UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

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File: 2160

FUNCTIONAL SERVICING REPORT

Westwood Estates (Phase 3)
City of Port Colborne
Revised April 2025

INTRODUCTION

This report is to address the servicing needs for the proposed residential development of Westwood Estates (Phase 3) located within the last remaining lands of the Westwood Park Secondary Plan, south of Stanley Street, east of Cement Road, west of Olga Drive, and north of the Eagle Marsh Drain in the City of Port Colborne.

The 30.55 hectare property will consist of a mix of single detached dwellings, street townhouse dwellings, and a future apartment Block (Block 160). The site will include associated asphalt parking lot, 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 are existing 200mm diameter Municipal watermains located on Sugarloaf Street and Cement Road as well as a 150mm diameter Municipal watermain located on Lancaster Drive, which is fed from the 200mm diameter watermain immediately to the north on Clarence Street West.

It is proposed to connect to the existing municipal watermain on Sugarloaf Street and extend a new 200mm diameter municipal watermain within the subject lands to Lancaster Drive and Cement Road to provide looped watermain system for domestic water supply and fire protection. A Preliminary Watermain Plan (Figure 2) has been provided for reference.

Upper Canada Consultants has undertaken a watermain analysis using the EPANET software to model flows and pressures within the existing and proposed system as a result of the proposed development under peak domestic demand conditions per MECP standards. The model has been calibrated utilizing hydrant test flow data provided by Niagara Regional Fire Protection (NFPA) in November of 2023 and have ensured supportable conclusions for this development. The Hydrant Flow Testing results are included in Appendix A for reference.

The EPANET model has utilized flow test data from fire hydrants located at the following locations noted on Figure 2:

1. On Cement Road, immediately north of the proposed intersection with Street 'A';
2. In front of #767 Sugarloaf Street; and,
3. Opposite to #250 Lancaster Drive.

The results of the conducted modelling have been included in Appendix A and Figures 1 and 2 show the existing and future EPANET model respectively. The existing testing outlines the existing watermain system having static pressures within a pressure range of 60-70 PSI, well above the minimum operating pressure of 40 PSI for domestic demand.

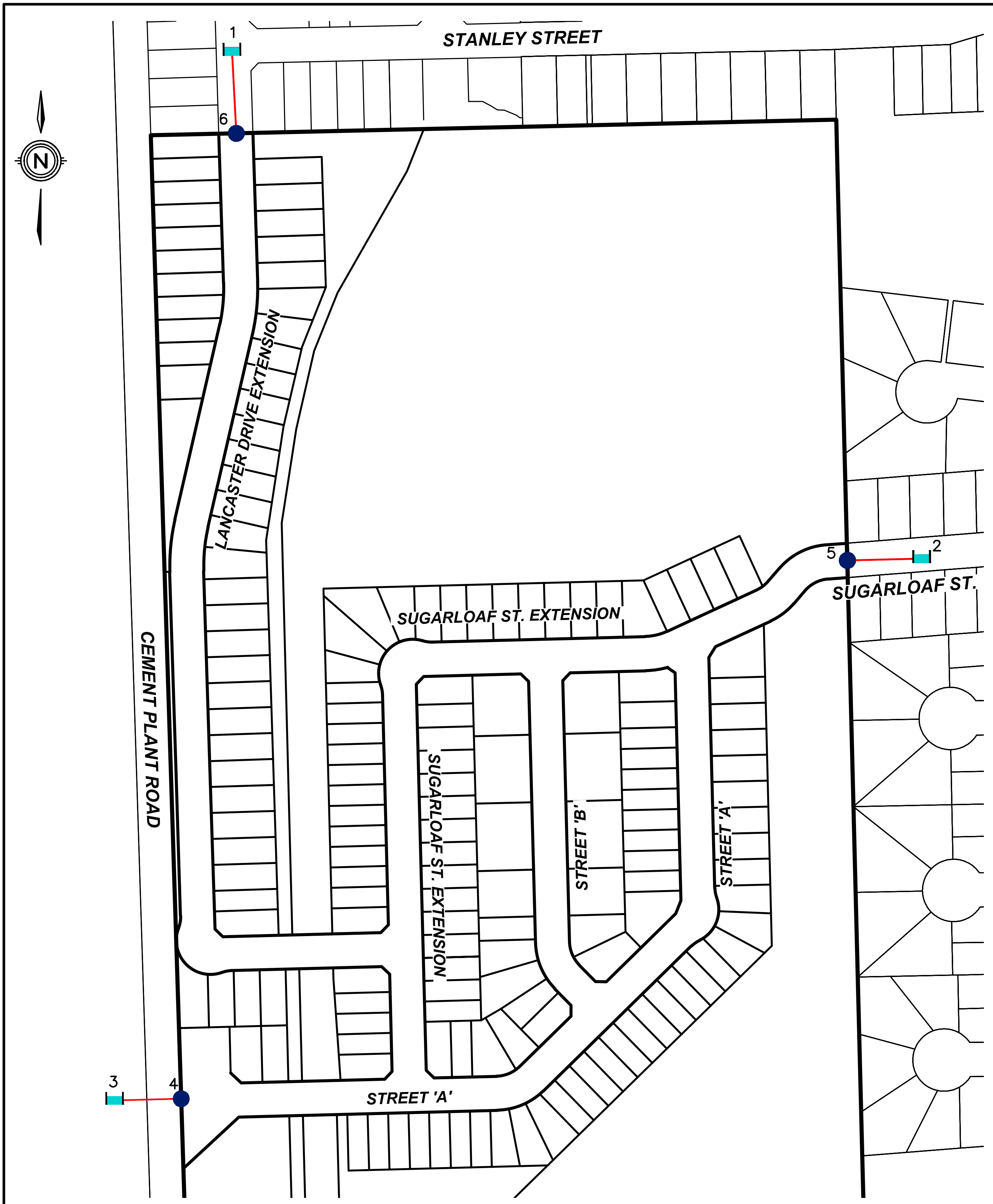
The calibrated existing static and residual pressures from the EPANET model were within 5% (typical) of the measured results of the hydrant flow tests which is considered within a reasonable range for accuracy of the model.

Under future peak daily conditions (860 LPCD), all existing and future hydrants will maintain static pressures of above 60 PSI under future developed conditions. Therefore, it is expected that the existing municipal watermain system will have adequate capacity to provide both domestic water supply for the proposed development.

As summarized in the chart provided within Appendix A, the minimum Fire Flow within the subject lands is provided at Node 12 on Sugarloaf Street Extension. The minimum Fire Flow is 144 L/s at this node, which is greater than the minimum requirement of 133 L/s (8000 LPM) specified for townhouses within Table 8 of the Fire Underwriter's Survey "Water Supply for Public Fire Protection (2020)" document. Therefore, there is expected to be adequate capacity within the existing watermain system to provide fire protection within the subject lands.

Proposed hydrants located within the development will provide adequate fire protection as discussed above. The spacing and location of the proposed fire hydrants will be identified as part of the detailed engineering design.

Due to the complicated nature of this model, theoretical flows calculated by the model are not directly comparable to theoretical flows modelled during the municipal hydrant flow tests. Therefore, the model has been utilized to model the difference between pressures observed in the system. It should be noted that the pressures and flow rates observed by this model are purely theoretical, attempting to replicate information provided by the City's hydrant flow test data for hydrants within the immediate vicinity of the proposed development site.



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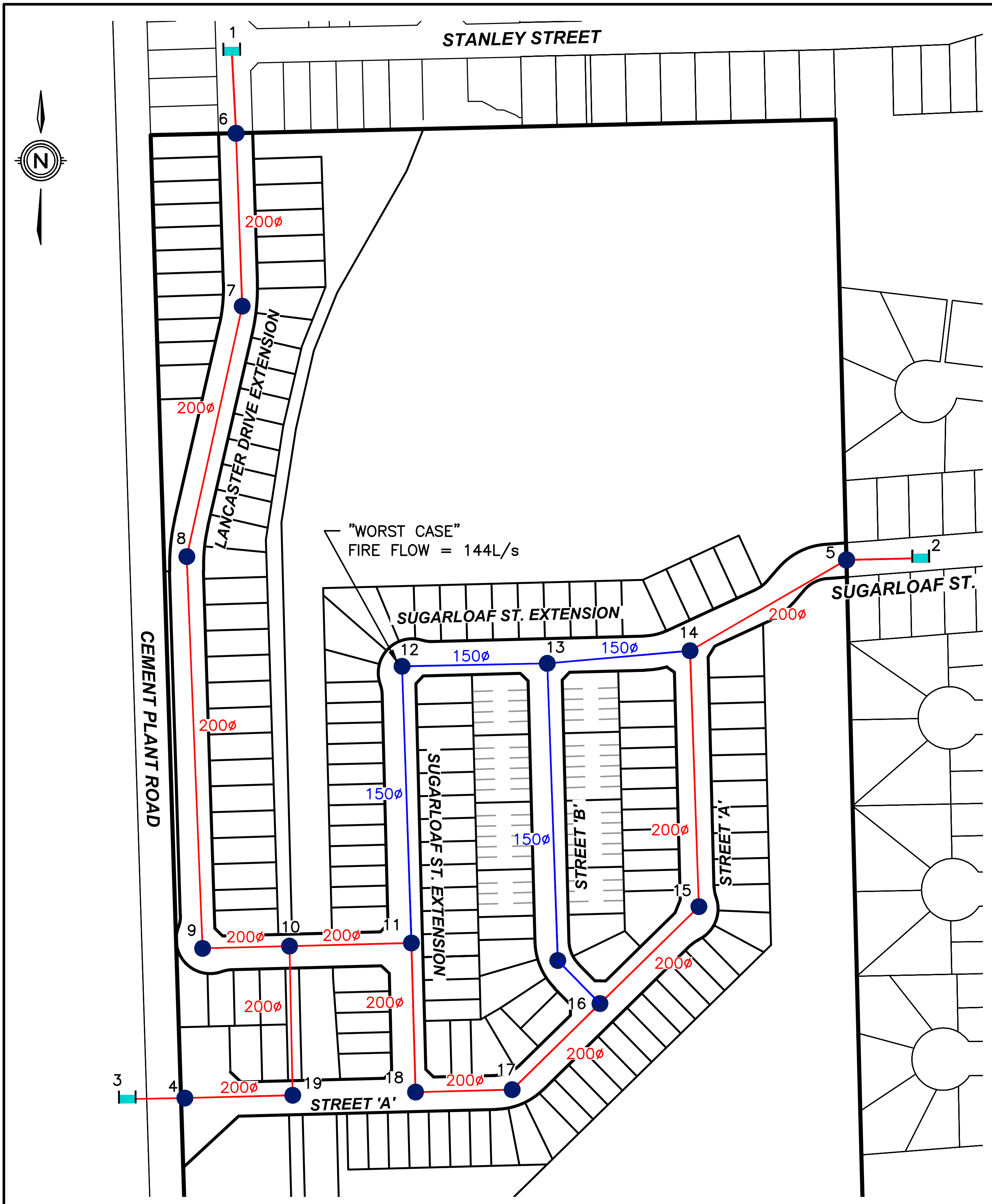
WESTWOOD ESTATES PHASE 3

CITY OF PORT COLBORNE
EXISTING EPANET MODEL

DATE	2025-03-19
SCALE	1:3000 m
REF No.	2160
DWG No.	FIGURE 1

DRAWING FILE: F:\2160\SWM\SWM Base Prelim.dwg PLOTTED: Apr 21, 2025 – 10:27am PLOTTED BY: roberto



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WESTWOOD ESTATES PHASE 3

CITY OF PORT COLBORNE

PROPOSED EPANET MODEL

DATE	2025–04–21
SCALE	1:3000 m
REF No.	2160
DWG No.	FIGURE 2

DRAWING FILE: F:\2160\SWM\SWM Base Prelim.dwg PLOTTED: Apr 21, 2025 – 11:25am PLOTTED BY: roberto

Without a complete model of the city's entire water system, a highly accurate model providing reliable flow rate data for the future development is unobtainable.

SANITARY SERVICING

There is an existing 350mm diameter sanitary sewer on Sugarloaf Street as well as an existing 200mm diameter sanitary sewer on Lancaster Drive. It is proposed to convey the proposed sanitary flows from the entire subject lands to the existing 350mm diameter sanitary sewer on Sugarloaf Street.

To provide adequate depth for the proposed sanitary sewer to be extended under the existing bedrock channel within the subject lands and to service the proposed dwellings on Lancaster Driver, the existing 350mm diameter sanitary sewer on Sugarloaf Street will be lowered and replaced with a new 250mm diameter sanitary sewer at 0.28% from the eastern limit of the subject lands to Schofield Avenue. Full details of the reconstruction works will be determined as part of the detailed engineering design.

Some proposed dwellings fronting on the Lancaster Drive Extension (at the extreme upstream of the sanitary sewer system) will be required to provide basement sewage pumps draining to the sanitary service due to the shallow sewer depth along this road. The lots requiring pumps will be noted as part of the detailed engineering design.

A Preliminary Overall Sanitary Drainage Area Plan (DWG# 2160-OSAN) has been prepared to demonstrate the available capacity of the existing sanitary sewer network to convey future sanitary flows from the subject lands to the existing Rosemount Sewage Pumping Station (SPS) and is enclosed in Appendix B for reference.

The subject lands consist of a total sanitary drainage area of approximately 13.24 hectares and a corresponding population of approximately 855 persons, including Block 160. The peak sanitary flow discharging to the Rosemount SPS from the subject lands is approximately 13.4 L/s. As shown in the sanitary sewer design sheet, the receiving sanitary system will operate at a maximum of approximately 67.0% of the full flow capacity within the system. Therefore, there is expected to be adequate capacity within the existing sanitary sewers to service the subject lands.

A wet and dry weather flow analysis was requested by the Region of Niagara to ensure the receiving system has adequate capacity throughout the sanitary sewer's lifecycle. Table 1 shows the corresponding wet and dry weather sanitary flows generated from the site.

Table 1. Wet and Dry Weather Flow Analysis	
Residential Dry Weather Flow	
255 L/cap/day - 855 *persons*	218,025 L/day
Allowable Initial Leakage per OPSS.MUNI 410	
0.075 L/mm diameter/100m of sewer/hour - *250 mm dia, 1850m total sewer length*	8,325 L/day
Maximum End of Life Infiltration Allowance	
0.286 L/s/ha – *13.24 ha*	327,166 L/day

STORMWATER MANAGEMENT PLAN

A separate Stormwater Management (SWM) Plan has been prepared by Upper Canada Consultants (UCC) for the subject lands, which has been enclosed in Appendix C for reference. Please refer to the enclosed SWM Plan for the detailed Stormwater Management requirements and calculations.

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 200mm diameter municipal watermains on Sugarloaf Street, Lancaster Drive and Cement Road will have sufficient capacity to provide both domestic and fire protection water supply.

2. The existing sanitary system to the Rosemount North SPS will have adequate capacity for the proposed development. The existing 350mm diameter sanitary sewer on Sugarloaf will be reconstructed and lowered to Schofield Avenue to provide adequate depth to service the subject lands.

3. There will be proposed dwellings fronting onto the Extension of Lancaster Drive that will require basement sewage pumps discharging to the sanitary service.

4. Stormwater quantity controls and erosion protection are not considered necessary for the subject lands.

5. Stormwater quality protection is being provided by a wet pond facility and Oil/Grit separator to Enhanced (80% TSS) Level Protection as per the recommendation of the Region of Niagara.

Based on the above and the enclosed calculations and documents, 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.

Respectfully Submitted,

Prepared By:	Reviewed by:
Roberto A. Duarte, B. Eng.	Brendan Kapteyn, P.Eng.
April 21, 2025	April 21, 2025

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

Encl.

