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Phone 905-688-9400
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FUNCTIONAL SERVICING REPORT

McLEOD MEADOWS
City of Niagara Falls
November 2024

INTRODUCTION

The proposed development of McLeod Meadows is located in the western limits of the City of Niagara Falls. The subject lands are located on the property known municipally as 9304 McLeod Road and includes the adjacent property located immediately west that does not have a municipal address. The subject property is situated south of McLeod Road, east of Beechwood Road, and west of a recently constructed development known as Forestview Estates. There is a tributary to Thompson Creek that traverses along the east boundary of the subject lands and separates the subject lands from the neighboring property (Forestview Estates) to the east.

The proposed 22.92 hectare development shall consist of approximately 149 single family lots, 201 street town units, 108 back to back town units and 86 reverse frontage street towns. The proposed development will be provided with full urban services including sanitary and storm sewers, watermain, asphalt road with concrete curb and gutters.

The objectives of this study are as follows:

1. Identify domestic water service needs for the site.
2. Identify sanitary servicing needs for the site.
3. Identify stormwater management needs for the site.

WATER SERVICING

There is an existing a 500mm diameter Regional watermain on north side of the McLeod Road and a 300mm diameter PVC Municipal watermain on south side of McLeod Road that extends to the entrance to the Forestview Estates Development on McLeod Road.

It is proposed to extend the existing 300mm diameter municipal watermain on McLeod Road westerly to the western limit of the site and construct an internal 200mm diameter watermain loop within the site with local 150mm diameter watermains off the proposed loop to provide both domestic water supply and fire protection for the proposed development. It is proposed to construct fire hydrants within the proposed development to provide adequate fire protection for the proposed units. The spacing and location of the proposed fire hydrants will be determined through detailed design.

SANITARY SERVICING

There is an existing 250mm dia. sanitary sewer stub located at the southeast limits of the subject lands that was designed and constructed as part of the construction of the Forestview Estates Development to service the subject lands. The existing sanitary sewer conveys the sanitary flows easterly through the Forestview Estates Development through a 300mm diameter sanitary sewer to an existing 375mm diameter sanitary sewer on the east side of Garner Road flowing southerly, and ultimately to a 525mm diameter trunk sanitary sewer flowing easterly from the intersection of Garner Road and Warren Woods Avenue to the Garner Road South West Pumping Station. It is proposed to construct a sanitary sewer network within subject lands to convey future sanitary flows from the proposed development to the existing 250mm diameter sanitary stub.

An Overall Sanitary Drainage Area Plan and Design Sheet was created as part of the submission for the Development of Forestview Estates to assess the available capacity in the 525mm diameter trunk sewer located at the intersection of Garner Road and Warren Woods Avenue and has been included in Appendix A. The subject lands were included in Drainage Area N1 and N2, as shown on the Drainage Area Plan as a mix of residential and industrial land use. However, the subject lands shall consist of entirely residential development. Therefore, the drainage area plan and design sheet have been revised to reflect the current draft plan of subdivision within the subject lands and have been included in Appendix B.

Drainage Area N2 has been revised to include the 24.12 ha Drainage Area from the subject lands, and a population of 1360 persons. Drainage Area N1 has been revised to include the remaining area of industrial land use on the west side of Beechwood Road.

The revised peak sanitary flow from areas N1 and N2 will be approximately 29.24 L/s, see Appendix B for the revised Sanitary Sewer Design Sheet. Therefore, the existing sanitary sewers shall have adequate capacity for the proposed development. A wet and dry weather flow analysis is required by the Region of Niagara to ensure the system has adequate capacity throughout the sanitary sewer's lifecycle. Table 1 shows the corresponding wet and dry weather sanitary flows generated from the site.

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

Table 1. Wet and Dry Weather Flow Analysis	
Residential Dry Weather Flow	
320 L/cap/day - 1360 *persons*	435,200 L/day
Allowable Initial Leakage per OPSS.MUNI 410	
0.075 L/mm diameter/100m of sewer/hour - *250 mm dia, 720m total sewer length*	3240 L/day
Maximum End of Life Infiltration Allowance as Provided by the City of Niagara Falls	
0.286 L/s/ha – 24.12 *ha*	596,015 L/day

STORMWATER MANAGEMENT

A separate Stormwater Management Plan has been prepared by Upper Canada Consultants (UCC) and has been enclosed in Appendix C for reference.

CONCLUSION AND RECOMMENDATIONS

Therefore, based on the above comments and design calculations provided for this site, the following summarizes the serving for this site:

1. The existing 300mm diameter municipal watermain on the McLeod Road will be extended to the west boundary of the site and will have sufficient capacity to provide both domestic and fire protection water supply.

2. The existing down stream sanitary sewer network will have adequate capacity for the proposed development.

3. Stormwater quantity and erosion controls can be provided by the proposed wetland facility up to and including 100 year design storm event.

4. Major overland flows are directed to the proposed Stormwater Management Facility.

5. Stormwater quality controls can be provided to MECP Enhanced protections levels (80% TSS Removal) by the proposed wetland facility.

Based on the above and the accompanying calculations, there exists adequate municipal servicing for this development. We trust the above comments and enclosed calculations are satisfactory for approval. If you have any questions or require additional information, please do not hesitate to contact our office.

Prepared By:

Zach Barber, E.I.T.
November 5, 2024

LICENSED PROFESSIONAL ENGINEER
B. J. KAPTEYN
100509155
PROVINCE OF ONTARIO

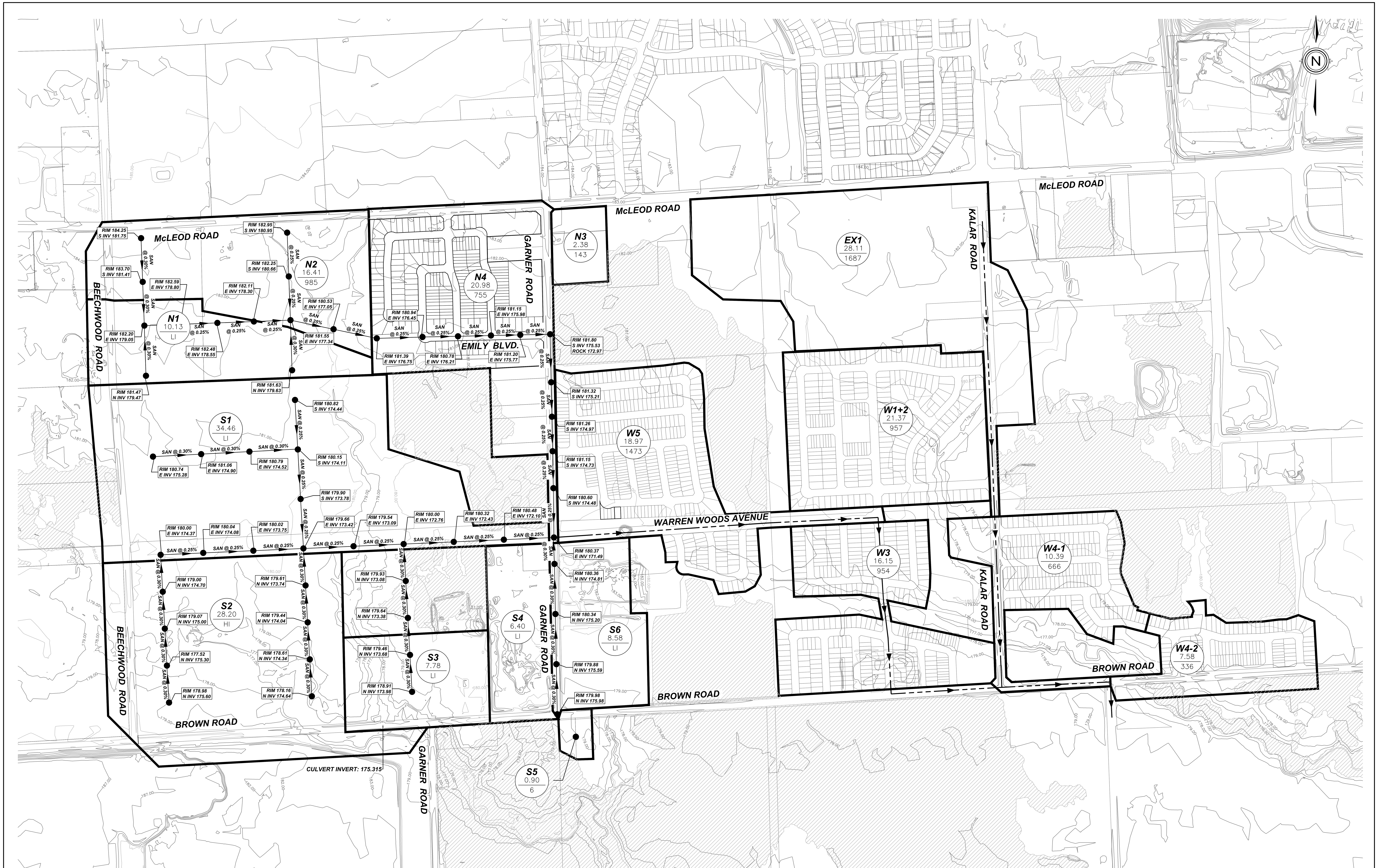
Reviewed By:

Brendan Kapteyn, P. Eng.
November 5, 2024

APPENDICES

APPENDIX A

Existing Overall Sanitary Sewer Drainage Areas
Existing Overall Sanitary Sewer Design Sheet



#	REVISION	DATE	INIT

NOTES:

1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER, AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
2. PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.
3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING BV
DESIGN MH
CHECKED BY MH
APPROVED BY AK

Niagara Falls CANADA

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS
30 Hanover Drive Unit 3
St. Catharines, Ontario
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Phone: (905)688-9400
Fax: (905)688-5274

OWNER

CONTRACT NO.

