



UCC File: 2130

## **FUNCTIONAL SERVICING REPORT**

### **Block 84 Condo – Modero Town of Niagara-on-the-Lake May 2025**

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#### **INTRODUCTION**

Upper Canada Consultants has been retained to undertake and provide a Functional Servicing Report to address the servicing needs and requirements for the proposed townhouse condominium development known as Block 84 located within the Draft Plan approved residential subdivision known as Modero.

The project site is located in the Town of Niagara-on-the-Lake as part of Lot 181 and is situated north of York Road (Regional Road 81), west of Concession 7 and south of Butlersburg Circle. The subject property has historically been agricultural land.

Block 84 is approximately 3.37 hectares and shall consist of 146 townhouse condominium units with three roadway entrances onto Butlersburg Circle, and a fourth entrance onto Concession 7 Road. The site shall include associated asphalt road, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

The objectives of this study are as follows:

1. Identify domestic and fire protection water service needs for the site;
2. Identify sanitary servicing needs for the site; and,
3. Identify stormwater management needs for the site.

#### **WATER SERVICING**

There is an existing Regional 400mm diameter PVC watermain located on York Road as well as an existing municipal 300mm diameter PVC watermain on Concession 7. As part of the Modero Subdivision, a 200mm diameter PVC watermain will be extended along Butlersburg Circle fronting the Block 84, and ultimately looped within the subdivision with two connections to the existing Concession 7 watermain.

It is proposed to connect to the Butlersburg Circle watermain with a single 200mm diameter watermain connection extending into the condominium block to provide both domestic water supply and fire protection. A Water Meter Chamber will be constructed at the property line to the condo in accordance with municipal standards.



Four (4) private hydrants will be constructed within the condominium block with an additional four (4) municipal hydrants located on Butlersburg Circle and Concession 7 Road to provide adequate fire protection for the development. All units within the Block 84 Condo will be located within 90m of a hydrant to the principle entrance.

Utilizing a population density of 2.4 persons per unit per in accordance with the Niagara Regional Official Plan, Block 84 Condo (146 units) will have a total population of 351 persons. The 2021 Regional Water Master Servicing Plan Update notes an average daily demand of 240 L/cap/day resulting in a total average demand of approximately 84,240 L/day. This correlates to maximum day and peak hourly demand rates of 231,660L/day and 347,911L/day, respectively.

As part of the completion of the Functional Servicing Report for the Modero Subdivision, an analysis was completed to ensure sufficient fire water supply would be provided to all units within the development. Per Table 8 of the 2020 'Water Supply for Public Fire Protection', townhouse developments require minimum fire flow rate of 8,000LPM (133L/s). The modelling concluded that two hydrants at the north end of the subdivision would result in theoretical flows less than 133L/s servicing single family dwellings. All other hydrants within the subdivision and Condo Block 84 would provide flow greater than 133 L/s and have acceptable static pressures.

Therefore, it is expected that the proposed watermain servicing strategy will provide sufficient domestic and fire water supply for the proposed development. All calculations can be found as part of the Modero Estates Functional Servicing Report in Appendix A.

### **SANITARY SERVICING**

There is an existing 375mm diameter sanitary sewer on York Road (Regional Road 81) fronting the adjacent Lifepointe Church property at #736 York Road. As part of the Modero Subdivision, a 300mm diameter sanitary sewer will be constructed north through an easement within the Lifepointe Church property, and continue through a subsequent easement through the Block 84 Condo in order to provide service for both the Block 84 Condo and upstream Modero Subdivision development.

Three (3) mainline connections will be made to the 300mm diameter sanitary sewer to service the proposed Block 84 Condo development. All units within the condo will be serviced via gravity sewer. Units 61-66 will discharge sanitary flows directly to the 300mm diameter municipal sanitary sewer passing through the Block 84, and as such, will be fitted with sanitary cleanouts as per Town of Niagara-on-the-Lake municipal standards. However, all other units within the development will not be constructed with cleanouts.

As part of the design of the Modero Subdivision, an Overall Sanitary Analysis has been conducted on the capacities within the York Road (Regional Road 81) municipal trunk sanitary sewer and downstream system to Taylor Road and included within the Modero Estates Functional Servicing Report in Appendix A. The analysis includes the complete Block 84 Condo with its' calculations. Using data provided within the 'Glendale Industrial Area Servicing Study Update'



provided by the Town of Niagara-on-the-Lake, peak sanitary flows rates were calculated using details utilized in the initial sewer design.

The sanitary analysis has determined that new development as part of the proposed Modero subdivision and associated condos will discharge a peak flow of 14.01L/s to the downstream municipal system. The analysis concludes that the post-development conditions of the previously designed 32.2-hectare drainage area will contribute approximately 35.1L/s to the downstream sanitary sewer system – less than the 52.1L/s originally designed for the area per the Glendale Servicing Study. Therefore, it is expected that the downstream municipal sanitary sewer system will have sufficient capacity for the proposed development. All overall sanitary calculations can be found in Appendix B of the Modero Functional Servicing Report included in Appendix A.

### **STORMWATER MANAGEMENT PLAN**

As part of the site development, the following is a summary of the stormwater management plan for the proposed residential development.

The criteria provided by the Town of Niagara-on-the-Lake and Region of Niagara for this development includes the requirement to control peak stormwater flows to existing levels up to and including the 100-year design storm event. It is also required to improve stormwater quality levels to MECP Normal Protection levels (70% TSS removal) prior to discharge from the development in accordance with the Town of Niagara-on-the-Lake Consolidated Linear Infrastructure Environmental Compliance Approval from the MECP.

The Block 84 Condo was included within the Stormwater Management (SWM) Plan for the Modero Subdivision. Stormwater flows discharge from the Block 84 Condo to the downstream Modero Subdivision storm sewers on Butlersburg Circle at two locations; the westerly roadway entrance, and at the path between units 138 & 139. The internal private Block 84 Condo stormwater sewers as well as the downstream Modero storm sewer systems have both been designed to accommodate flows up to and including the 5 year design storm event using the Town of Niagara-on-the-Lake IDF curves.

As part of the storm sewer sizing calculations, all drainage areas as part of the Condo Block 84 were completed utilizing a Runoff Coefficient of 0.75. A Weighted Impervious Calculation was conducted for the condo and included within Appendix A of the Modero Stormwater Management (SWM) Report in Appendix A concluding the condo has an effective Runoff Coefficient of 0.73. Therefore, all storm sewer within Condo Block 84 and downstream within the Modero Subdivision are expected to have adequate capacity for the condo up to and including the 5 year design storm event.

During storms greater than the 5 year design storm event, stormwater flows unable to enter the on-site storm sewer system will be directed overland to Butlersburg Circle fronting the condo and ultimately be directed to the Modero SWM Facility as outlined in the Modero SWM Plan.



The Modero SWM Facility will provide the necessary quality controls to Normal Protection Levels and quantity controls up to and including the 100 year design storm event prior to discharge to the downstream Six Mile Creek Tributary. Therefore, no adverse effects will occur to adjacent properties or downstream stormwater infrastructure as a result of the proposed Stormwater Management Plan. All additional details regarding the SWM strategy can be found in the Modero FSR/SWM Report included in Appendix A.

### **CONCLUSIONS AND RECOMMENDATIONS**

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

1. The existing 300mm diameter municipal York Road watermain and future 200mm diameter Butlersburg Circle watermain will have sufficient capacity to provide both domestic and fire protection water supply.
2. The 300mm diameter sanitary sewer passing through Block 84 and downstream municipal sanitary infrastructure will have adequate capacity for the proposed residential development.
3. Stormwater quality controls are being provided to Normal Protection (70% TSS removal) levels by the Modero Stormwater Management Wet Pond Facility before discharging to the Six Mile Creek tributary.
4. Stormwater quantity controls are being provided by the Modero Stormwater Management Wet Pond Facility up to the 100 year design storm event prior discharging to the Six Mile Creek tributary.
5. The site stormwater overland route from the road system is to the proposed Modero Stormwater Management Facility.

Based on the above and the accompanying General Servicing Plan, and Drainage Area Plans, 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.

Yours very truly,

Kurt Tiessen, P.Eng.  
May 1, 2025  
Encl.





**UPPER CANADA  
CONSULTANTS**  
*ENGINEERS / PLANNERS*

## **APPENDICES**

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**UPPER CANADA  
CONSULTANTS**  
*ENGINEERS / PLANNERS*

## **APPENDIX A**

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### **Modero Estates Functional Servicing Report/Stormwater Management Report**

UCC File: 2130

## **FUNCTIONAL SERVICING REPORT**

### **Modero Town of Niagara-on-the-Lake Revised March 2025**

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#### **INTRODUCTION**

Upper Canada Consultants has been retained to undertake and provide a Functional Servicing Report to address the servicing needs and requirements for the proposed Draft Plan approved residential development known as Modero.

The project site is located in the Town of Niagara-on-the-Lake as part of lots 180 & 181. The subject property is situated north of York Road (Regional Road 81), west of Concession 7 and south of Queenston Road. The site is bound by Six Mile Creek to the west and a tributary of Six Mile Creek at the north-east portion of the property. The site has historically been agricultural land.

The development site is approximately 15.42 hectares and shall consist of 2 condominium blocks and a mixed use block (206 units), 128 townhouses and 55 single family homes for a total unit count of 389 units. The site shall include associated asphalt road, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

The objectives of this study are as follows:

1. Identify domestic and fire protection water service needs for the site;
2. Identify sanitary servicing needs for the site; and,
3. Identify stormwater management needs for the site.

#### **WATER SERVICING**

There is an existing Regional 400mm diameter PVC watermain located on York Road as well as an existing municipal 300mm diameter PVC watermain located on Concession 7 fronting much of the development. The 300mm diameter Concession 7 watermain reduces to a 150mm diameter watermain approximately 20m south of the site boundary on Concession 7.

A 200mm diameter watermain will be connected to the existing municipal Concession 7 watermain at both development entrances and extended into the development site to provide both domestic water supply and fire protection. The connections will provide an internal loop within the development. 150mm diameter watermains will be constructed on Greenhill Gate, Meadows Manor and the north limit of Butlersburg Circle from the intersections of Lasalle Lane. The



remaining watermains will be 200mm diameter on Lasalle Lane, Chandler Chase and the remainder of Butlersburg Circle.

Twelve (12) municipal fire hydrants will be constructed within the proposed subdivision. An existing hydrant on York Road will be moved into the subdivision limits on Chandler Chase, and a second hydrant on York road will be adjusted out of the location of the Block 84 condo entrance. It is expected further private hydrants will be constructed within the condominium blocks, to be designed as part of future Site Plan Applications for those properties.

A Fire Underwriters Survey review has been completed as required by the Town of Niagara-on-the-Lake for the development. Using the 'Water Supply for Public Fire Protection' (2020, FUS), it is noted that suggested flow values in Tables 7 & 8 of the document are acknowledged at 66.7L/s for single family dwellings and 133.3L/s for townhouse units under the proposed development conditions. It should be noted that all buildings are expected to have at least 3.0m of separation and no single-family dwellings will be constructed larger than 450m<sup>2</sup>.

An analysis has been conducted by Upper Canada Consultants to determine the effectiveness of the future watermain system within the proposed subdivision using the EPANET software. The analysis utilizes the hydrant flow testing conducted by Niagara Regional Fire Protection on the three (3) existing hydrant on Concession 7 fronting the site. As of writing this submission, the design for the Block 84 condominium development is well underway and has been included in the watermain analysis. The Block 82 & Block 83 developments have been represented within the system as well, however just at their subdivision connection points.

The Hydrant Flow Test Data results as well as associated Fire Flow Calculation Sheets for each hydrant are included in Appendix A. Additionally, imagery of the conducted EPANET model as well as an EPANET Model Calculation Sheet have been included in Appendix A as well.

The existing Concession 7 watermain was replicated in the EPANET model utilizing the hydrant flow test data. UCC was able to calibrate the model to within an acceptable 5% of verified hydrant flow test data and calculated theoretical fire flow rates. Imagery of the existing model conditions are included in Appendix A.

Following confirmation of existing conditions, the proposed watermain was added to the model as outlet in the future conditions imagery in Appendix A. The modelling concluded that two hydrants (#9 & #10) fronting lots 12 & 19 will experience theoretical flows less than 133.3L/s under fire flow conditions. However, these hydrants are only in proximity to service single family dwellings and will therefore be acceptable for their location. All other hydrants will provide theoretical fire flows at rates greater than the required 133.3L/s. Additionally, all hydrants have been calculated to have static pressures greater than 64psi – greater than the minimum preferred 50psi.

Therefore, as all proposed hydrants will be able to provide acceptable theoretical flow rates at 20psi (fire flow conditions), it is expected that the outlined servicing strategy will be acceptable for the proposed development.



## **SANITARY SERVICING**

The upstream limit of the existing 375mm diameter sanitary sewer, located on York Road (Regional Road 18), fronts the Lifepointe Church property at #736 York Road. It is proposed to connect to the existing sanitary sewer system with a 300mm diameter sanitary sewer extended within the site. The sanitary sewer on York Road will be extended up to the east and continue through the Lifepointe Bible Church property within an 11.0m easement.

A majority of the proposed development will be serviced through gravity sewers with the sanitary mainline located beneath the basement elevation. However, due to the locations of the sanitary and stormwater outlets, grade restrictions have resulted in the necessity of Grinder Pumps as well as a Low Pressure Forcemain System (E/One) on site. Approximately 106 units will require basements pumps to the sanitary service. A further 28 dwellings located at the north portion of the development will be serviced with an E/One sanitary sewer system including Grinder Pumps to a sanitary forcemain conveying flows to the proposed gravity sanitary sewer system. These design considerations will ensure sufficient grade and cover is provided on all sanitary systems within the proposed development to meet minimum standards set forth in the MECP Design Criteria (2023).

An Overall Sanitary Analysis has been conducted on the capacities within the York Road (Regional Road 81) municipal trunk sanitary sewer and downstream system to Taylor Road. The UCC sanitary analysis utilizes downstream sewer information outlined within the 'Glendale Industrial Area Servicing Study Update' provided by the Town of Niagara-on-the-Lake. Both the UCC Sanitary Sewer Analysis as well as the original sanitary sewer calculation sheet and drainage area conditions as part of the Glendale Servicing Study update have been included in Appendix B.

The Servicing Study provides an analysis on the trunk sanitary sewer conveying peak sanitary flows to Taylor Road from an overall drainage area of 130.6 hectares. The proposed development site was included within a 33.2-hectare drainage area for the initial design of the trunk sewer under a 'Light Industrial' zoning classification producing a peak sanitary flow rate of 35 m<sup>3</sup>/ha/day. The peak sanitary outflow for this drainage area (Figure 4, Appendix A) has been re-calculated to include updated conditions for the contributing developments within the same drainage area to this section of sanitary sewer.

The sanitary analysis has determined that new development as part of the proposed Modero subdivision and associated condos will discharge a peak flow of **14.01L/s** to the downstream municipal system. The analysis concludes that the post-development conditions of the previously designed 32.2-hectare drainage area will contribute approximately 35.1L/s to the downstream sanitary sewer system - less than the 52.1L/s originally designed for the area per the Glendale Servicing Study. Therefore, it is expected that the downstream municipal sanitary sewer system will have sufficient capacity for the proposed development. All sanitary calculations can be found in Appendix B.



## **STORMWATER MANAGEMENT PLAN**

As part of the site development, the following is a summary of the stormwater management plan for the proposed residential development.

The criteria provided by the Town of Niagara-on-the-Lake and Region of Niagara for this development includes the requirement to control peak stormwater flows to existing levels up to and including the 100-year design storm event and improve stormwater quality levels to MECP Normal Protection levels prior to discharge from the development.

To limit future stormwater flows to allowable levels, and improve stormwater quality to the required TSS removal levels, a stormwater management wetpond facility will provide the necessary controls for the subdivision development. Roadway overland flows will be directed to the stormwater management facility at the north end of the site. Further quantity controls will be provided for the Concession 7 Road reconstruction prior to discharge to the Six Mile Creek to ensure quantity controls are provided for all storm events.

Due to the necessary geometry and dimensions of the proposed Stormwater Management Facility, stormwater quality levels will be provided to an Enhanced Standard before outletting to Six Mile Creek. A Hydroworks HD4 Oil/Grit Separator will provide the necessary quality controls for stormwater flows discharging from the Concession 7 Road storm sewer outlet. A Stormwater Management Plan for this development has been created and can be found in Appendix C.

## **CONCLUSIONS AND RECOMMENDATIONS**

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

1. The existing 300mm diameter municipal watermain will have sufficient capacity to provide both domestic and fire protection water supply.
2. The existing 375mm diameter municipal trunk sanitary sewer on York Road (Regional Road 81) and downstream infrastructure will have adequate capacity for the proposed residential development.
3. Stormwater quality controls are being provided to Normal Protection (70% TSS removal) levels by a stormwater wetpond facility and oil/grit separator prior to outletting to the Six Mile Creek tributary.
4. Stormwater quantity controls are being provided by a stormwater management wetpond facility up to the 100-year design storm event before outletting to the Six Mile Creek tributary.



5. The site stormwater overland route from the road system is to the proposed stormwater management facility before outletting to the Six Mile Creek tributary.

Based on the above and the accompanying General Servicing Plan, and Drainage Area Plans, 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.

Yours very truly,

Jason Schooley, P.Eng.  
Revised March 13, 2025



Encl.



**UPPER CANADA  
CONSULTANTS**  
*ENGINEERS / PLANNERS*

## **APPENDICES**

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**UPPER CANADA  
CONSULTANTS**  
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## **APPENDIX A**

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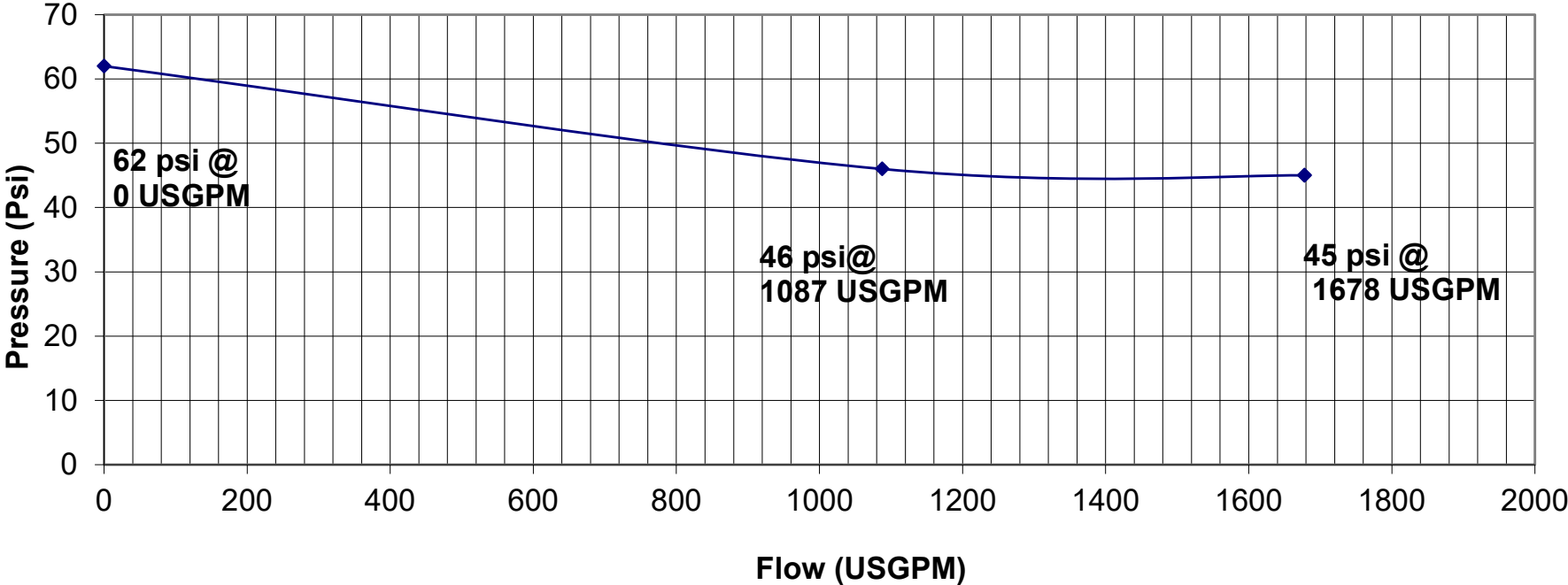
**Hydrant Flow Test Results – Niagara Regional Fire Protection  
Hydrant Fire Flow Calculations  
EPANET Calculation Sheet  
EPANET Imagery**

**NIAGARA REGIONAL FIRE PROTECTION INC.**

**Flow Test Location: Con. 7 125M North of York**

<b>Static Pressure (Psi)</b>		<b>Pitot Reading 1</b>	42	<b># of Outlets Flowed 1</b>	1
	62	<b>Outlet Size 1</b>	2.5	<b># of Outlets Flowed 2</b>	2
<b>Residual Pressure 1 (Psi)</b>		<b>Pitot Reading 2</b>	25	<b># of Outlets Flowed 3</b>	2
	46	<b>Outlet Size 2</b>	2.5	<b>Graph Data:</b>	
<b>Residual Pressure 2 (Psi)</b>		<b>Pitot Reading 3</b>	25	<b>Pressure Values (y-axis)</b>	<b>Flow Values (x-axis)</b>
	45	<b>Outlet Size 3</b>	2.5	62	0
<b>Residual Pressure 3 (Psi)</b>		<b>Flow 1 Calculated</b>		46	1087
	45		1087.4	45	1678
		<b>Flow 2 Calculated</b>		45	1678
			1677.9	<b>Date &amp; Time of Test :</b>	
<b>Coefficient value</b>		<b>Flow 3 Calculated</b>		<b>July 29/2024</b>	
	0.9		1677.9	<b>11:00AM</b>	
				<b>Performed by:</b>	
				Derek & Ryan	

**Water Graph**

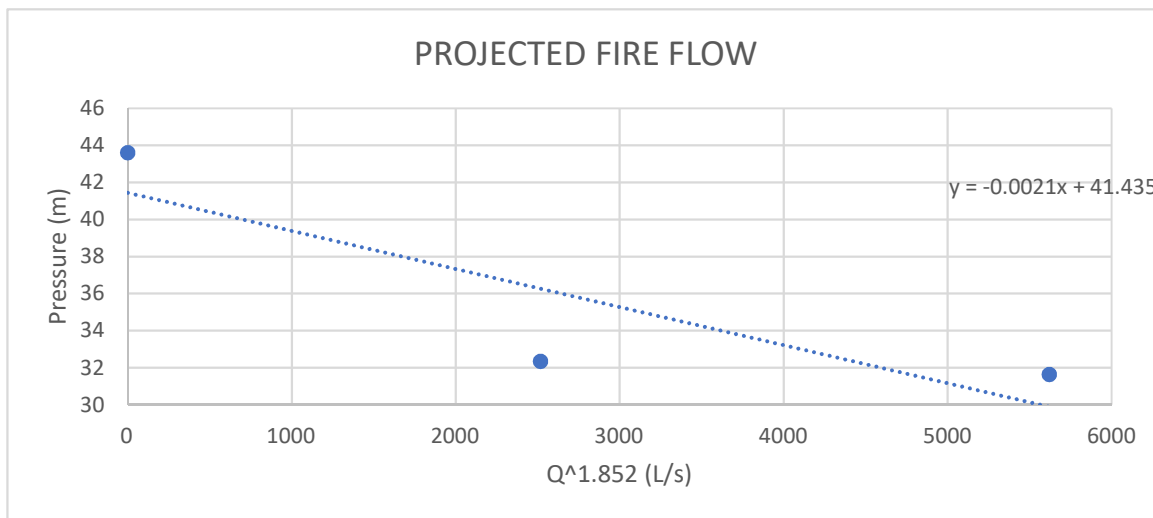


# FIRE FLOW CALCULATION SHEET

**Project:** Modero Estates  
**Project Number:** 2130  
**Date:** July 29, 2024  
**Prepared By:** Kurt Tiessen, EIT  
**Reviewed By:** Jason Schooley, P.Eng.  
  
**Flow Test Provided by:** Niagara Regional Fire Protection  
**Data of Test:** July 29, 2024  
**Hydrant Location:** Concession 7, 125m north of York Road

## FLOW TEST RESULTS

TEST	PRESSURE (psi)	FLOW RATE (USGPM)	FLOW RATE (L/s)	Q <sup>1.852</sup>	PRESSURE (m)
STATIC	62	0	0	0	43.60
RESIDUAL 1	46	1087.4	68.60	2517.21	32.35
RESIDUAL 2	45	1677.9	105.86	5620.74	31.64



## FIRE FLOW FORMULA (y = ax + b)

a = -0.0021  
 b = 41.435

## FIRE FLOW AT A SPECIFIED PRESSURE

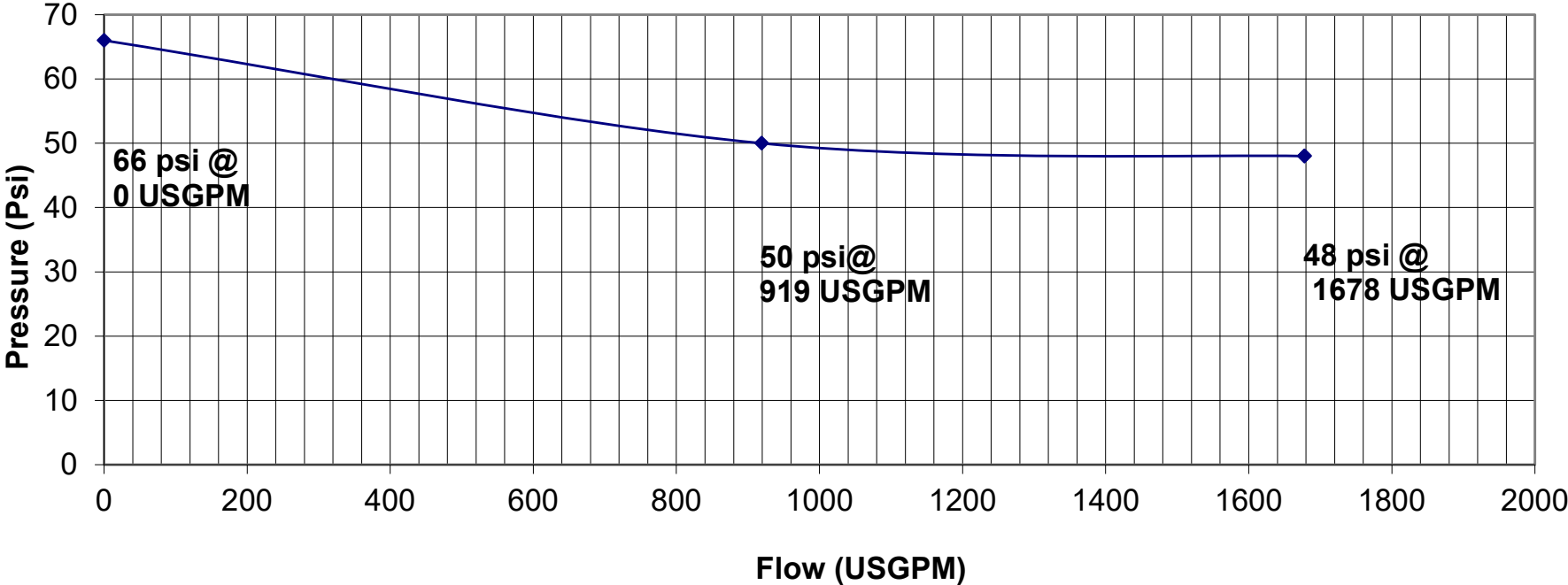
Pressure = 20 psi  
 Pressure = 14.064 m  
 Q<sup>1.852</sup> = 13033.81  
**Flow, Q = 166.71 L/s**  
 Flow, Q = 2642.41 USGPM

**NIAGARA REGIONAL FIRE PROTECTION INC.**

**Flow Test Location: Con. 7 240M North of York**

<b>Static Pressure (Psi)</b>		<b>Pitot Reading 1</b>	30	<b># of Outlets Flowed 1</b>	1
	66	<b>Outlet Size 1</b>	2.5	<b># of Outlets Flowed 2</b>	2
<b>Residual Pressure 1 (Psi)</b>		<b>Pitot Reading 2</b>	25	<b># of Outlets Flowed 3</b>	2
	50	<b>Outlet Size 2</b>	2.5	<b>Graph Data:</b>	
<b>Residual Pressure 2 (Psi)</b>		<b>Pitot Reading 3</b>	25	<b>Pressure Values (y-axis)</b>	<b>Flow Values (x-axis)</b>
	48	<b>Outlet Size 3</b>	2.5	66	0
<b>Residual Pressure 3 (Psi)</b>		<b>Flow 1 Calculated</b>		50	919
	48		919.0	48	1678
		<b>Flow 2 Calculated</b>		48	1678
			1677.9	<b>Date &amp; Time of Test :</b>	
<b>Coefficient value</b>		<b>Flow 3 Calculated</b>		<b>July 29/2024</b>	
	0.9		1677.9	<b>11:30AM</b>	
				<b>Performed by:</b>	
				Derek & Ryan	

**Water Graph**



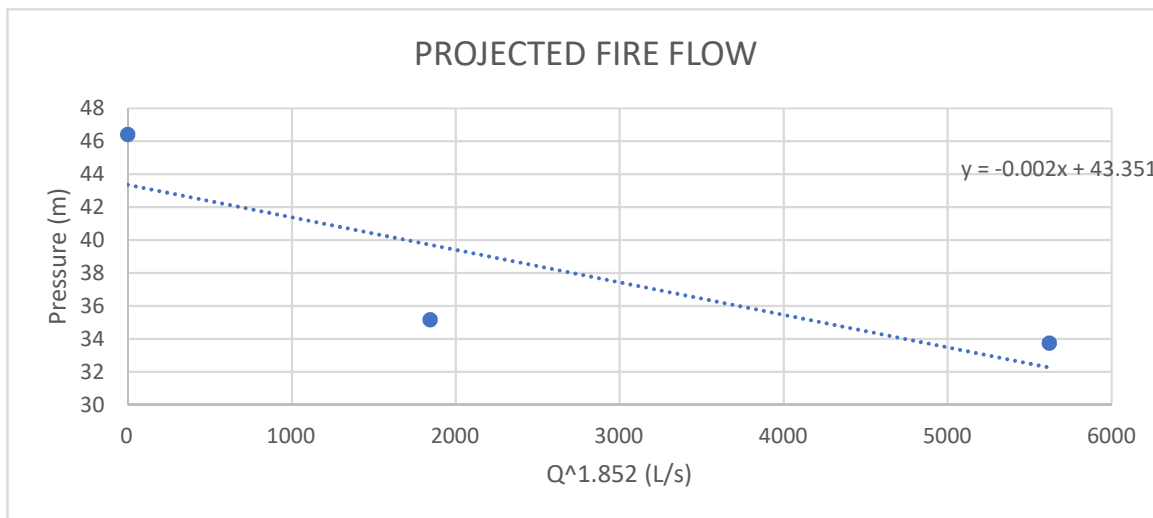
# FIRE FLOW CALCULATION SHEET

**Project:** Modero Estates  
**Project Number:** 2130  
**Date:** July 29, 2024  
**Prepared By:** Kurt Tiessen, EIT  
**Reviewed By:** Jason Schooley, P.Eng.

