Woodroffe	Ditch	End A9	End A10	0.36	0.43	0.43	137.33	29.60	0.28	0.28	Grass	0.035	0.0105	0.3296	0.33	68.10		1.47	0.77	
Prince of Wales Dr. (Wodroffe Ave. to Lodge Rd.)																					
A11	Prince of Wales	Ditch	End A10	End A11	8.13	0.31	7.06	138.10	29.47	0.48	0.48	Grass	0.035	0.0092	0.3296	0.33	340.00		1.47	3.85	
A12	Prince of Wales	Ditch	End A11	End A12	1.23	0.69	2.35	141.95	28.84	0.54	0.54	Grass	0.035	0.0128	0.3243	0.32	57.50		1.70	0.56	

Note 1: Time of Concentration for Subdivision (SD) calculated from Time of Peak for peak outlet flows from DDSWMM. Equation used is TP/0.6 (From SWMHYMO Manual) Tc = TP/0.6 = 75/0.6 = 125

Culvert #4 600mm CSP

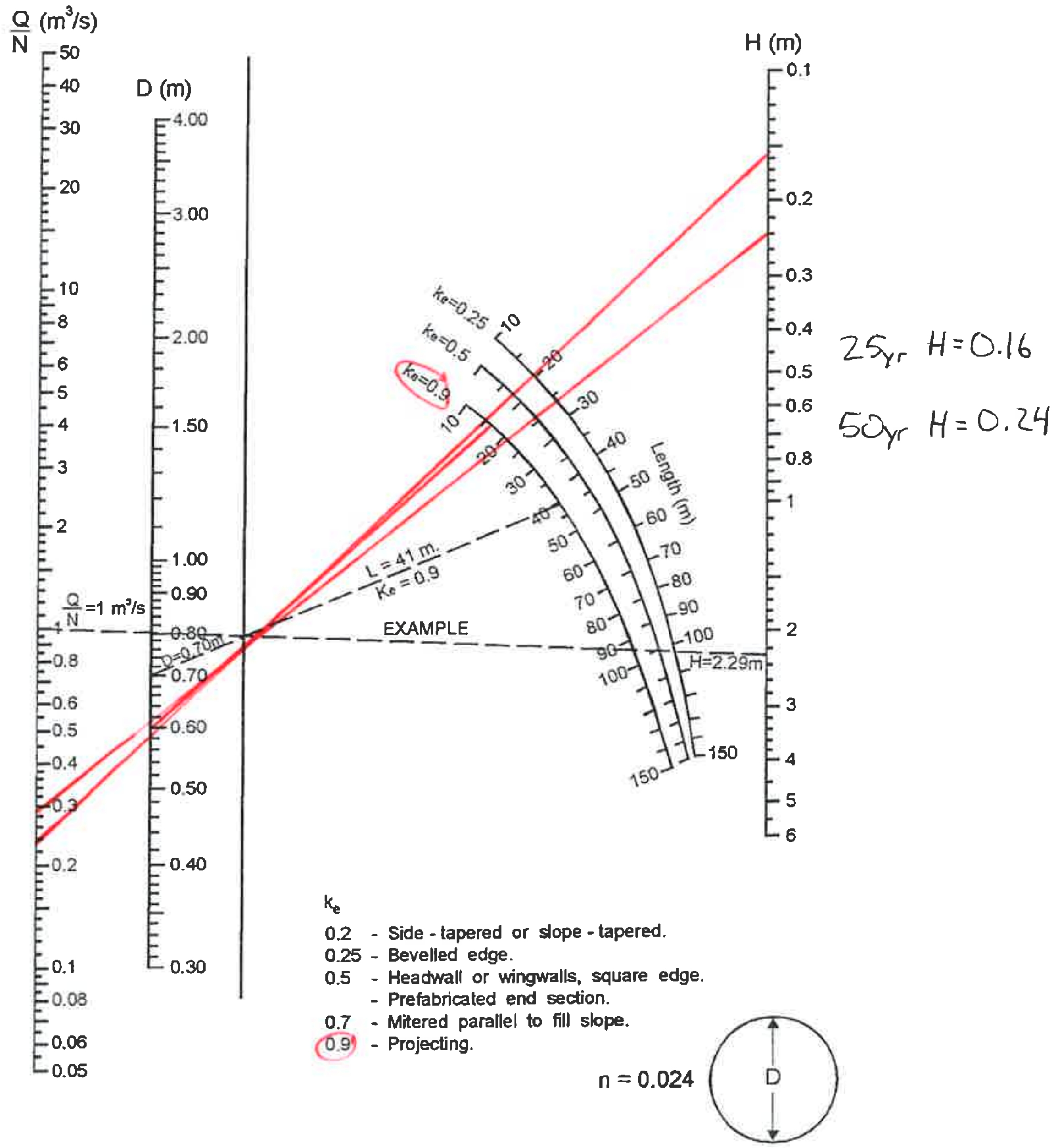
Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

Culvert #4 600mm CSP

Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



k_e

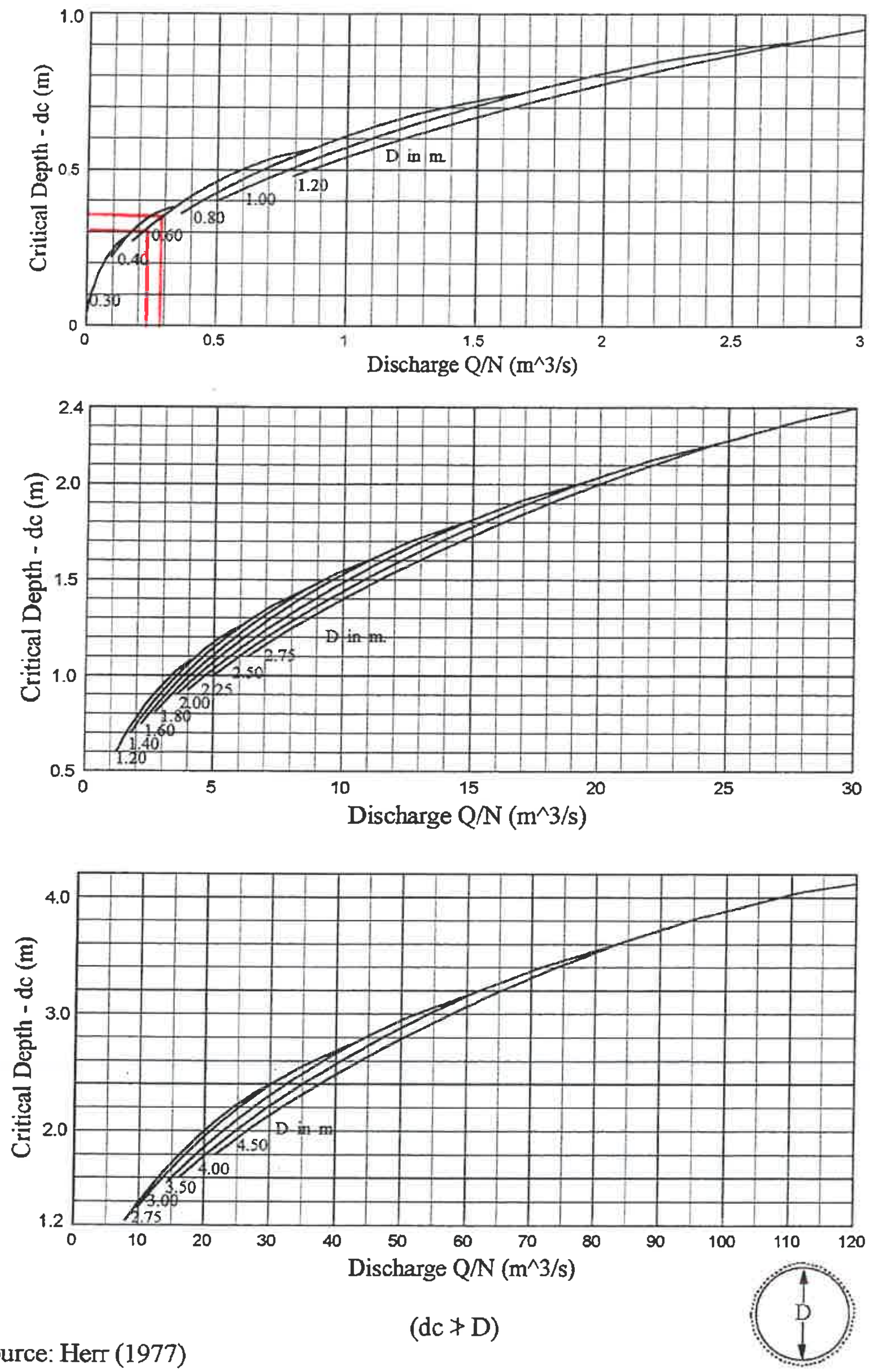
0.2 - Side - tapered or slope - tapered.
0.25 - Bevelled edge.
0.5 - Headwall or wingwalls, square edge.
- Prefabricated end section.
0.7 - Mitered parallel to fill slope.
0.9 - Projecting.

n = 0.024

Source: Herr (1977)

Culvert #4 600mm CSP

Design Chart 2.37: Critical Depth Chart for Circular Pipes



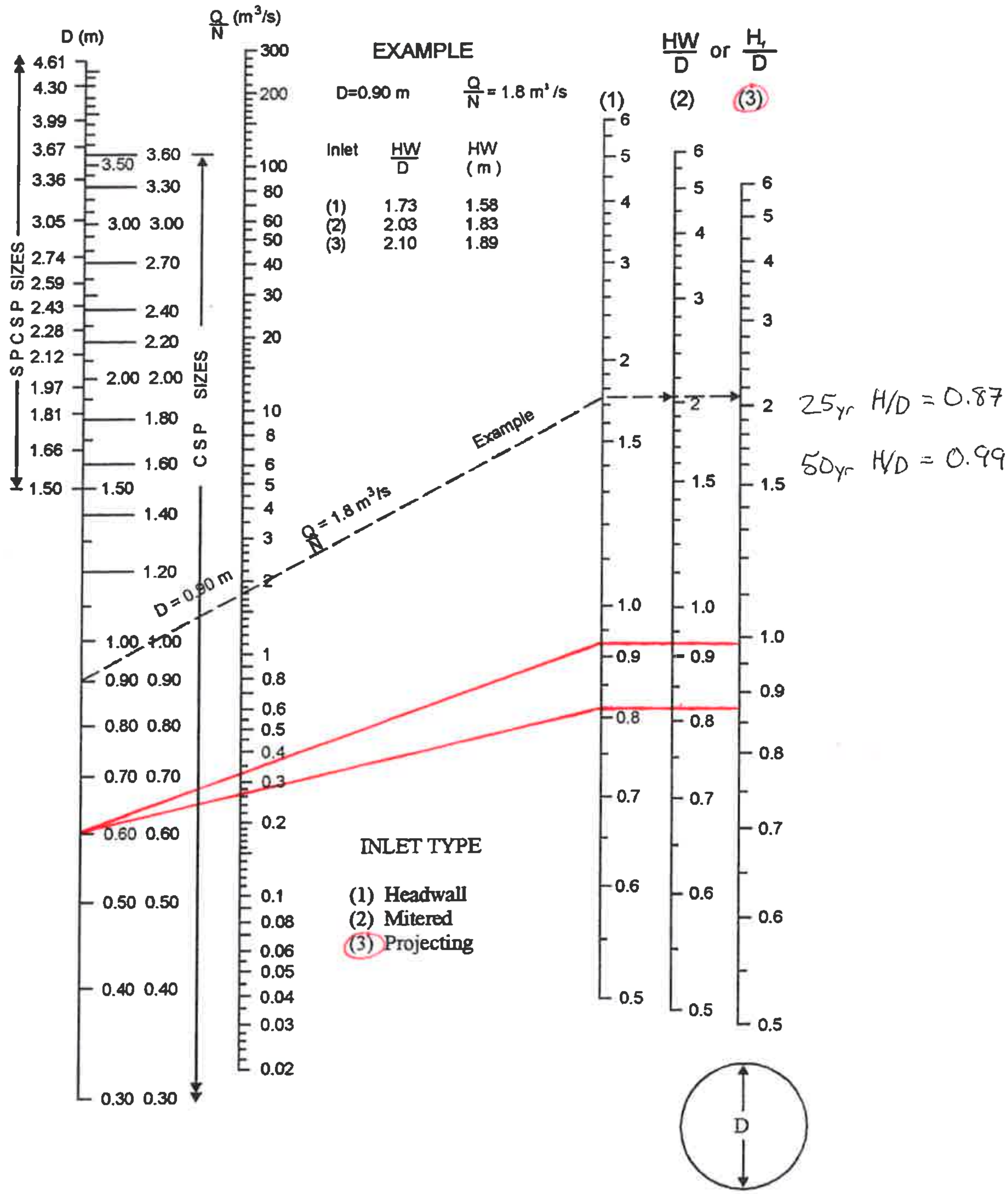
25yr dc = 0.30

50yr dc = 0.35

Source: Herr (1977)

Culvert #9 600mm CSP

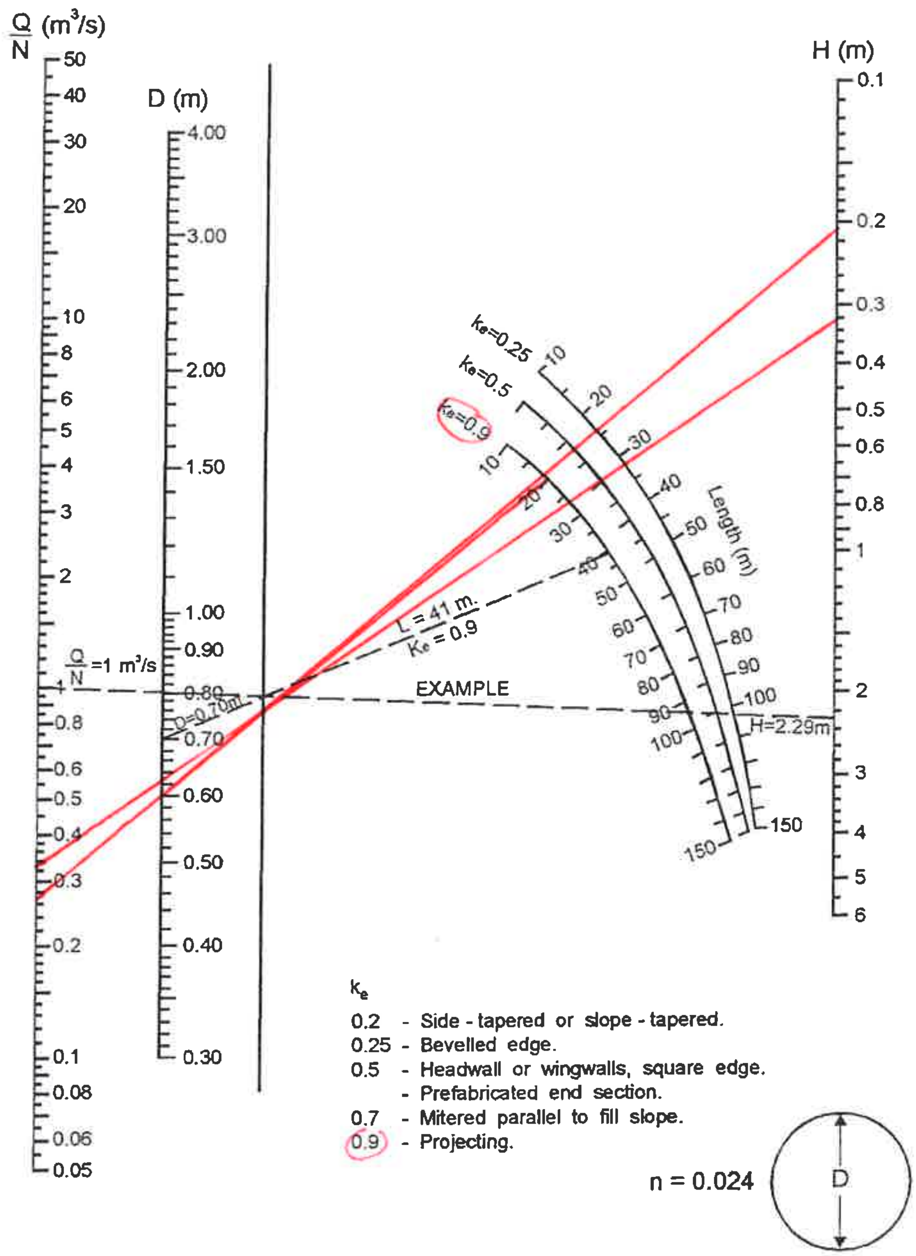
Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

