3958 CARDINAL DRIVE, NIAGARA FALLS, ON

FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

JULY 10, 2023

CLIENT: **12604515 CANADA CORPORATION**

MUNICIPALITY: **CITY OF NIAGARA FALLS**

ARIK ENGINEERING LTD.
Where Community Design & Develop

260 Nebo Road, Unit 205, Hamilton, Ontario, L8W 3K5
Email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

PROJECT # 22181

DISCLAIMER:

*This report entitled "**Functional Servicing & Stormwater Management Report**" is prepared by **ARIK Engineering Ltd.** (ARIK) on behalf of "**12604515 Canada Corporation.**", reliance on this document by any third party is not permitted. The information provided in this report is based on ARIK's best professional judegment with respect to the scope and limitations defined in this document. ARIK did not verify the information provided by others. Any reliance and use of this document by third party is a responsibility of such third party. ARIK is not responsible for any damages or consequences which may suffer third party as a result of any decision made based on this document.*

ARIK ENGINEERING LTD.

FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

3958 CARDINAL DRIVE

NIAGARA FALLS, ON

TABLE OF CONTENT

APPENDICES

APPENDIX A

Figure A1: Site Plan
Figure A2: Existing Topography

APPENDIX B

As-Built/Existing Drawings

APPENDIX C

ENGINEERING DRAWINGS:

Cover Sheet
DWG 1: General Notes And Details
DWG 2: Site Servicing Plan
DWG 3: Site Grading Plan
DWG 4: Erosion & Sediment Control Plan
DWG 5: Storm Drainage Area Plan
Table C1: Storm Sewer Analysis & Design Calculations

APPENDIX D

Domestic Water & Fire Flow Assessment
Figure D1: Fire Expousre Distances

APPENDIX E

Figure E1: Pre-Development Drainage Area Plan
Figure E2: Post-Development Drainage Area Plan
Imperviousness Calculations
Stage, Storage, Discharge & Orifice Calculations
SWMHYMO Model Output Files

APPENDIX F

Stormwater Storage Chambers Design
Oil & Grit Separator (OGS) Design

1.0 INTRODUCTION

1.1. STUDY OBJECTIVE

ARIK Engineering Ltd., has been retained by **12604515 Canada Corporation (c/o Mohaned M. Sawan)** to prepare a functional servicing and stormwater management report for the proposed development at 3958 Cardinal Drive, Niagara Falls, Ontario. The proposed development is located at northeast intersection of Cardinal Drive and Thorold Stone Road. The development is bounded by Cardinal Road to the west, Thorold Stone Road to the south and existing residential areas to the north and east. The subject land is currently vacant. The proposed development comprises of approximately area of 0.80 ha.

An illustration of the project location is presented in key plan **Exhibit 1**.

Exhibit 1: Key Plan

The objective of this report is to prepare a functional site servicing and grading design for the subject development based on existing municipal sanitary, storm sewers and watermains.

The report will also describe stormwater management servicing concept related to stormwater quantity and quality in accordance with the current drainage and stormwater management policies and design criteria established by the City of Niagara Falls.

Figure A1 represents the proposed site plan for the subject lands in **Appendix A** for reference.

1.2. EXISTING TOPOGRAPHY AND DRAINAGE PATTERN

The subject property generally drains from north to south towards Thorold Stone Road. The existing topography varies from a high elevation of approximately 190.08m along the northeast corner of the property to a low elevation of 187.28m along the southwest corner of the property. The subject site is currently vacant.

Figure A2 represents the existing topography in **Appendix A**.

1.3. PROPOSED SITE PLAN DEVELOPMENT

The proposed site plan will be comprised of approximate area of 0.80 ha. The development will include construction of 33 townhouse units and associated parking area. The site plan of the proposed development is attached in the **Appendix A** for reference.

2.0 DESIGN OF PRIVATE SANITARY, WATER AND STORM SERVICES

The proposed development is located in the City of Niagara Falls and it is bounded by existing municipal roads which contain municipal sanitary sewers, storm sewers and watermains which can be utilized for servicing the subject lands. The design criteria used in this functional servicing report are based on the City of Niagara Falls current design and construction standards.

Existing municipal sewers and watermain on Cardinal Drive will be able to service the proposed development.

There is an existing 525mm municipal sanitary sewer available on Cardinal Drive which drains from north to south will be utilized for sanitary servicing of the subject development.

There is an existing 2.4mx1.8m municipal concrete box culvert available on Thorold Stone Road which can be utilized for the storm outlet for the subject development. Onsite stormwater management storage will need to be provided and the post-development outflows from the site will have to match with the pre-development flow conditions.

An existing 300mm watermain is available on Cardinal Drive which can provide water servicing for the subject development.

2.1. SANITARY SERVICES

Sanitary service for the subject site will be provided through the existing municipal sanitary sewer available on Cardinal Drive. A profile drawing (refer to drawing # 91-29-06 and CC2835 in **Appendix B** for reference) shows that there is an existing 525mm sanitary sewer is located along Cardinal Drive will be able to provide sanitary service for the proposed development. It is our understanding from the city as-built drawing that the site is already sanitary serviced, the existing sanitary service to be removed or abandoned prior to construction.

The city staff has recommended to complete the third-party sanitary modeling analysis to confirm the available capacity of the existing 525mm sanitary sewer on Cardinal Drive with respect to the proposed development.

A 200mm PVC sanitary service has been proposed from the existing 525mm municipal sanitary sewer on Cardinal Drive to service the subject development. **DWG-2** in **Appendix C** represents the sanitary service connection for the proposed development.

2.2. WATER SERVICES

An existing 300mm watermain is available on Cardinal Drive which can provide water servicing for the subject property. It is our understanding from the city as-built drawing that the site is already water serviced, the existing water service to be removed or abandoned prior to construction.

A new 200mm PVC water service has been proposed from the existing 300mm municipal watermain on Cardinal Drive to service the subject development. **DWG-2** in **Appendix C** represents the water service connection for the proposed development.

Hydrant flow test is recommended for the hydrant on Cardinal Drive prior to approval to know the available domestic and fire flow in the vicinity of the development. **Appendix D** represents the domestic water and fire flow assessment for the subject site.

2.3. STORMWATER MANAGEMENT ANALYSIS AND DESIGN

There is an existing 2.4mx1.8m municipal concrete box culvert available on Thorold Stone Road which can be utilized for the storm outlet for the subject development. Onsite stormwater management storage will require controlling the post-development peak flows to pre-development conditions. Proposed storm service connection for the site has been provided from Thorold Stone Road.

DWG-2 represents the storm servicing and location of the onsite storage tank system. **DWG-3** shows the proposed site grading plan, **DWG-5** represents storm drainage area plan and **Table C1** represents storm sewer analysis and design calculations for the subject site in **Appendix C.**

2.3.1. RAINFALL DATA & STORMWATER MODELING

The Chicago 3-hour storm has been used to determine the pre-development and post-development peak flows and onsite storage. Chicago storms are considered to a better estimate for the urban development peak flows. The stormwater management simulation was completed using SWMHYMO hydrologic model in conformance with the City of Niagara Falls engineering standards. The model has been widely used in similar hydrologic analyses related to stormwater management across the province of Ontario and recognized as a reliable modelling tool available to simulate the hydrologic response to both rural and urban watershed under difference storm events.

2.3.2. PRE-DEVELOPMENT CONDITIONS

Pre-development analysis was performed based on the existing topographic survey. The subject site drains from north to south towards Thorold Stone Road. The allowable discharge rate for the site has been established based on pre-development conditions using CALIB NASHYD commend in SWMHYMO. **Figure E1** in **Appendix E** represents the pre-development drainage area boundary.

Table 1 represents a summary of hydrological parameters which has been utilized to develop the SWMHYMO model for the pre-development conditions.

Table 1: SWMHYMO MODEL INPUT PARAMETERS - PRE-DEVELOPMENT CONDITIONS				
AREA ID	AREA (HA)	CN	INITIAL ABSTRACTION (IA) mm	TIME OF PEAK (TP) HRS
101	0.80	75	0.80	0.26

Using the **Table 1** pre-development input parameters, the SWMHYMO model was simulated for 5-year and 100-year design storm events. A summary of the pre-development peak flows is depicted in **Table 2.** Refer to **Appendix E** for SWMHYMO model pre-development conditions output files.

Table 2: PEAK FLOWS (cms) - PRE-DEVELOPMENT CONDITIONS 3HOUR CHICAGO STORM			
AREA ID	AREA (HA)	5 YEAR FLOW (cms)	100 YEAR FLOW (cms)
101	0.80	0.025	0.058
Total	**0.80**	**0.025**	**0.058**

2.3.3. POST-DEVELOPMENT CONDITIONS

Overall proposed site grading has been established based on the proposed site plan layout and existing topography to minimize the cut and fill for the entire site. Under the post-development conditions, the site has been proposed to drain towards the existing box culvert on Thorold Stone Road at the allowable pre-development discharge rate during post-development conditions. **Figure E2** represents the post-development drainage area plan in **Appendix E**.

Table 3 represents a summary of the hydrological model parameters which has been used in the assessment of post development peak flows.

Table 3: SWMHYMO MODEL INPUT PARAMETERS - POST-DEVELOPMENT CONDITIONS									
AREA ID	AREA (HA)	CN	IMP (%)	LGI - Flow Length (m)	AVERAGE SLOPE (%)	IAPER (PERV.) (mm)	IAIMP (IMPERV.) (mm)	MNP (PERV.)	MNI (IMPERV.)
201	0.80	75	66	73	2.0	0.8	0.7	0.25	0.013

Using the **Table 3** post-development hydrological parameters, the SWMHYMO model was simulated for 2-year and 5-year design storm events. A summary of the post-development peak flows is depicted in **Table 4.** Refer to **Appendix E** for SWMHYMO model post-development conditions output files.

Table 4: PEAK FLOWS (cms) - POST-DEVELOPMENT CONDITIONS 3HOUR CHICAGO STORM (UNCONTROLLED)			
AREA ID	AREA (HA)	5 YEAR FLOW (cms)	100 YEAR FLOW (cms)
201	0.80	0.126	0.209
Total	**0.80**	**0.126**	**0.209**

2.3.4. STORMWATER QUANTITY CONTROL DESIGN

The proposed development will require onsite stormwater quantity control. The outflow rate of the site will be based on post-development outflow to match with pre-development conditions. The onsite stormwater quantity control will be established by providing stormwater storage in ADS underground chambers or equivalent which will detain storm runoff and control the post-development flows to pre-development conditions. The outlet of the proposed storage tank will be discharged to the existing 2.4mx1.8m municipal box culvert on Thorold Stone Road.

Table 5 depicts the hydrologic simulation results of the proposed onsite stormwater storage system. **Appendix E** represents the SWMHYMO output files for the onsite stormwater quantity control.

Table 5: POST-DEVELOPMENT CONDITIONS 3HOUR CHICAGO STORM ONSITE STORMWATER MANAGEMENT QUANTITY CONTROL		
Description	**5 YEAR STORM EVENT**	**100 YEAR STORM EVENT**
PRE-DEVELOPMENT PEAK FLOWS - ALLOWABLE DISCHARGE FLOW RATE FOR THE SITE (cms) (Area 101)	0.025	0.058
UNCONTROLLED POST-DEVELOPMENT PEAK FLOWS (cms) (Area 201)	0.126	0.209
OUTFLOW RATE BASED ON REQUIRED STORAGE (cms) (Area 201)	0.024	0.038
REQUIRED ONSITE STORAGE (m^3)	112.0	211.0

It has been noted in **Table 5** that the controlled post development peak flows are equal or less than pre-development peak flows. **Appendix E** represents SWMHYMO model output files.

The post-development outflow rate will be discharged through the proposed 123mm orifice in the 375mm storm sewer which will be connected to the existing 2.4mx1.8m box culvert on Thorold Stone Road. The ADS chamber or equivalent stormwater storage system, inlet and outlet will be provided in the parking area as shown on the servicing plan in **Appendix C**. Stage, storage, discharge and orifice size calculations are presented in **Appendix E**.

Design for the storage chamber system was completed by ADS Inc. and included in **Appendix F**.

2.3.5. STORMWATER QUALITY CONTROL DESIGN

City of Niagara Falls will require Level 2 (Normal) 70% long term suspended solids removal for stormwater quality treatment for the subject site. Stormwater quality will be controlled by providing oil and grit separator (OGS) upstream of the storage system which will control the stormwater quality. Ministry of Environment, Conservation and Parks (MECP) Level 2 (Normal) water quality criteria has been used to size the required OGS.

Design for the OGS was completed by ADS Inc. and included in **Appendix F.**

3.0 EROSION AND SEDIMENT CONTROL MEASURES

Erosion and sedimentation control measures must be implemented onsite during pre-grading activities, construction of primary and secondary services. All erosion and sediment control measures shall follow the manual "Erosion & Sediment Control Guideline for Urban Construction – December 2006".

Design and implementation of an affective erosion control plan is very important for minimizing potential adverse environmental affects originating from onsite construction activities. Site specific erosion control measures can prevent erosion during construction to deal with sediments at the source and reduce the sediment transport from the construction site. Erosion control mitigation measures must be implemented through regular maintenance and monitoring specially after any storm event until the entire site has been constructed and all proposed/disturbed grass areas are stabilized.

Sediment transport during construction can be prevented by installation of sediment/silt control fence around the perimeter of the site. Sediment control fence consists of non-woven synthetic fabric material (geotextile) stretched across attached to the supporting post and wire fence. This measure significantly reduces the amount of sediment leaving the construction site and decrease the velocity of flow. Silt fence shall be installed as per OPSD – 219.130.

It is also required to provide storm drain inlet protection which consists of control the sediment entering into existing and proposed rear yard and street catch basins prior to the permanent stabilization of disturbed areas. Rear yard catch basins grate shall be covered by the filter cloth material with clear stone material whereas street catch basins will require to provide silt sack under the grate in the street catch basin.

It is recommended to lower the grade at the property approximately between 100mm and 150mm below the top of curb during pre-grading activity so that sediment leaving the site can be reduced. Vehicle tracking control/mud mats are also required to install at the entrance of construction site to prevent sediment transport from the construction site as per the erosion control guidelines.

DWG 4 in **Appendix C** represents Erosion and Sediment Control Plan.

4.0 CONCLUSION SUMMARY

Following are the conclusions for this functional servicing and stormwater management report:

1. There are adequate servicing infrastructures available to service the proposed development.

2. Proposed grading for the entire site has been designed with respect to existing grades all around the subject property and the proposed grades within the site have been set to minimize cut/fill in the proposed development.

3. Municipal sanitary sewers are available in the vicinity of the development and the proposed site will be serviced from the existing 525mm sanitary sewer available on Cardinal Drive.

4. The existing 300mm municipal watermain available on Cardinal Drive will be utilized for the domestic and fire demand for the site. Hydrant flow test is recommended for the hydrants on Cardinal Drive prior to approval to know the available domestic and fire flow in the vicinity of the development.

5. Onsite stormwater management quantity and quality controls are required for the subject development. Quantity control will require to control the post-development peak flow conditions to match pre-development peak flow conditions. Onsite storage has been designed to maintained by providing underground storage tank system with an orifice control outlet discharge into the existing municipal box culvert on Thorold Stone Road. Stormwater quality will be maintained by providing OGS upstream of the storage system.

6. Functional servicing and stormwater management design concepts presented in this report shall be used as a basis for the detailed engineering design for the proposed development of the site.

7. Erosion and sedimentation control measures must be implemented onsite during pre-grading activities, construction of primary and secondary services to reduce the potential adverse environmental affects originating from onsite construction activities.

In conclusion, proposed sanitary, water and stormwater management servicing provided in this report are sufficient and in accordance with the City of Niagara Falls current development engineering design guidelines.

Respectfully Submitted By:

ARIK ENGINEERING LTD.

_____

Abdul Razzak, MEng., P.Eng.

APPENDIX A

Figure A1: Site Plan

Figure A2: Existing Topography

KEY PLAN

GENERAL NOTES:
ALL DRAWINGS AND DETAILS INCLUDED ARE FOR REFERENCE ONLY.

NO.	REVISION/ISSUE	DATE

NORTH

SEAL

PROJECT TITLE

CARDINAL MEADOWS
#33 TOWN HOUSES DEVELOPMENT

PROJECT ADDRESS

3958 CARDINAL DRIVE
NIAGARA FALLS, ON

OWNER

12604515 CANADA CORPORATION

CONCEPTLINES INC .CA
349 Beach Blvd. Hamilton ON L8H 6W4
Email: feed@conceptlines.ca
www.conceptlines.ca
Tel: 289-919-0607

Drawing title:

Buildings Foot Print and Areas

Scale: 1 : 200

Date: JUNE 2023

Project No. 2022-12

Drawing No. A104

FIGURE A1- SITE PLAN

City of Niagara Falls

Address:	3958 Cardinal Drive - Niagara Fall ON
Zoning:	R4-815
Proposed Zoning:	R4

House TYPE	Elevation Option	1ST FLOOR		2ND FLOOR		3RD FLOOR		GFA PER UNIT		# UNITS	TOTAL GFA	
		M²	FT.SQ	M²	FT.SQ	M²	FT.SQ	M²	FT.SQ		M²	FT.SQ
Type-1 unit - (*Typ. End Units*)	A	35.15	378.4	71.38	768.38	71.38	768.37	177.92	1'915.15	2	355.84636	3'830.30
Type-1 unit - (*Typ. End Units*)	B	35.15	378.4	71.82	773.04	71.82	773.04	178.79	1'924.48	2	357.57993	3'848.56
Type-2 unit - (*Typ. Middle Units*)	A	30.07	323.66	59.23	637.51	59.23	637.51	148.52	1'598.68	12	1782.266	19'184.16
Type-2 unit - (*Typ. Middle Units*)	B	30.07	323.66	59.60	641.51	59.60	641.51	149.27	1'606.68	17	2537.5117	27'313.56
Total GFA										**33**	**5033.204**	**54'176.98**

Includes 3 Bedrooms, Kitchen, Dining Room, Living Room

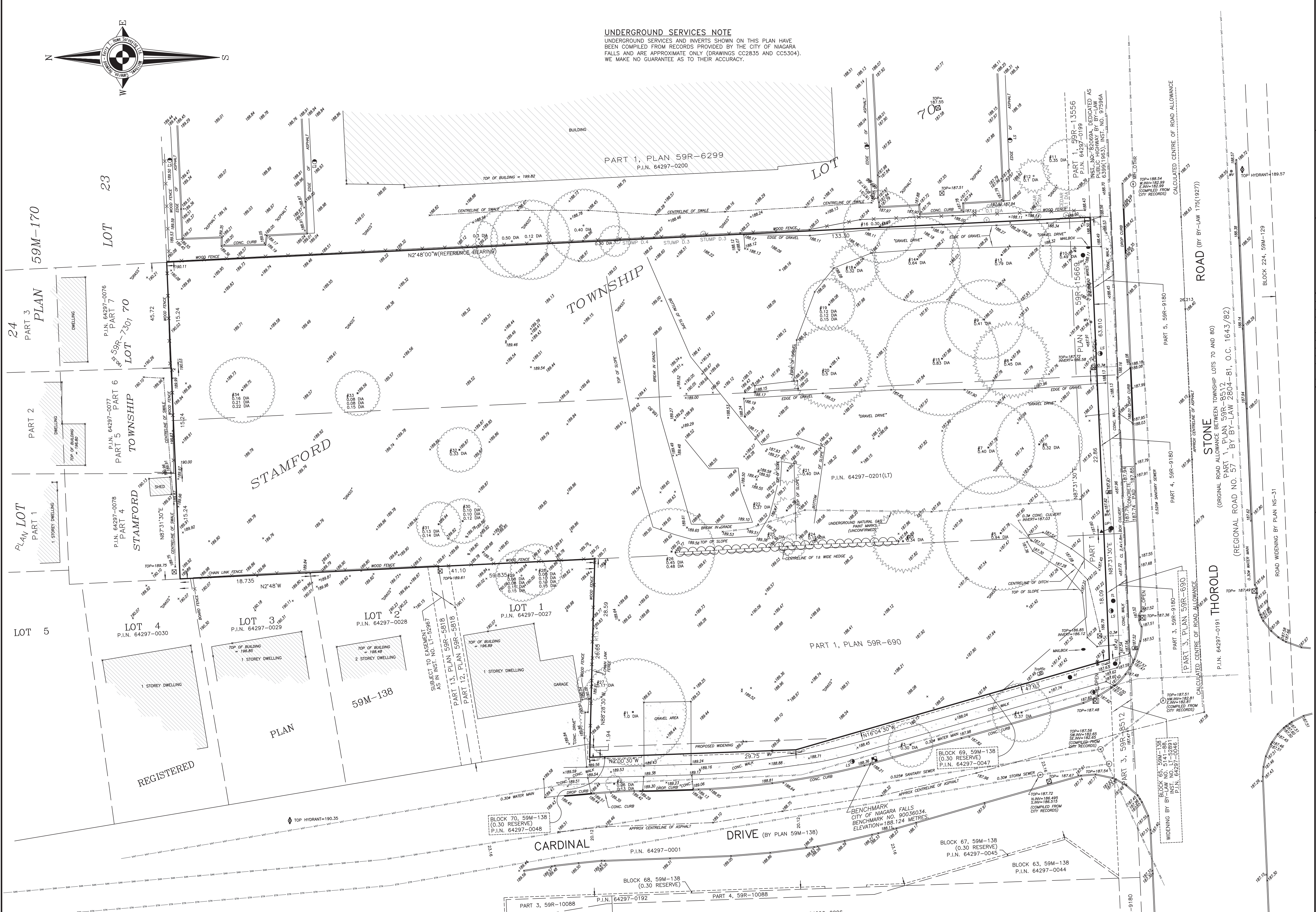


FIGURE A2- EXISTING TOPOGRAPHY

TOPOGRAPHIC SKETCH OF

PART OF LOT 70

(GEOGRAPHIC TOWNSHIP OF STAMFORD)

CITY OF NIAGARA FALLS

REGIONAL MUNICIPALITY OF NIAGARA

SCALE 1 : 250

5 0 5 10 15 metres

2023

SURVEYOR'S CERTIFICATE

I CERTIFY THAT THE FIELD WORK REPRESENTED ON THIS SKETCH WAS COMPLETED DECEMBER 5, 2023.

Jan 13, 2023
DATE

Dasha Page
ONTARIO LAND SURVEYOR

J.D.BARNES LIMITED
SURVEYING MAPPING GIS
LAND INFORMATION SPECIALISTS
4318 PORTAGE ROAD, UNIT 2, NIAGARA FALLS, ON L2E 6A4
T: (905) 358-3693 F: (905) 358-6224 www.jdbarnes.com

REV#	DATE	REMARKS
0	May 8, 2007	FIRST RELEASE
1	May 16, 2007	addition of overhead wires
2	Dec 3, 2015	removal of buildings, retaining walls and overhead wires. Additional features and elevations
3	Dec. 18, 2015	additional topo, hydrants, water valves
4	Jan. 4, 2016	curbs across Cardinal Drive
5	Feb. 2, 2016	legal limits across Cardinal Drive
6	Oct. 3, 2016	new widening
7	Dec. 5, 2022	addition of Concrete Pad on Thorold Stone Road, update coordinates to UTM, new proposed widening
8	Jul 10, 2023	additional trees

NOTES

MONUMENTATION NOTE

ALL FOUND MONUMENTATION SHOWN ON THIS PLAN WAS PLANTED BY MATTHEWS, CAMERON, HEYWOOD – KERRY T. HOWE SURVEYING LTD. OR A PREDECESSOR FIRM UNLESS OTHERWISE STATED.

ELEVATION NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO CITY OF NIAGARA FALLS BENCHMARK NO. 90036034. ELEVATION=188.124 METRES.

METRIC NOTE

DISTANCES/ELEVATIONS SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

LEGEND

DENOTES LIGHT STANDARD
" CATCH BASIN
" MANHOLE
" SPOT ELEVATION(METRES) (X DENOTES LOCATION)
" TRAFFIC SIGN
" UTILITY POLE
" BELL PEDESTAL
" CABLE PEDESTAL
" HYDRANT
" SHRUB
" CONIFEROUS TREE
" DECIDUOUS TREE
" BUILDING

WV DENOTES WATER VALVE
GV " GAS VALVE
TL " TRAFFIC LIGHT
BD " BOLLARD
" GUY WIRE ANCHOR
" BENCH
" BOREHOLE
" GAS METER
" GROUND LIGHT
" HOSEBIB
" JUNCTION BOX
" ELECTRICAL OUTLET
" RAILWAY SIGNAL
" RAILWAY SWITCH
" SPRINKLER
" TREE STUMP
" PARKING METER
" CLEANOUT

FENCE

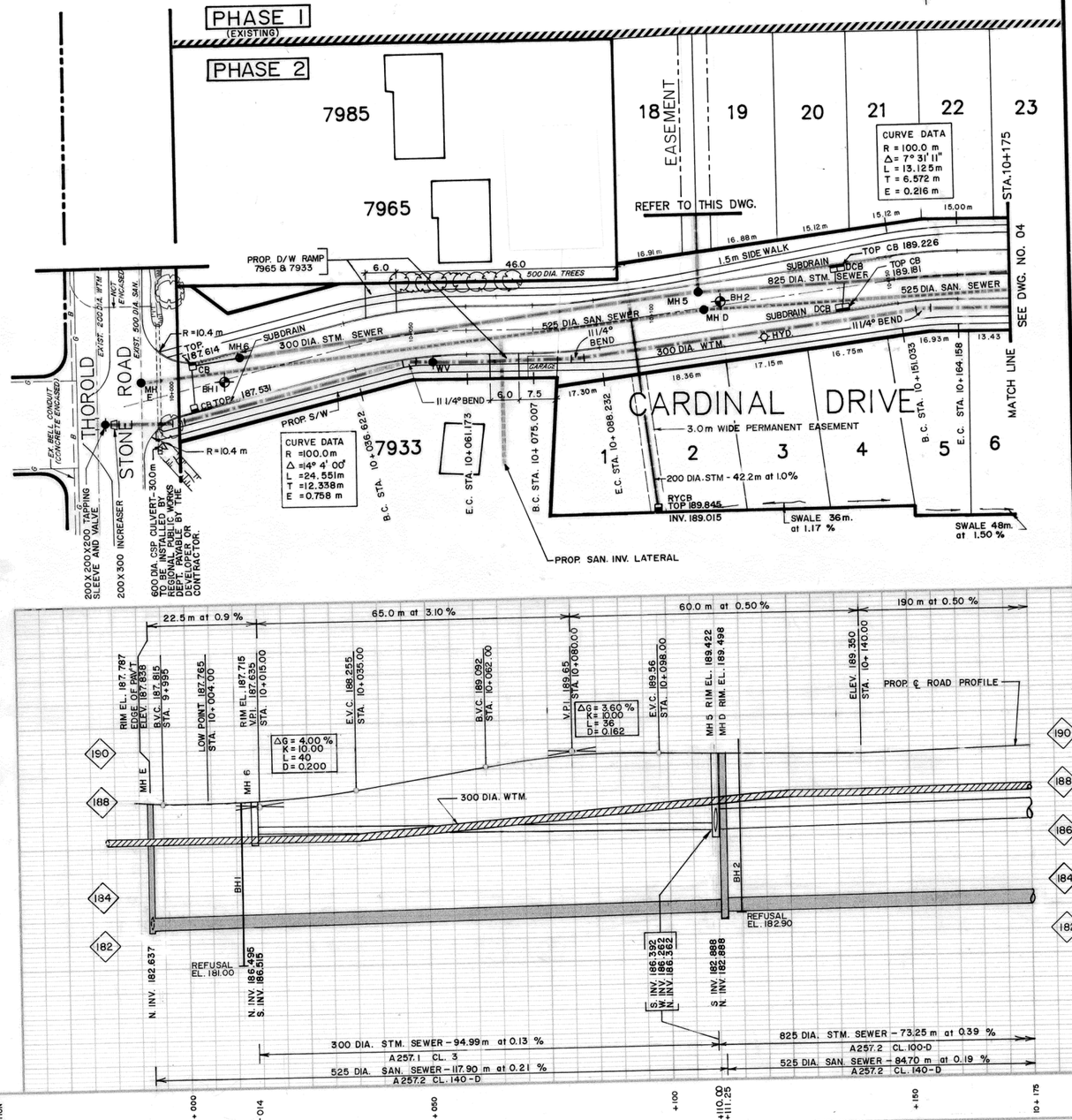
PROPERTY LINE

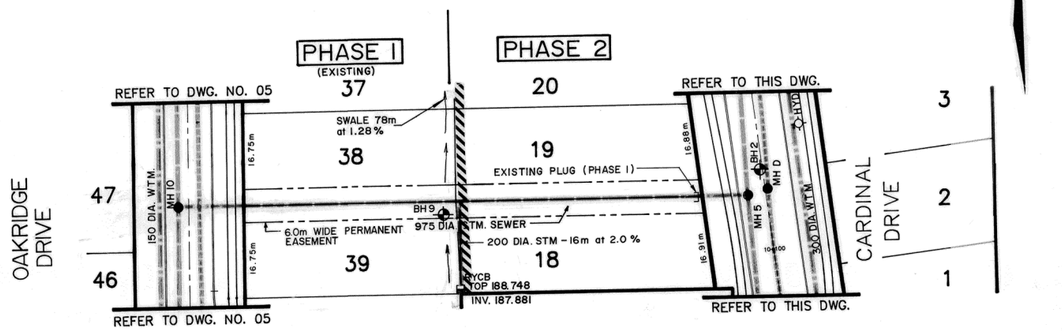
CAUTION
PRIOR TO CONSTRUCTION CONTRACTOR SHALL VERIFY & CONFIRM LOCATION OF APPURTENANT FEATURES.