GARNER SANITARY EXTENSION

CITY OF NIAGARA FALLS

SANITARY DRAINAGE ALTERNATIVE #3

CONSULTANT FILE No.	1611
DATE	2019-09-05
PRINTED	2019-09-10
SCALE	1:4000 m
REF No.	
DWG No.	1611-SANDA3
REV	0

DESIGN FLOWS

RESIDENTIAL	320	L/Capita/Day (NIAGARA FALLS AVERAGE DAILY FLOW)
HEAVY INDUSTRIAL	15000	L/Hectare/Day (GARNER/SOUTHWEST SANITARY SERVICE AREA MUNICIPAL CLASS EA (ASSOCIATED ENGINEERING, 2005))
LIGHT INDUSTRIAL	12500	L/Hectare/Day (GARNER/SOUTHWEST SANITARY SERVICE AREA MUNICIPAL CLASS EA (ASSOCIATED ENGINEERING, 2005))
INFILTRATION RATE	0.18	L/s/Hectare (MOE FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 l/S/ha)
POPULATION PER UNIT	3	

RESIDENTIAL PEAK FACTOR = $5/P^{0.2}$ where P = Populaton/1000 and maximum peak factor is 4.5

INDUSTRIAL PEAK FACTORS DETERMINED USING THE MOE GUIDELINES FROM THE DESIGN OF SANITARY SEWAGE SYSTEMS MANUAL (MOE, 1985)

MUNICIPALITY: CITY OF NIAGARA FALLS

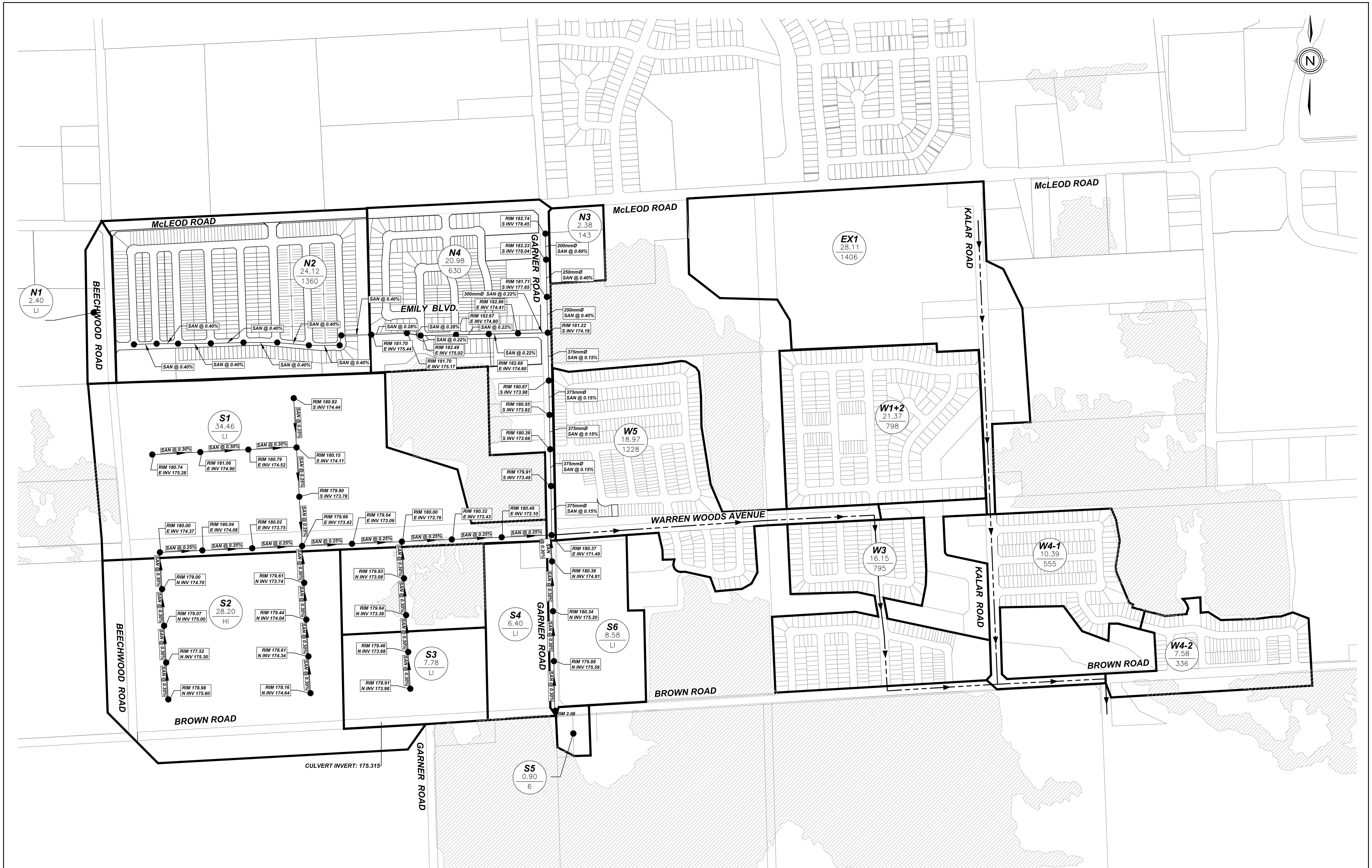
PROJECT: GARNER ROAD RECONSTRUCTION

SANITARY SEWER DESIGN SHEET

		RESIDENTIAL FLOWS					INDUSTRIAL FLOWS						ACCUMULATED PEAK FLOW			DESIGN FLOW					
AREA ID	DESCRIPTION	INCREMT RES. AREA	ACCUM RES. AREA	INCREMT (persons)	TOTAL (persons)	PEAK FACTOR	INC. HEAVY INDUSTRIAL AREA	ACC. HEAVY INDUSTRIAL AREA	PEAK FACTOR	INC. LIGHT INDUSTRIAL AREA	ACC. LIGHT INDUSTRIAL AREA	PEAK FACTOR	FLOW (L/s)	INFILT. FLOW (L/s)	TOTAL PEAK FLOW (L/s)	PIPE LENGTH (m)	PIPE DIAMETER (mm)	PIPE SLOPE (%)	FULL FLOW VELOCITY (m/s)	FULL FLOW CAPACITY (L/s)	PERCENT CAPACITY
Proposed Flow at Governing 525 Diameter Sanitary Sewer																					
N1	NORTH GARNER ROAD SAN									10.13	10.13	4.26	6.25	1.82	8.07		450	0.12	0.6	103.07	7.8%
N2	NORTH GARNER ROAD SAN	16.41	16.41	985	985	4.50					10.13	4.26	22.67	4.78	27.44		450	0.12	0.6	103.07	26.6%
N3	NORTH GARNER ROAD SAN	2.38	2.38	143	143	4.50							2.38	0.43	2.81		450	0.12	0.6	103.07	2.7%
N4	FORESTVIEW + EX DWELLINGS	20.98	39.77	755	1883	4.41					10.13	4.26	36.97	8.98	45.95		450	0.12	0.6	103.07	44.6%
S1	SOUTH GARNER ROAD SAN									34.46	34.46	3.48	17.37	6.20	23.57		300	0.22	0.6	47.34	49.8%
S2	SOUTH GARNER ROAD SAN						28.20	28.20	3.23		34.46	3.48	33.18	11.28	44.46		375	0.15	0.6	70.87	62.7%
S3	SOUTH GARNER ROAD SAN							28.20	3.23	7.78	42.24	3.35	36.31	12.68	48.99		375	0.15	0.6	70.87	69.1%
S4	SOUTH GARNER ROAD SAN									6.40	6.40	4.56	4.22	1.15	5.37		375	0.15	0.6	70.87	7.6%
S5	SOUTH GARNER ROAD SAN	0.90	0.90	6	6	4.50							0.10	0.16	0.26		375	0.15	0.6	70.87	0.4%
S6	SOUTH GARNER ROAD SAN		0.90		6	4.50				8.58	14.98	4.01	8.80	2.86	11.66		375	0.15	0.6	70.87	16.5%
W5	WARREN WOODS PH 5	18.97	59.64	1473	3362	3.92		28.20	3.23		67.35	3.06	94.45	27.93	122.38						
W3	WARREN WOODS PH 3	16.15	75.79	954	4316	3.73		28.20	3.23		67.35	3.06	105.25	30.84	136.09						
EX1	FUTURE EXTERNAL AREA	28.11	28.11	2574	2574	4.14							39.45	5.06	44.51						
W1+2	WARREN WOODS PH 1+2	21.37	49.48	957	3531	3.88							50.81	8.91	59.71						
W4-1	WARREN WOODS PH 4 STAGE 1	10.39	59.87	666	4197	3.75							58.34	10.78	69.12						
			135.66		8513	3.26		28.20	3.23		67.35	3.06	148.32	41.62	189.94		525	0.20	0.9	200.72	94.6%
																	525	0.14	0.8	167.94	113.1%

APPENDIX B

Future Overall Sanitary Sewer Drainage Areas
Future Overall Sanitary Sewer Design Sheet



NOTES:

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3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

#	REVISION	DATE	INIT

DRAFTING ZB
DESIGN MH
CHECKED BY
APPROVED BY

NiagaraFalls CANADA

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS
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St. Catharines, Ontario
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Phone: (905)688-9400
Fax: (905)688-5274

OWNER

CONTRACT NO.

9304 McLEOD ROAD

CITY OF NIAGARA FALLS

OVERALL SANITARY DRAINAGE AREAS

CONSULTANT FILE No. 1611
DATE 2024-11-01
PRINTED 2024-11-05
SCALE 1:4000 m
REF No.
DWG No. 2054-SANDA
REV 0

DRAWING FILE: F:\2054\Sewer Calculations\Overall SANDA 2 V2.dwg PLOTTED: Nov 05, 2024 - 2:14pm PLOTTED BY: brendan

DESIGN FLOWS

RESIDENTIAL 320 L/Capita/Day (NIAGARA FALLS AVERAGE DAILY FLOW)
HEAVY INDUSTRIAL 15000 L/Hectare/Day (GARNER/SOUTHWEST SANITARY SERVICE AREA MUNICIPAL CLASS EA (ASSOCIATED ENGINEERING, 2005))
LIGHT INDUSTRIAL 12500 L/Hectare/Day (GARNER/SOUTHWEST SANITARY SERVICE AREA MUNICIPAL CLASS EA (ASSOCIATED ENGINEERING, 2005))
INFILTRATION RATE 0.18 L/s/Hectare (MOE FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 l/S/ha)
POPULATION PER UNIT 2.5

RESIDENTIAL PEAK FACTOR = $5/P^{0.2}$ where P = Populaton/1000
and maximum peak factor is 4.5
INDUSTRIAL PEAK FACTORS DETERMINED USING THE MOE GUIDELINES
FROM THE DESIGN OF SANITARY SEWAGE SYSTEMS MANUAL (MOE, 1985)