Culvert #9 600mm CSP

Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full

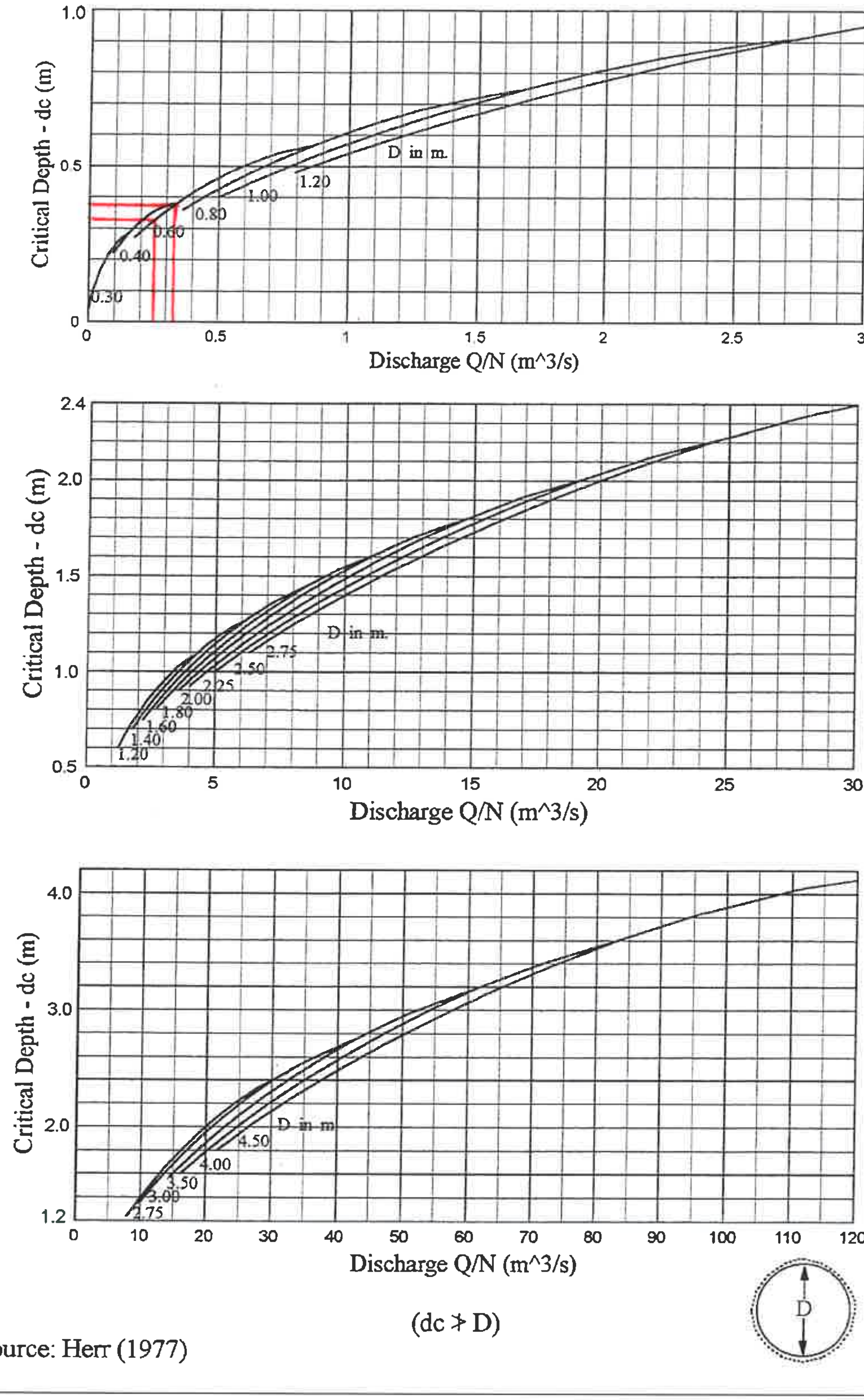


25yr H=0.21

50yr H=0.32

Source: Herr (1977)

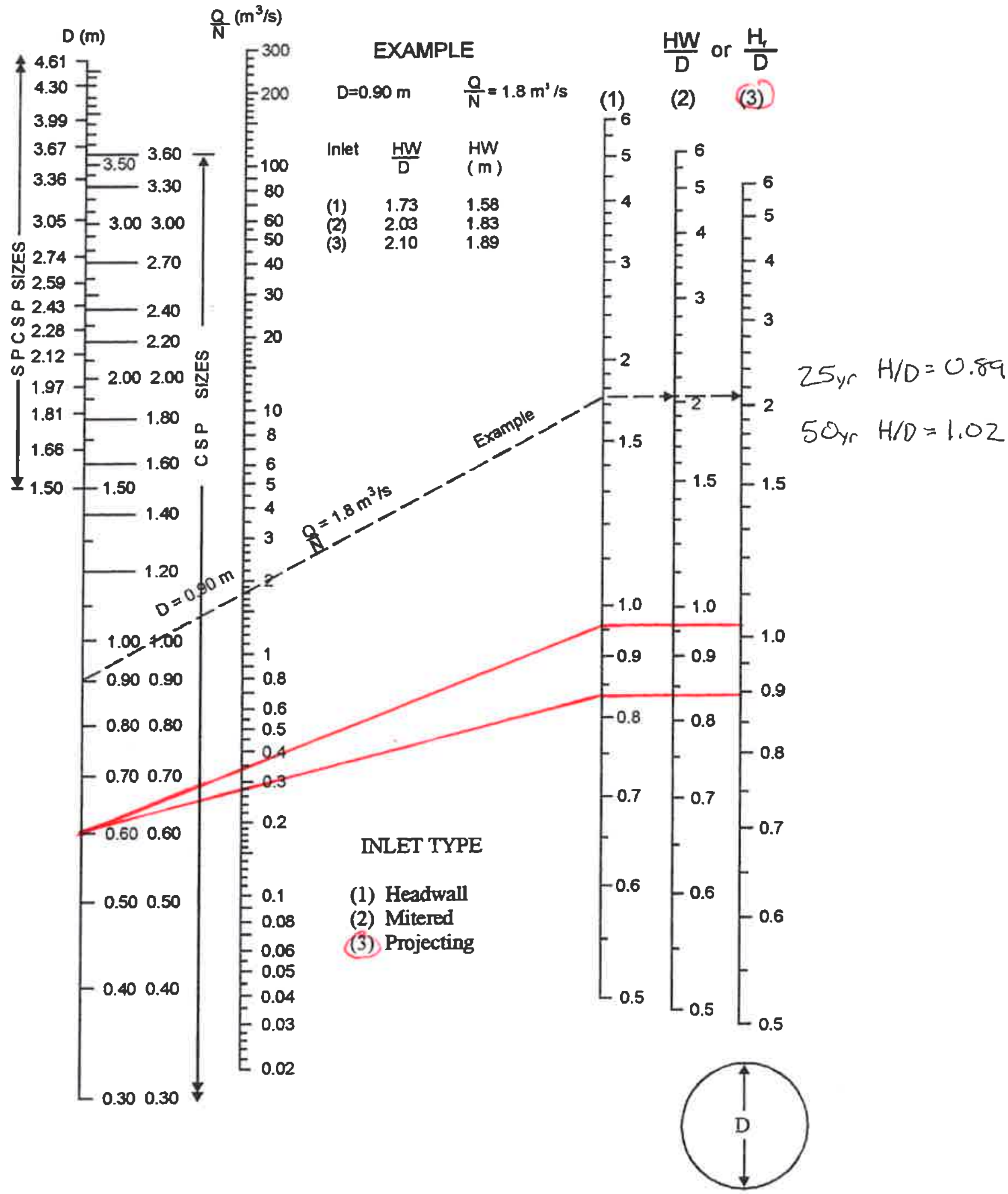
Design Chart 2.37: Critical Depth Chart for Circular Pipes



Source: Herr (1977)

Culvert #10 600mm CSP

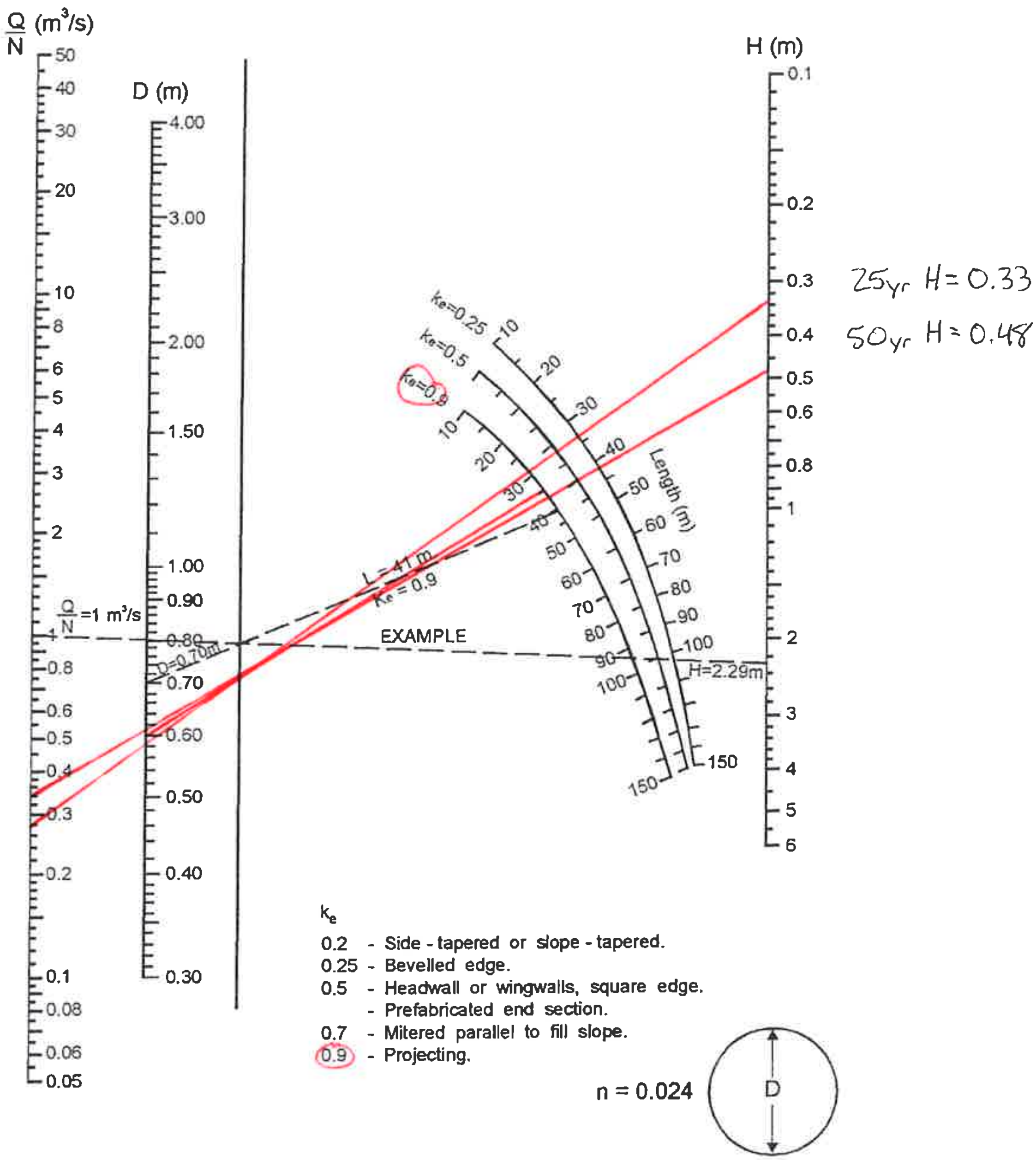
Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

Culvert #10 600mm CSP

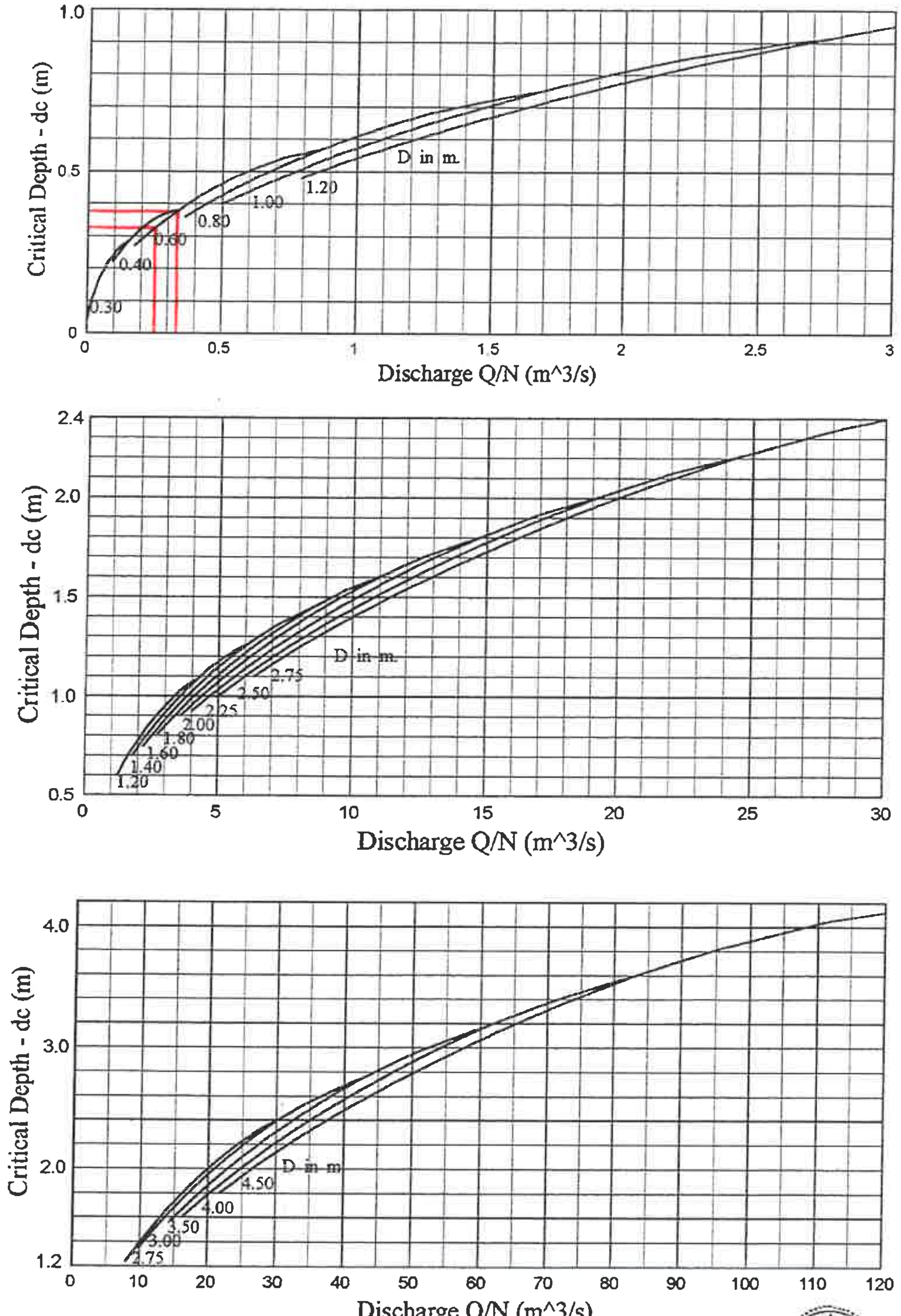
Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