**Flow Test Provided by:** Niagara Regional Fire Protection  
**Data of Test:** July 29, 2024  
**Hydrant Location:** Concession 7, 240m north of York Road

## FLOW TEST RESULTS

TEST	PRESSURE (psi)	FLOW RATE (USGPM)	FLOW RATE (L/s)	Q <sup>1.852</sup>	PRESSURE (m)
STATIC	66	0	0	0	46.41
RESIDUAL 1	50	919	57.98	1843.26	35.16
RESIDUAL 2	48	1677.9	105.86	5620.74	33.75



## FIRE FLOW FORMULA (y = ax + b)

a = -0.002  
 b = 43.351

## FIRE FLOW AT A SPECIFIED PRESSURE

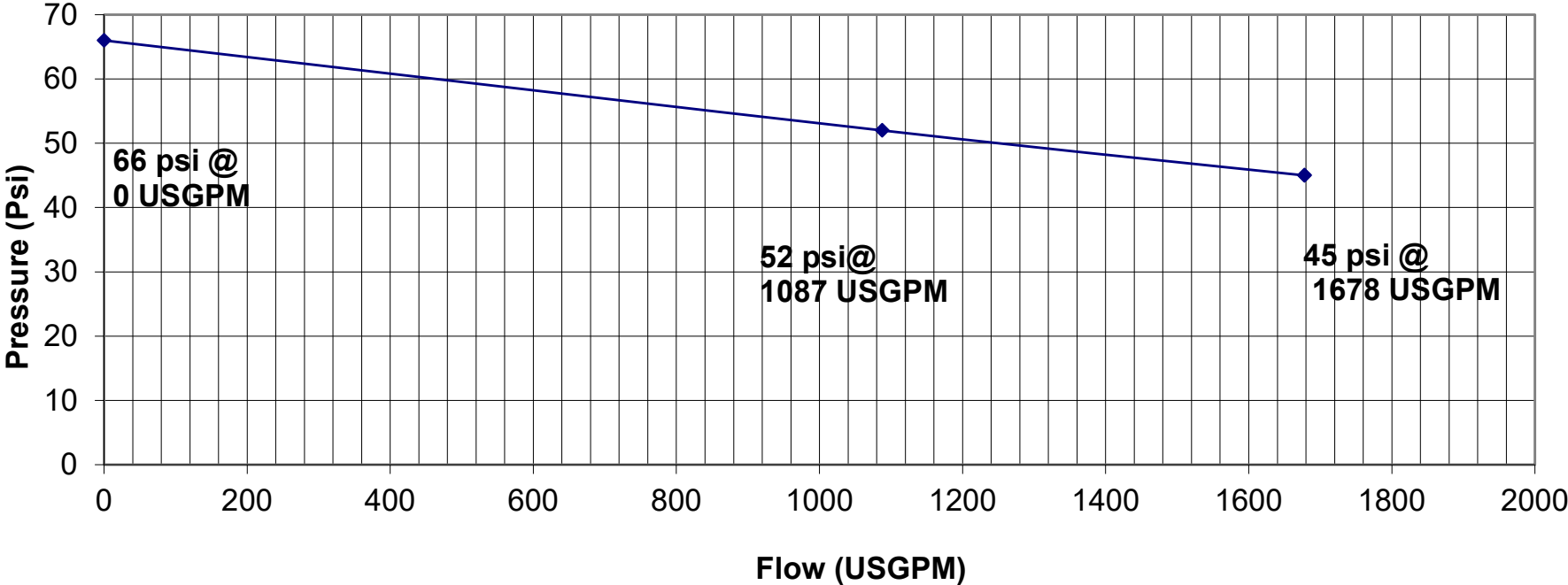
Pressure = 20 psi  
 Pressure = 14.064 m  
 Q<sup>1.852</sup> = 14643.50  
**Flow, Q = 177.53 L/s**  
 Flow, Q = 2813.89 USGPM

**NIAGARA REGIONAL FIRE PROTECTION INC.**

**Flow Test Location: Con. 7 350M North of York**

<b>Static Pressure (Psi)</b>		<b>Pitot Reading 1</b>	42	<b># of Outlets Flowed 1</b>	1
	66	<b>Outlet Size 1</b>	2.5	<b># of Outlets Flowed 2</b>	2
<b>Residual Pressure 1 (Psi)</b>		<b>Pitot Reading 2</b>	25	<b># of Outlets Flowed 3</b>	2
	52	<b>Outlet Size 2</b>	2.5	<b>Graph Data:</b>	
<b>Residual Pressure 2 (Psi)</b>		<b>Pitot Reading 3</b>	25	<b>Pressure Values (y-axis)</b>	<b>Flow Values (x-axis)</b>
	45	<b>Outlet Size 3</b>	2.5	66	0
<b>Residual Pressure 3 (Psi)</b>		<b>Flow 1 Calculated</b>		52	1087
	45		1087.4	45	1678
		<b>Flow 2 Calculated</b>		45	1678
			1677.9	<b>Date &amp; Time of Test :</b>	
<b>Coefficient value</b>		<b>Flow 3 Calculated</b>		<b>July 29/2024</b>	
	0.9		1677.9	<b>12:00AM</b>	
				<b>Performed by:</b>	Derek & Ryan

**Water Graph**



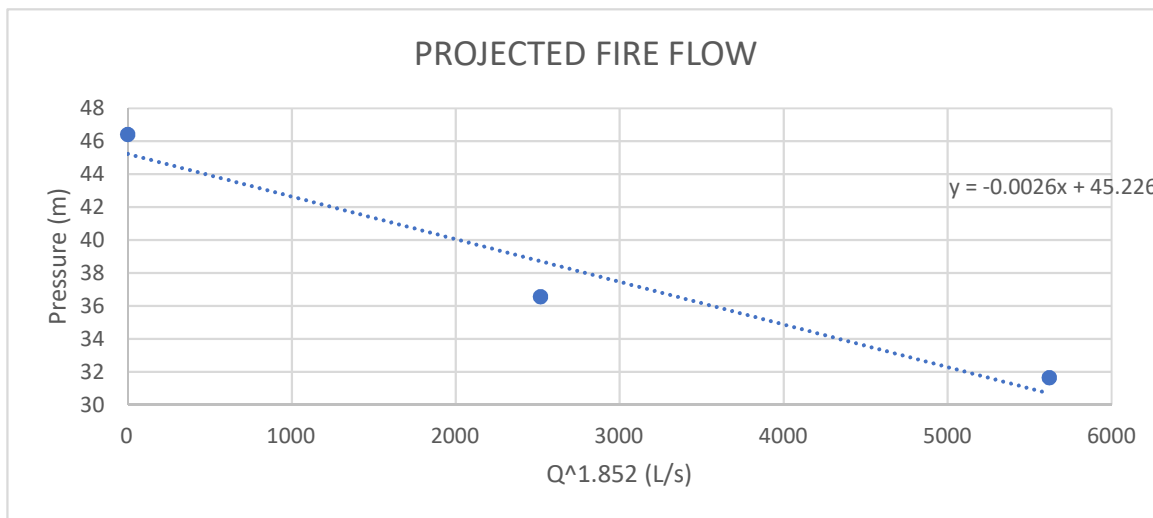
# FIRE FLOW CALCULATION SHEET

**Project:** Modero Estates  
**Project Number:** 2130  
**Date:** July 29, 2024  
**Prepared By:** Kurt Tiessen, EIT  
**Reviewed By:** Jason Schooley, P.Eng.

**Flow Test Provided by:** Niagara Regional Fire Protection  
**Data of Test:** July 29, 2024  
**Hydrant Location:** Concession 7, 350m north of York Road

## FLOW TEST RESULTS

TEST	PRESSURE (psi)	FLOW RATE (USGPM)	FLOW RATE (L/s)	Q <sup>1.852</sup>	PRESSURE (m)
STATIC	66	0	0	0	46.41
RESIDUAL 1	52	1087.4	68.60	2517.21	36.57
RESIDUAL 2	45	1677.9	105.86	5620.74	31.64



## FIRE FLOW FORMULA (y = ax + b)

a = -0.0026  
 b = 45.226

## FIRE FLOW AT A SPECIFIED PRESSURE

Pressure = 20 psi  
 Pressure = 14.064 m  
 Q<sup>1.852</sup> = 11985.38  
**Flow, Q = 159.33 L/s**  
 Flow, Q = 2525.43 USGPM

**MODERO ESTATES EPANET MODELLING**

FLOW UNITS = L/S

**\*\*\*\*NOTE: ONLY FILL OUT ITALICIZED CELLS**

Key Street	Hydrant Address	Hydrant Flow Test		EPANET		EPANET			Hydrant Flow Test		Hydrant Flow Test		EPANET		Fire Flow Calc Sheet		EPANET		EPANET	
		Static (PSI)	Static (m of H2O)	Static (m of H2O)	% Difference	Modelled Static Pressures (m of H2O)	Modelled Static Pressures (PSI)	% Difference	Actual Flow (GPM)	Actual Flow (LPS)	Residual PSI	Residual (m of H2O)	Modelled Residual	% Difference	Theoretical Flow (GPM @ 20psi)	Theoretical Flow (LPS @ 20psi)	Modelled Theoretical Flow (LPS @ 14.06m)	% Difference	Fire Flow (LPS @ 14.06m)	Fire Flow GPM
YORK	Con 7	62	43.6	45.0	3.2%		0.0	-100.0%	1677.9	105.9	45	31.6	33.2	-4.8%	2642.41	166.7	174.8	4.9%		0
	Con 7	66	46.4	44.9	-3.3%		0.0	-100.0%	1677.9	105.9	48	33.8	32.6	3.4%	2813.9	177.5	169.0	-4.8%		0
QUEENSTON	Con 7	66	46.4	45.6	-1.7%		0.0	-100.0%	1677.9	105.9	45	31.6	33.0	-4.2%	2525.43	159.3	167.3	5.0%		0

**BASE LOAD CALCULATIONS**

Node	Street	# of units	Population	USED			Modelled Static Pressures (PSI)	Modelled Hydrant Flow @ 20 PSI (L/s)
				Average Flow (L/s)	Max Day Flow (L/s)	Peak Day Flow (L/s)		
1	Butlersburg - Mixed Use Block 23	29	58	0.17	0.31	0.46	64.2	155.0
2	Butlersburg - Towns	11	22	0.06	0.12	0.18	65.6	157.0
3	Block 82	26	52	0.15	0.28	0.41	66.4	151.0
4	Butlersburg - Towns	10	20	0.06	0.11	0.16	66.6	151.0
5	Butlersburg - Towns	19	38	0.11	0.20	0.30	67.0	144.8
6	Meadows Manor	20	40	0.12	0.21	0.32	66.6	135.0
7	Butlersburg - Mixed	15	30	0.09	0.16	0.24	67.6	140.3
8	Lasalle Lane - Singles	18	36	0.11	0.19	0.29	66.7	135.0
9	Butlersburg - Singles	10	20	0.06	0.11	0.16	69.3	124.8
10	Butlersburg - Singles	16	32	0.09	0.17	0.26	69.3	123.2
11	Butlersburg - Mixed	15	30	0.09	0.16	0.24	66.4	137.5
12	Butlersburg - Towns	35	70	0.21	0.37	0.56	66.9	144.7
13	Butlersburg - Towns	13	26	0.08	0.14	0.21	66.4	147.0
14	Block 84	69	138	0.41	0.73	1.10	64.1	140.5
15	Block 84	28	56	0.17	0.30	0.45	64.8	136.1
16	Block 84	23	46	0.14	0.24	0.37	65.1	137.3
17	Block 84	32	64	0.19	0.34	0.51	66.7	134.2

Demand	Value	Peaking Factor	Conversions	
			PSI	m of H2O
Average	255	1	1	0.7030889
Max Day	459	1.8	20	14.061778
Peak	688.5	2.7	40	28.123556

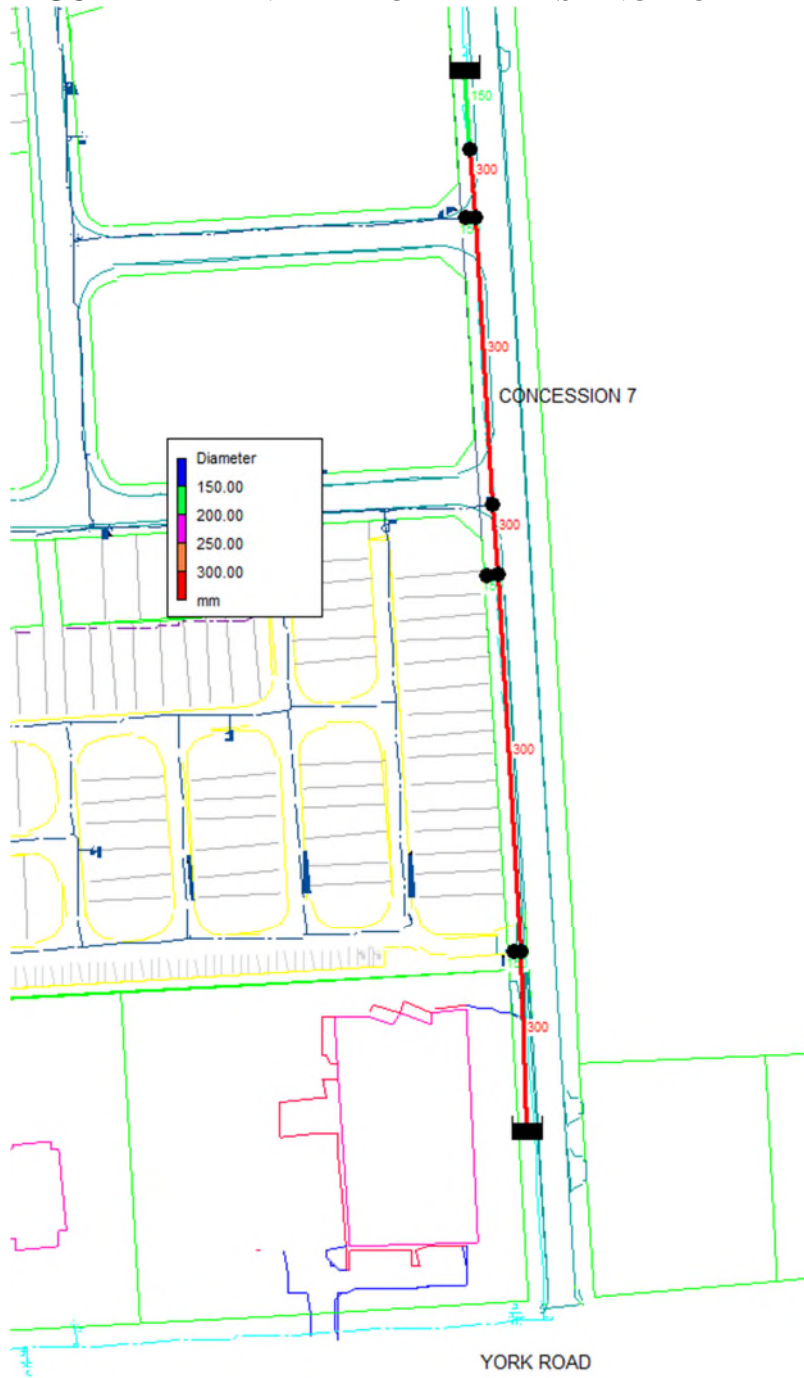
- Note:**
- 255L/cap/day utilized per 2021 Niagara Regional Wastewater MSPU.
  - Greater than 240 L/cap/day utilized in 2021 Niagara Regional Water MSPU.
  - Peaking Factors from MOE Design Guidelines for Drinking Water Systems (2008)
  - Peaking factors correspond to those utilized throughout Niagara Region

- FUS Requirements**
- Single Family Dwellings will require Fire Flow of 66.7L/s
  - Townhouses will require Fire Flow of 133.3L/s

- Conclusions:**
- Lowest hydrant flow rate will be at Hydrant 10 located fronting Lot 12 at the north end
  - All hydrants will provide acceptable flow rates for dwellings in their domain

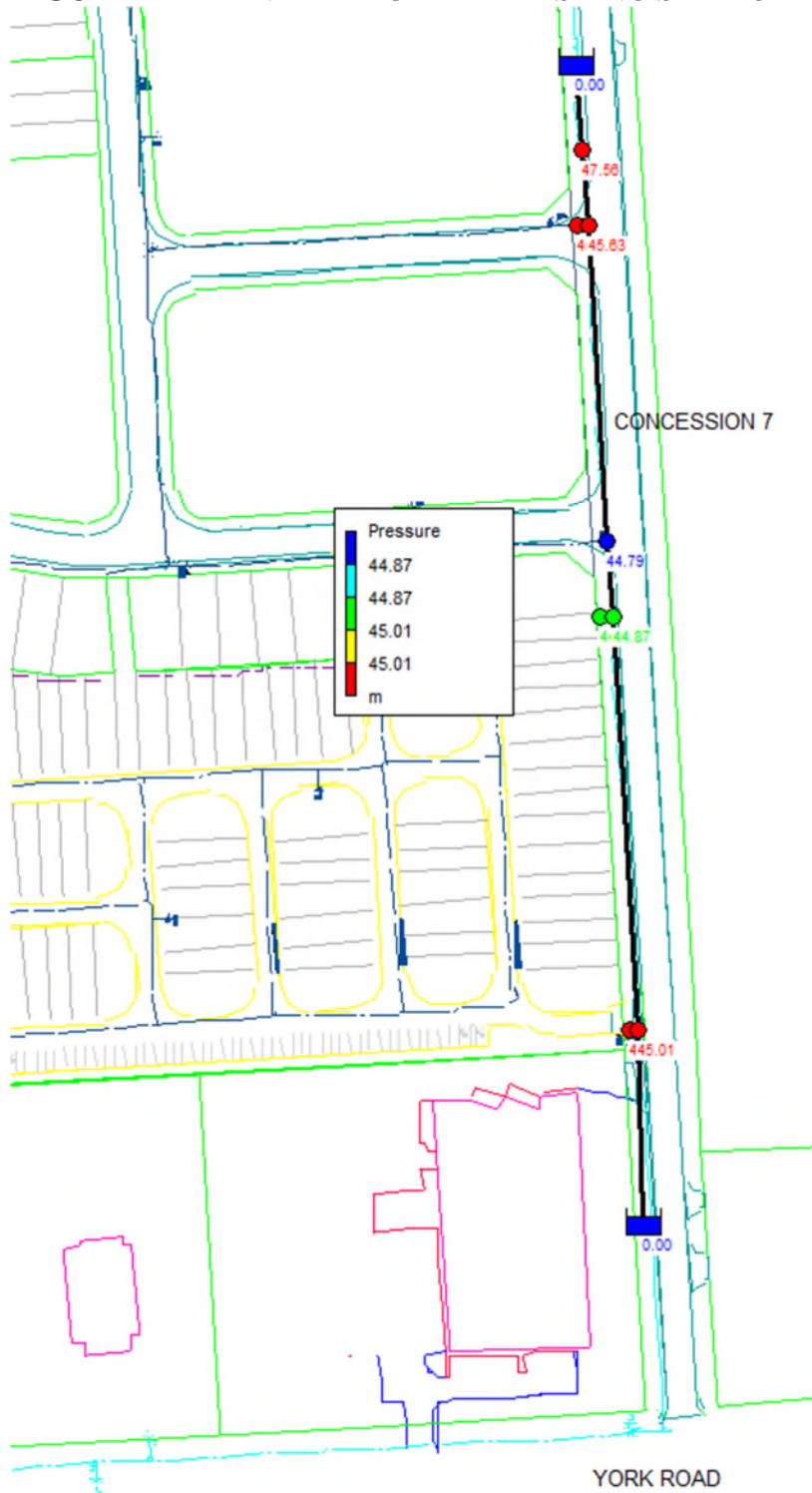


**FIGURE 1 – EPANET IMAGERY – EXISTING MODEL DIAMETERS**



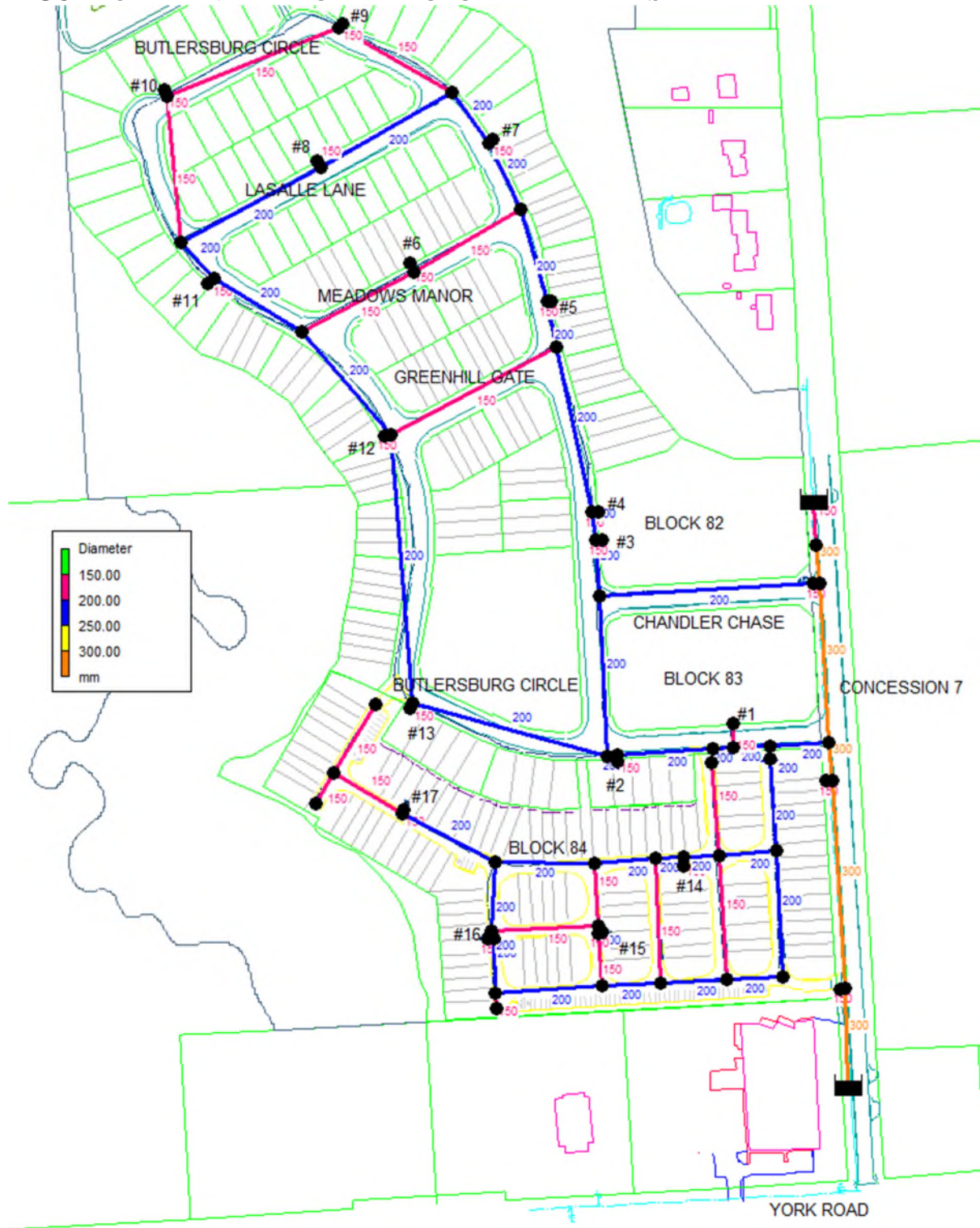


**FIGURE 2 – EPANET IMAGERY – EXISTING STATIC PRESSURES**





**FIGURE 3 – EPANET IMAGERY – FUTURE DIAMETERS**





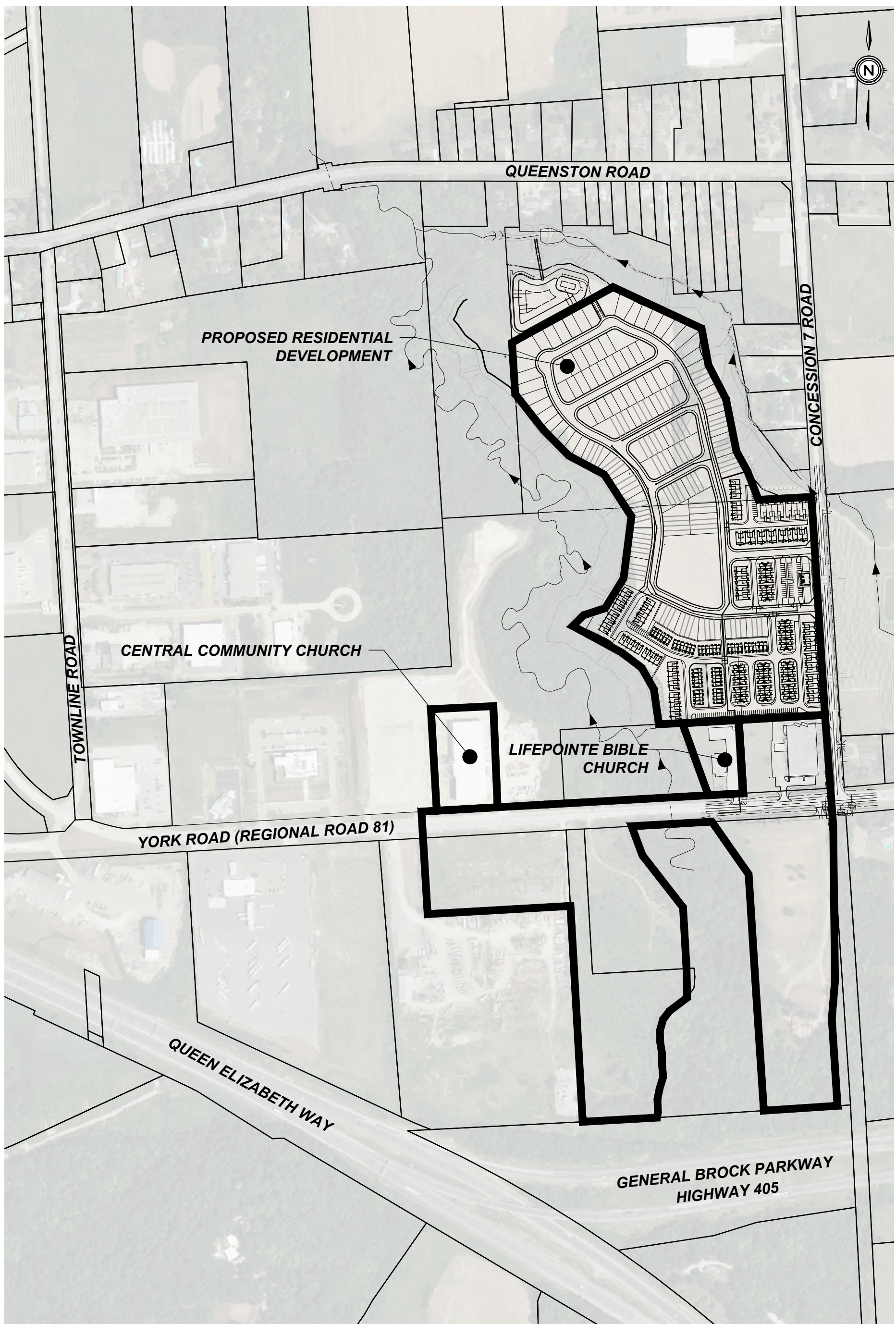


**UPPER CANADA  
CONSULTANTS**  
ENGINEERS / PLANNERS

## **APPENDIX B**

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**Figure 4 – Overall Sanitary Drainage Area Plan  
Overall Sanitary Sewer Calculations  
Glendale Industrial Area Servicing Study – Sanitary Sewer Calcs & Drainage Area Plan**



**UPPER CANADA  
CONSULTANTS**  
ENGINEERS / PLANNERS

**CONCESSION 7**  
**TOWN OF NIAGARA-ON-THE-LAKE**  
**OVERALL SANITARY DRAINAGE AREA PLAN**

DATE	2021-06-16
SCALE	1:5000 m
REF No.	<b>2130</b>
DWG No.	<b>FIGURE 4</b>

UPPER CANADA CONSULTANTS  
 3-30 HANNOVER DRIVE  
 ST.CATHARINES, ONTARIO  
 L2W 1A3

<b>DESIGN FLOWS</b>	INDUSTRIAL PEAKING FACTOR	2.00 (MINIMUM PER MECP DESIGN CRITERIA)
RESIDENTIAL:	255 LITRES/PERSON/DAY (AVERAGE DAILY FLOW)	
INSTITUTIONAL/CHURCH:	315 LITRES/PARKING SPACE (ASSUMING 3 PERSONS PER PARKING SPACE)	
INDUSTRIAL:	0.45 L / s / GROSS HECTARE (MECP DESIGN CRITERIA)	
INFILTRATION RATE:	0.286 L / s / ha (M.O.E FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 L / s / ha)	
POPULATION DENSITY:	2.4 PERSONS / UNIT	
	<b>SEWER DESIGN</b>	
	PIPE ROUGHNESS:	0.013 FOR MANNING'S EQUATION
	PIPE SIZES:	1.016 IMPERIAL EQUIVALENT FACTOR
	PERCENT FULL:	TOTAL PEAK FLOW / CAPACITY

**MUNICIPALITY:** TOWN OF NIAGARA-ON-THE-LAKE  
**PROJECT :** MODERO ESTATES  
**PROJECT NO:** 2130  
**SANITARY SEWER DESIGN SHEET**  
 Res. Peaking Factor=  $M = 1 + \frac{14}{4 + P^{0.5}}$  Where P = design population in thousands