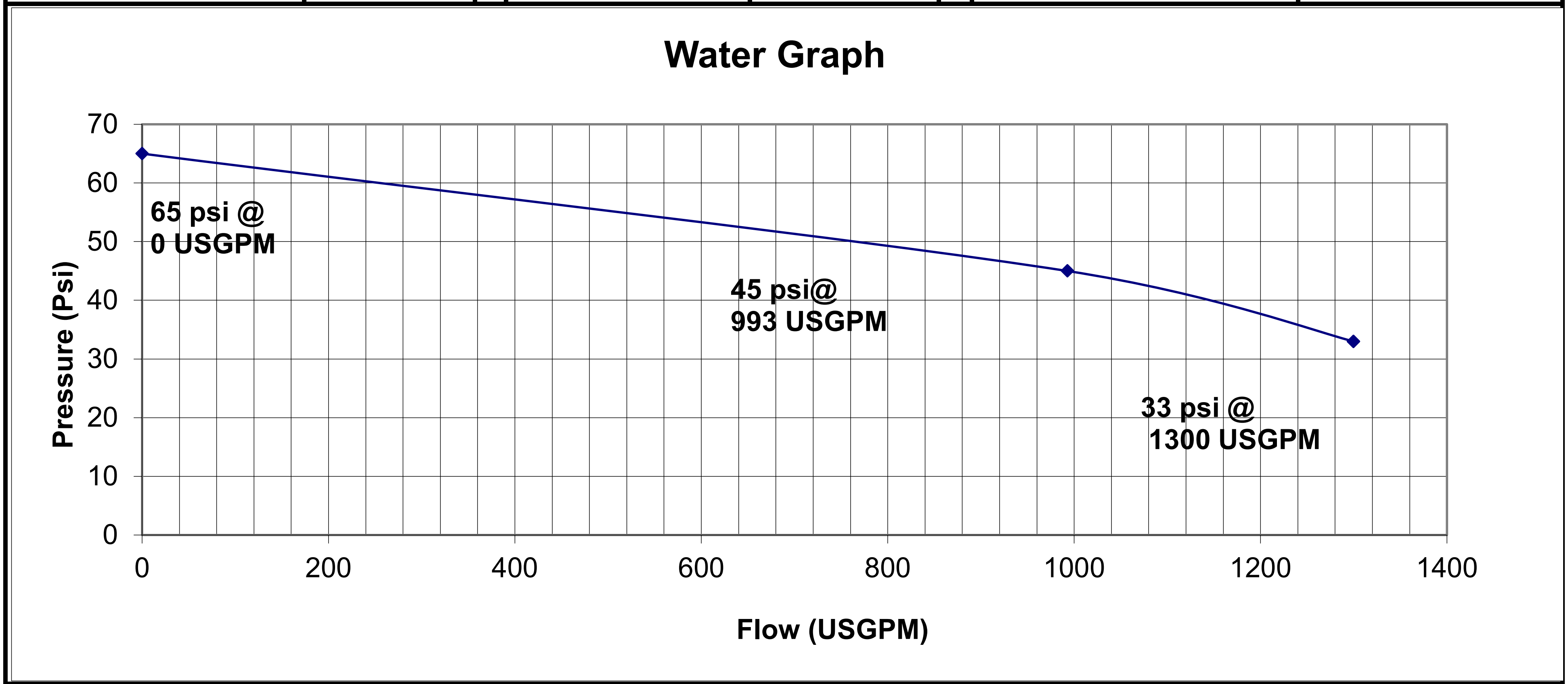
APPENDICES

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX A

Existing Fire Hydrant Flow Testing Results (Cement Plant Rd., Lancaster Dr., Sugarloaf St.)
Existing and Future EPANET Modelling Results

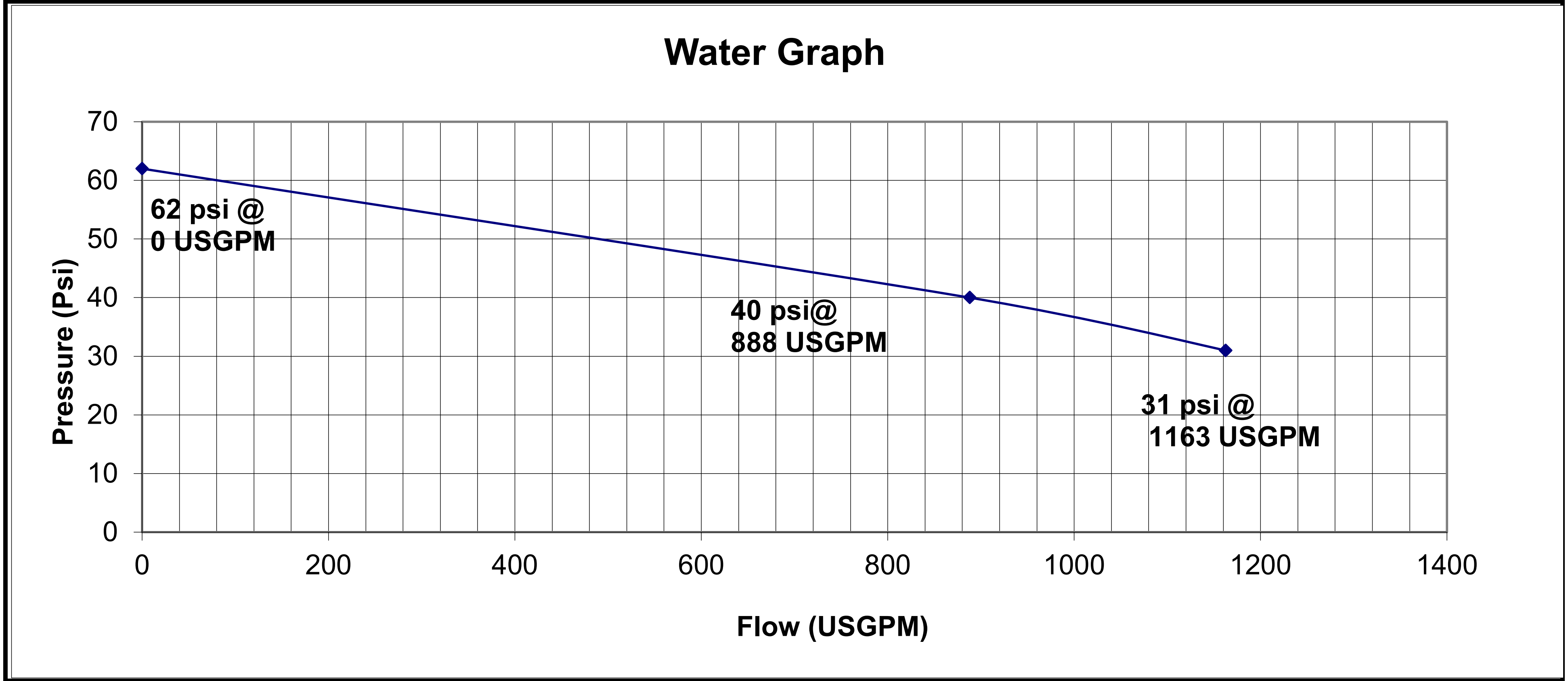
NIAGARA REGIONAL FIRE PROTECTION INC.					
Flow Test Location: On Cement Plant Rd.					
Static Pressure (Psi)		Pitot Reading 1	35	# of Outlets Flowed 1	1
	65	Outlet Size 1	2.5	# of Outlets Flowed 2	2
Residual Pressure 1 (Psi)		Pitot Reading 2	15	# of Outlets Flowed 3	2
	45	Outlet Size 2	2.5	Graph Data:	
Residual Pressure 2 (Psi)		Pitot Reading 3	15	Pressure Values (y-axis)	Flow Values (x-axis)
	33	Outlet Size 3	2.5	65	0
Residual Pressure 3 (Psi)		Flow 1 Calculated		45	993
	33		992.7	33	1300
		Flow 2 Calculated		33	1300
			1299.7	Date & Time of Test :	Nov.3/2023
Coefficient value		Flow 3 Calculated			10:00am
	0.9		1299.7	Performed by:	Alex & Ryan



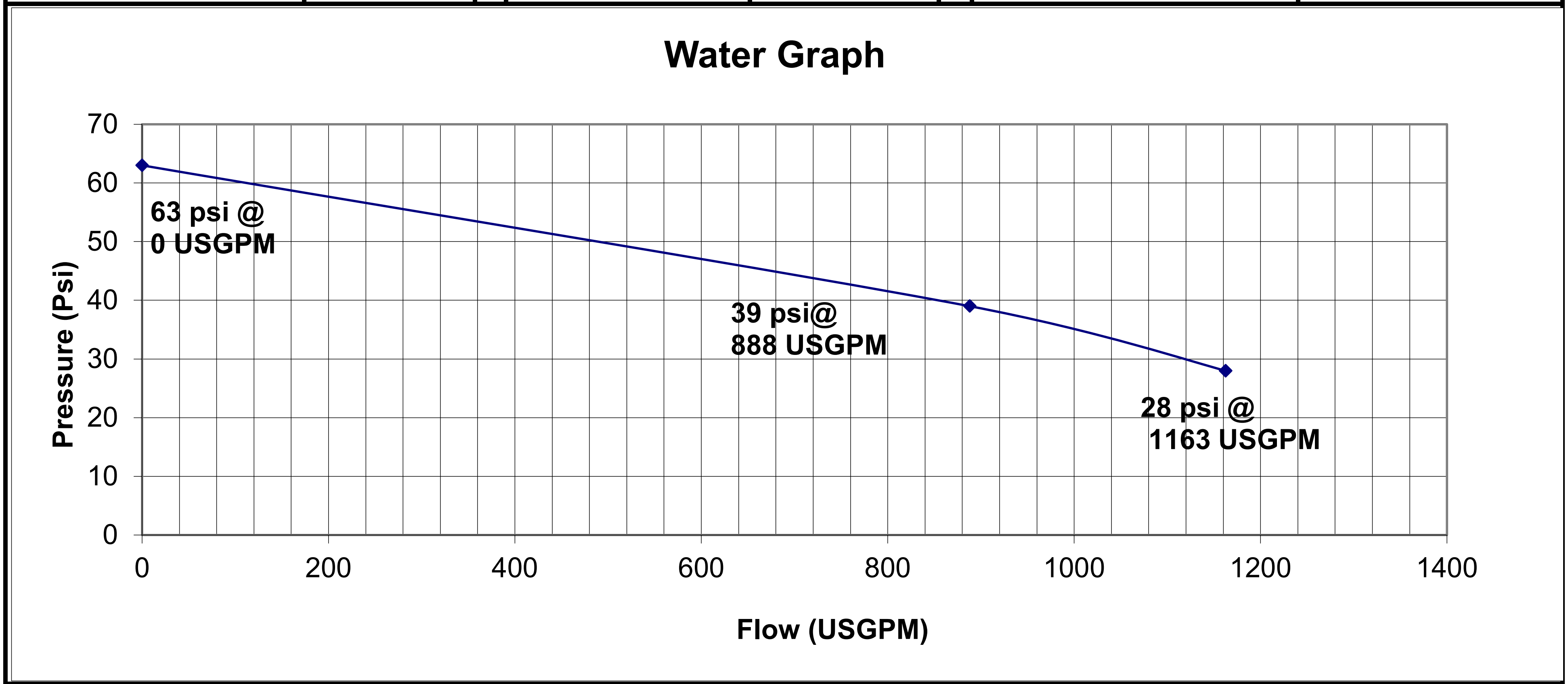
NIAGARA REGIONAL FIRE PROTECTION INC.

Flow Test Location: On Lancaster Dr.

Static Pressure (Psi)		Pitot Reading 1	28	# of Outlets Flowed 1	1
	62	Outlet Size 1	2.5	# of Outlets Flowed 2	2
Residual Pressure 1 (Psi)		Pitot Reading 2	12	# of Outlets Flowed 3	2
	40	Outlet Size 2	2.5	Graph Data:	
Residual Pressure 2 (Psi)		Pitot Reading 3	12	Pressure Values (y-axis)	Flow Values (x-axis)
	31	Outlet Size 3	2.5	62	0
Residual Pressure 3 (Psi)		Flow 1 Calculated		40	888
	31		887.9	31	1163
		Flow 2 Calculated		31	1163
			1162.5	Date & Time of Test :	Nov.3/2023
Coefficient value		Flow 3 Calculated			9:00am
	0.9		1162.5	Performed by:	Alex & Ryan



NIAGARA REGIONAL FIRE PROTECTION INC.					
Flow Test Location: On Sugarloaf St.					
Static Pressure (Psi)		Pitot Reading 1	28	# of Outlets Flowed 1	1
	63	Outlet Size 1	2.5	# of Outlets Flowed 2	2
Residual Pressure 1 (Psi)		Pitot Reading 2	12	# of Outlets Flowed 3	2
	39	Outlet Size 2	2.5	Graph Data:	
Residual Pressure 2 (Psi)		Pitot Reading 3	12	Pressure Values (y-axis)	Flow Values (x-axis)
	28	Outlet Size 3	2.5	63	0
Residual Pressure 3 (Psi)		Flow 1 Calculated		39	888
	28		887.9	28	1163
		Flow 2 Calculated		28	1163
			1162.5	Date & Time of Test :	Nov.3/2023
Coefficient value		Flow 3 Calculated			8:00am
	0.9		1162.5	Performed by:	Alex & Ryan



UCC File: 2160
Date: December 18, 2023

WESTWOODS (PHASE 3) EPANET WATER MODEL CALCULATIONS

			A	B	C	D	E	F	G	H	I	J	K	M	N	O	P	Q	R	S	T
			Hydrant Data		Existing Modelled		Future Modelled (with Westwoods Phase 3)			Hydrant Data		Existing Modelled		Hydrant Data		Hydrant Data		Existing Modelled		Future Modelled with Westwoods Phase 3	
Hyd Number	Key Street	Hydrant Address	Static (PSI)	Static (m of H20)	Static (m of H20)	% Difference	Modelled Static Pressures (m of H2O)	Modelled Static Pressures (PSI)	% Difference	Residual PSI	Residual (m of H20)	Modelled Residual	% Difference	Actual Flow (GPM)	Actual Flow (LPS)	Theoretical Flow (GPM @ 20psi)	Theoretical Flow (LPS @ 20psi)	Modelled Theoretical Flow (LPS @ 14.06m)	% Difference	Fire Flow (LPS @ 14.06m)	Fire Flow GPM
	Cement Road	NORTH OF PROPOSED 'STREET A' CONNECTION	65	45.7	45.7	0.0%	44.3	63.0	-3.1%	45	31.6	31.6	0.1%	993	62.6	1553	98.0	97	-1.2%	203	3218
	Sugarloaf Street	IN FROM OF #767 SUGARLOAF STREET	63	44.3	44.3	0.0%	44.2	62.9	-0.2%	39	27.4	27.4	0.1%	888	56.0	1268	80.0	77	-4.2%	174	2758
	Lancaster Drive	SIDE YARD OF #686 STANLEY STREET	62	43.6	43.6	0.0%	43.5	61.9	-0.2%	40	28.1	28.4	-0.9%	888	56.0	1331	84.0	80	-4.6%	173	2742

Conversions

PSI	m of H2O	
1	**0.703**	
20	14.062	Required Minimum Pressure under Fire Flow Conditions at Peak Day demand (10.2.2.1)
40	28.124	Required Minimum Static Pressure per Drinking Water Guidelines (10.2.2.1)
50	35.154	Minimum Preferred Static Pressure per Drinking Water Guidelines (10.2.2.1)
80	56.247	Maximum Preferred Static Pressure per Drinking Water Guidelines (10.2.2.1)

Column	Explanation
A	Static pressures in PSI provided by City
B	Static Pressures converted to m of H2O
C	Static Pressures (in m of H2O) from EPANET model attempting to replicate Column B values
D	% difference of Hydrant Data and Existing Model static pressures (Columns D & B)
E	New Modelled Pressures with inclusion of Rosedale and Meadow Heights Subdivisions
F	Pressures in Column E converted back to PSI
G	% difference of existing and future modelled static pressures (Columns C & E)
H	Residual Pressures in PSI provided by City
I	Residual Pressures converted to m of H2O
J	Residual Pressures (in m of H2O) from EPANET model attempting to replicate Column I values
K	% difference of Hydrant Data and Existing Model Residual Pressures (Columns Q & R)
L	Hydrant Number utilized to complete residual hydrant flow test
M	Actual Residual Flow data provided by City in GPM
N	Actual Residual Flow data provided by City converted to LPS
O	Theoretical Fire Flows in GPM at 20 PSI provided by City
P	Theoretical Fire Flows provided by City converted to LPS
Q	Theoretical Fire Flows in LPS (@ 14.06 m of H2O) from EPANET model attempting to replicate Column P values
R	% difference of city calculated existing theoretical flow and modelled theoretical flow at 20 PSI (Columns P & Q)
S	Calculated Fire Flows (@ 20PSI) calculated for future conditions with Rosedale Subdivision in LPS
T	Column S values converted to GPM