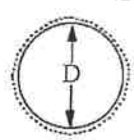
Source: Herr (1977)

Culvert #10 600mm CSP

Design Chart 2.37: Critical Depth Chart for Circular Pipes



25yr dc = 0.32
50yr dc = 0.38

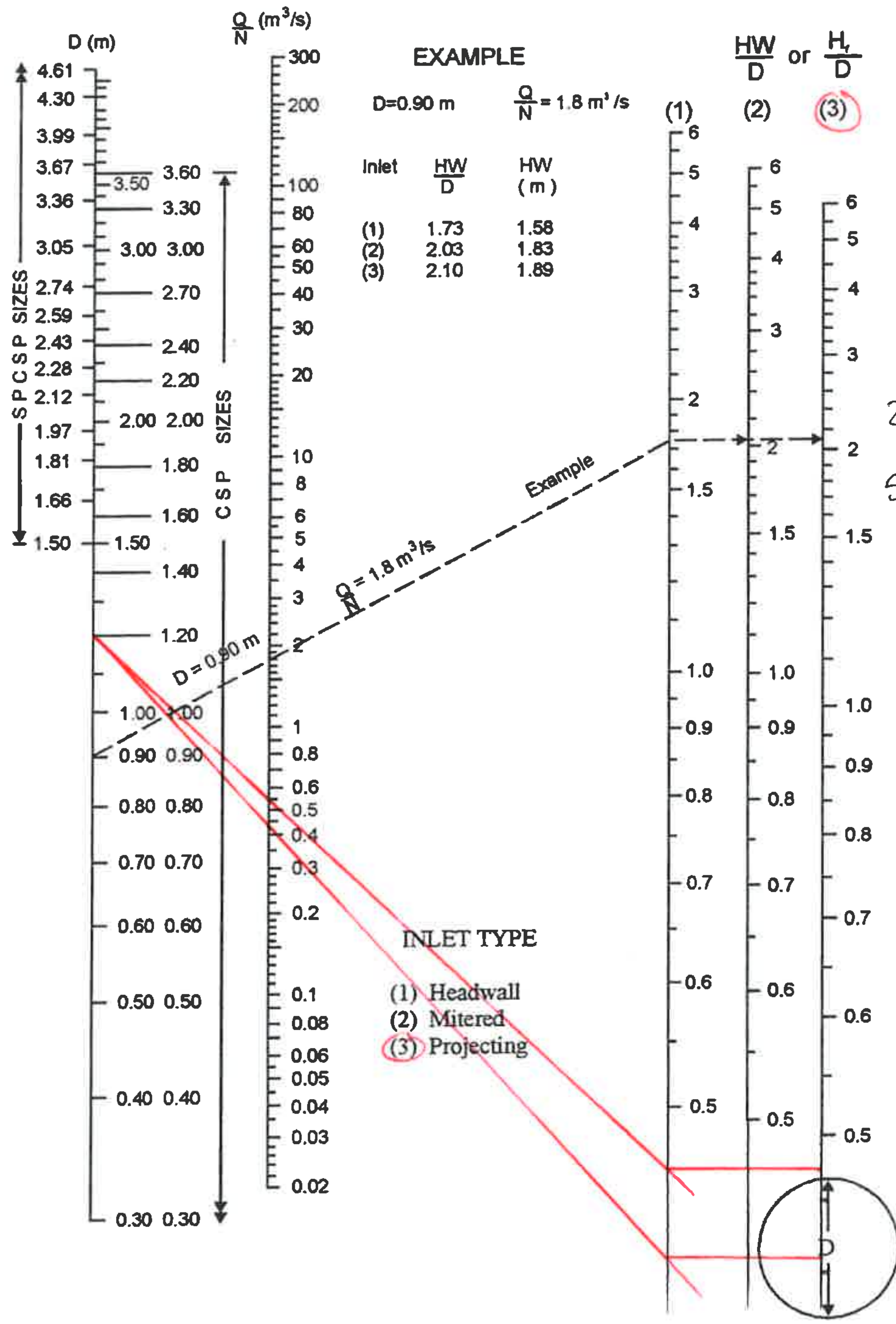


(dc ≯ D)

Source: Herr (1977)

Culvert #11 1200mm CSP

Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



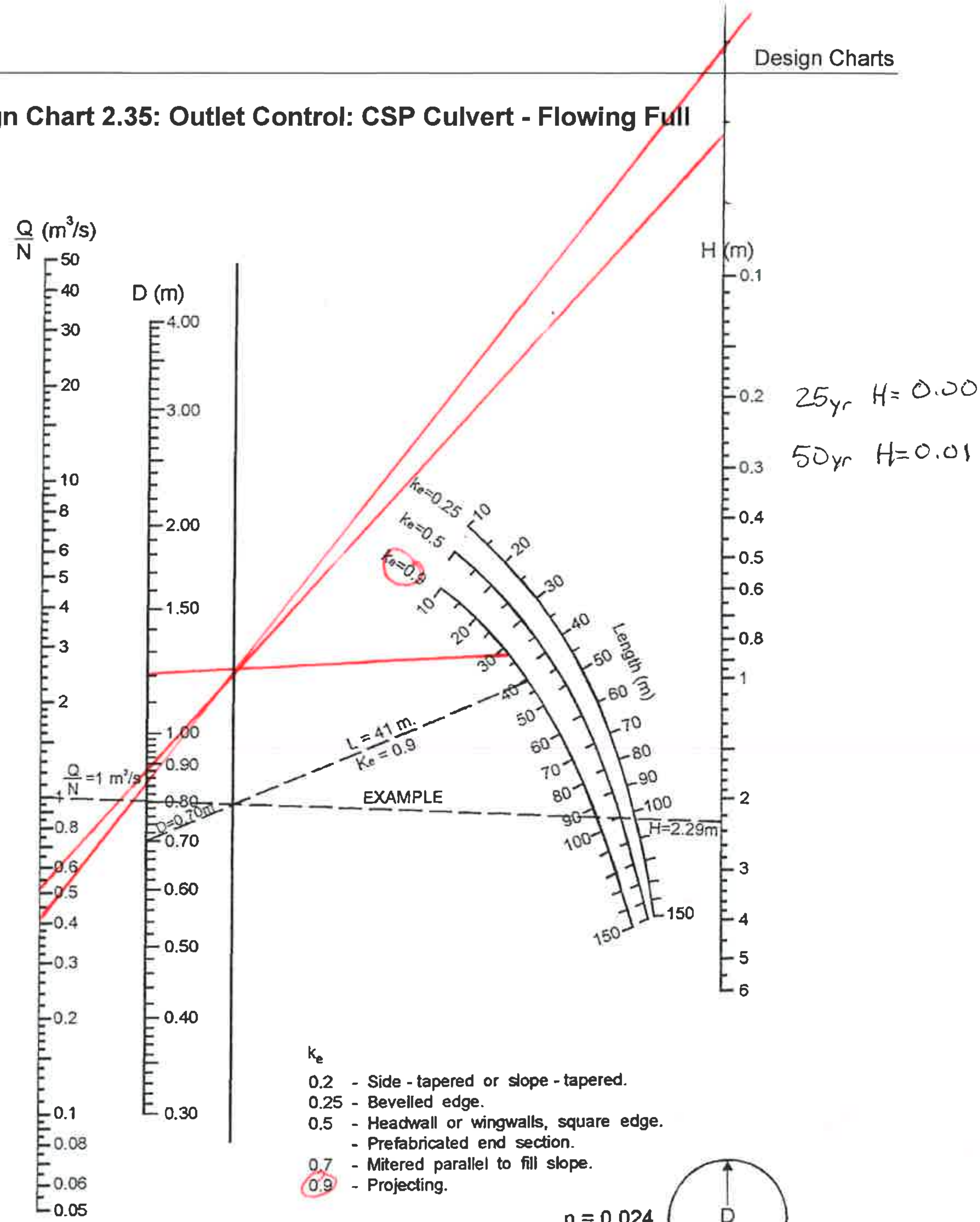
25yr H/D = 0.41

50yr H/D = 0.47

Source: Herr (1977)

Culvert #11 1200mm CSP

Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



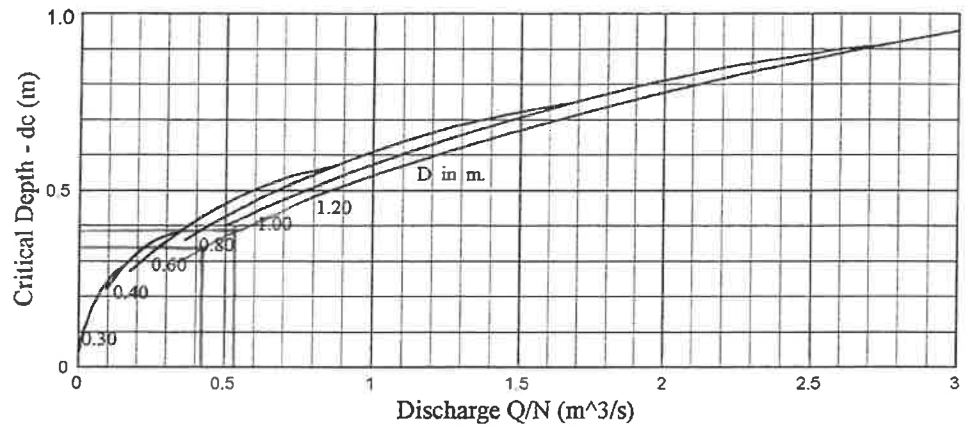
k_e
0.2 - Side - tapered or slope - tapered.
0.25 - Bevelled edge.
0.5 - Headwall or wingwalls, square edge.
- Prefabricated end section.
0.7 - Mitered parallel to fill slope.
0.9 - Projecting.

n = 0.024

Source: Herr (1977)

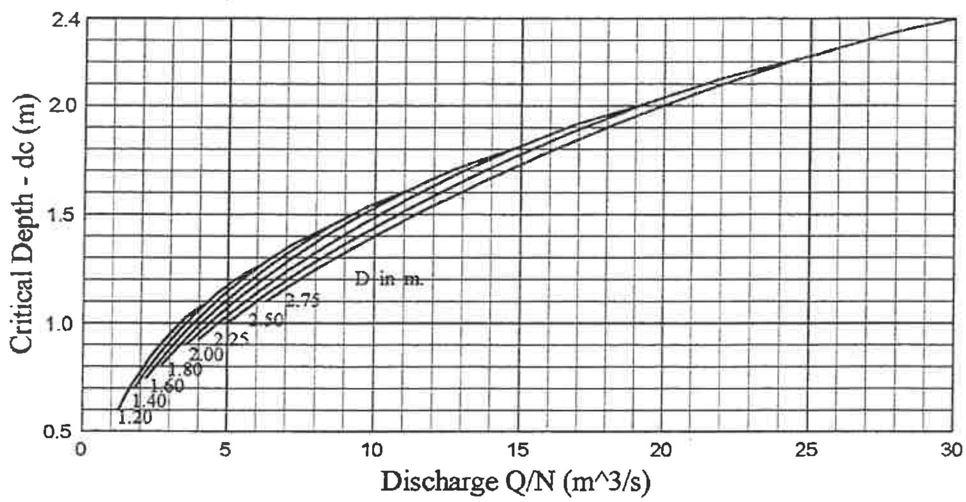
Culvert #11 1200mm CSP

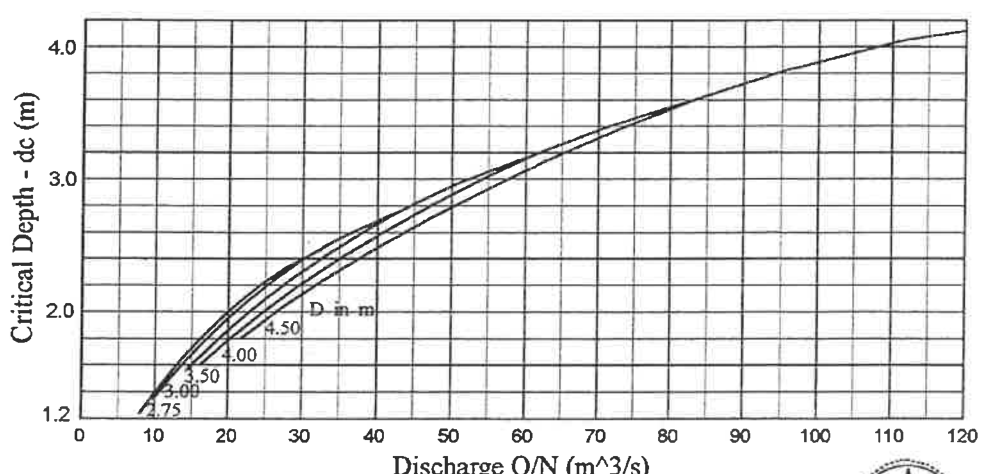
Design Chart 2.37: Critical Depth Chart for Circular Pipes