LOCATION			AREA		POPULATION				ACCUMULATED PEAK FLOW				DESIGN FLOW					
Location and Description	From M.H.	To M.H.	Increment (hectares)	Accumulated (hectares)	Number of Units	Population Density (persons/unit)	Population Increment	Total Population Served	Peaking Factor	Flow (L/s)	Infiltration Flow L/s	Total Peak Flow (L/s)	Pipe Diameter (mm)	Pipe Length (m)	Pipe Slope (%)	Full Flow Velocity (m/s)	Full Flow Capacity (L/s)	Percent Full
A1 - BUTLERSBURG CIR	PIT MH	F	1.06	1.06	15	2.4	36	36	4.34	0.46	0.30	0.76						
A2 - LASALLE LANE	E	F	0.64	0.64	13	2.4	31	31	4.35	0.40	0.18	0.58	200	100.0	0.60	0.82	26.50	2.2%
A3 - BUTLERSBURG CIR	F	G	0.16	1.86	2	2.4	5	72	4.28	0.91	0.53	1.44	250	27.2	0.25	0.61	31.02	4.6%
A4 - BUTLERSBURG CIR	G	K	0.24	2.10	7	2.4	17	89	4.26	1.12	0.60	1.72	250	50.9	0.25	0.61	31.02	5.5%
A5 - MEADOWS MANOR	H	I	0.22	0.22	5	2.4	12	12	4.41	0.16	0.06	0.22	200	25.2	1.00	1.06	34.22	0.6%
A6 - MEADOWS MANOR	I	J	0.63	0.85	18	2.4	43	55	4.31	0.70	0.24	0.94	200	84.3	0.40	0.67	21.64	4.4%
MEADOWS MANOR	J	K		0.85				55	4.31	0.70	0.24	0.94	200	8.0	0.40	0.67	21.64	4.4%
A7 - BUTLERSBURG CIR	K	O	0.34	3.29	10	2.4	24	168	4.17	2.07	0.94	3.01	250	77.7	0.25	0.61	31.02	9.7%
A8 - GREENHILL GATE	L	M	0.25	0.25	8	2.4	19	19	4.38	0.25	0.07	0.32	200	23.9	1.00	1.06	34.22	0.9%
A9 - GREENHILL GATE	M	N	0.36	0.61	11	2.4	26	46	4.32	0.58	0.17	0.76	200	43.0	0.40	0.67	21.64	3.5%
GREENHILL GATE	N	O		0.61				46	4.32	0.58	0.17	0.76	200	12.5	0.40	0.67	21.64	3.5%
A10 - BUTLERSBURG CIR	O	P	0.39	4.29	9	2.4	22	235	4.12	2.86	1.23	4.09	250	59.9	0.25	0.61	31.02	13.2%
A11 - BUTLERSBURG CIR	P	Q	0.23	4.52	5	2.4	12	247	4.11	3.00	1.29	4.29	250	37.8	0.25	0.61	31.02	13.8%
A12 - BLOCK 82	STUB	Q	0.91	0.91	26	2.4	62	62	4.29	0.79	0.26	1.05	200	7.5	0.40	0.67	21.64	4.9%
A13 - BUTLERSBURG CIR	Q	R	0.06	5.49				310	4.07	3.72	1.57	5.29	250	39.5	0.25	0.61	31.02	17.1%
A14 - BUTLERSBURG CIR	R	V	0.12	5.61				310	4.07	3.72	1.60	5.33	250	79.5	0.25	0.61	31.02	17.2%
A15 - BLOCK 83 EAST	STUB	S	0.49	0.49	13	2.4	31	31	4.35	0.40	0.14	0.54	200	10.5	0.40	0.67	21.64	2.5%
A16 - BUTLERSBURG CIR	S	U	0.10	0.59	1	2.4	2	34	4.35	0.43	0.17	0.60	200	33.5	0.40	0.67	21.64	2.8%
A17 - BLOCK 83 WEST	STUB	U	0.34	0.34	15	2.4	36	36	4.34	0.46	0.10	0.56	200	10.5	1.00	1.06	34.22	1.6%
A18 - BUTLERSBURG CIR	U	V	0.17	1.10	4	2.4	10	79	4.27	1.00	0.31	1.31	200	36.3	0.40	0.67	21.64	6.1%
BUTLERSBURG CIR	V	JJ		6.71				389	4.03	4.62	1.92	6.54	250	10.1	0.25	0.61	31.02	21.1%
A19 - BUTLERSBURG CIR	PIT MH	Z	1.01	1.01	14	2.4	34	34	4.35	0.43	0.29	0.72						
A20 - BUTLERSBURG CIR	E	Y	0.43	0.43	9	2.4	22	22	4.38	0.28	0.12	0.40	200	60.5	0.60	0.82	26.50	1.5%
	Y	Z		0.43				22	4.38	0.28	0.12	0.40	200	8.0	0.40	0.67	21.64	1.9%
A21 - BUTLERSBURG CIR	Z	AA	0.16	1.60	2	2.4	5	60	4.30	0.76	0.46	1.22	250	36.3	0.25	0.61	31.02	3.9%
A22 - BUTLERSBURG CIR	AA	BB	0.22	1.82	5	2.4	12	72	4.28	0.91	0.52	1.43	250	44.2	0.25	0.61	31.02	4.6%
A23 - BUTLERSBURG CIR	BB	CC	0.18	2.00	4	2.4	10	82	4.27	1.03	0.57	1.60	250	39.4	0.25	0.61	31.02	5.2%
A24 - BUTLERSBURG CIR	CC	DD	0.14	2.14	3	2.4	7	89	4.26	1.12	0.61	1.73	250	36.0	0.25	0.61	31.02	5.6%
A25 - BUTLERSBURG CIR	DD	EE	0.14	2.28	4	2.4	10	98	4.25	1.23	0.65	1.89	250	28.4	0.25	0.61	31.02	6.1%
A26 - BUTLERSBURG CIR	EE	FF	0.30	2.58	8	2.4	19	118	4.22	1.47	0.74	2.20	250	39.7	0.25	0.61	31.02	7.1%
A27 - BUTLERSBURG CIR	FF	GG	0.31	2.89	9	2.4	22	139	4.20	1.73	0.83	2.55	250	67.1	0.25	0.61	31.02	8.2%
A28 - BUTLERSBURG CIR	GG	HH	0.02	2.91				139	4.20	1.73	0.83	2.56	250	11.5	0.25	0.61	31.02	8.2%
A29 - BUTLERSBURG CIR	HH	II	0.30	3.21	6	2.4	14	154	4.19	1.90	0.92	2.82	250	71.0	0.25	0.61	31.02	9.1%
A30 - BUTLERSBURG CIR	II	JJ	0.15	3.36	3	2.4	7	161	4.18	1.98	0.96	2.95	250	31.5	0.25	0.61	31.02	9.5%
A31 - ACCESS	JJ	KK	0.04	10.11				550	3.95	6.41	2.89	9.30	300	64.5	0.20	0.62	45.12	20.6%
A32 - LANEWAY 84A	84-A	84-C	0.23	0.23	7	2.4	17	17	4.39	0.22	0.07	0.28	200	44.5	0.60	0.82	26.50	1.1%
A33 - LANEWAY 84A	84-B	84-C	0.09	0.09	3	2.4	7	7	4.43	0.09	0.03	0.12	200	17.0	0.60	0.82	26.50	0.5%
A34 - LANEWAY 84G	84-C	84-D	0.40	0.72	18	2.4	43	67	4.29	0.85	0.21	1.06	200	77.3	0.40	0.67	21.64	4.9%
A35 - LANEWAY 84G	84-D	84-E	0.13	0.85	4	2.4	10	77	4.27	0.97	0.24	1.21	200	34.3	0.40	0.67	21.64	5.6%
A36 - LANEWAY 84G	84-E	KK	0.21	1.06	11	2.4	26	103	4.24	1.29	0.30	1.59	200	43.7	0.40	0.67	21.64	7.4%
A37 - LANEWAY 84F	84-F	84-H	0.27	0.27	13	2.4	31	31	4.35	0.40	0.08	0.48	200	51.0	1.00	1.06	34.22	1.4%
A38 - LANEWAY 84F	84-G	84-H	0.38	0.38	16	2.4	38	38	4.34	0.49	0.11	0.60	200	61.9	1.00	1.06	34.22	1.8%
A39 - LANEWAY 84G	84-H	84-K	0.01	0.66				70	4.28	0.88	0.19	1.07	200	31.9	0.40	0.67	21.64	4.9%
A40 - LANEWAY 84E	84-I	84-K	0.13	0.13	6	2.4	14	14	4.40	0.19	0.04	0.22	200	50.4	1.00	1.06	34.22	0.7%
A41 - LANEWAY 84E	84-J	84-K	0.30	0.30	14	2.4	34	34	4.35	0.43	0.09	0.52	200	55.7	1.00	1.06	34.22	1.5%
A42 - LANEWAY 84G	84-K	84-M	0.10	1.19	4	2.4	10	127	4.21	1.58	0.34	1.92	200	35.1	0.40	0.67	21.64	8.9%
A43 - LANEWAY 84D	84-L	84-M	0.24	0.24	11	2.4	26	26	4.36	0.34	0.07	0.41	200	55.5	1.00	1.06	34.22	1.2%
A44 - LANEWAY 84G	84-M	KK	0.10	1.53	4	2.4	10	163	4.18	2.01	0.44	2.45	200	33.5	2.50	1.67	54.10	4.5%
A45 - LANEWAY 84C	KK	LL	0.12	12.82	6	2.4	14	830	3.85	9.44	3.67	13.10	300	69.0	0.20	0.62	45.12	29.0%
A46 - LANEWAY 84B	84-N	84-P	0.12	0.12	5	2.4	12	12	4.41	0.16	0.03	0.19	200	28.6	1.00	1.06	34.22	0.6%
A47 - LANEWAY 84H	84-O	84-P	0.17	0.17	12	2.4	29	29	4.36	0.37	0.05	0.42	200	44.0	1.00	1.06	34.22	1.2%
A48 - LANEWAY 84B	84-P	84-Q	0.11	0.40	5	2.4	12	53	4.31	0.67	0.11	0.79	200	34.3	0.40	0.67	21.64	3.6%
A49 - LANEWAY 84I	84-Q	LL	0.19	0.59	7	2.4	17	70	4.28	0.88	0.17	1.05	200	54.7	1.50	1.29	41.91	2.5%
A50 - LANEWAY 84I	LL	MM	0.03	13.44				900	3.83	10.17	3.84	14.01	300	12.5	0.20	0.62	45.12	31.1%
LIFEPOINTE CHURCH					75	3.0			2.00	1.64								
A51 - CHURCH	MM	NN	0.46	13.90				900	3.83	11.81	3.98	15.79	300	90.0	0.20	0.62	45.12	35.0%
A52 - CHURCH	NN	OO	0.03	13.93				900	3.83	11.81	3.98	15.80	300	38.4	0.20	0.62	45.12	35.0%
A53 - DEL PRIORE	SERVICE	OO	1.22	1.22	-				2.00	1.10	0.35	1.45						
YORK ROAD OUTLET	OO	EX MH		15.15				900	3.83	12.91	4.33	17.24	300	14.0	0.20	0.62	45.12	38.2%
<b>Remaining Light Industrial</b> - south side of York Road			13.85	13.85		0.45 L/s/ha			2.00	12.47	3.96	16.43						
<b>York Road</b> - 490m East of Townline to Townline Road			37.80	66.80		0.45 L/s/ha			2.00	25.37	8.64	35.12	375	388.0	0.22	0.75	85.79	40.9%
<b>Townline Road</b> - York Road to 140m North			11.00	77.80		0.45 L/s/ha			2.00	69.29	22.25	91.55	450	146.0	0.44	1.20	197.30	46.4%
<b>Townline Road</b> - 140m North of York to 350m South of G			13.40	91.20		0.45 L/s/ha			2.00	81.35	26.08	107.44	525	352.0	0.39	1.25	280.19	38.3%
<b>Townline Road</b> - 350m South of Queenston to Queenston			26.70	117.90		0.45 L/s/ha			2.00	105.38	33.72	139.10	525	343.0	0.17	0.83	184.99	75.2%
<b>Queenston Road</b> - Townline Road to Taylor Road			8.50	126.40		0.45 L/s/ha			2.00	113.03	36.15	149.18	525	850.0	0.17	0.83	184.99	80.6%
			<b>126.40</b>															

Note: Lands as part of 'Remaining Light Industrial' Area include south side properties from #785-#683 York Road as well as the northerly #680 York Road  
 \*\* All pipe lengths and slopes, as well as all drainage areas and flow rates downstream of the focus drainage area taken from the 'Glendale Industrial Area Servicing Study Update' (June 25, 1992)

CAPACITY CHECK - EXISTING AND PROPOSED SANITARY SEWERS

Design Flow, Q(d) = Peak Domestic Flow, Q(p) + Peak Infiltration, Q(i) + External Point Load, Q(x)

Q(p) = Aq<sub>h</sub>, where A = Contributing Area (ha)

q = Average Domestic Flow (l/ha-s)

0.4051 l/ha-s (3,100 IGPd) for light, service and prestige industrial  
 0.6366 l/ha-s (4,900 IGPd) for heavy industrial

0.3241 l/ha-s (2,500 IGPd) for commercial and institutional

M = Peaking Factor (use Appendix B from MOE Design Guidelines)

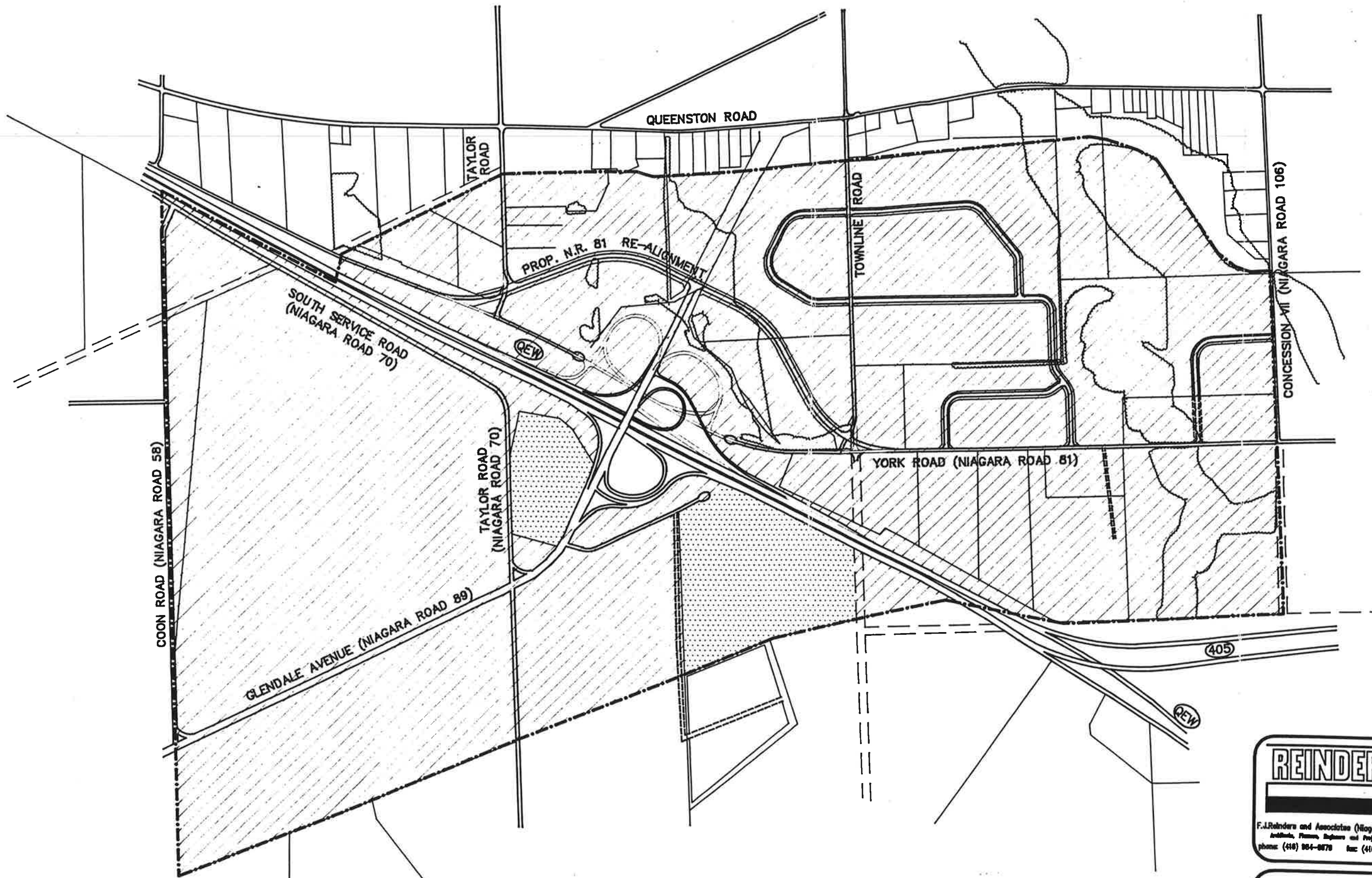
Q(i) = Ai, where A = Contributing Area (ha)  
 i = unit of peak infiltration  
 use 0.21 l/ha-s

0.67 0.5

Pipe Capacity = (R A S)<sup>1/n</sup>

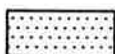


where Manning's n = 0.011 for PE & PVC  
 = 0.013 for concrete

STREET	LOCATION FROM	TO	PROBABLE LAND USE	AREA (ha)	q (l/ha-s)	M	Q(p) (l/s)	Q(i) (l/s)	Q(x) (l/s)	Q(d) (l/s)	LENGTH (m)	SIZE (mm)	TYPE	AVERAGE GRADE (%)	CAPACITY (l/s)	CAPACITY USED (%)
York Road	110m west of Concession VII	490m east of Townline Road	Light Ind.	33.2	0.4051	3.35	45.1	7.0	52.1	388	375	PVC (DR35)	0.22	97.2	54	
York Road	490m east of Townline Road	Townline Road	Light Ind.	71.0	0.4051	2.85	82.0	14.9	96.9	492	375	PVC (DR35)	0.42	134.3	72	
Townline Road	York Road	140m north of York Road	Light Ind.	82.0	0.4051	2.80	93.0	17.2	110.2	146	450	PVC (ribbed)	0.44	223.5	49	
Townline Road	York Road	140m north of 350m south of Queenston Road	Light Ind.	95.4	0.4051	2.70	104.3	20.0	124.3	352	525	PVC (ribbed)	0.39	317.4	39	
Townline Road	Queenston Road	350m south of Queenston Road	Light Ind.	122.1	0.4051	2.55	126.1	25.6	151.7	343	525	PVC (ribbed)	0.17	209.6	72	
Queenston Road	Townline Road	Taylor Road	Light Ind.	130.6	0.4051	2.55	134.9	27.4	162.3	850	525	PVC (ribbed)	0.17	209.6	77	
Taylor Road	Walker's Bros. Landfill	404m south of Glendale Ave.	Allowable discharge from Walker Bros. Landfill						5.3 (0.1MGD)	5.3	150	PVC (DR35)	1.24 (Not as-built)	20.0	under head	
Taylor Road	Glendale Ave.	404m south of Glendale Ave.	Allowable discharge from Walker Bros. Landfill						5.3	5.3	200	PVC (DR35)	1.24 (Not as-built)	43.2	under head	
Taylor Road	Glendale Ave.	390m south of Glendale Ave.	Comm./Inst. Light Ind.	16.5	0.4051	3.55	33.7	4.9	43.9	376	375	PVC (DR35)	0.72 (Not as-built)	175.8	25	
Glendale Ave.	Coon Road	450m west of Taylor Road	Light Ind.	30.2	0.4051	3.35	41.0	6.3	47.3	450	300	FUTURE!	0.30	62.6	70	
Glendale Ave.	Taylor Road	450m west of Taylor Road	Light Ind.	44.6	0.4051	3.15	56.9	9.4	66.3	375	375	FUTURE!	0.25	103.6	84	



**REINDERS**  
 F.J.Reinders and Associates (Niagara) Limited  
 Architects, Planners, Engineers and Project Managers  
 phone: (416) 864-8878 fax: (416) 862-5898

**LEGEND**

-  28 cu.m./ha.day ALLOWABLE
-  35 cu.m./ha.day ALLOWABLE
-  URBAN AREA BOUNDARY

**SANITARY SEWAGE  
 PRODUCTION QUOTAS**

GLENDALE INDUSTRIAL AREA  
 SERVICING STUDY UPDATE  
 NIAGARA-ON-THE-LAKE, ONTARIO

SCALE 1:10000      SCHEDULE D      JUNE 25, 1992



**UPPER CANADA  
CONSULTANTS**  
*ENGINEERS / PLANNERS*

## **APPENDIX B**

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**Modero Estates – Stormwater Management Plan**

**STORMWATER MANAGEMENT PLAN**  
**MODERO ESTATES**  
**TOWN OF NIAGARA-ON-THE-LAKE**

**Prepared for:**

**Marz Homes (NOTL) inc.**

**Prepared by:**

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

**Revised March 13, 2025**

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Stormwater Management Facility - Wet Pond Calculations  
Stormwater Management Facility – Concession 7 Storm Sewer Calculations
- Appendix B MIDUSS Output Files
- Appendix C Hydroworks Output File  
Sample Inspection Report

**REFERENCES**

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

# **STORMWATER MANAGEMENT PLAN**

## **MODERO ESTATES**

### **TOWN OF NIAGARA-ON-THE-LAKE**

#### **1.0 INTRODUCTION**

##### **1.1 Study Area**

The proposed residential development is located in the Town of Niagara-on-the-Lake as part of Lots 180 & 181. As shown on the enclosed Site Location Plan (Figure 1), the subject property is situated west of Concession 7 Road, north of York Road (Regional Road 81) and south of Queenston Road.

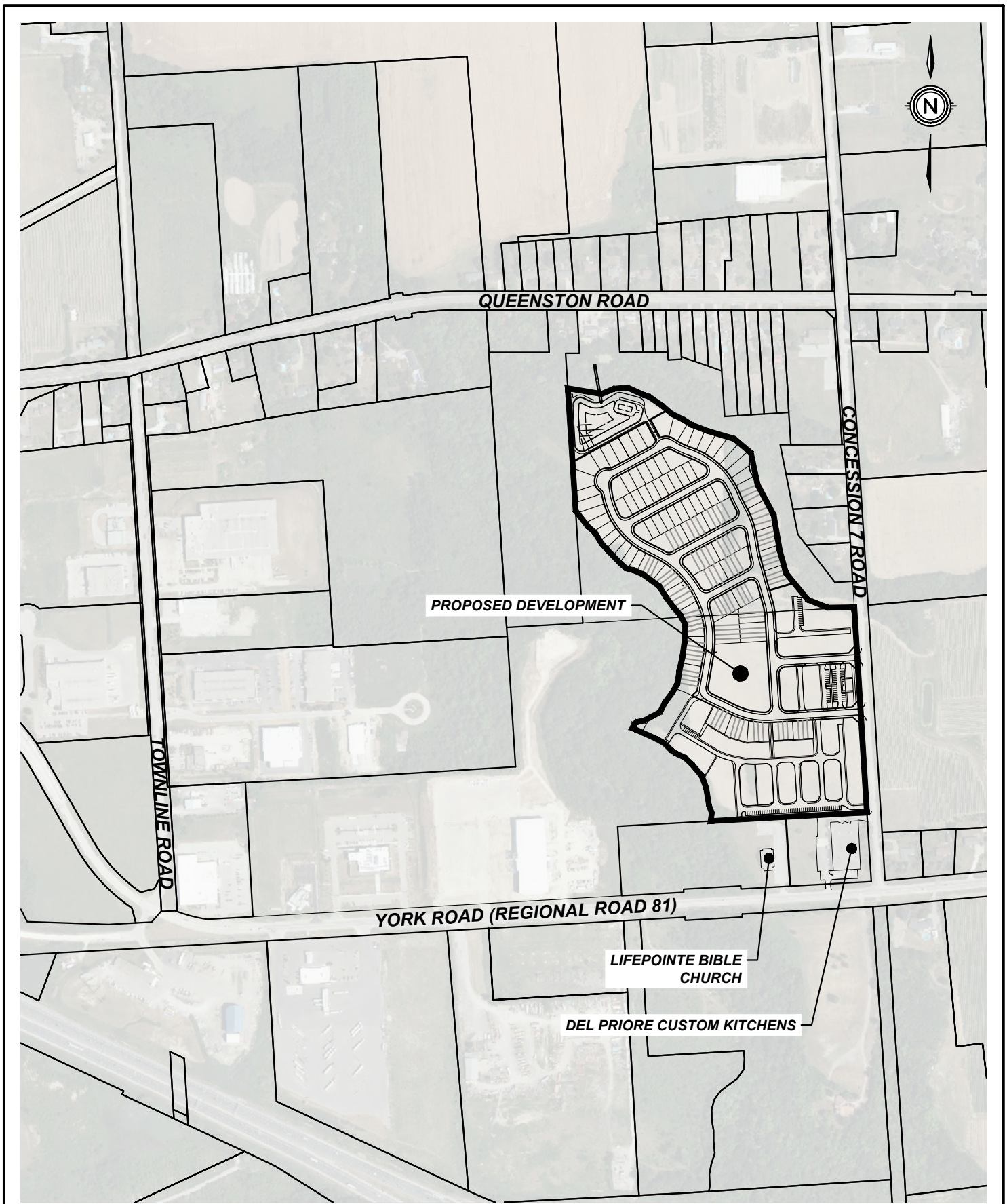
The 23.01-hectare property is bound by Six Mile Creek to the west, as well as a tributary of Six Mile Creek at the north-east portion of the property. Provincially Significant Wetland, and further forested lands as part of Six Mile Creek, makes up approximately 7.59 hectares of the proposed site. Lifepointe Church and Del Priore Kitchens occupy properties at the southern limits of the site fronting York Road (Regional Road 81) and proposed development property has approximately 300m of frontage on Concession 7 Road.

This Stormwater Management Plan will discuss the servicing strategy for two separate stormwater systems: the Modero Estates Subdivision (wet pond facility), as well as the Concession 7 Road Reconstruction (storm sewers). Lands to the south of the Modero Estates Subdivision (i.e. Lifepointe Bible Church & Del Priore Custom Kitchens) will drain through existing stormwater systems (ditch & storm sewers) to the Six Mile Creek to the west. The York Road (Regional Road 81) stormwater system will remain unaffected by the proposed works.

##### **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 development on the stormwater peak flows & volumes from this site.
3. Investigate alternatives for controlling the quantity and quality of stormwater from this site.
4. Recommend a comprehensive plan for the management of stormwater during and after construction.



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**CONCESSION 7 DEVELOPMENT**  
TOWN OF NIAGARA-ON-THE-LAKE  
SITE LOCATION PLAN

DATE	2021-06-17
SCALE	1:7500 m
REF No.	<b>2130</b>
DWG No.	<b>FIGURE 1</b>

### **1.3 Existing & Proposed Conditions**

#### a) Existing Conditions

The site has historically been used for agricultural purposes but is presently open space. The 23.01-hectare property includes 7.59 hectares of undevelopable lands along the west and north-east portion of the property comprised of Provincially Significant Wetland and forested lands as part of Six Mile Creek.

Peak stormwater flows from the site are conveyed to either the Main Branch west of the development or a tributary of Six Mile Creek at the north-east portion of the development under current conditions. A drainage area of approximately 655 hectares upstream of the York Road culvert (west of Lifepoint Bible Church) conveys stormwater flows from Niagara-on-the-Lake and Niagara Falls to the Main Branch of Six Mile Creek, west of the development. A drainage area of approximately 43.5 hectares conveys stormwater flows to the Concession 7 culvert (south of #330 Concession 7 Rd) and to the tributary of Six Mile Creek and the north-east portion of the development. Stormwater flows being conveyed through Six Mile Creek ultimately outlet to Lake Ontario to the North.

#### b) Proposed Conditions

The proposed development site is approximately 15.42 hectares and shall consist of 3 condominium blocks (206 units), 128 townhouses and 55 single family homes for a total count of 389 units. The site shall be provided with full municipal services including sanitary sewers, storm sewers and watermain with asphalt pavement, concrete curbs and gutters. The proposed stormwater management plan discusses the proposed development under fully developed conditions.

## **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/MNRF, May 1991)
- Stormwater Management Planning and Design Manual (MECP, March 2003)

Based on the comments and outstanding policies from various agencies (Town of Niagara-on-the-Lake, Regional Municipality of Niagara, Niagara Peninsula Conservation Authority (NPCA), and the Ministry of the Environment, Conservation and Parks (MECP), and others) the following site-specific considerations were identified:

- The receiving watercourse, Six Mile Creek has been identified by the Ministry of Natural Resources watercourse evaluation as a **Type 2 (Important)** fish habitat. Based on this fish habitat, the corresponding required minimum MECP level of protection for stormwater management quality practices for this development site is *Normal*.
- The site outlets to Six Mile Creek which contains lands that would be negatively impacted by increased flooding levels, and, therefore, stormwater quantity control is considered necessary to maintain the downstream peak water elevations.

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

- Stormwater **quality** controls are to be provided for the internal stormwater system of the development as well as the Concession 7 road reconstruction according to MECP guidelines. Quality enhancements will be provided to a minimum of *Normal Protection* (70% TSS removal) standard prior to discharge to Six Mile Creek Tributary.
- Stormwater **quantity** controls are to be provided for the outlet to limit the proposed development peak flows from the 2-, 5-, and 100-year storm events to existing peak flow levels.

### 3.0 STORMWATER ANALYSIS

A stormwater analysis has been conducted by Upper Canada Consultants as part of the design of this development using the MIDUSS computer modelling program. A new stormwater analysis was conducted to represent the existing and future conditions to Six Mile Creek.

This program was selected because it is applicable to an urban drainage area like the study area, it is relatively easy to use and modify for the proposed drainage conditions and control facilities, and it readily allows for the use of design storm hyetographs for the various return periods being investigated.

Copies of the current model output files are enclosed in Appendix B.

### 3.1 Design Storms

Design storm hyetographs were developed using a Chicago distribution based on the Town of Niagara-on-the-Lake Intensity-Duration-Frequency curves. Hyetographs for the 25mm, 5 and 100 year events were developed using a 4-hour Chicago distribution. The 100-year storm event has also been modelled for a 24-hour storm event to ensure sufficient capacities are provided as requested by the Region. Table 1 summarizes the rainfall data.