Average	320
Max Day	570
Peak	860

Summary of Modelled Fire Flows within Subject Lands

Node	Street	# of Houses	Population	Peak Day Flow (LPS)	Modelled Peak Day Hydrant Flow @ 20 PSI	
7	Lancaster Ext.	21	63	0.63	177	
8	Lancaster Ext.	12	36	0.36	187	
9	Lancaster Ext.	10	30	0.30	202	
10	Lancaster Ext.	2	6	0.06	212	
11	Sugarloaf Ext.	18	54	0.54	197	
12	**Sugarloaf Ext.**	**17**	**51**	**0.51**	**144**	**WORST CASE**
13	Sugarloaf Ext.	30	90	0.90	161	
14	Sugarloaf Ext.	15	45	0.45	176	
15	Street A	16	48	0.48	171	
16	Street A	31	93	0.93	178	
17	Street A	8	24	0.24	179	
18	Street A	11	33	0.33	183	
19	Street A	2	6	0.06	205	

Average Domestic Demand	**0.44**	**L/s**
Rounded Demand for Each Node	**0.50**	**L/s**

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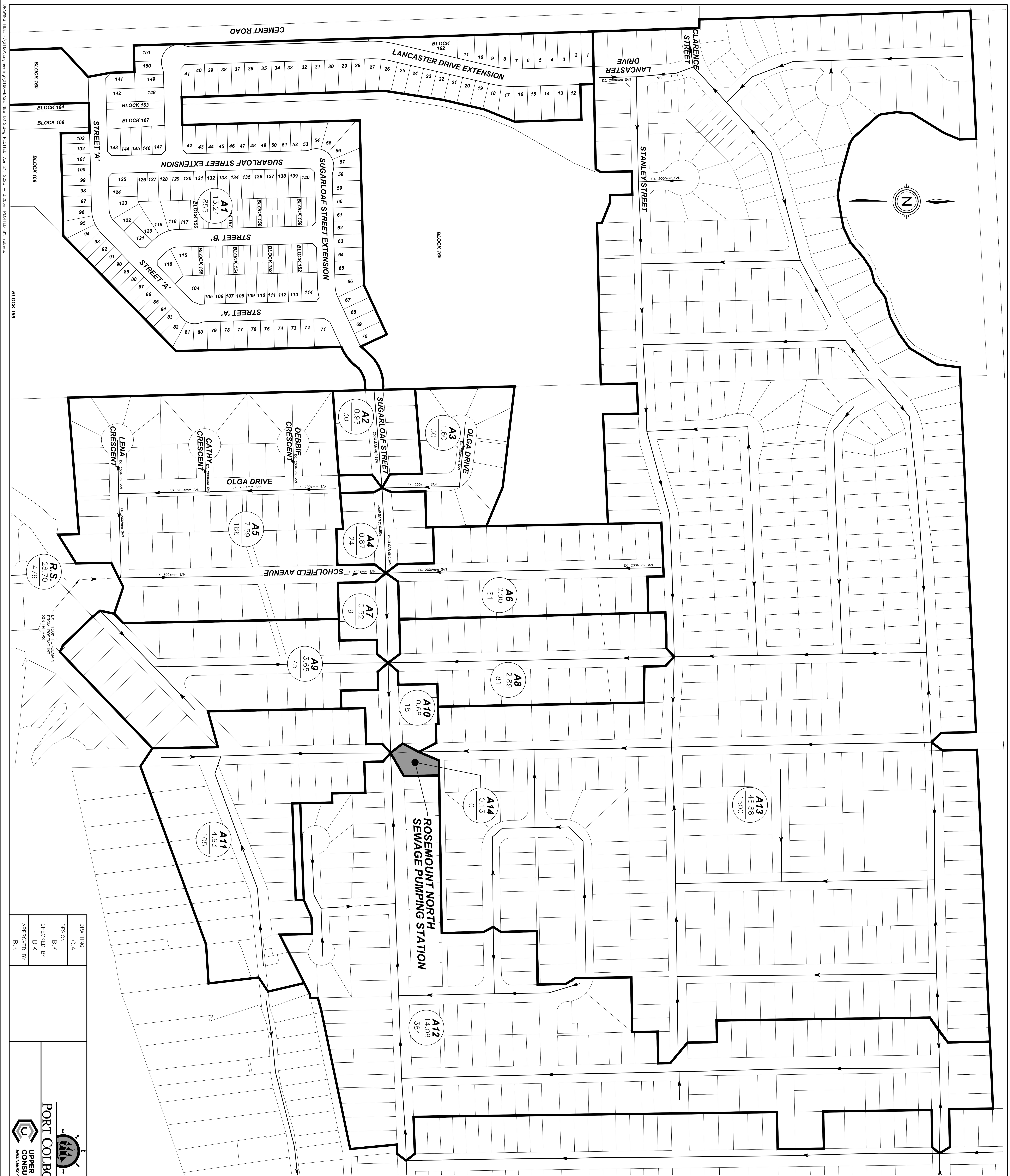
APPENDIX B

Preliminary Overall Sanitary Drainage Area Plan (DWG# 2160-OSAN)



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DESIGN FLOWS

RESIDENTIAL	255 LITRES/PERSON/DAY
COMMERCIAL	28 m^3 / ha / DAY PER MECP
COM PEAKING FACTOR	1.5
INFILTRATION RATE	0.28 L / s / ha
POPULATION DENSITY	3.0 PERSONS / UNIT

SEWER DESIGN

PIPE ROUGHNESS:	0.013 FOR MANNING'S EQUATION
PIPE SIZES:	1.016 IMPERIAL EQUIVALENT FACTOR
PERCENT FULL:	TOTAL PEAK FLOW / CAPACITY

MUNICIPALITY: CITY OF PORT COLBORNE
PROJECT : WESTWOOD ESTATES (PHASE 3)
PROJECT NO: 2160

SANITARY SEWER DESIGN SHEET
ROSEMOUNT NORTH SPS OVERALL SANITARY SEWER ANALYSIS

PEAKING FACTOR: $M = 1 + \frac{14}{4 + P^{0.5}}$

LOCATION			AREA		RESIDENTIAL					COMMERCIAL/ INSTITUTIONAL		Accumulated		DESIGN FLOW				
Location and Description	**From M.H**	**To M.H.**	**Increment (hectares)**	**Accumulated (hectares)**	**Number of Units**	**Population Increment**	**Total Population**	**Peaking Factor**	**Total Flow (L/s)**	**Area**	**Flow (L/s)**	**Infiltration Flow (L/s)**	**Total Peak Flow (L/s)**	**Pipe Diameter (mm)**	**Pipe Slope (%)**	**Full Flow Velocity (m/s)**	**Full Flow Capacity (L/s)**	**Percent Full**
A1			**13.24**	**13.24**	**285**	**855**	**855**	**3.84**	**9.7**			**3.7**	**13.4**	**250**	**0.28**	**0.6**	**32.8**	**40.8%**
A2			**0.93**	**14.17**	**10**	**30**	**885**	**3.83**	**10.0**			**4.0**	**14.0**	**250**	**0.28**	**0.6**	**32.8**	**42.6%**
A3			1.60	1.60	10	30	30	4.35	0.4			0.4	0.8					
A4			**0.87**	**16.64**	**8**	**24**	**939**	**3.82**	**10.6**			**4.7**	**15.2**	**250**	**0.28**	**0.6**	**32.8**	**46.4%**
** RS			28.70	28.70		476	476	3.99	5.6			8.0	13.6					
A5			7.59	36.29	62	186	662	3.91	7.6			10.2	17.8					
A6			2.90	2.90	27	81	81	4.27	1.0			0.8	1.8					
A7			**0.52**	**56.35**	**3**	**9**	**1691**	**3.64**	**18.2**			**15.8**	**34.0**	**400**	**0.16**	**0.7**	**86.9**	**39.1%**
A8			2.89	2.89	27	81	81	4.27	1.0			0.8	1.8					
A9			3.65	3.65	25	75	75	4.28	0.9			1.0	2.0					
A10			**0.68**	**63.57**	**6**	**18**	**1865**	**3.61**	**19.9**			**17.8**	**37.7**	**400**	**0.35**	**1.0**	**128.5**	**29.3%**
A11			4.93	4.93	35	105	105	4.24	1.3			1.4	2.7					
A12			14.08	14.08	128	384	384	4.03	4.6			3.9	8.5					
				82.58			**2354**	**3.53**	**24.5**			**23.1**	**47.6**	**300**	**1.23**	**1.5**	**111.9**	**42.6%**
A13			48.88	48.88	500	1500	1500	3.68	16.3	0.64	0.31	13.7	30.3					
*** **A14**				**131.46**			**3854**	**3.35**	**38.1**	**0.64**	**0.31**	**36.8**	**75.2**	**300**	**1.24**	**1.5**	**112.3**	**67.0%**

NOTE: Analysis terminates at Rosemount North Pumping Station. All sewer lengths and slopes taken from City provided GIS

** Sanitary Drainage Area and Population allocated to Rosemount South Pumping Station Forcemain (Drainage Area RS) obtained from 2021 Niagara Region Wastewater Master Servicing Plan Update

*** St. Patrick Catholic Elementary School - 164 Student Capacity per NCDSB Accomodation Plans: Equivalent Population of 90 persons (30 units)

LEGEND

A0 / 0.00 / 00	DRAINAGE AREA NUMBER / DRAINAGE AREA IN HECTARES / POPULATION
	DRAINAGE AREA BOUNDARY
MH	PROP SANITARY MANHOLE
	SANITARY SEWER WITH FLOW DIRECTION

NOTE: EXISTING SANITARY SEWER SIZES, SLOPES, AND FLOW DIRECTIONS HAVE BEEN DETERMINED FROM THE GIS DATA PROVIDED BY THE CITY OF PORT COLBORNE. ACTUAL INVERTS AND SIZES TO BE CONFIRMED PRIOR TO CONSTRUCTION.

DRAFTING	C.A
DESIGN	B.K
CHECKED BY	B.K
APPROVED BY	B.K

PORT COLBORNE

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

WESTWOOD ESTATES PHASE 3

CITY OF PORT COLBORNE
PRELIMINARY OVERALL SANITARY AREA PLAN

CONSULTANT FILE No.	2160
DATE	2024-01-09
PRINTED	2025-04-21
SCALE	1:2000 m
REF No.	
DWG No.	**2160-OSAN**
REV	0

DRAWING FILE: F:\2160\Engineering\2160-BASE NEW LOTS.dwg PLOTTED: Apr 21, 2025 - 3:20pm PLOTTED BY: roberto

APPENDIX C

Westwood Estates (Phase 3) Stormwater Management Plan

STORMWATER MANAGEMENT PLAN

WESTWOOD ESTATES (PHASE 3)

CITY OF PORT COLBORNE

Prepared by:

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

Revised April 2025

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REFERENCES

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

2. Soils of the Regional Municipality of Niagara Soil Survey Report No. 60 of the Ontario Institute of Pedology. (1989)

STORMWATER MANAGEMENT PLAN

WESTWOOD ESTATES (PHASE 3)

CITY OF PORT COLBORNE

1.0 INTRODUCTION

1.1 Study Area

The proposed residential development of Westwood Estates (Phase 3), is located within the remaining lands of the Westwood Estates Park Secondary Plan in City of Port Colborne. As shown on the enclosed Site Location Plan (Figure 1), the subject property is situated south of Stanley Street, east of Cement Plant Road, west of Olga Drive, and north of the Eagle Marsh Drain.

The study area is approximately 30.55 hectares and will consist of a mix of single detached dwellings, street townhouse dwellings, and a Block that can be developed as a future medium density residential site (Block 160). The site will include associated asphalt parking lot, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

1.2 Objectives

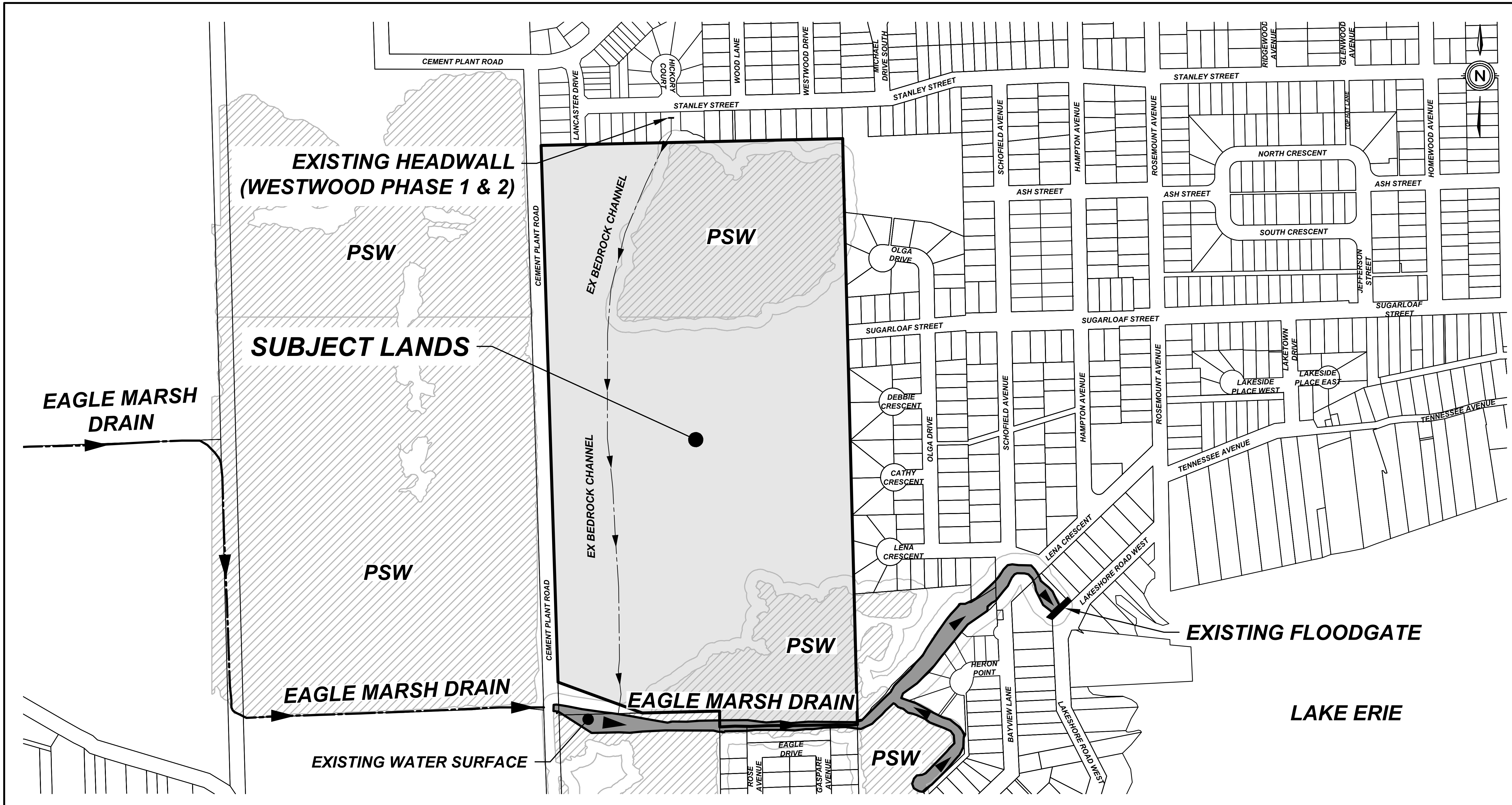
The objectives of this study are as follows:

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

2. Determine the impact of development on the stormwater peak flow & volume of stormwater from the drainage area.

3. Investigate alternatives for controlling the quality of stormwater discharging from the site.

4. Establish the property requirements to construct a stormwater management facility for the Draft Plan of Subdivision.



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WESTWOOD ESTATES (PHASE 3)

CITY OF PORT COLBORNE
SITE LOCATION PLAN

DATE	2022–12–08
SCALE	1:5000 m
REF No.	2160
DWG No.	FIGURE 1

1.3 Existing & Proposed Conditions

a) Existing Conditions

The site has historically been used as primarily agriculture land with one Provincially Significant Wetland (PSW) located in the south-east portion of the site.