25yr dc = 0.33

50yr dc = 0.38

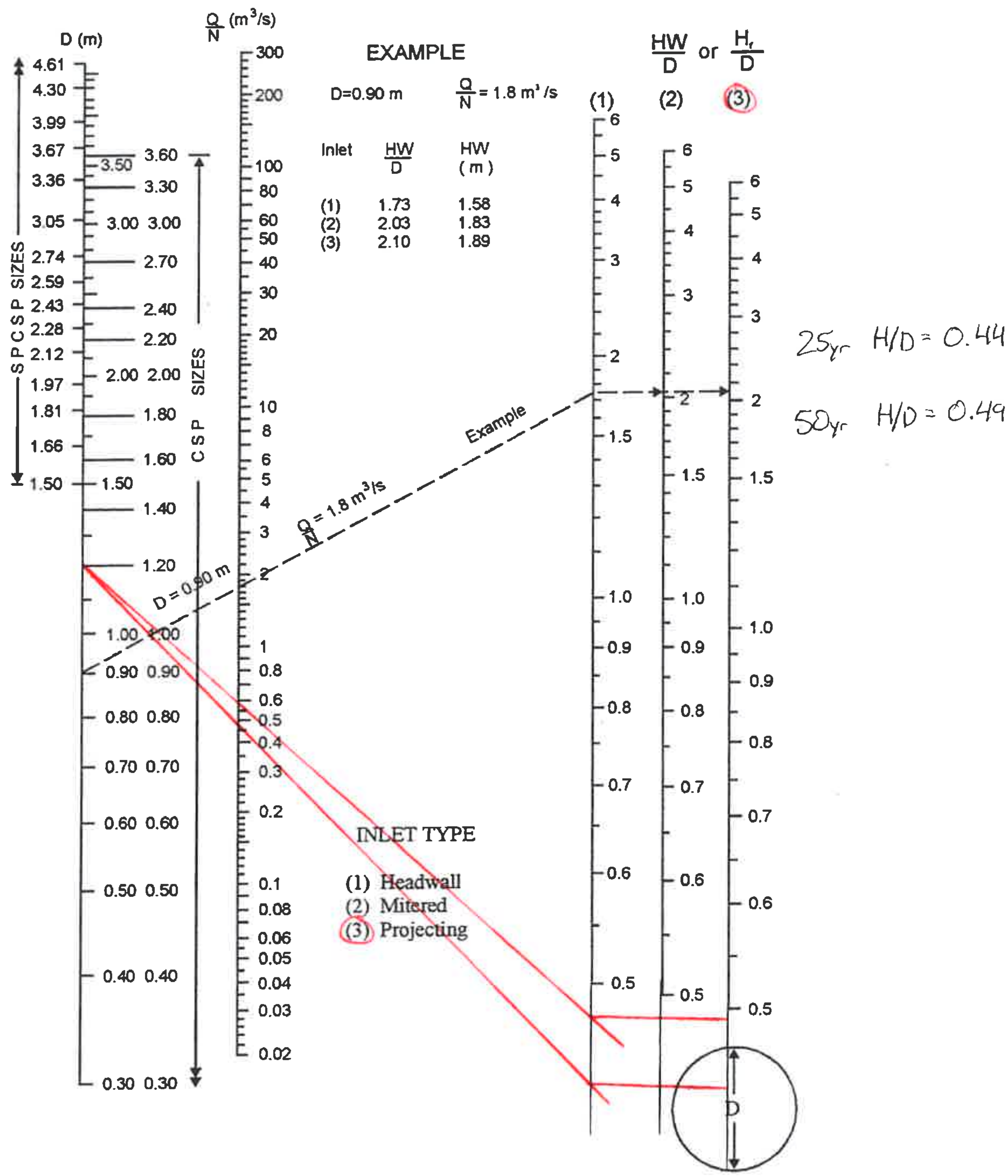




Source: Herr (1977)

Culvert #12 1200mm CSP

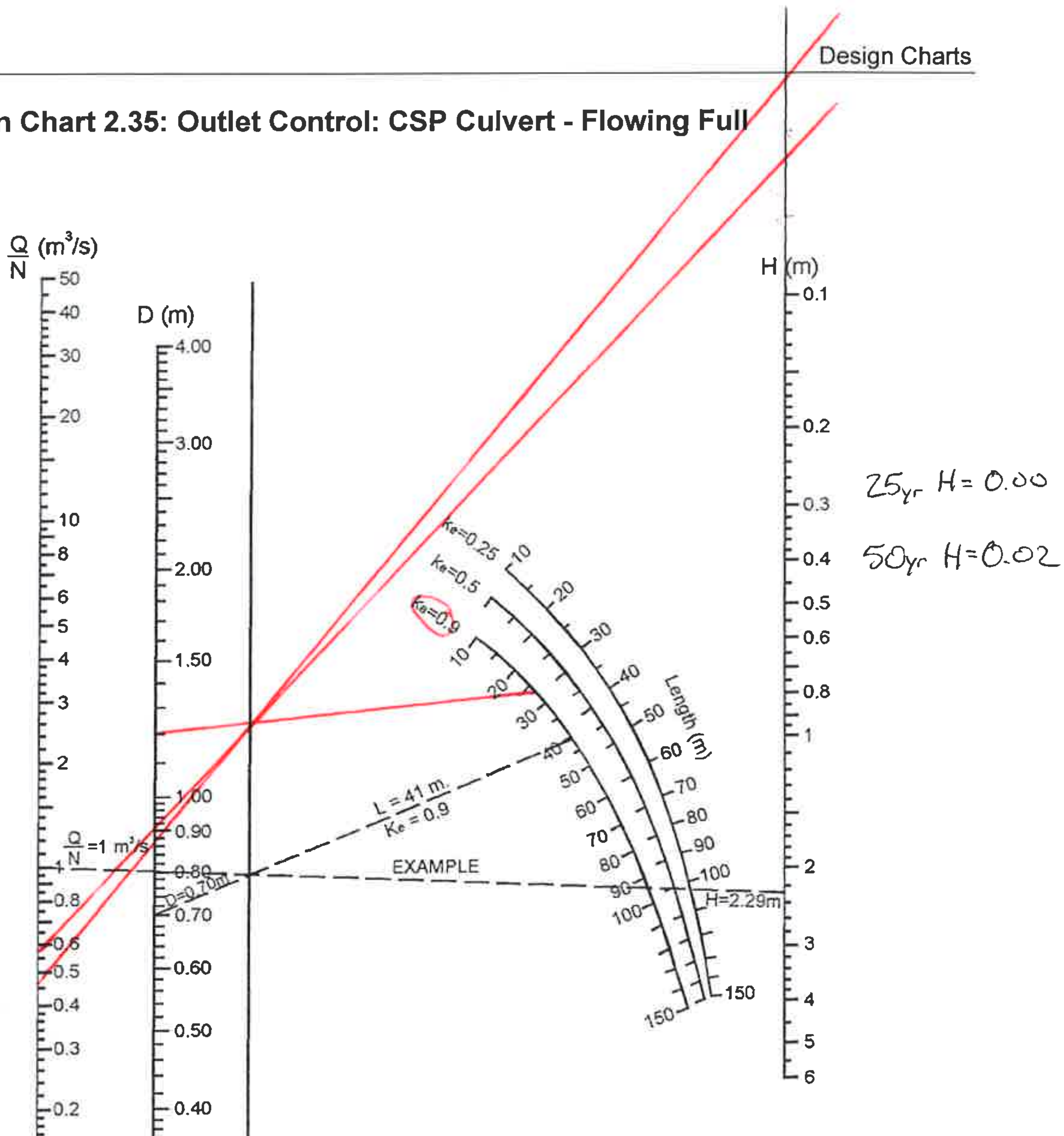
Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

Culvert #12 1200mm CSP

Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



k_e

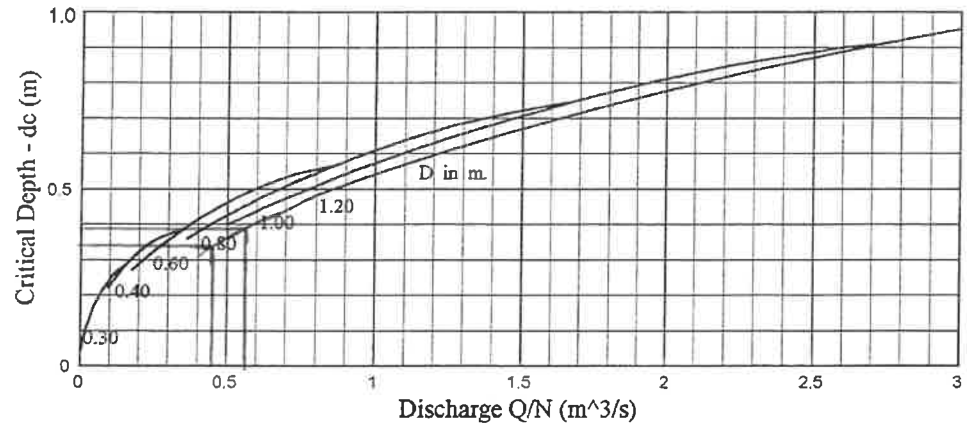
0.2 - Side - tapered or slope - tapered.
0.25 - Bevelled edge.
0.5 - Headwall or wingwalls, square edge.
- Prefabricated end section.
0.7 - Mitered parallel to fill slope.
0.9 - Projecting.

n = 0.024

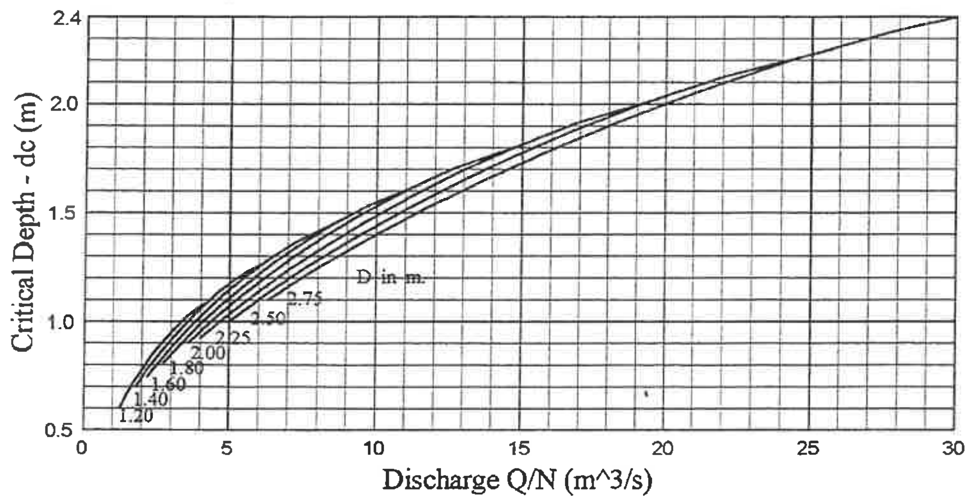
Source: Herr (1977)

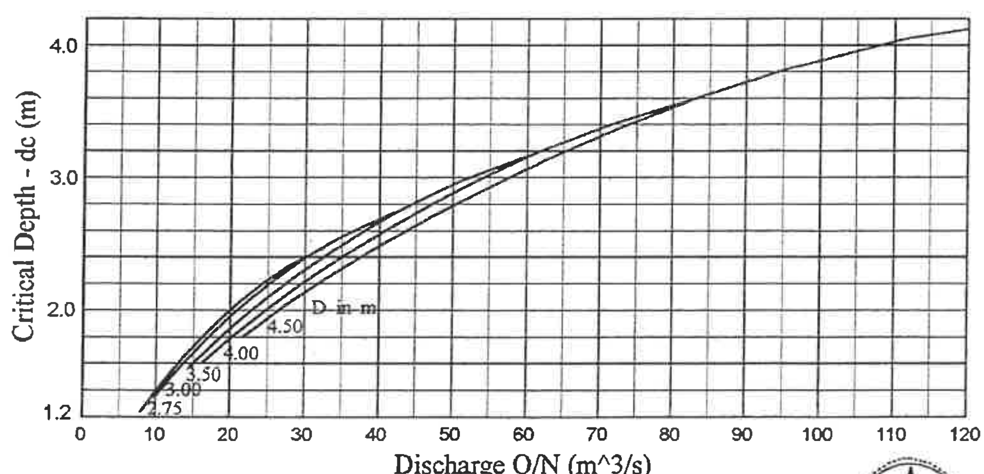
Culvert #12 1200mm CSP

Design Chart 2.37: Critical Depth Chart for Circular Pipes



25yr dc = 0.34
50yr dc = 0.39





(dc ≯ D)

Source: Herr (1977)

Table B.3
Rational Method Calculation Sheet
100 Year Storm Event (Ditch Capacity Check)

Ditch Section ID	Area (ha)	Runoff Coefficient, C	Time Conc. 25yr	Time Conc. 50yr	Rainfall Intensity (mm/hr)	Peak Design Flow (m^3/s)	Cumulative Peak Design Flow (m^3/s)
		C_{100yr}	(min.)	(min.)	100 year	100 year	100 year
Section A-A	0.53	0.43	17.0	15.8	138.45	0.087	0.558
Section B-B	1.89	0.40	18.6	17.4	130.80	0.275	0.833
Section C-C	0.21	0.41	18.7	17.5	130.45	0.031	0.940

Q = 0.00278 A x I x C **(m^3/s), Where:**

I = A/(T $_c$ ***+ C)*** ^{B} ***, where:***

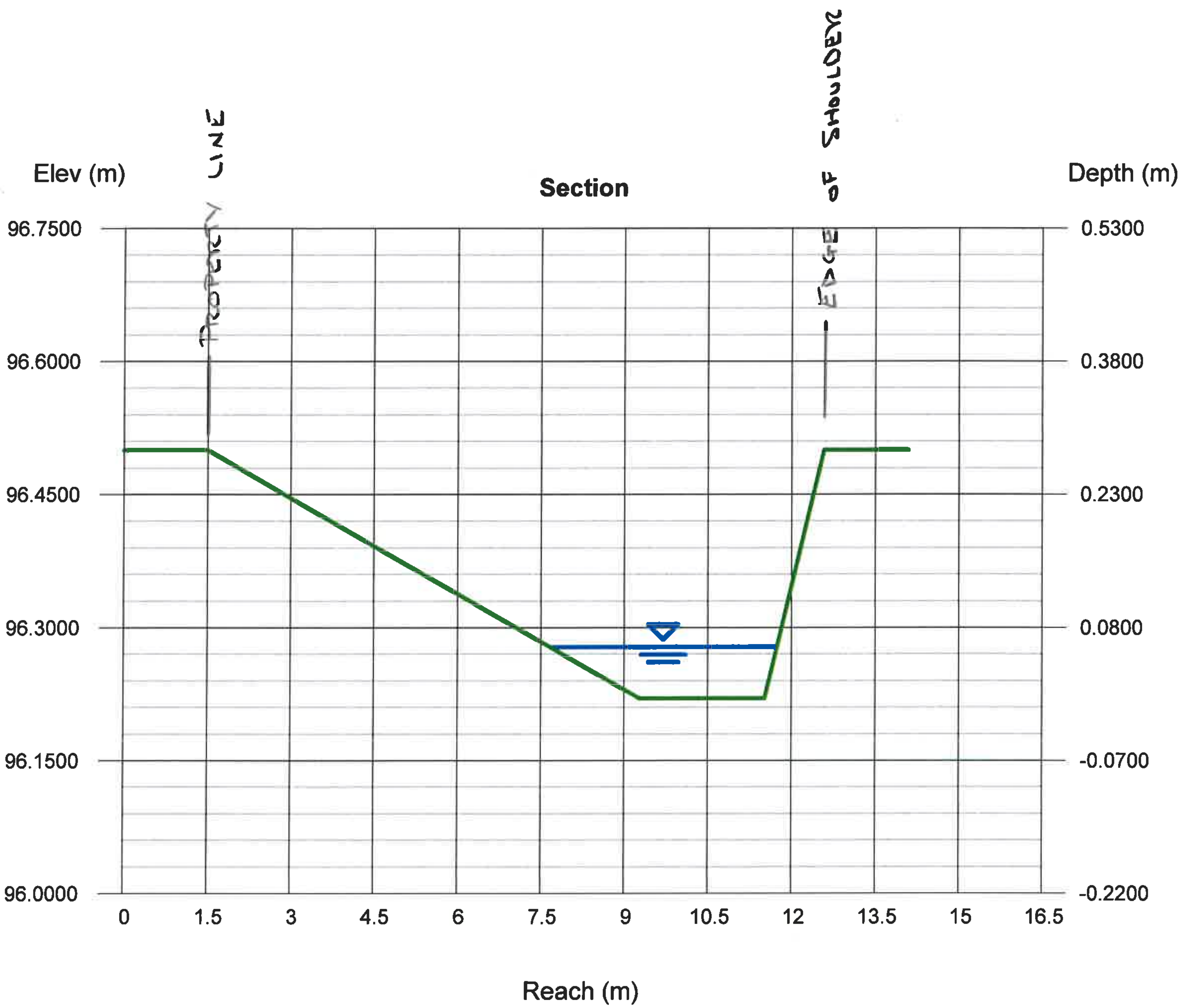
	100y yr
A =	1735.688
C =	6.014
B =	0.820