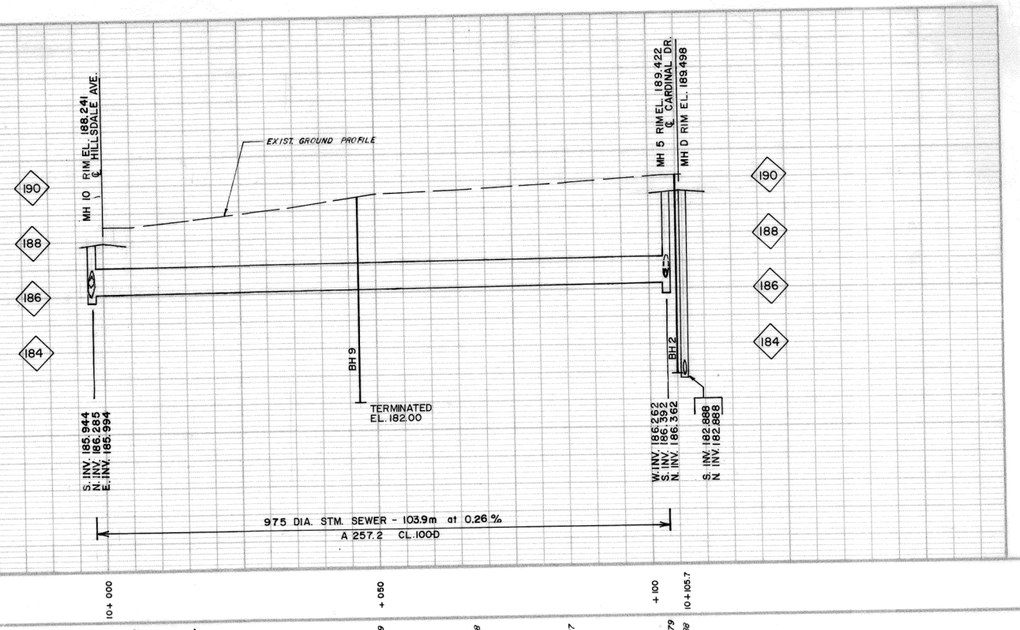
REF No.22-16-295-00 | 1:250

APPENDIX B

As-Built/Existing Drawings







NOTES:

(1) THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY ON THE CONSTRUCTION DRAWINGS AND WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.
(2) BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
(3) HYDRO AND BELL POLES ARE TO BE ANCHORED TO THE GROUND WHERE REQUIRED SO AS TO ENSURE THE STABILITY OF THE POLE LINES.
(4) THE CONTRACTOR IS TO CHECK WITH ALL UTILITIES INVOLVED.
(5) ALL MANHOLE FRAMES, CATCHBASIN FRAMES, WATER VALVES AND GAS VALVES ARE TO BE ADJUSTED TO FINISH GRADE.
(6) ALL MEASUREMENTS ARE IN METRES UNLESS OTHERWISE NOTED.
(7) MIN. COVER ON WATERMAIN TO BE 1.5m.
(8) ALL PROPOSED ROAD DIMENSIONS ARE FROM LIP/GUTTER TO LIP/GUTTER
(9) ALL SEWERS, LEADS AND LATERALS SHALL HAVE CL.'B' BEDDING AND NATIVE BACKFILL UNLESS OTHERWISE NOTED
(10) ALL SANITARY SEWERS SHALL BE DR-35 PVC PIPE AND LATERALS (100 DIA) SHALL BE DR-28 PVC. PIPE
(11) ALL STORM SEWERS ROADSIDE CB LEADS (250 DIA) AND RYCB LEADS (200 DIA.) SHALL BE CSA 257-74
(12) ALL SANITARY MANHOLES ON CARDINAL DRIVE TO HAVE SAFETY GRATING
(13) ALL WATERMAINS SHALL BE D.I. CL.52 OR PVC. DR-18 CL 150 PIPE WITH CL.'B' BEDDING AND NATIVE BACKFILL UNLESS OTHERWISE NOTED
(14) ALL CATCHBASINS ARE TO HAVE 10.0m PERFORATED PIPE LAID UPSTREAM
(15) ALL STORM LATERALS SHALL BE DR-28 PVC.

LEGEND

LS LIGHT STANDARD
TL TRAFFIC LIGHT
S SIGN
B BELL POLE
H HYDRO POLE
HYD HYDRANT
MANHOLE EXISTING
MANHOLE PROPOSED
CATCHBASIN EXISTING
CATCHBASIN PROPOSED
GUY & ANCHOR
STANDARD IRON BAR

The City of Niagara Falls Canada

NO.	DESCRIPTION	APP'D	DATE
7	ISSUED FOR CONSTRUCTION PHASE 2	ZA	AUG. 1988
6	ISSUED FOR TENDER	ZA	JULY 1988
5	ISSUED FOR CONSTRUCTION	ZA	JULY 1988
4	ISSUED FOR TENDER	ZA	APR. 1988
3	ISSUED FOR APPROVAL	ZA	OCT. 2087
9	ISSUED FOR TENDER		6-15 1988
8	CONSTRUCTION RECORD DRAWING	ZA	NOV. 1988

ISSUES AND REVISIONS

STAMPS

REGISTERED PROFESSIONAL ENGINEER Z. ALI PROVINCE OF ONTARIO

CONLIN
HEAD OFFICE :
176 KING STREET
WELLAND, ONT. L3B 3J5
(416) 735-5566
(416) 384-9600

CONLIN ENGINEERING & PLANNING LTD.
ENGINEERING
PLANNING
PROJECT MANAGEMENT
BRANCH OFFICES :
KENORA (807)468-5799
RED LAKE (807) 727-3172
LOMBARD (705) 566-8326
THUNDER BAY (807)623-2011

CIVIL	
ELEC.	
MECH.	
ARCH.	
SCALE	HOR. 1:500 VER. 1:100
DRAWN	T.K. R.D.
DATE	JUNE 1987
DESIGNED	ZA
CHECKED	
ISSUE NO.	8 9 3 4 5 6 7

FIELD NOTES

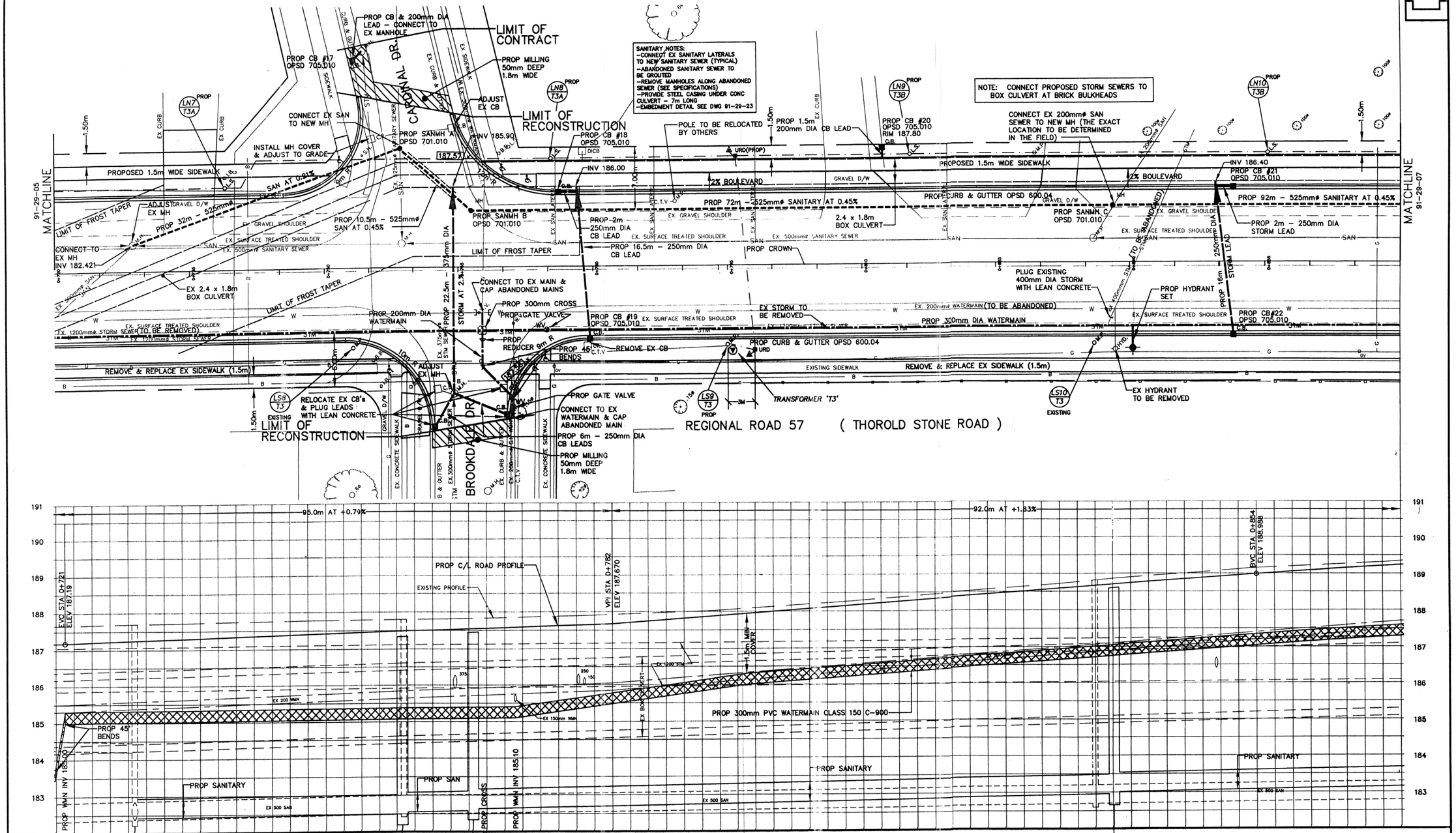
PROJECT: HILLSDALE ESTATES SUBDIVISION

DRAWING: CARDINAL DRIVE STA. 10+000 TO STA. 10+175 EASEMENT

PROJECT NO. 87115 DWG. NO. 03

CC-2835

CC-5304



STATION	0+720	0+721	0+738	0+750	0+765	0+767.54	0+771±	0+780	0+782	0+795	0+810	0+825	0+840	0+854	0+870	STATION
PROP C/L RD ELEV	187.18	187.19	187.30	187.42	187.54			187.65	187.67	187.91	188.18	188.46	188.73	188.99	189.24	PROP C/L RD ELEV
PROP SANITARY INVERT	NE 182.42		PROP 32m - 525mmø SANITARY SEWER AT 0.21% 100-D CONC		SW 182.46 SE 182.54	PROP 10.5m 525mmø SAN AT 0.45% 100-D CONC		NW 182.59 E 182.64		PROP 72m - 525mmø SANITARY SEWER AT 0.45% 100-D CONC			W 182.96 E 183.01	PROP 92m - 525mmø SANITARY SEWER AT 0.45% 100-D CONC		PROP SANITARY INVERT

JUN 11 1997

No.	REVISION	DATE	INIT.
3	ADD SANITARY REPLACEMENT	JUNE 10/97	GW
2	FOR PHASE THREE TENDER	MAR 1997	GW
1	FOR PHASE TWO TENDER	JAN 1996	GW

GENERAL NOTES:

1) THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND ABOVE-GROUND 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, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME LIABILITY FOR DAMAGE TO THEM.

2) CHECK ALL DIMENSIONS AND REPORT ANY INCONSISTENCIES TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK - DO NOT SCALE DRAWINGS.

3) THIS DRAWING IS AN INSTRUMENT OF PROFESSIONAL SERVICE AND IS INTENDED FOR USE ONLY IN CONNECTION WITH THE PROJECT COVERED BY THE ENGINEERING AGREEMENT.

4) ROBERT M. MARTIN ENGINEERING & PROJECT MANAGEMENT INC. DOES NOT ASSUME ANY RESPONSIBILITY FOR LOSSES, DAMAGES AND COSTS ARISING FROM USE OR REUSE OF THIS DRAWING BY PERSONS, FIRMS OR CORPORATIONS WITHOUT PRIOR WRITTEN CONSENT OF ROBERT M. MARTIN ENGINEERING INC.

5) COPYRIGHT (c) ROBERT M. MARTIN ENGINEERING & PROJECT MANAGEMENT INC., 1996. ALL RIGHTS RESERVED. NO PART OF THIS DRAWING MAY BE REPRODUCED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN PERMISSION OF ROBERT M. MARTIN ENGINEERING INC.

6) BOREHOLE DATA SHOWN ON THE DRAWINGS IS TAKEN FROM THE GEOTECHNICAL REPORT PREPARED BY THE GEOTECHNICAL ENGINEERING CONSULTANTS. ROBERT M. MARTIN ENGINEERING INC. ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THIS INFORMATION.

DRAFTING AK CADD
DESIGN GW
CHECKED BY RMM

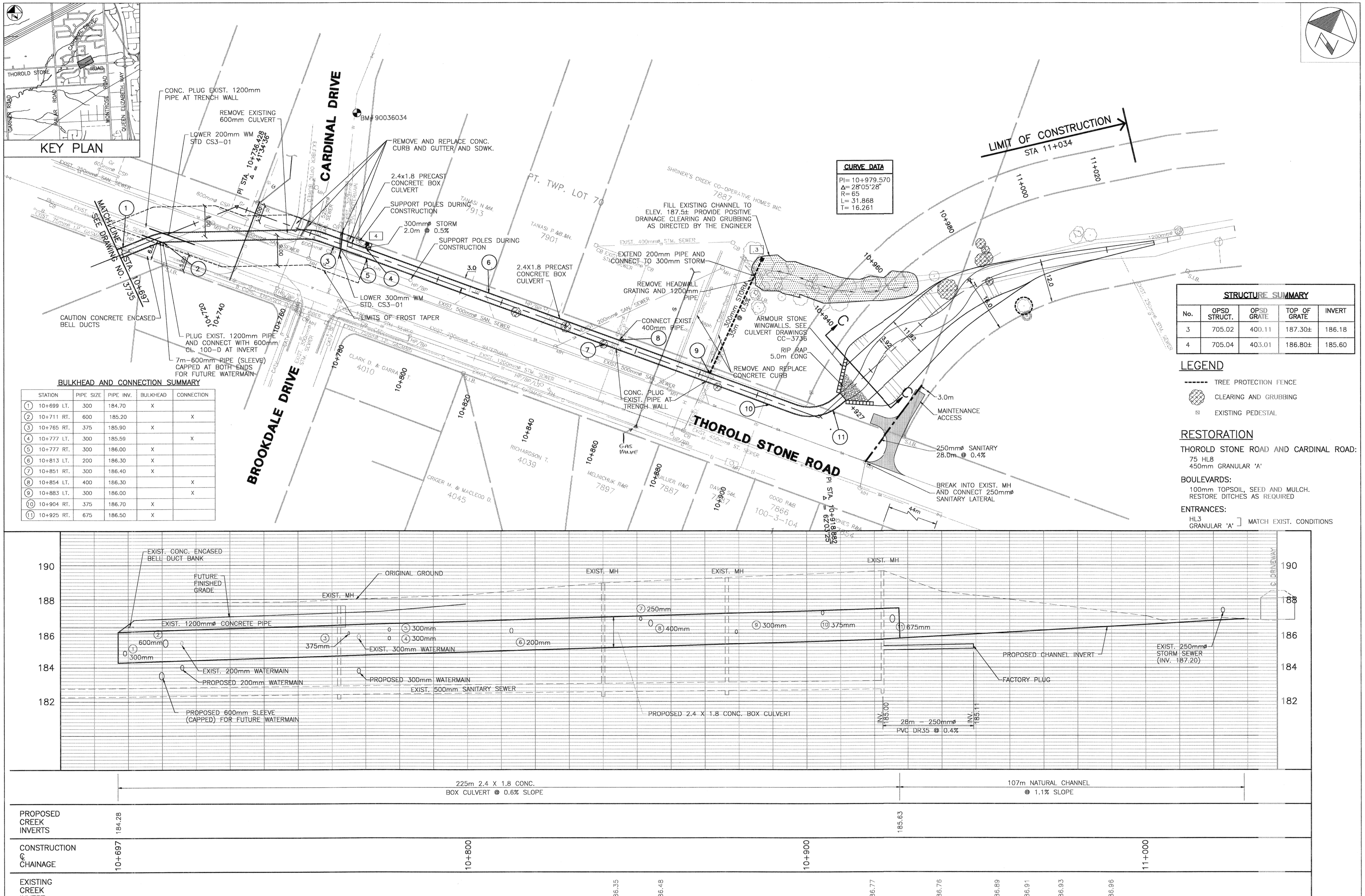
S. WAGENAAR 1990 REGISTERED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

Robert M. Martin Engineering & Project Management Inc.
8 Centre Street, St. Catharines
Ontario. L2R 3A7
Phone (905) 687-4020
Fax (905) 687-4164

REGIONAL MUNICIPALITY OF NIAGARA
WIDENING OF THOROLD ST. RD. (REG. RD. 57)
THOROLD STONE ROAD
STA 0+720 TO 0+870
NIAGARA FALLS, ONTARIO

FILENAME	A-TSRD95.DWG
DATE	MAR 1996
PLOT DATE	
SCALE	1:200 1:50
DWG. No.	91-29-06
MUN. REF. No.	REV. 3

97-DE-99



BULKHEAD AND CONNECTION SUMMARY

STATION	PIPE SIZE	PIPE INV.	BULKHEAD	CONNECTION
(1) 10+699 LT.	300	184.70	X	
(2) 10+711 RT.	600	185.20		X
(3) 10+765 RT.	375	185.90	X	
(4) 10+777 LT.	300	185.59		X
(5) 10+777 RT.	300	186.00	X	
(6) 10+813 LT.	200	186.30	X	
(7) 10+851 RT.	300	186.40	X	
(8) 10+854 LT.	400	186.30		X
(9) 10+883 LT.	300	186.00		X
(10) 10+904 RT.	375	186.70	X	
(11) 10+925 RT.	675	186.50	X	

STRUCTURE SUMMARY

No.	OPSD STRUCT.	OPSD GRATE	TOP OF GRATE	INVERT
3	705.02	400.11	187.30±	186.18
4	705.04	403.01	186.80±	185.60

LEGEND

- TREE PROTECTION FENCE
- CLEARING AND GRUBBING
- EXISTING PEDESTAL

RESTORATION

THOROLD STONE ROAD AND CARDINAL ROAD:
75 HL8
450mm GRANULAR 'A'

BOULEVARDS:
100mm TOPSOIL, SEED AND MULCH.
RESTORE DITCHES AS REQUIRED

ENTRANCES:
HL3
GRANULAR 'A'] MATCH EXIST. CONDITIONS

	REVISION	DATE	INIT.
1	ISSUED FOR TENDERING	23/05/96	
0	ISSUED FOR APPROVAL	03/96	

NOTES:

1- SEE DRAWING CC-3734, CC-3737 AND CC-3738 FOR ADDITIONAL NOTES AND DETAILS AND CC-3742 FOR PLANTING PLAN

LEGEND

LS LIGHT STANDARD
TL TRAFFIC LIGHT
S SIGN
B BELL POLE
H HYDRO POLE
HYD. HYDRANT
GUY AND ANCHOR
MANHOLE EXISTING
MANHOLE PROPOSED
CATCHBASIN EXISTING
CATCHBASIN PROPOSED
S.I.B. STANDARD IRON BAR

UNDERGROUND UTILITIES
H HYDRO CABLES
W WATERMAINS
G GASMAINS
B BELL CABLES
CAP OR PLUG
300-SAN. SANITARY SEWER
300-STM. STORM SEWER
300-COMB. COMBINED SEWER

DRAFTING M.B.K.
DESIGN M.B.K.
CHECKED BY R.B.S.
PROJ. SUPVR. R.B.S.

The City of Niagara Falls

Philips Planning + Engineering Limited

BENCH MARK DATUM
City of Niagara Falls BM # 90036034 Iron Pipe with brass cap on the east side of Cardinal Drive. Sta. 10+759 o/s 37m Left. Elev. 188.124m

SHRINER'S CREEK W-5-2 BRANCH WATERCOURSE SYSTEM IMPROVEMENTS CITY OF NIAGARA FALLS

THOROLD STONE RD.
CARDINAL DR. TO 190m EAST OF CARDINAL DR.
STA. 10+800 TO STA. 11+005

FIELD NOTES
DATE -
SCALE HOR. 1:500 VER. 1:100
DWG No. SHEET 3 OF 11
MUN. REF. No. CC-3736
REV. 1

May 17/96 - 94016-03

CC-3736

APPENDIX C

ENGINEERING DRAWINGS:

Cover Page

DWG 1: General Notes and Details

DWG 2: Site Servicing Plan

DWG 3: Site Grading Plan

DWG 4: Erosion & Sediment Control Plan

DWG 5: Storm Drainage Area Plan

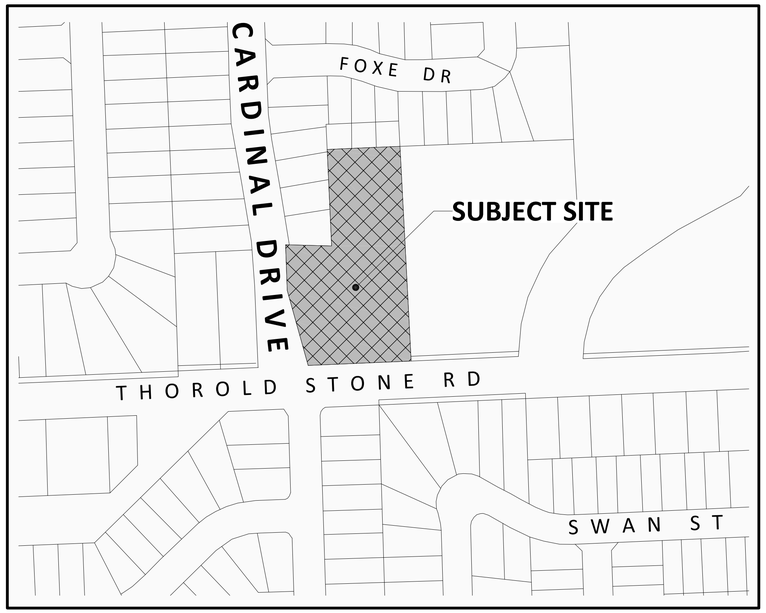
Table C1: Storm Sewer Analysis & Design Calculations

ARIK ENGINEERING LTD.
Where Community Design & Develop

260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

MUNICIPALITY: CITY OF NIAGARA FALLS

3958 CARDINAL DRIVE



KEY PLAN
N.T.S

LIST OF DRAWINGS

DWG-1	GENERAL NOTES AND DETAILS
DWG-2	SITE SERVICING PLAN
DWG-3	SITE GRADING PLAN
DWG-4	EROSION & SEDIMENT CONTROL PLAN
DWG-5	STORM DRAINAGE AREA PLAN

OWNER:
12604515 CANADA CORPORATION

JULY 10, 2023

PROJECT NUMBER: 22181

MUNICIPALITY: CITY OF NIAGARA FALLS

3958 CARDINAL DRIVE

STANDARD NOTES FOR PRIMARY & SECONDARY SERVICES:

A. SEWERS

SANITARY AND STORM SEWERS

a) CONSTRUCTION OF SANITARY AND STORM SEWERS AND PRIVATE SERVICES SHALL BE IN ACCORDANCE WITH CITY OF NIAGARA FALLS STANDARDS & SPECIFICATIONS (LATEST EDITION) AND MINISTRY OF ENVIRONMENT AND CONSERVATION PARKS (MECP) GUIDELINES (LATEST EDITION).

b) COVER AND BEDDING MATERIAL FOR CONCRETE PIPE SHALL BE GRANULAR 'A' MATERIAL AS PER OPSD 802.030 OR 802.033, CLASS 'B' BEDDING, OR AS PER GEOTECHNICAL SPECIFICATIONS.

c) COVER AND BEDDING MATERIAL FOR PVC PIPE SHALL BE GRANULAR 'A' MATERIAL AS PER OPSD 802.010 OR 802.013 OR AS PER GEOTECHNICAL SPECIFICATION.

d) ALL SEWERS SHALL BE CLEANED AND FLUSHED PRIOR TO VIDEO INSPECTION.

e) MANHOLE FRAMES AND COVERS SHALL BE AS PER OPSD 401.010 (STORM-OPEN, SANITARY-CLOSED).

f) SANITARY SEWER (200MM TO 675MM DIA) SHALL BE PVC PIPE, CSA B182.2. SDR-35.

g) STORM SEWER (300MM TO 600MM DIA.) SHALL BE PVC PIPE, CSA B182.2, SDR-35.

h) STORM SEWER > 600MM DIA. SHALL BE CONCRETE PIPE, CSA A257.2 (AS SPECIFIED)

i) ALTERNATE MATERIALS MAY BE ACCEPTABLE IF APPROVAL HAS BEEN OBTAINED FROM THE CITY OF NIAGARA FALLS.

j) THE CONNECTION TO THE MAIN SANITARY SEWER SHALL BE MADE WITH APPROVED MANUFACTURED TEE. APPROVED SADDLES SHALL BE USED FOR CONNECTING TO EXISTING SEWER MAIN.

k) MINIMUM SLOPE FOR PRIVATE SERVICES TO BE 2.0%.

l) TOP OF SANITARY PRIVATE SERVICES AT STREET LINE TO BE 2.80M (MIN.) BELOW CENTRELINE ROAD ELEVATION AT THAT POINT OR AS DETAILED.

m) TOP OF STORM PRIVATE DRAINS AT STREET LINE TO BE 1.2M (MIN.) BELOW CENTRELINE ROAD ELEVATION AT THAT POINT OR AS DETAILED.

n) BUILDING RAINWATER LEADERS SHALL NOT BE CONNECTED TO THE STORM PRIVATE DRAIN BUT SHALL DISCHARGE ONTO THE GROUND SURFACE VIA SPLASH PADS.

o) SUMP PUMPS WITH CHECK VALVES SHALL BE INSTALLED IN THE BUILDING TO PUMP THE BUILDING WEEPING TILES TO THE GRADE OUTSIDE THE BUILDING IF REQUIRED. THE SUMP OUTLET PIPE SHALL EXTEND A MINIMUM OF 150MM ABOVE THE PROPOSED GRADE AT THE DWELLING .