The topography of the site is relatively flat with a general southerly slope towards the Eagle Marsh Drain. There is an existing drainage channel through the middle of the site, flowing from north to south providing a stormwater outlet for the previously constructed Phases of the Westwood Estates Subdivision (Phases 1 and 2). This drainage channel was constructed within the existing shallow bedrock levels present within the subject lands.

The soils within the subject lands, according to the Ontario Institute of Pedology, predominantly consist of Brooke soils, with 50-100 cm of variable textures over bedrock and an infiltration rate classified as “Poorly Drained”.

b) Proposed Conditions

The subject lands are approximately 30.55 hectares and will consist of a mix of single family residential dwellings, street town residential dwellings and a Block that can be developed as a future medium density residential site (Block 160). The site shall be provided with full municipal services including sanitary sewers, storm sewers and watermain with asphalt pavement, concrete curbs and gutters.

2.0 STORMWATER MANAGEMENT CRITERIA

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

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

Based on the comments and outstanding policies from the City of Port Colborne, Regional Municipality of Niagara, Niagara Peninsula Conservation Authority (NPCA), and the Ministry of the Environment, Conservation and Parks (MECP), the following site-specific considerations were identified:

- Stormwater runoff from the development shall be collected and treated to an Enhanced (80% TSS removal) standard prior to discharge to the receiving watercourse (Eagle Marsh Drain); and,

- The subject lands are located immediately upstream of the Eagle Marsh Drain's ultimate outlet to Lake Erie. Detaining future peak stormwater flows on site will delay the stormwater peak from the site to match with the greater stormwater peak from the approximately 633 hectares of upstream lands within the Eagle Marsh Drain watershed per the NPCA's 2010 Floodplain Mapping Report for the Eagle Marsh Drain.

- The Regional Municipality of Niagara has requested that downstream erosion protection be provided prior to discharging to the Eagle Marsh Drain.

Based on the above and a review of the site-specific considerations, the following stormwater management criteria have been established for this site:

- Stormwater **quality** controls are to be provided to provide Enhanced Protection (80% TSS removal) in accordance with MECP guidelines prior to outletting to the Eagle Marsh Drain;

- Stormwater **quantity** controls are not required for stormwater flows discharging from the subject lands directly to the Eagle Marsh Drain; and,

- A permanent water elevation is present the Eagle Marsh Drain, which is maintained by the water elevation in Lake Erie. Therefore, downstream erosion effects are not anticipated in the Eagle Marsh Drain due to uncontrolled stormwater flows discharging from the subject lands in frequent storm events and it is not considered necessary to provide **downstream erosion protection** from proposed stormwater management facilities within the subject lands.

3.0 STORMWATER ANALYSIS

It is proposed to model existing and future flows with the MIDUSS modelling software. 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.

3.1 Design Storms

The 5 and 100 year design storm hyetographs w developed using a Chicago distribution based on City of Welland Intensity-Duration-Frequency (IDF) curves in accordance with City of Port Colborne standards. The 25mm design storm IDF curve parameters were derived using a 4-hour Chicago distribution. Table 1 summarizes the rainfall data.

Table 1. Rainfall Data

Design Storm (Return Period)	Chicago Distribution Parameters		
	a	b	c
25mm	512.0	6.00	0.800
5 Year	830.0	7.30	0.777
100 Year	1020.0	4.70	0.731

$$Intensity\ (mm/hr) = \frac{a}{(t_d + b)^c}$$

3.2 Existing Conditions

As shown in Figure 2, existing stormwater flows from the subject lands are conveyed southerly to the Eagle Marsh Drain, and ultimately to Lake Erie.

The eastern portion of the site will drain southerly directly to the existing PSW on the south limit of the site prior to discharging to the Eagle Marsh Drain. This drainage area is shown as Drainage Area EX1 in Figure 2. The remaining portion of the site will drain to the Eagle Marsh Drain either the via existing Bedrock Channel located within the subject lands or the Cement Plan Road roadside ditches.

Flows discharging directly to the Eagle Marsh Drain will not require quantity controls due to the location of the subject lands within the Eagle Marsh Drain watershed. Delaying the discharge of future flows from the subject lands will result in matching the governing upstream peak within the respective watershed, increasing downstream water levels.

Future flows discharging directly the existing PSW are to be limited to existing levels.

To ensure existing flows at the southerly PSW are maintained at or below existing levels, Figure 2 shows the existing stormwater drainage area discharging to this PSW and Table 2 summarizes the hydrologic parameters used in the existing conditions MIDUSS model.

Table 2. Hydrologic Parameters for Existing Conditions

Area No.	Area (ha)	Length (m)	Slope (%)	Manning – "n"		Soil Type	SCS CN	Percent Impervious
				Perv.	Imperv.			
EX1	11.20	273	1.0	0.25	0.015	C	77	1%
	11.20	**Total Area (ha)**						

3.3 Proposed Conditions

The future drainage areas for the proposed development, shown in Figure 3, were modelled to establish the stormwater future peak flows once development has been completed

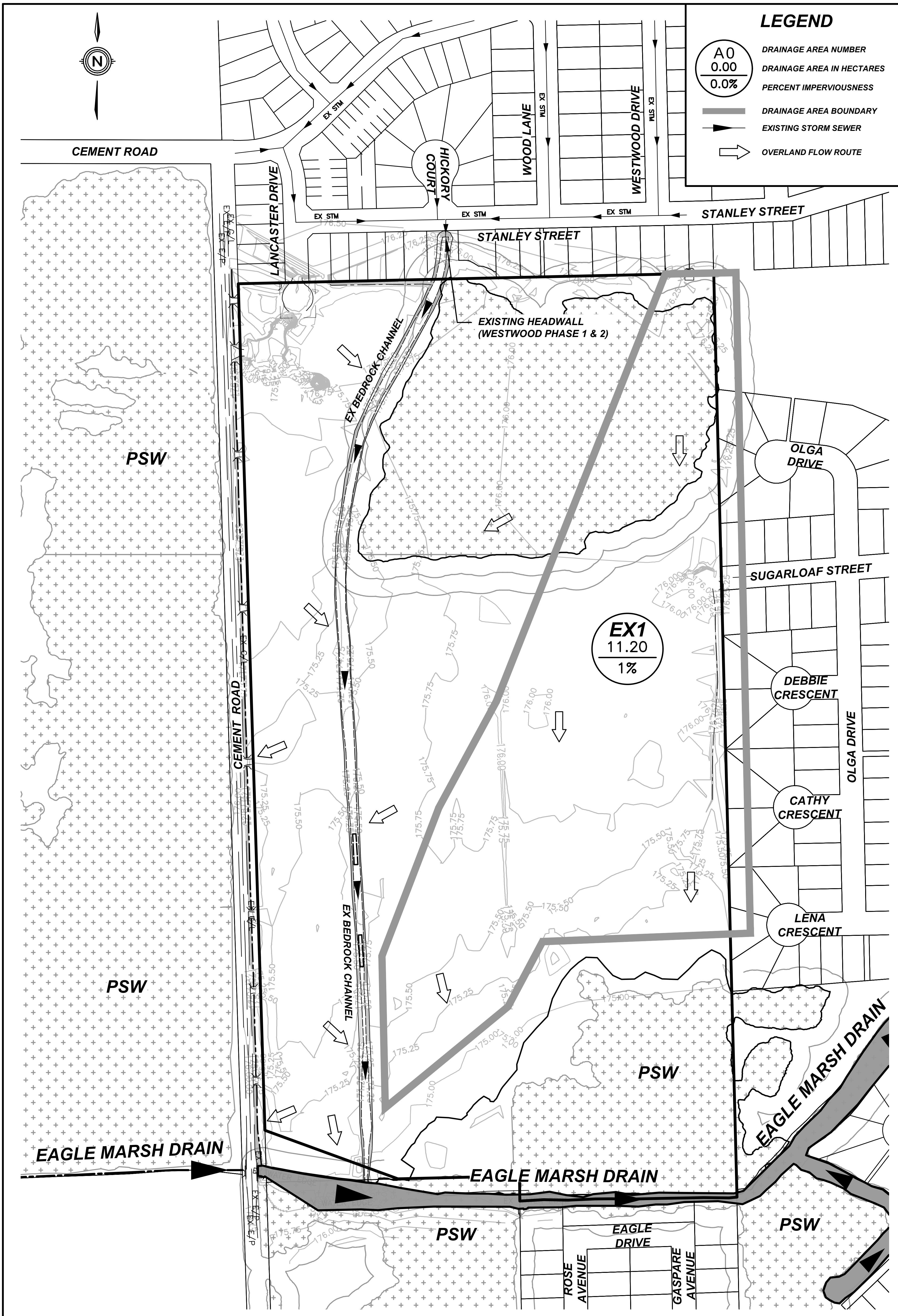
Future Drainage Areas A1 and A2 have been modelled for the purposes of sediment forebay sizing and determining stormwater quality controls only.

Area A3 has been modelled to identify the future peak flows discharging to the southern PSW. Input parameters for the computer model are shown in Table 2.

Table 3. Hydrologic Parameters for Future Conditions

Area No.	Area (ha)	Length (m)	Slope (%)	Manning – "n"		Soil Type	SCS CN	Percent Impervious
				Perv.	Imperv.			
A1	4.27	168	1.0	0.25	0.015	C	77	67%
A2	15.48	320	1.0	0.25	0.015	C	77	35%
A3	2.90	139	1.0	0.25	0.015	C	77	10%
	24.04	**Total Area (ha)**						

The detailed MIDUSS modelling output files have been enclosed in Appendix C for reference.



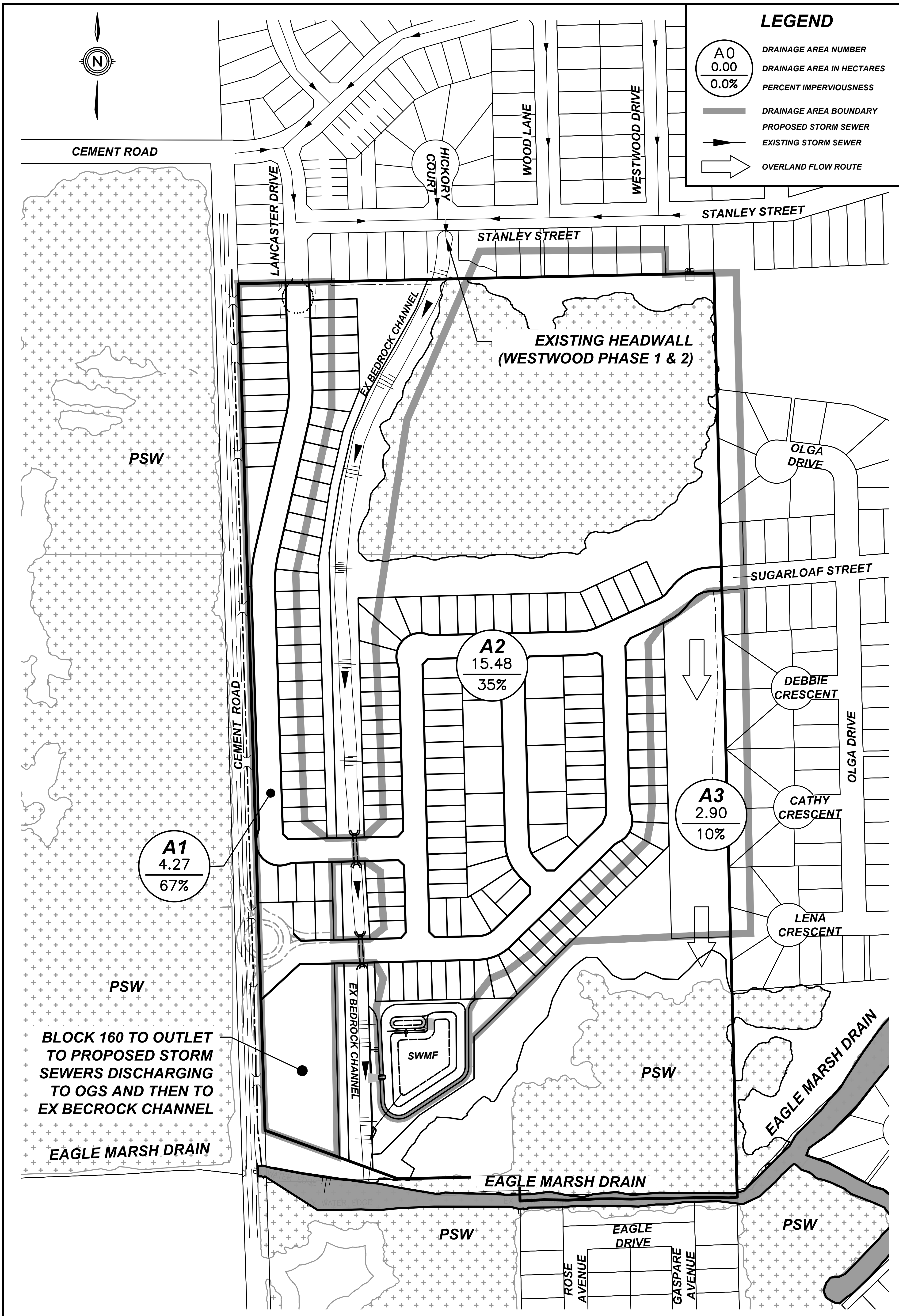
UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

WESTWOOD ESTATES (PHASE 3)

CITY OF PORT COLBORNE

EXISTING STORM DRAINAGE AREAS TO EXISTING PSW

DATE	2025-04-21
SCALE	1:3000 m
REF No.	2160
DWG No.	FIGURE 2



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WESTWOOD ESTATES (PHASE 3)

CITY OF PORT COLBORNE
FUTURE STORM DRAINAGE AREAS

DATE	2025-03-13
SCALE	1:3000 m
REF No.	2160
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. Wet facilities are effective practices for stormwater quality control for large drainage areas (>5 ha).

e) Other

Where the associated drainage areas are too small to support a permanent pool volume and available space are limited oil/grit separators can be very effective in providing quality protection.

Table 4. Evaluation of Stormwater Management Practices								
Westwood Estates (Phase 3)	**Criteria for Implementation of Stormwater Management Practices (SWMP)**					**Technical Effectiveness (10 high)**	**Recommend Implementation Yes / No**	**Comments**
	Topography	**Soils**	**Bedrock**	**Groundwater**	**Area**			
Site Conditions	***Flat ±1%***	***Variable ±15 mm/hr***	***Shallow***	***At Considerable Depth***	***± 4.27ha ± 15.48ha***			
Lot Level Controls								
Lot Grading	<5%	nlc	nlc	nlc	nlc	2	Yes	Quality/quantity benefits
Roof Leaders to Surface	nlc	nlc	nlc	nlc	nlc	2	Yes	Quality/quantity benefits
Roof Ldrs.to Soakaway Pits	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 0.5 ha	6	No	Unsuitable site conditions
Sump Pump Fdtn. Drains	nlc	nlc	nlc	nlc	nlc	2	Yes	Suitable site conditions
Vegetative								
Grassed Swales	< 5 %	nlc	nlc	nlc	nlc	7	Yes	Quality/quantity benefits
Filter Strips(Veg. Buffer)	< 10 %	nlc	nlc	>.5m Below Bottom	< 2 ha	5	No	Unsuitable site conditions
Infiltration								
Infiltration Basins	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 5 ha	2	No	Unsuitable site conditions
Infiltration Trench	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 2 ha	4	No	Unsuitable site conditions
Rear Yard Infiltration	< 2.0 %	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 0.5 ha	7	No	Unsuitable site conditions
Perforated Pipes	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	nlc	4	No	Unsuitable site conditions
Pervious Catch basins	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	nlc	3	No	Unsuitable site conditions
Sand Filters	nlc	nlc	nlc	>.5m Below Bottom	< 5 ha	5	No	High maintenance/poor aesthetics
Surface Storage								
Dry Ponds	nlc	nlc	nlc	nlc	> 5 ha	7	No	No quality control
Wet Ponds	nlc	nlc	nlc	nlc	> 5 ha	9	Yes	Very effective quality control
Wetlands	nlc	nlc	nlc	nlc	> 5 ha	6	No	Very effective quality control
Other								
Oil/Grit Separator	nlc	nlc	nlc	nlc	<2 ha	8	Yes	Limited benefit/area too large

Reference: Stormwater Management Practices Planning and Design Manual - 2003
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.