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Nov 3 2016

Ditch Section A-A (Pre-Development Ditch Capacity)

Trapezoidal		**Highlighted**	
Bottom Width (m)	= 2.2400	Depth (m)	= 0.0579
Side Slopes (z:1)	= 27.7700, 3.8000	Q (cms)	= 0.160
Total Depth (m)	= 0.2800	Area (sqm)	= 0.1827
Invert Elev (m)	= 96.2200	Velocity (m/s)	= 0.8759
Slope (%)	= 4.4000	Wetted Perim (m)	= 4.0768
N-Value	= 0.030	Crit Depth, Yc (m)	= 0.0701
		Top Width (m)	= 4.0683
Calculations		EGL (m)	= 0.0970
Compute by:	Known Q		
Known Q (cms)	= 0.1600		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Nov 3 2016

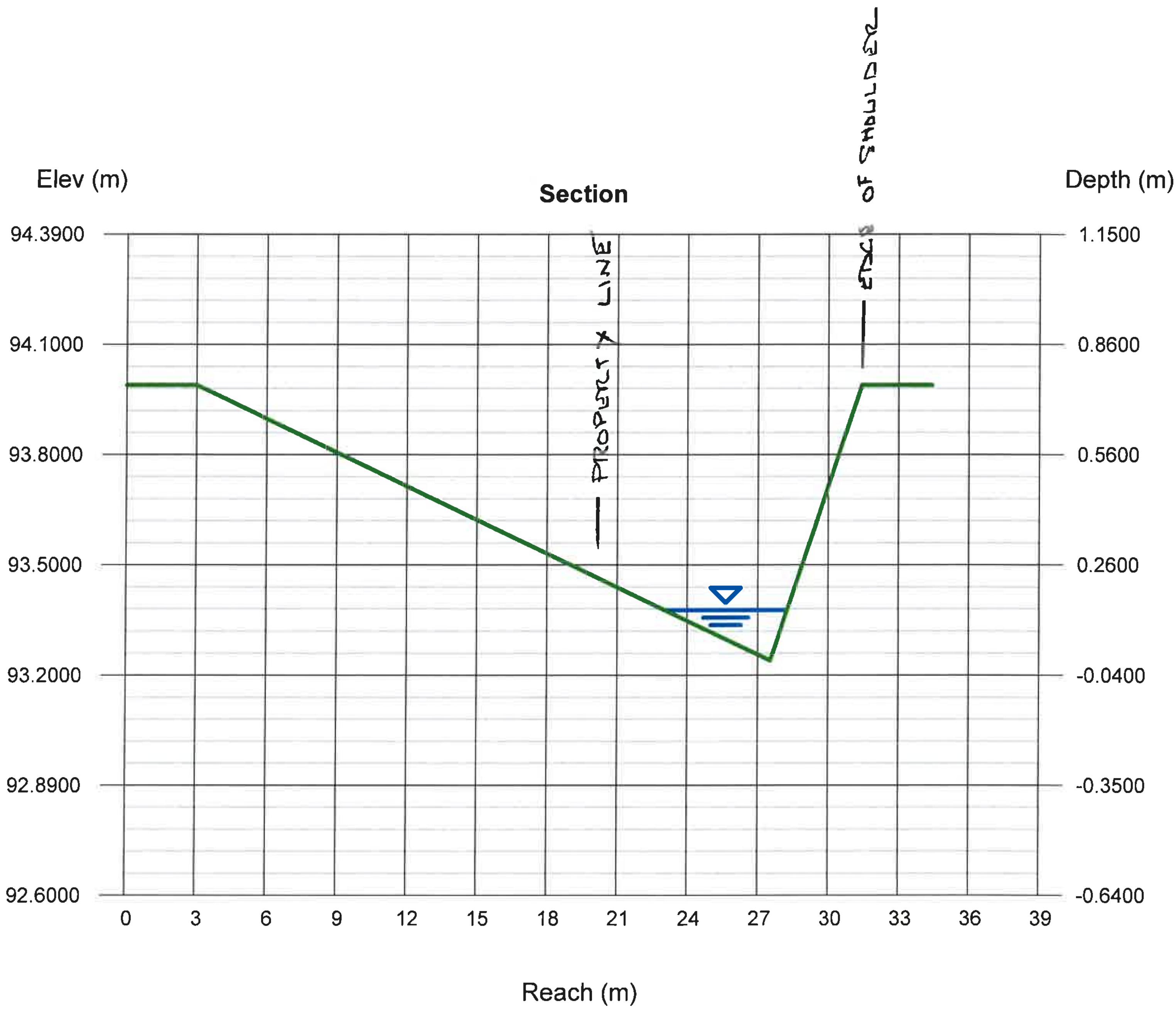
Ditch Section B-B (Pre-Development Ditch Capacity)

Triangular
Side Slopes (z:1) = 32.7000, 5.2000
Total Depth (m) = 0.7500

Invert Elev (m) = 93.2400
Slope (%) = 1.3600
N-Value = 0.030

Calculations
Compute by: Known Q
Known Q (cms) = 0.2200

Highlighted
Depth (m) = 0.1372
Q (cms) = 0.220
Area (sqm) = 0.3565
Velocity (m/s) = 0.6171
Wetted Perim (m) = 5.2135
Crit Depth, Yc (m) = 0.1250
Top Width (m) = 5.1984
EGL (m) = 0.1566



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. | Thursday, Nov 3 2016

Ditch Section C-C (Pre-Development Ditch Capacity)

Triangular

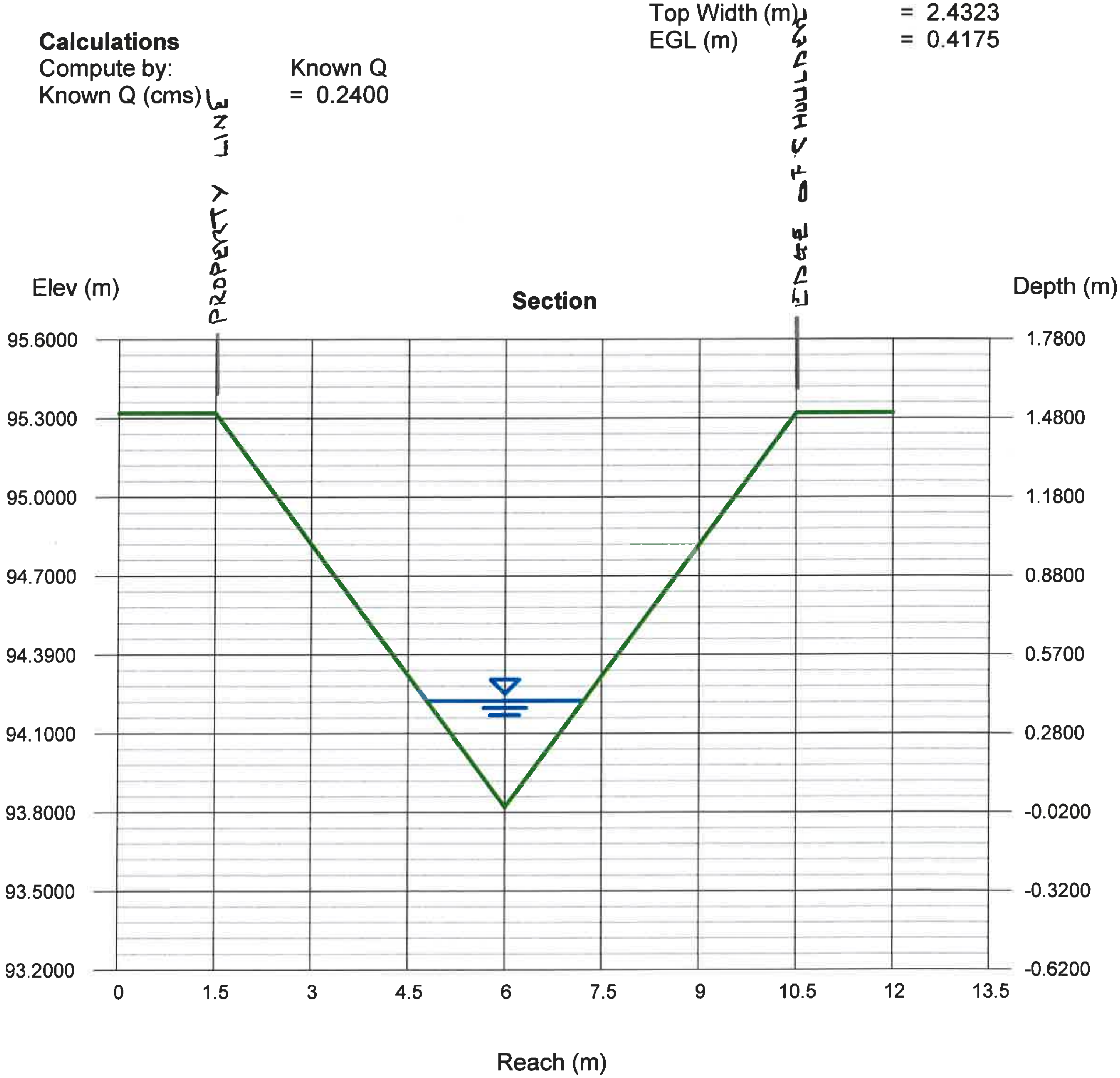
Side Slopes (z:1)	= 3.0000, 3.0000
Total Depth (m)	= 1.5000
Invert Elev (m)	= 93.8200
Slope (%)	= 0.2000
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cms)	= 0.2400

Highlighted

Depth (m)	= 0.4054
Q (cms)	= 0.240
Area (sqm)	= 0.4930
Velocity (m/s)	= 0.4868
Wetted Perim (m)	= 2.5639
Crit Depth, Yc (m)	= 0.2652
Top Width (m)	= 2.4323
EGL (m)	= 0.4175



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Thursday, Nov 3 2016

Ditch Section A-A (Post-Development Ditch Capacity)

Trapezoidal

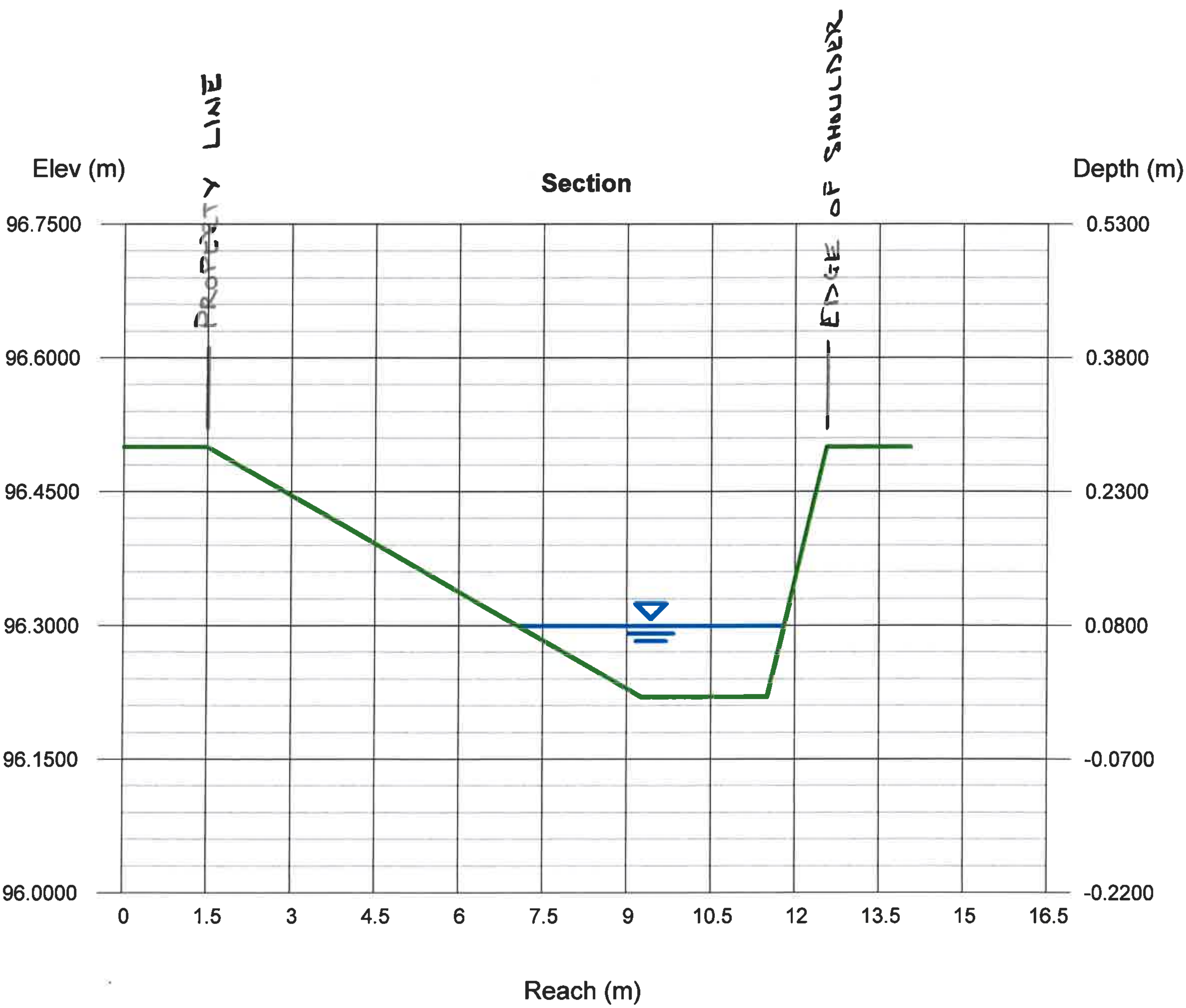
Bottom Width (m)	= 2.2400
Side Slopes (z:1)	= 27.7000, 3.8000
Total Depth (m)	= 0.2800
Invert Elev (m)	= 96.2200
Slope (%)	= 4.4000
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cms)	= 0.2700

Highlighted

Depth (m)	= 0.0792
Q (cms)	= 0.270
Area (sqm)	= 0.2764
Velocity (m/s)	= 0.9767
Wetted Perim (m)	= 4.7480
Crit Depth, Yc (m)	= 0.0914
Top Width (m)	= 4.7363
EGL (m)	= 0.1279