CATCH BASINS

a. ALL CATCH BASIN CONNECTIONS TO BE 200mm DIA PVC CSA B182.2, SDR-35 OR AS DETAILED.

b. CATCH BASIN AS PER OPSD705.010.

c. CATCH BASIN COVER IN ASPHALT AREA AS PER OPSD 400.100.

d. CATCH BASIN COVER IN GRASS AREA SHALL BE BEEHIVE TYPE GRATE OR AS PER OPSD 400.120.

B. WATERMAINS AND WATER SERVICES

WATER SERVICES

a) GRANULAR A MATERIAL IS TO BE USED FOR BEDDING UNDER THE WATERMAIN. BALANCE OF TRENCH BACKFILL MATERIAL TO GROUND LEVEL IS ACCORDING TO COUNTY SPECIFICATIONS.

b) CONCRETE THRUST BLOCK OR APPROVED RESTRAINING DEVICES ARE REQUIRED AS PER OPSD-1103.010, 1103.020.

c) ALL VALVES, HYDRANTS WATER METERS TO BE INSTALLED AS PER CITY OF NIAGARA FALLS STANDARDS AND SPECIFICATIONS.

d) TO BE INSTALLED TO A MINIMUM COVER OF 1.7m.

C. ROADWORKS

1. SIDEWALKS, CURBS, AND GUTTERS

a) CONCRETE CURB AS PER OPSD 600.110 - (BARRIER TYPE).

b) CURB DEPRESSION AT DRIVEWAYS AS PER OPSD 600.040 AND OPSD 310-050.

c) 1.5M WIDE CONCRETE SIDEWALK AS PER CITY STANDARD AND SPECIFICATIONS.

d) MAXIMUM DRIVEWAY SLOPE NOT MORE THAN 8.0% AND NOT LESS THAN 2.0%.

e) 150MM FILTER WRAPPED CORRUGATED SUBDRAINS TO BE INSTALLED CONTINUOUSLY BELOW THE CURB AND GUTTER AND CONNECTED TO THE STORM OUTLET OR AS DETAILED ON SERVICING AND GRADING PLANS.

D. COMPACTION REQUIREMENTS

a) ALL BEDDING AND BACKFILL MATERIAL, ROAD SUB-GRADES AND GENERALLY ALL MATERIAL USED FOR LOT GRADING AND FILL SECTIONS, ETC., SHALL BE COMPACTED TO MIN. 100% SPD (UNLESS OTHERWISE RECOMMENDED BY THE GEOTECHNICAL ENGINEER). ALL MATERIAL SHALL BE PLACED IN LAYERS NOT EXCEEDING 300MM LIFTS.

b) ALL GRANULAR ROAD BASE MATERIALS SHALL BE COMPACTED TO 100% SPD.

c) FOR ALL SEWERS AND WATERMAINS IN FILL SECTIONS, THE COMPACTION SHALL BE CERTIFIED BY A GEOTECHNICAL ENGINEER PRIOR TO LAYING OF PIPE.

d) REFER TO GEOTECHNICAL REPORT FOR ADDITIONAL ON SITE SOIL INFORMATION AND RECOMMENDATION.

E. SILTATION AND EROSION CONTROL

a) SILTATION CONTROL BARRIERS SHALL BE PLACED AS DETAILED.

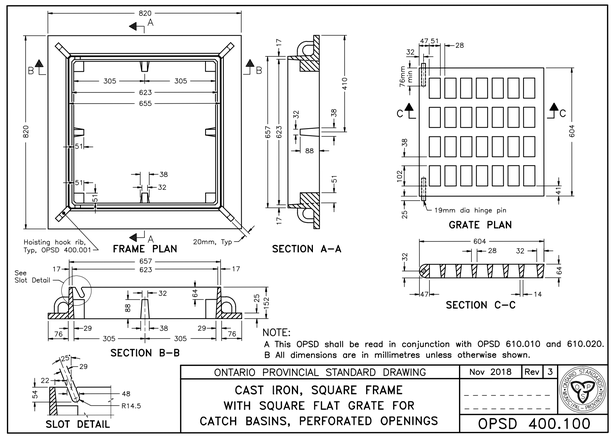
b) ALL SILTATION CONTROL MEASURES SHALL BE CLEANED AND MAINTAINED AFTER EACH RAINFALL AS DIRECTED AND TO THE SATISFACTION OF THE OF CITY OF NIAGARA FALLS.

c) ADDITIONAL SILT CONTROL LOCATIONS MAY BE REQUIRED AS DETERMINED BY THE CITY OF NIAGARA FALLS.

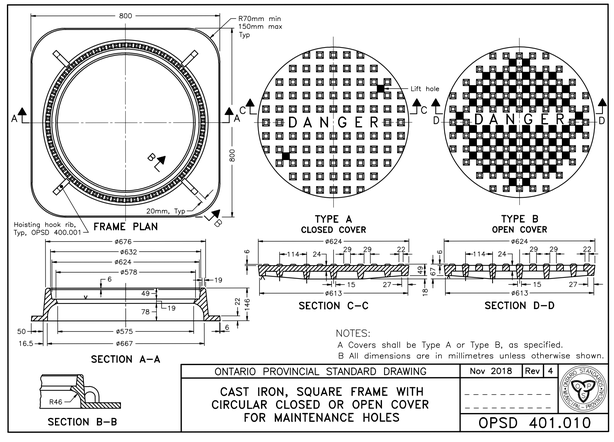
d) SEDIMENT CONTROL FENCES AS PER OPSD 219.130

F. GENERAL NOTES

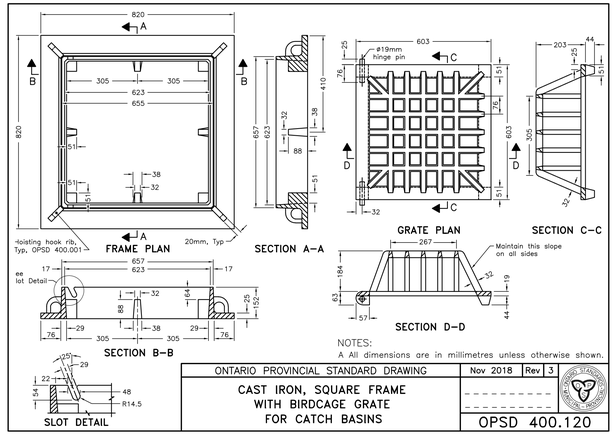
1. EXISTING SEWERS, WATERMAINS & UTILITIES ALIGNMENTS AND ELEVATIONS ARE ONLY PROVIDED FOR INFORMATION PURPOSES. THE CONTRACTOR ONSITE SHALL BE RESPONSIBLE TO LOCATE ALL EXISTING SEWERS, WATERMAINS & UTILITIES ALIGNMENT & ELEVATIONS PRIOR TO START OF CONSTRUCTION.
2. THE BIDDER/CONTRACTOR MUST REVIEW/VERIFY EXISTING SOIL CONDITIONS ONSITE.
3. THE CONTRACTOR WILL BE RESPONSIBLE FOR COSTS ASSOCIATED WITH THE CROSSING OF ANY EXISTING SEWERS, WATERMAINS AND UTILITIES INCLUDING ANY SUPPORTS AND PRECAUTIONS REQUIRED ON SITE SPECIFIC BASIS.
4. THE BIDDER/CONTRACTOR MUST VERIFY ALL DIMENSIONS ON ALL THE DRAWINGS. ANY ERRORS AND/OR OMISSIONS MUST BE REPORTED TO THE ENGINEER IMMEDIATELY.



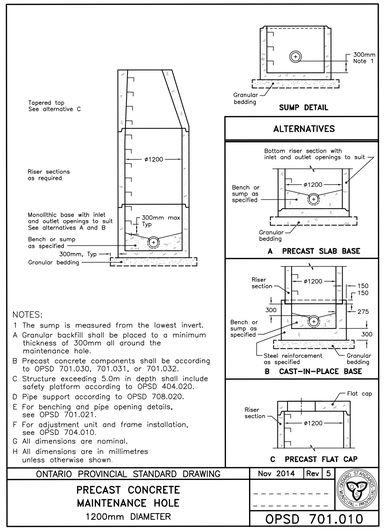
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 3
CAST IRON, SQUARE FRAME WITH SQUARE FLAT GRATE FOR CATCH BASINS, PERFORATED OPENINGS		OPSD 400.100



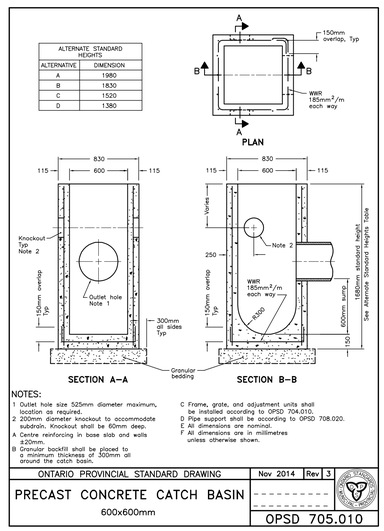
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 4
CAST IRON, SQUARE FRAME WITH CIRCULAR CLOSED OR OPEN COVER FOR MAINTENANCE HOLES		OPSD 401.010



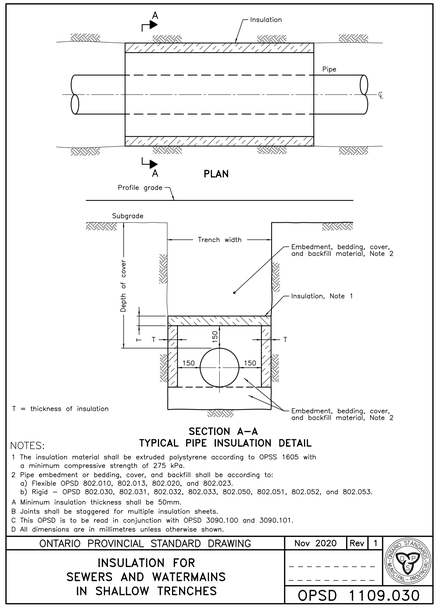
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 3
CAST IRON, SQUARE FRAME WITH BIRDCAGE GRATE FOR CATCH BASINS		OPSD 400.120



ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2014	Rev 5
PRECAST CONCRETE MAINTENANCE HOLE 1200mm DIAMETER		OPSD 701.010



ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2014	Rev 3
PRECAST CONCRETE CATCH BASIN 600x600mm		OPSD 705.010



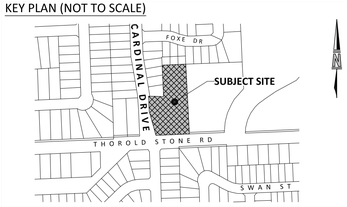
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2020	Rev 1
INSULATION FOR SEWERS AND WATERMAINS IN SHALLOW TRENCHES		OPSD 1109.030

ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

SITE BENCH MARK

- TOPOGRAPHIC INFORMATION IS BASED ON J.D BARNES LTD. DATED JANUARY 13, 2023.
- ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO CITY OF NIAGARA FALLS BENCHMARK NO. 90036034. ELEVATION = 188.124 METERS

KEY PLAN (NOT TO SCALE)



REVISIONS RECORD

No.	BY	DD/MM/YYYY	DESCRIPTION
1.	A.R	10/07/2023	FIRST SUBMISSION

NOT ISSUED FOR CONSTRUCTION

DATE: JULY 10, 2023

DESIGN BY: A.R

DRAWN BY: A.J

CHECKED BY: A.R

SCALE: N/A

LICENSED PROFESSIONAL ENGINEER — A. RAZZAK — 100505914 — JULY 10, 2023 — PROVINCE OF ONTARIO

ENGINEER'S STAMP

LEGEND

PROJECT: 3958 CARDINAL DRIVE

OWNER: 12604515 CANADA CORPORATION

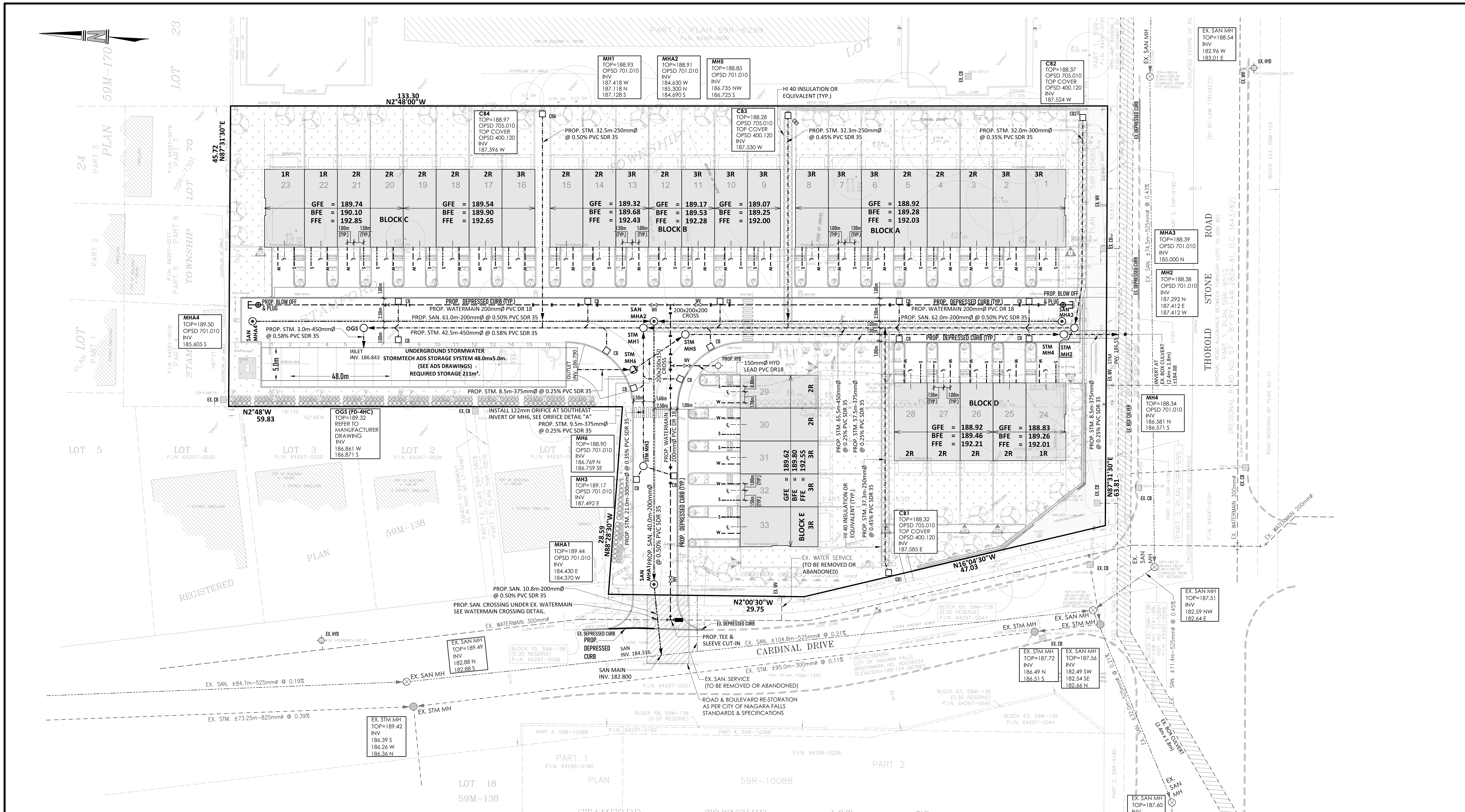
MUNICIPALITY: CITY OF NIAGARA FALLS

GENERAL NOTES AND DETAILS

PROJECT NUMBER: 22181

DRAWING: DWG-1

3958 CARDINAL DRIVE

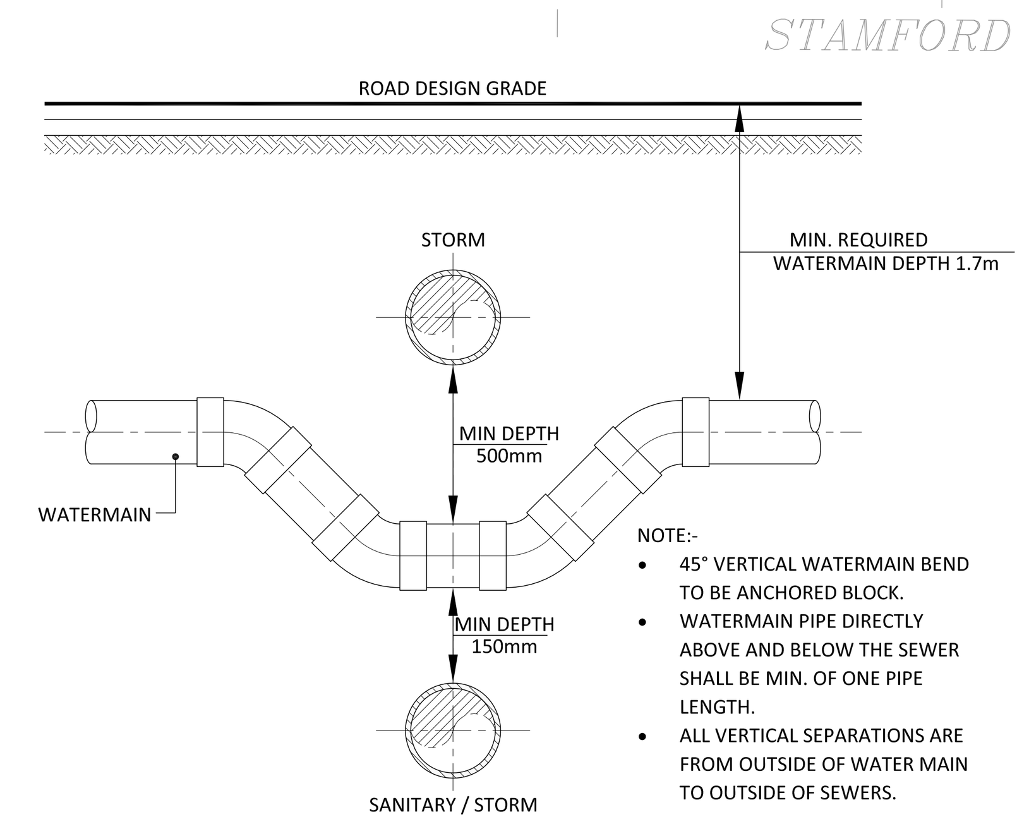


GENERAL NOTES FOR SERVICING:

1. ALL MUNICIPAL AND PRIVATE SANITARY, STORM AND WATERMAIN SERVICES TO BE INSTALLED AS PER THE CURRENT CITY STANDARDS AND SPECIFICATIONS.
2. EXISTING MUNICIPAL AND PRIVATE SEWERS, WATERMAINS AND UTILITIES ALIGNMENTS AND THEIR ELEVATIONS ARE ONLY PROVIDED FOR INFORMATION PURPOSES. THE CONTRACTOR ONSITE SHALL BE RESPONSIBLE TO LOCATE ALL EXISTING SEWERS, WATERMAINS AND UTILITIES ALIGNMENT AND ELEVATIONS PRIOR TO START OF CONSTRUCTION.
3. THE BIDDER/CONTRACTOR MUST REVIEW/VERIFY EXISTING SOIL CONDITIONS ONSITE.
4. THE CONTRACTOR WILL BE RESPONSIBLE FOR COST ASSOCIATED WITH THE CROSSING OF ANY EXISTING SEWERS, WATERMAINS AND UTILITIES INCLUDING ANY SUPPORTS AND PRECAUTIONS REQUIRED ON SITE SPCIFIC BASIS.
5. THE BIDDER/CONTRACTOR MUST VERIFY ALL DIMENSIONS ON ALL THE DRAWINGS. ANY ERRORS AND/OR OMISSIONS MUST BE REPORTED TO THE ENGINEER IMMEDIATELY.

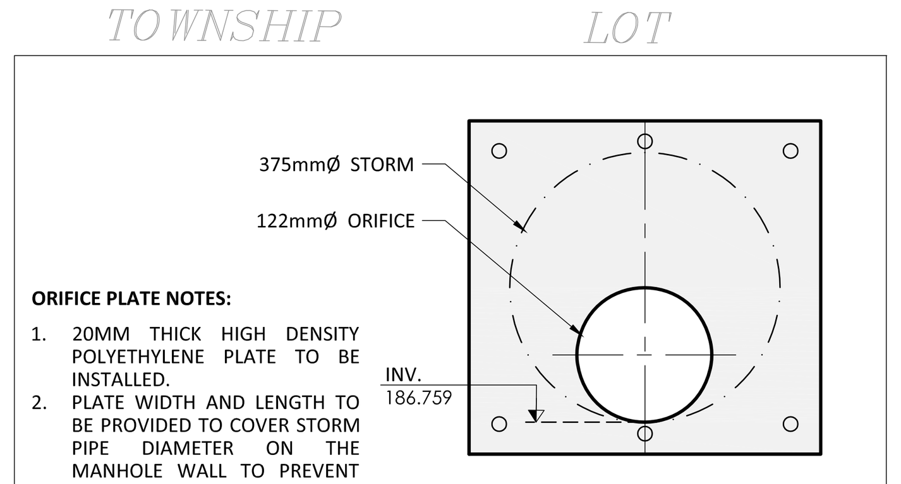
STANDARD SERVICING NOTES :

1. THE PROPERTY OWNER IS RESPONSIBLE FOR RESTORATION OF ALL DAMAGED AND/OR DISTURBED PROPERTY WITHIN THE CITY OR REGIONAL RIGHT-OF-WAY TO CITY OF NIAGARA FALLS STANDARDS.
2. IF, FOR UNFORESEEN REASONS, THE OWNER AND/OR HIS/HER REPRESENTATIVE ENCROACH ONTO PRIVATE LANDS TO UNDERTAKE ANY WORKS, HE/SHE MUST OBTAIN WRITTEN PERMISSION FROM THE ADJACENT PROPERTY OWNERS PRIOR TO ENTERING UPON THE PRIVATE PROPERTY TO PERFORM ANY WORKS. COPIES OF THESE LETTERS OF CONSENT MUST BE SUBMITTED TO DEVELOPMENT ENGINEERING DIVISION, PRIOR TO ANY WORK BEING PERFORMED. FAILURE TO COMPLY WITH THE ABOVE IS AT THE PROPERTY OWNERS OWN RISK.
3. REFER TO LANDSCAPING PLAN FOR TREE PRESERVATIONS AND PROPOSED TREES WITH RESPECT TO THE SITE SERVICING.
4. ALL PRIVATE WATER, SANITARY AND STORM SERVICE CONNECTIONS TO BE CONSTRUCTED AS PER CITY OF NIAGARA FALLS STANDARDS AND GUIDELINES.
5. CONTRACTOR IS RESPONSIBLE TO LOCATE ALL EXISTING UTILITIES AROUND THE DEVELOPMENT PRIOR TO START CONSTRUCTION AND NOTIFY TO THE OWNER AND THE ENGINEER.

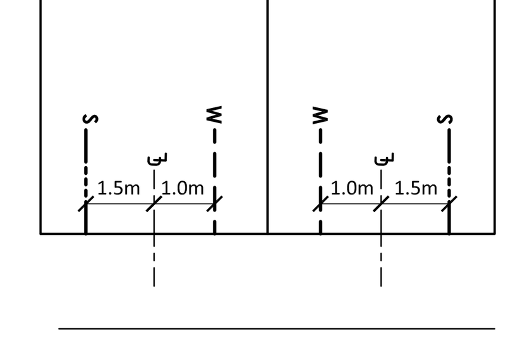


WATERMAIN CROSSING DETAIL
N.T.S.

RAINWATER ROOF LEADERS AND SUMP PUMPS:
- ALL RAINWATER LEADERS SHALL DISCHARGE ONTO SPLASH PADS AND THEN TO GRASSED OR LANDSCAPED AREAS A MINIMUM OF 0.60M FROM THE BUILDING FACE.
- SUMP PUMP REQUIREMENT TO BE CONFIRMED BY GEOTECHNICAL INVESTIGATIONS.



ORIFICE PLATE DETAIL "A"
N.T.S.



W = WATER SERVICE 25mmØ TYPE K SOFT COPPER.
(CURB STOP TO BE PROVIDED AS PER CITY OF NIAGARA FALLS STANDARDS)
INDIVIDUAL WATER METER TO BE PROVIDED IN EACH TOWNHOUSE UNIT.
S = SANITARY SERVICE 100mm PVC SDR-28 @ MINIMUM 2.0% SLOPE

TYPICAL TOWNHOUSE SERVICE CONNECTION DETAIL UNLESS OTHERWISE NOTED ON SERVICING PLAN
N.T.S.

SPECIAL NOTES:

1. **REFER TO LATEST ARCHITECTURAL PLANS FOR BUILDING LEVELS, RETAINING WALLS SETBACKS, SITE STATISTICS AND PERIMETER AND/OR OTHER FENCES.**
2. **ALL EXISTING MUNICIPAL SANITARY AND STORM SEWERS LOCATION AND INVERTS WHERE PROPOSED SITE SERVICES WILL TIE IN TO BE VERIFIED ON SITE PRIOR TO CONSTRUCTION.**
3. **MINIMUM BASEMENT FLOOR ELEVATION SHALL BE BASED ON INVERT OF THE SANITARY SERVICE. CONTRACTOR MUST VERIFY SANITARY SERVICE INVERT PRIOR TO SETTING BASEMENT FOUNDATION LEVEL.**
4. **ALL EXISTING UTILITIES TO BE LOCATED ON SITE.**
5. **THE BIDDER/CONTRACTOR MUST REVIEW/VERIFY EXISTING SOIL CONDITIONS ONSITE.**
6. **THE CONTRACTOR WILL BE RESPONSIBLE FOR COST ASSOCIATED WITH THE CROSSING OF ANY EXISTING SEWERS, WATERMAINS AND UTILITIES INCLUDING ANY SUPPORTS AND PRECAUTIONS REQUIRED ON SITE SPECIFIC BASIS WHERE APPLICABLE.**
7. **THE BIDDER/CONTRACTOR MUST VERIFY ALL DIMENSIONS ON THE DRAWING. ANY ERRORS AND/OR OMISSIONS MUST BE REPORTED TO THE ENGINEER IMMEDIATELY.**

ALL EXISTING SANITARY AND STORM MANHOLES AND INVERTS WERE EXTRACTED FROM CITY OF NIAGARA FALLS DRAWINGS AND MUST BE CONFIRMED ONSITE PRIOR TO CONSTRUCTION.