MUNICIPALITY: CITY OF NIAGARA FALLS
PROJECT: 9304 MCLEOD ROAD

SANITARY SEWER DESIGN SHEET

		RESIDENTIAL FLOWS					INDUSTRIAL FLOWS						ACCUMULATED PEAK FLOW			DESIGN FLOW					
AREA ID	DESCRIPTION	INCREMT RES. AREA	ACCUM RES. AREA	INCREMT (persons)	TOTAL (persons)	PEAK FACTOR	INC. HEAVY INDUSTRIAL AREA	ACC. HEAVY INDUSTRIAL AREA	PEAK FACTOR	INC. LIGHT INDUSTRIAL AREA	ACC. LIGHT INDUSTRIAL AREA	PEAK FACTOR	FLOW (L/s)	INFILT. FLOW (L/s)	TOTAL PEAK FLOW (L/s)	PIPE LENGTH (m)	PIPE DIAMETER (mm)	PIPE SLOPE (%)	FULL FLOW VELOCITY (m/s)	FULL FLOW CAPACITY (L/s)	PERCENT CAPACITY
Proposed Flow at Governing 525 Diameter Sanitary Sewer																					
N1	NORTH GARNER ROAD SAN									2.40	2.40	5.18	1.80	0.43	2.23		200	0.40	0.7	21.65	10.3%
N2	NORTH GARNER ROAD SAN	24.12	24.12	1360	1360	4.50					2.40	5.18	24.47	4.77	29.24		250	0.28	0.6	32.84	89.0%
N3	NORTH GARNER ROAD SAN	2.38	2.38	143	143	4.50						0.00	2.38	0.43	2.81		200	0.60	0.8	26.51	10.6%
N4	FORESTVIEW + EX DWELLINGS	20.98	47.48	630	2133	4.30					2.40	5.18	35.74	8.98	44.72		375	0.15	0.6	70.87	63.1%
S1	SOUTH GARNER ROAD SAN									34.46	34.46	3.48	17.37	6.20	23.57		250	0.28	0.6	32.84	71.8%
S2	SOUTH GARNER ROAD SAN						28.20	28.20	3.23			0.00	15.81	5.08	20.88		375	0.15	0.6	70.87	29.5%
S3	SOUTH GARNER ROAD SAN							28.20	3.23	7.78	7.78	4.43	20.80	6.48	27.27		375	0.15	0.6	70.87	38.5%
S4	SOUTH GARNER ROAD SAN									6.40	6.40	4.56	4.22	1.15	5.37		375	0.15	0.6	70.87	7.6%
S5	SOUTH GARNER ROAD SAN	0.90	0.90	6	6	4.50							0.10	0.16	0.26		375	0.15	0.6	70.87	0.4%
S6	SOUTH GARNER ROAD SAN		0.90		6	4.50				8.58	14.98	4.01	8.80	2.86	11.66		375	0.15	0.6	70.87	16.5%
W5	WARREN WOODS PH 5	18.97	67.35	1228	3367	3.92		28.20	3.23		25.16	3.68	78.13	21.73	99.86						
W3	WARREN WOODS PH 3	16.15	83.50	795	4162	3.76		28.20	3.23		25.16	3.68	87.17	24.63	111.80						
EX1	FUTURE EXTERNAL AREA	28.11	28.11	1406	1406	4.50							23.43	5.06	28.49						
W1+2	WARREN WOODS PH 1+2	21.37	49.48	798	2204	4.27							34.85	8.91	43.75						
W4-1	WARREN WOODS PH 4 STAGE 1	10.39	59.87	555	2759	4.08							41.71	10.78	52.48						
			143.37		6921	3.40		28.20	3.23		25.16	3.68	116.26	35.41	151.67		525	0.20	0.9	200.72	75.6%

APPENDIX C

Stormwater Management Plan. McLeod Meadows (UCC, 2024)

STORMWATER MANAGEMENT PLAN

McLEOD MEADOWS

CITY OF NIAGARA FALLS

Prepared by:

Upper Canada Consultants
30 Hannover Drive, Unit 3
St. Catharines, Ontario
L2W 1A3

November 2024

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REFERENCES

1. Stormwater Management Planning and Design Manual
Ontario Ministry of Environment and Energy (March 2003)

2. Stormwater Quality Best Management Practices
Ontario Ministry of Environment and Energy (June 1991)

3. MTO Drainage Management Technical Guidelines
Ontario Ministry of Transportation (November 1989)

4. Engineering Design Guidelines Manual
City of Niagara Falls (Amended January 2012)

STORMWATER MANAGEMENT PLAN

McLeod Meadows

CITY OF NIAGARA FALLS

1.0 INTRODUCTION

1.1 Study Area

The proposed development of McLeod Meadows is located in the western limits of the City of Niagara Falls. The subject lands are located on the property known municipally as 9304 McLeod Road and includes the adjacent property located immediately west that does not have a municipal address. As shown in Figure 1, Site Location Plan, the subject property is situated south of McLeod Road, east of Beechwood Road, and west of a recently constructed development known as Forestview Estates. There is a tributary to Thompson Creek that traverses along the east boundary of the subject lands and separates the subject lands from the neighboring property (Forestview Estates) to the east.

The approximately 22.92ha property will include associated asphalt roads, concrete curb, catch basins, storm sewers, sanitary sewers and watermain. The stormwater drainage areas evaluated in this Stormwater Management Plan consist primarily of the subject lands and an external area located north of the subject lands. All existing and future stormwater flows from the site outlet to Thompson Creek.

1.2 Objectives

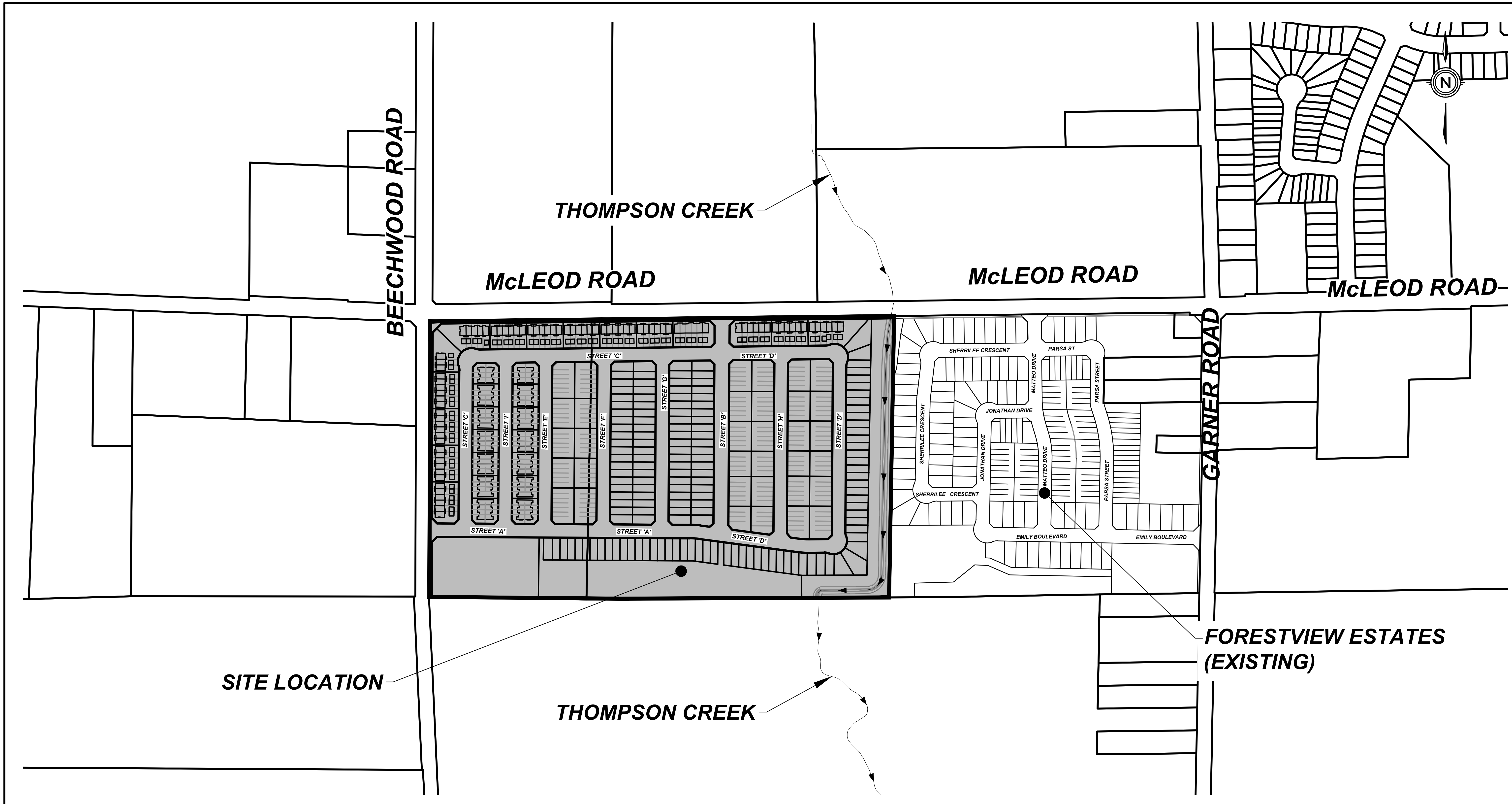
The objectives of this study are as follows:

1. Establish specific criteria for the management of stormwater from this site.

2. Determine the impact of this development on the peak flows of from this site.

3. Investigate alternatives for controlling the quantity and quality of stormwater from this site.

4. Establish land requirements as part of the Draft Plan of Subdivision application for the subject lands.



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

McLEOD MEADOWS
SITE LOCATION

CITY OF NIAGARA FALLS

DATE	2024-11-04
SCALE	1:5000 m
REF No.	2054
DWG No.	FIGURE 1

DRAWING FILE: F:\2054\SWM\2054_SWM BASE.dwg PLOTTED: Nov 05, 2024 – 1:35pm PLOTTED BY: zachb

1.3 Existing and Future Conditions

a) Existing Conditions

The site is presently vacant agricultural lands and historically contained a single residential family dwelling that has been demolished. The topography of the site conveys flows overland from north to south with three drainage outlets located at the southern portion of the property. Flows from the three drainage outlets ultimately converge and convey flows overland to Thompson Creek.

The native soils in the development areas of the subject lands consist mainly of lacustrine heavy clays. This soil type in the development and valley areas are classified as imperfectly drained and variably drained, respectively. This soil is classified in the Soil Conservation Service (SCS) classification method as belonging to hydrologic soil group C.

b) Future Conditions

This stormwater management plan will consider the proposed development under fully developed conditions. The proposed 22.92 hectare development shall consist of approximately 149 single family lots, 201 street town units, 108 back to back town units and 86 reverse frontage street towns. An existing reach of Thompson Creek is located along the east boundary of the subject lands. The proposed development will be provided with full urban services including sanitary and storm sewers, watermains, and asphalt roads with concrete curb and gutters.

2.0 STORMWATER MANAGEMENT CRITERIA

New developments are required to provide stormwater management in accordance with provincial and municipal policies including:

- Stormwater Quality Guidelines for New Development (MECP/MNR, May 1991)
- Stormwater Management Planning and Design Manual (MECP, March 2003)

The site currently outlets to three different outlets located on the southern boundary of the subject property, which convey flows south to Thompson Creek and ultimately the Welland River. The Welland River is classified as a Type 1 fish habitat where Thompson Creek outlets. Based on this fish habitat, the corresponding MECP Level of Protection for stormwater management quality practices is Enhanced.

Based on the above policies and site specific considerations, the following stormwater management criteria have been established for this site.

a. Stormwater **quality** controls are to be provided for the more frequent storm events to provide Enhanced Protection in accordance with MECP guidelines.

b. Stormwater **quantity** controls are to be provided as follows:

   i. Erosion controls to be provided in accordance with MECP guidelines. The guidelines require the storm runoff from a 25mm rainfall event to be detained for 24 hours.

   ii. Quantity controls will be provided to control future site peak flows to existing levels at the existing outlet for various storm events up to the 100 year design storm event.

3.0 STORMWATER ANALYSIS

Stormwater flows and volumes for the existing and future conditions were estimated using the MIDUSS computer modelling program. This program was selected because it is applicable to an urban drainage area like the study area. This program is relatively easy to use and modify for the future drainage conditions and control facilities, and it readily allows for the use of design storm hyetographs for the various return periods being investigated.

3.1 Design Storms

Design storm hyetographs were developed using a 4 hour Chicago distribution based on the City of Niagara Falls Intensity-Duration Frequency (IDF) Curves. The 25mm rainfall data is a generic design storm for the purpose of generating 25mm of rainfall over a 4 hour Chicago distribution. Table 1 summarizes the rainfall data.