<b>Table 1. Rainfall Data</b>			
<b>Design Storm (Return Period)</b>	<b>Chicago Distribution Parameters</b>		
	<b>a</b>	<b>b</b>	<b>c</b>
25mm	512.0	6.00	0.800
2 Year	567.0	5.20	0.746
5 Year	664.0	4.70	0.744
100 Year	980.0	3.70	0.732
$Intensity \ (mm/hr) = \frac{a}{(t_d + b)^c}$			

### 3.2 Existing Conditions

Existing conditions were modelled to establish peak stormwater flows and volumes prior to any development within this site. The existing drainage areas for this subwatershed (shown on Figure 2 & 2a) were determined from field investigation, recent topographic surveys. The stormwater drainage for the proposed development has been split into three outlets, as well as a combined flow outlet for the purpose of stormwater modelling. As seen on Figure 2, the majority of the existing site conveys stormwater flows to the Six Mile Creek Tributary at the north-eastern portion of the site which has been split into two stormwater outlets (Stormwater Outlet B and C) to more accurately depict upstream and downstream conditions within the tributary. Stormwater Outlet 'D' represents the combined flowrate from outlets 'B' and 'C' within the Six Mile Creek tributary. Figure 2a outlines the delineated upstream drainage area discharging to Outlet B at the Six Mile Creek Tributary.

Input parameters for the model for existing conditions are shown in Table 2, with stormwater flows and volumes outlined in Table 3. The SCS Curve Number chosen for this development represents the current vacant open space conditions for a B/C Soil Group.

### 3.3 Proposed Conditions

The future drainage areas for the proposed development, shown in Figure 3, were delineated and modelled to establish the stormwater peak flows and volumes once development has been completed at the proposed site. Input parameters for the computer model with the proposed development conditions are shown in Table 2.

<b>Table 2. Hydrologic Parameters</b>					
<b>Area No.</b>	<b>Area (ha)</b>	<b>Length (m)</b>	<b>Slope (%)</b>	<b>SCS CN</b>	<b>Percent Impervious</b>
<b>Existing Conditions</b>					
EX1	3.41	60	1.5	77	1.0%
EX2	1.86	60	2.0	77	3.2%
EX3	1.36	50	1.0	77	9.7%
EX4	8.14	400	1.0	77	1.0%
EX5	2.62	60	1.0	77	1.0%
EXT -E	54.09	900	1.0	77	3.0%
<b>71.48</b>		<b>Total Area</b>			
<b>Future Conditions</b>					
A1	1.28	50	1.0	77	26.2
A2	2.35	140	1.0	77	28.8
A3	0.85	40	1.0	77	23.6
A4	13.08	600	1.0	77	70.0
EXT-F	54.00	900	1.0	77	3.0%
<b>71.56</b>		<b>Total Area</b>			

Shown in Figures 2 and 3, peak stormwater flows and volumes have been calculated for three stormwater outlets under proposed and existing conditions. Stormwater Outlet 'A' represents stormwater flows being conveyed to the Main Branch of Six Mile Creek on the west limit of the site. Stormwater Outlets 'B' and 'C' both represent stormwater flows being directed to points along the Six Mile Creek tributary on the north-east portion of the site. Stormwater Outlet 'D' represents the combined peak stormwater flows from Outlets 'B' and 'C' within the Six Mile Creek tributary.

All stormwater flows conveyed to Stormwater Outlet 'A' under existing and proposed conditions are under sheet flow conditions from both Drainage Areas EX1 and A1. To model peak stormwater flows within the so named 'Six Mile Creek Tributary' on the north-east side of the site, the complete upstream drainage area has been delineated and noted as Drainage Area EXT (Figure 2a). For stormwater modelling of this development, Stormwater Outlet 'B' consists of the accumulation of peak stormwater flows from the upstream Drainage Area EXT in addition to Drainage Areas EX2, EX3 and EX4 under existing conditions and Drainage Areas A2 and A3 under proposed conditions.

Stormwater Outlet 'C' consists solely of Drainage Area EX5 under existing sheet flow conditions as well as outflows from the future SWM Facility as part of Drainage Area A4. This outlet has been denoted specifically to assist in specifying the location and quantity of flows discharging from both the future stormwater management facility and Drainage Area EX5. However, the calculations completed as part of this Stormwater Management Report have been conducted to ensure that peak stormwater flows at outlets A, B & D are maintained or are below existing conditions during the modelled storm events.

Under Existing Conditions (Figure 2), Drainage Areas EX1, EX4 & EX5 have all been attributed an imperviousness of 1.0% aligning with the open space conditions of these areas. A Weighted Impervious Calculation Sheet has been completed and included in Appendix A, detailing the calculations to determine the respective imperviousness levels of Drainage Areas EX2 & EX3. For the purpose of this report, Drainage Area EXT has been attributed an imperviousness of 3.0% aligning with general impervious level of the overly agricultural lands in this space.

Under Future Conditions (Figure 3), weighted impervious calculations were completed for Drainage Areas A1, A2 & A3 with Drainage Area EXT remaining at an estimated imperviousness of 3.0%. A general weighted Runoff Calculation was conducted to Drainage Area A4 determining an average Runoff Coefficient of 0.68 (67.9% impervious). This SWM Plan has conservatively attributed an imperviousness of 70% for Drainage Area A4. Due to the urbanization of Concession 7, Drainage Area EXT is minorly reduced from 54.09 to 54.00 hectares under future conditions, however it will be discussed as Drainage Area EXT under both existing and future conditions within this report.

The stormwater conditions have been modelled for the various articulated outlets as part of this Stormwater Management Plan with the results shown in Table 3 on the next page. The table is meant to outline the difference in peak flows and volumes at the various outlets under existing conditions as well as future conditions without the inclusion of peak flow quantity controls. Modelling has been conducted for the 2-, 5- and 100-year events for a 4-hour Chicago storm event as well as a 100-year, 24-hour Chicago storm event as requested by the Region of Niagara.

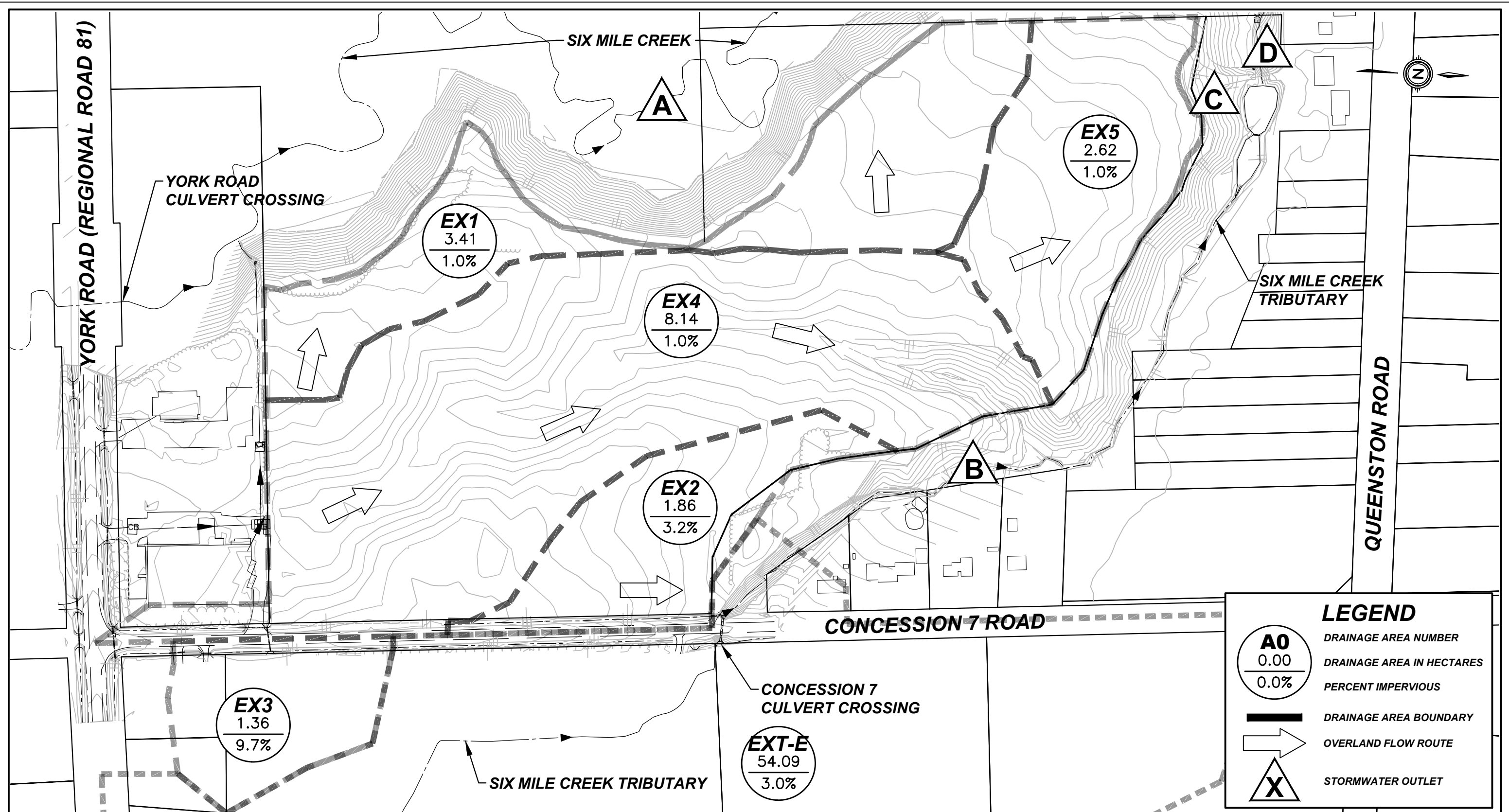
**Stormwater Management Plan**  
**Modero Estates - Town of Niagara-on-the-Lake**

<b>Table 3. Peak Flow and Volume for Future Development Conditions</b>						
<b>Outlet</b>	<b>Peak Flow (L/s)</b>			<b>Volume (m<sup>3</sup>)</b>		
	<b>Existing</b>	<b>Future*</b>	<b>Change</b>	<b>Existing</b>	<b>Future*</b>	<b>Change</b>
<b>2 Year Design Storm Event (4-hr Storm)</b>						
A	47	47	0%	295	186	-109
B	246	258	+5%	5959	5253	-706
C	33	981	+2,872%	227	3274	+3,047
D	261	1,239	+375%	6182	8526	+2,344
<b>5 Year Design Storm Event (4-hr Storm)</b>						
A	75	64	-15%	418	242	-176
B	402	346	-14%	8364	7318	-1,046
C	54	1,273	+2,257%	321	4,057	+3,736
D	419	1,619	+286%	8682	11,371	+2,689
<b>100 Year Design Storm Event (4-hr Storm)</b>						
A	244	120	-51%	975	480	-495
B	1,281	1,052	-19%	19,188	16,586	-2,602
C	177	2,497	+1,311%	748	6,999	+6,251
D	1,326	3,265	+146%	19,933	23,584	+3,651
<b>100 Year Design Storm Event (24-hr Storm)</b>						
A	395	171	-57%	2141	948	-1,193
B	2,055	1,682	-18%	41,765	35,844	-5,921
C	298	2566	+761%	1648	12,381	+10,733
D	2,125	3,595	+69%	43,408	48,226	+4,858
*Note: Future Flows in this table area calculated without peak flow quantity controls						

As seen above in Table 3, stormwater flows directed to Outlet A will remain the same or decrease during all storm events. Therefore, stormwater quantity controls will not be required for this outlet.

Stormwater flows conveyed to Outlet B will increase slightly during the 2-year design storm event, though will be reduced during all other storm events. Therefore, stormwater quantity controls will be required to ensure no significant increase in flows occur at Outlet B during the 2-year event.

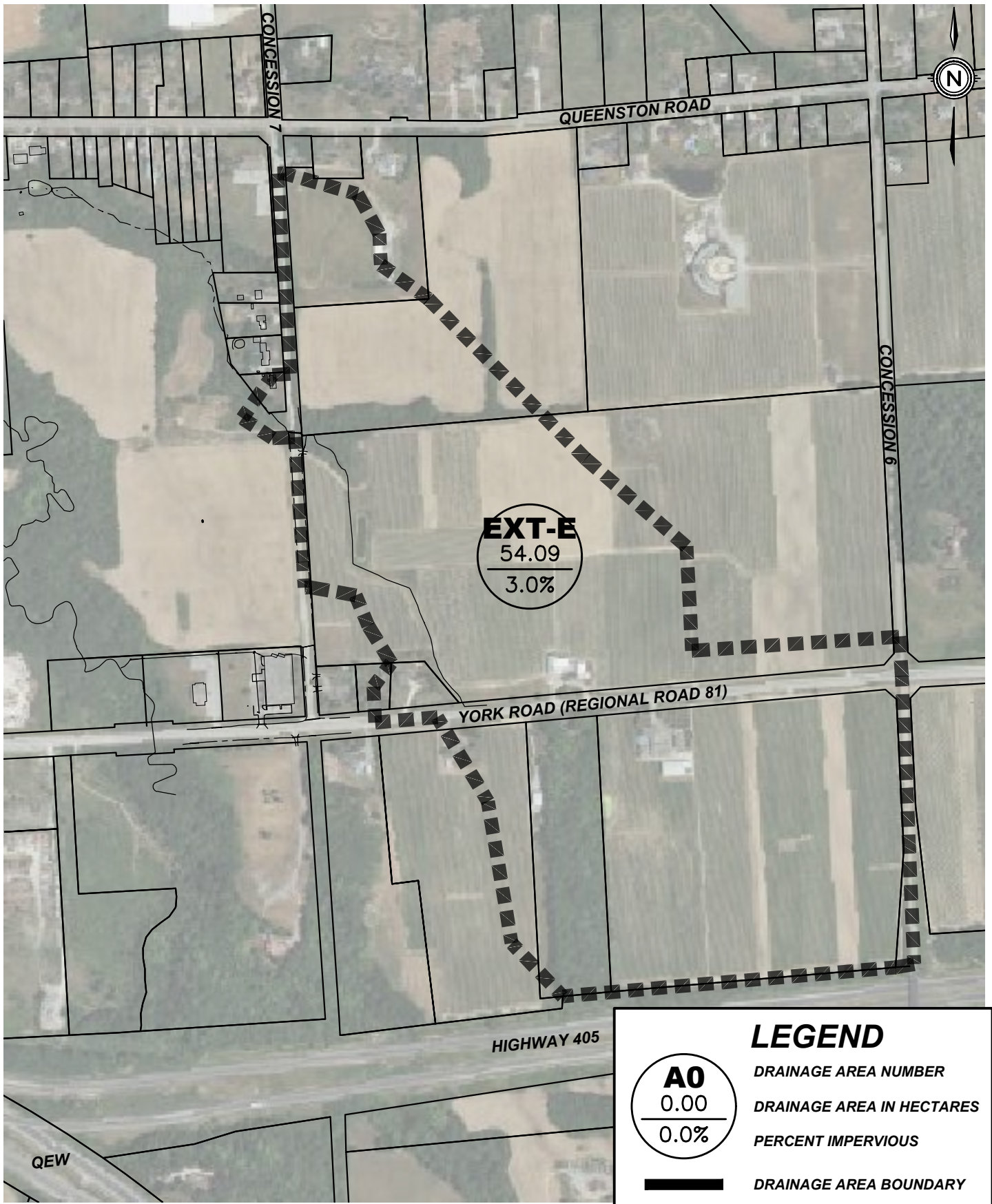
Outlet C has been included to outline the differential in peak flows due to the development, but does not represent flows within the adjacent Six Mile Creek watercourse. A significant increase is quantified at Outlet D under future conditions. Therefore, stormwater quantity controls will also be required for this outlet.




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**TOWN OF NIAGARA-ON-THE-LAKE**  
**EXISTING STORM DRAINAGE AREA PLAN**

DATE	2024-08-13
SCALE	1:2500 m
REF No.	2130
DWG No.	FIGURE 2



**LEGEND**

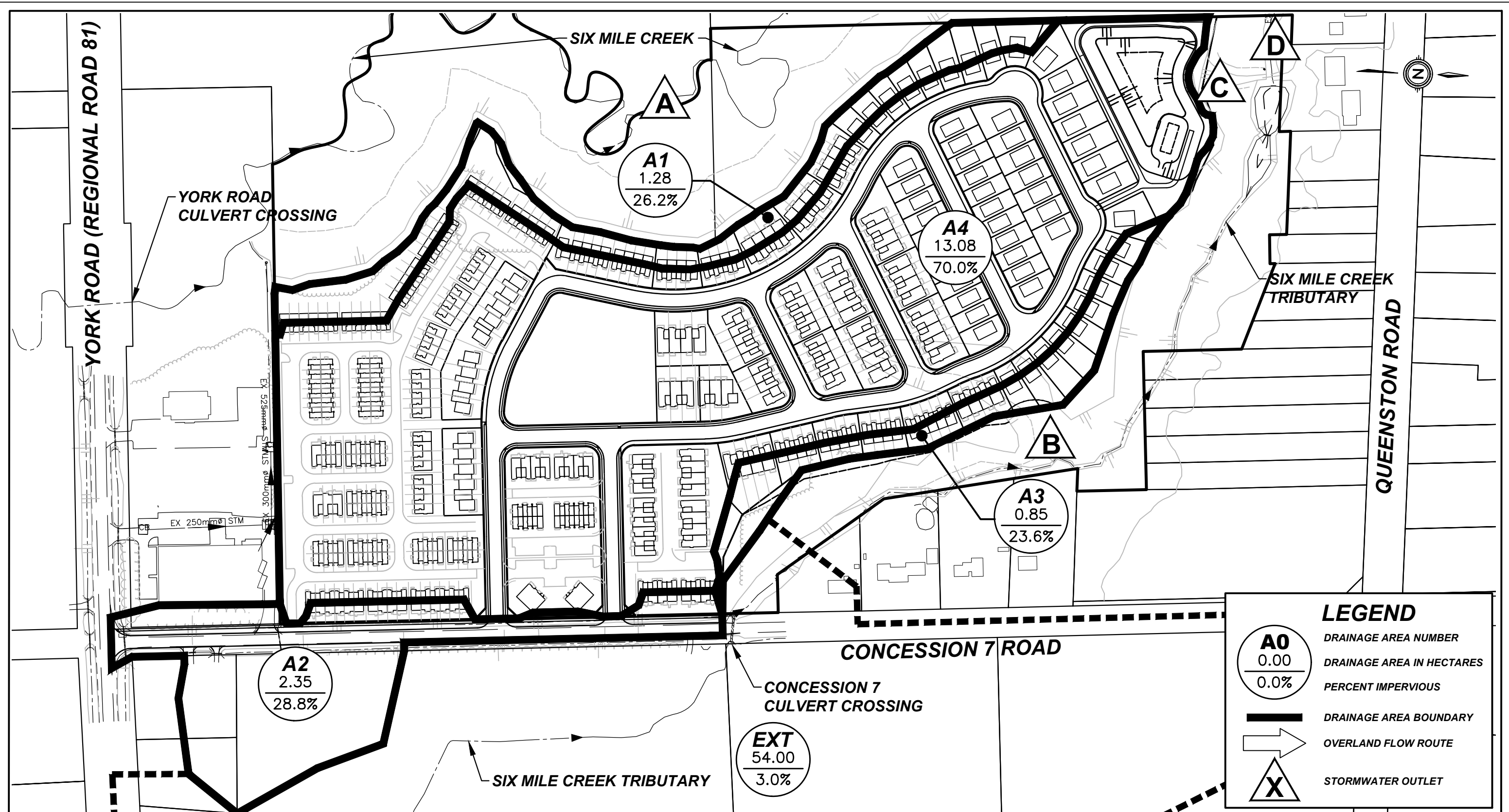
<b>A0</b>	<b>DRAINAGE AREA NUMBER</b>
0.00	<b>DRAINAGE AREA IN HECTARES</b>
0.0%	<b>PERCENT IMPERVIOUS</b>
	<b>DRAINAGE AREA BOUNDARY</b>



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**MODERO ESTATES SUBDIVISION**  
TOWN OF NIAGARA-ON-THE-LAKE  
**EXISTING UPSTREAM DRAINAGE AREA PLAN**

DATE	2025-03-13
SCALE	1:7,500 m
REF No.	2130
DWG No.	FIGURE 2a



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**CONCESSION 7 - HUMMEL**  
TOWN OF NIAGARA-ON-THE-LAKE  
**PROPOSED OVERALL STORM DRAINAGE AREA PLAN**

DATE	2024-08-13
SCALE	1:2500 m
REF No.	2130
DWG No.	FIGURE 3

## **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) Lot Level Controls

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) Vegetative Alternatives

Vegetative stormwater management practices 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.

c) Infiltration Alternatives

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) End-of-Pipe Alternatives

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**

Modero Estates	Criteria for Implementation of Stormwater Management Practices (SWMP)					Technical Effectiveness (10 high)	Recommend Implementation Yes / No	Comments
	Topography	Soils	Bedrock	Groundwater	Area			
Site Conditions	Variable 1 to 3%	Silty Sand ±13.3mm/hr	At Considerable Depth	At Considerable Depth	± 13.1ha			
<b>Lot Level Controls</b>								
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	Yes	Suitable site conditions
<b>Vegetative</b>								
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
<b>Infiltration</b>								
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
<b>Surface Storage</b>								
Dry Ponds	nlc	nlc	nlc	nlc	> 5 ha	7	No	No quality control
Wet Ponds	nlc	nlc	nlc	nlc	> 5 ha	9	Yes	Very effective quality control
Wetlands	nlc	nlc	nlc	nlc	> 5 ha	10	No	Very effective quality control
<b>Other</b>								
Oil/Grit Separator	nlc	nlc	nlc	nlc	<2 ha	3	Yes	Effective for Concession 7

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 **wet pond facility** to be constructed to provide stormwater quality enhancement for frequent storms.

## **5.0 STORMWATER MANAGEMENT PLAN**

A MIDUSS model was created to assess existing, future and ultimate development peak flows and stormwater volumes generated by the proposed subdivision. The stormwater management facility was sized according to MECP Guidelines (MECP, March 2003) as follows:

### **5.1 Modero Estates Stormwater Management Wet Pond Facility**

#### **5.1.1 Stormwater Quality Control**

The stormwater drainage outlet for the proposed development is Six Mile Creek, which has been identified by the Ministry of Natural Resources watercourse evaluation as a **Type 2** fish habitat. Based on this fish habitat, the corresponding MECP level of protection for stormwater management quality practices prior to discharging to this watercourse shall be *Normal*. However, due to the necessary geometry and dimensions, the proposed SWM facility will be able to provide *Enhanced* quality controls prior to discharge to Six Mile Creek. Based on Table 3.2 of SWMP & Design Manual, the water quality storage requirement is approximately 225m<sup>3</sup>/ha for *Enhanced* protection for developments with 70% impervious areas. The drainage area requiring stormwater quality improvement draining to the proposed facility is 13.08 hectares. The required and provided storage volumes for this facility are shown in Table 5.

<b>Table 5. Stormwater Quality Volume Calculations</b>	
<b>Total Water Quality Volume</b>	
= 13.08 ha x 225 m <sup>3</sup> /ha	Reference: Table 3.2, SWMP & Design Manual (MECP 2003)
= 2,943 m <sup>3</sup> (5,303m <sup>3</sup> provided)	
<b>Permanent Pool Volume</b>	<b>Extended Detention Volume</b>
= 13.08 ha x 185 m <sup>3</sup> /ha	= 13.08 ha x 40 m <sup>3</sup> /ha
= 2,420 m <sup>3</sup> (2,690m <sup>3</sup> provided)	= 523 m <sup>3</sup> (2,613m <sup>3</sup> provided)

### 5.1.2 Stormwater Quantity Control

As shown in the previous Table 3, stormwater management quantity controls are required to reduce the peak flows from the development area to existing conditions for 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 discharging from the proposed facility.

### 5.1.3 Stormwater Management Facility Configuration

As seen within the accompanying General Servicing Plan for the Modero Estates development, the layout of the stormwater management facility is providing a single sewer outlet to the existing watercourse, Six Mile Creek Tributary. Rear yards for the proposed dwellings backing on to the significant wetlands as part of Six Mile Creek and its' tributary will drain towards the wetlands.

It is proposed to construct a two-stage outlet for the proposed Stormwater Management (SWM) Facility. The first stage of control consists of a reverse slope pipe acting as a 127mm (5") diameter orifice to provide the required quality controls. The second stage of control consists of a ditch inlet catch basin and outlet pipe which provides an outlet for flows exceeding the extended detention volume. An emergency spillway will provide an outlet for flows exceeding the capacity of the ditch inlet catch basin and outlet pipe.

The proposed effective bottom elevation of the facility is 112.50m, and the permanent pool water level is 114.00m for a water depth of 1.5 metres. The configuration of the facility provides 2,690 m<sup>3</sup> of permanent pool volume, which is more than the required 2,420m<sup>3</sup>. The proposed top of pond is at an elevation of 115.50m which provides a total active volume of 6,484m<sup>3</sup>. The complete Stage-Storage-Discharge Calculation Table can be found in Appendix A.

The proposed facility has a single storm sewer inlet, therefore, the sediment forebay was designed to minimize the transport of heavy sediment from the storm sewer outlet throughout the facility and localize maintenance activities. Calculations for the forebay sizing follow MECP guidelines and are shown in Table 6.

<b>Table 6. Stormwater Management Facility Forebay Sizing</b>		
a) Forebay Settling Length (MOECC SWMP&D, Equation 4.5)		
$Settling\ Length = \sqrt{\frac{r * Q_p}{V_s}}$	$r = 2.2 :1$ $Q_p = 0.018\ m^3/s$ $V_s = 0.0003\ m/s$	(Length:Width Ratio) (25mm Storm Pond Discharge) (Settling Velocity)
Settling Length = <b>11.46 m</b>		
b) Dispersion Length (MOECC SWMP&D, Equation 4.6)		
$Dispersion\ Length = \frac{8 * Q}{D * V_f}$	$Q = 1.273\ m^3/s$ $D = 1.50\ m$ $V_f = 0.5\ m/s$	(5 Yr Stm Sew Design Inflow) (Depth of Forebay) (Desired Velocity)
Dispersion Length = <b>13.58 m</b>		
c) Minimum Forebay Deep Zone Bottom Width (MOECC SWMP&D, Equation 4.7)		
$Width = \frac{Dispersion\ Length}{8}$	$13.58\ m$	Minimum Forebay Length from Equations 3.3 and 3.4 (minimum required length)
Width = <b>1.70 m</b> (minimum required width)		
d) Average Velocity of Flow		
$Average\ Velocity = \frac{Q}{A}$	$Q = 0.580\ m^3/s$ $A = 22.50\ m^2$ $D = 1.50\ m$ $W = 10.50\ m$ $S = 3 :1$	(Quality Design Inflow) (Cross Sectional Area) (Depth of Forebay) (Proposed Bottom Width) (Side slopes - minimum)
Average Velocity = <b>0.03 m/s</b>		
Is this Acceptable? <b>Yes</b> (Maximum velocity of flow = 0.15 m/s)		
e) Cleanout Frequency		
Is this Acceptable? <b>Yes</b>	$L = 23.0\ m$ $ASL = 2.8\ m^3/ha$ $A = 13.08\ ha$ $FRC = 80\ %$ $FV = 649.1\ m^3$	(Proposed Bottom Length) (Annual Sediment Loading) (Drainage Area) (Facility Removal Efficiency) (Forebay Volume)
Cleanout Frequency = <b>14.2 years</b>		
Is this Acceptable? <b>Yes</b> (10 year minimum cleanout frequency)		

Based on the configuration of the proposed facility, it was determined that a 127mm (5”) diameter quality orifice shall provide 52.4 hours of detention (24-hour minimum required duration of detention). The rim elevation for the proposed ditch inlet catch basin is 114.70m and will provide an extended detention volume of 2,613m<sup>3</sup>, which is more than the required 523m<sup>3</sup>.

The outflow pipe from the stormwater management facility is to be 450mm in diameter and will convey the stormwater flows from the ditch inlet to the proposed headwall structure discharging to the Six Mile Creek tributary north of the development. A stage-storage-discharge relationship was determined for the facility and is included in Appendix A for reference purposes.

Overland flows from the development area shall be directed to the proposed stormwater management facility.

Table 7 summarizes the peak inflows and outflows (Outlet C) for the SWM Facility along with corresponding pond elevations and volumes. Based on the MIDUSS model, Table 7 shows the maximum wet pond elevation of 115.17m, and an active storage volume of 4,785 m<sup>3</sup> for the 4-hour 100-year design storm event. approximately 0.33m of free board will be provided by the stormwater management facility during this event.

<b>Table 7. Stormwater Management Wet Pond Facility Characteristics</b>				
<b>Design Storm (Return Period)</b>	<b>Peak Flows (L/s)</b>		<b>Maximum Elevation</b>	<b>Maximum Volume (m<sup>3</sup>)</b>
	<b>Inflow</b>	<b>Outflow</b>		
25mm	580	18	114.45	1,678
2 Year	981	38	114.73	2,749
5 Year	1,273	72	114.84	3,226
100 Year	2,497	226	115.17	4,785
100 Year (24 hr)	2,566	454	115.33	5,568

Therefore, the proposed Stormwater Management Facility has sufficient capacity for stormwater flows from the proposed development. As discussed previously, the SWM Facility does not restrict flows to levels based on Drainage Area EX5, though provides quantity controls to ensure peak flows at outlets B & D remain below existing levels. Table 9 further in this report outlines the combined impacts of this facility as well as the subsequently outlined Concession 7 controls on the overall peak stormwater flows within Six Mile Creek.

## **5.2 Concession 7 Stormwater Management Facility**

As part of the urbanization of Concession 7 in front of the proposed development site, a storm sewer will be constructed on Concession 7 discharging to the Six Mile Creek. The storm sewer will discharge at the location of existing culvert outlet for the Concession 7 roadside ditch, and immediately adjacent to the 1200mm diameter culvert crossing Concession 7 for the upstream lands.

During the stormwater modelling for this development and as concluded in Table 3, it was determined that peak flows within Outlet B (as part of the downstream Six Mile Creek watercourse from the Concession 7 outlet to the existing ponds) will experience greater than existing peak flow levels during the 2-year design storm event. Therefore, quantity controls are to be provided within the proposed Concession 7 storm sewer. Additionally, as required by the MECP for the urbanization of roads, quality controls will also be required.

### 5.2.1 Stormwater Quantity Control

For the Concession 7 storm sewer, an orifice and underground pipe storage will provide the necessary quantity controls. As outlined in Figure 3, the storm sewer will provide an outlet for stormwater flows from Drainage Area A2 – an area of 2.35 hectares at an imperviousness of 28.8%.

A 150mm (6”) diameter orifice will be utilized to restrict peak stormwater flows discharging from the storm sewer. The orifice will be incorporated into the design of the Hydroworks HydroDome HD4 Oil/Grit Separator to be constructed as part of STM MH 55. A Stage-Storage-Discharge Calculation Sheet has been included in Appendix A.