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Thursday, Nov 3 2016

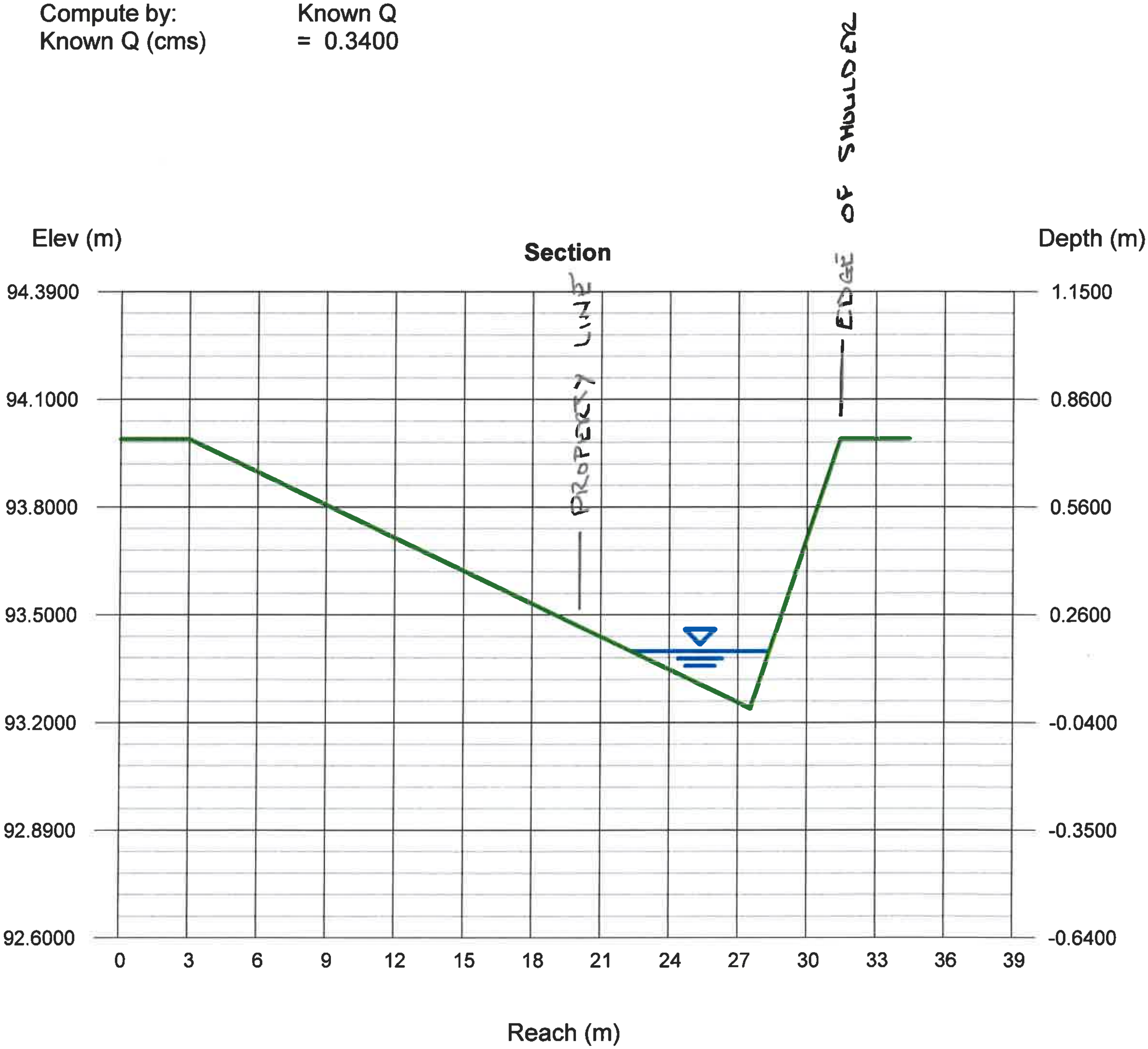
Ditch Section B-B (Post Development Ditch Capacity)

Triangular
Side Slopes (z:1) = 32.7000, 5.2000
Total Depth (m) = 0.7500

Invert Elev (m) = 93.2400
Slope (%) = 1.3600
N-Value = 0.030

Calculations
Compute by: Known Q
Known Q (cms) = 0.3400

Highlighted
Depth (m) = 0.1585
Q (cms) = 0.3400
Area (sqm) = 0.4760
Velocity (m/s) = 0.7142
Wetted Perim (m) = 6.0245
Crit Depth, Yc (m) = 0.1463
Top Width (m) = 6.0070
EGL (m) = 0.1845

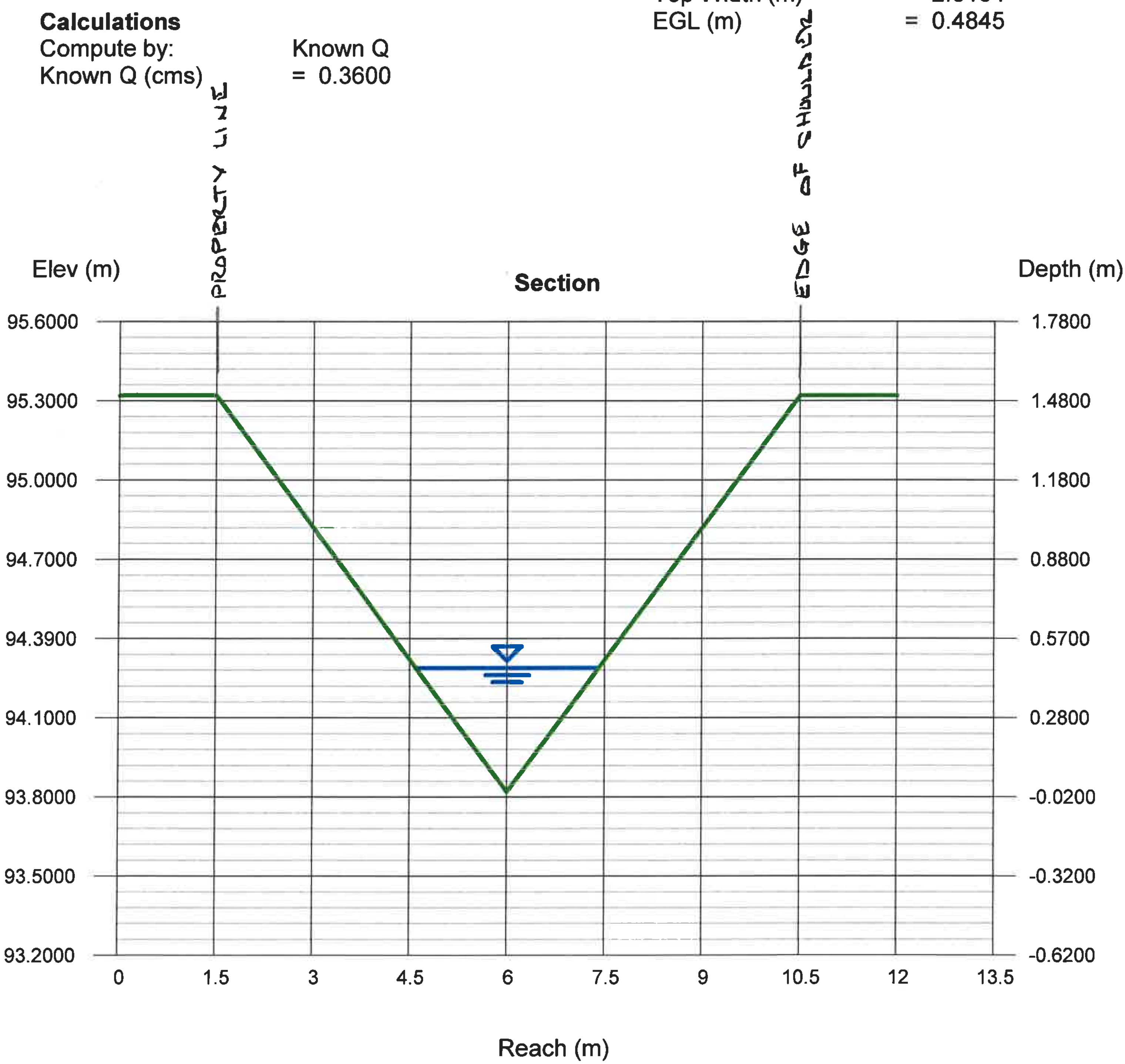


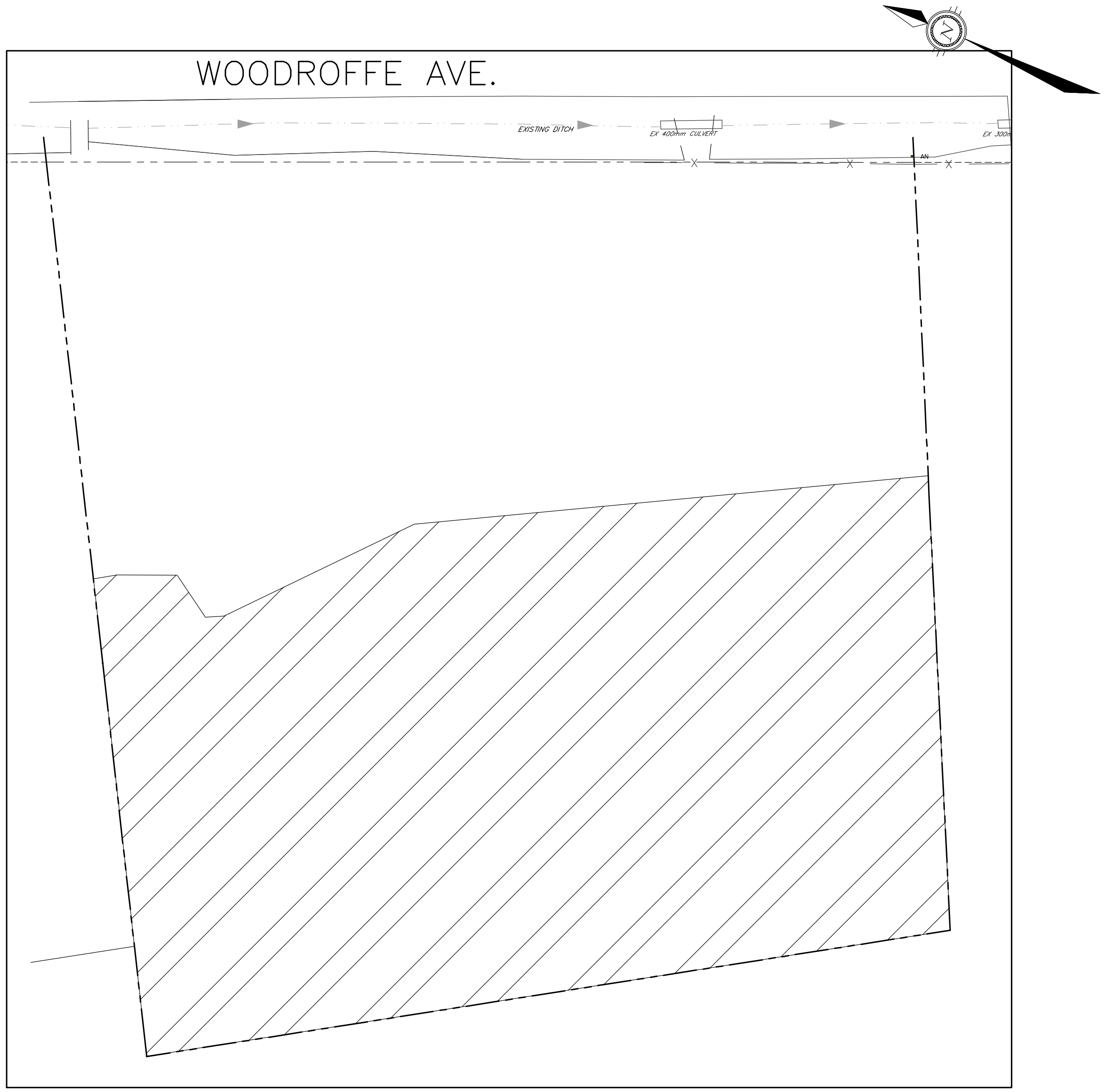
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Nov 3 2016

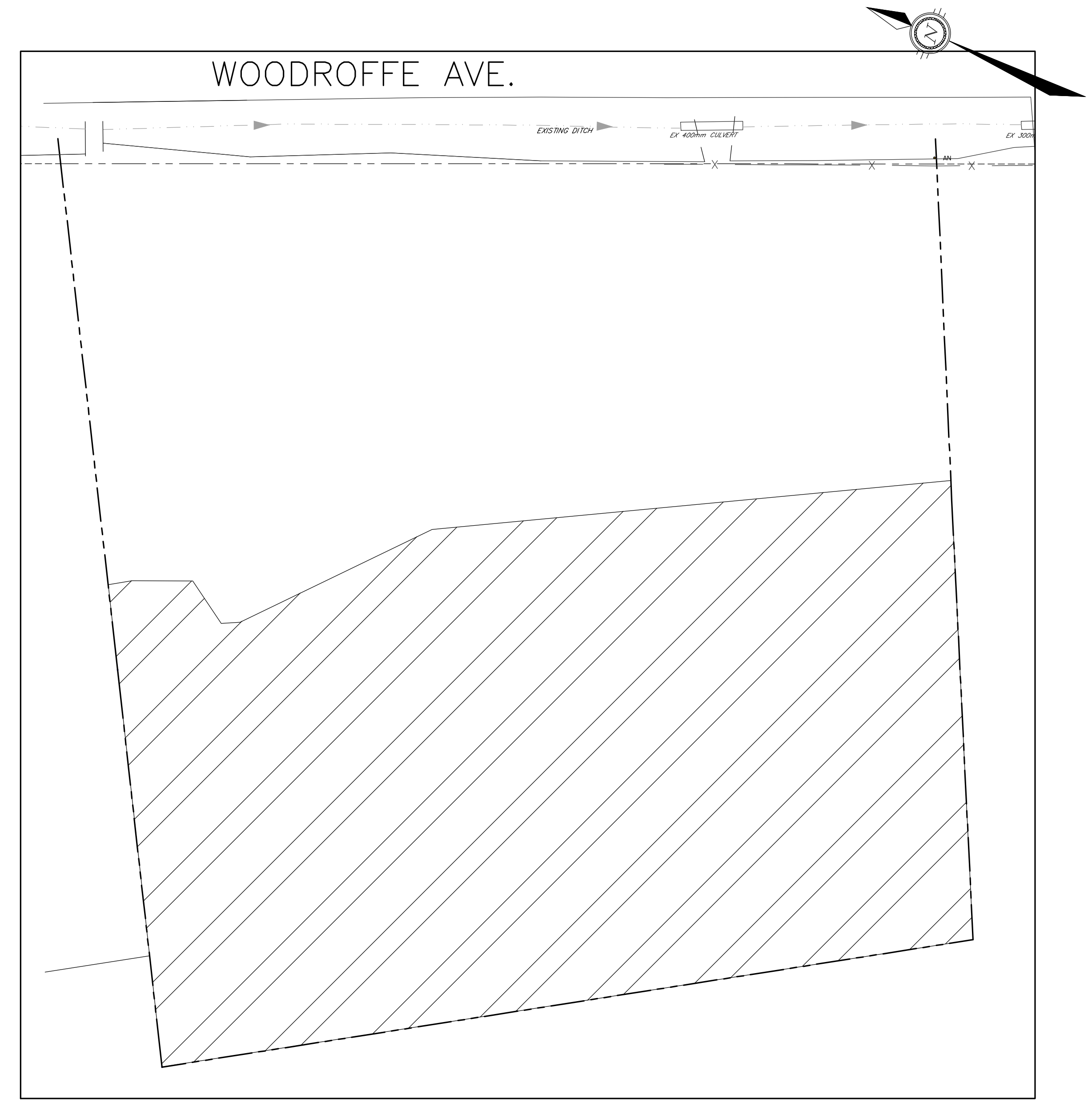
Ditch Section C-C (Post-Development Ditch Capacity)

Triangular		**Highlighted**	
Side Slopes (z:1)	= 3.0000, 3.0000	Depth (m)	= 0.4694
Total Depth (m)	= 1.5000	Q (cms)	= 0.3600
		Area (sqm)	= 0.6610
Invert Elev (m)	= 93.8200	Velocity (m/s)	= 0.5446
Slope (%)	= 0.2000	Wetted Perim (m)	= 2.9687
N-Value	= 0.030	Crit Depth, Yc (m)	= 0.3139
		Top Width (m)	= 2.8164
Calculations		EGL (m)	= 0.4845
Compute by:	Known Q		
Known Q (cms)	= 0.3600		