ONSITE STORMWATER MANAGEMENT REQUIREMENTS:

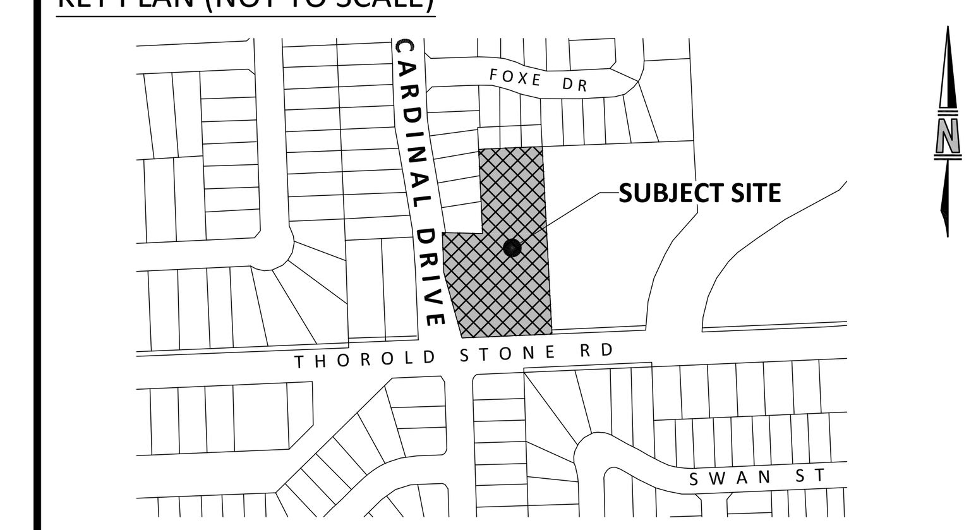
1. POST-DEVELOPMENT FLOWS TO MATCH WITH PRE-DEVELOPMENT CONDITIONS UNDER 5-YEAR & 100 YEAR STORM EVENTS.
2. STORMWATER MANAGEMENT ONSITE QUANTITY CONTROL REQUIRED STORAGE OF 211m^3 IS TO BE PROVIDED AT THE ALLOWABLE DISCHARGE RATE OF 0.038cms WITH AN ORIFICE SIZE OF 122mm DIAMETER.
3. REFER TO ADS STORMTECH DESIGN/DRAWINGS FOR UNDERGROUND STORAGE SYSTEM.

ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

SITE BENCH MARK

- TOPOGRAPHIC INFORMATION IS BASED ON J.D BARNES LTD. DATED JANUARY 13, 2023.
- ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO CITY OF NIAGARA FALLS BENCHMARK NO. 90036034. ELEVATION = 188.124 METERS

KEY PLAN (NOT TO SCALE)



REVISIONS RECORD

No.	BY	DD/MM/YYYY	DESCRIPTION
1.	A.R	10/07/2023	FIRST SUBMISSION

NOT ISSUED FOR CONSTRUCTION

DATE: JULY 10, 2023
DESIGN BY: A.R
DRAWN BY: A.J
CHECKED BY: A.R
SCALE: 1:300

LICENSED PROFESSIONAL ENGINEER — A. RAZZAK — 100505914 — JULY 10, 2023 — PROVINCE OF ONTARIO

ENGINEER'S STAMP

LEGEND

- EXISTING STORM SEWER & MANHOLE
- EXISTING SANITARY SEWER & MANHOLE
- PROPOSED STORM SEWER & MANHOLE
- PROPOSED SANITARY SEWER & MANHOLE
- EXISTING WATERMAIN
- PROPOED WATERMAIN
- WATERMAIN CROSSING
- PROPOSED CURB & GUTTER
- EXISTING CURB & GUTTER
- DEPRESSED CURB
- EXISTING DEPRESSED CURB
- EXISTING CURB STOP
- PROPOSED WATER VALVE
- EXISTING WATER VALVE
- EXISTING CATCHBASIN
- PROPOSED CATCHBASIN
- PROPOSED DOUBLE CATCHBASIN
- EXISTING HYDRANT
- PROPOSED HYDRANT
- PROPOSED CATCHBASIN MANHOLE
- PROPOSED WATER METER
- PROPOSED BACKFLOW PREVENTER
- PROPOSED RETAINING WALL
- TW[000.00] BW[000.00] PROPOSED TOP OF RETAINING WALL
- PROPOSED SUBDRAIN
- EXISTING FENCE
- PROPOSED FENCE
- HYDRO POLE
- PROPOSED TRANSFORMER
- EXISTING BELL LINES
- EXISTING HYDRO LINES
- EXISTING GAS LINES
- FFE FIRST FLOOR ELEVATION
- BFE BASEMENT FLOOR ELEVATION
- PROPOSED MAILBOX
- EXISTING TREE
- PROPOSED BLOW OFF
- PROPOSED LIGHT POLE
- EXISTING LIGHT POLE
- PROPOSED FLOOR DRAIN

PROJECT:
3958 CARDINAL DRIVE

OWNER:
12604515 CANADA CORPORATION

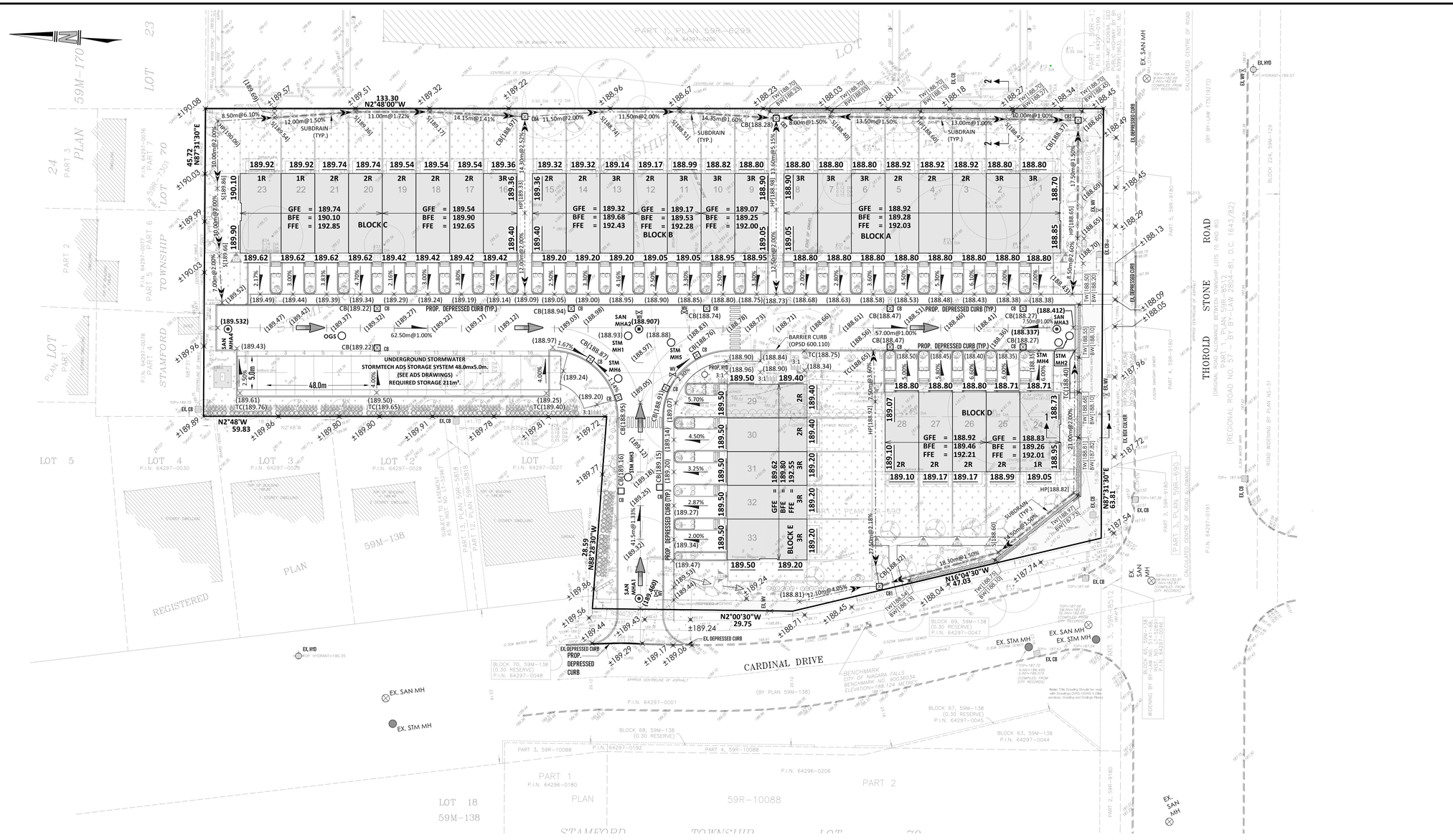
MUNICIPALITY:
CITY OF NIAGARA FALLS

SITE SERVICING PLAN

PROJECT NUMBER: 22181
DRAWING: DWG-2

3958 CARDINAL DRIVE

d:\arik eng\jobs 2022\22181_3958 cardinal drive, niagara falls\engineering\detailed design\1st submission\autocad drawing\current 17 July 2023 11:18 am



GENERAL LOT GRADING NOTES

1. ALL RETAINING WALLS 1.0M OR HIGHER SHALL BE DESIGNED AND CERTIFIED BY THE STRUCTURAL ENGINEER.
2. IF A RETAINING WALL BE REQUIRED, THE TOP OF WALL ELEVATION SHALL BE SET 150MM ABOVE THE PROPOSED SIDE YARD SWALE WHERE APPLICABLE.
3. RETAINING WALL 0.60M IN HEIGHT OR MORE WILL REQUIRE CONSTRUCTION OF A FENCE OR GUARD RAIL AT THE TOP OF THE REAR OF THE WALL. GUARDS FOR THE RETAINING WALLS SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF EXTERIOR GUARD AS PER THE ONTARIO BUILDING CODE.
4. ADJOINING PROPERTIES GRADE SHALL MEET EXISTING OR PROPOSED ELEVATIONS WITH SODDED SLOPES (MIN. 3H TO 1V) AND/OR RETAINING WALLS AS SPECIFIED.
5. TOP OF FOUNDATION WALLS FOR BUILDINGS SHALL BE MINIMUM 150MM ABOVE FINISHED GRADE.
6. MINIMUM DRIVEWAY SLOPES SHALL BE 2% AND MAXIMUM SLOPE 8.0%.
7. ALL FILL PLACED SHALL BE COMPACTED TO A MINIMUM 95% SPD (UNLESS OTHERWISE RECOMMENDED BY THE GEOTECHNICAL ENGINEER). ALL MATERIAL SHALL BE PLACED IN LAYERS NOT EXCEEDING 300MM LIFTS.
8. FOR TREE PROTECTION /REMOVAL AND HOARDING FENCE DETAILS REFER TO TREE PROTECTION PLAN AND REPORT PREPARED BY THE ARBORIST.
9. GRADING SHALL FOLLOW STRICTLY WITH THIS DRAWING. ANY CHANGES, UNLESS APPROVED PRIOR TO CONSTRUCTION BY THE MUNICIPALITY, SHALL RESULT IN NON-ACCEPTANCE OF THE MUNICIPALITY.
10. IF GRADING IS REQUIRED ON LANDS ADJACENT TO THE DEVELOPMENT WHICH ARE NOT OWNED BY THE DEVELOPER, THEN THE DEVELOPER MUST OBTAIN WRITTEN AGREEMENT FROM THE ADJACENT PROPERTY OWNER TO ALLOW THE DEVELOPER TO GRADE ON THE ADJACENT LANDS, OTHERWISE RETAINING WALLS SHALL BE USED.
11. WRITTEN AGREEMENT REQUIRED FROM THE ADJACENT LANDOWNER SHALL BE OBTAINED PRIOR TO ENTERING THE LANDS. IF AGREEMENT NOT BE OBTAINED OR IS WITHDRAWN PRIOR TO COMMENCING THE CONSTRUCTION, THEN THE DEVELOPER MUST LIMIT ACTIVITIES TO THE LIMITS OF THEIR DEVELOPMENT SITE.

SITE PLAN ROAD PAVENENT STRUCTURE:

TO BE CONFIRMED BY GEOTECHNICAL ENGINEER
STANDARD PAVEMENT TO BE INSTALLED AS PER CITY STANDARDS:

LIGHT DUTY ASPHALT (FOR PARKING AREAS)

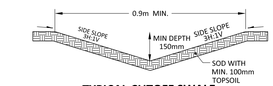
40mm HL3 – ASPHALT
50mm HL8 – ASPHALT
150mm GRANULAR 'A'
300mm GRANULAR 'B'

HEAVY DUTY ASPHALT (FOR HEAVY TRAFFIC FIRE ROUTE AREAS)

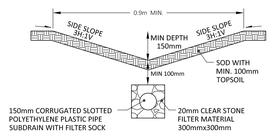
40mm HL3 – ASPHALT
80mm HL8 – ASPHALT
150mm GRANULAR 'A'
450mm GRANULAR 'B'

RAINWATER ROOF LEADERS AND SUMP PUMPS:

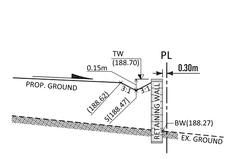
- ALL RAINWATER LEADERS SHALL DISCHARGE ONTO SPLASH PADS AND THEN TO GRASSED OR LANDSCAPED AREAS A MINIMUM OF 0.60M FROM THE BUILDING FACE.
- SUMP PUMP REQUIREMENT TO BE CONFIRMED BY GEOTECHNICAL INVESTIGATIONS.



TYPICAL CUTOFF SWALE
N.T.S.

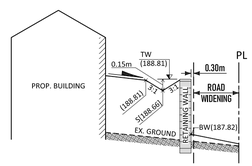


TYPICAL CUTOFF SWALE WITH SUBDRAIN
N.T.S.



RETAINING WALL CROSS SECTION
SECTION 2-2
N.T.S.

- RETAINING WALLS TO BE DESIGNED BY STRUCTURAL ENGINEER.
- RETAINING WALLS 0.60m IN HEIGHT OR GREATER REQUIRE A FENCE OR RAILING.
- IF FENCE TO BE INSTALLED AT THE TOP OF RETAINING WALLS, RETAINING WALLS TO BE DESIGNED TO ACCOMMODATE FENCE LOADING. .
- ALL PROPOSED RETAINING WALL LOCATION/DETAIL MUST BE COORDINATED WITH LANDSCAPE AND STRUCTURAL DESIGN/DRAWINGS.



RETAINING WALL CROSS SECTION
SECTION 1-1
N.T.S.

- RETAINING WALLS TO BE DESIGNED BY STRUCTURAL ENGINEER.
- RETAINING WALLS 0.60m IN HEIGHT OR GREATER REQUIRE A FENCE OR RAILING.
- IF FENCE TO BE INSTALLED AT THE TOP OF RETAINING WALLS, RETAINING WALLS TO BE DESIGNED TO ACCOMMODATE FENCE LOADING.
- ALL PROPOSED RETAINING WALL LOCATION/DETAIL MUST BE COORDINATED WITH LANDSCAPE AND STRUCTURAL DESIGN/DRAWINGS.

ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

SITE BENCH MARK

- TOPOGRAPHIC INFORMATION IS BASED ON J.D BARNES LTD. DATED JANUARY 13, 2023.
- ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO CITY OF NIAGARA FALLS BENCHMARK NO. 90036034. ELEVATION = 188.124 METERS

KEY PLAN (NOT TO SCALE)

REVISIONS RECORD

No.	BY	DD/MM/YYYY	DESCRIPTION
1.	A.R	10/07/2023	FIRST SUBMISSION

NOT ISSUED FOR CONSTRUCTION

DATE: JULY 10, 2023
DESIGN BY: A.R
DRAWN BY: A.J
CHECKED BY: A.R
SCALE: 1:300

LICENSED PROFESSIONAL ENGINEER
A. RAZZAK
100505914
JULY 10, 2023
PROVINCE OF ONTARIO
ENGINEER'S STAMP

LEGEND

±000.00	EXISTING GROUND ELEVATION TO REMAIN
	CONTOUR ELEVATION
000.00	EXISTING GROUND ELEVATION
(000.00)	PROPOSED DESIGN GRADE
TC(000.00)	PROPOSED TOP OF CURB DESIGN GRADE
000.00	APPROXIMATE GRADE AT THE BUILDING
S[000.00]	PROPOSED SWALE ELEVATION
	PROPOSED RETAINING WALL
TW[000.00] BW[000.00]	PROPOSED TOP OF RETAINING WALL PROPOSED BOTTOM OF RETAINING WALL
FFE	FIRST FLOOR ELEVATION
BFE	BASEMENT FLOOR ELEVATION
GFE	GARAGE FLOOR ELEVATION
	DIRECTION OF MAJOR DRAINAGE ROUTE
	SHEET FLOW DIRECTION
1.00%	ROAD/PARKING/GRASS AREA SLOPE
5m@1.00%	GRASS SWALE
	PROPOSED CURB & GUTTER
	EXISTING CURB & GUTTER
	DEPRESSED CURB
	EXISTING DEPRESSED CURB
	EXISTING STORM MANHOLE
	EXISTING SANITARY MANHOLE
	PROPOSED STORM MANHOLE
	PROPOSED SANITARY MANHOLE
	PROPOSED SUBDRAIN
	EXISTING CATCHBASIN
	PROPOSED CATCHBASIN
	PROPOSED DOUBLE CATCHBASIN
	EXISTING HYDRANT
	PROPOSED HYDRANT
	PROPOSED CATCHBASIN MANHOLE
	EXISTING FENCE
	PROPOSED FENCE
	HYDRO POLE
	PROPOSED TRANSFORMER
BELL BELL	EXISTING BELL LINES
HYD HYD	EXISTING HYDRO LINES
GAS GAS	EXISTING GAS LINES
FD-1	PROPOSED FLOOR DRAIN
	EXISTING TREE
	PROPOSED LIGHT POLE
	EXISTING LIGHT POLE

PROJECT:
3958 CARDINAL DRIVE

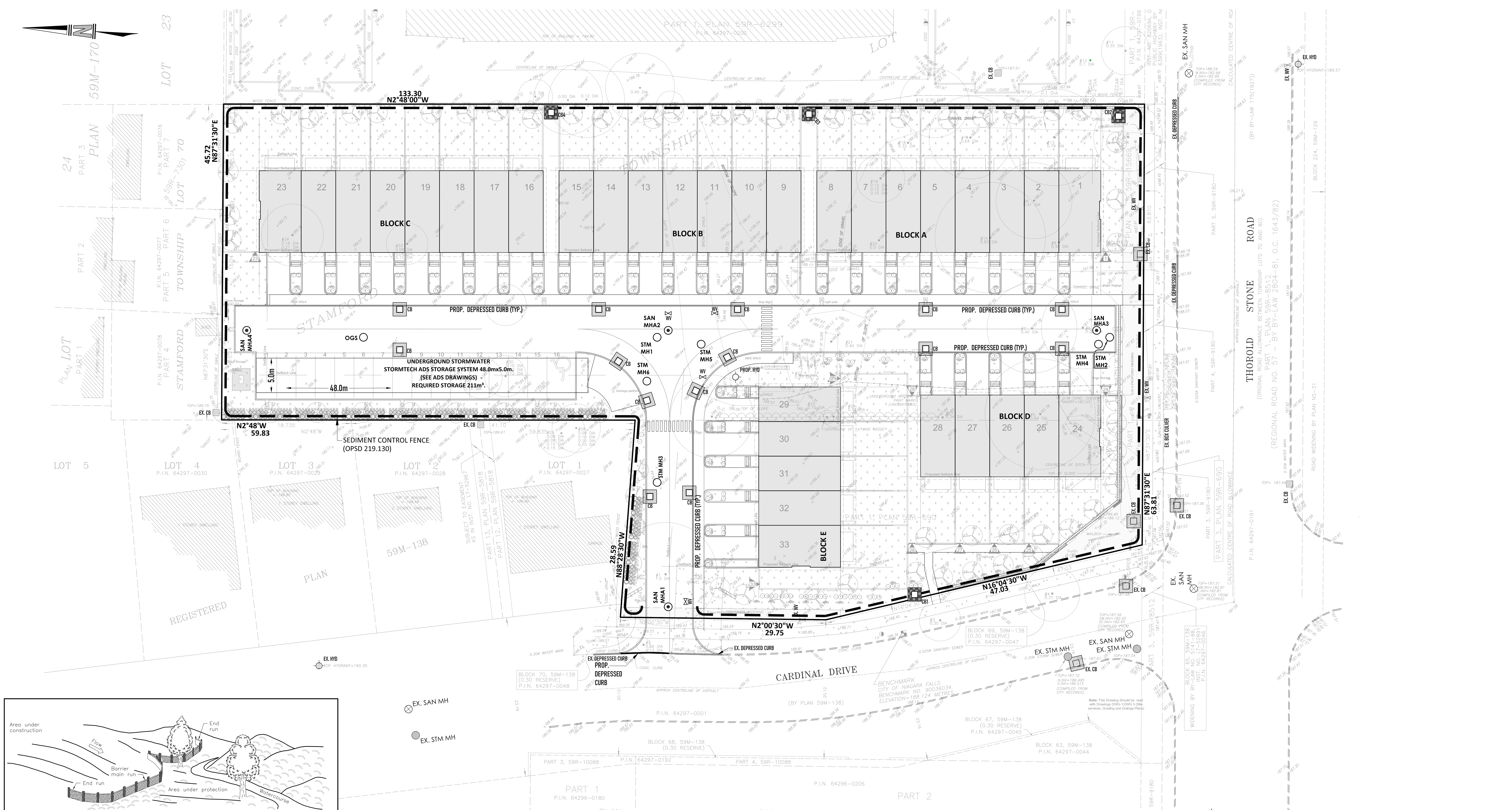
OWNER:
12604515 CANADA CORPORATION

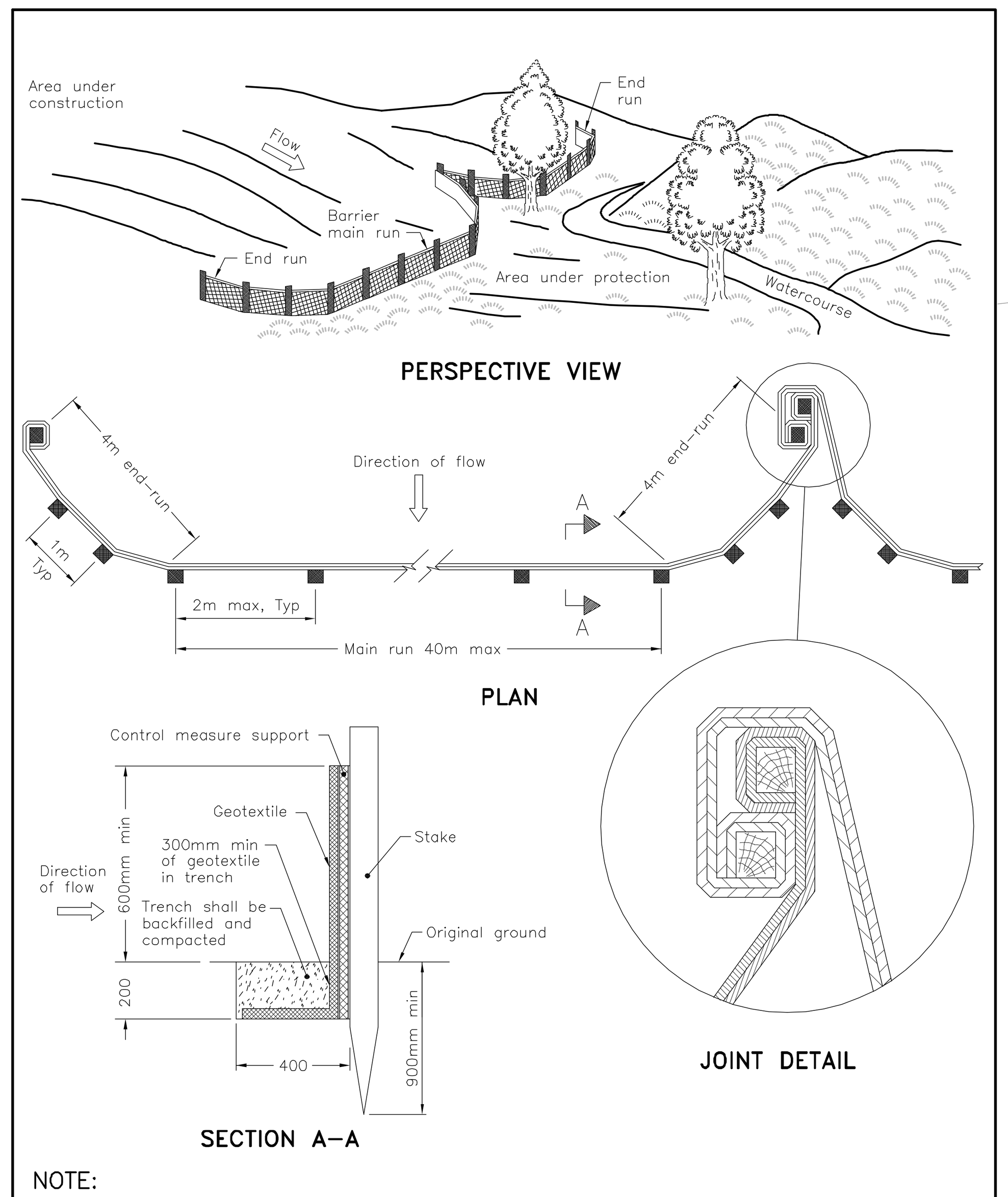
MUNICIPALITY:
CITY OF NIAGARA FALLS

SITE GRADING PLAN

PROJECT NUMBER: 22181
DRAWING: DWG-3

3958 CARDINAL DRIVE





NOTE:
A All dimensions are in millimetres unless otherwise shown.