The storm sewers will be constructed to provide adequate capacity for the stormwater flows during the 5-year design storm event. As well, the drainage areas within the STMDA Plan (2130-STMDA) for the Concession 7 storm sewers have been extended further into the adjacent easterly property to remain conservative in the sizing. However, Drainage Area A2 on Figure 3, is an accurate representation of the drainage area for the Concession 7 storm sewer system. The single length of 825mm diameter storm sewer immediately upstream of the control (MH 55) has been upsized to provide sufficient stormwater storage to accommodate the additional volume during the necessary storm events.

Table 8 below outlines the future peak flows and volumes to be experienced by the Stormwater Management System during the various storm events.

<b>Design Storm (Return Period)</b>	<b>Peak Flows (L/s)</b>		<b>Maximum Elevation</b>	<b>Maximum Volume (m<sup>3</sup>)</b>
	<b>Inflow</b>	<b>Outflow</b>		
2 Year	93	59	119.76	30
5 Year	114	68	120.30	42

As noted above, during the 5-year event, stormwater levels will remain below the lowest catch basin rim elevation of 120.60 located immediately upstream of the control manhole. It is expected that during major storm events, stormwater flows unable to pass through the control orifice will surcharge out of the adjacent catch basins on Concession 7 and flow to the Six Mile Creek. Due to the slope of Concession 7, all extreme overland flows will be directed northerly to the Six Mile Creek crossing. As well, the depth of the storm sewers will ensure no significant surcharging occurs at the upstream end of the storm sewer system. A stage-storage relationship is in Appendix A.

Table 9 in the next section provides a summary of total peak flows in Six Mile Creek.

### 5.2.2 Stormwater Quality Control

To improve stormwater quality levels from this development site, an oil/grit separator (OGS) is typically proposed. For MECP Normal Protection, oil/grit separators are required to provide a minimum average of 70% TSS removal. The contributing drainage area to the proposed OGS is 2.35 hectares at conservatively utilized impervious coverage of 30%. The modelling for a Hydroworks Unit has indicated that an HD4 oil/grit separator unit will provide 76.8% TSS overall removal and capture 99.3% of the stormwater flows. Therefore, the Hydroworks HD4 is proposed for this outlet. All calculations regarding the quality assessment and sample inspection report can be found in Appendix C.

### 5.3 Six Mile Creek Peak Flow Summary

The following table provides a summary of peak stormwater flows within Six Mile Creek at the denoted outlets under existing and future conditions. As noted previously in Table 3, stormwater flows conveyed overland to Outlet A will be reduced from existing conditions and have therefore been excluded from this table. Additionally, peak outflows at Outlet C were denoted in Table 7 and do not represent total flows within the Six Mile Creek and have also been omitted from Table 9.

<b>Table 9. Impacts of Wet Pond Facility on Peak Flows</b>			
<b>Outlet</b>	<b>Peak Flow (L/s)</b>		
	<b>Existing</b>	<b>Future with SWM</b>	<b>Change*</b>
2 Year Design Storm Event			
B	246	245	-0.4%
D	261	258	-1.1%
5 Year Design Storm Event			
B	402	328	-18.4%
D	419	395	-5.7%
100 Year Design Storm Event – 4 Hour			
B	1,281	1,065	-16.9%
D	1,326	1,277	-3.7%
100 Year Design Storm Event – 24 Hour			
B	2,055	1,687	-17.9%
D	2,125	2,122	-0.1%
<b>Note:</b> *indicates the percent change between existing conditions and future conditions with stormwater management controls in place.			

Per Table 9 above, peak stormwater flow rates at both sections within the Six Mile Creek will remain the same or reduce from existing flows rates under post-development conditions during the various storm events. Therefore, the proposed stormwater management plan will be acceptable for this development.

## **6.0 SEDIMENT AND EROSION CONTROL**

Sediment and erosion controls are required during all construction phases of this development to limit the transport of sediment into the Six Mile Creek Tributary.

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

- Install silt control fencing along the limits of construction of the development to collect sediment in overland flows before discharging to downstream systems. The silt control fence installed along east end of site will be installed along the wetland buffer to act as the limit of construction.
- 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 Wetpond Facility**

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

The wet pond 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 wet pond 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 wet pond 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 wet pond are operating improperly, such as the detention times may be inadequate or excessive.
- c) The accumulation of sediment and debris at the wet pond inlet sediment forebay or around the high water line of the wet pond should be inspected. This will indicate the need for sediment removal or debris clean up.
- d) The wet pond 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 cleanup, 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.

## **7.2 Oil/Grit Separator**

The function of the proposed stormwater quality protection facility, a stormwater oil/grit separator, will require maintenance on an annual basis. The following is a summary of the maintenance activities required.

Regular inspections of the stormwater Maintenance Hole (MH) oil/grit interceptor will indicate whether maintenance is required or not. They should be made after every significant storm during the first two years of operation to ensure that it is functioning properly. This will translate into an average of six inspections per year.

Points of regular inspections are as follows:

- a) Is there sediment in the separator sump? The level of sediment can be measured from the surface without entry into the oil/grit separator via a dipstick tube equipped with a ball valve (Sludge Judge) or with a graduated pole with a flat plate attached to the bottom.
- b) Is there oil in the separator sump? This can be checked from the surface by inserting a

- dipstick in the 150mm vent tube. The presence of oil is usually indicated by an oily sheen, frothing or unusual colouring. The separator should be cleaned in the event of a major spill contamination.
- c) Is there debris or trash at the inlet weir and drop pipe? This can be observed from the surface without entry into the separator. Clogging at the inlet drop pipe will cause stormwater to bypass the sedimentation section and continue downstream without treatment.
  - d) Completion of the Inspection Report (a sample report is included in Appendix C for reference purposes). These reports will provide details about the operation and maintenance requirements for this type of stormwater quality device. After an evaluation period (usually 2 years) this information will be used to maximize efficiency and minimize the costs of operation and maintenance for the maintenance hole oil/grit separator.

Typically, stormwater MH oil/grit separators are cleaned out using vacuum pumping. No entry into the unit is required for maintenance. Cleaning should occur annually or whenever the accumulation reaches sediment storage specified by the manufacturer and after any major spills have occurred. Oil levels greater than 2.5 centimeters should be removed immediately by a licensed waste management firm.

Generally, the sediment removed from the separator 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. The Ministry of Environment, Conservation and Parks publishes sediment disposal guidelines which should be consulted for up-to-date information pertaining to the exact parameters and acceptable levels for the various disposal options. The preferred option is an off-site disposal, arranged by a licensed waste management firm.

The future owners of a Hydroworks facility are provided with an Owner's Manual upon installation, which explains the function, maintenance requirements and procedures for the facility with extensive use. It is recommended to follow the manufacturer's instructions to allow the oil/grit separator to perform as intended. A Sample Oil/Grit Separator Inspection Report has been included in Appendix C.

## **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.
- The proposed Stormwater Management Wetpond Facility will provide stormwater quality controls to *Enhanced* Protection levels and quantity controls for the approximately 13.08-hectare catchment area within the Modero Estates development.
- Further quantity controls will be provided by a combination of 150mm diameter orifice and storm sewer storage within the proposed Concession 7 storm sewer. A Hydrowork HD4 Oil/Grit Separator will provide quality controls to *Normal* Protection levels.
- 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".

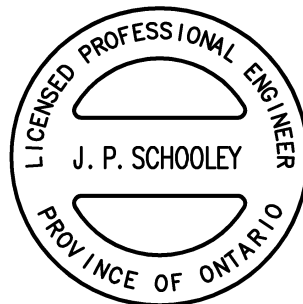
The above conclusions lead to the following recommendations:

- That the stormwater management criteria established in this report be accepted.
- That the Stormwater Management Facilities outlined in this report be constructed to provide stormwater quality protection to MECP *Normal* Protection levels and quantity controls to allowable levels.
- That additional lot level controls and vegetative stormwater management practices as described previously in this report be implemented.

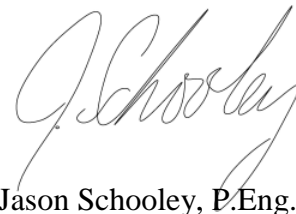
Prepared By:



Kurt Tiessen  
Revised March 13, 2025



Reviewed By:



Jason Schooley, P.Eng.

**APPENDICES**

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**APPENDIX A**

**Weighted Impervious Calculation Sheet**  
**Stormwater Management Facility – Wet Pond Calculations**  
**Stormwater Management Facility – Concession 7 Storm Sewer Calculations**

## Weighted Imperviousness Percentage Calculation Worksheet

Project Name: MODERO ESTATES  
 Project Number: 2130  
 Date: AUGUST 2024  
 Person: K.Tiessen

### EX2 - TO TRIBUTARY

	<i>Footprint</i>	<i>Imperviousness</i>	<i>Effective Impervious Area</i>
Roadway	600.0 m <sup>2</sup>	100%	600.0 m <sup>2</sup>
Green Space/Agricultural Lands	17988.7 m <sup>2</sup>	0%	0.0 m <sup>2</sup>
<b>TOTAL CATCHMENT IMPERVIOUS AREAS</b>			600 m <sup>2</sup>
<b>TOTAL CATCHMENT AREA</b>			18,589 m <sup>2</sup>
<b>EFFECTIVE PERCENT IMPERVIOUS</b>			<b>3.2%</b>

### EX3 - TO TRIBUTARY

	<i>Footprint</i>	<i>Imperviousness</i>	<i>Effective Impervious Area</i>
Roadway/Driveway	890.0 m <sup>2</sup>	100%	890.0 m <sup>2</sup>
Roof Top	445.0 m <sup>2</sup>	100%	445.0 m <sup>2</sup>
Green Space/Agricultural Lands	12232.6 m <sup>2</sup>	0%	0.0 m <sup>2</sup>
<b>TOTAL CATCHMENT IMPERVIOUS AREAS</b>			1,335 m <sup>2</sup>
<b>TOTAL CATCHMENT AREA</b>			13,568 m <sup>2</sup>
<b>EFFECTIVE PERCENT IMPERVIOUS</b>			<b>9.8%</b>

### A1 - PROPOSED CONDITIONS

	<i>Footprint</i>	<i>Imperviousness</i>	<i>Effective Impervious Area</i>
Roof Top	3365.0 m <sup>2</sup>	100%	3365.0 m <sup>2</sup>
Landscape/Greenspace	9482.7 m <sup>2</sup>	0%	0.0 m <sup>2</sup>
<b>TOTAL CATCHMENT IMPERVIOUS AREAS</b>			3,365 m <sup>2</sup>
<b>TOTAL CATCHMENT AREA</b>			12,848 m <sup>2</sup>
<b>EFFECTIVE PERCENT IMPERVIOUS</b>			<b>26.2%</b>

### A2 - PROPOSED CONDITIONS FOR CONCESSION 7

	<i>Footprint</i>	<i>Imperviousness</i>	<i>Effective Impervious Area</i>
Sidewalk	570.0 m <sup>2</sup>	100%	570.0 m <sup>2</sup>
Asphalt Roadway/Driveway Aprons	4485.0 m <sup>2</sup>	100%	4485.0 m <sup>2</sup>
Buildings	1708.5 m <sup>2</sup>	100%	1708.5 m <sup>2</sup>
Landscape/Greenspace	16722.5 m <sup>2</sup>	0%	0.0 m <sup>2</sup>
<b>TOTAL CATCHMENT IMPERVIOUS AREAS</b>			6,764 m <sup>2</sup>
<b>TOTAL CATCHMENT AREA</b>			23,486 m <sup>2</sup>
<b>EFFECTIVE PERCENT IMPERVIOUS</b>			<b>28.8%</b>

### A3 - PROPOSED CONDITIONS

	<i>Footprint</i>	<i>Imperviousness</i>	<i>Effective Impervious Area</i>
Roof Top	2012.0 m <sup>2</sup>	100%	2012.0 m <sup>2</sup>
Landscape/Greenspace	6497.6 m <sup>2</sup>	0%	0.0 m <sup>2</sup>
<b>TOTAL CATCHMENT IMPERVIOUS AREAS</b>			2,012 m <sup>2</sup>
<b>TOTAL CATCHMENT AREA</b>			8,510 m <sup>2</sup>
<b>EFFECTIVE PERCENT IMPERVIOUS</b>			<b>23.6%</b>

## Weighted Imperviousness Percentage Calculation Worksheet

Project Name: MODERO ESTATES  
 Project Number: 2130  
 Date: MARCH 2025  
 Person: K.Tiessen

<b>Block 82 Condo</b>	<i>Footprint</i>	<i>Imperviousness</i>	<i>Effective Impervious Area</i>
Impervious - Buildings, Sidewalk, Roadway, etc.	5005.9 m <sup>2</sup>	100%	5005.9 m <sup>2</sup>
Pervious - Landscape, etc.	3158.7 m <sup>2</sup>	0%	0.0 m <sup>2</sup>
<b>TOTAL CATCHMENT IMPERVIOUS AREAS</b>			5,006 m <sup>2</sup>
<b>TOTAL CATCHMENT AREA</b>			8,165 m <sup>2</sup>
		<b>EFFECTIVE IMPERVIOUSNESS</b>	<b>61.3%</b>
		<b>EFFECTIVE RUNOFF COEFFICIENT</b>	<b>0.63</b>

<b>Block 83 Condo</b>	<i>Footprint</i>	<i>Imperviousness</i>	<i>Effective Impervious Area</i>
Impervious - Buildings, Sidewalk, Roadway, etc.	5305.6 m <sup>2</sup>	100%	5305.6 m <sup>2</sup>
Pervious - Landscape, etc.	2080.7 m <sup>2</sup>	0%	0.0 m <sup>2</sup>
<b>TOTAL CATCHMENT IMPERVIOUS AREAS</b>			5,306 m <sup>2</sup>
<b>TOTAL CATCHMENT AREA</b>			7,386 m <sup>2</sup>
		<b>EFFECTIVE IMPERVIOUSNESS</b>	<b>71.8%</b>
		<b>EFFECTIVE RUNOFF COEFFICIENT</b>	<b>0.70</b>

<b>Block 84 Condo</b>	<i>Footprint</i>	<i>Imperviousness</i>	<i>Effective Impervious Area</i>
Impervious - Buildings, Sidewalk, Roadway, etc.	22895.7 m <sup>2</sup>	100%	22895.7 m <sup>2</sup>
Pervious - Landscape, etc.	7481.8 m <sup>2</sup>	0%	0.0 m <sup>2</sup>
<b>TOTAL CATCHMENT IMPERVIOUS AREAS</b>			22,896 m <sup>2</sup>
<b>TOTAL CATCHMENT AREA</b>			30,378 m <sup>2</sup>
		<b>EFFECTIVE IMPERVIOUSNESS</b>	<b>75.4%</b>
		<b>EFFECTIVE RUNOFF COEFFICIENT</b>	<b>0.73</b>

<b>A4 - MODERO ESTATES</b>	<i>Footprint</i>	<i>Runoff Coefficient</i>	<i>Effective Impervious Area</i>
Park	7698.0 m <sup>2</sup>	0.25	1924.5 m <sup>2</sup>
Singles	24916.0 m <sup>2</sup>	0.65	16195.4 m <sup>2</sup>
Townhouses/Condos	90905.6 m <sup>2</sup>	0.70	63633.9 m <sup>2</sup>
Pond	7290.4 m <sup>2</sup>	0.90	6561.4 m <sup>2</sup>
<b>TOTAL CATCHMENT IMPERVIOUS AREAS</b>			88,315 m <sup>2</sup>
<b>TOTAL CATCHMENT AREA</b>			130,810 m <sup>2</sup>
		<b>EFFECTIVE RUNOFF COEFFICIENT</b>	<b>0.68</b>
		<b>EFFECTIVE IMPERVIOUSNESS</b>	<b>67.9%</b>

Upper Canada Consultants  
 30 HANNOVER DRIVE, UNIT 3  
 St. Catharines, Ontario L2W 1A3  
 PROJECT NAME: MODERO ESTATES  
 PROJECT NO.: 2130

DATE: AUGUST 2024

**STORMWATER MANAGEMENT FACILITY WETPOND**

Quality Requirements	Quality Orifice	Ditch Inlet Weir	Outflow Pipe Orifice	Overflow Spillway
Drainage Area (ha) = 13.08	Diameter (m) = 0.127	Length (m) = 0.60	Diameter (m) = 0.450	Minor Length (m) = 0.75
Enhanced (m <sup>3</sup> /ha) = 225	(@ 70% Imp) Cd = 0.63	Width (m) = 0.60	Cd = 0.63	Slopes (X:1) = 1.00
Perm Pool (m <sup>3</sup> /ha) = 185	Invert (m) = 114.00	Grate Slope (X:1) = 4	Invert (m) = 114.00	Minor Invert (m) = 115.15
Perm Pool Vol (m <sup>3</sup> ) = 2,420		Inlet Elevation (m) = 114.70	Overt (m) = 114.45	Major Length (m) = 1.45
Active Vol (m <sup>3</sup> ) 523		Cd = 1.84		Major Invert (m) = 155.50
<b>Perm. Pool Elev. = 114.00</b>	m			

Elevation	Increment Depth (m)	Active Depth (m)	Surface Area (m <sup>2</sup> )	Average Surface Area (m <sup>2</sup> )	Increment Volume (m <sup>3</sup> )	Permanent Volume (m <sup>3</sup> )	Active Volume (m <sup>3</sup> )	Quality Orifice (m <sup>3</sup> /s)	Ditch Inlet (m <sup>3</sup> /s)	Max Pipe Orifice (m <sup>3</sup> /s)	Overflow Spillway (m <sup>3</sup> /s)	Total Outflow (m <sup>3</sup> /s)	Average Discharge (m <sup>3</sup> /s)	Time (hrs)
<b>112.50</b>		-1.50	<b>1,079</b>			0								
	0.50			1,292	646									
113.00		-1.00	1,504			646								
	1.00			2,044	2,044									
<b>114.00</b>		0.00	<b>2,584</b>			<b>2,690</b>								
	0.00													
114.00		0.00	3,209				0.0	0.000	0.000	0.00	0.000	0.00	0.014	0.0
	0.70			3,733	2,613									
114.70		0.70	4,257				2613.1	0.028	0.000	0.28	0.000	0.028	0.076	<b>52.4</b>
	0.30			4,472	1,342									
115.00		1.00	4,687				3954.7	0.034	0.091	0.371	0.000	0.125	0.164	66.8
	0.15			4,797	720									
115.15		1.15	4,908				4674.4	0.036	0.167	0.409	0.000	0.203	0.255	74.7
	0.10			4,982	498									
115.25		1.25	5,056				5172.6	0.038	0.225	0.433	0.044	0.308	0.550	80.3
	0.25			5,246	1,311									
115.50		1.50	5,435				6484.0	0.042	0.395	0.486	0.356	0.793		83.6

- 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 calculated 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 trapezoidal 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.

Underground Superpipe Stage Storage Discharge Calculations											
Project Name:		Concession 7 Road									
Project No.:		2130									
Date:		OCTOBER 2024									
Controlling Rim Elev:		MH 54 TO MH 55			CB to Sewer		TOTAL STORAGE VOLUME		Orifice	Slot Weir	Total Outflow
120.60		Pipe	MH 55	MH 54	Pipe	CB			Dia (m) = 0.150	Width (m) = 8.500	
Invert:		119.21	118.06	119.73	119.40	119.40	ROADWAY VOLUME		Cd = 0.60	Invert (m) = 120.60	
Pipe Diameter:		0.838			0.200						
Structure/Pipe Length:		69.9	1500	1500	7.20	100x600mm					
Elevation (m)		(m <sup>3</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )	(m <sup>3</sup> )	Total (m <sup>3</sup> )	Orifice (m <sup>3</sup> /s)	Slot Weir (m <sup>3</sup> /s)	(L/s)	
120.70		38.55	4.67	1.71	0.23	0.94	8.70	54.8	0.075	0.495	569.4
120.65		38.55	4.58	1.63	0.23	0.90	4.35	50.2	0.074	0.175	249.0
120.60		38.55	4.49	1.54	0.23	0.86		45.7	0.073	0.000	73.4
120.50		38.55	4.31	1.36	0.23	0.79		45.2	0.072	-	71.9
120.40		38.55	4.14	1.18	0.23	0.72		44.8	0.070	-	70.3
120.30		38.55	3.96	1.01	0.23	0.65		44.4	0.069	-	68.7
120.20		38.55	3.78	0.83	0.23	0.58		44.0	0.067	-	67.1
120.10		38.55	3.60	0.65	0.23	0.50		43.5	0.065	-	65.4
120.00		37.67	3.43	0.48	0.23	0.43		42.2	0.064	-	63.7
119.90		33.96	3.25	0.30	0.23	0.36		38.1	0.062	-	62.0
119.80		29.01	3.07	0.12	0.23	0.29		32.7	0.060	-	60.2
119.70		23.42	2.90	-	0.23	0.22		26.8	0.058	-	58.3
119.60		17.58	2.72	-	0.23	0.14		20.7	0.056	-	56.4
119.50		11.84	2.54	-	0.11	0.07		14.6	0.054	-	54.4
119.40		6.56	2.37	-	-	-		8.9	0.052	-	52.3
119.30		2.23	2.19	-	-	-		4.4	0.050	-	50.2
119.20		-	2.01	-	-	-		2.0	0.048	-	47.9
119.10		-	1.84	-	-	-		1.8	0.046	-	45.5
119.00		-	1.66	-	-	-		1.7	0.043	-	43.1
118.90		-	1.48	-	-	-		1.5	0.040	-	40.4
118.80		-	1.31	-	-	-		1.3	0.038	-	37.6
118.70		-	1.13	-	-	-		1.1	0.035	-	34.5
118.60		-	0.95	-	-	-		1.0	0.031	-	31.2
118.50		-	0.78	-	-	-		0.8	0.027	-	27.4
118.40		-	0.60	-	-	-		0.6	0.023	-	23.0
118.30		-	0.42	-	-	-		0.4	0.018	-	17.6
118.20		-	0.25	-	-	-		0.2	0.009	-	9.4
118.10		-	0.07	-	-	-		0.1	-	-	-

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**APPENDIX B**  
**MIDUSS Output Files**

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

### Existing Conditions

					.027	.000	.192	.192 c.m/s
					.224	.853	.244	C perv/imperv/total
				15	ADD RUNOFF			
					.027	.027	.192	.192 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
					.027	.027	.027	.192 c.m/s
				17	COMBINE			
					1			Junction Node No.
					.027	.027	.027	.201 c.m/s
				14	START			
					1			1=Zero; 2=Define
				35	COMMENT			
					1			line(s) of comment
								** EXTERNAL DRAINAGE AREA EX3 TO EX4 *****
				35	CATCHMENT			
					4			ID No.6 99999
					3.000			Area in hectares
					1.360			Length (PERV) metres
					50.000			Gradient (%)
					1.000			Per cent Impervious
					9.800			Length (IMPERV)
					50.000			%Imp. with Zero Dpth
					.000			Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
					1			Manning "n"
					.250			SCS Curve No or C
					77.000			Ia/S Coefficient
					.100			Initial Abstraction
					7.587			Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
					1			.022
					.022	.000	.027	.201 c.m/s
					.225	.851	.286	C perv/imperv/total
				15	ADD RUNOFF			
					.022	.022	.027	.201 c.m/s
				35	COMMENT			
					1			line(s) of comment
								** EXTERNAL DRAINAGE AREA EX4 TO EAST - OUTLET B *****
				35	CATCHMENT			
					4			ID No.6 99999
					4.000			Area in hectares
					8.140			Length (PERV) metres
					400.000			Gradient (%)
					1.000			Per cent Impervious
					400.000			Length (IMPERV)
					.000			%Imp. with Zero Dpth
					1			Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
					.250			Manning "n"
					77.000			SCS Curve No or C
					.100			Ia/S Coefficient
					7.587			Initial Abstraction
					1			Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
					.043	.022	.027	.201 c.m/s
					.225	.861	.231	C perv/imperv/total
				15	ADD RUNOFF			
					.043	.052	.027	.201 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
					.043	.052	.052	.201 c.m/s
				35	COMMENT			
					1			line(s) of comment
								COMBINED VALUE BELOW IS EXISTING OUTFLOW TO OUTLET B
				17	COMBINE			
					1			Junction Node No.
					.043	.052	.052	.245 c.m/s
				27	HYDROGRAPH DISPLAY			
					7			is # of Hyeto/Hydrograph chosen
								Volume = .5959073E+04 c.m
				14	START			
					1			1=Zero; 2=Define
				35	COMMENT			
					1			line(s) of comment
								** DRAINAGE AREA EX5 TO EAST - OUTLET C *****
				4	CATCHMENT			
					5.000			ID No.6 99999
					2.620			Area in hectares
					60.000			Length (PERV) metres
					1.000			Gradient (%)
					1.000			Per cent Impervious
					60.000			Length (IMPERV)
					.000			%Imp. with Zero Dpth
					1			Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
					.250			Manning "n"
					77.000			SCS Curve No or C
					.100			Ia/S Coefficient
					7.587			Initial Abstraction
					1			Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
					.192	.000	.000	.000 c.m/s
					.225	.863	.244	C perv/imperv/total
				15	ADD RUNOFF			
					.192	.192	.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
					.192	.192	.192	.000 c.m/s
				17	COMBINE			
					1			Junction Node No.
					.192	.192	.192	.192 c.m/s
				14	START			
					1			1=Zero; 2=Define
				35	COMMENT			
					1			line(s) of comment
								** DRAINAGE AREA EX2 TO EAST *****
				4	CATCHMENT			
					2.000			ID No.6 99999
					1.860			Area in hectares
					60.000			Length (PERV) metres
					2.000			Gradient (%)
					3.200			Per cent Impervious
					60.000			Length (IMPERV)
					.000			%Imp. with Zero Dpth
					1			Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
					.250			Manning "n"
					77.000			SCS Curve No or C
					.100			Ia/S Coefficient
					7.587			Initial Abstraction
					1			Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
					.033	.000	.052	.245 c.m/s
					.225	.853	.231	C perv/imperv/total
				27	HYDROGRAPH DISPLAY			
					4			is # of Hyeto/Hydrograph chosen
								Volume = .2265578E+03 c.m
				15	ADD RUNOFF			
					.033	.033	.052	.245 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
					.033	.033	.033	.245 c.m/s
				17	COMBINE			
					1			Junction Node No.
					.033	.033	.033	.261 c.m/s
				35	COMMENT			
					1			line(s) of comment
								CONFLUENCE VALUE BELOW IS TOTAL EX OUTFLOW TO EAST CREEK - D
				18	CONFLUENCE			

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

```

1 Junction Node No.
.033 .033 .000 c.m/s
27 HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .6182399E+04 c.m
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
*****
** 5 YEAR DESIGN STORM EVENT *****
*****
2 STORM
1 1=Chicago;2=Huff;3=User;4=Cdnlhr;5=Historic
664.000 Coefficient a
4.700 Constant b (min)
.744 Exponent c
.450 Fraction to peak r
240.000 Duration δ 1440 min
44.365 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
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
***** DRAINAGE AREA EX1 - TO WEST, OUTLET A *****
4 CATCHMENT
1.000 ID No.δ 99999
3.410 Area in hectares
60.000 Length (PERV) metres
1.500 Gradient (%)
1.000 Per cent Impervious
60.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.075 .000 .033 .000 c.m/s
.271 .872 .277 C perv/imperv/total
27 HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .4184780E+03 c.m
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
***** DRAINAGE AREA EXT-E *****
4 CATCHMENT
2.000 ID No.δ 99999
54.090 Area in hectares
900.000 Length (PERV) metres
1.000 Gradient (%)
3.000 Per cent Impervious
900.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.316 .000 .033 .000 c.m/s
.271 .883 .289 C perv/imperv/total
15 ADD RUNOFF
.316 .316 .033 .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
.316 .316 .316 .000 c.m/s
17 COMBINE
1 Junction Node No.
.316 .316 .316 .316 c.m/s
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** DRAINAGE AREA EX2 TO EAST *****
4 CATCHMENT
2.000 ID No.δ 99999
1.860 Area in hectares
60.000 Length (PERV) metres
2.000 Gradient (%)
3.200 Per cent Impervious
60.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.047 .000 .316 .316 c.m/s
.270 .871 .289 C perv/imperv/total
15 ADD RUNOFF
.047 .047 .316 .316 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
.047 .047 .047 .316 c.m/s
17 COMBINE
1 Junction Node No.
.047 .047 .047 .047 c.m/s
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** DRAINAGE AREA EX3 TO EX4 *****
4 CATCHMENT
3.000 ID No.δ 99999
1.360 Area in hectares
50.000 Length (PERV) metres
1.000 Gradient (%)
9.800 Per cent Impervious
50.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.032 .000 .047 .327 c.m/s
.271 .872 .329 C perv/imperv/total
15 ADD RUNOFF
.032 .032 .047 .327 c.m/s
35 COMMENT
1 line(s) of comment
** EXTERNAL DRAINAGE AREA EX4 TO EAST - OUTLET B *****
4 CATCHMENT
4.000 ID No.δ 99999
8.140 Area in hectares
400.000 Length (PERV) metres
1.000 Gradient (%)
1.000 Per cent Impervious
400.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.071 .032 .047 .327 c.m/s
.271 .873 .277 C perv/imperv/total
15 ADD RUNOFF
.071 .084 .047 .327 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
.071 .084 .084 .327 c.m/s
35 COMMENT
1 line(s) of comment
COMBINED VALUE BELOW IS EXISTING OUTFLOW TO OUTLET B
17 COMBINE
1 Junction Node No.
.071 .084 .084 .402 c.m/s
27 HYDROGRAPH DISPLAY
7 is # of Hyeto/Hydrograph chosen
Volume = .8364115E+04 c.m
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** DRAINAGE AREA EX5 TO EAST - OUTLET C *****
4 CATCHMENT
5.000 ID No.δ 99999
2.620 Area in hectares
60.000 Length (PERV) metres
1.000 Gradient (%)
1.000 Per cent Impervious
60.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.054 .000 .084 .402 c.m/s
.270 .870 .276 C perv/imperv/total
27 HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .3211979E+03 c.m
15 ADD RUNOFF
.054 .054 .084 .402 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
.054 .054 .054 .402 c.m/s
17 COMBINE
1 Junction Node No.
.054 .054 .054 .419 c.m/s
35 COMMENT
1 line(s) of comment
CONFLUENCE VALUE BELOW IS TOTAL EX OUTFLOW TO EAST CREEK - D
18 CONFLUENCE
1 Junction Node No.
.054 .419 .054 .000 c.m/s
27 HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .8682002E+04 c.m
14 START
1 1=Zero; 2=Define
35 COMMENT
3 line(s) of comment
*****
** 100 YEAR DESIGN STORM EVENT *****
*****
2 STORM
1 1=Chicago;2=Huff;3=User;4=Cdnlhr;5=Historic

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# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