- **An oil/grit separator** to provide stormwater quality controls in accordance with MECP guidelines.

5.0 STORMWATER MANAGEMENT PLAN

A MIDUSS model was created to assess future peak flows and stormwater volumes generated within the site. The proposed stormwater management facilities shall provide quality controls for future drainage areas ‘A1’ and ‘A2’.

It is proposed to construct a stormwater management wet pond facility to provide stormwater management quality controls to MECP Enhanced levels (80% TSS Removal) prior to discharging to the Eagle Marsh Drain for the eastern portion of the subject lands.

To provide quality controls for the western portion of the subject lands, it is proposed to provide an Oil/Grit Separator prior to discharging to the Eagle Marsh Drain as the overall drainage areas is less than 5 hectares.

5.1 Existing PSW

A MIDUSS model has been prepared for existing and future conditions draining to the southern PSW shown in Figures 2 and 3 respectively. The peak flows under existing and future conditions are summarized in Table 5.

Table 5. Existing and Future Peak Flows Comparison - PSW		
Design Storm (Return Period)	**Peak Flows (m^3/s)**	
	Existing	**Future**
5 Year	0.132	0.060
100 Year	0.408	0.150

As shown in Table 5, future flows are below existing conditions in the 5 and 100 year design storm events without controls. Therefore, quantity controls are not required.

Additionally, future flows from Drainage Area A3 will be comprised of rear yard drainage and the proposed Corridor Enhancement Area (Block 171), which contribute clean stormwater flows to the adjacent PSW. Therefore, stormwater quality controls will also not be required for this area prior to discharging to the adjacent PSW.

5.2 Proposed Wet Pond

5.2.1 Stormwater Quality Control

Based on Table 3.2 of SWMP & Design Manual, the water quality storage requirement is approximately 140 m^3/ha for *Enhanced* protection for developments with 35% impervious areas. The drainage area contributing peak stormwater flows to facility A2 is 15.48 hectares. The storage volumes required for the proposed quality controls are shown in Table 9.

Table 6. Wet Pond - Stormwater Quality Volume Calculations	
Total Water Quality Volume = 15.48 ha x 140 m^3/ha = 2,167 m^3	Reference: Table 3.2, SWMP & Design Manual (MECP 2003)
Permanent Pool Volume = 15.48 ha x 100 m^3/ha = 1,548 m^3	**Extended Detention Volume** = 15.48 ha x 40 m^3/ha = 619 m^3

5.2.2 Stormwater Management Facility Configuration

As shown in Figure 4, it is proposed to construct a two-stage control outlet for the proposed stormwater management facility. The first stage of control consists of a reverse slope pipe acting as a tubular control 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 major storm events.

The proposed bottom elevation of the facility is 173.00 m, and the permanent pool water level is 174.20 m for a water depth of 1.2 metres. The configuration of the facility provides 2,958 m^3 of permanent pool volume, which is more than the required 1,548 m^3. The proposed top of pond is at an elevation of 175.70 m which provides a total active volume of 6,627 m^3 with 5:1 side slopes.

Based on the configuration of the proposed facility, it was determined that a 135 mm diameter quality orifice at an invert of 174.20 m can provide 26 hours of detention for the 25mm design storm event, which complies with the minimum required drawdown time of 24 hours.

The proposed ditch inlet catchbasin will be constructed with the rim at an elevation of 174.95 which will provide an extended detention volume of 2,918 m^3, which is greater than the minimum volume of 619 m^3 specified in Table 6.

Stage-storage-discharge calculations have been prepared for this facility and are included in Appendix A for reference.

Major overland flows within the drainage area tributary to facility A2 will be directed to the Eagle Marsh Drain.

The proposed facility has a single storm sewer inlet. Therefore, a sediment forebay has been designed to minimize the transport of heavy sediments from the storm sewer outlet throughout the facility and localize maintenance activities. Calculations for the forebay sizing follow MECP guidelines and are shown in 12.

Table 7. SWM Facility– MECP Quality Requirements Comparison

SWM Facility Characteristic	MECP Requirement	Provided by SWM Facility
Permanent Pool Volume (m^3) - *minimum*	1,548	2,958
Extended Detention Volume (m^3) – *minimum*	619	2,918
Total Quality + Detention Storage (m^3) – *minimum*	2,167	5,876
Facility Drawdown Time (hours) – *minimum*	24	26
Forebay Length (m) – *minimum*	15.49	24.00
Forebay Width (m) – *minimum*	1.94	4.00
Average Forebay Velocity (m/s) – *maximum*	0.15	0.07
Cleanout Frequency (years) - *minimum*	10	17

As shown in Table 7, the proposed stormwater management facility configuration satisfies the quality requirements outlined by the MECP for the 15.48 hectare drainage area.

Table 8. SWM Facility Characteristics				
Design Storm (Return Period)	**Peak Flows (m^3/s)**		**Maximum Elevation (m)**	**Maximum Volume (m^3)**
	Inflow	**Outflow**		
25 mm	0.485	0.012	174.48	1,079
5 Year	0.966	0.031	174.93	2,847

As shown in Table 18, the proposed stormwater management facility has adequate storage capacity to detain future 25mm and 5 year design storm flows to provide the required quality controls.

Table 9. Stormwater Management Facility Forebay Sizing

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

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

r =	6.0	:1	(Length:Width Ratio)
Q_p =	0.012	m^3/s	(25mm Storm Pond Discharge)
V_s =	0.0003	m/s	(Settling Velocity)

Settling Length = **15.49** **m**

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

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

Q =	0.966	m^3/s	(5 Yr Stm Sew Design Inflow)
D =	1.00	m	(Depth of Forebay)
V_f =	0.5	m/s	(Desired Velocity)

Dispersion Length = **15.46** **m**

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

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

15.49 m DI (minimum required length)

Width = **1.94** **m** (minimum required width)

d) Average Velocity of Flow

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

Q =	0.485	m^3/s	(25mm Storm Design Inflow)
A =	7.00	m^2	(Cross Sectional Area)
D =	1.00	m	(Depth of Forebay)
W =	4.00	m	(Proposed Bottom Width)
SS =	3	:1	(Side Slopes - Minimum)

Average Velocity = **0.07** **m/s**

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

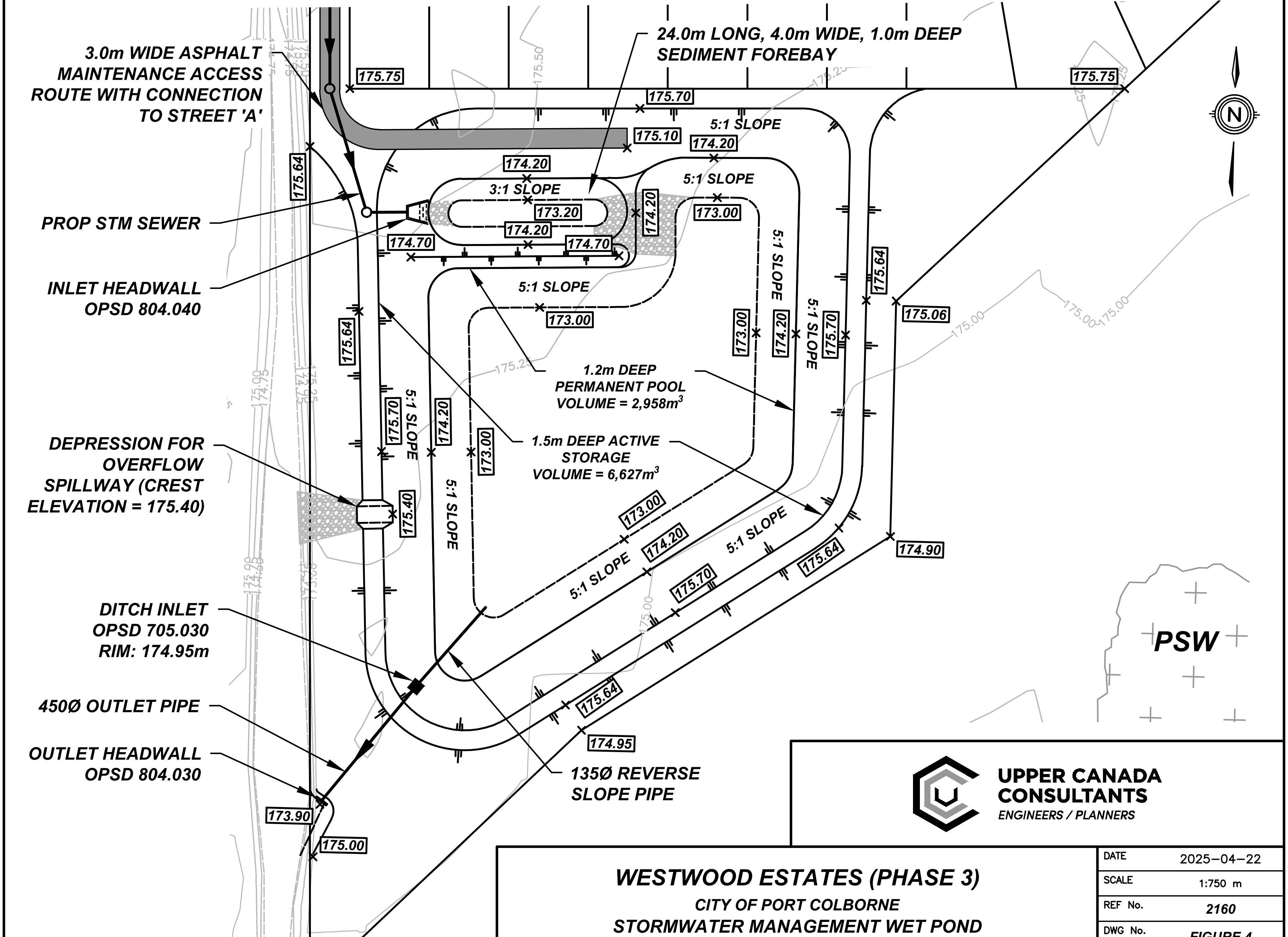
e) Cleanout Frequency

Is this Acceptable? **Yes**

L =	24.0	m	(Proposed Bottom Length)
ASL =	0.6	m^3/ha	(Annual Sediment Loading)
A =	15.48	ha	(Drainage Area)
FRC =	80	%	(Facility Removal Efficiency)
FV =	198.0	m^3	(Forebay Volume)

Cleanout Frequency = **17** **Years**

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



UPPER CANADA CONSULTANTS
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WESTWOOD ESTATES (PHASE 3)
CITY OF PORT COLBORNE
STORMWATER MANAGEMENT WET POND

DATE	2025–04–22
SCALE	1:750 m
REF No.	2160
DWG No.	FIGURE 4

5.3 Proposed Oil/Grit Separator

To improve the stormwater quality for the Drainage Area A1, an oil/grit MH system will be used to provide the required Enhance Quality Protection (80% TSS Removal) prior to discharging to the Eagle Marsh Drain.

The contributing drainage area to the proposed oil/grit separator is 4.24 hectares with an imperviousness of 67%. The modelling for a Hydroworks unit has indicated that an HD8 will provide 86% TSS removal and capture 100% of the stormwater flows. Therefore, the Hydroworks HD8 is proposed for this site to treat the stormwater flows from Drainage Area A1. Output calculations for the quality assessment can be found in Appendix B.

5.4 Regulated 100 Year Floodplain

The NPCA generated a 100 year floodplain for the Eagle Marsh Drain with a detailed HEC-RAS model. The HEC-RAS model includes detailed cross sections along the watercourse to determine the extents of the existing 100 year floodplain to the outlet at Lake Erie. The cross sections along the southern limit of the site and the existing 100 year floodplain are shown in Figure 5.

The construction of the Wet Pond will include earthworks within Block 164 of the proposed Draft Plan of Subdivision respectively, which can potentially impact the 100 year floodplain associated to the Eagle Marsh Drain.

In accordance with NPCA policies, no earthworks will occur within the adjacent regulated wetland or the associated 15m regulated Wetland Buffer (Block 161). Therefore, since the existing 100 year floodplain is completely contained within Block 161, the proposed lots along the boundary of this Block will not impact the existing 100 year floodplain.

To determine the impact of future grading works within Blocks 155 and 164, a “levee” was added to the HEC-RAS model at the southern limits of these Blocks to simulate future conditions, where the footprint of the floodplain will be reduced by the future pond banks. A comparison of the 100 year flood elevations modelled with and without the “levee” is shown in Table 13.

Table 10. Comparison of Existing and Future 100 Year Floodplain Elevations

Cross-section ID	Flood Elevation (m)		
	Existing Conditions (without levee)	Future Conditions (with levee)	Change
1029.780	175.21	175.20	-0.01
1005.961	175.18	175.18	0
964.9745	175.13	175.13	0
917.2293	175.11	175.11	0
863.8885	175.07	175.07	0

As shown in the above table, there is no measurable impact on the existing 100 year floodplain elevations resulting from the construction of the proposed Wet Pond and future development. The 0.01m decrease at cross section 1029.780 is likely due to internal rounding and is considered within the margin of error associated to the model. Therefore, the proposed wet pond facility can be permitted to be constructed within the existing 100 year floodplain extent without negatively impacting neighbouring or upstream properties.

The existing and future HEC-RAS cross sections summarized above have been enclosed in Appendix D and E for reference.

From the comments received from the City of Port Colborne's Engineering Peer Review consultant, it was indicated that there was a discrepancy between the 100 year floodplain extents provided within the NPCA's HEC-RAS model and the extents generated using the 100 year water surface elevations reported in Table 10 against the geodetic topographical data obtained by Upper Canada Consultants via on-site surveys using GPS equipment.

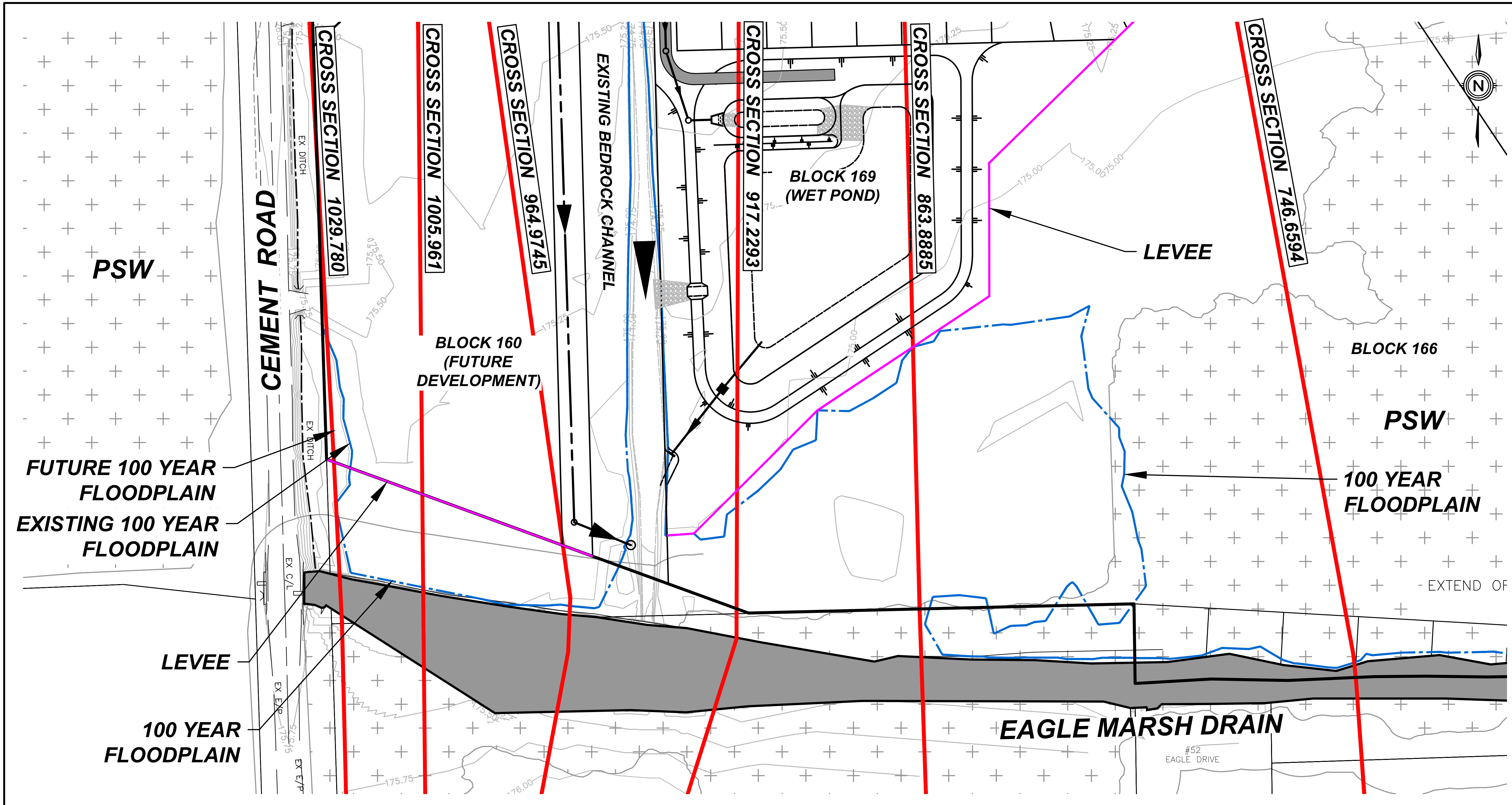
To address the Peer Review comments, additional topographical data within Block 161 was obtained and compared against the topographical data used by the NPCA to generated HEC-RAS model along the Eagle Marsh Drain.