5 YEAR PRE–DEVELOPMENT DRAINAGE BOUNDARY

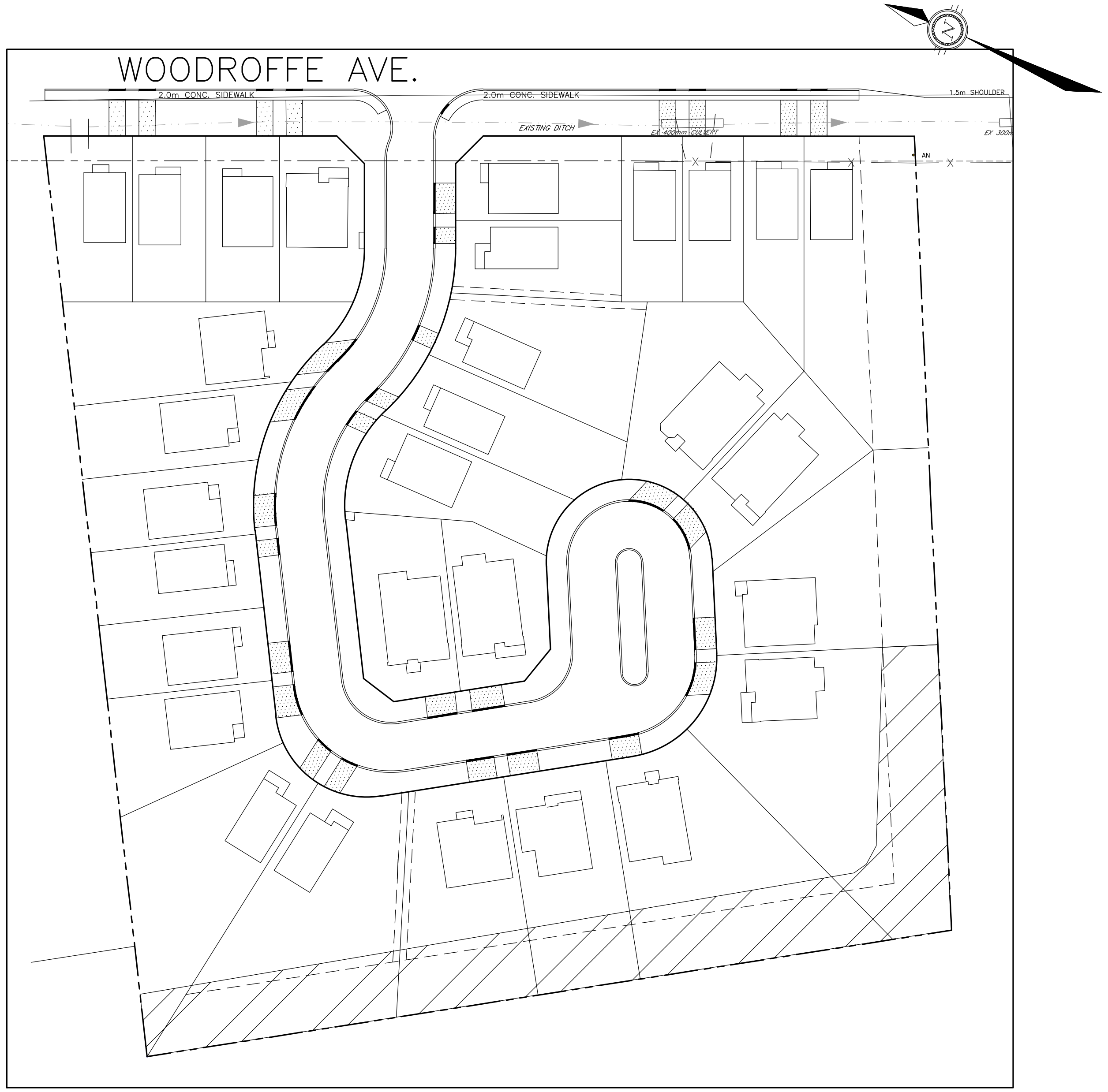


100 YEAR PRE–DEVELOPMENT DRAINAGE BOUNDARY

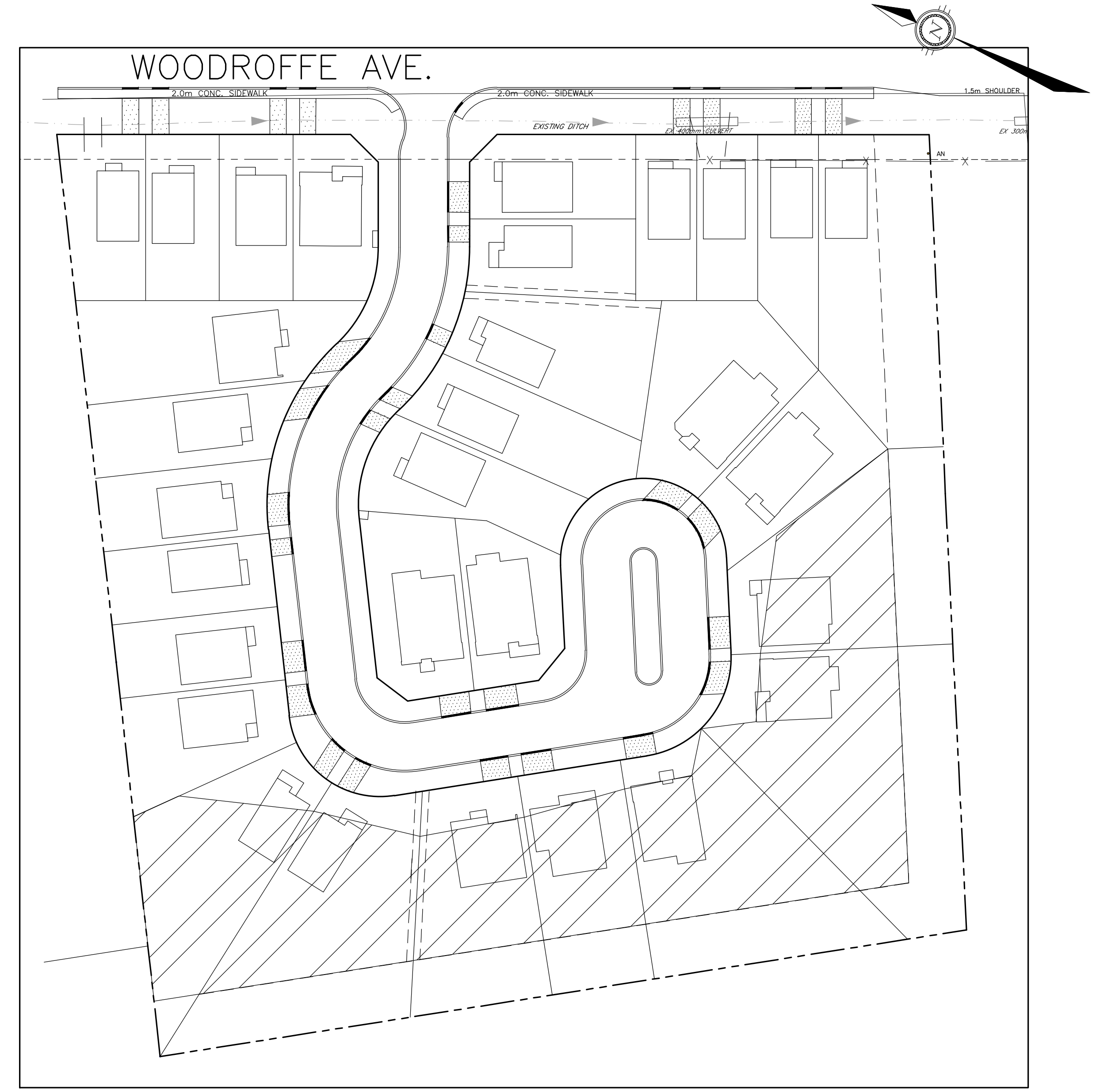
PRE–DEVELOPMENT RUNOFF			
RETURN PERIOD	T_C (min.)	C VALUE	FLOW (L/s)
5 YEAR	7.7	0.20	142.30
100 YEAR	7.7	0.25	177.80

Robinson Land Development

scale N.T.S.	BORRELLO SUBDIVISION	project no. 14057
date 10/12/15	PRE–DEVELOPMENT DRAINAGE	PRE–WEST
drawn by BLM		



5 YEAR POST-DEVELOPMENT DRAINAGE BOUNDARY

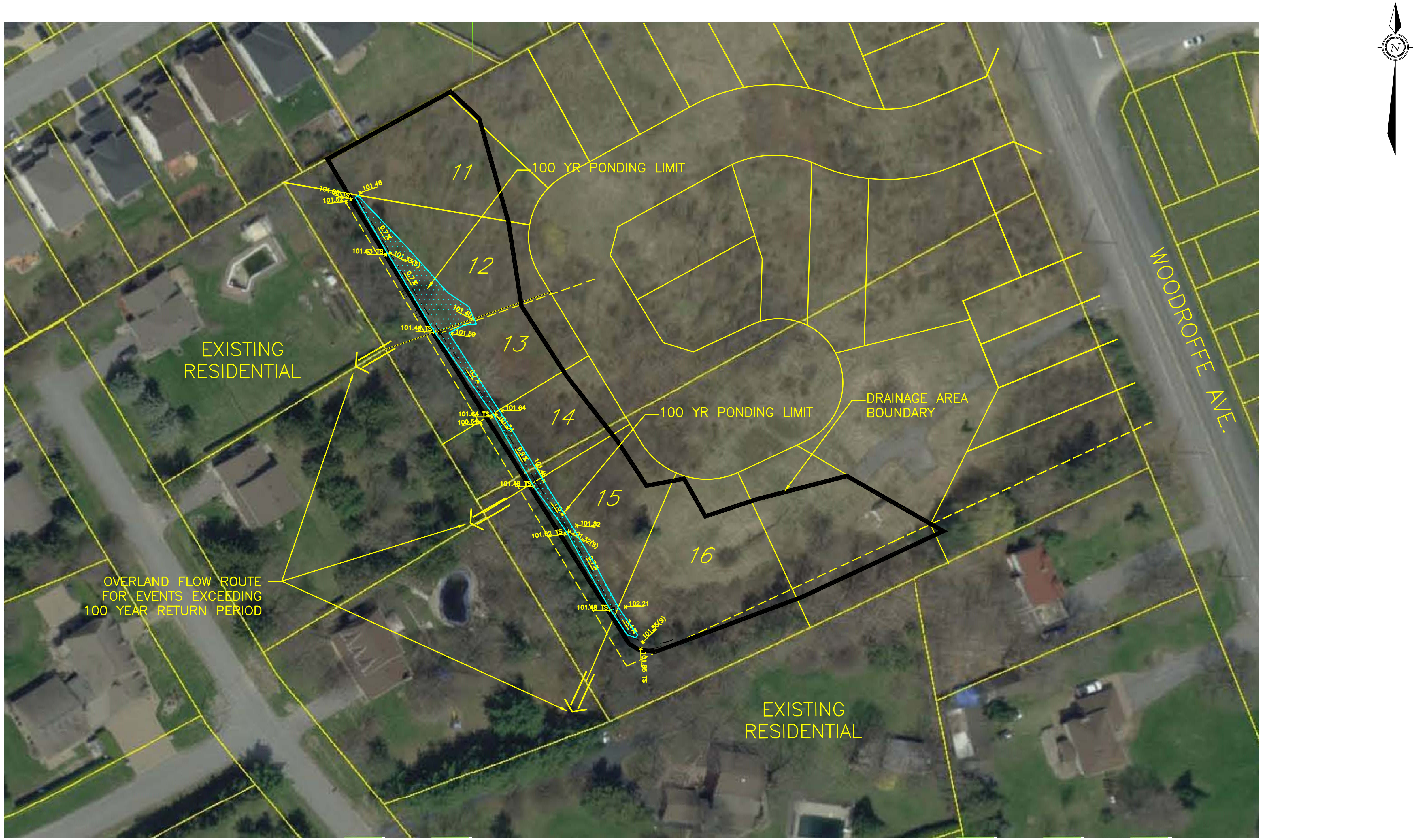


100 YEAR POST-DEVELOPMENT DRAINAGE BOUNDARY

POST-DEVELOPMENT RUNOFF			
RETURN PERIOD	T_C (min.)	C VALUE	FLOW (L/s)
5 YEAR	5.0	0.20	30.50
100 YEAR	10.0	0.34	89.20

Robinson
Land Development

scale N.T.S.	BORRELLO SUBDIVISION	project no. 14057
date 10/12/15		
drawn by BLM	POST-DEVELOPMENT DRAINAGE	POST-WEST



100 YR PONDING
ELEVATION = 101.48
STORAGE PROVIDED = 57.0 m^3
STORAGE REQUIRED = 56.6 m^3

Robinson
Land Development

scale	BORRELLO SUBDIVISION	project no.
N.T.S.		14057
date 10/12/15	LOT 11–16 OVERLAND FLOW DIRECTION	OFD
drawn by BLM		

Appendix D

Watermain Hydraulic Analysis Report

Borrello Subdivision
Hydraulic Analysis Report

Prepared For:

3428 Woodroffe Avenue
Antonino Borrello

Prepared By:

Robinson Land Development

Our Project No. 14057
November 2015

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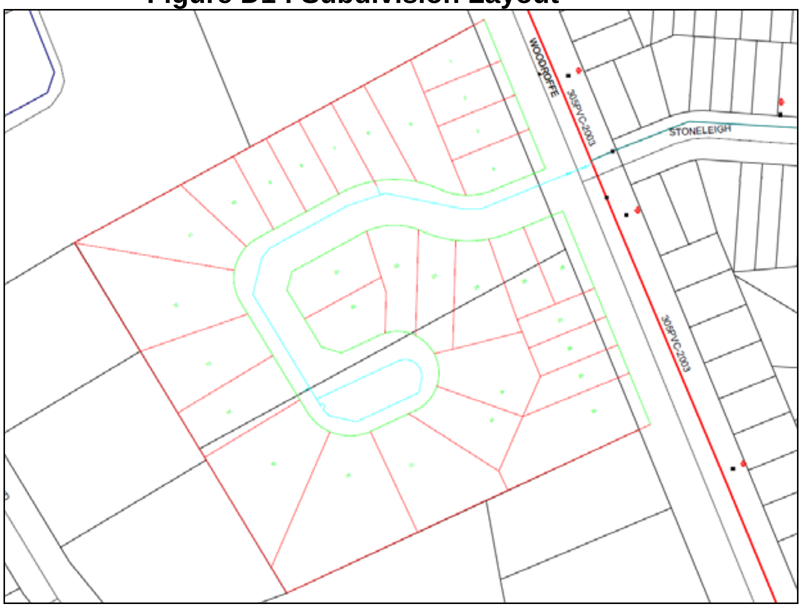
1.0 INTRODUCTION

The proposed Borrello subdivision is a 30 lot subdivision located on the west side of Woodroffe Avenue south of Strandherd Drive near Stoneleigh Crescent. The water supply for this subdivision will be provided by connecting to the existing 305mm diameter PVC watermain on Woodroffe Avenue. As per the City of Ottawa standard detail for cul-de-sac streets, the watermain will be reduced to 51mm in diameter after the last hydrant. (See Figure D1)

Figure D1 : Subdivision Layout

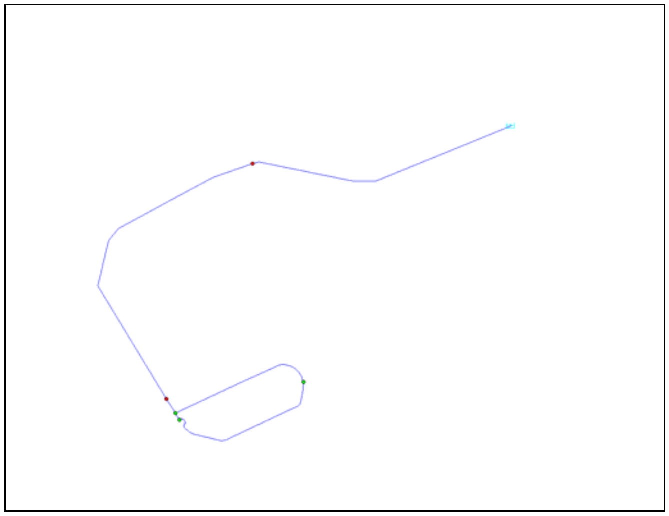


2.0 WATER NETWORK HYDRAULIC ANALYSIS

A steady-state water hydraulic model was created, utilizing the boundary conditions provided by the City of Ottawa. (See Figure D2) The boundary conditions provided by the City are shown below. The model was run for the following conditions:

- Peak Hour
- Maximum Day plus fire flow
- High Pressure Check

Figure D2 : Hydraulic Model Set-up



Boundary Conditions at Borrello Subdivision

Information Provided:

Date provided: 27 October 2015

Criteria	Demand (L/s)
Average Demand	0.30
Maximum Daily Demand	0.76
Peak Hourly Demand	1.67
Fire Flow Demand	167
Maximum Daily + Fire Flow Demand	167.3

Location:

Results:

Criteria	Head (m)	Pressure (psi)
Max HGL	166.3	91.5
PKHR	137.6	50.7
MXDY + Fire Flow (167.3 L/s)	122.2	28.8

Note: The site is located in future 3C pressure zone and assessed for both pre and post zone reconfiguration conditions. The provided boundary conditions represent the governing set of BCs.