```

980.000 Coefficient a 1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
3.700 Constant b (min) .250 Manning "n"
.732 Exponent c 77.000 SCS Curve No or C
.450 Fraction to peak r 1.000 Ia/S Coefficient
240.000 Duration δ 1440 min 7.587 Initial Abstraction
70.157 mm Total depth 1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
3 IMPERVIOUS .098 .000 .136 1.053 c.m/s
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat 15 ADD RUNOFF .402 .909 .452 C perv/imperv/total
.015 Manning "n" .098 .098 .136 1.053 c.m/s
98.000 SCS Curve No or C 35 COMMENT
.100 Ia/S Coefficient 1 line(s) of comment
.518 Initial Abstraction ** EXTERNAL DRAINAGE AREA EX4 TO EAST - OUTLET B *****
14 START 4 CATCHMENT
1 1=Zero; 2=Define 4.000 ID No.δ 99999
35 COMMENT 8.140 Area in hectares
1 line(s) of comment 400.000 Length (PERV) metres
**** DRAINAGE AREA EX1 - TO WEST, OUTLET A ***** 1.000 Gradient (%)
4 CATCHMENT 1.000 Per cent Impervious
1.000 ID No.δ 99999 400.000 Length (IMPERV)
3.410 Area in hectares %Imp. with Zero Dpth
60.000 Length (PERV) metres .000 %Imp. with Zero Dpth
1.500 Gradient (%) 1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
1.000 Per cent Impervious .250 Manning "n"
60.000 Length (IMPERV) 77.000 SCS Curve No or C
.000 %Imp. with Zero Dpth 1.000 Ia/S Coefficient
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat 7.587 Initial Abstraction
.250 Manning "n" 15 ADD RUNOFF .230 .098 .136 1.053 c.m/s
77.000 SCS Curve No or C .403 .919 .408 C perv/imperv/total
.100 Ia/S Coefficient
7.587 Initial Abstraction 9 ROUTE
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv .230 .266 .136 1.053 c.m/s
.244 .000 .054 .000 c.m/s
.402 .909 .408 C perv/imperv/total 27 HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .9750022E+03 c.m
14 START 1 1=Zero; 2=Define
35 COMMENT 1 line(s) of comment
**** DRAINAGE AREA EXT-E *****
4 CATCHMENT 17 COMBINE
2.000 ID No.δ 99999 1 Junction Node No.
54.090 Area in hectares .230 .266 .136 1.281 c.m/s
900.000 Length (PERV) metres 27 HYDROGRAPH DISPLAY
1.000 Gradient (%) 7 is # of Hyeto/Hydrograph chosen
3.000 Per cent Impervious Volume = .1918774E+05 c.m
900.000 Length (IMPERV) 14 START
.000 %Imp. with Zero Dpth 1 1=Zero; 2=Define
.000 %Imp. with Zero Dpth 35 COMMENT
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat 1 line(s) of comment
.250 Manning "n" ** DRAINAGE AREA EX5 TO EAST - OUTLET C *****
77.000 SCS Curve No or C 4 CATCHMENT
.100 Ia/S Coefficient 5.000 ID No.δ 99999
7.587 Initial Abstraction 2.620 Area in hectares
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv 60.000 Length (PERV) metres
1.024 .000 .054 .000 c.m/s 1.000 Gradient (%)
.403 .920 .419 C perv/imperv/total 1.000 Per cent Impervious
15 ADD RUNOFF 60.000 Length (IMPERV)
1.024 1.024 .054 .000 c.m/s .000 %Imp. with Zero Dpth
9 ROUTE 1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.000 Conduit Length .250 Manning "n"
.000 No Conduit defined 77.000 SCS Curve No or C
.000 Zero lag 1.000 Ia/S Coefficient
.000 Beta weighting factor 7.587 Initial Abstraction
.000 Routing timestep 1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
0 No. of sub-reaches .177 .000 .266 1.281 c.m/s
1.024 1.024 1.024 .000 c.m/s .402 .911 .407 C perv/imperv/total
17 COMBINE 27 HYDROGRAPH DISPLAY
1 Junction Node No. 4 is # of Hyeto/Hydrograph chosen
1.024 1.024 1.024 1.024 c.m/s Volume = .7484020E+03 c.m
14 START 15 ADD RUNOFF
1 1=Zero; 2=Define .177 .177 .266 1.281 c.m/s
35 COMMENT 9 ROUTE
1 line(s) of comment .000 Conduit Length
** DRAINAGE AREA EX2 TO EAST ***** .000 No Conduit defined
4 CATCHMENT .000 Zero lag
2.000 ID No.δ 99999 .000 Beta weighting factor
1.860 Area in hectares .000 Routing timestep
60.000 Length (PERV) metres 0 No. of sub-reaches
2.000 Gradient (%) .177 .177 .177 1.281 c.m/s
3.200 Per cent Impervious 17 COMBINE
60.000 Length (IMPERV) 1 Junction Node No.
.000 %Imp. with Zero Dpth .177 .177 .177 1.326 c.m/s
.000 %Imp. with Zero Dpth 35 COMMENT
.250 Manning "n" 1 line(s) of comment
77.000 SCS Curve No or C CONFLUENCE VALUE BELOW IS TOTAL EX OUTFLOW TO EAST CREEK - D
.100 Ia/S Coefficient CONFLUENCE
7.587 Initial Abstraction 1 Junction Node No.
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv .177 .177 1.326 .000 c.m/s
.136 .000 1.024 1.024 c.m/s 27 HYDROGRAPH DISPLAY
.402 .907 .418 C perv/imperv/total 5 is # of Hyeto/Hydrograph chosen
15 ADD RUNOFF .136 .136 1.024 1.024 c.m/s Volume = .1993319E+05 c.m
9 ROUTE 14 START
.000 Conduit Length 1 1=Zero; 2=Define
.000 No Conduit defined 35 COMMENT
.000 Zero lag 3 line(s) of comment
.000 Beta weighting factor *****
.000 Routing timestep ** 100 YEAR DESIGN STORM EVENT - 24 HOUR *****
0 No. of sub-reaches .136 .136 .136 1.024 c.m/s
17 COMBINE 2 STORM
1 Junction Node No. 1 1=Chicago; 2=Huff; 3=User; 4=Cdnlhr; 5=Historic
.136 .136 .136 1.053 c.m/s 980.000 Coefficient a
14 START 3.700 Constant b (min)
1 1=Zero; 2=Define .732 Exponent c
35 COMMENT .450 Fraction to peak r
1 line(s) of comment 1440.000 Duration δ 1440 min
**** EXTERNAL DRAINAGE AREA EX3 TO EX4 ***** 114.472 mm Total depth
4 CATCHMENT 3 IMPERVIOUS
3.000 ID No.δ 99999 1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
1.360 Area in hectares .015 Manning "n"
50.000 Length (PERV) metres 98.000 SCS Curve No or C
1.000 Gradient (%) .100 Ia/S Coefficient
9.800 Per cent Impervious .518 Initial Abstraction
50.000 Length (IMPERV) 14 START
.000 %Imp. with Zero Dpth 1 1=Zero; 2=Define

```

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

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35 COMMENT
1 line(s) of comment
**** DRAINAGE AREA EX1 - TO WEST, OUTLET A *****
4 CATCHMENT
1.000 ID No.6 99999
3.410 Area in hectares
60.000 Length (PERV) metres
1.500 Gradient (%)
1.000 Per cent Impervious
60.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.395 .000 .177 .000 c.m/s
.545 .939 .549 C perv/imperv/total
27 HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .2140826E+04 c.m
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
***** DRAINAGE AREA EXT-E *****
4 CATCHMENT
2.000 ID No.6 99999
54.090 Area in hectares
900.000 Length (PERV) metres
1.000 Gradient (%)
3.000 Per cent Impervious
900.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
1.651 .000 .177 .000 c.m/s
.546 .950 .558 C perv/imperv/total
15 ADD RUNOFF
1.651 1.651 .177 .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
1.651 1.651 1.651 .000 c.m/s
17 COMBINE
1 Junction Node No.
1.651 1.651 1.651 1.651 c.m/s
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** DRAINAGE AREA EX2 TO EAST *****
4 CATCHMENT
2.000 ID No.6 99999
1.860 Area in hectares
60.000 Length (PERV) metres
2.000 Gradient (%)
3.200 Per cent Impervious
60.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.237 .000 1.651 1.651 c.m/s
.544 .937 .557 C perv/imperv/total
15 ADD RUNOFF
.237 .237 1.651 1.651 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
.237 .237 .237 1.651 c.m/s
17 COMBINE
1 Junction Node No.
.237 .237 .237 1.687 c.m/s
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** EXTERNAL DRAINAGE AREA EX3 TO EX4 *****
4 CATCHMENT
3.000 ID No.6 99999
1.360 Area in hectares
50.000 Length (PERV) metres
1.000 Gradient (%)
9.800 Per cent Impervious
50.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.165 .000 .237 1.687 c.m/s
.545 .939 .584 C perv/imperv/total
15 ADD RUNOFF
.165 .165 .237 1.687 c.m/s
35 COMMENT
1 line(s) of comment
** EXTERNAL DRAINAGE AREA EX4 TO EAST - OUTLET B *****
4 CATCHMENT
4.000 ID No.6 99999
8.140 Area in hectares
400.000 Length (PERV) metres
1.000 Gradient (%)
1.000 Per cent Impervious
400.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.386 .165 .237 1.687 c.m/s
.546 .949 .550 C perv/imperv/total
15 ADD RUNOFF
.386 .437 .237 1.687 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
.386 .437 .437 1.687 c.m/s
35 COMMENT
1 line(s) of comment
COMBINED VALUE BELOW IS EXISTING OUTFLOW TO OUTLET B
COMBINE
1 Junction Node No.
.386 .437 .437 2.055 c.m/s
27 HYDROGRAPH DISPLAY
7 is # of Hyeto/Hydrograph chosen
Volume = .4176507E+05 c.m
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** DRAINAGE AREA EX5 TO EAST - OUTLET C *****
4 CATCHMENT
5.000 ID No.6 99999
2.620 Area in hectares
60.000 Length (PERV) metres
1.000 Gradient (%)
1.000 Per cent Impervious
60.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.298 .000 .437 2.055 c.m/s
.546 .941 .550 C perv/imperv/total
27 HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .1648355E+04 c.m
15 ADD RUNOFF
.298 .298 .437 2.055 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
.298 .298 .298 2.055 c.m/s
17 COMBINE
1 Junction Node No.
.298 .298 .298 2.125 c.m/s
35 COMMENT
1 line(s) of comment
CONFLUENCE VALUE BELOW IS TOTAL EX OUTFLOW TO EAST CREEK - D
CONFLUENCE
1 Junction Node No.
.298 2.125 .298 .000 c.m/s
27 HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .4340879E+05 c.m
20 MANUAL

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# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

### Future Conditions – NO SWM

```

Output File (4.7) NOSWM.OUT      opened 2024-10-09 11:48
Units used are defined by G =    9.810
144 288 10.000 are MAXDT MAXHYD & DTMIN values
Licensee: UPPER CANADA CONSULTANTS
35 COMMENT
4 line(s) of comment
CONCESSION 7 HUMMEL
STORMWATER MANAGEMENT PLAN
FUTURE CONDITIONS TO SIX MILE CREEK
MAY 2021
14 START
1 1=Zero; 2=Define
35 COMMENT
3 line(s) of comment
***** 2 YEAR DESIGN STORM EVENT *****
2 STORM
1 1=Chicago;2=Huff;3=User;4=Cdnlhr;5=Historic
567.000 Coefficient a
5.200 Constant b (min)
.746 Exponent c
.450 Fraction to peak r
240.000 Duration 6 1440 min
37.413 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
1 line(s) of comment
** A1 - UNCONTROLLED DRAINAGE AREA TO WEST *****
4 CATCHMENT
1.000 ID No.6 99999
1.280 Area in hectares
50.000 Length (PERV) metres
1.000 Gradient (%)
26.000 Per cent Impervious
50.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.047 .000 .000 .000 c.m/s
.225 .851 .388 C perv/imperv/total
27 HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .1856209E+03 c.m
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
***** DRAINAGE AREA EXT-F *****
4 CATCHMENT
2.000 ID No.6 99999
52.370 Area in hectares
900.000 Length (PERV) metres
1.000 Gradient (%)
3.000 Per cent Impervious
900.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.186 .000 .000 .000 c.m/s
.225 .863 .244 C perv/imperv/total
15 ADD RUNOFF
.186 .186 .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
.186 .186 .186 .000 c.m/s
17 COMBINE
1 Junction Node No.
.186 .186 .186 .186 c.m/s
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** A2 - CON 7 DRAINAGE AREA TO CREEK *****
4 CATCHMENT
2.000 ID No.6 99999
2.348 Area in hectares
140.000 Length (PERV) metres
1.000 Gradient (%)
28.800 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"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.093 .000 .186 .186 c.m/s
.225 .847 .404 C perv/imperv/total
15 ADD RUNOFF
.093 .093 .186 .186 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
.093 .093 .093 .186 c.m/s
.000 Beta weighting factor
.000 Routing timestep
0 No. of sub-reaches
.093 .093 .093 .186 c.m/s
17 COMBINE
1 Junction Node No.
.093 .093 .093 .232 c.m/s
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** A3 - UNCONTROLLED DRAINAGE AREA TO EAST *****
4 CATCHMENT
3.000 ID No.6 99999
.850 Area in hectares
40.000 Length (PERV) metres
1.000 Gradient (%)
23.600 Per cent Impervious
40.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.032 .000 .093 .232 c.m/s
.225 .853 .373 C perv/imperv/total
15 ADD RUNOFF
.032 .032 .093 .232 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
.032 .032 .032 .232 c.m/s
35 COMMENT
1 line(s) of comment
***** OUTLET B *****
17 COMBINE
1 Junction Node No.
.032 .032 .032 .258 c.m/s
27 HYDROGRAPH DISPLAY
7 is # of Hyeto/Hydrograph chosen
Volume = .5253400E+04 c.m
14 START
1 1=Zero; 2=Define
35 COMMENT
2 line(s) of comment
** A4 - CONTROLLED DRAINAGE AREA TO POND **
***** OUTLET C *****
4 CATCHMENT
4.000 ID No.6 99999
13.080 Area in hectares
600.000 Length (PERV) metres
1.000 Gradient (%)
70.000 Per cent Impervious
600.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.981 .000 .032 .258 c.m/s
.225 .859 .669 C perv/imperv/total
27 HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .3273709E+04 c.m
15 ADD RUNOFF
.981 .981 .032 .258 c.m/s
27 HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .3273709E+04 c.m
9 ROUTE
.000 Conduit Length
.000 No Conduit defined
.000 Zero lag
.000 Beta weighting factor
.000 Routing timestep
0 No. of sub-reaches
.981 .981 .981 .258 c.m/s
17 COMBINE
1 Junction Node No.
.981 .981 .981 1.239 c.m/s
35 COMMENT
1 line(s) of comment
***** OUTLET D *****
18 CONFLUENCE
1 Junction Node No.
.981 1.239 .981 .000 c.m/s
27 HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .8526002E+04 c.m
14 START
1 1=Zero; 2=Define
35 COMMENT
3 line(s) of comment
***** 5YR DESIGN STORM EVENT *****
2 STORM
1 1=Chicago;2=Huff;3=User;4=Cdnlhr;5=Historic
664.000 Coefficient a
4.700 Constant b (min)
.744 Exponent c
.450 Fraction to peak r
240.000 Duration 6 1440 min
44.365 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

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# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

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.518 Initial Abstraction .000 Zero lag
35 COMMENT .000 Beta weighting factor
1 line(s) of comment .000 Routing timestep
** A1 - UNCONTROLLED DRAINAGE AREA TO WEST *****
4 CATCHMENT 0 No. of sub-reaches
1.000 ID No.6 99999 35 COMMENT .040 .040 .040 .323 c.m/s
1.280 Area in hectares 1 line(s) of comment
50.000 Length (PERV) metres ***** OUTLET B *****
1.000 Gradient (%) COMBINE
26.000 Per cent Impervious 1 Junction Node No.
50.000 Length (IMPERV) .040 .040 .346 c.m/s
.000 %Imp. with Zero Dpth 27 HYDROGRAPH DISPLAY
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat 7 is # of Hyeto/Hydrograph chosen
.250 Manning "n" Volume = .7318154E+04 c.m
77.000 SCS Curve No or C 14 START
.100 Ia/S Coefficient 1 1=Zero; 2=Define
7.587 Initial Abstraction 35 COMMENT
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv 2 line(s) of comment
.064 .000 .981 .000 c.m/s ** A4 - CONTROLLED DRAINAGE AREA TO POND **
.271 .872 .427 C perv/imperv/total ***** OUTLET C *****
27 HYDROGRAPH DISPLAY 4 CATCHMENT
4 is # of Hyeto/Hydrograph chosen 4.000 ID No.6 99999
Volume = .2423836E+03 c.m 13.080 Area in hectares
14 START 600.000 Length (PERV) metres
1 1=Zero; 2=Define 1.000 Gradient (%)
35 COMMENT 70.000 Per cent Impervious
1 line(s) of comment 600.000 Length (IMPERV)
***** DRAINAGE AREA EXT-F ***** .000 %Imp. with Zero Dpth
4 CATCHMENT 1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
2.000 ID No.6 99999 .250 Manning "n"
52.370 Area in hectares 77.000 SCS Curve No or C
900.000 Length (PERV) metres .100 Ia/S Coefficient
1.000 Gradient (%) 7.587 Initial Abstraction
3.000 Per cent Impervious 1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
900.000 Length (IMPERV) 1.273 .000 .040 .346 c.m/s
.000 %Imp. with Zero Dpth .271 .883 .289 C perv/imperv/total
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat 27 HYDROGRAPH DISPLAY
.250 Manning "n" 4 is # of Hyeto/Hydrograph chosen
77.000 SCS Curve No or C Volume = .4056540E+04 c.m
.100 Ia/S Coefficient 15 ADD RUNOFF
7.587 Initial Abstraction 1.273 1.273 .040 .346 c.m/s
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv 27 HYDROGRAPH DISPLAY
.306 .000 .981 .000 c.m/s 5 is # of Hyeto/Hydrograph chosen
.271 .883 .289 C perv/imperv/total Volume = .4056540E+04 c.m
15 ADD RUNOFF 9 ROUTE
.306 .306 .981 .000 c.m/s .000 Conduit Length
9 ROUTE .000 No Conduit defined
.000 Conduit Length .000 Zero lag
.000 No Conduit defined .000 Beta weighting factor
.000 Zero lag .000 Routing timestep
.000 Beta weighting factor 0 No. of sub-reaches
.000 Routing timestep 17 COMBINE
0 No. of sub-reaches 1 Junction Node No.
.306 .306 .306 .000 c.m/s 1.273 1.273 1.273 1.619 c.m/s
17 COMBINE 35 COMMENT
1 Junction Node No. 1 line(s) of comment
.306 .306 .306 .306 c.m/s ***** OUTLET D *****
14 START 18 CONFLUENCE
1 1=Zero; 2=Define 1 Junction Node No.
35 COMMENT 1.273 1.619 1.273 .000 c.m/s
1 line(s) of comment 27 HYDROGRAPH DISPLAY
** A2 - CON 7 DRAINAGE AREA TO CREEK ***** 5 is # of Hyeto/Hydrograph chosen
4 CATCHMENT Volume = .1137180E+05 c.m
2.000 ID No.6 99999 14 START
2.348 Area in hectares 1 1=Zero; 2=Define
140.000 Length (PERV) metres 35 COMMENT
1.000 Gradient (%) 1 line(s) of comment
28.800 Per cent Impervious *****
140.000 Length (IMPERV) ** 100 YEAR DESIGN STORM EVENT **
.000 %Imp. with Zero Dpth *****
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat 2 STORM
.250 Manning "n" 1 1=Chicago;2=Huff;3=User;4=Cdnlhr;5=Historic
77.000 SCS Curve No or C 980.000 Coefficient a
.100 Ia/S Coefficient 3.700 Constant b (min)
7.587 Initial Abstraction 7.732 Exponent c
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv .450 Fraction to peak r
.114 .000 .306 .306 c.m/s 240.000 Duration 6 1440 min
.271 .860 .440 C perv/imperv/total 70.157 min Total depth
15 ADD RUNOFF 9 ROUTE
.114 .114 .306 .306 c.m/s 3 IMPERVIOUS
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.000 Conduit Length .015 Manning "n"
.000 No Conduit defined 98.000 SCS Curve No or C
.000 Zero lag .100 Ia/S Coefficient
.000 Beta weighting factor .518 Initial Abstraction
.000 Routing timestep 35 COMMENT
0 No. of sub-reaches 1 line(s) of comment
.114 .114 .114 .306 c.m/s ** A1 - UNCONTROLLED DRAINAGE AREA TO WEST *****
17 COMBINE 4 CATCHMENT
1 Junction Node No. 1.000 ID No.6 99999
.114 .114 .114 .323 c.m/s 1.280 Area in hectares
14 START 50.000 Length (PERV) metres
1 1=Zero; 2=Define 1.000 Gradient (%)
35 COMMENT 26.000 Per cent Impervious
1 line(s) of comment 50.000 Length (IMPERV)
** A3 - UNCONTROLLED DRAINAGE AREA TO EAST ***** .000 %Imp. with Zero Dpth
4 CATCHMENT 1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
3.000 ID No.6 99999 .250 Manning "n"
.850 Area in hectares 77.000 SCS Curve No or C
40.000 Length (PERV) metres .100 Ia/S Coefficient
1.000 Gradient (%) 7.587 Initial Abstraction
23.600 Per cent Impervious 1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
40.000 Length (IMPERV) .120 .000 1.273 .000 c.m/s
.000 %Imp. with Zero Dpth .402 .909 .534 C perv/imperv/total
.000 %Imp. with Zero Dpth 27 HYDROGRAPH DISPLAY
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat 4 is # of Hyeto/Hydrograph chosen
.250 Manning "n" Volume = .4795691E+03 c.m
77.000 SCS Curve No or C 14 START
.100 Ia/S Coefficient 1 1=Zero; 2=Define
7.587 Initial Abstraction 35 COMMENT
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv 2 line(s) of comment
.040 .000 .114 .323 c.m/s ***** DRAINAGE AREA EXT-F *****
.270 .871 .412 C perv/imperv/total 4 CATCHMENT
15 ADD RUNOFF 2.000 ID No.6 99999
.040 .040 .114 .323 c.m/s 52.370 Area in hectares
9 ROUTE 900.000 Length (PERV) metres
.000 Conduit Length 1.000 Gradient (%)
.000 No Conduit defined

```

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

```

3.000 Per cent Impervious
900.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.992 .000 1.273 .000 c.m/s
.403 .920 .419 C perv/imperv/total
15 ADD RUNOFF .992 .992 1.273 .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
.992 .992 .992 .000 c.m/s
17 COMBINE
1 Junction Node No.
.992 .992 .992 .992 c.m/s
14 START
1 l=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** A2 - CON 7 DRAINAGE AREA TO CREEK *****
4 CATCHMENT
2.000 ID No.6 99999
2.348 Area in hectares
140.000 Length (PERV) metres
1.000 Gradient (%)
28.800 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"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.199 .000 .992 .992 c.m/s
.402 .911 .549 C perv/imperv/total
15 ADD RUNOFF .199 .199 .992 .992 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
.199 .199 .199 .992 c.m/s
17 COMBINE
1 Junction Node No.
.199 .199 .199 1.038 c.m/s
14 START
1 l=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** A3 - UNCONTROLLED DRAINAGE AREA TO EAST *****
4 CATCHMENT
3.000 ID No.6 99999
.850 Area in hectares
40.000 Length (PERV) metres
1.000 Gradient (%)
23.600 Per cent Impervious
40.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.079 .000 .199 1.038 c.m/s
.402 .905 .521 C perv/imperv/total
15 ADD RUNOFF .079 .079 .199 1.038 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
.079 .079 .079 1.038 c.m/s
35 COMMENT
1 line(s) of comment
***** OUTLET B *****
17 COMBINE
1 Junction Node No.
.079 .079 .079 1.052 c.m/s
27 HYDROGRAPH DISPLAY
7 is # of Hyeto/Hydrograph chosen
Volume = .1658609E+05 c.m
14 START
1 l=Zero; 2=Define
35 COMMENT
2 line(s) of comment
** A4 - CONTROLLED DRAINAGE AREA TO POND **
***** OUTLET C *****
4 CATCHMENT
4.000 ID No.6 99999
13.080 Area in hectares
600.000 Length (PERV) metres
1.000 Gradient (%)
70.000 Per cent Impervious
600.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
2.497 .000 .079 1.052 c.m/s
.403 .917 .763 C perv/imperv/total
27 HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .6998922E+04 c.m
15 ADD RUNOFF 2.497 2.497 .079 1.052 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
2.497 2.497 2.497 1.052 c.m/s
17 COMBINE
1 Junction Node No.
2.497 2.497 2.497 3.265 c.m/s
35 COMMENT
1 line(s) of comment
***** OUTLET D *****
18 CONFLUENCE
1 Junction Node No.
2.497 3.265 2.497 .000 c.m/s
27 HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .2358479E+05 c.m
14 START
1 l=Zero; 2=Define
35 COMMENT
3 line(s) of comment
*****
** 100 YEAR DESIGN STORM EVENT - 24 HOUR *****
2 STORM
1 l=Chicago;2=Huff;3=User;4=Cdnlr;5=Historic
980.000 Coefficient a
3.700 Constant b (min)
.732 Exponent c
.450 Fraction to peak r
1440.000 Duration 6 1440 min
114.472 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
1 line(s) of comment
** A1 - UNCONTROLLED DRAINAGE AREA TO WEST *****
4 CATCHMENT
1.000 ID No.6 99999
1.280 Area in hectares
50.000 Length (PERV) metres
1.000 Gradient (%)
26.000 Per cent Impervious
50.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.171 .000 2.497 .000 c.m/s
.545 .939 .647 C perv/imperv/total
27 HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .9483962E+03 c.m
14 START
1 l=Zero; 2=Define
35 COMMENT
1 line(s) of comment
***** DRAINAGE AREA EXT-F *****
4 CATCHMENT
2.000 ID No.6 99999
52.370 Area in hectares
900.000 Length (PERV) metres
1.000 Gradient (%)
3.000 Per cent Impervious
900.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
1.599 .000 2.497 .000 c.m/s
.546 .950 .558 C perv/imperv/total
15 ADD RUNOFF 1.599 1.599 2.497 .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
1.599 1.599 1.599 .000 c.m/s
17 COMBINE
1 Junction Node No.
1.599 1.599 1.599 1.599 c.m/s
14 START
1 l=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** A2 - CON 7 DRAINAGE AREA TO CREEK *****
4 CATCHMENT
2.000 ID No.6 99999
2.348 Area in hectares
140.000 Length (PERV) metres

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# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

```

1.000 Gradient (%)
28.800 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"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.241 .000 1.599 1.599 c.m/s
.546 .943 .660 C perv/imperv/total
15 ADD RUNOFF
.241 .241 1.599 1.599 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
.241 .241 .241 1.599 c.m/s
17 COMBINE
1 Junction Node No.
.241 .241 .241 1.665 c.m/s
14 START
1 1=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** A3 - UNCONTROLLED DRAINAGE AREA TO EAST *****
4 CATCHMENT
3.000 ID No.6 99999
.850 Area in hectares
40.000 Length (PERV) metres
1.000 Gradient (%)
23.600 Per cent Impervious
40.000 Length (IMPERV)
.000 $Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.120 .000 .241 1.665 c.m/s
.545 .936 .637 C perv/imperv/total
15 ADD RUNOFF
.120 .120 .241 1.665 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
.120 .120 .120 1.665 c.m/s
35 COMMENT
1 line(s) of comment
***** OUTLET B *****
17 COMBINE
1 Junction Node No.
.120 .120 .120 1.682 c.m/s
27 HYDROGRAPH DISPLAY
7 is # of Hyeto/Hydrograph chosen
Volume = .3584419E+05 c.m
14 START
1 1=Zero; 2=Define
35 COMMENT
2 line(s) of comment
** A4 - CONTROLLED DRAINAGE AREA TO POND **
***** OUTLET C *****
4 CATCHMENT
4.000 ID No.6 99999
13.080 Area in hectares
600.000 Length (PERV) metres
1.000 Gradient (%)
70.000 Per cent Impervious
600.000 Length (IMPERV)
.000 $Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
2.566 .000 .120 1.682 c.m/s
.546 .947 .827 C perv/imperv/total
27 HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .1238127E+05 c.m
15 ADD RUNOFF
2.566 2.566 .120 1.682 c.m/s
27 HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .1238127E+05 c.m
9 ROUTE
.000 Conduit Length
.000 No Conduit defined
.000 Zero lag
.000 Beta weighting factor
.000 Routing timestep
0 No. of sub-reaches
2.566 2.566 2.566 1.682 c.m/s
17 COMBINE
1 Junction Node No.
2.566 2.566 2.566 3.595 c.m/s
35 COMMENT
1 line(s) of comment
***** OUTLET D *****
18 CONFLUENCE
1 Junction Node No.
2.566 3.595 2.566 .000 c.m/s
27 HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .4822620E+05 c.m
20 MANUAL