It was determined that the NPCA topographical data requires an adjustment of approximately -0.14m is required to be comparative to the geodetic elevations obtained by Upper Canada Consultants.

Table 11 below summarizes the localized geodetic 100 year water surface elevations used to generate the associated 100 year floodplain extents shown on Figure 5.

Table 11. Adjusted Future 100 Year Floodplain Elevations

Cross-section ID	Flood Elevation (m)	
	NPCA HEC-RAS Model	Localized Geodetic Floodplain Elevation
1029.780	175.20	175.06
1005.961	175.18	175.04
964.9745	175.13	174.99
917.2293	175.11	174.97
863.8885	175.07	174.93



UPPER CANADA CONSULTANTS
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WESTWOOD ESTATES (PHASE 3)

CITY OF PORT COLBORNE

HEC-RAS CROSS SECTION LOCATIONS

DATE	2025–04–22
SCALE	1:1000 m
REF No.	2160
DWG No.	FIGURE 5

6.0 SEDIMENT CONTROL

Sediment controls are required during construction. The proposed extended detention facility can be used for this purpose. Therefore, the proposed constructed wet pond facility should be constructed prior to the facility for sediment control during construction.

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

- Install silt control fencing along the limits of construction where overland flows will flow beyond the limits of the development or into downstream watercourse.
- Re-vegetate disturbed areas as soon as possible after grading works have been completed.
- Lot grading and siltation controls plans will be provided with sediment and erosion control measures to the appropriate agencies for approval during the final design stage.
- The Stormwater management facility be cleaned after construction prior to assumption by municipality.

7.0 STORMWATER MANAGEMENT FACILITY MAINTENANCE

7.1 Wet Pond

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

The wet pond for this development is subject to frequent wetting and deposition of sediments as a result of frequent low intensity storm event. 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 clean-up, usually in the spring, is a minimum requirement. After this, trash removal is performed as required basis on observation of trash build-up during inspections.

To ensure long term effectiveness, the sediment that accumulates in the forebay area should be removed periodically to ensure that sediment in 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 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 B 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 manufacturers instructions to allow the oil/grit separator to perform as intended.

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.
- The proposed wet pond facility will provide stormwater quality control, quantity control and erosion controls to the future Drainage Area A2 of the proposed development.
- The proposed Oil/Grit separator Hydroworks HD8 will provide stormwater quality control to the future Drainage Area A1 of the proposed development
- 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 wet pond facilitiy be constructed to provide stormwater quality protection to MECP *Enhanced* Protection levels.
- That the Oil/Grit separator Hydroworks HD8 be constructed to provide stormwater quality protection to MECP *Enhanced* Protection levels.
- That additional lot level controls and vegetative stormwater management practices as described previously in this report be implemented.
- That the sediment during construction as described in this report be implemented.

Respectfully Submitted,

Prepared By:

Roberto A. Duarte, B. Eng.
April 21, 2025

Reviewed by:

B. Kapteyn

Brendan Kapteyn, P.Eng.
April 21, 2025

LICENSED PROFESSIONAL ENGINEER
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PROVINCE OF ONTARIO

Encl.

APPENDICES

APPENDIX A

Stormwater Management Facility Calculations (Wet Pond)

Upper Canada Consultants
3-30 Hannover Drive
St. Catharines, ON, L2W 1A3
PROJECT NAME: **Westwood Estates (Phase 3)**
PROJECT NO.: **2160**

PROPOSED WET POND CALCULATIONS

Quality Requirements

Drainage Area (ha) = 15.48
Enhanced (m3/ha) = 140 @ 35%
Perm Pool (m3/ha) = 100
Perm Pool Vol (m3) = 1,548
Extended Det. Vol (m3) 619
Total Quality Volume = 2,167
Water Level Elev. = 174.20 m

Quality Orifice

Diameter (m) = 0.135
Cd = 0.63
Invert (m) = 174.20

Outlet Weir

Perimeter Length (m) = 0.60
Inlet Elevation (m) = 174.95

Overflow Spillway

Length (m) = 2.50
Slopes (X:1) = 3.00
Invert (m) = 175.40

Outflow Pipe Orifice

Diameter (m) = 0.450
Cd = 0.65
Invert (m) = 174.20
Obvert (m) = 174.65
Top of Pipe (m) = 174.75

Pond Drawdown Time Calculation (MOE, 2003)

25mm Design Storm Water Surface Elevation (m) = 174.48
MOE Equation 4.11 Drawdown Coefficient 'C2' = 1,380
MOE Equation 4.11 Drawdown Coefficient 'C3' = 3,373
MOE Equation 4.11 Drawdown Time (h) = **26**

Elevation	Increment Depth (m)	Active Depth (m)	Surface Area (m^2)	Average Surface Area (m^2)	Increment Volume (m^3)	Permanent Volume (m^3)	Active Volume (m^3)	Quality Orifice (m^3/s)	Ditch Inlet (m^3/s)	Max Pipe Orifice (m^3/s)	Overflow Spillway (m^3/s)	Total Outflow (m^3/s)	Side Slope
173.00		-1.20	1,752			0							
	0.40			2,171	869								5:1
173.40		-0.80	2,171			869							
	0.40			2,389	955								5:1
173.80		-0.40	2,606			1,824							
	0.40			2,836	1,134								
174.20		**0.00**	**3,066**			**2,958**							
174.20		0.00	3,373				0	0.000	0.000	0.000	0.000	0.000	
	0.75			3,891	2,918								5:1
174.95		0.75	4,409			0	2,918	0.032	0.000	0.307	0.000	0.032	
	0.25			4,575	1,144								5:1
175.20		1.00	4,741			0	4,062	0.038	0.128	0.383	0.000	0.166	
	0.20			4,878	976								5:1
175.40		1.20	5,014			0	5,038	0.042	0.309	0.434	0.000	0.351	
	0.30			5,296	1,589								5:1
175.70		1.50	5,579			0	6,627	0.047	0.665	0.502	0.886	1.388	

Notes

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

APPENDIX B

Hydroworks Output Files
OGS Sample of Inspection Report

```
         *************************************************
         *      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  *
         ***************************************************

         WESTWOOD ESTATES (PHASE 3)
         Copyright Hydroworks, LLC, 2022

         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     #
###################################################

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
Rate 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

*********************************************************
*         C H A N N E L   A N D   P I P E   D A T A     *
*********************************************************

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

 ***************************************************
 *         S U B C A T C H M E N T   D A T A       *
 ***************************************************

*NOTE. SEE LATER TABLE FOR OPTIONAL SUBCATCHMENT PARAMETERS*
      SUBCATCH-  CHANNEL       WIDTH     AREA  PERCENT     SLOPE     RESISTANCE  FACTOR    DEPRES. STORAGE(MM) INFILTRATION    DECAY RATE GAGE  MAXIMUM
       MENT NO.  OR INLET       (M)      (HA)  IMPERV.     (M/M)      IMPERV.     PERV.    IMPERV.    PERV.       RATE(MM/HR)     (1/SEC)    NO.  VOLUME
                                                                                                               MAXIMUM MINIMUM                       (MM)
 ---  --------   -------- --------- -------- -----     -------     -------  --------    ------     ------      ----   -------   -------  ------ -------
  1       300         200    168.00     4.24  67.00     0.0100       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).           4.24
IMPERVIOUS AREA (HECTARES)......           2.84
PERVIOUS AREA (HECTARES)........           1.40
TOTAL WIDTH (METERS)............         168.00
PERCENT IMPERVIOUSNESS..........          67.00

********************************************************
*     G R O U N D W A T E R   I N P U T   D A T A     *
********************************************************

    SUB-      CHANNEL     ========== E L E V A T I O N S ========  =========== F L O W   C O N S T A N T S ============
    CATCH          OR       GROUND  BOTTOM   STAGE     BC      TW       A1          B1         A2          B2          A3
    NUMBER      INLET         (M)     (M)      (M)     (M)     (M) (MM/HR-M^B1)           (MM/HR-M^B2)           (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


***********************************************************
* G R O U N D W A T E R   I N P U T   D A T A (CONTINUED) *
***********************************************************

               S O I L   P R O P E R T I E S
                       SATURATED                                         PERCOLATION     E T  P A R A M E T E R S
       SUBCAT.           HYDRAULIC  WILTING  FIELD   INITIAL     MAX. DEEP  PARAMETERS          DEPTH  FRACTION OF ET
       NO.   POROSITY CONDUCTIVITY  POINT  CAPACITY MOISTURE  PERCOLATION  HCO    PCO        OF ET  TO UPPER ZONE
                        (mm/hr)                               (mm/hr)                        (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 *
* 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.................... KLNBGN.......      120
 DAY OF YEAR ON WHICH STREET
 SWEEPING ENDS...................... KLNEND.......      270

###########################################
#     Land use data on data group J2      #
###########################################
                                                              LIMITING                      CLEANING  AVAIL.    DAYS SINCE
                                                              BUILDUP    BUILDUP  BUILDUP   INTERVAL  FACTOR       LAST
AND USE   BUILDUP EQUATION TYPE   FUNCTIONAL DEPENDENCE OF    QUANTITY   POWER    COEFF.    IN DAYS   FRACTION   SWEEPING
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. (RCOEF)....          0.086
Init catchb conc (CBFACT)        100.000
Precip. conc. (CONCRN)...          0.000
Street sweep effic (REFF)          0.300
Remove fraction (REMOVE).          0.000
1st order QDECAY, 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 *
*****************************************************
```

No.	Land Usage	Land Use No.	Total Gutter Length Km	Number of Catch-Basins	Input Loading load/ha Total Su
1 300	Urban De	1	0.29	10.00	0.0E+00
Totals (Loads in kg or other)			0.29	10.00	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

```
**********************
*    DATA GROUP M3    *
**********************
```

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

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

WESTWOOD ESTATES (PHASE 3)
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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

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

Final Date (Mo/Day/Year)   =                   1/ 1/2006
Total number of time steps =                     2056986
Final Julian Date  =                             2006001
Final time of day  =                                  1. 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   6293855   1676669

##################################################
*     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   *
##############################################
                                                                    Millimeters over
                                                      cubic meters  Total Basin
Total Precipitation (Rain plus Snow)                       816726.     19263.
Total Infiltration                                         268855.      6341.
Total Evaporation                                           66314.      1564.
Surface Runoff from Watersheds                             483432.     11402.
Total Water remaining in Surface Storage                        0.         0.
Infiltration over the Pervious Area...                     268855.     19215.
                      --------
Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
Water remaining in Snow Cover.........                     818600.     19307.
Total Precipitation + Initial Storage.                     816726.     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.................................       -0.230 Percent

##############################################
*       Continuity Check for Channel/Pipes   *
##############################################
                                                                    Millimeters over
                                                      cubic meters  Total Basin
Initial Channel/Pipe Storage................                    0.         0.
Final Channel/Pipe Storage..................                    0.         0.
Surface Runoff from Watersheds..............               483432.     11402.
Baseflow....................................                    0.
Groundwater Subsurface Inflow...............                    0.         0.
Evaporation Loss from Channels..............                    0.         0.
Channel/Pipe/Inlet Outflow..................               483432.     11402.
Initial Storage + Inflow....................               483432.     11402.
Final Storage + Outflow.....................               483432.     11402.
```

```
********************************************
* 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       *
***************************************************

                                                                   Millimeters over
                                                  cubic meters     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                              38769.       914.
Final Subsurface Storage                                38769.       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

                                  SUMMARY STATISTICS FOR SUBCATCHMENTS
                                  ====================================

                                                     PERVIOUS AREA     IMPERVIOUS AREA     TOTAL SUBCATCHMENT AREA
                                                  -------------------  -----------------  -------------------------
                                        TOTAL     TOTAL          PEAK                PEAK                PEAK    PEAK
            GUTTER                    SIMULATED   RUNOFF TOTAL RUNOFF     RUNOFF    RUNOFF      RUNOFF  RUNOFF   UNIT
   SUBCATCH-  OR INLET  AREA  PERCENT  RAINFALL   DEPTH LOSSES  RATE       DEPTH     RATE        DEPTH   RATE    RUNOFF
   MENT NO.     NO.     (HA)  IMPER.    (MM)      (MM)   (MM)  (CMS)       (MM)    (CMS)        (MM)   (CMS)  (MM/HR)
  ---------------------------------------------------------------------------------------------------------------------
       300       200     4.24    67.019262.47    43.839********   0.17016991.297     1.488 11398.636     1.658  141.913

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


                                       SUMMARY STATISTICS FOR CHANNEL/PIPES
                                     ================================================

                                       MAXIMUM   MAXIMUM   MAXIMUM  MAXIMUM      TIME        LENGTH      MAXIMUM     RATIO OF  RATIO OF
            FULL      FULL      FULL   COMPUTED  COMPUTED  COMPUTED COMPUTED      OF           OF       SURCHARGE    MAX. TO  MAX. DEPTH
   CHANNEL  FLOW    VELOCITY    DEPTH   INFLOW   OUTFLOW    DEPTH   VELOCITY OCCURRENCE    SURCHARGE    VOLUME      FULL      TO FULL
    NUMBER  (CMS)    (M/S)       (M)    (CMS)     (CMS)      (M)     (M/S)    DAY   HR.      (HOUR)      (CU-M)     FLOW       DEPTH
  --------- ------------------------  ---------------------------------------------------  ---------------------- -------------------
       201                               0.00                                 1/ 0/1900  0.00
       200                               1.66                                 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........       92.
 2. TOTAL SURFACE BUILDUP.......    67421.
 3. INITIAL CATCHBASIN LOAD.....        1.
 4. TOTAL CATCHBASIN LOAD.......        0.
 5. TOTAL CATCHBASIN AND
    SURFACE BUILDUP (2+4).......    67421.

Remaining Loads
---------------
 6. LOAD REMAINING ON SURFACE...       37.
 7. REMAINING IN CATCHBASINS....        0.
 8. REMAINING IN CHANNEL/PIPES..        0.

Removals
--------
 9. STREET SWEEPING REMOVAL.....     6235.
10. NET SURFACE BUILDUP (2-9)...    61186.
11. SURFACE WASHOFF.............    61132.
12. CATCHBASIN WASHOFF..........        0.
```

```
13. TOTAL WASHOFF (11+12).......    61132.
14. LOAD FROM OTHER CONSTITUENTS        0.
15. PRECIPITATION LOAD..........        0.
15a.SUM SURFACE LOAD (13+14+15).    61132.
16. TOTAL GROUNDWATER LOAD......        0.
16a.TOTAL I/I LOAD..............        0.
17. NET SUBCATCHMENT LOAD
    (15a-15b-15c-15d+16+16a)....    61132.
>>Removal in channel/pipes (17a, 17b):
17a.REMOVE BY BMP FRACTION......        0.
17b.REMOVE BY 1st ORDER DECAY...        0.
18. TOTAL LOAD TO INLETS........    61132.
19. FLOW WT'D AVE.CONCENTRATION  mg/l
    (INLET LOAD/TOTAL FLOW).....      127.