Table 1. Rainfall Data

Design Storm (Return Period)	Distribution Parameters			Duration (minutes)
	Chicago Design Storm Parameters			
	a	b	c	
25mm	512.00	6.00	0.800	240
5 Year	719.50	6.34	0.769	240
100 Year	1264.60	7.72	0.781	240

Existing Conditions

The existing conditions were modelled to establish the stormwater peak flows and volumes prior to any development in this subwatershed. The existing stormwater drainage areas for this site are shown on Figure 2. There is an external drainage area EX1 located north of the subject lands which is comprised primarily of farm land that conveys flows overland southerly to the existing roadside ditches on McLeod Road. Flows from drainage area EX1 combine with the flows from Drainage Area A1 and flow through Thompson Creek to the southeastern limit of the site (Outlet A). Existing drainage area B1 flows through a series of local drainage ditches within the subject lands and outlets through a central ditch at the southern portion of the site (Outlet B). Existing Drainage Area C1 outlets to the existing road side ditch on the east side of Beechwood Road (Outlet C). Flows from all three outlets ultimately converge at Brown Road and continue to flow southerly as part of the Thompson Creek watercourse. Input parameters for the computer model for the existing conditions are shown in Table 2. Table 3 shows the stormwater peak flows and volumes generated by the various design storm events.

Proposed Conditions

It is proposed to convey overland stormwater flows from the proposed development to the existing ditch at the southern limits of the property and ultimately outlet to Outlet A. The proposed drainage areas for the development shown in Figure 3, were modelled to establish the stormwater peak flows and volumes once development has been completed.

External Drainage EX1 will continue to flow through Thompson Creek along the eastern limits of the subject lands. Flows from Drainage Area A10 will drain to Thompson Creek uncontrolled and will combine with the flows from the External Drainage Area EX1. Drainage Area A11 represents a majority of the proposed development. A conservatively assumed imperviousness value of 60% has been assumed for the future residential development. Drainage Area A11 will flow through the internal storm sewer system and outlet to the proposed Stormwater Management Facility (SWMF) (Block 215) located at the southern limits of the subject lands. Drainage Area A12 represents the proposed park block and SWMF block. Flows from Drainage Area A11 and A12 will combine with the flows from Drainage Areas EX1 and A10 and outlet at Outlet A. Drainage Area C10 represents flows from the proposed development that will continue to outlet to Beechwood Road uncontrolled (Outlet C).

Input parameters for the computer model for proposed development conditions are shown in Table 2. The results of this modelling are shown in Table 3 for the various design storm events.

Table 2. Hydrologic Parameters

Subcatchment No.	Area (ha)	Length (m)	Slope (%)	Impervious (%)	SCS CN
Existing Conditions					
EX1	54.29	605.0	1.0	3.0	74
A1	15.89	325.5	1.0	1.5	74
B1	5.72	195.3	1.0	1.0	74
C1	2.29	123.6	1.0	4.4	74
	78.19	**Total Area**			
Future Conditions					
EX1	55.61	610.0	1.0	4.0	74
A10	2.46	130.0	1.0	10.0	74
A11	16.32	330.0	1.0	60.0	74
A12	2.96	140.0	1.0	10.0	74
C10	0.84	123.6	1.0	18.0	74
	78.19	**Total Area**			

Table 3. Peak Flow and Volume Comparisons

Design Storm	Peak Flow (m^3/s)			Volume (m^3)		
	Existing	Future	Change	Existing	Future	Change
Outlet A						
5 Year	0.356	1.947	+447%	6690	10246	+3556
100 Year	1.378	3.499	+154%	17359	23235	+5876
Outlet B						
5 Year	0.047	0	-100%	519	0	-519
100 Year	0.182	0	-100%	1377	0	-1377
Outlet C						
5 Year	0.024	0.024	+0%	228	114	-114
100 Year	0.091	0.046	-49%	581	257	-324

As seen in Table 3, the future stormwater flows at Outlet B will be directed to Outlet A. Therefore, there will be no future stormwater flows from the proposed development outletting to Outlet B. However, there will be increased stormwater flows at Outlet A. As shown in Table 3, the future peak flows to Outlet A are increased above existing levels in the 5 and 100 year design storm event. Therefore, stormwater management quantity controls are required for the future stormwater flows discharging from the site to Outlet A. Future peak flows to Outlet C are reduced below existing levels and does not require quantity controls. The detailed MIDUSS modelling output files have been enclosed in Appendix B for reference.

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

McLEOD MEADOWS
EXISTING STORM DRAINAGE AREAS

CITY OF NIAGARA FALLS

DATE	2024-11-04
SCALE	1:5000 m
REF No.	2054
DWG No.	FIGURE 2

DRAWING FILE: F:\2054\SWM\2054_SWM BASE.dwg PLOTTED: Nov 05, 2024 – 1:30pm PLOTTED BY: zachb

DATE	2024-11-04
SCALE	1:5000 m
REF No.	2054
DWG No.	FIGURE 3

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

McLEOD MEADOWS
PROPOSED STORM DRAINAGE AREAS

CITY OF NIAGARA FALLS

DRAWING FILE: F:\2054\SWM\2054_SWM BASE.dwg PLOTTED: Nov 05, 2024 – 1:27pm PLOTTED BY: zachb

4.0 STORMWATER MANAGEMENT ALTERNATIVES

4.1 Screening of Stormwater Management Alternatives

A variety of stormwater management alternatives are available to control the quality of stormwater, most of which are described in the Stormwater Management Planning and Design Manual (MECP, March 2003). Alternatives for the proposed and ultimate developments were considered in the following broad categories: lot level, vegetative, infiltration, and end-of-pipe controls. General comments on each category are provided below. Individual alternatives for the proposed development are listed in Table 4 with comments on their effectiveness and applicability to the proposed outlet.

a) <u>Lot Level Controls</u>

Lot level controls are not generally suitable as the primary control facility for quality control. They are generally used to enhance stormwater quality in conjunction with other types of control facilities.

b) <u>Vegetative Alternatives</u>

Vegetative stormwater management practices are not generally suitable as the primary control facility for quality control. They are generally used enhance stormwater quality in conjunction with other types of control facilities.

c) <u>Infiltration Alternatives</u>

Where soils are suitable, infiltration techniques can be very effective in providing quantity and quality control. However, the very small amount of surface area on this site dedicated to permeable surfaces such as greenspace and landscaping make this an impractical option. Therefore, infiltration techniques will not be considered for this development.

d) <u>End-of-Pipe Alternatives</u>

Surface storage techniques can be very effective in providing quality and quantity control. Dry facilities are effective practices for stormwater erosion and flood control for large drainage areas.

Wet facilities are effective practices for stormwater erosion, quality and quantity control for large drainage areas.

Table 4. Evaluation of Stormwater Management Practices								
	Criteria for Implementation of Stormwater Management Practices (SWMP)							
McLeod Meadows	**Topography**	**Soils**	**Bedrock**	**Groundwater**	**Area**	**Technical Effectiveness (10 high)**	**Recommend Implementation Yes / No**	**Comments**
Site Conditions	***Variable 1 to 3%***	***Silty Sand ±13.3mm/hr***	***At Considerable Depth***	***At Considerable Depth***	***± 19.28ha***			
Lot Level Controls								
Lot Grading	<5%	nlc	nlc	nlc	nlc	2	Yes	Quality/quantity benefits
Roof Leaders to Surface	nlc	nlc	nlc	nlc	nlc	2	Yes	Quality/quantity benefits
Roof Ldrs.to Soakaway Pits	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 0.5 ha	6	No	Unsuitable site conditions
Sump Pump Fdtn. Drains	nlc	nlc	nlc	nlc	nlc	2	No	Unsuitable site conditions
Vegetative								
Grassed Swales	< 5 %	nlc	nlc	nlc	nlc	7	Yes	Quality/quantity benefits
Filter Strips(Veg. Buffer)	< 10 %	nlc	nlc	>.5m Below Bottom	< 2 ha	5	No	Unsuitable site conditions
Infiltration								
Infiltration Basins	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 5 ha	2	No	Unsuitable site conditions
Infiltration Trench	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 2 ha	4	No	Unsuitable site conditions
Rear Yard Infiltration	< 2.0 %	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 0.5 ha	7	No	Unsuitable site conditions
Perforated Pipes	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	nlc	4	No	Unsuitable site conditions
Pervious Catch basins	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	nlc	3	No	Unsuitable site conditions
Sand Filters	nlc	nlc	nlc	>.5m Below Bottom	< 5 ha	5	No	High maintenance/poor aesthetics
Surface Storage								
Dry Ponds	nlc	nlc	nlc	nlc	> 5 ha	7	No	No quality control
Wet Ponds	nlc	nlc	nlc	nlc	> 5 ha	9	No	Very effective quality control
Wetlands	nlc	nlc	nlc	nlc	> 5 ha	9	Yes	Very effective quality control
Other								
Oil/Grit Separator	nlc	nlc	nlc	nlc	<2 ha	3	No	Limited benefit/area too large

Reference: Stormwater Management Practices Planning and Design Manual - 1994
nlc - No Limiting Criteria

4.2 Selection of Stormwater Management Alternatives

Stormwater management alternatives were screened based on technical effectiveness, physical suitability for this site, and their ability to meet the stormwater management criteria established for proposed and future development areas. The following stormwater management alternatives are recommended for implementation on the proposed development:

- **Lot grading** to be kept as flat as practical in order to slow down stormwater and encourage infiltration.

- **Roof leaders to be discharged to the ground surface** in order to slow down stormwater and encourage infiltration.

- **Grassed swales** to be used to collect rear lot drainage. Grassed swales tend to filter sediments and slow down the rate of stormwater.

- A **wetland facility** is proposed to be constructed to provide stormwater quality enhancement for frequent storms and quantity controls up to and including the 100 year design storm event.

5.0 STORMWATER MANAGEMENT PLAN

5.1 Proposed Stormwater Management Facility

5.1.1 Stormwater Quality

The stormwater drainage outlet for the proposed development is Thompson Creek and ultimately the Welland River which has been identified by the Ministry of Natural Resources watercourse evaluation as Type 1 fish habitat. Therefore, the minimum level of protection from the subjects lands is Enhanced protection (80% TSS Removal).

Based on Table 3.2 of SWMP & Design Manual, the water quality storage requirement is approximately 101m^3/ha for wetland facilities providing *Enhanced* protection for developments with 52% impervious areas. The drainage area requiring stormwater quality improvement draining to the proposed facility is 19.28 hectares. The storage volumes required for this proposed facility are shown in Table 5.

Table 5. Stormwater Quality Volume Calculations	
Total Water Quality Volume = 19.28 ha x 101 m^3/ha = 1947 m^3	Reference: Table 3.2, SWMP & Design Manual (MECP 2003)
Permanent Pool Volume = 19.28 ha x 61 m^3/ha = 1176 m^3	**Extended Detention Volume** = 19.28 ha x 40 m^3/ha = 771 m^3

5.1.2 Stormwater Quantity Control

As shown in the previous Table 3, stormwater management quantity controls are required to reduce future peak flows from the development area to existing levels up to and including the 100-year design storm event. The stormwater peak flows from the proposed development shall be reduced to the existing levels by providing stormwater quantity storage. It is proposed to construct a control structure outlet to reduce the peak stormwater flows outletting from the proposed wetland facility.