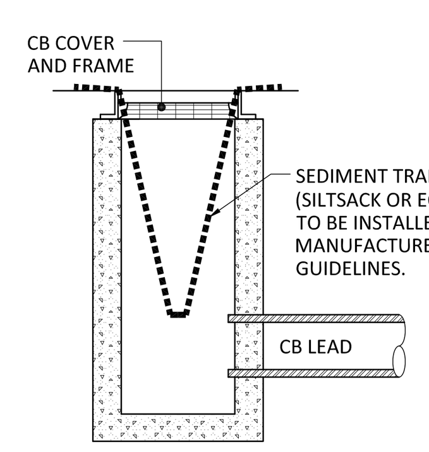
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2015	Rev 2
HEAVY–DUTY SILT FENCE BARRIER	OPSD 219.130	

CONTRACTOR TO CLEAN SEDIMENTS FROM EXISTING ROADWAYS DUE TO CONSTRUCTION TRAFFIC EVERY DAY

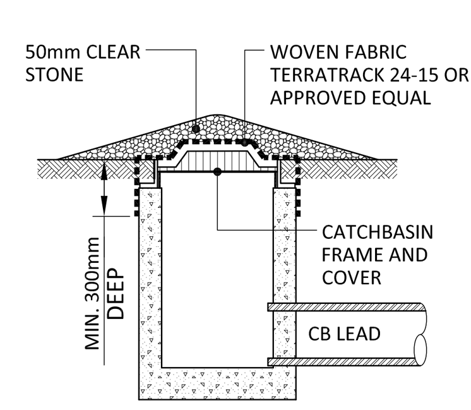
3958 CARDINAL DRIVE

EROSION AND SEDIMENT CONTROL GENERAL NOTES

1. ALL EROSION AND SEDIMENT CONTROL MEASURES (TEMPORARY SEDIMENT CONTROL FENCES, MUD MAT CONTROL AND SEDIMENT BASINS, ETC) MUST BE INSTALLED PRIOR TO DEVELOPMENT AND MAINTAINED THROUGHOUT THE CONSTRUCTION, UNTIL ALL DISTURBED AREAS HAVE BEEN REVEGETATED. ALL ESC MEASURES SHALL BE INSTALLED AS DETAILED ON THIS DRAWINGS AND AS PER 'EROSION & SEDIMENT CONTROL GUIDELINES FOR URBAN CONSTRUCTION', DECEMBER 2006.
2. TEMPORARY VEHICLE TRACKING CONTROLS TO BE CONSTRUCTED AT ALL ACCESS POINTS. CONTRACTOR SHALL MAINTAIN THESE AS REQUIRED AND AS DIRECTED BY THE CITY ENGINEER .
3. SEDIMENT CONTROL FENCES SHALL BE AS PER OPSD 219.130.
4. CUT-OFF SWALES TO BE CONSTRUCTED WHERE SPECIFIED AND PERIODICALLY INSPECTED TO ENSURE THAT EROSION DOES NOT OCCUR.
5. REGULAR MAINTENANCE FOR ALL CATCH BASIN IS REQUIRED. ACCUMULATED SEDIMENTS SHALL BE REMOVED FROM CATCH BASIN. FLUSHING OF SEDIMENTS IN TO THE STORM SEWER IS NOT PERMITTED. FILTER CLOTH IN CATCH BASIN MUST BE CLEANED OR REPLACED IF STANDING WATER REMAIN IN THE CATCH BASIN MORE THAN 24 HOURS AFTER A STORM EVENT.
6. STREET CATCH BASIN SEDIMENT TRAP TO BE INSTALLED AS PER DETAIL “AA” AND BACKYARD CATCH BASIN SEDIMENT TRAP TO BE INSTALLED AS PER DETAIL “BB”. VEHICLE TRACKING CONTROL/MUD MAT TO BE INSTALLED AS PER DETAIL “CC”.
7. TOPSOIL PILES SHALL BE TEMPORARY SEEDED TO PREVENT EROSION. ANY DISTURBED AREA IN THE PROPOSED DEVELOPMENT NOT SCHEDULE FOR FURTHER CONSTRUCTION WITHIN 45 DAYS MUST BE STABILIZED WITH A SUITABLE TEMPORARY MULCH AND SEED COVER WITHIN 7 DAYS OF THE COMPLETION OF THAT PARTICULAR PHASE OF CONSTRUCTION.
8. ALL DISTURBED EXTERNAL AREAS SHALL BE VEGETATED WITH PERMANENT SOD WITHIN 7 DAYS OF THE COMPLETION OF THE CONSTRUCTION.
9. WORK LIMIT FENCE SHALL CONSIST OF PLASTIC SNOW FENCE SUPPORTED BY STEEL “T” POSTS AT A MINIMUM 2.4M CENTRE TO CENTRE.
10. THE OWNER SHALL SUBMIT A MONTHLY SEDIMENT AND EROSION CONTROL RECORDS AND REPORT PREPARED BY A PROFESSIONAL ENGINEER TO THE SATISFACTION OF THE LOCAL MUNICIPALITY AND CONSERVATION AUTHORITY. THE REPORT MUST INDICATE FREQUENCY OF INSPECTION AND AREA INSPECTED.
11. VEGETATION RESTORATION FOR ALL AREAS DISTURBED BY GRADING ACTIVITY SHALL BE SEEDED AS FOLLOWS WITH THE APPLICATION RATE OF 2.5 KG/100 SQUARE METERS. THE CONTRACTOR SHALL MAINTAIN THESE AREAS UNTIL SATISFACTORY GROUND COVER IS ESTABLISHED:
    i. CREEPING RED FESCUE 30%
    ii. PERENNIAL RYE 30%
    iii. CANADA BLUEGRASS 20%
    iv. RED TOP 20%



STREET CATCH BASIN SEDIMENT TRAP DETAIL "AA"
N.T.S.



BACKYARD CATCH BASIN SEDIMENT TRAP DETAIL "BB"
N.T.S.

MAINTENANCE SCHEDULE FOR SEDIMENT TRAPS AND BASINS

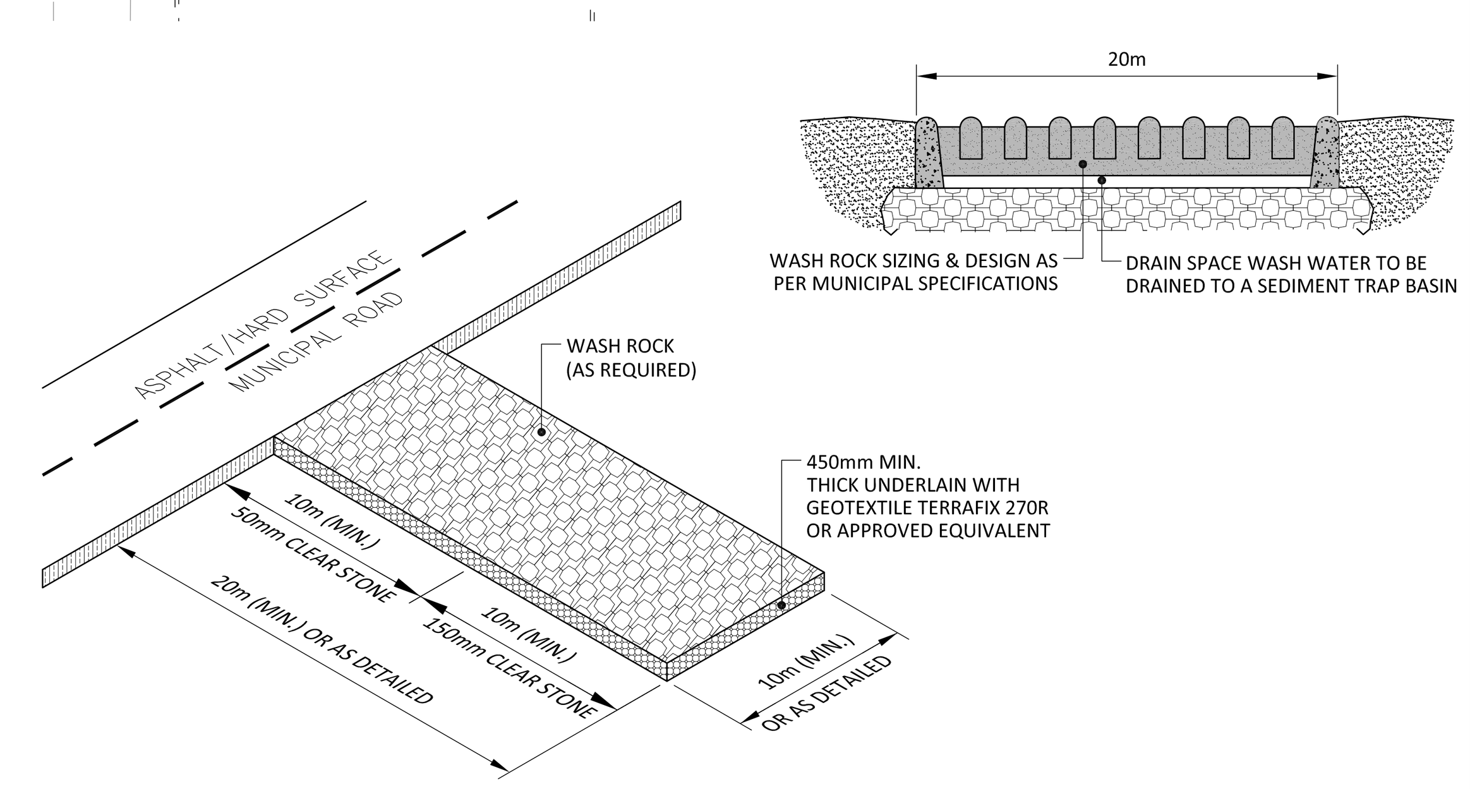
1. SEDIMENT TRAPS/BASINS MUST BE INSPECTED AND MAINTAINED AFTER EVERY RAINFALL EVENT TO THE SATISFACTION OF LOCAL MUNICIPALITY AND CONSERVATION AUTHORITY.
2. TRASH AND DEBRIS SHALL BE REMOVED FROM WITHIN THE TRAP/BASIN. ANY DAMAGE TO THE TRAPS/BASIN OUTLET MUST BE REPAIRED IMMEDIATELY.
3. THE SEDIMENT TRAP/BASIN SIDES ONTO DITCH SIDE SLOPES MUST BE INSPECTED TO ENSURE THAT THEY HAVE NOT ERODED OR SETTLED. IMMEDIATE ACTION SHALL BE TAKEN TO RESHAPE AND STABILIZE SLOPES.
4. WHEN SEDIMENT ACCUMULATES TO HALF THE HEIGHT OF THE SEDIMENT TRAP/BASIN DESIGN

DEPTHTHENSEDIMENTREMOVAL IS REQUIRED. CARE MUST BE TAKENTO AVOIDDAMAGING

THEOUTLET ANDINLET DURING THIS MAINTENANCE OPERATION. DISPOSAL OF THE SEDIMENT

SHALL BE TO A CONTROLLEDAREA AND STABILIZED (VEGETATED).

5. IF STANDING WATER REMAINS IN THE SEDIMENT TRAP/BASIN FOR 48 HOURS (MINIMUM) AFTER A STORM EVENT THEN IT COULD INDICATE A BLOCKAGE. VISUALLY INSPECT THE EXCESSIVE SEDIMENTS AND/OR TRASH BUILDUP. IF SURFACE SEDIMENT AND TRASH REMOVAL DOES NOT ALLEVIATE THE PROBLEM THEN REPLACEMENT OF TRAP AND/OR GRANULAR MATERIAL IN THE SEDIMENT BASIN IS REQUIRED.
6. ALL WORKS MUST BE PERFORMED TO THE SATISFACTION OF THE LOCAL MUNICIPALITY AND CONSERVATION AUTHORITY.



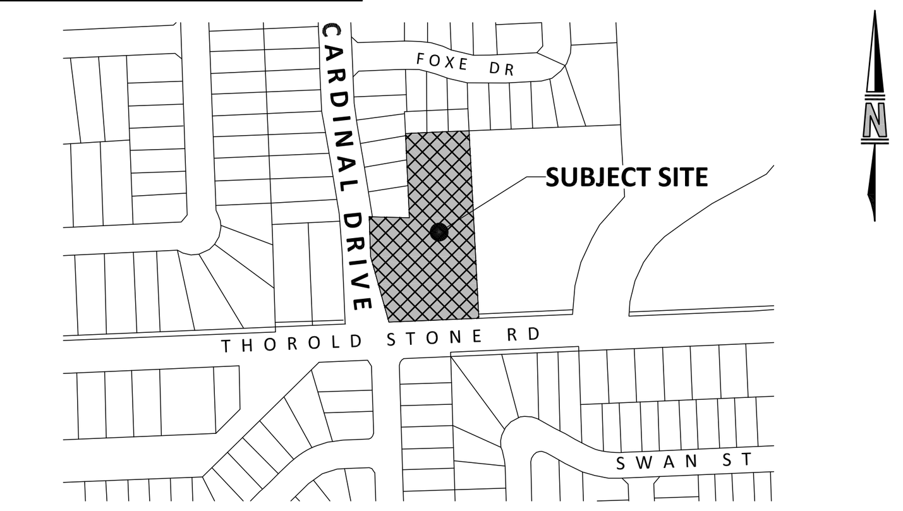
VEHICLE TRACKING CONTROL/MUD MAT DETAIL 'CC'
N.T.S.

ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

SITE BENCH MARK

- TOPOGRAPHIC INFORMATION IS BASED ON J.D BARNES LTD. DATED JANUARY 13, 2023.
- ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO CITY OF NIAGARA FALLS BENCHMARK NO. 90036034. ELEVATION = 188.124 METERS

KEY PLAN (NOT TO SCALE)



REVISIONS RECORD

No.	BY	DD/MM/YYYY	DESCRIPTION
1.	A.R	10/07/2023	FIRST SUBMISSION

NOT ISSUED FOR CONSTRUCTION

DATE: JULY 10, 2023
DESIGN BY: A.R
DRAWN BY: A.J
CHECKED BY: A.R
SCALE: 1:300

LICENSED PROFESSIONAL ENGINEER A. RAZZAK 100505914 JULY 10, 2023 PROVINCE OF ONTARIO
ENGINEER'S STAMP

LEGEND

- SEDIMENT CONTROL FENCE - OPSD 219.130
- SEDIMENT TRAP FOR STREET CATCHBASIN DETAIL "AA"
- SEDIMENT TRAP FOR BACKYARD CATCHBASIN DETAIL "BB"
- MUD MAT CONSTRUCTION VEHICLE TRACKING CONTROL DETAIL "CC"

PROJECT: 3958 CARDINAL DRIVE

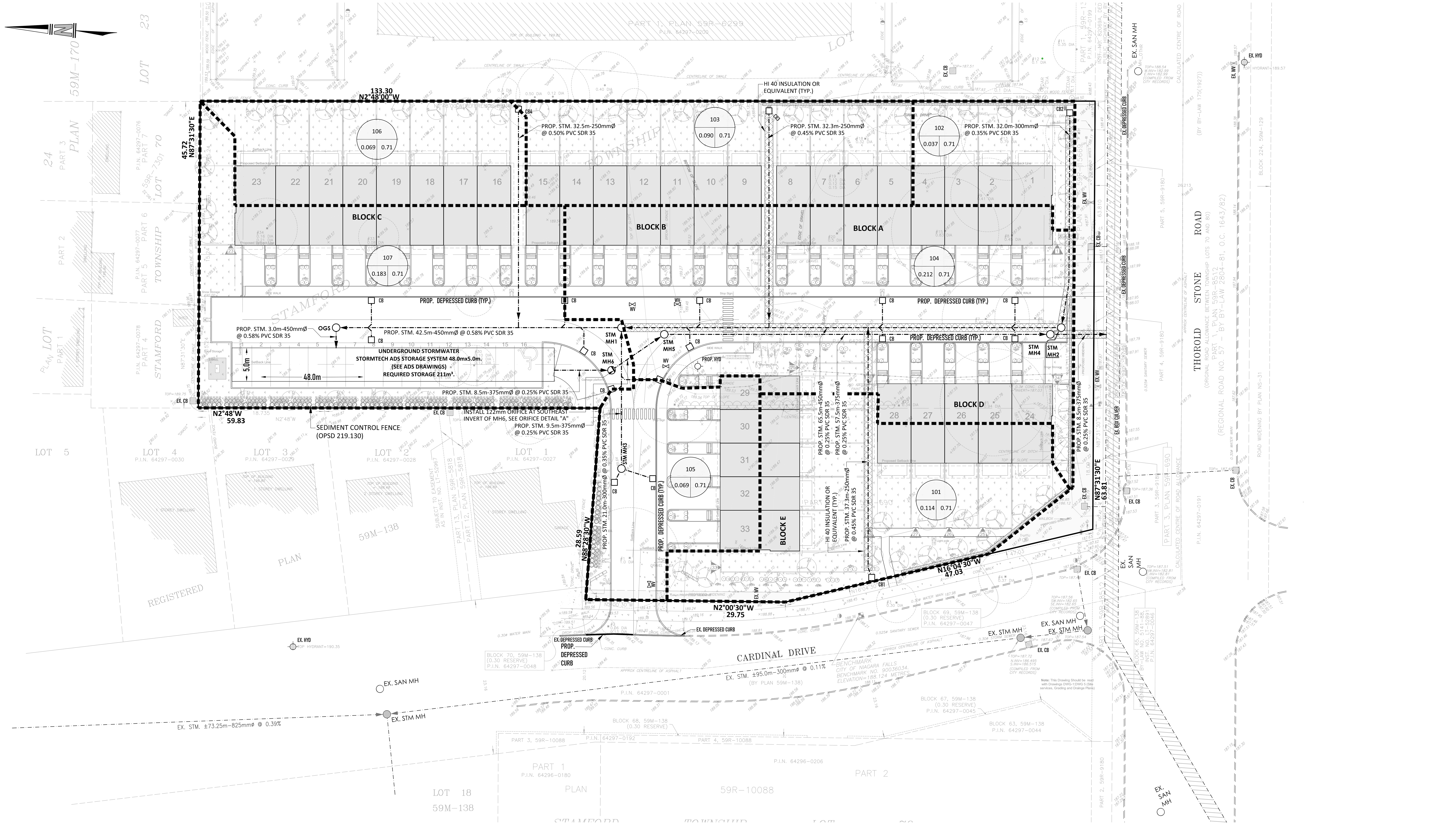
OWNER: 12604515 CANADA CORPORATION

MUNICIPALITY: CITY OF NIAGARA FALLS

EROSION & SEDIMENT CONTROL PLAN

PROJECT NUMBER: 22181
DRAWING: DWG-4

d:\arik eng\jobs 2022\22181_3958 cardinal drive, niagara falls\engineering\detailed design\1st submission\autocad drawing\current 14 July 2023 7:07 pm

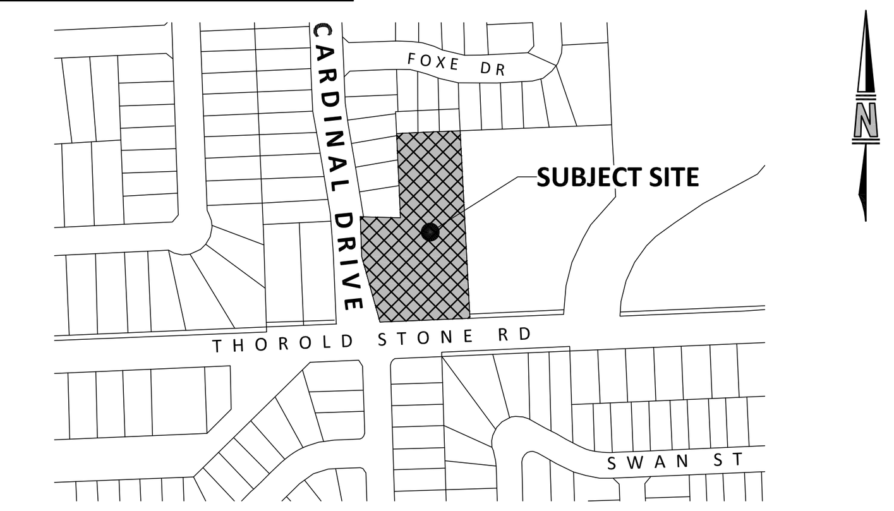


ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

SITE BENCH MARK

- TOPOGRAPHIC INFORMATION IS BASED ON J.D BARNES LTD. DATED JANUARY 13, 2023.
- ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO CITY OF NIAGARA FALLS BENCHMARK NO. 90036034. ELEVATION = 188.124 METERS

KEY PLAN (NOT TO SCALE)



REVISIONS RECORD

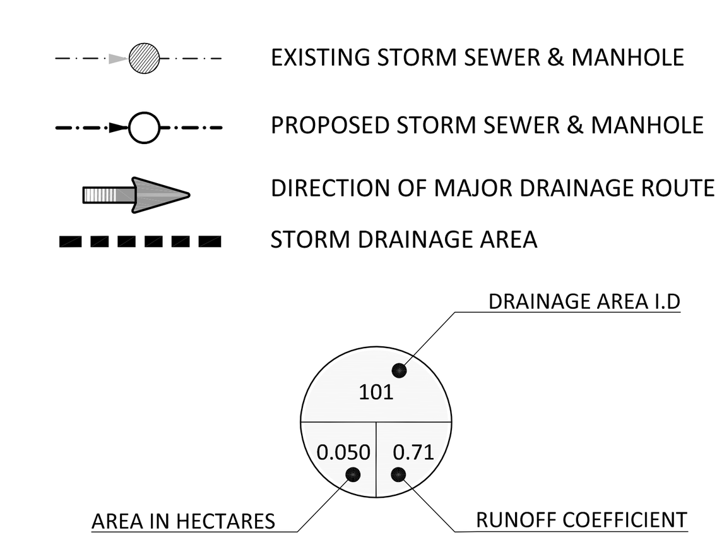
No.	BY	DD/MM/YYYY	DESCRIPTION
1.	A.R	10/07/2023	FIRST SUBMISSION

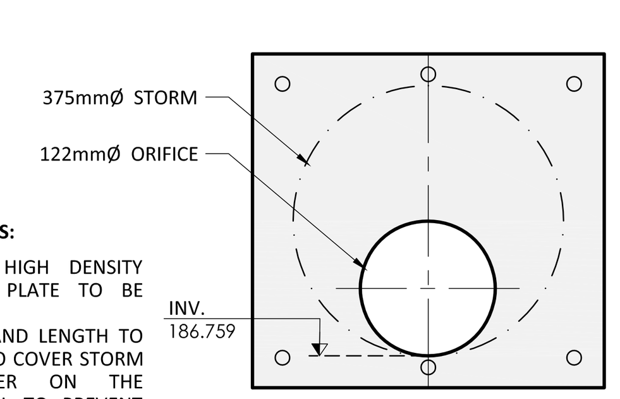
NOT ISSUED FOR CONSTRUCTION

DATE: JULY 10, 2023
DESIGN BY: A.R
DRAWN BY: A.J
CHECKED BY: A.R
SCALE: 1:300

LICENSED PROFESSIONAL ENGINEER
A. RAZZAK
100505914
JULY 10, 2023
PROVINCE OF ONTARIO
ENGINEER'S STAMP

LEGEND





ORIFICE PLATE NOTES:

1. 20MM THICK HIGH DENSITY POLYETHYLENE PLATE TO BE INSTALLED.
2. PLATE WIDTH AND LENGTH TO BE PROVIDED TO COVER STORM PIPE DIAMETER ON THE MANHOLE WALL TO PREVENT LEAKAGE.
3. FASTENER SHALL BE STAINLESS STEEL 13MM X 95MM BOLT WITH NUT AND WASHER.
4. PLATE MUST BE SEALED TO PREVENT LEAKAGE.

ORIFICE PLATE DETAIL "A"
N.T.S.

ONSITE STORMWATER MANAGEMENT REQUIREMENTS:

1. POST-DEVELOPMENT FLOWS TO MATCH WITH PRE-DEVELOPMENT CONDITIONS UNDER 5-YEAR & 100 YEAR STORM EVENTS.
2. STORMWATER MANAGEMENT ONSITE QUANTITY CONTROL REQUIRED STORAGE OF 211m^3 IS TO BE PROVIDED AT THE ALLOWABLE DISCHARGE RATE OF 0.038cms WITH AN ORIFICE SIZE OF 122mm DIAMETER.
3. REFER TO ADS STORMTECH DESIGN/DRAWINGS FOR UNDERGROUND STORAGE SYSTEM.

PROJECT: 3958 CARDINAL DRIVE

OWNER: 12604515 CANADA CORPORATION

MUNICIPALITY: CITY OF NIAGARA FALLS

STORM DRAINAGE AREA PLAN

PROJECT NUMBER: 22181
DRAWING: DWG-5

3958 CARDINAL DRIVE

d:\arik eng\jobs 2022\22181_3958 cardinal drive, niagara falls\engineering\detailed design\1st submission\autocad drawing\current 14 July 2023 7:07 pm

	CITY OF NIAGARA FALLS
ARIK FILE NO.	22181
PROJECT NAME	3958 CARDINAL DRIVE
Storm Pipe Manning "n" Value	0.013

I = A*(t+B)^c	IDF Parameters (City of Niagara Falls)		
	2-YEAR STM	5-YEAR STM	100-YEAR STM
A	521.97	719.50	1264.57
c	-0.7590	-0.7687	-0.7814
B	5.280	6.340	7.720

Table C1: Storm Sewer Analysis & Design Calculations

ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

DESIGNED BY:	AR	DATE PREPARED:	July 10, 2023
REVIEWED BY:	AR	DATE PRINT:	July 10, 2023

NOTES	U/S MANHOLE ID FROM	D/S MANHOLE ID TO	STORM FREQUENCY (YEAR)	AREA (HA)	CUMULATIVE AREA (HA)	COEFFICIENT OF RUNOFF (C)	AxC	CUMULATIVE (AxC)	INITIAL TIME OF CONCENTRATION (min)	TIME IN PIPE (min)	CUMULATIVE TIME (min)	INTENSITY I (mm/hr)	FLOW IN PIPE (m^3/s)	BASE FLOW (IF APPLICABLE) (m^3/s)	FLOW ADDED (m^3/s)	TOTAL DESIGN FLOW Q (m^3/s)	STM. SEWER LENGTH (m)	STM. SEWER DIAMETER (mm)	STM. SEWER SLOPE %	STM. SEWER CAPACITY (m^3/s)	STM. SEWER VELOCITY (m/s)	STM. SEWER % FULL
AREA 101	CB1	MH2	100-YEAR STM	0.114	0.114	0.71	0.081	0.081	10.00	0.76	10.76	133.78	0.030		0.000	0.030	37.30	250	0.45	0.042	0.82	72.3%
AREA 102	CB2	MH2	100-YEAR STM	0.037	0.037	0.71	0.026	0.026	10.00	0.65	10.65	133.78	0.010		0.000	0.010	32.00	300	0.35	0.060	0.82	16.3%
AREA 103	CB3	MH2	100-YEAR STM	0.090	0.090	0.71	0.064	0.064	10.00	0.66	10.66	133.78	0.024		0.000	0.024	32.30	250	0.45	0.042	0.82	57.1%
AREA 104	MH2	MH1	100-YEAR STM	0.212	0.453	0.71	0.151	0.322	10.76	1.21	11.96	129.48	0.116		0.000	0.116	65.50	450	0.25	0.149	0.91	77.9%
AREA 105	MH3	MH1	100-YEAR STM	0.069	0.069	0.71	0.049	0.049	10.00	0.43	10.43	133.78	0.018		0.000	0.018	21.00	300	0.35	0.060	0.82	30.5%
AREA 106	CB4	MH1	100-YEAR STM	0.069	0.069	0.71	0.049	0.049	10.00	0.63	10.63	133.78	0.018		0.000	0.018	32.50	250	0.50	0.044	0.87	41.5%
AREA 107	MH1	OGS	100-YEAR STM	0.183	0.774	0.71	0.130	0.550	11.96	0.51	12.48	123.24	0.188		0.000	0.188	42.50	450	0.58	0.226	1.38	83.1%
	OGS	INLET	100-YEAR STM	0.000	0.774	0.71	0.000	0.550	12.48	0.04	12.51	120.78	0.184		0.000	0.184	3.00	450	0.58	0.226	1.38	81.5%
Allowable Discharge @ 0.038cms	OUTLET	MH6	100-YEAR STM	0.000	0.000	0.71	0.000	0.000	10.00	0.18	10.18	133.78	0.000	0.038	0.038	0.038	8.50	375	0.25	0.091	0.80	41.6%
	MH6	MH5	100-YEAR STM	0.000	0.000	0.71	0.000	0.000	10.18	0.20	10.37	132.75	0.000		0.038	0.038	9.50	375	0.25	0.091	0.80	41.6%
	MH5	MH4	100-YEAR STM	0.000	0.000	0.71	0.000	0.000	10.37	1.19	11.57	131.62	0.000		0.038	0.038	57.50	375	0.25	0.091	0.80	41.6%
	MH4	EXSTORM	100-YEAR STM	0.000	0.000	0.71	0.000	0.000	11.57	0.18	11.75	125.20	0.000		0.038	0.038	8.50	375	0.25	0.091	0.80	41.6%

APPENDIX D

Domestic & Fire Flow Assessemnt

Figure D1: Fire Exposure Distances

DATE PREPARED :	June 16, 2023
DATE PRINT :	July 17, 2023
PROJECT:	3958 Cardinal Drive, Niagara Falls
PROJECT NUMBER:	22181
DESIGNED BY:	AR
REVIEWED BY:	AR

ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

ONTARIO BUILDING CODE (OBC) REQUIRED FIRE FLOW CALCULATIONS
CACULATIONS FOR BLOCK A

$Q = KVS_{Tot}$

WHERE

Q= Minimum Suppy of Water (L), V= Total Building Volume (m3)

K= Water Supply Coefficient from Table 1,

STot= Total of Spatial Coefficient Values from property line exposure on all sides, as obtained from the formula