Percentages
-----------
20. STREET SWEEPING (9/2).......        9.
21. SURFACE WASHOFF (11/2)......       91.
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.
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    %     Specific    Settling Velocity   Critical Peclet
     (um)             Gravity        (m/s)               Number


      20.    20.0      2.65        0.000267           0.080977
      60.    20.0      2.65        0.002319           0.160673
     150.    20.0      2.65        0.012234           0.284537
     400.    20.0      2.65        0.047806           0.524584
    2000.    20.0      2.65        0.180097           1.431405


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

TSS Removal based on Lab Performance Curve

 Model      Low Q Treated  High Q Treated     Runoff Treated        TSS Removed
   #           (cms)          (cms)                (%)                  (%)

 Unavailabl   0.481           0.481               99.6                 47.6
 HD 4         0.481           0.481               99.6                 58.1
 HD 5         0.481           0.481               99.6                 68.4
 HD 6         0.481           0.481               99.6                 76.8
 Unavailabl   0.481           0.481               99.6                 82.4
 HD 8         0.481           0.481               99.6                 86.1
 HD 10        0.481           0.481               99.6                 91.1
 HD 12        0.481           0.481               99.6                 94.0


****************************************************
*                                                  *
*  Summary of Annual Flow Treatmnet & TSS Removal  *
*                                                  *
****************************************************
```

HD 8

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	50284.	49494.	1214.	1010.	204.	2.	98.4	83.1
1972.	64276.	60532.	1601.	1387.	214.	47.	94.2	84.1
1973.	64114.	64114.	1707.	1468.	239.	0.	100.0	86.0
1974.	65468.	65095.	1778.	1598.	180.	8.	99.4	89.5
1975.	55801.	55662.	1563.	1330.	233.	2.	99.8	85.0
1976.	83005.	82232.	1975.	1712.	264.	18.	99.1	85.9
1977.	88836.	87891.	1926.	1571.	356.	16.	98.9	80.9
1978.	71022.	71022.	1840.	1549.	292.	0.	100.0	84.1
1979.	84990.	84379.	2052.	1762.	290.	11.	99.3	85.4
1980.	68201.	68201.	1954.	1676.	278.	0.	100.0	85.8
1981.	94641.	94641.	2169.	1923.	246.	0.	100.0	88.7
1982.	66720.	66720.	1759.	1572.	187.	0.	100.0	89.4
1983.	88099.	87917.	2275.	1965.	310.	5.	99.8	86.2
1984.	70722.	70722.	1752.	1496.	256.	0.	100.0	85.4
1985.	61465.	61465.	1703.	1495.	208.	0.	100.0	87.8
1986.	90001.	90001.	2354.	2080.	274.	0.	100.0	88.3
1987.	93138.	92812.	2373.	2045.	328.	4.	99.7	86.0
1988.	74397.	74397.	1961.	1734.	227.	0.	100.0	88.4
1989.	82489.	82489.	1906.	1674.	232.	0.	100.0	87.8
1990.	93462.	93462.	2446.	2170.	276.	0.	100.0	88.7
1991.	87550.	87550.	2245.	1951.	295.	0.	100.0	86.9
1992.	111355.	111355.	2667.	2262.	405.	0.	100.0	84.8
1993.	75329.	75329.	2171.	1958.	213.	0.	100.0	90.2
1994.	80571.	79645.	1818.	1488.	329.	15.	98.9	81.2
1995.	94158.	94137.	2199.	1835.	364.	1.	100.0	83.4
1998.	23585.	23585.	810.	707.	103.	0.	100.0	87.3
1999.	58910.	58910.	1687.	1450.	237.	0.	100.0	85.9
2000.	68693.	68693.	1502.	1202.	300.	0.	100.0	80.0
2001.	53800.	53800.	1363.	1243.	120.	0.	100.0	91.2
2002.	55986.	55986.	1603.	1423.	180.	0.	100.0	88.8
2003.	63847.	63847.	1649.	1414.	235.	0.	100.0	85.8
2004.	76838.	76838.	1720.	1471.	249.	0.	100.0	85.5
2005.	55197.	54823.	1309.	1047.	262.	2.	99.3	79.8

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

  WESTWOOD ESTATES (PHASE 3)
 Copyright Hydroworks, LLC, 2022

     Date     Time        Flow   Total Su
 Mo/Da/Year  Hr:Min       cum/s  mg/l
 ----------  -------    -------  --------
Flow wtd means.....        0.001      127.
Flow wtd std devs..        0.009       64.
Maximum value......        1.658      292.
Minimum value......        0.000        0.
Total loads........      483262.    61168.
                        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... March      18, 2025                *
*          Time...         13: 4:14.240               *
*   Ending Date... March      18, 2025                *
*          Time...         13: 4:17.895               *
*  Elapsed Time...               0.061 minutes.       *
*  Elapsed Time...               3.655 seconds.       *
*******************************************************
```

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

SAMPLE INSPECTION REPORT

Owner:

Location:

Manhole Oil/Grit Separator:

Type of Inspection ☐ Monthly ☐ Annually ☐ Special

Inlet/Outlet Information

	Inlet		Outlet	
Clear of Debris	☐ Yes	☐ No	☐ Yes	☐ No
Build Up of Sediment	☐ Yes	☐ No	☐ Yes	☐ No

Action Taken:

Sediment Tank Information

A. Manhole Sump Depth: ± m from cover rim (to be as-constructed verified)

B. Measurement from Rim to Sediment Level m

C. Depth of Sediment: m (A - B)

Note: If the measured depth of sediment is greater than **200mm** then sediment removal is required.

Presence of Contaminants

Oil	☐ Yes	☐ No	Depth	m
Foam	☐ Yes	☐ No	Depth	m

Action Taken:

Name of Regulatory Agency Telephone No.:

Transaction No.:

Name of Licensed Waste Management Collector Telephone No.:

Transaction No.:

Owner Notification ☐ Yes ☐ No Other:

Time: Date:

Name of Inspector:

Signed: Date:

APPENDIX C

MIDUSS Output Files

Existing Conditions

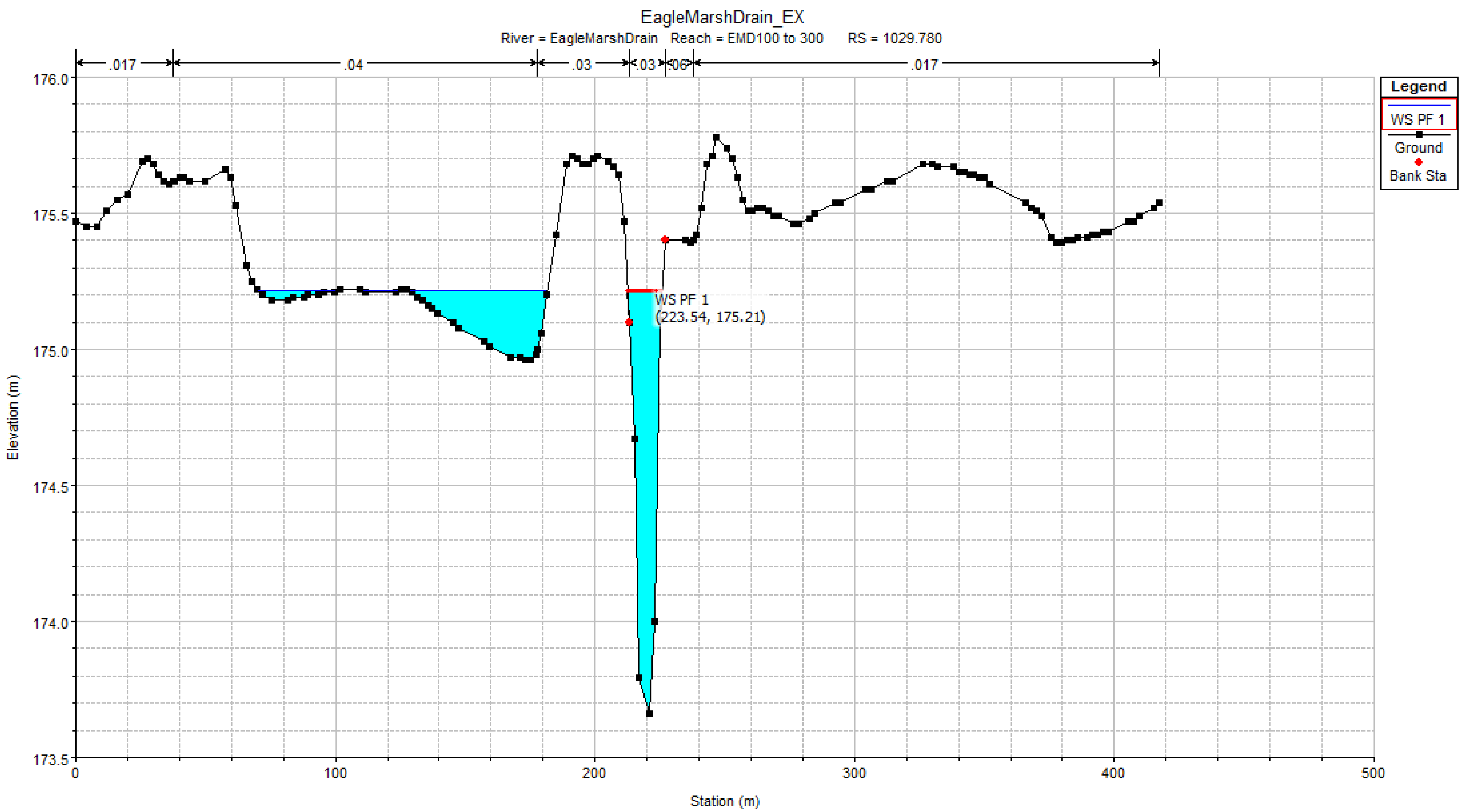
```
        Output File (4.7) EXSWM.OUT    opened 2025-04-21  10:17
        Units used are defined by G =    9.810
            24   144    10.000        are MAXDT MAXHYD & DTMIN values
        Licensee: UPPER CANADA CONSULTANTS
 35     COMMENT
       3     line(s) of comment
        WESTWOOD PHASE 3, CITY OF PORT COLBORNE
        STORMWATER MANAGEMENT PLAN
        *** EXISTING CONDITIONS ***
 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=Cdn1hr;5=Historic
      830.000     Coefficient  a
        7.300     Constant  b    (min)
         .777     Exponent  c
         .450     Fraction to peak  r
      240.000     Duration ó  240 min
               45.874 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
  4     CATCHMENT
        1.000     ID No.ó 99999
       11.200     Area in hectares
      273.000     Length (PERV) metres
        1.000     Gradient (%)
        1.000     Per cent Impervious
      273.000     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
               .132       .000       .000       .000 c.m/s
               .280       .886       .286     C perv/imperv/total
 15     ADD RUNOFF
               .132       .132       .000       .000 c.m/s
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        ******************************
        ** 100YR DESIGN STORM EVENT **
        ******************************
  2     STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     1020.000     Coefficient  a
        4.700     Constant  b    (min)
         .731     Exponent  c
         .450     Fraction to peak  r
      240.000     Duration ó  240 min
               73.203 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
  4     CATCHMENT
        1.000     ID No.ó 99999
       11.200     Area in hectares
      273.000     Length (PERV) metres
        1.000     Gradient (%)
        1.000     Per cent Impervious
      273.000     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
               .408       .000       .000       .000 c.m/s
               .416       .918       .421     C perv/imperv/total
 15     ADD RUNOFF
               .408       .408       .000       .000 c.m/s
```

Future Conditions

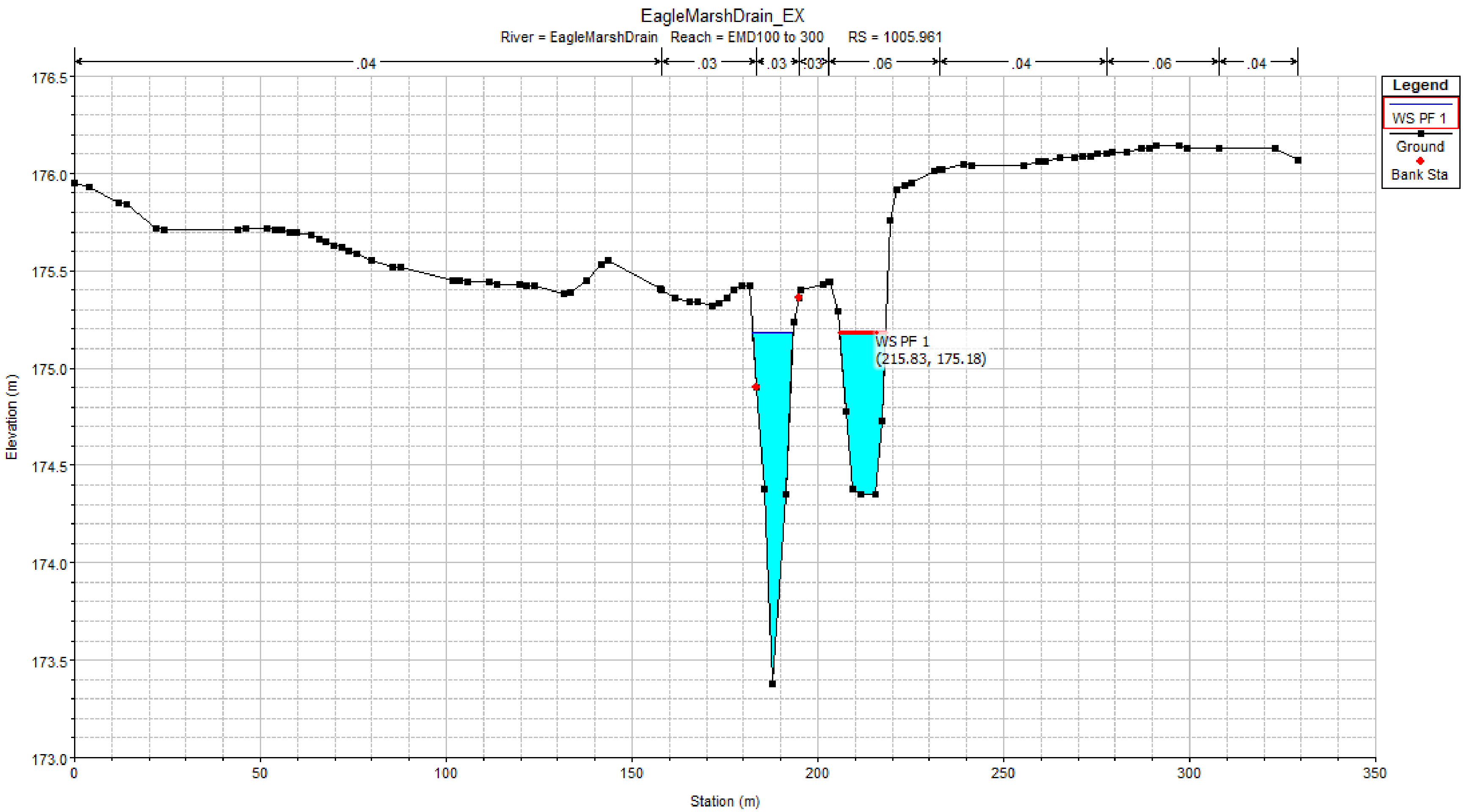
```
         Output File (4.7) SWM.OUT      opened 2025-04-22  10:31
         Units used are defined by G =    9.810
             24   144    10.000        are MAXDT MAXHYD & DTMIN values
         Licensee: UPPER CANADA CONSULTANTS
  35     COMMENT
        3     line(s) of comment
         WESTWOOD PHASE 3, CITY OF PORT COLBORNE
         STORMWATER MANAGEMENT PLAN
         TURE CONDITIONS ***
  14     START
        1     1=Zero; 2=Define
  35     COMMENT
        3     line(s) of comment
         **********************************
         ** 25mm MECP DESIGN STORM EVENT **
         **********************************
   2     STORM
             1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
       512.000      Coefficient  a
         6.000      Constant  b    (min)
          .800      Exponent  c
          .450      Fraction to peak  r
       210.000      Duration ó  240 min
                  24.309 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
         *** FROM WET POND TO OUTLET ***
   4     CATCHMENT
         2.000      ID No.ó 99999
        15.480      Area in hectares
       320.000      Length (PERV) metres
         1.000      Gradient (%)
        35.000      Per cent Impervious
       320.000      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
                .485       .000       .000       .000 c.m/s
                .124       .800       .361     C perv/imperv/total
  15     ADD RUNOFF
                .485       .485       .000       .000 c.m/s
  27     HYDROGRAPH DISPLAY
        4     is # of Hyeto/Hydrograph chosen
         Volume  =  .1354987E+04 c.m
  10     POND
        5 Depth - Discharge - Volume sets
         174.200        .000          .0
         174.950       .0320      2918.0
         175.200        .166      4062.0
         175.400        .351      5038.0
         175.700       1.388      6627.0
         Peak Outflow    =      .012 c.m/s
         Maximum Depth   =   174.477 metres
         Maximum Storage =     1079. c.m
                .485       .485       .012       .000 c.m/s
  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=Cdn1hr;5=Historic
       830.000      Coefficient  a
         7.300      Constant  b    (min)
          .777      Exponent  c
          .450      Fraction to peak  r
       240.000      Duration ó  240 min
                  45.874 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
         *** FROM OGS TO OUTLET ***
   4     CATCHMENT
         1.000      ID No.ó 99999
         4.270      Area in hectares
       168.000      Length (PERV) metres
         1.000      Gradient (%)
        67.000      Per cent Impervious
       168.000      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
                .484       .000       .012       .000 c.m/s
                .280       .872       .676     C perv/imperv/total
  15     ADD RUNOFF
                .484       .484       .012       .000 c.m/s
  14     START
        1     1=Zero; 2=Define
  35     COMMENT
        1     line(s) of comment
         *** FROM WET POND TO OUTLET ***
   4     CATCHMENT
         2.000      ID No.ó 99999
        15.480      Area in hectares
       320.000      Length (PERV) metres
         1.000      Gradient (%)
        35.000      Per cent Impervious
       320.000      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
                .966       .000       .012       .000 c.m/s
                .280       .881       .490     C perv/imperv/total
  15     ADD RUNOFF
                .966       .966       .012       .000 c.m/s
  27     HYDROGRAPH DISPLAY
        4     is # of Hyeto/Hydrograph chosen
         Volume  =  .3480572E+04 c.m
  10     POND
        5 Depth - Discharge - Volume sets
         174.200        .000          .0
         174.950       .0320      2918.0
         175.200        .166      4062.0
         175.400        .351      5038.0
         175.700       1.388      6627.0
         Peak Outflow    =      .031 c.m/s
         Maximum Depth   =   174.932 metres
         Maximum Storage =     2847. c.m
                .966       .966       .031       .000 c.m/s
  14     START
        1     1=Zero; 2=Define
  35     COMMENT
        1     line(s) of comment
         *** FROM A3 TO PSW ***
   4     CATCHMENT
         3.000      ID No.ó 99999
         2.900      Area in hectares
       139.000      Length (PERV) metres
         1.000      Gradient (%)
        10.000      Per cent Impervious
       139.000      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
                .060       .000       .031       .000 c.m/s
                .280       .864       .338     C perv/imperv/total
  15     ADD RUNOFF
                .060       .060       .031       .000 c.m/s
  14     START
        1     1=Zero; 2=Define
  35     COMMENT
        3     line(s) of comment
         ******************************
         ** 100YR DESIGN STORM EVENT **
         ******************************
   2     STORM
             1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      1020.000      Coefficient  a
         4.700      Constant  b    (min)
          .731      Exponent  c
          .450      Fraction to peak  r
       240.000      Duration ó  240 min
                  73.203 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
         *** FROM A3 TO PSW ***
   4     CATCHMENT
         3.000      ID No.ó 99999
         2.900      Area in hectares
       139.000      Length (PERV) metres
         1.000      Gradient (%)
        10.000      Per cent Impervious
       139.000      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
                .150       .000       .031       .000 c.m/s
                .415       .914       .465     C perv/imperv/total
  15     ADD RUNOFF
                .150       .150       .031       .000 c.m/s
```