5.1.3 Stormwater Management Facility Configuration

It is proposed to construct a two-stage outlet to provide the required stormwater quantity controls. The first stage of control consists of a reverse slope pipe acting as an orifice to control future stormwater flows generated from frequent storm events. The second stage of control consists of an outlet weir which provides an outlet for flows exceeding the required extended detention volume. An emergency spillway will provide an outlet for major storm events.

The top of the permanent pool is at an elevation of 179.50m and the bottom of the permeant pool is at an elevation of 179.20m for a depth of 0.3m. At the proposed outlet, a 1.0m deep pool is also provided (Bottom of the deep pool is 178.20m). The area of the deep pool is 1,100m², which is 22% of the total permanent pool area (5,053m²) and less than the maximum permissible area of 25%. The configuration of the facility provides 2,313m^3 of permanent pool volume, which is more than the required 1,176m^3. The proposed top of pond is at an elevation of 181.00m, providing a total active storage volume of 12,977m^3.

Based on the proposed configuration of the proposed facility, it was determined that a 100mm diameter reverse slope pipe, functioning as an orifice with an invert of 179.50m within the ditch inlet, provides 92.2 hours of detention which is greater than the minimum 24 hours required in accordance with MECP guidelines. The ditch inlet catch basin will be located at an elevation of 180.80m and a 450mm diameter outlet pipe within the ditch inlet catch basin will have an invert of 179.50m and will outlet to Thompson Creek. An overflow spillway at an elevation of 180.85 will provide an outlet during extreme storm events. A stage-storage-discharge relationship was determined for the facility and is included in Appendix A.

Overland flows from the subject lands shall be directed to the proposed stormwater management facility through the proposed internal roadways. The preliminary foot print of the proposed wet pond facility is shown in Figure 4.

A sediment forebay was designed to minimize the transport of heavy sediment through the facility to Thompson Creek and to localize future maintenance activities. Calculations for the forebay sizing follow MECP Guidelines and are shown in Table 6.

Table 6. Stormwater Management Facility Forebay Sizing

a) Forebay Settling Length (MOE SWMP&D, Equation 4.5)

$$Settling\ Length = \sqrt{\left(\frac{r \times Q}{V_s}\right)}$$

r =	3.5	:1	(Length:Width Ratio)
Q_p =	0.01	m^3/s	(25mm Storm Pond Discharge)
V_s =	0.0003	m/s	(Settling Velocity)

Settling Length = **10.87** **m**

b) Dispersion Length (MOE SWMP&D, Equation 4.6)

$$Dispersion\ Length = \frac{8 \times Q}{D \times V_f}$$

Q =	1.601	m^3/s	(5 Yr Stm Sew Design Inflow)
D =	1.50	m	(Depth of Forebay)
V_f =	0.5	m/s	(Desired Velocity)

Dispersion Length = **17.08** **m**

c) Minimum Forebay Deep Zone Bottom Width (MOE SWMP&D), Equation 4.7)

$$Width = \frac{Min.Forebay\ Length}{8}$$

17.08 m (minimum required length)

Width = **2.13** **m** (minimum required width)

d) Average Velocity of Flow

$$Average\ Velocity = \frac{Q}{A}$$

Q =	0.907	m^3/s	(25mm Storm Design Inflow)
A =	24.30	m^2	(Cross Sectional Area)
D =	1.50	m	(Depth of Forebay)
W =	11.70	m	(Proposed Bottom Width)
SS =	3	:1	(Side Slopes - Minimum)

Average Velocity = **0.04** **m/s**

Is this Acceptable? **Yes** (Maximum velocity of flow = 0.15 m/s)

c) Cleanout Frequency

Is this Acceptable? **Yes**

L =	41.5	m	(Proposed Bottom Length)
ASL =	1.7	m^3/ha	(Annual Sediment Loading)
A =	19.28	ha	(Drainage Area)
FRC =	80	%	(Facility Removal Efficiency)
FV =	1148.2	m^3	(Forebay Volume)

Cleanout Frequency = **43.7** **Years**

Is this Acceptable? **Yes** (10 Year Minimum Cleanout Frequency)

Table 7 summarizes the peak flows discharging to and from the proposed wet pond facility in the 5 and 100 year design storm event. As shown in the below table, the maximum wet pond elevation reaches 180.51m, with utilized active storage volume of 8,023 m^3 for the 100 year design storm event.

Table 7. Stormwater Management Wet Pond Facility Characteristics

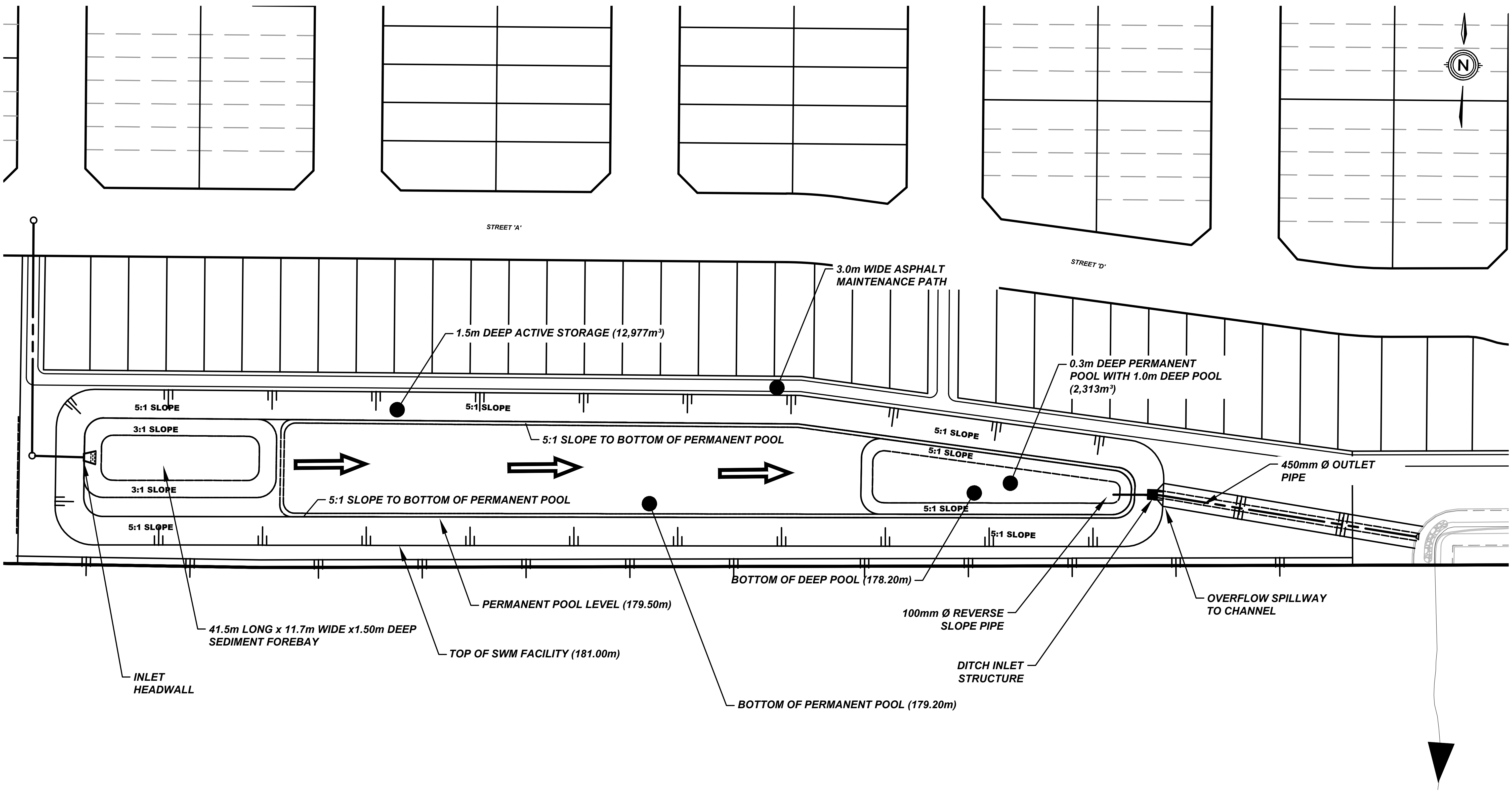
Design Storm (Return Period)	Peak Flows (m^3/s)		Maximum Elevation (m)	Maximum Volume (m^3)
	Inflow	Outflow		
5 Year	1.601	0.016	180.62	4,075
100 Year	2.677	0.022	180.51	8,023

Table 8. Impacts of Wet Pond Facility on Future Peak Flows at Outlet A

Design Storm	Peak Flow (m^3/s)		
	Existing	Future with SWM	Change*
5 Year	0.356	0.353	-0.8%
100 Year	1.378	1.091	-21%

Note: *indicates the percent change between existing conditions and future conditions with stormwater management controls in place.

As shown in Table 8 above, the proposed stormwater management facility can provide adequate stormwater quantity controls to reduce future peak stormwater flows below existing levels to Outlet A up to and including the 100 year design storm event.



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McLEOD MEADOWS
PROPOSED SWM FACILITY
CITY OF NIAGARA FALLS

DATE	2024-11-04
SCALE	1:1000 m
REF No.	2054
DWG No.	FIGURE 4

DRAWING FILE: F:\2054\SWM\2054_SWM BASE.dwg PLOTTED: Nov 04, 2024 – 8:36am PLOTTED BY: zachb

6.0 SEDIMENT AND EROSION CONTROL

Sediment and erosion controls are required during construction. The proposed extended detention facilities can be used for this purpose. Therefore, the proposed constructed wet pond facilities should be constructed prior to development of the remainder of the site. Runoff from the site can then be directed to the facility for sediment control during construction. Following construction, the accumulated sediments will be removed from the facilities and disposed at an appropriate dumping location.

The following additional erosion and sediment controls will also be implemented during construction:

- Install silt control fencing along the limits of construction where overland flows will flow beyond the limits of the development or into a downstream watercourse.

- Re-vegetate disturbed areas as soon as possible after grading works have been completed.

- Lot grading and siltation controls plans will be provided with sediment and erosion control measures to the appropriate agencies for approval during the final design stage.

7.0 STORMWATER MANAGEMENT FACILITY MAINTENANCE

7.1 Wetland Facility

Maintenance is a necessary and important aspect of urban stormwater quality and quantity measures such as constructed wetlands. Many pollutants (i.e. nutrients, metals, bacteria, etc.) bind to sediment and therefore removal of sediment on a scheduled basis is required.

The wetland for this development is subject to frequent wetting and deposition of sediments as a result of frequent low intensity storm events. The purpose of the wetland is to improve post development sediment and contaminant loadings by detaining the 'first flush' flow for a 24-hour period. For the initial operation period of the stormwater management facility, the required frequency of maintenance is not definitively known and many of the maintenance tasks will be performed on an 'as required' basis. For example, during the home construction phase of the development there will be a greater potential for increased maintenance frequency, which depends on the effectiveness of sediment and erosion control techniques employed.