STot = 1.0 + [(Sside 1) + (Sside 2) + (Sside 3) + (Side 4)] ≤ 2.0

MAJOR ACCUPANCY CLASSIFICATION (OBC TABLE 3.1.2.1)

DESCRIPTION OF MAJOR OCCUPANCY	CLASSIFICATION BY GROUP
C	Residential occupancies

WATER SUPPLY COEFFICIENT - K (OBC TABLE 1)

TYPE OF CONSTRCUTION	K VALUE
Building is of combustible construction. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	K= 23

TOTAL BUILDING VOLUME - V (m3)

BUILDING FLOOR AREA (m2)	AVERAGE BUILDING HEIGHT FROM ROOF TO BASEMENT (m)	TOTAL BUILDING VOLUME (m3)
486.00 m2	12.04 m	V=5851.44 m3

TOTAL SPATIAL COFFICIENT (S_{Tot}) (OBC FIGURE-1 SPATIAL COEFFICIENT Vs EXPOSURE DISTANCE)

BUILDING SIDES	EXPOSURE DISTANCE (m)	SPETIAL COEFFICIENT	TOTAL SPATIAL COEFFICIENT ≤ 2
NORTH	2.30 m	0.50	1.50
SOUTH	>10m	0.00	
WEST	>10m	0.00	
EAST	>10m	0.00	

$Q = KVS_{Tot}$	201,875 L

MINIMUM REQUIRED FIRE FLOW (L/min) (OBC TABLE 2)

OBC TABLE 2 FIRE FLOW RANGE	REQUIRED FIRE FLOW
6,300 L/min (IF Q > 190,000 L & ≤270,000 L)	6,300 L/min
	105 L/S

DATE PREPARED :	June 16, 2023
DATE PRINT :	June 16, 2023
PROJECT:	3958 Cardinal Drive, Niagara Falls
PROJECT NUMBER:	22181
DESIGNED BY:	AR
REVIEWED BY:	AR

ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

ONTARIO BUILDING CODE (OBC) REQUIRED FIRE FLOW CALCULATIONS
CACULATIONS FOR BLOCK B

$Q = KVS_{Tot}$

WHERE

Q= Minimum Suppy of Water (L), V= Total Building Volume (m3)

K= Water Supply Coefficient from Table 1,

STot= Total of Spatial Coefficient Values from property line exposure on all sides, as obtained from the formula

STot = 1.0 + [(Sside 1) + (Sside 2) + (Sside 3) + (Side 4)] ≤ 2.0

MAJOR ACCUPANCY CLASSIFICATION (OBC TABLE 3.1.2.1)

DESCRIPTION OF MAJOR OCCUPANCY	CLASSIFICATION BY GROUP
C	Residential occupancies

WATER SUPPLY COEFFICIENT - K (OBC TABLE 1)

TYPE OF CONSTRCUTION	K VALUE
Building is of combustible construction. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	K= 23

TOTAL BUILDING VOLUME - V (m3)

BUILDING FLOOR AREA (m2)	AVERAGE BUILDING HEIGHT FROM ROOF TO BASEMENT (m)	TOTAL BUILDING VOLUME (m3)
414.60 m2	12.04 m	V=4991.78 m3

TOTAL SPATIAL COFFICIENT (S_{Tot}) (OBC FIGURE-1 SPATIAL COEFFICIENT Vs EXPOSURE DISTANCE)

BUILDING SIDES	EXPOSURE DISTANCE (m)	SPETIAL COEFFICIENT	TOTAL SPATIAL COEFFICIENT ≤ 2
NORTH	2.30 m	0.50	2.00
SOUTH	2.30 m	0.50	
WEST	>10m	0.00	
EAST	>10m	0.00	

$Q = KVS_{Tot}$	229,622 L

MINIMUM REQUIRED FIRE FLOW (L/min) (OBC TABLE 2)

OBC TABLE 2 FIRE FLOW RANGE	REQUIRED FIRE FLOW
6,300 L/min (IF Q > 190,000 L & ≤270,000 L)	6,300 L/min
	105 L/S

DATE PREPARED :	June 16, 2023
DATE PRINT :	July 17, 2023
PROJECT:	3958 Cardinal Drive, Niagara Falls
PROJECT NUMBER:	22181
DESIGNED BY:	AR
REVIEWED BY:	AR

ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

ONTARIO BUILDING CODE (OBC) REQUIRED FIRE FLOW CALCULATIONS
CACULATIONS FOR BLOCK C

$Q = KVS_{Tot}$

WHERE

Q= Minimum Suppy of Water (L), V= Total Building Volume (m3)

K= Water Supply Coefficient from Table 1,

STot= Total of Spatial Coefficient Values from property line exposure on all sides, as obtained from the formula

STot = 1.0 + [(Sside 1) + (Sside 2) + (Sside 3) + (Side 4)] ≤ 2.0

MAJOR ACCUPANCY CLASSIFICATION (OBC TABLE 3.1.2.1)

DESCRIPTION OF MAJOR OCCUPANCY	CLASSIFICATION BY GROUP
C	Residential occupancies

WATER SUPPLY COEFFICIENT - K (OBC TABLE 1)

TYPE OF CONSTRCUTION	K VALUE
Building is of combustible construction. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	K= 23

TOTAL BUILDING VOLUME - V (m3)

BUILDING FLOOR AREA (m2)	AVERAGE BUILDING HEIGHT FROM ROOF TO BASEMENT (m)	TOTAL BUILDING VOLUME (m3)
486.00 m2	12.04 m	V=5851.44 m3

TOTAL SPATIAL COFFICIENT (S_{Tot}) (OBC FIGURE-1 SPATIAL COEFFICIENT Vs EXPOSURE DISTANCE)

BUILDING SIDES	EXPOSURE DISTANCE (m)	SPETIAL COEFFICIENT	TOTAL SPATIAL COEFFICIENT ≤ 2
NORTH	>10m	0.00	1.50
SOUTH	2.30 m	0.50	
WEST	>10m	0.00	
EAST	>10m	0.00	

$Q = KVS_{Tot}$	201,875 L

MINIMUM REQUIRED FIRE FLOW (L/min) (OBC TABLE 2)

OBC TABLE 2 FIRE FLOW RANGE	REQUIRED FIRE FLOW
6,300 L/min (IF Q > 190,000 L & ≤270,000 L)	6,300 L/min
	105 L/S

DATE PREPARED :	June 16, 2023
DATE PRINT :	July 17, 2023
PROJECT:	3958 Cardinal Drive, Niagara Falls
PROJECT NUMBER:	22181
DESIGNED BY:	AR
REVIEWED BY:	AR

ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

ONTARIO BUILDING CODE (OBC) REQUIRED FIRE FLOW CALCULATIONS
CACULATIONS FOR BLOCK D

$Q = KVS_{Tot}$

WHERE

Q= Minimum Suppy of Water (L), V= Total Building Volume (m3)

K= Water Supply Coefficient from Table 1,

STot= Total of Spatial Coefficient Values from property line exposure on all sides, as obtained from the formula

STot = 1.0 + [(Sside 1) + (Sside 2) + (Sside 3) + (Side 4)] ≤ 2.0

MAJOR ACCUPANCY CLASSIFICATION (OBC TABLE 3.1.2.1)

DESCRIPTION OF MAJOR OCCUPANCY	CLASSIFICATION BY GROUP
C	Residential occupancies

WATER SUPPLY COEFFICIENT - K (OBC TABLE 1)

TYPE OF CONSTRCUTION	K VALUE
Building is of combustible construction. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	K= 23

TOTAL BUILDING VOLUME - V (m3)

BUILDING FLOOR AREA (m2)	AVERAGE BUILDING HEIGHT FROM ROOF TO BASEMENT (m)	TOTAL BUILDING VOLUME (m3)
308.30 m2	12.04 m	V=3711.93 m3

TOTAL SPATIAL COFFICIENT (S_{Tot}) (OBC FIGURE-1 SPATIAL COEFFICIENT Vs EXPOSURE DISTANCE)

BUILDING SIDES	EXPOSURE DISTANCE (m)	SPETIAL COEFFICIENT	TOTAL SPATIAL COEFFICIENT ≤ 2
NORTH	>10m	0.00	1.00
SOUTH	>10m	0.00	
WEST	>10m	0.00	
EAST	>10m	0.00	

$Q = KVS_{Tot}$	85,374 L

MINIMUM REQUIRED FIRE FLOW (L/min) (OBC TABLE 2)

OBC TABLE 2 FIRE FLOW RANGE	REQUIRED FIRE FLOW
2,700 L/min (IF Q ≤ 108,000 L)	2,700 L/min
	45 L/S

DATE PREPARED :	June 16, 2023
DATE PRINT :	July 17, 2023
PROJECT:	3958 Cardinal Drive, Niagara Falls
PROJECT NUMBER:	22181
DESIGNED BY:	AR
REVIEWED BY:	AR

ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

ONTARIO BUILDING CODE (OBC) REQUIRED FIRE FLOW CALCULATIONS
CACULATIONS FOR BLOCK E

$Q = KVS_{Tot}$

WHERE

Q= Minimum Suppy of Water (L), V= Total Building Volume (m3)

K= Water Supply Coefficient from Table 1,

STot= Total of Spatial Coefficient Values from property line exposure on all sides, as obtained from the formula

STot = 1.0 + [(Sside 1) + (Sside 2) + (Sside 3) + (Side 4)] ≤ 2.0

MAJOR ACCUPANCY CLASSIFICATION (OBC TABLE 3.1.2.1)

DESCRIPTION OF MAJOR OCCUPANCY	CLASSIFICATION BY GROUP
C	Residential occupancies

WATER SUPPLY COEFFICIENT - K (OBC TABLE 1)

TYPE OF CONSTRCUTION	K VALUE
Building is of combustible construction. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	K= 23

TOTAL BUILDING VOLUME - V (m3)

BUILDING FLOOR AREA (m2)	AVERAGE BUILDING HEIGHT FROM ROOF TO BASEMENT (m)	TOTAL BUILDING VOLUME (m3)
308.30 m2	12.04 m	V=3711.93 m3

TOTAL SPATIAL COFFICIENT (S_{Tot}) (OBC FIGURE-1 SPATIAL COEFFICIENT Vs EXPOSURE DISTANCE)

BUILDING SIDES	EXPOSURE DISTANCE (m)	SPETIAL COEFFICIENT	TOTAL SPATIAL COEFFICIENT ≤ 2
NORTH	>10m	0.00	1.00
SOUTH	>10m	0.00	
WEST	>10m	0.00	
EAST	>10m	0.00	

$Q = KVS_{Tot}$	85,374 L

MINIMUM REQUIRED FIRE FLOW (L/min) (OBC TABLE 2)

OBC TABLE 2 FIRE FLOW RANGE	REQUIRED FIRE FLOW
2,700 L/min (IF Q ≤ 108,000 L)	2,700 L/min
	45 L/S

DATE PREPARED :	June 16, 2023
DATE PRINT :	June 16, 2023
PROJECT:	3958 Cardinal Drive, Niagara Falls
NUMBER:	22181
DESIGNED BY:	AR
REVIEWED BY:	AR

ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

CALCULATIONS FOR WATER SERVICE

DOMESTIC WATER DEMAND

S.No.	FIXTURE OR DEVICE	HYDRAULIC LOAD, FIXTURE UNIT	NUMBER OF UNITS	TOTAL FIXTURE
1	BATH ROOM GROUP WITH 6LPF FLUSH TANK	3.6	99	356.4
2	CLOTHES WASHER, 3.5 kg	1.4	33	46.2
3	LAVATORY, 8.3 L/min OR LESS	0.7	33	23.1
4	WATER CLOSET, 6 LPF OR LESS WITH FLUSH TANK	2.2	33	72.6
5	DISHWASHER, DOMESTIC	1.4	33	46.2
6	HOSE BIBB	2.5	33	82.5
7	SINK, KITCHEN, DOMESTIC, GREATER THAN 8.3 L/min	1.4	33	46.2
TOTA				673.2

TOTAL FIXTURES =	673	136.76 IGPM	10.35 L/s	AS PER OBC TABLE 7.4.10.5

FIRE FLOW DEMAND

REQUIRED FIRE FLOW= 105.00 L/s — NO SPRINKLER SYSTEM IN THE BUILDING AS EXISTING FIRE HYDRANT AVAILABLE

TOTAL REQUIRED FLOW

TOTAL REQUIRED FLOW= 115.35 L/s

HEADLOSS CALCULATIONS

MAJOR HEAD LOSS

l = length of pipe (m)	112.00 m
c = Hazen-Williams roughness constant	110
q = volume flow (liter/sec)	115.35 L/s
dh = inside or hydraulic diameter (mm)	200.00 mm

Calculated Pressure Loss

f = friction head loss in mm of water per 100 m of pipe (mm H20 per 100 m pipe): 8373.22 — Head loss (mm H20): 9378.00

f = friction head loss in kPa per 100 m of pipe (kPa per 100 m pipe): 82.14 — Head loss (kPa): 92.00

Calculated Flow Velocity

v = flow velocity (m/s): 3.67

Total Head Loss : H major + H minor +Δ Z
Available Pressure – (H major + H minor +Δ Z)

MAJOR HEADLOSS: 9.38 m

Hazen-Williams Formula in Metric Units

$h = 10.67\ q^{1.85} / (c^{1.85}\ d_h^{4.8655})$

where

h = head loss per unit pipe (m_{h2o}/m pipe)

c = design coefficient determined for the type of pipe or tube - the higher the factor, the smoother the pipe or tube

q = flow rate (m^3/s)

d_h = inside hydraulic diameter (m)

MINOR HEADLOSS

$$h_L = K\left(\frac{v^2}{2g}\right)$$

MINOR HEADLOSS (10% OF MAJOR HEADLOSS): 0.94 m

FITTING	LOSS COEFFICIENT
Globe valve, fully open	10.0
Angle valve, fully open	5.0
Swing check valve, fully open	2.5
Gate valve, fully open	0.2
Short-radius elbow	0.9
Medium-radius elbow	0.8
Long-radius elbow	0.6
45 degree elbow	0.4
Closed return bend	2.2
Standard tee - flow through run	0.6
Standard tee - flow through branch	1.8
Square entrance	0.5
Exit	1.0

ELEVATION LOSS

ELEVATION LOSS	189.50 m	188.41 m	1.09 m

TOTAL HEADLOSS

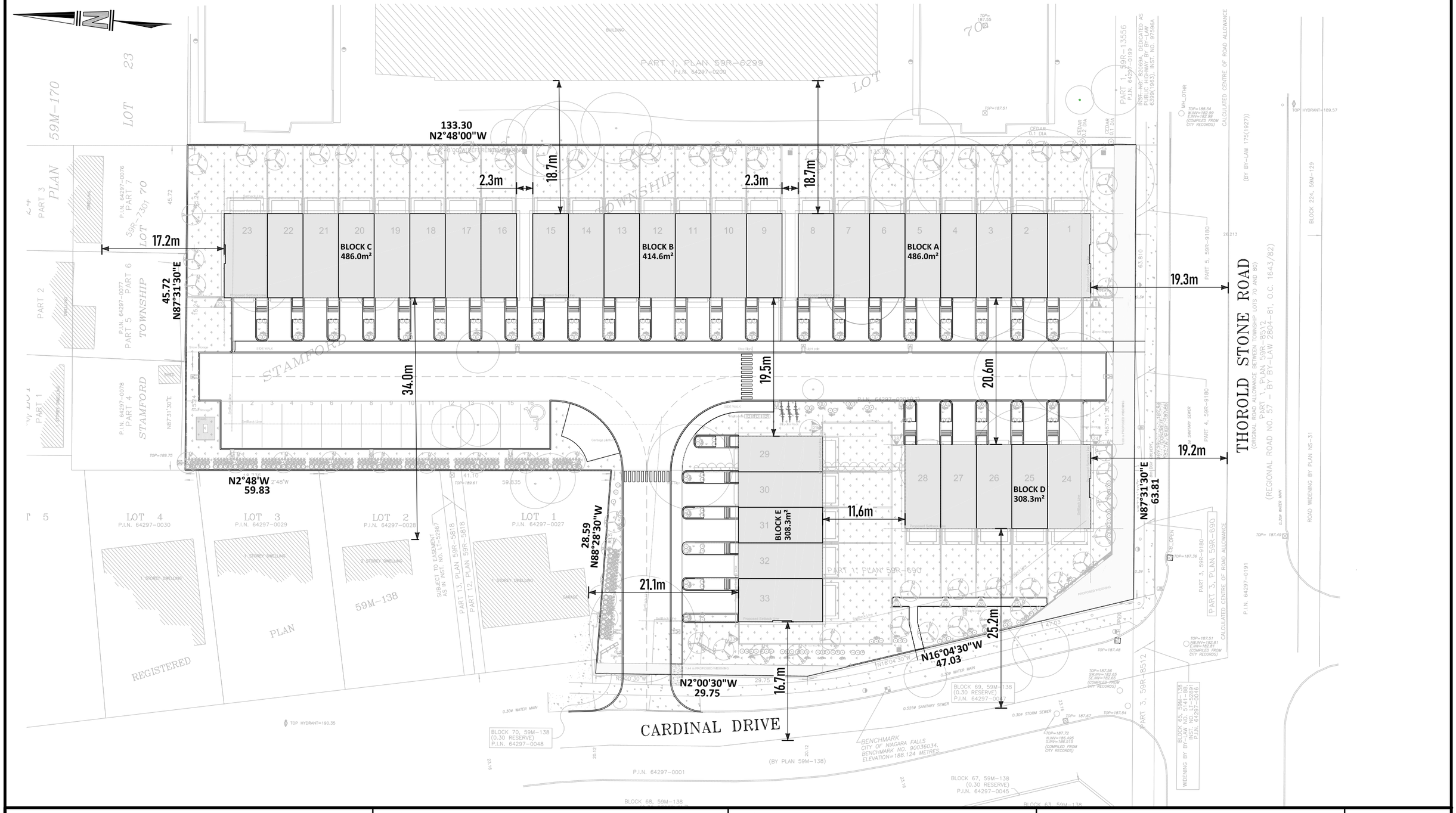
TOTAL HEAD LOSS: 11.41 m

MINIMUM AVAILABLE PRESSURE

MINIMUM PRESSURE	40.0 PSI
EQUIVALENT HEAD	28.13 m

NET HEAD

NET HEAD: 16.72 m — POSITIVE PRESSURE - PROPOSED WATER SERVICE SUFFICIENT



ARIK ENGINEERING LTD.
Where Community Design & Develop

260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

LEGEND

N/A

PROJECT:

3958 CARDINAL DRIVE
CITY OF NIAGARA FALLS

FIGURE -D1

FIRE EXPOSURE DISTANCES

DATE: JULY 10, 2023

SCALE: 1:500

PROJECT NO. 22181

3958 CARDINAL DRIVE

APPENDIX E

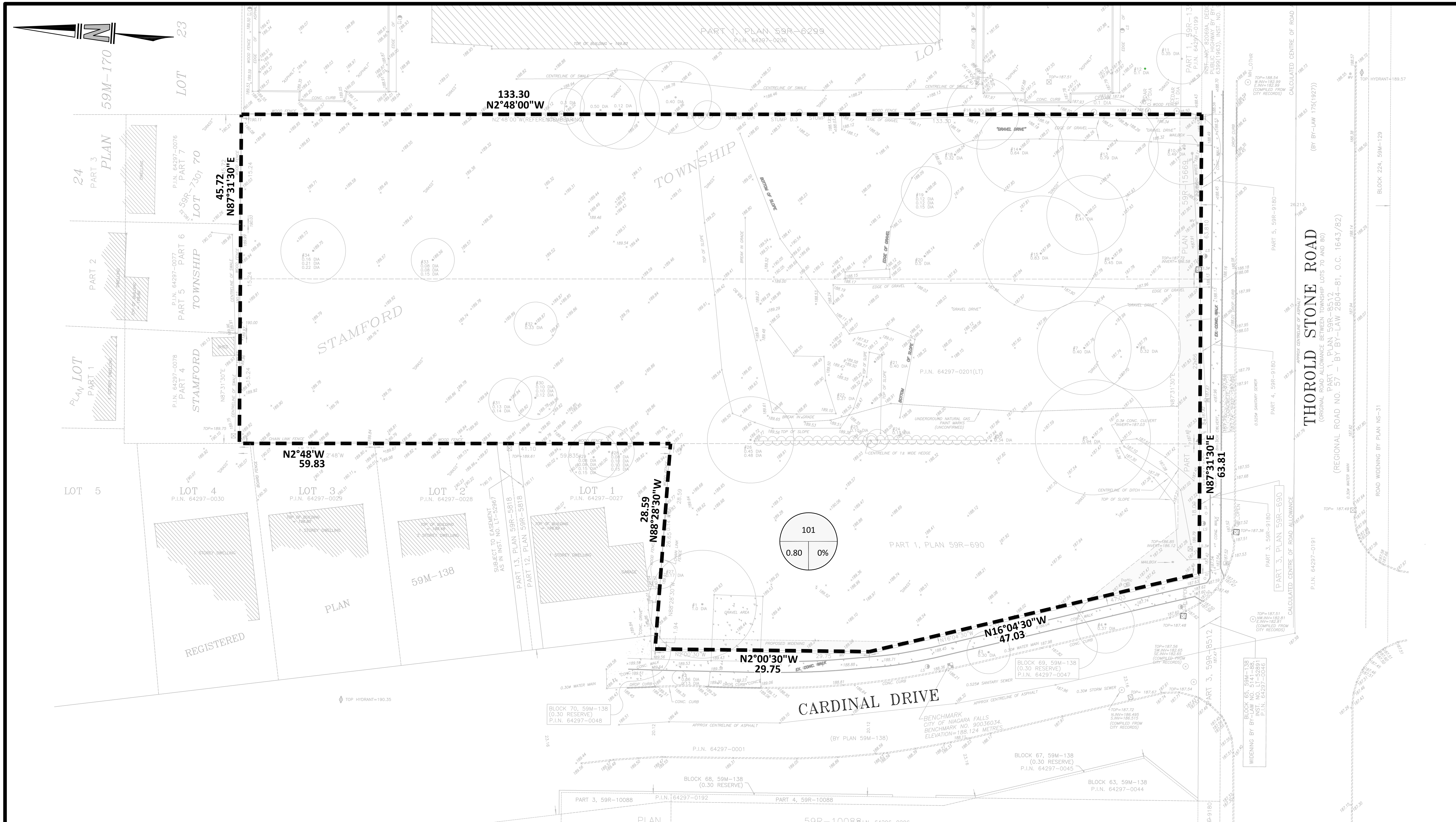
Figure E1: Pre-Development Draiange Area Plan

Figure E2: Post-Development Drainage Area Plan

Imperviousness Calculations

Stage, Storage & Dischrage Curves and Orifice Calculations

SWMHYMO Model Output Files



ENGINEERING
Where Community Design & Develop

ARIK ENGINEERING LTD.
Where Community Design & Develop
260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

LEGEND

- PRE-DEVELOPMENT DRAINAGE AREA
- DRAINAGE AREA I.D
- % IMPERVIOUSNESS
- AREA IN HECTARES

(Legend symbol: 101 / 0.80 / 0%)

PROJECT:

3958 CARDINAL DRIVE
CITY OF NIAGARA FALLS

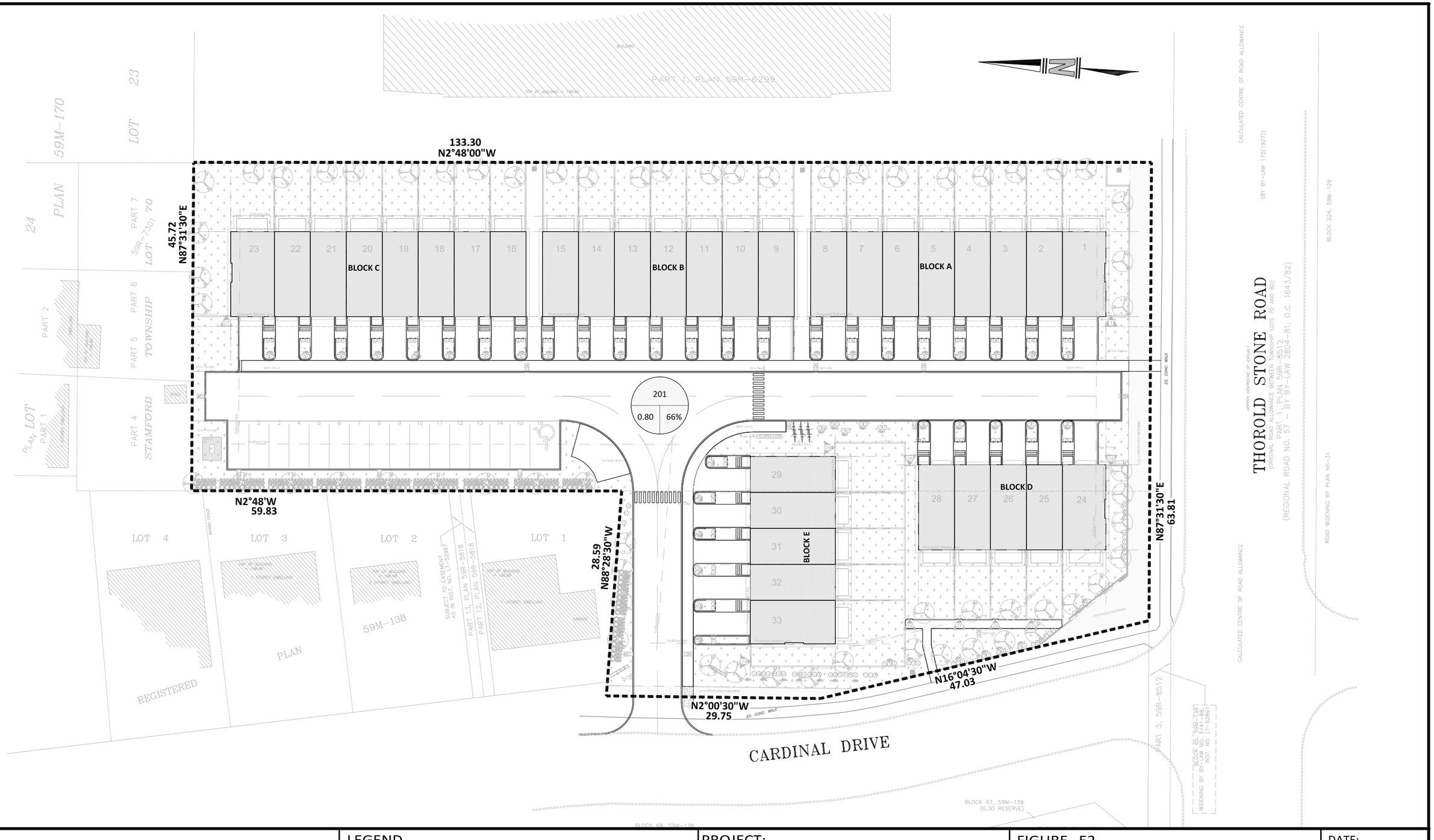
FIGURE -E1

PRE-DEVELOPMENT DRAINAGE AREA PLAN

DATE:	JULY 10, 2023
SCALE:	1:500
PROJECT NO.	22181

3958 CARDINAL DRIVE

d:\arik eng\jobs 2022\22181_3958 cardinal drive, niagara falls\engineering\report\swm report\july 10, 2023\autocad drawing\current July 14, 2023 10:12 AM



ARIK ENGINEERING LTD.
Where Community Design & Develop

260 Nebo Road, Unit 205, Hamilton
Ontario, L8W 3K5
email: info@arikengineering.com
web: www.arikengineering.com
phone: +1-289-965-9772

LEGEND

- STORM DRAINAGE AREA
- DRAINAGE AREA I.D
- % IMPERVIOUSNESS
- AREA IN HECTARES

PROJECT:

3958 CARDINAL DRIVE
CITY OF NIAGARA FALLS

FIGURE - E2

POST-DEVELOPMENT DRAINAGE AREA PLAN

DATE: JULY 10, 2023

SCALE: 1:500

PROJECT NO. 22181

d:\arik eng\jobs 2022\22181_3958 cardinal drive, niagara falls\engineering\report\swm report\july 10, 2023\autocad drawing\current July 14, 2023 10:12 AM

ERK ENGINEERING
Where Community Design & Develop

3958 CARDINAL DRIVE, NIAGARA FALLS

PRE-DVELOPMENT CONDITIONS - TIME OF CONCENTRATION

Airport Formula

For Runoff Coefficient up to 0.4

$$t_c = \frac{3.26\,(1.1 - C)\,L^{0.5}}{S^{0.33}}$$ **(min)**

C= Runoff Coefficient
L= Length of watershed (m)
S= Slope of watershed (%)

C	L	S	tc	Time of Peak Tp (=0.6Tc)	Velocity
	m	%	minute	hr	m/s
0.25	135	2.00	25.61	0.26	0.09

POST-DEVELOPMENT CONDITIONS IMPERVIOUSNESS CALCULATIONS

GRASS AREA	0.274	ha
IMPERVIOUS AREA	0.526	ha
TOTAL AREA	0.800	ha

IMP (% IMPERVIOUSNESS). 66 %

POST-DEVELOPMENT CONDITIONS RUNOFF COEFFICIENT CALCULATIONS

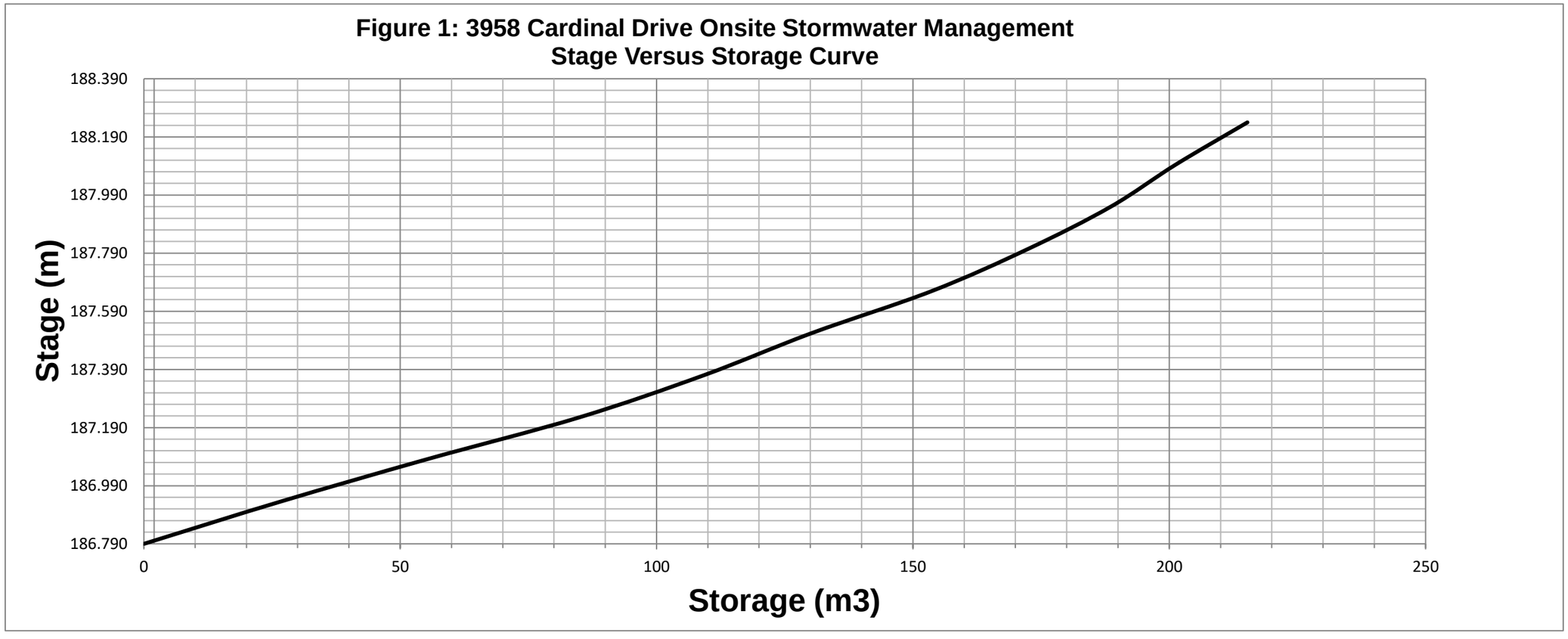
IMP= (C - 0.25)/0.70
C= (IMP x 0.70) +0.25

C (RUNOFF COEFFICIENT) 0.71

3958 Cardinal Drive, Niagara Falls
STAGE vs STORAGE

Stage vs Storage	
Stage (M)	Cumulative V (m3)
186.790	0.00
186.935	26.59
187.080	55.02
187.225	84.92
187.370	109.22
187.515	130.27
187.660	153.74
187.805	172.52
187.950	188.60
188.095	201.29
188.240	215.25

(As per ADS Stage Storage Data)

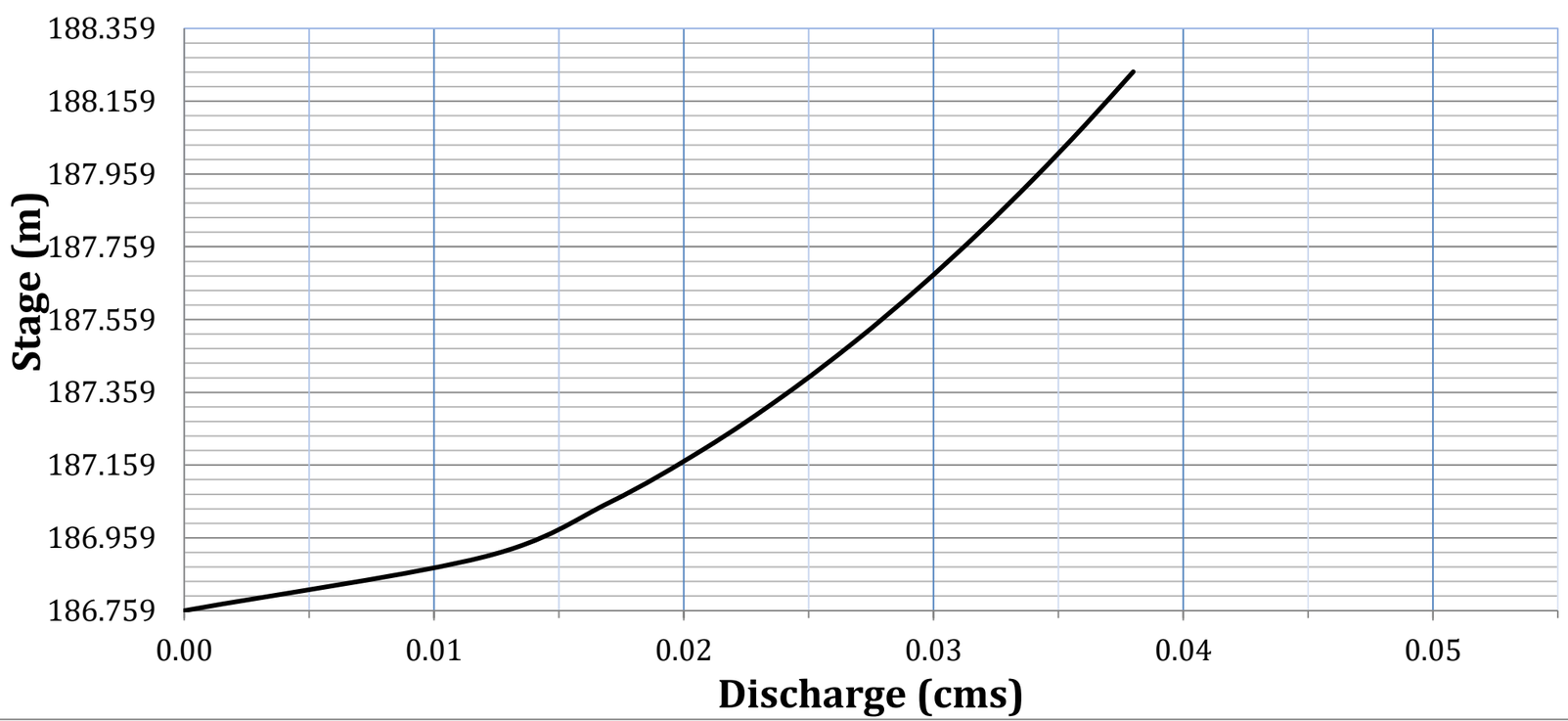


3958 Cardinal Drive, Niagar Falls
STAGE vs DISCHARGE

Stage vs Discharge	
Stage (M)	Discharge (cms)
186.759	0.0000
186.907	0.0120
187.055	0.0170
187.203	0.0208
187.351	0.0240
187.500	0.0269
187.648	0.0294
187.796	0.0318
187.944	0.0340
188.092	0.0360
188.240	0.0380

ORIFICE CALCULATIONS		
Orifice Equation		
Q=Coef*A*SQR(2*g*h)		
Q (Max)=	0.0380	cms
Orifice Coef=	0.6	
Max Head=	1.481	m
Orifice Area=	0.01175	m2
Orifice Dia=	122	mm

Figure 2: 3958 Cardinal Drive Onsite Stormwater Management
Stage Versus Discharge Curve



```
================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9   =========
                                                         9   9  9   9   # 3124689
        StormWater Management HYdrologic Model            999    999    =========

 ********************************************************************************
 ***************************** SWMHYMO Ver/4.05  ********************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                  OTTHYMO-83 and OTTHYMO-89.                  *********
 ********************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ********************************************************************************

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: ARIK ENGINEERING LTD                          +++++++++
 +++++++++                Hannon                SERIAL#:3124689        +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ********************************************************************************
 *********           ++++++ PROGRAM ARRAY DIMENSIONS ++++++            *********
 *********           Maximum value for ID numbers  :     10           *********
 *********           Max. number of rainfall points: 105408           *********
 *********           Max. number of flow points    : 105408           *********
 ********************************************************************************


 **********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2023-06-19     TIME: 14:01:03     RUN COUNTER: 000917         *
 ********************************************************************************
 * Input   filename: C:\SWMHYMO\3958CAR\3958CAR\3958CAR.DAT                      *
 * Output  filename: C:\SWMHYMO\3958CAR\3958CAR\3958CAR.out                      *
 * Summary filename: C:\SWMHYMO\3958CAR\3958CAR\3958CAR.sum                      *
 * User comments:                                                               *
 * 1:_____________________________________________________________________________*
 * 2:_____________________________________________________________________________*
 * 3:_____________________________________________________________________________*
 ********************************************************************************

--------------------------------------------------------------------------------
--
```

```
001:0001----------------------------------------------------------------------------
--
*#*************************************************************************
*#  Project Name: 3958 CARDINAL DRIVE, NIAGARA FALLS
*#  Project Numbe: 22181
*#  Date        : JUNE 19, 2023
*#  Modeller    : ABDUL RAZZAK
*#  Company     : ARIK ENGINEERING LTD.
*#  License #   : 3124689
*#*************************************************************************
--------------------
| START            |  Project  dir.: C:\SWMHYMO\3958CAR\3958CAR\

--------------------  Rainfall dir.: C:\SWMHYMO\3958CAR\3958CAR\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
-------------------------------------------------------------------------------
--
001:0002----------------------------------------------------------------------------
--
*
*
*
*++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
*==================PRE-DEVELOPMENT CONDITIONS=======================
*++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
*
*
*#=================================================
*# 5-YEAR PRE-DEVELOPMENT DRAINAGE AREA 101 (0.80 HA)
*#=================================================
*
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 719.500
| Ptotal= 38.79 mm |                          B=   6.340
--------------------                          C=    .769
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =   .33

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   4.009 |   1.00  84.024 |   1.83   6.940 |   2.67   3.836
               .33   4.904 |   1.17  28.873 |   2.00   5.924 |   2.83   3.542
               .50   6.425 |   1.33  15.670 |   2.17   5.189 |   3.00   3.295
```

```
               .67   9.661 |   1.50  10.900 |   2.33   4.630 |
               .83  22.257 |   1.67   8.443 |   2.50   4.191 |

-------------------------------------------------------------------------------
--
001:0003----------------------------------------------------------------------
--
*
*
*
----------------------
| CALIB NASHYD       |   Area    (ha)=     .80   Curve Number   (CN)=75.00
| 01:000101 DT= 1.00 |   Ia      (mm)=    .800   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .260

     Unit Hyd Qpeak  (cms)=     .118

     PEAK FLOW       (cms)=     .025 (i)
     TIME TO PEAK    (hrs)=    1.300
     RUNOFF VOLUME    (mm)=   11.764
     TOTAL RAINFALL   (mm)=   38.786
     RUNOFF COEFFICIENT   =     .303

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--
001:0004----------------------------------------------------------------------
--
*
*
*
*
*#==================================================
*# 100-YEAR PRE-DEVELOPMENT DRAINAGE AREA 101 (0.80 HA)
*#==================================================
*
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1264.570
| Ptotal= 63.42 mm |                          B=   7.720
--------------------                          C=    .781
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =   .33

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   6.430 |   1.00 133.781 |   1.83  11.385 |   2.67   6.142
```

```
               .33   7.930 |   1.17  48.896 |   2.00   9.655 |   2.83   5.655
               .50  10.507 |   1.33  26.437 |   2.17   8.410 |   3.00   5.246
               .67  16.059 |   1.50  18.196 |   2.33   7.470 |
               .83  37.642 |   1.67  13.960 |   2.50   6.734 |

--------------------------------------------------------------------------------
--
001:0005--------------------------------------------------------------------------
--
*
*
*
----------------------
| CALIB NASHYD       |   Area    (ha)=     .80   Curve Number   (CN)=75.00
| 01:000101 DT= 1.00 |   Ia      (mm)=    .800   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .260

     Unit Hyd Qpeak  (cms)=     .118

     PEAK FLOW       (cms)=     .058 (i)
     TIME TO PEAK    (hrs)=    1.283
     RUNOFF VOLUME    (mm)=   26.625
     TOTAL RAINFALL   (mm)=   63.422
     RUNOFF COEFFICIENT   =     .420

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--
001:0006--------------------------------------------------------------------------
--
*
*
*
*
*++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
*====================POST-DEVELOPMENT CONDITIONS=======================
*++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
*
*
*#=========================================
*# 5-YEAR POST-DEVELOPMENT DRAINAGE AREA 201
*#=========================================
*
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 719.500
| Ptotal= 38.79 mm |                          B=   6.340
--------------------                          C=    .769
                       used in:   INTENSITY =  A / (t + B)^C
```

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = .33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	4.009	1.00	84.024	1.83	6.940	2.67	3.836
.33	4.904	1.17	28.873	2.00	5.924	2.83	3.542
.50	6.425	1.33	15.670	2.17	5.189	3.00	3.295
.67	9.661	1.50	10.900	2.33	4.630		
.83	22.257	1.67	8.443	2.50	4.191		

001:0007---
*
*
*

CALIB STANDHYD	Area (ha)= .80
01:000201 DT= 1.00	Total Imp(%)= 66.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	.53	.27	
Dep. Storage	(mm)=	.70	.80	
Average Slope	(%)=	2.00	2.00	
Length	(m)=	73.00	40.00	
Mannings n	=	.013	.250	
Max.eff.Inten.	(mm/hr)=	84.02	17.78	
over	(min)	2.00	16.00	
Storage Coeff.	(min)=	1.84 (ii)	15.92 (ii)	
Unit Hyd. Tpeak	(min)=	2.00	16.00	
Unit Hyd. peak	(cms)=	.59	.07	
				TOTALS
PEAK FLOW	(cms)=	.12	.01	.126 (iii)
TIME TO PEAK	(hrs)=	1.00	1.25	1.000
RUNOFF VOLUME	(mm)=	38.09	11.76	29.136
TOTAL RAINFALL	(mm)=	38.79	38.79	38.786
RUNOFF COEFFICIENT	=	.98	.30	.751

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 75.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
001:0008-------------------------------------------------------------------------
--
*
*
*
*
*
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(000201)   |
| OUT<02:(ONSITE)   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .029  .1537E-01
                            .012  .2659E-02   |     .032  .1725E-01
                            .017  .5502E-02   |     .034  .1886E-01
                            .021  .8492E-02   |     .036  .2013E-01
                            .024  .1092E-01   |     .038  .2152E-01
                            .027  .1303E-01   |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (000201)        .80      .126     1.000     29.136
     OUTFLOW<02: (ONSITE)        .80      .024     1.417     29.136

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.403
                   TIME SHIFT OF PEAK FLOW         (min)=    25.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1118E-01

-------------------------------------------------------------------------------
--
001:0009-------------------------------------------------------------------------
--
*
*
*#========================================
*# 100-YEAR POST-DEVELOPMENT DRAINAGE AREA 201
*#========================================
*#============================================================
*# POST-DEVELOPMENT TO MATCH WITH PRE-DEVELOPMENT CONDITOINS
*#============================================================
*
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1264.570
| Ptotal= 63.42 mm |                          B=   7.720
--------------------                          C=    .781
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
```

Storm time step = 10.00 min
Time to peak ratio = .33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	6.430	1.00	133.781	1.83	11.385	2.67	6.142
.33	7.930	1.17	48.896	2.00	9.655	2.83	5.655
.50	10.507	1.33	26.437	2.17	8.410	3.00	5.246
.67	16.059	1.50	18.196	2.33	7.470		
.83	37.642	1.67	13.960	2.50	6.734		

001:0010---
*
*
*

CALIB STANDHYD	Area (ha)= .80
01:000201 DT= 1.00	Total Imp(%)= 66.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	.53	.27	
Dep. Storage	(mm)=	.70	.80	
Average Slope	(%)=	2.00	2.00	
Length	(m)=	73.00	40.00	
Mannings n	=	.013	.250	
Max.eff.Inten.(mm/hr)=		133.78	48.44	
over (min)		2.00	11.00	
Storage Coeff. (min)=		1.53 (ii)	10.96 (ii)	
Unit Hyd. Tpeak (min)=		2.00	11.00	
Unit Hyd. peak (cms)=		.66	.10	
				TOTALS
PEAK FLOW	(cms)=	.20	.02	.209 (iii)
TIME TO PEAK	(hrs)=	1.00	1.15	1.000
RUNOFF VOLUME	(mm)=	62.72	26.62	50.449
TOTAL RAINFALL	(mm)=	63.42	63.42	63.422
RUNOFF COEFFICIENT	=	.99	.42	.795

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 75.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

001:0011---

```
--
*
*
*
*
*
*#============================================================
*# POST-DEVELOPMENT TO MATCH WITH PRE-DEVELOPMENT CONDITOINS
*#============================================================
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(000201)   |
| OUT<02:(ONSITE)   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .029  .1537E-01
                            .012  .2659E-02   |     .032  .1725E-01
                            .017  .5502E-02   |     .034  .1886E-01
                            .021  .8492E-02   |     .036  .2013E-01
                            .024  .1092E-01   |     .038  .2152E-01
                            .027  .1303E-01   |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (000201)        .80      .209     1.000     50.449
     OUTFLOW<02: (ONSITE)        .80      .037     1.517     50.449

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   17.903
                   TIME SHIFT OF PEAK FLOW         (min)=    31.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2111E-01