Considerations:

1. According to the City of Ottawa Water Design Guidelines as well as the Ontario Building Code, the maximum pressure at any point within a distribution system shall not exceed 80 psi in occupied areas. Measures should be taken to try to reduce the residual pressure

below 80 psi without the use of special pressure control equipment. In circumstances where the residual pressure cannot be reduced below 80 psi without the use of pressure control equipment, pressure reducing valve (s) (**PRV**) should be installed at site.

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

2.2 Hydraulic Modelling Results

2.2.1 Hydraulic Model Summary

Based on the boundary conditions provided by the City, the peak hour demand conditions are based on future system operation within the reconfigured 3C pressure zone. Maximum pressure and maximum day plus fireflow are based on present day system configuration. Junction elevations used in the model are based on ground elevations from the proposed grading plan.

An initial sensitivity check was performed considering a pipe diameter of 152mm, which quickly yielded fireflow results that were lower than desired. For this reason, the pipe diameter up to the final hydrant was set at 203mm in diameter, with a c-value of 110. Pipe tables including diameter and c-values are presented in Appendix ‘A’.

2.2.2 Peak Hour and Maximum Pressure

A simulation was completed for peak hour demand, as well as for maximum pressures, using the boundary conditions provided. The results are shown in below.

Table D1: Peak Hour and Maximum Pressure Results

Junction	Peak Hour (psi)	Maximum Pressure (psi)
J1	48.1	88.9
J2	48.0	88.8

Results of the peak hour simulation show a pressure range of 48 psi to 89 psi. The site is located in the future 3C pressure zone, which is reflected in the boundary condition for peak hour demands that was provided by the City of Ottawa. Since pressure will be above 80 psi for the maximum pressure check, it is recommended that pressure reducing valves be installed in each home.

2.2.3 Fire Flow Simulation

The Fire Underwriter’s Survey – Long form was utilized to determine the required fire flow for a 2 storey, wood frame building. The required fire flow from this calculation is 9,000 lpm, which is included at the end of this appendix. To ensure that Technical Bulletin ISDTB-2014-02 is being satisfied, the required fireflow was rounded up to 167 l/s (10,000 lpm).

Table D2
Fireflow Simulation Results

		ID	Static Demand (Lpm)	Fire-Flow Demand (Lpm)	Available Flow at Hydrant (Lpm)
1		12	8.40	10,019.93	21,108.56
2		14	10.20	10,019.93	13,576.83

The fire flow results indicate that there is significantly more than the required fireflow of 10,000 lpm available for a 203mm diameter watermain.

2.2.4 High Pressure

It was found, based on the boundary conditions provided by the City,that the expected maximum pressure will be greater than 80 psi and therefore pressure reducing valves are recommended in each home.

3.0 CONCLUSION

The hydraulic modelling has demonstrated that the proposed Borrello Subdivision can be serviced by a new 203mm diameter watermain. Due to pressure being higher than 80psi, pressure reducing valves are being recommended for installation in each home.

Borrello Subdivision - Customized Pipe Report

	PIPE: ID (Char)	PIPEHYD: LENGTH (Num)	PIPEHYD: DIAMETER (Num)	PIPEHYD: ROUGHNESS (Num)
1	80002	4.90	203.00	110.00
2	80003	2.28	203.00	110.00
3	11	80.31	203.00	110.00
4	80001	101.24	203.00	110.00
5	79	43.49	51.00	90.00
6	75	48.13	51.00	90.00

WATERMAIN DESIGN SHEET

Borrello Subdivision
Project No. 14057

TABLE

Junction Node Number	RESIDENTIAL POPULATION ACTUAL COUNT				NON-RES		AVG. DAILY DEMAND (l/s)				MAX. DAILY DEMAND (l/s)				MAX. HOURLY DEMAND (l/s)			
	Low Density	Medium Density	High Density	Total Population	COMM. (HA)	INST. (HA)	RES.	COMM.	INST.	TOTAL	RES.	COMM.	INST.	TOTAL	RES.	COMM.	INST.	TOTAL
1	10			34.00			0.14			0.14	0.34			0.34	0.76			0.76
2	12			40.80			0.17			0.17	0.41			0.41	0.91			0.91
Total	22			74.80			0.30			0.30	0.76			0.76	1.67			1.67

Residential Densities

Low Density (SFH's) =	3.4	cap/unit
Medium Density (Townhouses) =	2.7	cap/unit
High Density (Apartments) =	1.8	cap/unit

Avg. Daily Demand:
Residential = 350 L/cap/day

Max. Daily Demand:
2.5 x Avg. Day

Max. Hourly Demand:
2.2 x Max. Day

FUS Fire Flow Calculations

Robinson Consultants

Project #: 14057

Project Name: Borrello Subdivision

Date: 1 May, 2015

Calculations Based on 1999 Publication "Water Supply for Public Fire Protection" by Fire Underwriters' Survey (FUS)

Building Type/Description/Name: Single Family Dwellings

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method								
Step	**Task**	**Term**	**Options**	**Multiplier Associated with Option**	**Choose:**	**Value Used**	**Unit**	**Total Fire Flow (L/min)**
		Framing Material						
1	**Choose Frame Used for Construction of Unit**	Coefficient related to type of construction (C)	Wood Frame	1.5	Wood Frame	1.5	m	
			Ordinary Construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (< 2 hrs)	0.7				
			Fire resistive construction (> 2 hrs)	0.6				
		Floor Space Area						
2	**Choose Type of Housing (if TH, Enter Number of Units per TH Block)**	Type of Housing	Single Family	1	Single Family	1	Units	
			Townhouse - indicate # of units	3				
			Other (comm, ind, etc.)	1				
2.2	**# of Storeys**	Number of Floors/Storeys in the Unit (do not include basement):			2	2	Storeys	
3	**Enter Ground Floor Area of One Unit**	Enter Ground Floor Area (A) of One Unit Only:			1200	222.9673	Area in Square Metres (m^2)	
		Measurement Units	Square Feet (ft^2)	0.09290304	Square Feet (ft2)			
			Square Metres (m^2)	1				
			Hectares (ha)	10,000				
4	**Obtain Required Fire Flow Without Reductions**	Required Fire Flow (without reductions or increases per FUS) (F=220*C*VA), round to nearest 1000 L/min						**5000**
5	**Apply Factors Affecting Burning**	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	**Choose Combustibility of Building Contents**	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	**5000**
			Limited Combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid Burning	0.25				
5.2	**Choose Reduction Due to Presence of Sprinklers**	Sprinkler reduction	Complete Automatic Sprinkler Protection	-0.3	None	0	N/A	**0**
			None	0				
5.3	**Choose Separation Distance Between Units**	Exposure Distance Between Units	North Side	10.1 to 20m	0.15	0.7	N/A	**3500**
			East Side	3.1 to 10m	0.2			
			South Side	10.1 to 20m	0.15			
			West Side	3.1 to 10m	0.2			
6	**Obtain Required Fire Flow, Duration & Volume**	***Total Required Fire Flow, rounded to nearest 1000 L/min:***						**9000**
		Total Required Fire Flow (above) in L/s:						**150**
		Required Duration of Fire Flow (hrs)						**9.5**
		Required Volume of Fire Flow (m^3)						**5130**

Note: The most current FUS document should be referenced before design to ensure that the above figures are consistent with the intent of the Guidelines

Legend	
(green)	Drop down menu - choose option, or enter value
(grey)	No information, No input required

Appendix E

Development Servicing Study Checklist

4.1 General Content

☒ Executive Summary (for larger reports only).

Comments: *N/A due to report length*

☒ Date and revision number of the report.

Comments: *See title page*

☒ Location map and plan showing municipal address, boundary, and layout of proposed development.

Comments: *See Figure 1.0 in report*

☒ Plan showing the site and location of all existing services.

Comments: *see Servicing Plan 14057-S1 for services*

☒ Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.

Comments: *The applicable governing reports are documented in Section 1.0. Adherence to zoning has been covered in consultation with City staff.*

☒ Summary of Pre-consultation Meetings with City and other approval agencies.

Comments: *Various pre-consultations have taken place between land owner and City staff for the subdivision configuration*

☒ Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.

Comments: *See Section 1.0*

☒ Statement of objectives and servicing criteria.

Comments: *Stated throughout the report*

☒ Identification of existing and proposed infrastructure available in the immediate area.

Comments: *see Servicing Plan 14057-S1 for services*

☒ Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).

Comments: *N/A*

☒ Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.

Comments: *see Grading Plan 14057-GR1 in Appendix A*

☒ Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.

Comments: *N/A*

☒ Proposed phasing of the development, if applicable.

Comments: *Any proposed phasing is not known at this time.*

☒ Reference to geotechnical studies and recommendations concerning servicing.

Comments: *A geotechnical Report is being completed by Golder Associates and will be forwarded when complete. No exceptional geotechnical requirements are*

☒ All preliminary and formal site plan submissions should have the following information:

- ☒ Metric scale
- ☒ North arrow (including construction North)
- ☒ Key plan
- ☒ Name and contact information of applicant and property owner
- ☒ Property limits including bearings and dimensions
- ☒ Existing and proposed structures and parking areas
- ☒ Easements, road widening and rights-of-way
- ☒ Adjacent street names

Comments: *N/A*

4.2 Development Servicing Report: Water

☒ Confirm consistency with Master Servicing Study, if available

Comments: *Water as per City standards and updated design guidelines*

☒ Availability of public infrastructure to service proposed development

Comments: *See Section 2.0 and Appendix D*

☒ Identification of system constraints

Comments: *N/A*

☒ Identify boundary conditions

Comments: *See Section 2.0 and Appendix D*

☒ Confirmation of adequate domestic supply and pressure

Comments: *See Section 2.0 and Appendix D*

☒ Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow at locations throughout the development.

Comments: *See Section 2.0 and Appendix D*

☒ Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves.

Comments: *See Section 2.0 and Appendix D*

☒ Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design

Comments: *No constraints.*

☒ Address reliability requirements such as appropriate location of shut-off valves

Comments: *N/A*

☒ Check on the necessity of a pressure zone boundary modification.

Comments: *N/A*

☒ Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range

Comments: *See section 2.0 and Appendix D*

☒ Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions.

Comments: *See section 2.0 and Appendix D and servicing drawing.*

☒ Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation.

Comments: *N/A*

☒ Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.

Comments: *See Section 2.0 and Appendix D*

☒ Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.

Comments: *See Appendix D*

4.3 Development Servicing Report: Wastewater

☒ Summary of proposed design criteria (Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure).

Comments: *See Section 3.0 and Appendix B*

☒ Confirm consistency with Master Servicing Study and/or justifications for deviations.

Comments: *See Section 3.0 and Appendix B*

☒ Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age and condition of sewers.

Comments: *N/A*

☒ Description of existing sanitary sewer available for discharge of wastewater from proposed development.

Comments: *see Section 3.0, design sheets and drawing 14057-S1 and 14057-SAN1*

☒ Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable)

Comments: *Verified in sewer design sheet*

☒ Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.

Comments: *N/A*

☒ Special considerations such as contamination, corrosive environment etc.

Comments: *N/A*

4.4 Development Servicing Report: Stormwater

☒ Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)

Comments: *Minor system goes to Woodroffe Avenue sewer, major overland to Woodroffe Avenue - See Section 4.0*

☒ Analysis of available capacity in existing public infrastructure.

Comments: *See storm sewer design sheet.*

☒ A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.

Comments: *See drawing 14057-S1 and 14057-STM1*

☒ Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.

Comments: *See Section 4.0 and 5.0 for various details. Quality control is provided by the Nepean South Chapman Mills SWM Pond*

☒ Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.

Comments: *Quality control is provided by the Strandherd SWM Pond.*

☒ Description of the stormwater management concept with facility locations and descriptions with references and supporting information.

Comments: *See Section 4.0 and 5.0 for various details.*

☒ Set-back from private sewage disposal systems.

Comments: *N/A*

☒ Watercourse and hazard lands setbacks.

Comments: *N/A*

☒ Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.

Comments: *SWM pond has already been approved and the site is not in close proximity to any watercourses. Pre-consult not required.*

☒ Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.

Comments: See discussion in Section 4.0

☒ Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).

Comments: See Section 4.0 and Appendix C

☒ Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.

Comments: N/A

☒ Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.

Comments: See Section 4.0 and Appendix C. Pre/post not required. Design is based upon a prescribed 70 L/s/ha

☒ Any proposed diversion of drainage catchment areas from one outlet to another.

Comments: N/A

☒ Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.

Comments: See drawings 14057-S1 and SWM1 in Appendix A and C

☒ If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event.

Comments: Quantity control is proposed. See Section 4.0 for details

☒ Identification of potential impacts to receiving watercourses

Comments: N/A

☒ Identification of municipal drains and related approval requirements.

Comments: N/A

☒ Descriptions of how the conveyance and storage capacity will be achieved for the development.

Comments: *See Section 4.0 and Appendix C for details of surface storage.*

☒ 100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.

Comments: *Maximum ponding levels of 0.3m on local roads and 0.25m on collector roads. Major flow routing to Woodroffe Avenue.*

☒ Inclusion of hydraulic analysis including hydraulic grade line elevations.

Comments: *See Section 4.0*

☒ Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.

Comments: *See Section 5.0 and Erosion and Sediment Control drawing*

☒ Identification of floodplains - proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.

Comments: *N/A*

☒ Identification of fill constraints related to floodplain and geotechnical investigation.

Comments: *N/A*

4.5 Approval and Permit Requirements: Checklist

The Servicing Study shall provide a list of applicable permits and regulatory approvals necessary for the proposed development as well as the relevant issues affecting each approval. The approval and permitting shall include but not be limited to the following:

☒ Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.

Comments: *N/A*

☒ Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.

Comments: *The development will require an application for the installation of the sanitary and storm sewers.*

☒ Changes to Municipal Drains.

Comments: *N/A*

☒ Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)

Comments: *N/A*

4.6 Conclusion Checklist

☒ Clearly stated conclusions and recommendations

Comments: *See Section 6.0*

☒ Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.

Comments: *N/A*

☒ All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario

Comments: *Report are signed.*