Inspections of the wetland will indicate whether or not maintenance is required. Inspections should be made after every significant storm during the first two years of operation or until all development is completed to ensure the wet pond is functioning properly. This may translate into an average of six inspections per year. Once all building activity is finalized, inspections shall be performed annually. The following points should be addressed during inspections of the facility.

a) Standing water above the inlet storm sewer invert a day or more after a storm may indicate a blockage in the reverse slope pipe or orifice. The blockage may be caused by trash or sediment and a visual inspection would be required to determine the cause.

b) The vegetation around the wet pond should be inspected to ensure its function and aesthetics. Visual inspections will indicate whether replacement of plantings are required. A decline in vegetation habitat may indicate that other aspects of the constructed wetland are operating improperly, such as the detention times may be inadequate or excessive.

c) The accumulation of sediment and debris at the wetland inlet sediment forebay or around the high-water line of the wetland should be inspected. This will indicate the need for sediment removal or debris clean up.

d) The wetland has been created by excavating a detention area. The integrity of the embankments should be periodically checked to ensure that it remains watertight and the side slopes have not sloughed.

Grass cutting is a maintenance activity that is done solely for aesthetic purposes. It is recommended that grass cutting be eliminated. It should be noted that municipal by-laws may require regular grass maintenance for weed control.

Trash removal is an integral part of maintenance and an annual clean-up, usually in the spring, is a minimum requirement. After this, trash removal is performed as required basis on observation of trash build-up during inspections.

To ensure long term effectiveness, the sediment that accumulates in the forebay area should be removed periodically to ensure that sediment is not deposited throughout the facility. For sediment removal operations, typical grading/excavating equipment should be used to remove sediment from the inlet forebay and detention areas. Care should be taken to ensure that limited damage occurs to existing vegetation and habitat.

Generally, the sediment which is removed from the detention pond will not be contaminated to the point that it would be classified as hazardous waste. However, the sediment should be tested to determine the disposal options.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of this study, the following conclusions are offered:

- Infiltration techniques are not suitable for this site as the primary control facility due to the low soil infiltration rates and the large drainage area for this development.
- Roof water leaders shall discharge to grade to enhance future infiltration levels.
- The proposed stormwater management wetland facility will provide stormwater quality and quantity controls for the approximately 19.28 hectare catchment area.
- Various lot level vegetative stormwater management practices can be implemented to enhance stormwater quality.
- This report was prepared in accordance with the provincial guidelines contained in "Stormwater Management Planning and Design Manual, March 2003".

The above conclusions lead to the following recommendations:

- That the stormwater management criteria established in this report be accepted.
- That a stormwater management wetland facility be constructed to provide stormwater quality protection to MECP Enhanced Protection levels and quantity controls up to and including the 100 year design storm event, as outlined in this report.
- That additional lot level controls and vegetative stormwater management practices as described previously in this report be implemented.
- That sediment and erosion controls during construction as described in this report be implemented.

Prepared By:

Zach Barber, E.I.T.
November 4, 2024

Reviewed By:

Brendan Kapteyn, P. Eng.
November 4, 2024

APPENDICES

APPENDIX A

Stormwater Management Facility Calculations

Upper Canada Consultants
3-30 Hannover Drive
St. Catharines, ON, L2W 1A3
PROJECT NAME: **McLeod Meadows**
PROJECT NO.: **2054**

PROPOSED CONSTRUCTED WETLAND CALCULATIONS

Quality Requirements
Drainage Area (ha) = 19.28
Enhanced (m3/ha) = 101
Perm Pool (m3/ha) = 61
Perm Pool Vol (m3) = 1,176
Active Vol (m3) 771
25mm MOE Volume = 2,017
Water Level Elev. = 179.50 m

Quality Orifice
Diameter (m) = 0.100
Cd = 0.65
Invert (m) = 179.50

Outlet Weir
Perimeter Length (m) = 0.60
Inlet Elevation (m) = 180.80

Overflow Spillway
Length (m) = 8.00
Slopes (X:1) = 5.00
Invert (m) = 180.85

Outflow Pipe Orifice
Diameter (m) = 0.450
Cd = 0.65
Invert (m) = 179.50
Obvert (m) = 179.95
Top of Pipe (m) = 180.05

Pond Drawdown Time Calculation (MOE, 2003)
25mm Event Water Surface Elevation (m) = 179.79
MOE Equation 4.11 Drawdown Coefficient 'C2' = 3,044
MOE Equation 4.11 Drawdown Coefficient 'C3' = 6,365
MOE Equation 4.11 Drawdown Time (h) = **92.2**

Elevation	Increment Depth (m)	Active Depth (m)	Surface Area (m2)	Average Surface Area (m2)	Increment Volume (m3)	Permanent Volume (m3)	Active Volume (m3)	Quality Orifice (m3/s)	Ditch Inlet (m3/s)	Max Pipe Orifice (m3/s)	Overflow Spillway (m3/s)	Total Outflow (m3/s)	Average Discharge (m3/s)
178.20		-1.30	629			0							
Deep	0.50			744	372								
178.70		-0.80	859			372							
Deep	0.50			980	490								
179.20		**-0.30**	**1,100**			**862**							
179.20		-0.30	4,617			862							
Perm	0.30			4,835	1,450								
179.50		0.00	5,053			2,313							
179.50		0.00	6,373				0	0.000	0.000	0.000	0.000	0.000	
Active	0.30			6,825	2,048								0.005
179.80		0.30	7,277				2,048	0.011	0.000	0.051	0.000	0.011	
Active	0.30			7,729	2,319								0.014
180.10		0.60	8,180				4,366	0.017	0.000	0.251	0.000	0.017	
Active	0.30			8,639	2,592								0.019
180.40		0.90	9,098				6,958	0.021	0.000	0.355	0.000	0.021	
Active	0.30			9,563	2,869								0.022
180.70		1.20	10,029				9,827	0.024	0.000	0.434	0.000	0.024	
Active	0.30			10,502	3,150								0.494
181.00		1.50	10,974				12,977	0.027	0.092	0.502	0.845	0.964	

Deep Pool Surface Area (m^2) =	**1,100**
Total Permanent Pool Surface Area (m^2) =	**5,053**
Deep Pool Area Coverage (25% MAX) =	**22%**

Notes

1. Quality Orifice flow is the orifice controlling for the 24 hour detention period and uses an orifice formula.
2. Pipe Orifice flow is calcuated using an orifice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice.
3. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway.
4. Total Outflow is calculated by adding the Overflow Spillway with the lowest of Quality Orifice plus Ditch Inlet or Max Pipe Orifice.

APPENDIX B

MIDUSS Output Files

B-1. Existing Conditions

```
                          Output File (4.7) EX.OUT       opened 2024-10-08
11:53
          Units used are defined by G =    9.810
              24   144    10.000        are MAXDT MAXHYD & DTMIN values
          Licensee: UPPER CANADA CONSULTANTS
   35     COMMENT
         4    line(s) of comment
          STORMWATER MANAGEMENT PLAN
          MCLEOD ROAD FRUITBELT
          CITY OF NIAGARA FALLS
          EXISTING CONDITIONS
   14     START
         1    1=Zero; 2=Define
   35     COMMENT
         3    line(s) of comment
          ***********
          5-YEAR STORM EVENT
          ***********
    2     STORM
              1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
        719.500     Coefficient  a
          6.340     Constant  b    (min)
           .769     Exponent  c
           .450     Fraction to peak  r
        240.000     Duration ó  240 min
                 41.683 mm     Total depth
    3     IMPERVIOUS
              1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .015     Manning "n"
         98.000     SCS Curve No or C
           .100     Ia/S Coefficient
           .518     Initial Abstraction
   35     COMMENT
         3    line(s) of comment
          ***********
          Area EX1 AND A1 to Outlet A
          ***********
    4     CATCHMENT
         10.000     ID No.ó 99999
         54.290     Area in hectares
        605.000     Length (PERV) metres
          1.000     Gradient (%)
          3.000     Per cent Impervious
        605.000     Length (IMPERV)
           .000     %Imp. with Zero Dpth
              1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250     Manning "n"
         74.000     SCS Curve No or C
           .100     Ia/S Coefficient
          8.924     Initial Abstraction
              1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                 .259       .000       .000       .000 c.m/s
                 .211       .875       .231     C perv/imperv/total
   15     ADD RUNOFF
                 .259       .259       .000       .000 c.m/s
    4     CATCHMENT
          1.000     ID No.ó 99999
         15.890     Area in hectares
        325.500     Length (PERV) metres
          1.000     Gradient (%)
          1.530     Per cent Impervious
        325.500     Length (IMPERV)
           .000     %Imp. with Zero Dpth
              1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250     Manning "n"
         74.000     SCS Curve No or C
           .100     Ia/S Coefficient
          8.924     Initial Abstraction
              1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                 .102       .259       .000       .000 c.m/s
                 .211       .869       .221     C perv/imperv/total
   15     ADD RUNOFF
                 .102       .356       .000       .000 c.m/s
   27     HYDROGRAPH DISPLAY
         5    is # of Hyeto/Hydrograph chosen
          Volume  =  .6690148E+04 c.m
   14     START
         1    1=Zero; 2=Define
   35     COMMENT
         3    line(s) of comment
          ***********
          Area B1 to Outlet B
          ***********
    4     CATCHMENT
          2.000     ID No.ó 99999
          5.720     Area in hectares
        195.300     Length (PERV) metres
          1.000     Gradient (%)
          1.000     Per cent Impervious
        195.300     Length (IMPERV)
           .000     %Imp. with Zero Dpth
              1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250     Manning "n"
         74.000     SCS Curve No or C
           .100     Ia/S Coefficient
          8.924     Initial Abstraction
              1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                 .047       .000       .000       .000 c.m/s
                 .211       .871       .218     C perv/imperv/total
   15     ADD RUNOFF
                 .047       .047       .000       .000 c.m/s
   27     HYDROGRAPH DISPLAY
         5    is # of Hyeto/Hydrograph chosen
          Volume  =  .5186454E+03 c.m
   14     START
         1    1=Zero; 2=Define
   35     COMMENT
         3    line(s) of comment
          ***********
          Area C1 to Outlet C
          ***********
    4     CATCHMENT
          3.000     ID No.ó 99999
          2.290     Area in hectares
        123.600     Length (PERV) metres
          1.000     Gradient (%)
          4.410     Per cent Impervious
        123.600     Length (IMPERV)
           .000     %Imp. with Zero Dpth
              1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250     Manning "n"
         74.000     SCS Curve No or C
           .100     Ia/S Coefficient
          8.924     Initial Abstraction
              1        Option  1=Trianglr;  2=Rectanglr;  3=SWM  HYD;  4=Lin.
Reserv
                 .024       .000       .000       .000 c.m/s
                 .211       .856       .239     C perv/imperv/total
   15     ADD RUNOFF
                 .024       .024       .000       .000 c.m/s
   27     HYDROGRAPH DISPLAY
         5    is # of Hyeto/Hydrograph chosen
          Volume  =  .2285447E+03 c.m
   14     START
         1    1=Zero; 2=Define
   35     COMMENT
         3    line(s) of comment
          *************
          100-YEAR STORM EVENT
          *************
    2     STORM
              1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
       1264.600     Coefficient  a
          7.720     Constant  b    (min)
           .781     Exponent  c
           .450     Fraction to peak  r
        240.000     Duration ó  240 min
                 68.280 mm     Total depth
    3     IMPERVIOUS
              1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .015     Manning "n"
         98.000     SCS Curve No or C
           .100     Ia/S Coefficient
           .518     Initial Abstraction
   35     COMMENT
         3    line(s) of comment
          ***********
          Area EX1 AND A1 to Outlet A
          ***********
    4     CATCHMENT
         10.000     ID No.ó 99999
         54.290     Area in hectares
        605.000     Length (PERV) metres
          1.000     Gradient (%)
          3.000     Per cent Impervious
        605.000     Length (IMPERV)
           .000     %Imp. with Zero Dpth
              1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250     Manning "n"
         74.000     SCS Curve No or C
           .100     Ia/S Coefficient
          8.924     Initial Abstraction
              1        Option  1=Trianglr;  2=Rectanglr;  3=SWM  HYD;  4=Lin.
Reserv
                 .998       .000       .000       .000 c.m/s
                 .347       .918       .364     C perv/imperv/total
   15     ADD RUNOFF
                 .998       .998       .000       .000 c.m/s
    4     CATCHMENT
          1.000     ID No.ó 99999
         15.890     Area in hectares
        325.500     Length (PERV) metres
          1.000     Gradient (%)
          1.530     Per cent Impervious
        325.500     Length (IMPERV)
           .000     %Imp. with Zero Dpth
              1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250     Manning "n"
         74.000     SCS Curve No or C
           .100     Ia/S Coefficient
          8.924     Initial Abstraction
              1        Option  1=Trianglr;  2=Rectanglr;  3=SWM  HYD;  4=Lin.
Reserv
                 .399       .998       .000       .000 c.m/s
                 .347       .920       .356     C perv/imperv/total
   15     ADD RUNOFF
                 .399      1.378       .000       .000 c.m/s
   27     HYDROGRAPH DISPLAY
         5    is # of Hyeto/Hydrograph chosen
          Volume  =  .1735919E+05 c.m
   14     START
         1    1=Zero; 2=Define
   35     COMMENT
         3    line(s) of comment
          ***********
          Area B1 to Outlet B
          ***********
    4     CATCHMENT
          2.000     ID No.ó 99999
          5.720     Area in hectares
        195.300     Length (PERV) metres
          1.000     Gradient (%)
          1.000     Per cent Impervious
        195.300     Length (IMPERV)
           .000     %Imp. with Zero Dpth
              1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250     Manning "n"
         74.000     SCS Curve No or C
           .100     Ia/S Coefficient
          8.924     Initial Abstraction
              1        Option  1=Trianglr;  2=Rectanglr;  3=SWM  HYD;  4=Lin.
Reserv
```

```
              .182       .000       .000       .000 c.m/s
              .347       .901       .353     C perv/imperv/total
 15     ADD RUNOFF
              .182       .182       .000       .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .1377275E+04 c.m
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        ***********
        Area C1 to Outlet C
        ***********
  4     CATCHMENT
        3.000     ID No.ó 99999
        2.290     Area in hectares
      123.600     Length (PERV) metres
        1.000     Gradient (%)
        4.410     Per cent Impervious
      123.600     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .091       .000       .000       .000 c.m/s
              .347       .909       .372     C perv/imperv/total
 15     ADD RUNOFF
              .091       .091       .000       .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .5813171E+03 c.m
 20     MANUAL
```