--------------------------------------------------------------------------------
--
001:0012-----------------------------------------------------------------------
--
*
*
*
*
*
*
      FINISH
--------------------------------------------------------------------------------
--
********************************************************************************
**
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2023-06-19     at 14:01:04
```

==========
==

APPENDIX F

Stormwater Storage Chambers Design

Oil & Grit Separator (OGS) Design

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	HAIDER NASRULLAH 647-850-9417 HAIDER.NASRULLAH@ADSPIPE.COM
ADS SALES REP	ANDREW OKOLISAN 519-670-0564 ANDREW.OKOLISAN@ADS-PIPE.COM
PROJECT NO.	S360852
ONTARIO SITE COORDINATOR:	RYAN RUBENSTEIN 519-710-3687 RYAN.RUBENSTEIN@ADS-PIPE.COM

Advanced Drainage Systems, Inc.

SiteAssist™
FOR STORMTECH
INSTALLATION INSTRUCTIONS
VISIT OUR APP

3958 CARDINAL DRIVE
NIAGARA FALLS, ON, CANADA

MC-3500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL BE CERTIFIED TO CSA B184, "POLYMERIC SUB-SURFACE STORMWATER MANAGEMENT STRUCTURES", AND MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE CSA S6 CL-625 TRUCK AND THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 75 mm (3").
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 23° C / 73° F), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 150 mm (6") SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 300 mm (12") INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE WELL GRADED BETWEEN ¾" AND 2" (20-50 mm)..
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
10. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 900 mm (36") OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

PROPOSED LAYOUT

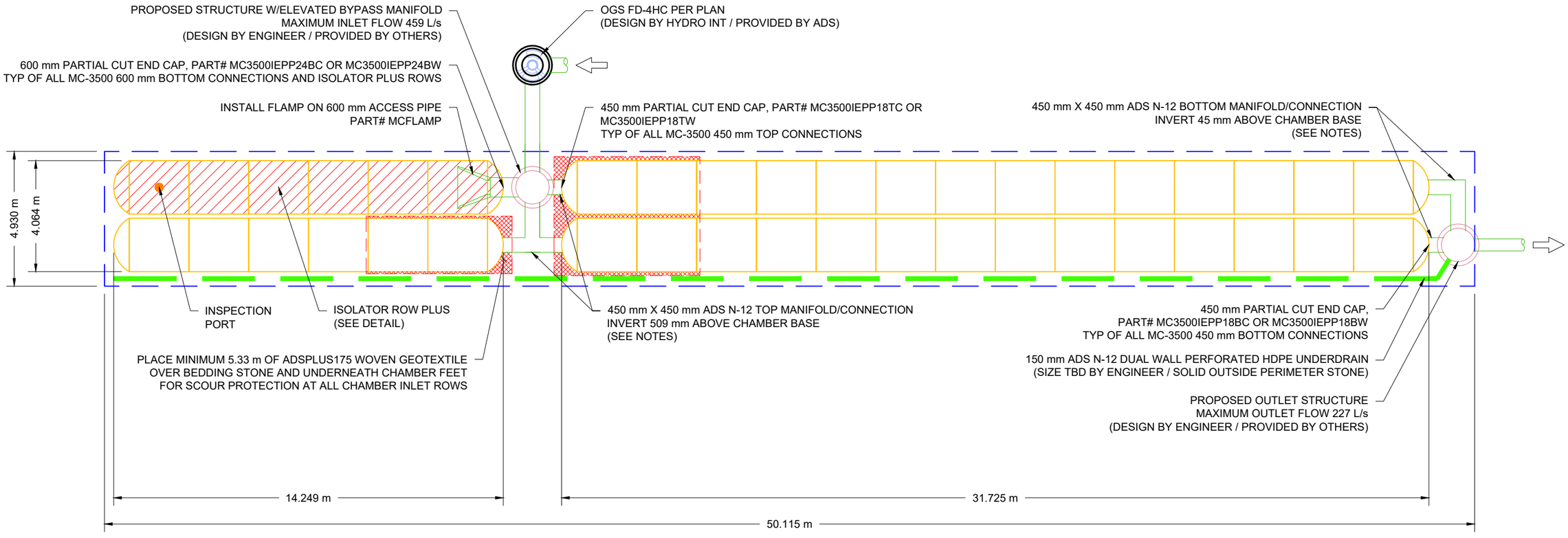
40	STORMTECH MC-3500 CHAMBERS
8	STORMTECH MC-3500 END CAPS
305	STONE ABOVE (mm)
229	STONE BELOW (mm)
40	% STONE VOID
211.4	**INSTALLED SYSTEM VOLUME (m³) ABOVE ELEVATION 186.790 (PERIMETER STONE INCLUDED)**
247.0	SYSTEM AREA (m²)
110.0	SYSTEM PERIMETER (m)

PROPOSED ELEVATIONS

190.326	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):
188.498	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):
188.345	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):
188.345	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):
188.345	MINIMUM ALLOWABLE GRADE (TOP OF RIGID PAVEMENT):
188.193	TOP OF STONE:
187.888	TOP OF MC-3500 CHAMBER:
187.254	450 mm TOP MANIFOLD/CONNECTION INVERT:
186.797	600 mm ISOLATOR ROW PLUS INVERT:
186.790	450 mm BOTTOM MANIFOLD INVERT:
186.745	BOTTOM OF MC-3500 CHAMBER:
186.516	BOTTOM OF STONE:

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECHNICAL NOTE 6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.



3958 CARDINAL DRIVE
NIAGARA FALLS, ON, CANADA
DATE:
DRAWN: HN
PROJECT #:
CHECKED: N/A

DATE	DRW	CHK	DESCRIPTION

StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM

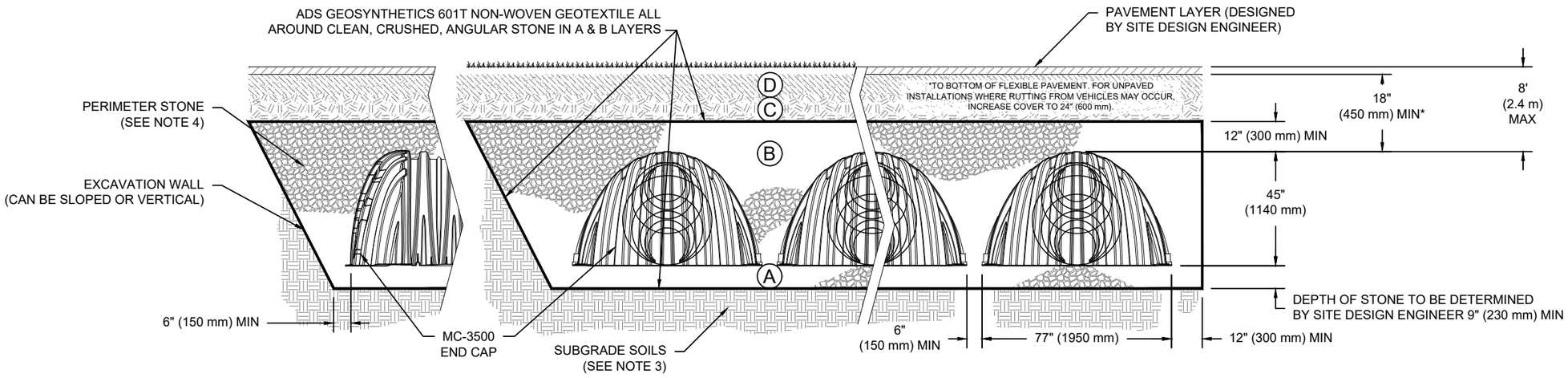
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

SCALE = 1 : 150

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

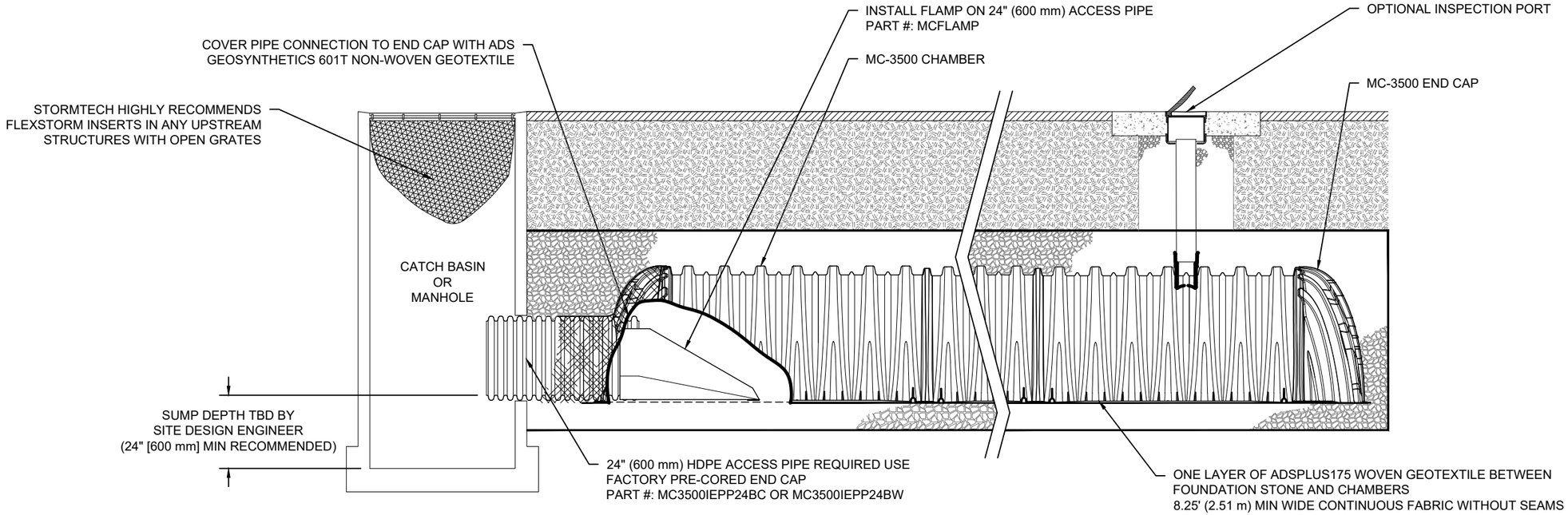
1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

3958 CARDINAL DRIVE
NIAGARA FALLS, ON, CANADA
DATE:
DRAWN: HN
CHECKED: N/A
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM

4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473



MC-3500 ISOLATOR ROW PLUS DETAIL
NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

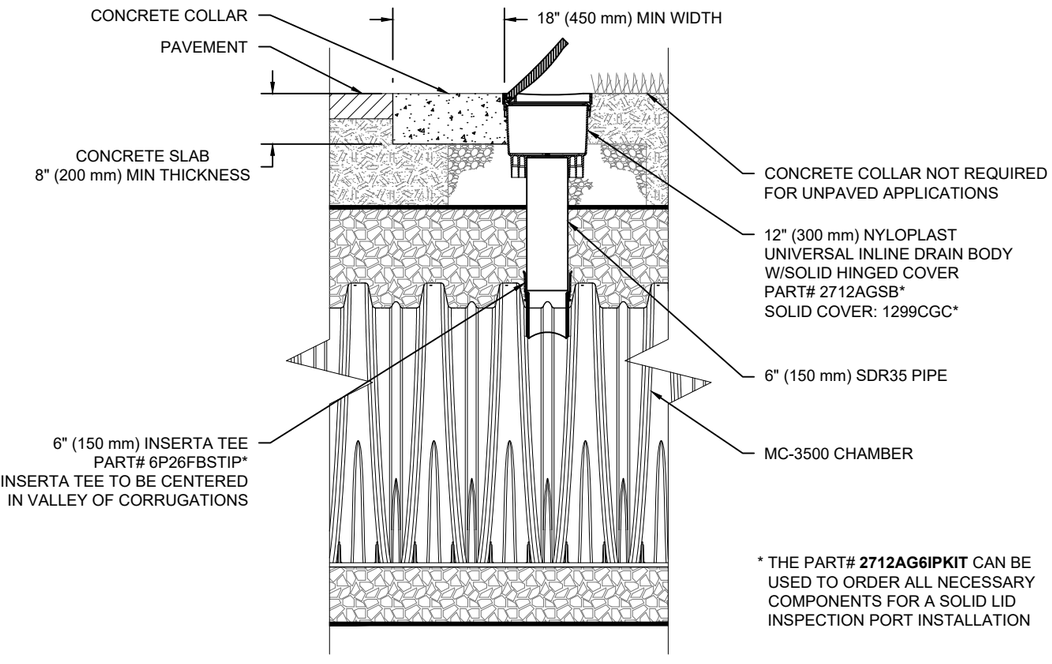
STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.

2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



* THE PART# **2712AG6IPKIT** CAN BE USED TO ORDER ALL NECESSARY COMPONENTS FOR A SOLID LID INSPECTION PORT INSTALLATION

MC-3500 6" (150 mm) INSPECTION PORT DETAIL
NTS

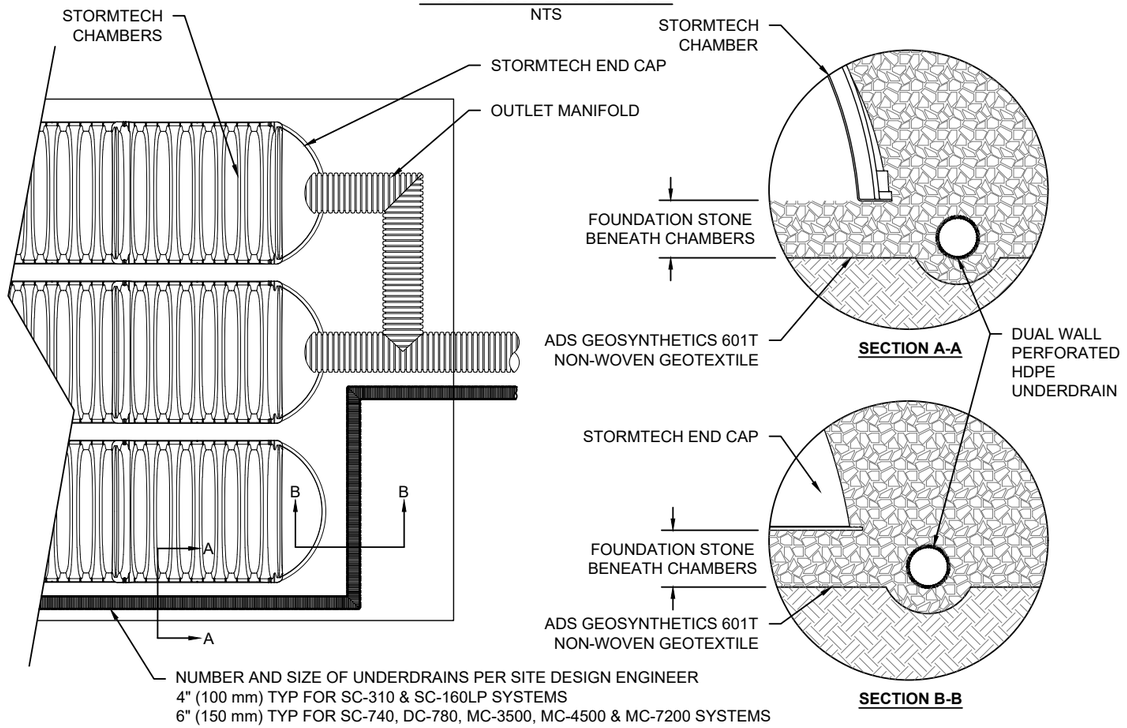
3958 CARDINAL DRIVE
NIAGARA FALLS, ON, CANADA
DATE:
DRAWN: HN
PROJECT #:
CHECKED: N/A

DATE	DRW	CHK	DESCRIPTION

StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

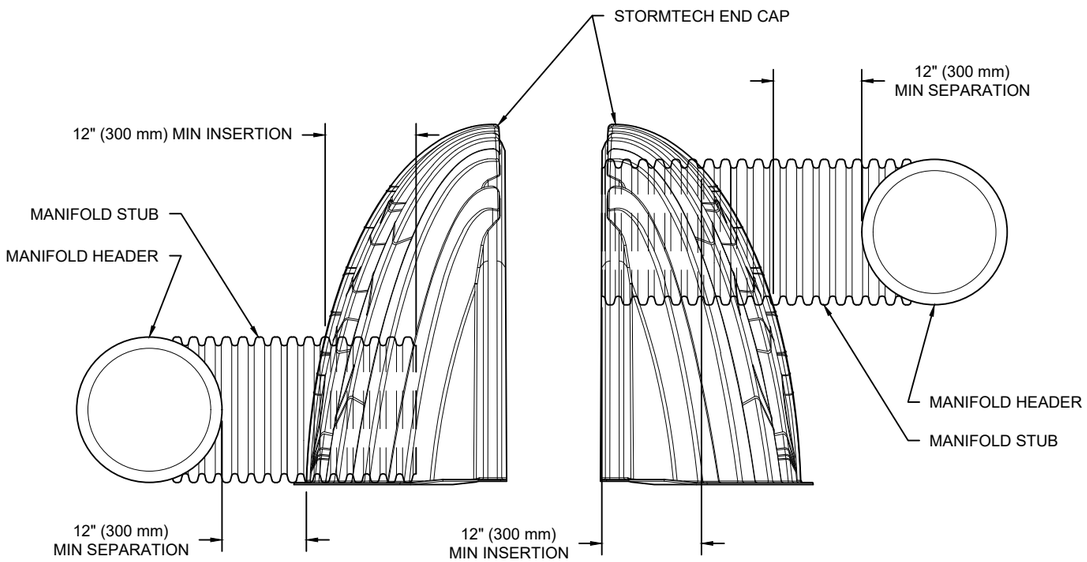
UNDERDRAIN DETAIL

NTS



MC-SERIES END CAP INSERTION DETAIL

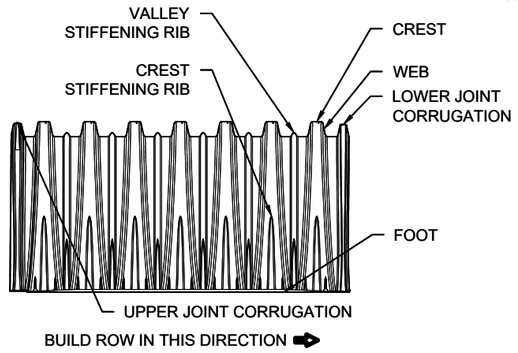
NTS

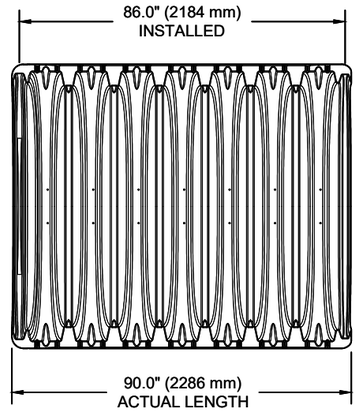


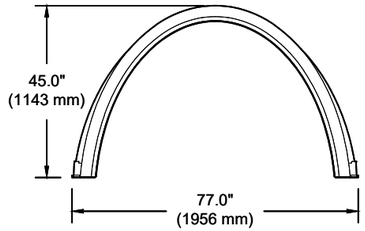
NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

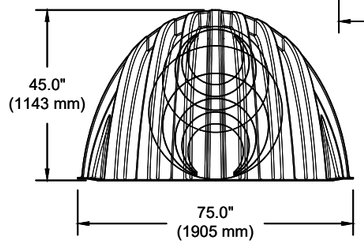
MC-3500 TECHNICAL SPECIFICATION

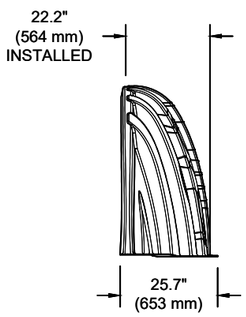
NTS











NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 86.0"	(1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE	109.9 CUBIC FEET	(3.11 m³)
MINIMUM INSTALLED STORAGE*	175.0 CUBIC FEET	(4.96 m³)
WEIGHT	134 lbs.	(60.8 kg)

NOMINAL END CAP SPECIFICATIONS

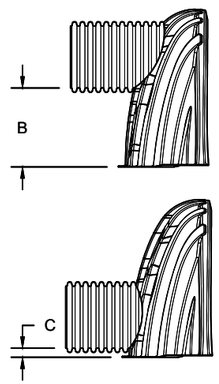
SIZE (W X H X INSTALLED LENGTH)	75.0" X 45.0" X 22.2"	(1905 mm X 1143 mm X 564 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m³)
MINIMUM INSTALLED STORAGE*	45.1 CUBIC FEET	(1.28 m³)
WEIGHT	49 lbs.	(22.2 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" SPACING BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18TW			
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW			
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

3958 CARDINAL DRIVE
NIAGARA FALLS, ON, CANADA
DATE: DRAWN: HN CHECKED: N/A
PROJECT #:

DESCRIPTION	CHK	DRW	DATE

StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11

GFE = 189.74
BFE = 190.10
FFE = 192.85

GFE = 189.54
BFE = 189.90
FFE = 192.65

GFE = 189.32
BFE = 189.68
FFE = 192.43

1.00m (TYP.) 1.50m (TYP.)

SIDE WALK

PROP. BLOW OFF & PLUG

CB

PROP. DEPRESSED CURB (TYP.)

PROP. WATERMAIN 200mmØ PVC DR 18

PROP. SAN. 61.0m-200mmØ @ 0.50% PVC SDR 35

SAN MHA4

PROP. STM. 3.0m-450mmØ @ 0.58% PVC SDR 35

OGS

PROP. STM. 42.5m-450mmØ @ 0.58% PVC SDR 35

1.00m | 2.50m | 1.00m

INLET
INV 186.843

UNDERGROUND STORMWATER
STORMTECH ADS STORAGE SYSTEM 48.0mx5.0m.
(SEE ADS DRAWINGS)
REQUIRED STORAGE 224m³.

5.0m

48.0m

OUTLET INV. 186.790

PROP. STM. 8.5m-375mmØ @ 0.25% PVC SDR 35

SAN MHA2

WV

200x200x20 CROSS

STM MH1

STM MH5

STM MH6

200x200x150 CROSS

Garbage platform

1.50m | 1.60m | 2.50m | 1.00m

PROP. STM. 21.0m-300mmØ @ 0.35% PVC SDR 35

PROP. WATERMAIN 200mmØ PVC DR 18

PROP. SAN. 40.0m-200mmØ @ 0.5% PVC SDR 35

PROP. DEPRESSED CURB (TYP.)

STM MH3

MHA4
TOP=189.50
OPSD 701.010
INV
185.605 S

EX. CB
TOP=189.75

CHAIN LINK FENCE

WOOD FENCE

N 4°01'10" W
59.83

OGS (FD4HC)
TOP=189.32
REFER TO MANUFACTURER DRAWING
INV
186.861 W
186.871 S

EX. CB

INSTALL 118mm ORIFICE AT SOUTHEAST INVERT OF MH6, SEE ORIFICE DETAIL "A"

PROP. STM. 9.5m-375mmØ @ 0.25% PVC SDR 35

MH6
TOP=188.90
OPSD 701.010
INV
186.769 N
186.759 SE

MH3
TOP=189.17
OPSD 701.010
INV
187.492 E

MHA1

28.59
S 39°44'20" W

LOT 4
P.I.N. 64297-0030

LOT 3
P.I.N. 64297-0029

LOT 2
P.I.N. 64297-0028

59M-138

SUBJECT TO EASEMENT AS IN INST. NO. LT-52967

PART 13, PLAN 59R-5818

PART 12, PLAN 59R-5818

1 STOREY DWELLING

2 STOREY DWELLING

GARAGE

TOP OF BUILDING = 196.85

TOP OF BUILDING = 193.48

TOP OF BUILDING = 196.89

"GRASS"

BOARD FENCE

CENTRELINE OF SWALE

TOWNSHIP

PART 5

PART 6

P.I.N. 64297-0077

P.I.N. 64297-0078

STAMFORD

Project: 3958 Cardinal Drive

Chamber Model -	MC-3500	
Units -	**Metric**	
Number of Chambers -	40	
Number of End Caps -	8	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	186.52	m
Amount of Stone Above Chambers -	305	mm
Amount of Stone Below Chambers -	229	mm

247 sq.meters Min. Area - 196.23 sq.meters

☑ Include Perimeter Stone in Calculations

☐ Click for Stage Area Data

☐ Click to Invert Stage Area Data

Click Here for Imperial

StormTech MC-3500 Cumulative Storage Volumes

Height of System (mm)	Incremental Single Chamber (cubic meters)	Incremental Single End Cap (cubic meters)	Incremental Chambers (cubic meters)	Incremental End Cap (cubic meters)	Incremental Stone (cubic meters)	Incremental Ch, EC and Stone (cubic meters)	Cumulative System (cubic meters)	Elevation (meters)
1676	0.00	0.00	0.00	0.00	2.508	2.51	242.30	188.19
1651	0.00	0.00	0.00	0.00	2.508	2.51	239.79	188.17
1626	0.00	0.00	0.00	0.00	2.508	2.51	237.28	188.14
1600	0.00	0.00	0.00	0.00	2.508	2.51	234.77	188.12
1575	0.00	0.00	0.00	0.00	2.508	2.51	232.27	188.09
1549	0.00	0.00	0.00	0.00	2.508	2.51	229.76	188.07
1524	0.00	0.00	0.00	0.00	2.508	2.51	227.25	188.04
1499	0.00	0.00	0.00	0.00	2.508	2.51	224.74	188.01
1473	0.00	0.00	0.00	0.00	2.508	2.51	222.23	187.99
1448	0.00	0.00	0.00	0.00	2.508	2.51	219.72	187.96
1422	0.00	0.00	0.00	0.00	2.508	2.51	217.22	187.94
1397	0.00	0.00	0.00	0.00	2.508	2.51	214.71	187.91
1372	0.00	0.00	0.07	0.00	2.482	2.55	212.20	187.89
1346	0.01	0.00	0.22	0.01	2.418	2.64	209.65	187.86
1321	0.01	0.00	0.33	0.01	2.372	2.71	207.01	187.84
1295	0.01	0.00	0.46	0.01	2.321	2.79	204.30	187.81
1270	0.02	0.00	0.78	0.02	2.191	2.98	201.51	187.79
1245	0.03	0.00	1.16	0.02	2.034	3.22	198.52	187.76
1219	0.04	0.00	1.42	0.02	1.932	3.37	195.30	187.74
1194	0.04	0.00	1.61	0.03	1.852	3.49	191.93	187.71
1168	0.04	0.00	1.78	0.03	1.782	3.60	188.44	187.68
1143	0.05	0.00	1.93	0.04	1.720	3.69	184.84	187.66
1118	0.05	0.01	2.07	0.04	1.663	3.78	181.15	187.63
1092	0.05	0.01	2.19	0.05	1.612	3.85	177.38	187.61
1067	0.06	0.01	2.31	0.05	1.564	3.92	173.52	187.58
1041	0.06	0.01	2.42	0.05	1.520	3.99	169.60	187.56
1016	0.06	0.01	2.52	0.06	1.478	4.05	165.61	187.53
991	0.07	0.01	2.61	0.06	1.439	4.11	161.55	187.51
965	0.07	0.01	2.70	0.06	1.402	4.17	157.44	187.48
940	0.07	0.01	2.79	0.07	1.367	4.22	153.27	187.46
914	0.07	0.01	2.86	0.07	1.335	4.27	149.05	187.43
889	0.07	0.01	2.94	0.07	1.304	4.31	144.79	187.41
864	0.08	0.01	3.01	0.08	1.275	4.36	140.47	187.38
838	0.08	0.01	3.08	0.08	1.247	4.40	136.11	187.35
813	0.08	0.01	3.14	0.08	1.220	4.44	131.71	187.33
787	0.08	0.01	3.20	0.08	1.195	4.48	127.27	187.30
762	0.08	0.01	3.26	0.09	1.171	4.51	122.79	187.28
737	0.08	0.01	3.31	0.09	1.148	4.55	118.28	187.25
711	0.08	0.01	3.36	0.09	1.126	4.58	113.73	187.23
686	0.09	0.01	3.41	0.09	1.105	4.61	109.15	187.20
660	0.09	0.01	3.46	0.10	1.086	4.64	104.53	187.18
635	0.09	0.01	3.50	0.10	1.066	4.67	99.89	187.15
610	0.09	0.01	3.55	0.10	1.049	4.70	95.22	187.13
584	0.09	0.01	3.59	0.10	1.032	4.72	90.52	187.10
559	0.09	0.01	3.62	0.11	1.016	4.75	85.80	187.07
533	0.09	0.01	3.66	0.11	1.001	4.77	81.06	187.05
508	0.09	0.01	3.69	0.11	0.986	4.79	76.29	187.02
483	0.09	0.01	3.73	0.11	0.972	4.81	71.50	187.00
457	0.09	0.01	3.76	0.11	0.959	4.83	66.68	186.97
432	0.09	0.01	3.79	0.12	0.947	4.85	61.85	186.95
406	0.10	0.01	3.82	0.12	0.935	4.87	57.00	186.92
381	0.10	0.01	3.84	0.12	0.923	4.89	52.13	186.90
356	0.10	0.02	3.87	0.12	0.913	4.90	47.25	186.87
330	0.10	0.02	3.89	0.12	0.902	4.92	42.34	186.85
305	0.10	0.02	3.92	0.12	0.892	4.93	37.43	186.82
279	0.10	0.02	3.94	0.13	0.882	4.95	32.49	186.80
254	0.10	0.02	3.97	0.13	0.866	4.97	27.55	186.77
229	0.00	0.00	0.00	0.00	2.508	2.51	22.57	186.74
203	0.00	0.00	0.00	0.00	2.508	2.51	20.07	186.72
178	0.00	0.00	0.00	0.00	2.508	2.51	17.56	186.69
152	0.00	0.00	0.00	0.00	2.508	2.51	15.05	186.67
127	0.00	0.00	0.00	0.00	2.508	2.51	12.54	186.64
102	0.00	0.00	0.00	0.00	2.508	2.51	10.03	186.62
76	0.00	0.00	0.00	0.00	2.508	2.51	7.52	186.59
51	0.00	0.00	0.00	0.00	2.508	2.51	5.02	186.57
25	0.00	0.00	0.00	0.00	2.508	2.51	2.51	186.54

211.46m^3 above elevation 186.79

ADS OGS Sizing Summary

Project Name:	3958 Cardinal Drive
Consulting Engineer:	ARIK Engineering Ltd
Location:	Niagara, Ontario
Sizing Completed By:	Haider Nasrullah

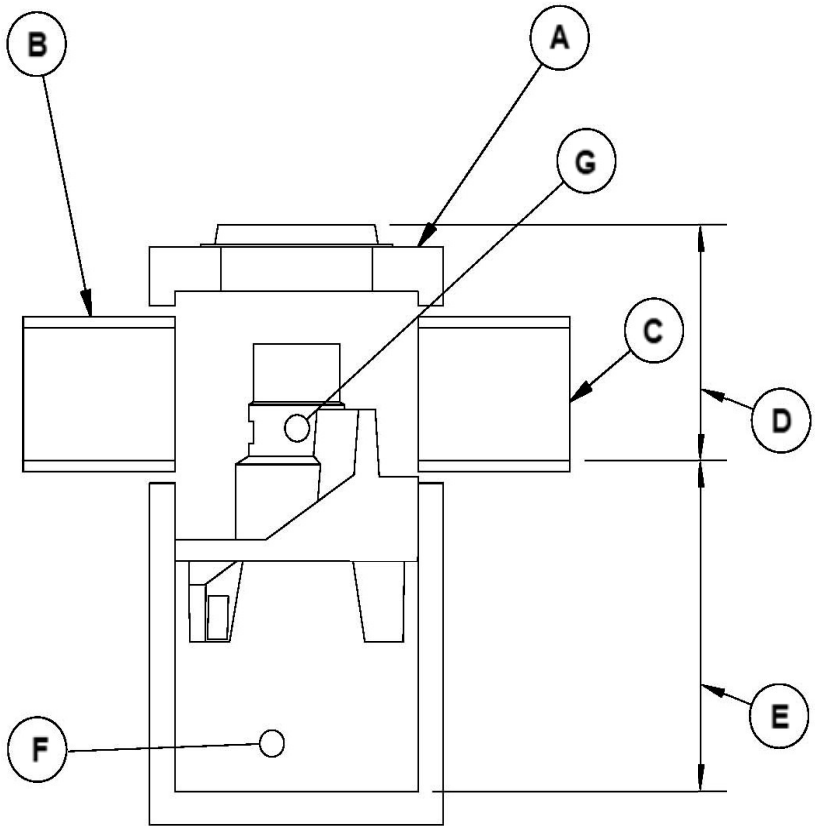
Email: haider.nasrullah@adspipe.com

Treatment Requirements		
Treatment Goal:	Enhanced (MOE)	
Selected Parameters:	80% TSS	90% Volume
Selected Unit:	**FD-4HC**	

Site Details	
Site Area:	0.8 ha
% Impervious:	66%
Rational C:	0.71
Rainfall Station:	Niagara Falls, ONT
Particle Size Distribution:	Fine
Peak Flowrate:	510 L/s

Summary of Results		
Model	**TSS Removal**	**Volume Treated**
FD-4HC	89.0%	99.9%
FD-5HC	92.0%	99.9%
FD-6HC	94.0%	99.9%
FD-8HC	96.0%	99.9%

FD-4HC Specification	
Unit Diameter (A):	1,200 mm
Inlet Pipe Diameter (B):	450 mm
Outlet Pipe Diameter (C):	450 mm
Height, T/G to Outlet Invert (D):	2459 mm
Height, Outlet Invert to Sump (E):	1515 mm
Sediment Storage Capacity (F):	0.78 m³
Oil Storage Capacity (G):	723 L
Recommended Sediment Depth for Maintenance:	440 mm
Max. Pipe Diameter:	600 mm
Peak Flow Capacity:	510 L/s



Site Elevations:	
Rim Elevation:	189.32
Inlet Pipe Elevation:	186.871,
Outlet Pipe Elevation:	186.86

Notes:

Removal efficiencies are based on NJDEP Test Protocols and independently verified.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

Project Name: 3958 Cardinal Drive
Consulting Engineer: ARIK Engineering Ltd
Location: Niagara, Ontario

Net Annual Removal Efficiency Summary: FD-4HC

Rainfall Intensity[1]	Fraction of Rainfall[1]	FD-4HC Removal Efficiency[2]	Weighted Net-Annual Removal Efficiency
mm/hr	%	%	%
0.50	0.0%	100.0%	0.0%
1.00	11.2%	99.7%	11.2%
1.50	18.6%	96.0%	17.8%
2.00	13.3%	93.4%	12.4%
2.50	2.9%	91.5%	2.7%
3.00	1.5%	90.0%	1.3%
3.50	8.9%	88.7%	7.9%
4.00	5.6%	87.6%	4.9%
4.50	1.0%	86.7%	0.8%
5.00	5.5%	85.8%	4.7%
6.00	4.3%	84.4%	3.6%
7.00	4.4%	83.2%	3.7%
8.00	3.5%	82.1%	2.9%
9.00	2.1%	81.3%	1.7%
10.00	2.3%	80.5%	1.9%
20.00	9.9%	75.4%	7.5%
30.00	2.7%	72.6%	2.0%
40.00	1.1%	70.7%	0.8%
50.00	0.6%	69.3%	0.4%
100.00	0.5%	64.9%	0.3%
150.00	0.1%	62.5%	0.0%
200.00	0.0%	60.9%	0.0%
		Total Net Annual Removal Efficiency:	89.0%
		Total Runoff Volume Treated:	99.9%

Notes:

(1) Rainfall Data: 1965:1990, HLY03, Niagara Falls, ONT, 6135638.

(2) Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution

(3) Rainfall adjusted to 5 min peak intensity based on hourly average.