```

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

### Future Conditions – WITH SWM

```

Output File (4.7) SWM.OUT      opened 2024-10-23 17:45
Units used are defined by G =  9.810
144 288 10.000 are MAXDT MAXHYD & DTMIN values
Licensee: UPPER CANADA CONSULTANTS
35 COMMENT
4 line(s) of comment
CONCESSION 7 - HUMMEL
STORMWATER MANAGEMENT PLAN
FUTURE CONDITIONS TO SIX MILE CREEK
MAY 2021
35 COMMENT
3 line(s) of comment
*****
** 25MM STORM EVENT *****
*****
2 STORM
1 l=Chicago;2=Huff;3=User;4=Cdnlnr;5=Historic
512.000 Coefficient a
6.000 Constant b (min)
.800 Exponent c
.450 Fraction to peak r
240.000 Duration ó 1440 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
14 START
1 l=Zero; 2=Define
35 COMMENT
2 line(s) of comment
** A4 - CONTROLLED DRAINAGE AREA TO POND **
*****
***** OUTLET C *****
4 CATCHMENT
4.000 ID No.ó 99999
13.080 Area in hectares
600.000 Length (PERV) metres
1.000 Gradient (%)
70.000 Per cent Impervious
600.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.580 .000 .000 .000 c.m/s
.130 .807 .604 C perv/imperv/total
27 HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .1972449E+04 c.m
15 ADD RUNOFF
.580 .580 .000 .000 c.m/s
27 HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .1972449E+04 c.m
10 POND
6 Depth - Discharge - Volume sets
114.000 .000 0
114.700 .0280 2613.1
115.000 .125 3954.7
115.150 .203 4674.4
115.250 .308 5172.6
115.500 .793 6484.0
Peak Outflow = .018 c.m/s
Maximum Depth = 114.450 metres
Maximum Storage = 1678. c.m
.580 .580 .018 .000 c.m/s
14 START
1 l=Zero; 2=Define
35 COMMENT
3 line(s) of comment
*****
** 2 YEAR DESIGN STORM EVENT *****
*****
2 STORM
1 l=Chicago;2=Huff;3=User;4=Cdnlnr;5=Historic
567.000 Coefficient a
5.200 Constant b (min)
.746 Exponent c
.450 Fraction to peak r
240.000 Duration ó 1440 min
37.413 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
1 line(s) of comment
** A1 - UNCONTROLLED DRAINAGE AREA TO WEST *****
*****
4 CATCHMENT
1.000 ID No.ó 99999
1.280 Area in hectares
50.000 Length (PERV) metres
1.000 Gradient (%)
26.200 Per cent Impervious
50.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.050 .000 .018 .000 c.m/s
.225 .851 .389 C perv/imperv/total
27 HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .1862528E+03 c.m
14 START
1 l=Zero; 2=Define
35 COMMENT
1 line(s) of comment
*****
***** DRAINAGE AREA EXT-F *****
*****
4 CATCHMENT
2.000 ID No.ó 99999
52.370 Area in hectares
900.000 Length (PERV) metres
1.000 Gradient (%)
3.000 Per cent Impervious
900.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.186 .000 .018 .000 c.m/s
.225 .863 .244 C perv/imperv/total
15 ADD RUNOFF
.186 .186 .018 .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
.186 .186 .186 .000 c.m/s
17 COMBINE
1 Junction Node No.
.186 .186 .186 .186 c.m/s
14 START
1 l=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** A2 - CON 7 DRAINAGE AREA TO CREEK *****
*****
4 CATCHMENT
2.000 ID No.ó 99999
2.348 Area in hectares
140.000 Length (PERV) metres
1.000 Gradient (%)
28.800 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"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.093 .000 .186 .186 c.m/s
.225 .847 .404 C perv/imperv/total
15 ADD RUNOFF
.093 .093 .186 .186 c.m/s
10 POND
7 Depth - Discharge - Volume sets
118.100 .000 0
119.000 .0430 1.7
119.500 .0540 14.6
119.900 .0620 38.1
120.600 .0730 45.7
120.650 .249 50.2
120.700 .569 54.8
Peak Outflow = .059 c.m/s
Maximum Depth = 119.760 metres
Maximum Storage = 30. c.m
.093 .093 .059 .186 c.m/s
17 COMBINE
1 Junction Node No.
.093 .093 .059 .228 c.m/s
14 START
1 l=Zero; 2=Define
35 COMMENT
1 line(s) of comment
** A3 - UNCONTROLLED DRAINAGE AREA TO EAST *****
*****
4 CATCHMENT
3.000 ID No.ó 99999
.850 Area in hectares
40.000 Length (PERV) metres
1.000 Gradient (%)
23.600 Per cent Impervious
40.000 Length (IMPERV)
.000 %Imp. with Zero Dpth
1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
.250 Manning "n"
77.000 SCS Curve No or C
.100 Ia/S Coefficient
7.587 Initial Abstraction
1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.032 .000 .059 .228 c.m/s
.225 .853 .373 C perv/imperv/total
15 ADD RUNOFF
.032 .032 .059 .228 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
.032 .032 .032 .228 c.m/s
35 COMMENT
1 line(s) of comment
*****
***** OUTLET B *****
*****
17 COMBINE
1 Junction Node No.
.032 .032 .032 .245 c.m/s
27 HYDROGRAPH DISPLAY
7 is # of Hyeto/Hydrograph chosen
Volume = .5250400E+04 c.m
14 START
1 l=Zero; 2=Define
35 COMMENT
2 line(s) of comment

```

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

	** A4 - CONTROLLED DRAINAGE AREA TO POND **		.000	Beta weighting factor	
	***** OUTLET C *****		.000	Routing timestep	
4	CATCHMENT		0	No. of sub-reaches	
	4.000 ID No.6 99999		.306	.306	.000 c.m/s
	13.080 Area in hectares	17	COMBINE		
	600.000 Length (PERV) metres	1	Junction Node No.		
	1.000 Gradient (%)		.306	.306	.306 c.m/s
	70.000 Per cent Impervious	14	START		
	600.000 Length (IMPERV)	1	1=Zero; 2=Define		
	.000 %Imp. with Zero Dpth	35	COMMENT		
	1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat	1	line(s) of comment		
	.250 Manning "n"	4	** A2 - CON 7 DRAINAGE AREA TO CREEK *****		
	77.000 SCS Curve No or C	140.000	CATCHMENT		
	.100 Ia/S Coefficient	2.000	ID No.6 99999		
	7.587 Initial Abstraction	2.348	Area in hectares		
	1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv	140.000	Length (PERV) metres		
	.981 .000 .032 .245 c.m/s	1.000	Gradient (%)		
15	ADD RUNOFF	28.800	Per cent Impervious		
	.225 .859 .669 C perv/imperv/total	140.000	Length (IMPERV)		
	.981 .981 .032 .245 c.m/s	.000	%Imp. with Zero Dpth		
27	HYDROGRAPH DISPLAY	1	Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat		
5	is # of Hyeto/Hydrograph chosen	1	Manning "n"		
	Volume = .3273709E+04 c.m	.250	%Imp. with Zero Dpth		
10	POND	77.000	SCS Curve No or C		
	6 Depth - Discharge - Volume sets	.100	Ia/S Coefficient		
	114.000 .000 .0 .0	7.587	Initial Abstraction		
	114.700 .0280 2613.1	1	Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv		
	115.000 .125 3954.7	.114	.000 .306	.306 c.m/s	
	115.150 .203 4674.4	.271	.860 .440	C perv/imperv/total	
	115.250 .308 5172.6	15	ADD RUNOFF		
	115.500 .793 6484.0	.114	.114 .306	.306 c.m/s	
	Peak Outflow = .038 c.m/s	10	POND		
	Maximum Depth = 114.730 metres	7	Depth - Discharge - Volume sets		
	Maximum Storage = 2749. c.m	118.100	.000 .0		
	.981 .981 .038 .245 c.m/s	119.000	.0430 1.7		
17	COMBINE	119.500	.0540 14.6		
1	Junction Node No.	119.900	.0620 38.1		
	.981 .981 .038 .258 c.m/s	120.600	.0730 45.7		
35	COMMENT	120.650	.249 50.2		
1	line(s) of comment	120.700	.569 54.8		
***** OUTLET D *****			Peak Outflow = .068 c.m/s		
18	CONFLUENCE	1	Junction Node No.		
1	Junction Node No.	.114	.114 .068	.306 c.m/s	
	.981 .258 .038 .000 c.m/s	17	COMBINE		
27	HYDROGRAPH DISPLAY	1	Junction Node No.		
5	is # of Hyeto/Hydrograph chosen	.114	.114 .068	.323 c.m/s	
	Volume = .6941400E+04 c.m	14	START		
14	START	1	1=Zero; 2=Define		
1	1=Zero; 2=Define	35	COMMENT		
35	COMMENT	1	line(s) of comment		
3	line(s) of comment	4	** A3 - UNCONTROLLED DRAINAGE AREA TO EAST *****		
*****			CATCHMENT		
2	STORM	3.000	ID No.6 99999		
1	1=Chicago;2=Huff;3=User;4=Cdnlhr;5=Historic	.850	Area in hectares		
664.000	Coefficient a	40.000	Length (PERV) metres		
4.700	Constant b (min)	1.000	Gradient (%)		
.744	Exponent c	23.600	Per cent Impervious		
.450	Fraction to peak r	40.000	Length (IMPERV)		
240.000	Duration 6 1440 min	.000	%Imp. with Zero Dpth		
	44.365 mm Total depth	1	Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat		
3	IMPERVIOUS	.250	Manning "n"		
1	Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat	77.000	SCS Curve No or C		
	.015 Manning "n"	.100	Ia/S Coefficient		
	98.000 SCS Curve No or C	7.587	Initial Abstraction		
	.100 Ia/S Coefficient	1	Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv		
	.518 Initial Abstraction	.040	.000 .068	.323 c.m/s	
35	COMMENT	.270	.871 .412	C perv/imperv/total	
1	line(s) of comment	15	ADD RUNOFF		
** A1 - UNCONTROLLED DRAINAGE AREA TO WEST *****		.040	.040 .068	.323 c.m/s	
4	CATCHMENT	9	ROUTE		
1.000	ID No.6 99999	.000	Conduit Length		
1.280	Area in hectares	.000	No Conduit defined		
50.000	Length (PERV) metres	.000	Zero lag		
1.000	Gradient (%)	.000	Beta weighting factor		
26.200	Per cent Impervious	.000	Routing timestep		
50.000	Length (IMPERV)	0	No. of sub-reaches		
.000	%Imp. with Zero Dpth	.040	.040 .040	.323 c.m/s	
1	Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat	35	COMMENT		
.250	Manning "n"	1	line(s) of comment		
77.000	SCS Curve No or C	***** OUTLET B *****			
.100	Ia/S Coefficient	17	COMBINE		
7.587	Initial Abstraction	1	Junction Node No.		
1	Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv	.040	.040 .040	.328 c.m/s	
.064 .000 .038 .000 c.m/s		27	HYDROGRAPH DISPLAY		
.271 .872 .428 C perv/imperv/total		7	is # of Hyeto/Hydrograph chosen		
27	HYDROGRAPH DISPLAY	14	START		
4	is # of Hyeto/Hydrograph chosen	1	1=Zero; 2=Define		
	Volume = .2430660E+03 c.m	35	COMMENT		
14	START	2	line(s) of comment		
1	1=Zero; 2=Define	** A4 - CONTROLLED DRAINAGE AREA TO POND **			
35	COMMENT	***** OUTLET C *****			
1	line(s) of comment	4	CATCHMENT		
***** DRAINAGE AREA EXT-F *****			CATCHMENT		
4	CATCHMENT	4.000	ID No.6 99999		
2.000	ID No.6 99999	13.080	Area in hectares		
52.370	Area in hectares	600.000	Length (PERV) metres		
900.000	Length (PERV) metres	1.000	Gradient (%)		
1.000	Gradient (%)	70.000	Per cent Impervious		
3.000	Per cent Impervious	600.000	Length (IMPERV)		
900.000	Length (IMPERV)	.000	%Imp. with Zero Dpth		
.000	%Imp. with Zero Dpth	1	Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat		
1	Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat	.250	Manning "n"		
.250	Manning "n"	77.000	SCS Curve No or C		
77.000	SCS Curve No or C	.100	Ia/S Coefficient		
.100	Ia/S Coefficient	7.587	Initial Abstraction		
7.587	Initial Abstraction	1	Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv		
1	Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv	1.273	.000 .040	.328 c.m/s	
.306 .000 .038 .000 c.m/s		.271	.883 .699	C perv/imperv/total	
.271 .883 .289 C perv/imperv/total		15	ADD RUNOFF		
15	ADD RUNOFF	1.273	1.273 .040	.328 c.m/s	
.306 .306 .038 .000 c.m/s		27	HYDROGRAPH DISPLAY		
9	ROUTE	5	is # of Hyeto/Hydrograph chosen		
.000	Conduit Length		Volume = .4056540E+04 c.m		
.000	No Conduit defined	10	POND		
.000	Zero lag	6	Depth - Discharge - Volume sets		
		114.000	.000 .0		
		114.700	.0280 2613.1		

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

	115.000	.125	3954.7			.402	.911	.549	C perv/imperv/total
	115.150	.203	4674.4	15	ADD RUNOFF				
	115.250	.308	5172.6			.199	.199	.992	.992 c.m/s
	115.500	.793	6484.0	10	POND				
	Peak Outflow =		.072 c.m/s		7	Depth - Discharge - Volume sets			
	Maximum Depth =	114.837	metres			118.100	.000	.0	
	Maximum Storage =	3226.	c.m			119.000	.0430	1.7	
	1.273	1.273	.072			119.500	.0540	14.6	
17	COMBINE					119.900	.0620	38.1	
	1	Junction Node No.				120.600	.0730	45.7	
		1.273	.072			120.650	.249	50.2	
35	COMMENT					120.700	.569	54.8	
	1	line(s) of comment				Peak Outflow =		.198 c.m/s	
	*****	OUTLET D	*****			Maximum Depth =		120.636 metres	
18	CONFLUENCE					Maximum Storage =		49. c.m	
	1	Junction Node No.				.199	.199	.198	.992 c.m/s
		1.273	.395		17	COMBINE			
			.072			1	Junction Node No.		
27	HYDROGRAPH DISPLAY						.199	.198	1.051 c.m/s
	5	is # of Hyeto/Hydrograph chosen			14	START			
	Volume =	.9656398E+04	c.m			1	1=Zero; 2=Define		
14	START				35	COMMENT			
	1	line(s) of comment				1	line(s) of comment		
35	COMMENT				4	*****	A3 - UNCONTROLLED DRAINAGE AREA TO EAST	*****	
	3	*****				3.000	ID No.6 99999		
	*****	** 100 YEAR DESIGN STORM EVENT **				.850	Area in hectares		
2	STORM					40.000	Length (PERV) metres		
	1	1=Chicago;2=Huff;3=User;4=Cdnlhr;5=Historic				1.000	Gradient (%)		
980.000	Coefficient a					23.600	Per cent Impervious		
3.700	Constant b (min)					40.000	Length (IMPERV)		
.732	Exponent c					.000	%Imp. with Zero Dpth		
.450	Fraction to peak r					1	Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat		
240.000	Duration 6 1440 min					.250	Manning "n"		
	70.157 mm	Total depth				77.000	SCS Curve No or C		
3	IMPERVIOUS					.100	Ia/S Coefficient		
	1	Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat				7.587	Initial Abstraction		
	.015	Manning "n"				1	Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv		
98.000	SCS Curve No or C					.079	.000	.198	1.051 c.m/s
.100	Ia/S Coefficient					.402	.905	.521	C perv/imperv/total
.518	Initial Abstraction				15	ADD RUNOFF			
35	COMMENT				9	ROUTE			
	1	line(s) of comment				.000	Conduit Length		
	*****	A1 - UNCONTROLLED DRAINAGE AREA TO WEST	*****			.000	No Conduit defined		
4	CATCHMENT					.000	Zero lag		
	1.000	ID No.6 99999				.000	Beta weighting factor		
	1.280	Area in hectares				.000	Routing timestep		
50.000	Length (PERV) metres					0	No. of sub-reaches		
1.000	Gradient (%)					.079	.079	.079	1.051 c.m/s
26.200	Per cent Impervious				35	COMMENT			
50.000	Length (IMPERV)					1	line(s) of comment		
.000	%Imp. with Zero Dpth					*****	OUTLET B	*****	
1	Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat					17	COMBINE		
.250	Manning "n"					1	Junction Node No.		
77.000	SCS Curve No or C						.079	.079	1.065 c.m/s
.100	Ia/S Coefficient					27	HYDROGRAPH DISPLAY		
7.587	Initial Abstraction					7	is # of Hyeto/Hydrograph chosen		
1	Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv					Volume =	.1655609E+05	c.m	
.121	.000	.072	.000 c.m/s			START			
.402	.909	.535	C perv/imperv/total			1	1=Zero; 2=Define		
27	HYDROGRAPH DISPLAY				35	COMMENT			
	4	is # of Hyeto/Hydrograph chosen				2	line(s) of comment		
Volume =	.4804795E+03	c.m				*****	A4 - CONTROLLED DRAINAGE AREA TO POND	*****	
14	START				4	CATCHMENT			
	1	1=Zero; 2=Define				4.000	ID No.6 99999		
35	COMMENT					13.080	Area in hectares		
	1	line(s) of comment				600.000	Length (PERV) metres		
	*****	DRAINAGE AREA EXT-F	*****			1.000	Gradient (%)		
4	CATCHMENT					70.000	Per cent Impervious		
	2.000	ID No.6 99999				600.000	Length (IMPERV)		
	52.370	Area in hectares				.000	%Imp. with Zero Dpth		
900.000	Length (PERV) metres					1	Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat		
1.000	Gradient (%)					.250	Manning "n"		
3.000	Per cent Impervious					77.000	SCS Curve No or C		
900.000	Length (IMPERV)					.100	Ia/S Coefficient		
.000	%Imp. with Zero Dpth					7.587	Initial Abstraction		
1	Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat					1	Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv		
.250	Manning "n"					2.497	.000	.079	1.065 c.m/s
77.000	SCS Curve No or C					.403	.917	.763	C perv/imperv/total
.100	Ia/S Coefficient					15	ADD RUNOFF		
7.587	Initial Abstraction					27	HYDROGRAPH DISPLAY		
1	Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv					5	is # of Hyeto/Hydrograph chosen		
.992	.000	.072	.000 c.m/s			Volume =	.6998922E+04	c.m	
.403	.920	.419	C perv/imperv/total			10	POND		
15	ADD RUNOFF					6	Depth - Discharge - Volume sets		
	.992	.992	.072	.000 c.m/s		114.000	.000	.0	
9	ROUTE					114.700	.0280	2613.1	
	.000	Conduit Length				115.000	.125	3954.7	
	.000	No Conduit defined				115.150	.203	4674.4	
	.000	Zero lag				115.250	.308	5172.6	
	.000	Beta weighting factor				115.500	.793	6484.0	
	.000	Routing timestep				Peak Outflow =		.226 c.m/s	
	0	No. of sub-reaches				Maximum Depth =		115.172 metres	
	.992	.992	.992	.000 c.m/s		Maximum Storage =		4785. c.m	
17	COMBINE					2.497	2.497	.226	1.065 c.m/s
	1	Junction Node No.				17	COMBINE		
	.992	.992	.992	.992 c.m/s		1	Junction Node No.		
14	START						2.497	2.497	.226
35	COMMENT					35	COMMENT		
	1	line(s) of comment				1	line(s) of comment		
	*****	A2 - CON 7 DRAINAGE AREA TO CREEK	*****			*****	OUTLET D	*****	
4	CATCHMENT					18	CONFLUENCE		
	2.000	ID No.6 99999				1	Junction Node No.		
	2.348	Area in hectares					2.497	1.277	.226
140.000	Length (PERV) metres					27	HYDROGRAPH DISPLAY		
1.000	Gradient (%)					5	is # of Hyeto/Hydrograph chosen		
28.800	Per cent Impervious					Volume =	.2166300E+05	c.m	
140.000	Length (IMPERV)					START			
.000	%Imp. with Zero Dpth					1	1=Zero; 2=Define		
1	Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat					35	COMMENT		
.250	Manning "n"					3	line(s) of comment		
77.000	SCS Curve No or C					*****	*****		
.100	Ia/S Coefficient					*****	** 100 YEAR DESIGN STORM EVENT - 24 HOUR	*****	
7.587	Initial Abstraction					*****	*****		
1	Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv								
.199	.000	.992	.992 c.m/s						

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

```

2  STORM
   1 1-Chicago;2=Huff;3=User;4=Cdnlhr;5=Historic
980.000 Coefficient a
3.700 Constant b (min)
.732 Exponent c
.450 Fraction to peak r
1440.000 Duration of 1440 min
114.472 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
   1 line(s) of comment
   ** A1 - UNCONTROLLED DRAINAGE AREA TO WEST *****
4  CATCHMENT
   1.000 ID No. of 99999
   1.280 Area in hectares
50.000 Length (PERV) metres
   1.000 Gradient (%)
26.200 Per cent Impervious
50.000 Length (IMPERV)
   .000 %Imp. with Zero Dpth
   1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
   .250 Manning "n"
77.000 SCS Curve No or C
   .100 Ia/S Coefficient
   7.587 Initial Abstraction
   1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
     .171 .000 .226 .000 c.m/s
     .545 .939 .648 C perv/imperv/total
27 HYDROGRAPH DISPLAY
   4 is # of Hyeto/Hydrograph chosen
   Volume = .949515E+03 c.m
14 START
   1 1=Zero; 2=Define
35 COMMENT
   1 line(s) of comment
   ***** DRAINAGE AREA EXT-F *****
4  CATCHMENT
   2.000 ID No. of 99999
52.370 Area in hectares
900.000 Length (PERV) metres
   1.000 Gradient (%)
   3.000 Per cent Impervious
900.000 Length (IMPERV)
   .000 %Imp. with Zero Dpth
   1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
   .250 Manning "n"
77.000 SCS Curve No or C
   .100 Ia/S Coefficient
   7.587 Initial Abstraction
   1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
     1.599 .000 .226 .000 c.m/s
     .546 .950 .558 C perv/imperv/total
15 ADD RUNOFF
   1.599 1.599 .226 .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
   1.599 1.599 1.599 .000 c.m/s
17 COMBINE
   1 Junction Node No.
     1.599 1.599 1.599 1.599 c.m/s
14 START
   1 1=Zero; 2=Define
35 COMMENT
   1 line(s) of comment
   ** A2 - CON 7 DRAINAGE AREA TO CREEK *****
4  CATCHMENT
   2.000 ID No. of 99999
2.348 Area in hectares
140.000 Length (PERV) metres
   1.000 Gradient (%)
28.800 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"
77.000 SCS Curve No or C
   .100 Ia/S Coefficient
   7.587 Initial Abstraction
   1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
     .241 .000 1.599 1.599 c.m/s
     .546 .943 .660 C perv/imperv/total
15 ADD RUNOFF
   .241 .241 1.599 1.599 c.m/s
10 POND
   7 Depth - Discharge - Volume sets
     118.100 .000 .0
     119.000 .0430 1.7
     119.500 .0540 14.6
     119.900 .0620 38.1
     120.600 .0730 45.7
     120.650 .249 50.2
     120.700 .569 54.8
Peak Outflow = .239 c.m/s
Maximum Depth = 120.647 metres
Maximum Storage = 50. c.m
17 COMBINE
   1 Junction Node No.
     .241 .241 .239 1.599 c.m/s
14 START
   1 1=Zero; 2=Define
35 COMMENT
   1 line(s) of comment
   ** A3 - UNCONTROLLED DRAINAGE AREA TO EAST *****
4  CATCHMENT
   3.000 ID No. of 99999
   .850 Area in hectares
40.000 Length (PERV) metres
   1.000 Gradient (%)
23.600 Per cent Impervious
40.000 Length (IMPERV)
   .000 %Imp. with Zero Dpth
   1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
   .250 Manning "n"
77.000 SCS Curve No or C
   .100 Ia/S Coefficient
   7.587 Initial Abstraction
   1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
     .120 .000 .239 1.670 c.m/s
     .545 .936 .637 C perv/imperv/total
15 ADD RUNOFF
   .120 .120 .239 1.670 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
   .120 .120 .120 1.670 c.m/s
35 COMMENT
   1 line(s) of comment
   ***** OUTLET B *****
17 COMBINE
   1 Junction Node No.
     .120 .120 .120 1.687 c.m/s
27 HYDROGRAPH DISPLAY
   7 is # of Hyeto/Hydrograph chosen
   Volume = .3586220E+05 c.m
14 START
   1 1=Zero; 2=Define
35 COMMENT
   2 line(s) of comment
   ** A4 - CONTROLLED DRAINAGE AREA TO POND **
   ***** OUTLET C *****
4  CATCHMENT
   4.000 ID No. of 99999
13.080 Area in hectares
600.000 Length (PERV) metres
   1.000 Gradient (%)
70.000 Per cent Impervious
600.000 Length (IMPERV)
   .000 %Imp. with Zero Dpth
   1 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
   .250 Manning "n"
77.000 SCS Curve No or C
   .100 Ia/S Coefficient
   7.587 Initial Abstraction
   1 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
     2.566 .000 .120 1.687 c.m/s
     .546 .947 .827 C perv/imperv/total
15 ADD RUNOFF
   2.566 2.566 .120 1.687 c.m/s
27 HYDROGRAPH DISPLAY
   5 is # of Hyeto/Hydrograph chosen
   Volume = .1238127E+05 c.m
10 POND
   6 Depth - Discharge - Volume sets
     114.000 .000 .0
     114.700 .0280 2613.1
     115.000 .125 3954.7
     115.150 .203 4674.4
     115.250 .308 5172.6
     115.500 .793 6484.0
     Peak Outflow = .454 c.m/s
     Maximum Depth = 115.325 metres
     Maximum Storage = 5568. c.m
     2.566 2.566 .454 1.687 c.m/s
17 COMBINE
   1 Junction Node No.
     2.566 2.566 .454 2.122 c.m/s
35 COMMENT
   1 line(s) of comment
   ***** OUTLET D *****
18 CONFLUENCE
   1 Junction Node No.
     2.566 2.122 .454 .000 c.m/s
27 HYDROGRAPH DISPLAY
   5 is # of Hyeto/Hydrograph chosen
   Volume = .4653001E+05 c.m
20 MANUAL

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**APPENDIX C**  
**Hydroworks Output Files**  
**Sample Inspection Report**

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

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*****
* Storm Water Management Sizing Model *
* Hydroworks, LLC *
* Version 4.4 *
*
* Continuous Simulation Program *
* Based on SWMM 4.4H *
* Hydroworks, LLC *
* Graham Bryant *
* 2003 - 2021 *
*****
Developed by
*****
* Hydroworks, LLC *
* Metcalf & Eddy, Inc. *
* University of Florida *
* Water Resources Engineers, Inc. *
* (Now Camp Dresser & McKee, Inc.) *
* Modified SWMM 4.4 *
*****
Distributed and Maintained by
*****
* Hydroworks, LLC *
* 888-290-7900 *
* www.hydroworks.com *
*****
* If any problems occur executing this *
* model, contact Mr. Graham Bryant at *
* Hydroworks, LLC by phone at 888-290-7900 *
* or by e-mail: support@hydroworks.com *
*****
* This model is based on EPA SWMM 4.4 *
* "Nature is full of infinite causes which *
* have never occurred in experience" da Vinci *
*****

*****
* Entry made to the Rain Block *
* Created by the University of Florida - 1988 *
* Updated by Oregon State University, March 2000 *
*****
Concession 7 Storm Sewer
Niagara-on-the-Lake
HydroDome Simulation
#####
# Precipitation Block Input Commands #
#####
Station Name..... St. Catherines A
Station Location..... Ontario
Station, ISTA..... 7287
Beginning date, IYBEG (Yr/Mo/Dy)..... 1971/ 1/ 1
Ending date, IYEND (Yr/Mo/Dy)..... 2005/12/31
Minimum interevent time, MIT..... 1
Number of ranked storms, NPTS..... 10
NWS format, IFORM (See text)..... 1
Print storm summary, ISUM (0-No 1-Yes) 0
Print all rainfall, IYEAR (0-No 1-Yes) 0
Save storm event data on NSCRAT(1).... 0
(IFILE =0 -Do not save, =1 -Save data)
IDECID 0 - Create interface file
1 - Create file and analyze
2 - Synoptic analysis..... 2
Plotting position parameter, A..... 0.40
Storm event statistics, NOSTAT..... 1100

KODEA (from optional group B0)..... 2
= 0, Do not include NCDC cumulative values.
= 1, Average NCDC cumulative values.
= 2, Use NCDC cumulative value as inst. rain.

KODEPR (from optional group B0)..... 0
Print NCDC special codes in event summary:
= 0, only on days with events.
= 1, on all days with codes present.
Codes: A = accumulated value, I = incomplete value,
M = missing value, O = other code present

*****
* Precipitation output created using the Rain block *
* Number of precipitation stations... 1 *
*****
Location Station Number
-----
1. 7287
STATION ID ON PRECIP. DATA INPUT FILE = 7287
REQUESTED STATION ID = 7287 CHECK TO BE SURE THEY MATCH.

#####
Note, 15-min. data are being processed, but hourly
print-out, summaries, and statistics are based on
hourly totals only. Data placed on interface file
are at correct 15-min. intervals.
#####
#####
# Entry made to the Runoff Block, last updated by #
# Oregon State University, and Camp, Dresser and #
# McKee, Inc., March 2002. #
#####
# "And wherever water goes, amoebae go along for #
# the ride" Tom Robbins #
#####

```

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

Concession 7 Storm Sewer  
Niagara-on-the-Lake

```

Snowmelt parameter - ISNOW..... 0
Number of rain gages - NRGAG..... 1
Horton infiltration equation used - INFILM..... 2
Maximum infiltration volume is limited to RMAXINF input on subcatchment lines.
Infiltration volume regenerates during non rainfall periods.
Quality is simulated - KWALTY..... 1
IVAP is negative. Evaporation will be set to zero
during time steps with rainfall.
Read evaporation data on line(s) F1 (F2) - IVAP.. 1
Hour of day at start of storm - NHR..... 1
Minute of hour at start of storm - NMN..... 1
Time TZERO at start of storm (hours)..... 1.017
Use Metric units for I/O - METRIC..... 1
==> Ft-sec units used in all internal computations
Runoff input print control... 0
Runoff graph plot control.... 1
Runoff output print control.. 0
Print headers every 50 lines - NOHEAD (0=yes, 1=no) 0
Print land use load percentages -LANDUPR (0=no, 1=yes) 0
Limit number of groundwater convergence messages to 10000 (if simulated)
Month, day, year of start of storm is: 1/ 1/1971
Wet time step length (seconds)..... 300.
Dry time step length (seconds)..... 900.
Wet/Dry time step length (seconds)... 450.
Simulation length is..... 20051231.0 Yr/Mo/Dy
Percent of impervious area with zero detention depth 25.0
Horton infiltration model being used
ate for regeneration of infiltration = REGEN * DECAY
DECAY is read in for each subcatchment
REGEN = ..... 0.01000

```

```

*****
* Processed Precipitation will be read from file *
*****
#####
# Data Group F1 #
# Evaporation Rate (mm/day) #
#####

```

JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.00	0.00	0.00	2.54	2.54	3.81	3.81	3.81	2.54	2.54	0.00	0.00

```

*****
* CHANNEL AND PIPE DATA *
*****

```

Input equen umber	NAMEBG: Channel ID #	Drains to NGTO:	Channel Type	Width (m)	Length (m)	Invert Slope (m/m)	L Side Slope (m/m)	R Side Slope (m/m)	Intial Depth (m)	Max Depth (m)	Mann- ings "N"	Full Flow (cms)
1	201	200	Dummy	0.0	0.0	0.0000	0.0000	0.0000	0.0	0.0	0.0000	0.00E+00

```

*****
* SUBCATCHMENT DATA *
*****