B-2. Future Conditions without SWM

```
          Output File (4.7) FUT.OUT      opened 2024-11-04   9:13
          Units used are defined by G =     9.810
              24   144    10.000        are MAXDT MAXHYD & DTMIN values
          Licensee: UPPER CANADA CONSULTANTS
   35     COMMENT
         4     line(s) of comment
          STORMWATER MANAGEMENT PLAN
          MCLEOD ROAD FRUITBELT
          CITY OF NIAGARA FALLS
          FUT CONDITIONS
   35     COMMENT
         3     line(s) of comment
          ***********
          5-YEAR STORM EVENT
          ***********
    2     STORM
              1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
        719.500      Coefficient  a
          6.340      Constant  b    (min)
           .769      Exponent  c
           .450      Fraction to peak  r
        240.000      Duration ó  240 min
                   41.683 mm     Total depth
    3     IMPERVIOUS
              1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .015      Manning "n"
         98.000      SCS Curve No or C
           .100      Ia/S Coefficient
           .518      Initial Abstraction
   35     COMMENT
         3     line(s) of comment
          ***********
          Uncontrolled Area - C10 to Outlet C
          ***********
    4     CATCHMENT
         10.000      ID No.ó 99999
           .840      Area in hectares
        123.600      Length (PERV) metres
          1.000      Gradient (%)
         18.000      Per cent Impervious
        123.600      Length (IMPERV)
           .000      %Imp. with Zero Dpth
              1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
              1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                 .024       .000       .000       .000 c.m/s
                 .211       .856       .327     C perv/imperv/total
   15     ADD RUNOFF
                 .024       .024       .000       .000 c.m/s
   27     HYDROGRAPH DISPLAY
         5     is # of Hyeto/Hydrograph chosen
          Volume  =  .1145267E+03 c.m
   14     START
         1     1=Zero; 2=Define
   35     COMMENT
         3     line(s) of comment
          ***********
          Uncontrolled Areas
          ***********
    4     CATCHMENT
          1.000      ID No.ó 99999
         55.610      Area in hectares
        610.000      Length (PERV) metres
          1.000      Gradient (%)
          4.000      Per cent Impervious
        610.000      Length (IMPERV)
           .000      %Imp. with Zero Dpth
              1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
              1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                 .304       .000       .000       .000 c.m/s
                 .211       .875       .238     C perv/imperv/total
   15     ADD RUNOFF
                 .304       .304       .000       .000 c.m/s
    4     CATCHMENT
         10.000      ID No.ó 99999
          2.460      Area in hectares
        130.000      Length (PERV) metres
          1.000      Gradient (%)
         10.000      Per cent Impervious
        130.000      Length (IMPERV)
           .000      %Imp. with Zero Dpth
              1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
              1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                 .042       .304       .000       .000 c.m/s
                 .211       .854       .275     C perv/imperv/total
   15     ADD RUNOFF
                 .042       .346       .000       .000 c.m/s
    9     ROUTE
           .000      Conduit Length
           .000      No Conduit defined
           .000      Zero lag
           .000      Beta weighting factor
           .000      Routing timestep
              0      No. of sub-reaches
                 .042       .346       .346       .000 c.m/s
   17     COMBINE
         1     Junction Node No.
                 .042       .346       .346       .346 c.m/s
   14     START
```

```
         1     1=Zero; 2=Define
   35     COMMENT
         3     line(s) of comment
          ***********
          Area A11
          ***********
    4     CATCHMENT
         11.000      ID No.ó 99999
         16.320      Area in hectares
        330.000      Length (PERV) metres
          1.000      Gradient (%)
         60.000      Per cent Impervious
        330.000      Length (IMPERV)
           .000      %Imp. with Zero Dpth
              1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
              1        Option  1=Trianglr;  2=Rectanglr;  3=SWM  HYD;  4=Lin.
Reserv
               1.551       .000       .346       .346 c.m/s
                .211       .868       .605     C perv/imperv/total
   15     ADD RUNOFF
               1.551      1.551       .346       .346 c.m/s
    4     CATCHMENT
         12.000      ID No.ó 99999
          2.960      Area in hectares
        140.000      Length (PERV) metres
          1.000      Gradient (%)
         10.000      Per cent Impervious
        140.000      Length (IMPERV)
           .000      %Imp. with Zero Dpth
              1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
              1        Option  1=Trianglr;  2=Rectanglr;  3=SWM  HYD;  4=Lin.
Reserv
                .050      1.551       .346       .346 c.m/s
                .211       .856       .275     C perv/imperv/total
   15     ADD RUNOFF
                .050      1.601       .346       .346 c.m/s
    9     ROUTE
           .000      Conduit Length
           .000      No Conduit defined
           .000      Zero lag
           .000      Beta weighting factor
           .000      Routing timestep
              0      No. of sub-reaches
                .050      1.601      1.601       .346 c.m/s
   17     COMBINE
         1     Junction Node No.
                .050      1.601      1.601      1.947 c.m/s
   35     COMMENT
         3     line(s) of comment
          ***********
          Flow at Outlet A
          ***********
   18     CONFLUENCE
         1     Junction Node No.
                .050      1.947      1.601       .000 c.m/s
   27     HYDROGRAPH DISPLAY
         5     is # of Hyeto/Hydrograph chosen
          Volume  =  .1024620E+05 c.m
   14     START
         1     1=Zero; 2=Define
   35     COMMENT
         3     line(s) of comment
          *************
          100-YEAR STORM EVENT
          *************
    2     STORM
              1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
       1264.600      Coefficient  a
          7.720      Constant  b    (min)
           .781      Exponent  c
           .450      Fraction to peak  r
        240.000      Duration ó  240 min
                   68.280 mm     Total depth
    3     IMPERVIOUS
              1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .015      Manning "n"
         98.000      SCS Curve No or C
           .100      Ia/S Coefficient
           .518      Initial Abstraction
   35     COMMENT
         3     line(s) of comment
          ***********
          Uncontrolled Area - C10 to Outlet C
          ***********
    4     CATCHMENT
         10.000      ID No.ó 99999
           .840      Area in hectares
        123.600      Length (PERV) metres
          1.000      Gradient (%)
         18.000      Per cent Impervious
        123.600      Length (IMPERV)
           .000      %Imp. with Zero Dpth
              1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
              1        Option  1=Trianglr;  2=Rectanglr;  3=SWM  HYD;  4=Lin.
Reserv
                .046       .000      1.601       .000 c.m/s
                .347       .909       .448     C perv/imperv/total
   15     ADD RUNOFF
                .046       .046      1.601       .000 c.m/s
   27     HYDROGRAPH DISPLAY
         5     is # of Hyeto/Hydrograph chosen
```

```
       Volume  =  .2570677E+03 c.m
 14     START
      1     1=Zero; 2=Define
 35     COMMENT
      3     line(s) of comment
       ***********
       Uncontrolled Areas
       ***********
  4     CATCHMENT
       1.000     ID No.ó 99999
      55.610     Area in hectares
     610.000     Length (PERV) metres
       1.000     Gradient (%)
       4.000     Per cent Impervious
     610.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             1.020       .000      1.601       .000 c.m/s
              .347       .918       .370     C perv/imperv/total
 15     ADD RUNOFF
             1.020      1.020      1.601       .000 c.m/s
  4     CATCHMENT
      10.000     ID No.ó 99999
       2.460     Area in hectares
     130.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     130.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .099      1.020      1.601       .000 c.m/s
              .347       .909       .403     C perv/imperv/total
 15     ADD RUNOFF
              .099      1.071      1.601       .000 c.m/s
  9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .099      1.071      1.071       .000 c.m/s
 17     COMBINE
      1     Junction Node No.
              .099      1.071      1.071      1.071 c.m/s
 14     START
      1     1=Zero; 2=Define
 35     COMMENT
      3     line(s) of comment
       ***********
       Area A11
       ***********
  4     CATCHMENT
      11.000     ID No.ó 99999
      16.320     Area in hectares
     330.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
     330.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             2.569       .000      1.071      1.071 c.m/s
              .347       .920       .691     C perv/imperv/total
 15     ADD RUNOFF
             2.569      2.569      1.071      1.071 c.m/s
  4     CATCHMENT
      12.000     ID No.ó 99999
       2.960     Area in hectares
     140.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     140.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .116      2.569      1.071      1.071 c.m/s
              .347       .907       .403     C perv/imperv/total
 15     ADD RUNOFF
              .116      2.677      1.071      1.071 c.m/s
  9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .116      2.677      2.677      1.071 c.m/s
 17     COMBINE
      1     Junction Node No.
              .116      2.677      2.677      3.499 c.m/s
 35     COMMENT
      3     line(s) of comment
       ***********
       Flow at Outlet A
       ***********
 18     CONFLUENCE
      1     Junction Node No.
              .116      3.499      2.677       .000 c.m/s
 27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .2323560E+05 c.m
 20     MANUAL
```

B-3. Future Conditions with SWM

```
          Output File (4.7) SWM.OUT      opened 2024-11-04   9:14
          Units used are defined by G =     9.810
              24   144    10.000        are MAXDT MAXHYD & DTMIN values
          Licensee: UPPER CANADA CONSULTANTS
  35      COMMENT
         4     line(s) of comment
          STORMWATER MANAGEMENT PLAN
          MCLEOD ROAD FRUITBELT
          CITY OF NIAGARA FALLS
          SWM CONDITIONS
  35      COMMENT
         3     line(s) of comment
          ***********
          25mm STORM EVENT
          ***********
   2      STORM
               1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
        512.000      Coefficient  a
          6.000      Constant  b    (min)
           .800      Exponent  c
           .450      Fraction to peak  r
        240.000      Duration ó  240 min
                   25.035 mm     Total depth
   3      IMPERVIOUS
               1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .015      Manning "n"
         98.000      SCS Curve No or C
           .100      Ia/S Coefficient
           .518      Initial Abstraction
  35      COMMENT
         3     line(s) of comment
          ***********
          Area A11
          ***********
   4      CATCHMENT
         11.000      ID No.ó 99999
         16.320      Area in hectares
        330.000      Length (PERV) metres
          1.000      Gradient (%)
         60.000      Per cent Impervious
        330.000      Length (IMPERV)
           .000      %Imp. with Zero Dpth
               1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
               1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .879       .000       .000       .000 c.m/s
                .098       .805       .522     C perv/imperv/total
  15      ADD RUNOFF
                .879       .879       .000       .000 c.m/s
   4      CATCHMENT
         12.000      ID No.ó 99999
          2.960      Area in hectares
        140.000      Length (PERV) metres
          1.000      Gradient (%)
         10.000      Per cent Impervious
        140.000      Length (IMPERV)
           .000      %Imp. with Zero Dpth
               1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
               1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .028       .879       .000       .000 c.m/s
                .098       .803       .169     C perv/imperv/total
  15      ADD RUNOFF
                .028       .907       .000       .000 c.m/s
  10      POND
         6 Depth - Discharge - Volume sets
          179.500        .000          .0
          179.800       .0110      2048.0
          180.100       .0170      4366.0
          180.400       .0210      6958.0
          180.700       .0240      9827.0
          181.000        .964     12977.0
          Peak Outflow    =      .011 c.m/s
          Maximum Depth   =   179.795 metres
          Maximum Storage =     2017. c.m
                .028       .907       .011       .000 c.m/s
  14      START
         1     1=Zero; 2=Define
  35      COMMENT
         3     line(s) of comment
          ***********
          5-YEAR STORM EVENT
          ***********
   2      STORM
               1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
        719.500      Coefficient  a
          6.340      Constant  b    (min)
           .769      Exponent  c
           .450      Fraction to peak  r
        240.000      Duration ó  240 min
                   41.683 mm     Total depth
   3      IMPERVIOUS
               1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .015      Manning "n"
         98.000      SCS Curve No or C
           .100      Ia/S Coefficient
           .518      Initial Abstraction
  35      COMMENT
         3     line(s) of comment
          ***********
          Uncontrolled Area - C10 to Outlet C
          ***********
   4      CATCHMENT
         10.000      ID No.ó 99999
           .840      Area in hectares
        123.600      Length (PERV) metres
          1.000      Gradient (%)
         18.000      Per cent Impervious
        123.600      Length (IMPERV)
           .000      %Imp. with Zero Dpth
               1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
               1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .024       .000       .011       .000 c.m/s
                .211       .856       .327     C perv/imperv/total
  15      ADD RUNOFF
                .024       .024       .011       .000 c.m/s
  14      START
         1     1=Zero; 2=Define
  35      COMMENT
         3     line(s) of comment
          ***********
          Uncontrolled Areas
          ***********
   4      CATCHMENT
          1.000      ID No.ó 99999
         55.610      Area in hectares
        610.000      Length (PERV) metres
          1.000      Gradient (%)
          4.000      Per cent Impervious
        610.000      Length (IMPERV)
           .000      %Imp. with Zero Dpth
               1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
               1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .304       .000       .011       .000 c.m/s
                .211       .875       .238     C perv/imperv/total
  15      ADD RUNOFF
                .304       .304       .011       .000 c.m/s
   4      CATCHMENT
         10.000      ID No.ó 99999
          2.460      Area in hectares
        130.000      Length (PERV) metres
          1.000      Gradient (%)
         10.000      Per cent Impervious
        130.000      Length (IMPERV)
           .000      %Imp. with Zero Dpth
               1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
               1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .042       .304       .011       .000 c.m/s
                .211       .854       .275     C perv/imperv/total
  15      ADD RUNOFF
                .042       .346       .011       .000 c.m/s
   9      ROUTE
           .000      Conduit Length
           .000      No Conduit defined
           .000      Zero lag
           .000      Beta weighting factor
           .000      Routing timestep
              0      No. of sub-reaches
                .042       .346       .346       .000 c.m/s
  17      COMBINE
         1     Junction Node No.
                .042       .346       .346       .346 c.m/s
  14      START
         1     1=Zero; 2=Define
  35      COMMENT
         3     line(s) of comment
          ***********
          Area A11
          ***********
   4      CATCHMENT
         11.000      ID No.ó 99999
         16.320      Area in hectares
        330.000      Length (PERV) metres
          1.000      Gradient (%)
         60.000      Per cent Impervious
        330.000      Length (IMPERV)
           .000      %Imp. with Zero Dpth
               1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
               1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
               1.551       .000       .346       .346 c.m/s
                .211       .868       .605     C perv/imperv/total
  15      ADD RUNOFF
               1.551      1.551       .346       .346 c.m/s
   4      CATCHMENT
         12.000      ID No.ó 99999
          2.960      Area in hectares
        140.000      Length (PERV) metres
          1.000      Gradient (%)
         10.000      Per cent Impervious
        140.000      Length (IMPERV)
           .000      %Imp. with Zero Dpth
               1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
               1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
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Reserv
              .050      1.551       .346       .346 c.m/s
              .211       .856       .275     C perv/imperv/total
 15     ADD RUNOFF
              .050      1.601       .346       .346 c.m/s
 10     POND
       6 Depth - Discharge - Volume sets
        179.500        .000          .0
        179.800       .0110      2048.0
        180.100       .0170      4366.0
        180.400       .0210      6958.0
        180.700       .0240      9827.0
        181.000        .964     12977.0
        Peak Outflow    =      .016 c.m/s
        Maximum Depth   =   180.062 metres
        Maximum Storage =     4075. c.m
              .050      1.601       .016       .346 c.m/s
 17     COMBINE
       1     Junction Node No.
              .050      1.601       .016       .353 c.m/s
 35     COMMENT
       3     line(s) of comment
        ***********
        Flow at Outlet A
        ***********
 18     CONFLUENCE
       1     Junction Node No.
              .050       .353       .016       .000 c.m/s
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        *************
        100-YEAR STORM EVENT
        *************
  2     STORM
           1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    1264.600     Coefficient  a
       7.720     Constant  b    (min)
        .781     Exponent  c
        .450     Fraction to peak  r
     240.000     Duration ó  240 min
              68.280 mm     Total depth
  3     IMPERVIOUS
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015     Manning "n"
      98.000     SCS Curve No or C
        .100     Ia/S Coefficient
        .518     Initial Abstraction
 35     COMMENT
       3     line(s) of comment
        ***********
        Uncontrolled Area - C10 to Outlet C
        ***********
  4     CATCHMENT
      10.000     ID No.ó 99999
        .840     Area in hectares
     123.600     Length (PERV) metres
       1.000     Gradient (%)
      18.000     Per cent Impervious
     123.600     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .046       .000       .016       .000 c.m/s
              .347       .909       .448     C perv/imperv/total
 15     ADD RUNOFF
              .046       .046       .016       .000 c.m/s
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        ***********
        Uncontrolled Areas
        ***********
  4     CATCHMENT
       1.000     ID No.ó 99999
      55.610     Area in hectares
     610.000     Length (PERV) metres
       1.000     Gradient (%)
       4.000     Per cent Impervious
     610.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             1.020       .000       .016       .000 c.m/s
              .347       .918       .370     C perv/imperv/total
 15     ADD RUNOFF
             1.020      1.020       .016       .000 c.m/s
  4     CATCHMENT
      10.000     ID No.ó 99999
       2.460     Area in hectares
     130.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     130.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .099      1.020       .016       .000 c.m/s
              .347       .909       .403     C perv/imperv/total
 15     ADD RUNOFF
              .099      1.071       .016       .000 c.m/s
  9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
              .099      1.071      1.071       .000 c.m/s
 17     COMBINE
       1     Junction Node No.
              .099      1.071      1.071      1.071 c.m/s
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        ***********
        Area A11
        ***********
  4     CATCHMENT
      11.000     ID No.ó 99999
      16.320     Area in hectares
     330.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
     330.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             2.569       .000      1.071      1.071 c.m/s
              .347       .920       .691     C perv/imperv/total
 15     ADD RUNOFF
             2.569      2.569      1.071      1.071 c.m/s
  4     CATCHMENT
      12.000     ID No.ó 99999
       2.960     Area in hectares
     140.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     140.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              .116      2.569      1.071      1.071 c.m/s
              .347       .907       .403     C perv/imperv/total
 15     ADD RUNOFF
              .116      2.677      1.071      1.071 c.m/s
 10     POND
       6 Depth - Discharge - Volume sets
        179.500        .000          .0
        179.800       .0110      2048.0
        180.100       .0170      4366.0
        180.400       .0210      6958.0
        180.700       .0240      9827.0
        181.000        .964     12977.0
        Peak Outflow    =      .022 c.m/s
        Maximum Depth   =   180.511 metres
        Maximum Storage =     8023. c.m
              .116      2.677       .022      1.071 c.m/s
 17     COMBINE
       1     Junction Node No.
              .116      2.677       .022      1.091 c.m/s
 35     COMMENT
       3     line(s) of comment
        ***********
        Flow at Outlet A
        ***********
 18     CONFLUENCE
       1     Junction Node No.
              .116      1.091       .022       .000 c.m/s
 20     MANUAL
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