```

```

*NOTE. SEE LATER TABLE FOR OPTIONAL SUBCATCHMENT PARAMETERS*

```

SUBCATCH- MENT NO.	CHANNEL OR INLET	WIDTH (M)	AREA (HA)	PERCENT IMPERV.	SLOPE (M/M)	RESISTANCE IMPERV.	FACTOR PERV.	DEPRES. IMPERV.	STORAGE(MM) PERV.	INFILTRATION RATE(MM/HR)	DECAY RATE (1/SEC)	GAGE NO.	MAXIMUM VOLUME (MM)		
1	300	200	108.40	2.35	30.00	0.0200	0.015	0.250	0.510	5.080	63.50	10.16	0.00055	1	101.60000

```

TOTAL NUMBER OF SUBCATCHMENTS... 1
TOTAL TRIBUTARY AREA (HECTARES)... 2.35
IMPERVIOUS AREA (HECTARES)..... 0.70
PERVIOUS AREA (HECTARES)..... 1.64
TOTAL WIDTH (METERS)..... 108.40
PERCENT IMPERVIOUSNESS..... 30.00

```

```

*****
* UPSTREAM STORAGE DATA *
*****

```

Storage (m3)	Flow (m3/s)
0.	0.000
2.	0.042
5.	0.054
29.	0.061
46.	0.072
51.	0.074

```

*****
* GROUNDWATER INPUT DATA *
*****

```

SUB- CATCH NUMBER	CHANNEL OR INLET	===== E L E V A T I O N S =====	===== F L O W C O N S T A N T S =====								
		GROUND (M)	BOTTOM (M)	STAGE (M)	BC (M)	TW (M)	A1 (MM/HR-M*B1)	B1	A2 (MM/HR-M*B2)	B2	A3 (MM/HR-M*2)
0	602	3.05	0.00	0.00	0.61	0.61	3.484E-04	2.600	0.000E+00	1.000	0.00E+00

```

*****
* GROUNDWATER INPUT DATA (CONTINUED) *
*****

```

### SOIL PROPERTIES

SUBCAT. NO.	SATURATED POROSITY	HYDRAULIC CONDUCTIVITY (mm/hr)	WILTING POINT	FIELD CAPACITY	INITIAL MOISTURE	PERCOLATION PARAMETERS MAX. DEEP PERCOLATION (mm/hr)	HCO	PCO	ET P A R A M E T E R S DEPTH FRACTION OF ET OF ET TO UPPER ZONE (m)	
0	.4000	127.000	.1500	.3000	.3000	5.080E-02	10.00	4.57	4.27	0.350

```

*****
* Arrangement of Subcatchments and Channel/Pipes *
*****
* See second subcatchment output table for connectivity *

```

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

```

* of subcatchment to subcatchment flows.
*****
Channel
or Pipe
  201 No Tributary Channel/Pipes
      No Tributary Subareas.....
INLET
  200 Tributary Channel/Pipes... 201
      Tributary Subareas..... 300
*****
* Hydrographs will be stored for the following 1 INLETS *
*****
200

#####
# Quality Simulation #
#####
# General Quality Control Data Groups #
#####
Description Variable Value
-----
Number of quality constituents.... NQS..... 1
Number of land uses..... JLAND..... 1
Standard catchbasin volume..... CBVOL..... 1.22 cubic meters
Erosion is not simulated..... IROS..... 0
DRY DAYS PRIOR TO START OF STORM... DRYDAY..... 3.00 DAYS
DRY DAYS REQUIRED TO RECHARGE
CATCHBASIN CONCENTRATION TO
INITIAL VALUES..... DRYBSN..... 5.00 DAYS
DUST AND DIRT
STREET SWEEPING EFFICIENCY..... REFFDD..... 0.300
DAY OF YEAR ON WHICH STREET
SWEEPING BEGINS..... KLNBN..... 120
DAY OF YEAR ON WHICH STREET
SWEEPING ENDS..... KLNEND..... 270

#####
# Land use data on data group J2 #
#####
AND USE BUILDUP EQUATION TYPE FUNCTIONAL DEPENDENCE OF
LIMITING BUILDUP BUILDUP CLEANING AVAIL. DAYS SINCE
BUILDUP POWER COEFF. INTERVAL FACTOR LAST
(LNAME) (METHOD) BUILDUP PARAMETER (JACGUT) (DDLIM) (DDPOW) (DDFACT) (CLFREQ) (AVSWP) (DSLCL)
-----
Urban De EXPONENTIAL(1) AREA(1) 2.802E+01 0.500 67.250 30.000 0.300 30.000

#####
# Constituent data on data group J3 #
#####
Total Su
-----
Constituent units..... mg/l
Type of units..... 0
KALC..... 2
Type of buildup calc.... EXPONENTIAL(2)
KWASH..... 0
Type of washoff calc.... POWER EXPONEN.(0)
KACGUT..... 1
Dependence of buildup.... AREA(1)
LINKUP..... 0
Linkage to snowmelt..... NO SNOW LINKAGE
Buildup param 1 (QFACT1).. 28.020
Buildup param 2 (QFACT2).. 0.500
Buildup param 3 (QFACT3).. 67.250
Buildup param 4 (QFACT4).. 0.000
Buildup param 5 (QFACT5).. 0.000
Washoff power (WASHPO)... 1.100
Washoff coef. (RCEFF)... 0.086
Init catchb conc (CBFACT) 100.000
Precip. conc. (CONCRN)... 0.000
Street sweep effc (REFF) 0.300
Remove fraction (REMOVE).. 0.000
1st order QDECA, 1/day.. 0.000
Land use number..... 1

*****
* Constant Groundwater Quality Concentration(s) *
*****
Total Susp has a concentration of.. 0.0000 mg/l

*****
* REMOVAL FRACTIONS FOR SELECTED CHANNEL/PIPES *
* FROM J7 LINES *
*****
CHANNEL/ CONSTITUENT
PIPE Total Susp
-----
201 0.000

*****
* Subcatchment surface quality on data group L1 *
*****
Land Land Total Number Input
No. Usage No. Length of Loading
----- Catch- load/ha
1 300 Urban De 1 0.22 2.00 0.0E+00
Totals (Loads in kg or other) 0.22 2.00 0.0E+00
*****
* DATA GROUP M1 *
*****

TOTAL NUMBER OF PRINTED GUTTERS/INLETS...NPRNT.. 1
NUMBER OF TIME STEPS BETWEEN PRINTINGS...INTERV.. 0
STARTING AND STOPPING PRINTOUT DATES..... 0 0

```

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

\*\*\*\*\*  
 \* DATA GROUP M3 \*  
 \*\*\*\*\*

CHANNEL/INLET PRINT DATA GROUPS..... -200

====> WARNING !! STORAGE UNIT IS FLOODING. EXCESS VOLUME CONVEYED AS DISCHARGE  
 ====> WARNING !! STORAGE UNIT IS FLOODING. EXCESS VOLUME CONVEYED AS DISCHARGE

\*\*\*\*\*  
 \* Rainfall from Nat. Weather Serv. file \*  
 \* in units of hundredths of an inch \*  
 \*\*\*\*\*

Concession 7 Storm Sewer  
 Niagara-on-the-Lake

Rainfall Station St. Catherines A  
 State/Province Ontario

Rainfall Depth Summary (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1971.	31.	0.	0.	0.	0.	0.	126.	93.	52.	60.	29.	0.	391.
1972.	0.	0.	0.	47.	65.	100.	39.	115.	63.	90.	1.	0.	521.
1973.	0.	0.	0.	103.	77.	71.	53.	29.	63.	139.	0.	0.	534.
1974.	0.	0.	0.	67.	105.	62.	50.	31.	74.	37.	110.	0.	536.
1975.	0.	0.	0.	0.	0.	94.	78.	76.	73.	56.	59.	6.	442.
1976.	0.	0.	0.	119.	136.	87.	101.	60.	72.	73.	13.	1.	662.
1977.	0.	0.	0.	94.	29.	69.	57.	150.	230.	71.	0.	1.	701.
1978.	0.	0.	0.	72.	43.	72.	43.	86.	156.	95.	0.	0.	567.
1979.	0.	0.	0.	84.	92.	33.	91.	88.	84.	129.	71.	0.	673.
1980.	0.	0.	0.	81.	39.	122.	60.	32.	79.	96.	45.	0.	554.
1981.	0.	0.	0.	91.	71.	106.	122.	61.	123.	91.	84.	0.	749.
1982.	0.	0.	0.	28.	65.	97.	36.	66.	82.	25.	143.	0.	544.
1983.	0.	0.	0.	78.	100.	65.	55.	106.	75.	122.	92.	0.	694.
1984.	0.	0.	0.	31.	113.	136.	19.	51.	144.	24.	44.	0.	562.
1985.	0.	0.	67.	32.	52.	64.	40.	94.	42.	109.	0.	1.	501.
1986.	0.	0.	0.	93.	113.	60.	85.	83.	98.	80.	43.	65.	719.
1987.	0.	2.	11.	77.	42.	80.	122.	97.	99.	71.	94.	34.	730.
1988.	0.	0.	41.	71.	42.	21.	110.	82.	70.	68.	75.	5.	585.
1989.	0.	0.	13.	63.	137.	108.	36.	45.	89.	73.	84.	0.	647.
1990.	0.	2.	38.	99.	124.	44.	68.	95.	56.	112.	96.	0.	735.
1991.	0.	0.	86.	124.	67.	31.	85.	57.	79.	64.	61.	28.	682.
1992.	0.	0.	29.	127.	56.	92.	185.	116.	77.	47.	103.	38.	869.
1993.	3.	0.	7.	83.	56.	86.	32.	61.	71.	92.	80.	38.	610.
1994.	0.	0.	44.	88.	105.	124.	48.	77.	117.	15.	0.	15.	633.
1995.	112.	23.	16.	48.	37.	60.	123.	66.	8.	137.	94.	0.	724.
1998.	0.	0.	0.	0.	51.	54.	64.	29.	9.	0.	1.	0.	207.
1999.	0.	0.	0.	79.	59.	35.	61.	58.	116.	78.	0.	0.	487.
2000.	0.	0.	0.	123.	134.	216.	51.	0.	0.	0.	10.	0.	534.
2001.	0.	0.	0.	56.	88.	45.	25.	30.	81.	129.	0.	0.	454.
2002.	0.	0.	0.	73.	104.	64.	53.	49.	52.	65.	8.	0.	468.
2003.	0.	0.	0.	10.	163.	77.	81.	64.	67.	73.	2.	0.	537.
2004.	0.	0.	0.	131.	126.	99.	115.	40.	88.	17.	0.	0.	616.
2005.	0.	0.	0.	38.	42.	78.	53.	120.	112.	0.	0.	0.	443.
Total Rainfall Depth for Simulation Period													19310. (mm)

Rainfall Intensity Analysis (mm/hr)

(mm/hr)	(#)	(%)	(mm)	(%)
2.50	21481	74.6	6454.	33.4
5.00	3585	12.4	3088.	16.0
7.50	1973	6.8	2886.	14.9
10.00	575	2.0	1233.	6.4
12.50	389	1.4	1070.	5.5
15.00	194	0.7	660.	3.4
17.50	210	0.7	846.	4.4
20.00	66	0.2	306.	1.6
22.50	92	0.3	487.	2.5
25.00	39	0.1	232.	1.2
27.50	37	0.1	246.	1.3
30.00	34	0.1	245.	1.3
32.50	29	0.1	228.	1.2
35.00	5	0.0	42.	0.2
37.50	10	0.0	90.	0.5
40.00	10	0.0	97.	0.5
42.50	12	0.0	124.	0.6
45.00	9	0.0	99.	0.5
47.50	1	0.0	12.	0.1
50.00	3	0.0	37.	0.2
>50.00	49	0.2	829.	4.3
Total # of Intensities		28803		

Daily Rainfall Depth Analysis (mm)

(mm)	(#)	(%)	(mm)	(%)
2.50	1077	38.9	1247.	6.5
5.00	507	18.3	1850.	9.6
7.50	326	11.8	2006.	10.4
10.00	226	8.2	1958.	10.1
12.50	150	5.4	1672.	8.7
15.00	111	4.0	1495.	7.7
17.50	100	3.6	1620.	8.4
20.00	67	2.4	1260.	6.5
22.50	45	1.6	958.	5.0
25.00	37	1.3	881.	4.6
27.50	23	0.8	609.	3.2
30.00	20	0.7	575.	3.0
32.50	20	0.7	631.	3.3
35.00	12	0.4	405.	2.1
37.50	8	0.3	290.	1.5
40.00	9	0.3	350.	1.8
42.50	4	0.1	165.	0.9
45.00	4	0.1	173.	0.9
47.50	2	0.1	91.	0.5
50.00	4	0.1	192.	1.0
>50.00	15	0.5	882.	4.6
Total # Days with Rain		2767		

\*\*\*\*\*

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

\* End of time step DO-loop in Runoff \*

```

*****
Final Date (Mo/Day/Year) =          1/ 1/2006
Total number of time steps =        2056423
Final Julian Date =                2006001
Final time of day =                  2. seconds.
Final time of day =                  0.00 hours.
Final running time =                 306816.0000 hours.
Final running time =                 12784.0000 days.
  
```

```

*****
* Extrapolation Summary for Watersheds *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of OVERLND Calls *
*****
  
```

Subcatch	# Steps	# Calls	Subcatch	# Steps	# Calls	Subcatch	# Steps	# Calls
300	6218037	1584419						

```

*****
* Extrapolation Summary for Channel/Pipes *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of GUTNR Calls *
*****
  
```

Chan/Pipe	# Steps	# Calls	Chan/Pipe	# Steps	# Calls	Chan/Pipe	# Steps	# Calls
201	0	0						

\* Continuity Check for Surface Water \*

	cubic meters	Millimeters over Total Basin
Total Precipitation (Rain plus Snow)	452666.	19263.
Total Infiltration	316184.	13455.
Total Evaporation	14005.	596.
Surface Runoff from Watersheds	123627.	5261.
Total Water remaining in Surface Storage	0.	0.
Infiltration over the Pervious Area...	316184.	19221.
Infiltration + Evaporation + Surface Runoff + Snow removal + Water remaining in Surface Storage + Water remaining in Snow Cover.....	453816.	19312.
Total Precipitation + Initial Storage.	452666.	19263.

The error in continuity is calculated as

```

*****
* Precipitation + Initial Snow Cover *
* - Infiltration - *
*Evaporation - Snow removal - *
*Surface Runoff from Watersheds - *
*Water in Surface Storage - *
*Water remaining in Snow Cover *
*-----*
* Precipitation + Initial Snow Cover *
*****
Error..... -0.254 Percent
  
```

\* Continuity Check for Channel/Pipes \*

	cubic meters	Millimeters over Total Basin
Initial Channel/Pipe Storage.....	0.	0.
Final Channel/Pipe Storage.....	0.	0.
Surface Runoff from Watersheds.....	123627.	5261.
Baseflow.....	0.	
Groundwater Subsurface Inflow.....	0.	0.
Evaporation Loss from Channels.....	0.	0.
Channel/Pipe/Inlet Outflow.....	123627.	5261.
Initial Storage + Inflow.....	123627.	5261.
Final Storage + Outflow.....	123627.	5261.
* Final Storage + Outflow + Evaporation - * * Watershed Runoff - Groundwater Inflow - * * Initial Channel/Pipe Storage * *-----* * Final Storage + Outflow + Evaporation * *****		
Error.....	0.000 Percent	

\* Continuity Check for Subsurface Water \*

	cubic meters	Millimeters over Subsurface Basin
Total Infiltration	0.	0.
Total Upper Zone ET	0.	0.
Total Lower Zone ET	0.	0.
Total Groundwater flow	0.	0.
Total Deep percolation	0.	0.
Initial Subsurface Storage	21488.	914.
Final Subsurface Storage	21488.	914.
Upper Zone ET over Pervious Area	0.	0.
Lower Zone ET over Pervious Area	0.	0.

```

*****
* Infiltration + Initial Storage - Final *
* Storage - Upper and Lower Zone ET - *
* Groundwater Flow - Deep Percolation *
*-----*
* Infiltration + Initial Storage *
*****
Error..... 0.000 Percent
  
```

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

### SUMMARY STATISTICS FOR SUBCATCHMENTS

SUBCATCHMENT NO.	GUTTER OR INLET NO.	AREA (HA)	PERCENT IMPER.	PERVIOUS AREA			IMPERVIOUS AREA		TOTAL SUBCATCHMENT AREA		
				TOTAL SIMULATED RAINFALL (MM)	TOTAL RUNOFF DEPTH (MM)	PEAK TOTAL RUNOFF RATE (CMS)	RUNOFF DEPTH (MM)	PEAK RUNOFF RATE (CMS)	RUNOFF DEPTH (MM)	PEAK RUNOFF RATE (CMS)	PEAK UNIT RUNOFF (MM/HR)
300	200	2.35	30.019262	47	37.510*****	0.16217444	924	0.384	5259.735	0.546	84.358

\*\*\* NOTE \*\*\* IMPERVIOUS AREA STATISTICS AGGREGATE IMPERVIOUS AREAS WITH AND WITHOUT DEPRESSION STORAGE

### SUMMARY STATISTICS FOR CHANNEL/PIPES

CHANNEL NUMBER	FULL FLOW (CMS)	FULL VELOCITY (M/S)	FULL DEPTH (M)	MAXIMUM COMPUTED INFLOW		MAXIMUM COMPUTED OUTFLOW		MAXIMUM COMPUTED DEPTH (M)	MAXIMUM COMPUTED VELOCITY (M/S)	TIME OF OCCURRENCE DAY HR.	LENGTH OF SURCHARGE (HOUR)	MAXIMUM SURCHARGE VOLUME (CU-M)	RATIO OF FULL FLOW	RATIO OF MAX. TO FULL DEPTH
				(CMS)	(CMS)	(CMS)	(CMS)							
201				0.00						1/ 0/1900	0.00			
200				0.55						8/14/1972	14.25			

TOTAL NUMBER OF CHANNELS/PIPES = 2

\*\*\* NOTE \*\*\* THE MAXIMUM FLOWS AND DEPTHS ARE CALCULATED AT THE END OF THE TIME INTERVAL

```
#####
# Runoff Quality Summary Page #
# If NDIM = 0 Units for: loads mass rates #
# METRIC = 1 lb lb/sec #
# METRIC = 2 kg kg/sec #
# If NDIM = 1 Loads are in units of quantity #
# and mass rates are quantity/sec #
# If NDIM = 2 loads are in units of concentration #
# times volume and mass rates have units#
# of concentration times volume/second #
#####
```

Total Su NDIM = 0  
METRIC = 2

Total Su  
-----

#### Inputs

```
-----
1. INITIAL SURFACE LOAD..... 51.
2. TOTAL SURFACE BUILDUP..... 24555.
3. INITIAL CATCHBASIN LOAD..... 0.
4. TOTAL CATCHBASIN LOAD..... 0.
5. TOTAL CATCHBASIN AND SURFACE BUILDUP (2+4)..... 24555.
```

#### Remaining Loads

```
-----
6. LOAD REMAINING ON SURFACE... 36.
7. REMAINING IN CATCHBASINS.... 0.
8. REMAINING IN CHANNEL/PIPES.. 0.
```

#### Removals

```
-----
9. STREET SWEEPING REMOVAL..... 3691.
10. NET SURFACE BUILDUP (2-9)... 20864.
11. SURFACE WASHOFF..... 20825.
12. CATCHBASIN WASHOFF..... 0.
13. TOTAL WASHOFF (11+12)..... 20825.
14. LOAD FROM OTHER CONSTITUENTS 0.
15. PRECIPITATION LOAD..... 0.
15a. SUM SURFACE LOAD (13+14+15). 20825.
16. TOTAL GROUNDWATER LOAD..... 0.
16a. TOTAL I/I LOAD..... 0.
17. NET SUBCATCHMENT LOAD (15a-15b-15c-15d+16a).... 20825.
>>Removal in channel/pipes (17a, 17b):
17a. REMOVE BY BMP FRACTION..... 0.
17b. REMOVE BY 1st ORDER DECAY... 0.
18. TOTAL LOAD TO INLETS..... 20825.
19. FLOW WT'D AVE. CONCENTRATION mg/l
(INLET LOAD/TOTAL FLOW)..... 169.
```

#### Percentages

```
-----
20. STREET SWEEPING (9/2)..... 15.
21. SURFACE WASHOFF (11/2)..... 85.
22. NET SURFACE WASHOFF(11/10).. 100.
23. WASHOFF/SUBCAT LOAD(11/17).. 100.
24. SURFACE WASHOFF/INLET LOAD (11/18)..... 100.
25. CATCHBASIN WASHOFF/ SUBCATCHMENT LOAD (12/17)... 0.
26. CATCHBASIN WASHOFF/ INLET LOAD (12/18)..... 0.
27. OTHER CONSTITUENT LOAD/ SUBCATCHMENT LOAD (14/17)... 0.
28. INSOLUBLE FRACTION/ INLET LOAD (14/18)..... 0.
29. PRECIPITATION/ SUBCATCHMENT LOAD (15/17)... 0.
30. PRECIPITATION/ INLET LOAD (15/18)..... 0.
31. GROUNDWATER LOAD/ SUBCATCHMENT LOAD (16/17)... 0.
32. GROUNDWATER LOAD/ INLET LOAD (16/18)..... 0.
32a. INFILTRATION/INFLOW LOAD/ SUBCATCHMENT LOAD (16a/17).. 0.
32b. INFILTRATION/INFLOW LOAD/ INLET LOAD (16a/18)..... 0.
32c. CH/PIPE BMP FRACTION REMOVAL/ SUBCATCHMENT LOAD (17a/17).. 0.
32d. CH/PIPE 1st ORDER DECAY REMOVAL/ SUBCATCHMENT LOAD (17b/17).. 0.
```

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

33. INLET LOAD SUMMATION ERROR  
(18+8+6a+17a+17b-17)/17..... 0.

CAUTION. Due to method of quality routing (Users Manual, Appendix IX) quality routing through channel/pipes is sensitive to the time step. Large "Inlet Load Summation Errors" may result. These can be reduced by adjusting the time step(s). Note: surface accumulation during dry time steps at end of simulation is not included in totals. Buildup is only performed at beginning of wet steps or for street cleaning.

\*\*\*\*\*  
\* TSS Particle Size Distribution \*  
\*\*\*\*\*

Diameter (um)	%	Specific Gravity	Settling Velocity (m/s)	Critical Peclet Number
20.	20.0	2.65	0.000267	0.093400
30.	10.0	2.65	0.000597	0.113900
50.	10.0	2.65	0.001629	0.152500
100.	20.0	2.65	0.006044	0.235000
250.	20.0	2.65	0.026615	0.391296
1000.	20.0	2.65	0.111334	0.928988

\*\*\*\*\*  
\* Summary of TSS Removal \*  
\*\*\*\*\*

TSS Removal based on Lab Performance Curve

Model #	Low Q Treated (cms)	High Q Treated (cms)	Runoff Treated (%)	TSS Removed (%)
Unavailabl	0.077	0.077	99.3	68.2
HD 4	0.077	0.077	99.3	76.8
HD 5	0.077	0.077	99.3	82.8
HD 6	0.077	0.077	99.3	87.1
HD 7	0.077	0.077	99.3	89.9
HD 8	0.077	0.077	99.3	92.5
HD 10	0.077	0.077	99.3	95.5
HD 12	0.077	0.077	99.3	97.5

\*\*\*\*\*  
\* Summary of Annual Flow Treatment & TSS Removal \*  
\*\*\*\*\*

HD 4

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	15976.	15195.	415.	294.	122.	7.	95.1	69.6
1972.	20245.	18589.	538.	414.	125.	21.	91.8	74.0
1973.	19677.	19677.	567.	439.	128.	0.	100.0	77.3
1974.	20011.	19856.	586.	486.	100.	5.	99.2	82.2
1975.	17013.	16762.	512.	379.	134.	5.	98.5	73.2
1976.	25314.	24968.	678.	525.	153.	10.	98.6	76.3
1977.	27206.	26781.	699.	494.	205.	11.	98.4	69.6
1978.	21740.	21740.	625.	460.	166.	0.	100.0	73.5
1979.	25913.	25654.	722.	565.	158.	6.	99.0	77.6
1980.	20918.	20918.	632.	481.	151.	0.	100.0	76.1
1981.	28900.	28876.	759.	601.	159.	1.	99.9	79.0
1982.	20338.	20338.	581.	468.	114.	0.	100.0	80.5
1983.	26765.	26696.	755.	598.	156.	3.	99.7	79.0
1984.	21598.	21598.	603.	448.	155.	0.	100.0	74.3
1985.	18834.	18834.	560.	438.	122.	0.	100.0	78.1
1986.	27461.	27461.	783.	623.	159.	0.	100.0	79.6
1987.	28332.	28193.	807.	625.	182.	3.	99.5	77.1
1988.	22872.	22741.	656.	529.	126.	1.	99.4	80.6
1989.	25017.	24911.	669.	533.	136.	2.	99.6	79.4
1990.	28392.	28392.	809.	664.	146.	0.	100.0	82.0
1991.	26543.	26428.	760.	607.	153.	3.	99.6	79.6
1992.	33813.	33813.	932.	709.	223.	0.	100.0	76.1
1993.	22996.	22996.	696.	582.	114.	0.	100.0	83.6
1994.	24609.	23949.	640.	470.	170.	14.	97.3	71.8
1995.	28576.	28576.	776.	585.	191.	0.	100.0	75.4
1998.	7412.	7412.	247.	181.	65.	0.	100.0	73.5
1999.	18154.	18154.	547.	412.	135.	0.	100.0	75.3
2000.	20912.	20912.	550.	387.	164.	0.	100.0	70.3
2001.	16516.	16516.	454.	376.	78.	0.	100.0	82.9
2002.	17257.	17257.	515.	411.	104.	0.	100.0	79.8
2003.	19627.	19627.	548.	414.	135.	0.	100.0	75.5
2004.	23631.	23631.	605.	453.	152.	0.	100.0	74.9
2005.	17013.	16669.	455.	305.	150.	7.	98.0	66.1

HD 5

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	15976.	15195.	415.	326.	90.	7.	95.1	77.2
1972.	20245.	18589.	538.	441.	97.	21.	91.8	78.9
1973.	19677.	19677.	567.	476.	91.	0.	100.0	83.9
1974.	20011.	19856.	586.	512.	75.	5.	99.2	86.6
1975.	17013.	16762.	512.	415.	97.	5.	98.5	80.3
1976.	25314.	24968.	678.	568.	110.	10.	98.6	82.5
1977.	27206.	26781.	699.	548.	151.	11.	98.4	77.2
1978.	21740.	21740.	625.	503.	123.	0.	100.0	80.4
1979.	25913.	25654.	722.	600.	122.	6.	99.0	82.4
1980.	20918.	20918.	632.	525.	107.	0.	100.0	83.1
1981.	28900.	28876.	759.	645.	115.	1.	99.9	84.8
1982.	20338.	20338.	581.	503.	79.	0.	100.0	86.5
1983.	26765.	26696.	755.	635.	119.	3.	99.7	83.8
1984.	21598.	21598.	603.	492.	111.	0.	100.0	81.6
1985.	18834.	18834.	560.	471.	89.	0.	100.0	84.1
1986.	27461.	27461.	783.	669.	114.	0.	100.0	85.5
1987.	28332.	28193.	807.	676.	131.	3.	99.5	83.4

# Stormwater Management Plan

## Modero Estates, Town of Niagara-on-the-Lake

1988.	22872.	22741.	656.	562.	93.	1.	99.4	85.6
1989.	25017.	24911.	669.	572.	97.	2.	99.6	85.3
1990.	28392.	28392.	809.	707.	102.	0.	100.0	87.4
1991.	26543.	26428.	760.	644.	115.	3.	99.6	84.5
1992.	33813.	33813.	932.	776.	156.	0.	100.0	83.3
1993.	22996.	22996.	696.	616.	80.	0.	100.0	88.5
1994.	24609.	23949.	640.	510.	130.	14.	97.3	78.0
1995.	28576.	28576.	776.	633.	143.	0.	100.0	81.6
1998.	7412.	7412.	247.	201.	46.	0.	100.0	81.3
1999.	18154.	18154.	547.	448.	99.	0.	100.0	81.9
2000.	20912.	20912.	550.	427.	124.	0.	100.0	77.5
2001.	16516.	16516.	454.	399.	55.	0.	100.0	87.9
2002.	17257.	17257.	515.	437.	78.	0.	100.0	84.9
2003.	19627.	19627.	548.	446.	102.	0.	100.0	81.4
2004.	23631.	23631.	605.	491.	114.	0.	100.0	81.1
2005.	17013.	16669.	455.	339.	116.	7.	98.0	73.4

\*\*\*\*\*  
 \* Summary of Toronto Rainfall Intensities \*  
 \*  
 \*\*\*\*\*

ainfall Intensity (mm/h)	Flow (L/s)	Percentage %
1.50	4.2	39.4
2.25	6.2	9.6
3.00	8.3	6.8
3.75	10.4	5.4
4.75	13.2	5.6
5.75	16.0	5.0
8.00	22.2	6.1
10.00	27.7	3.9
15.50	43.0	7.1
23.25	64.5	11.0

\*\*\*\*\*  
 \* Summary of Quantity and Quality Results at \*  
 \* Location 200 INFlow in cms. \*  
 \* Values are instantaneous at indicated time step \*  
 \*\*\*\*\*

Concession 7 Storm Sewer  
 Niagara-on-the-Lake

Date	Time	Flow	Total Su
Mo/Da/Year	Hr:Min	cum/s	mg/l
Flow wtd means.....		0.002	169.
Flow wtd std devs..		0.006	68.
Maximum value.....		0.546	3974.
Minimum value.....		0.000	0.
Total loads.....		123270.	20782.
		Cub-Met	KILOGRAM

==> Runoff simulation ended normally.

==> SWMM 4.4 simulation ended normally.  
 Always check output file for possible warning messages.

\*\*\*\*\*  
 \* SWMM 4.4 Simulation Date and Time Summary \*  
 \*\*\*\*\*  
 \* Starting Date... October 9, 2024 \*  
 \* Time... 16:20: 0.379 \*  
 \* Ending Date... October 9, 2024 \*  
 \* Time... 16:20: 3.637 \*  
 \* Elapsed Time... 0.054 minutes. \*  
 \* Elapsed Time... 3.258 seconds. \*  
 \*\*\*\*\*