APPENDIX D

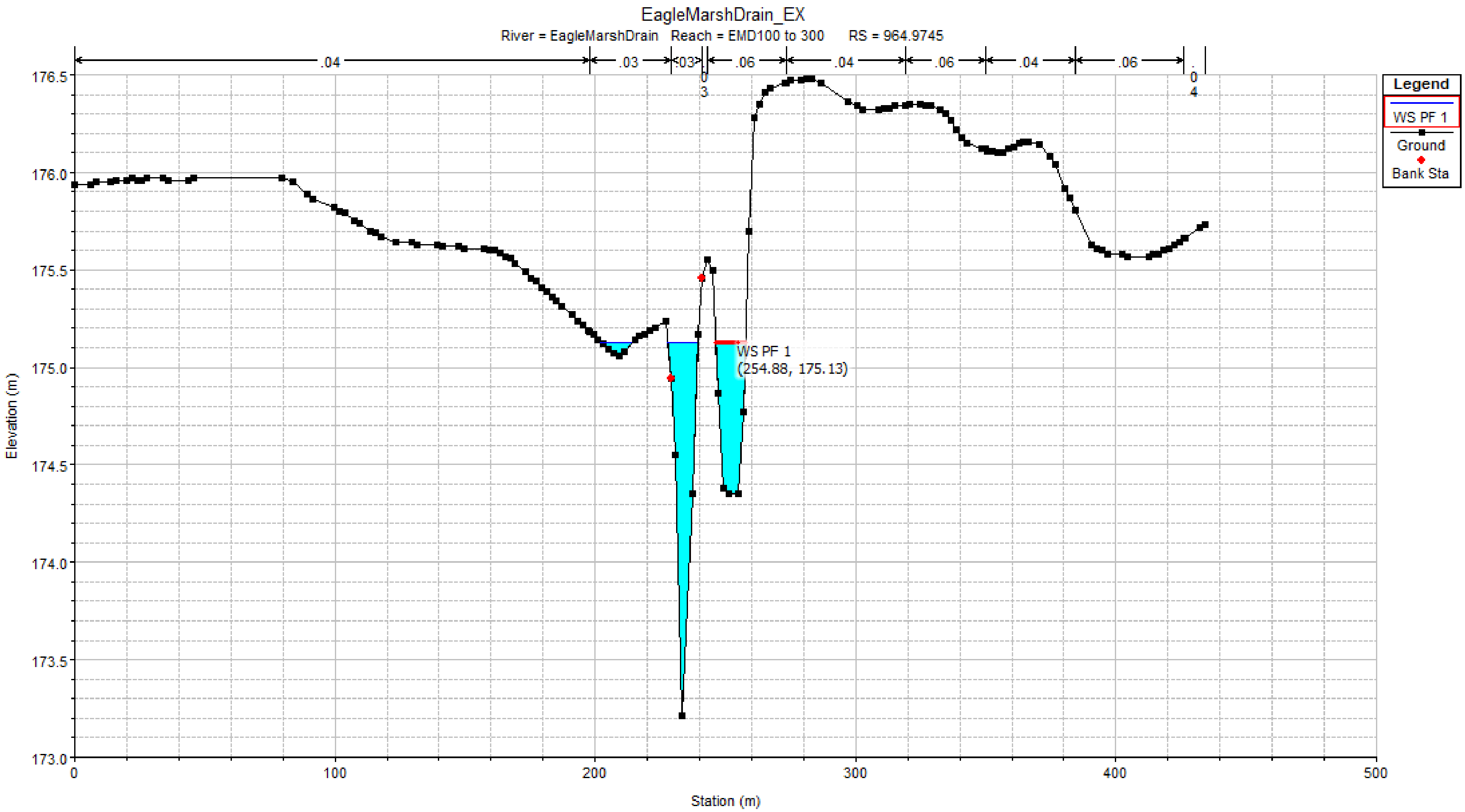
Existing HEC-RAS Cross Sections (without Levee)

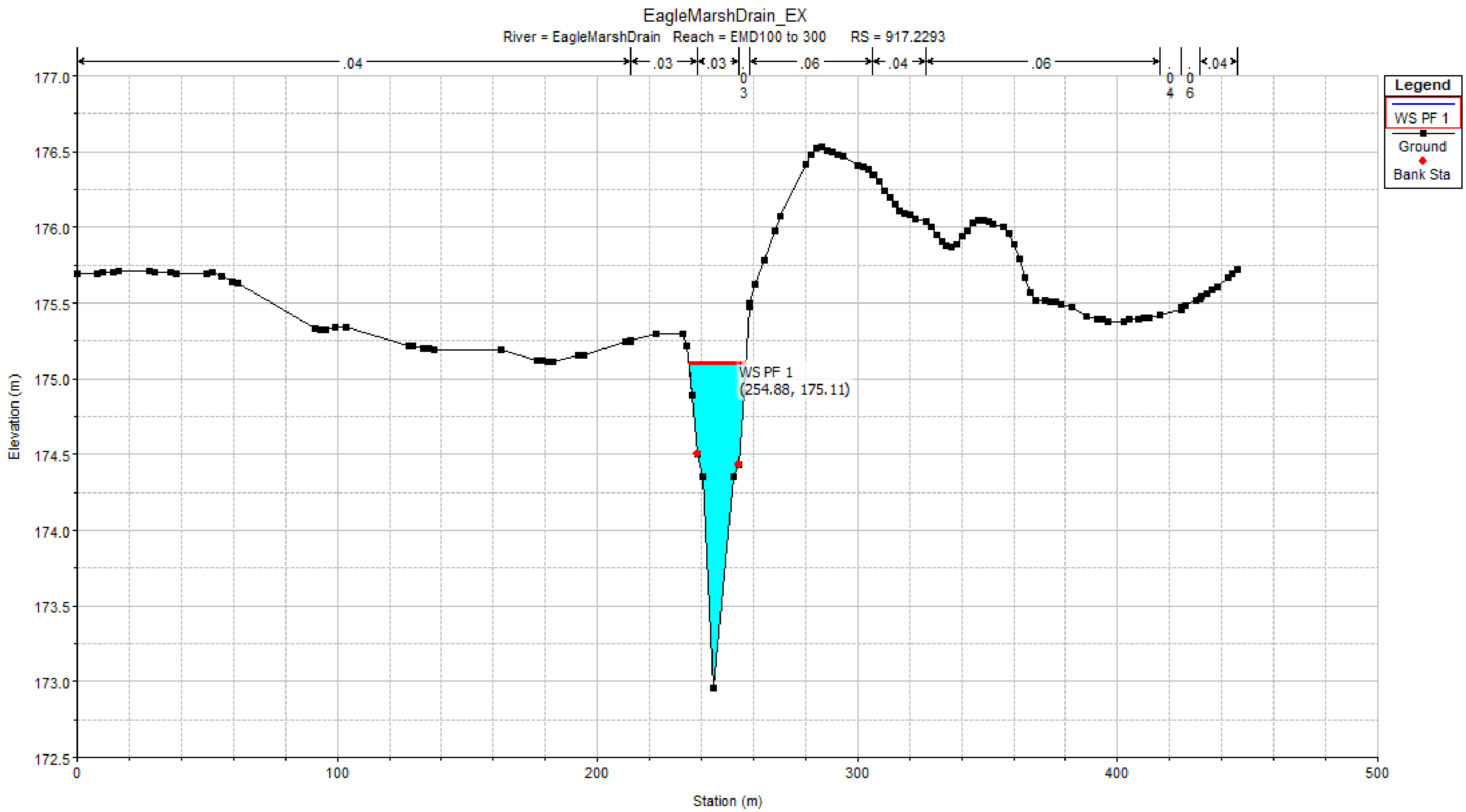


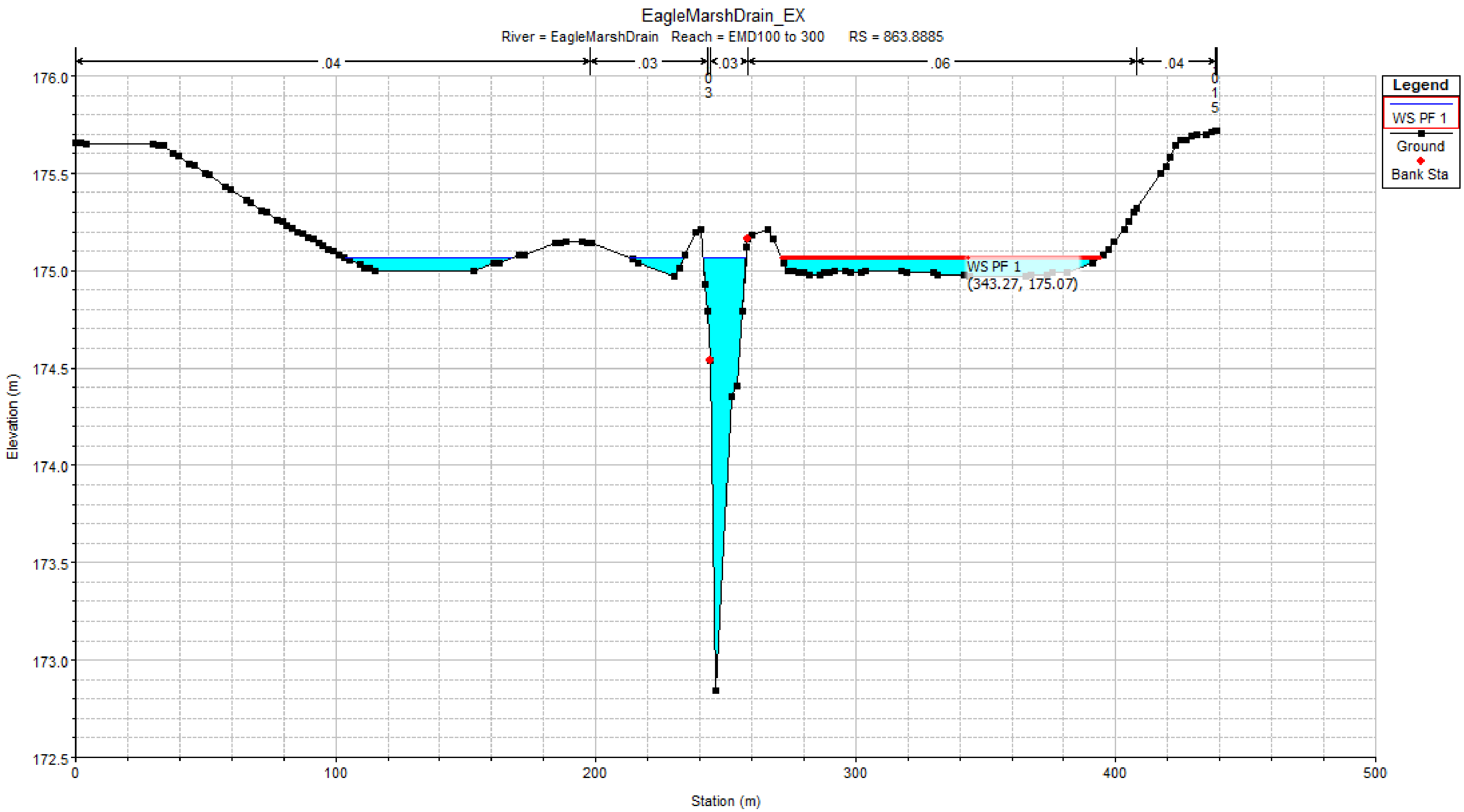
EagleMarshDrain_EX
River = EagleMarshDrain Reach = EMD100 to 300 RS = 1029.780
.017
.04
.03
.03
.06
.017
Legend
WS PF 1
Ground
Bank Sta
WS PF 1
(223.54, 175.21)
Elevation (m)
Station (m)
176.0
175.5
175.0
174.5
174.0
173.5
0
100
200
300
400
500



EagleMarshDrain_EX
River = EagleMarshDrain Reach = EMD100 to 300 RS = 1005.961
.04
.03
.03
.03
.06
.04
.06
.04
Legend
WS PF 1
Ground
Bank Sta
WS PF 1
(215.83, 175.18)
Elevation (m)
Station (m)
176.5
176.0
175.5
175.0
174.5
174.0
173.5
173.0
0
50
100
150
200
250
300
350

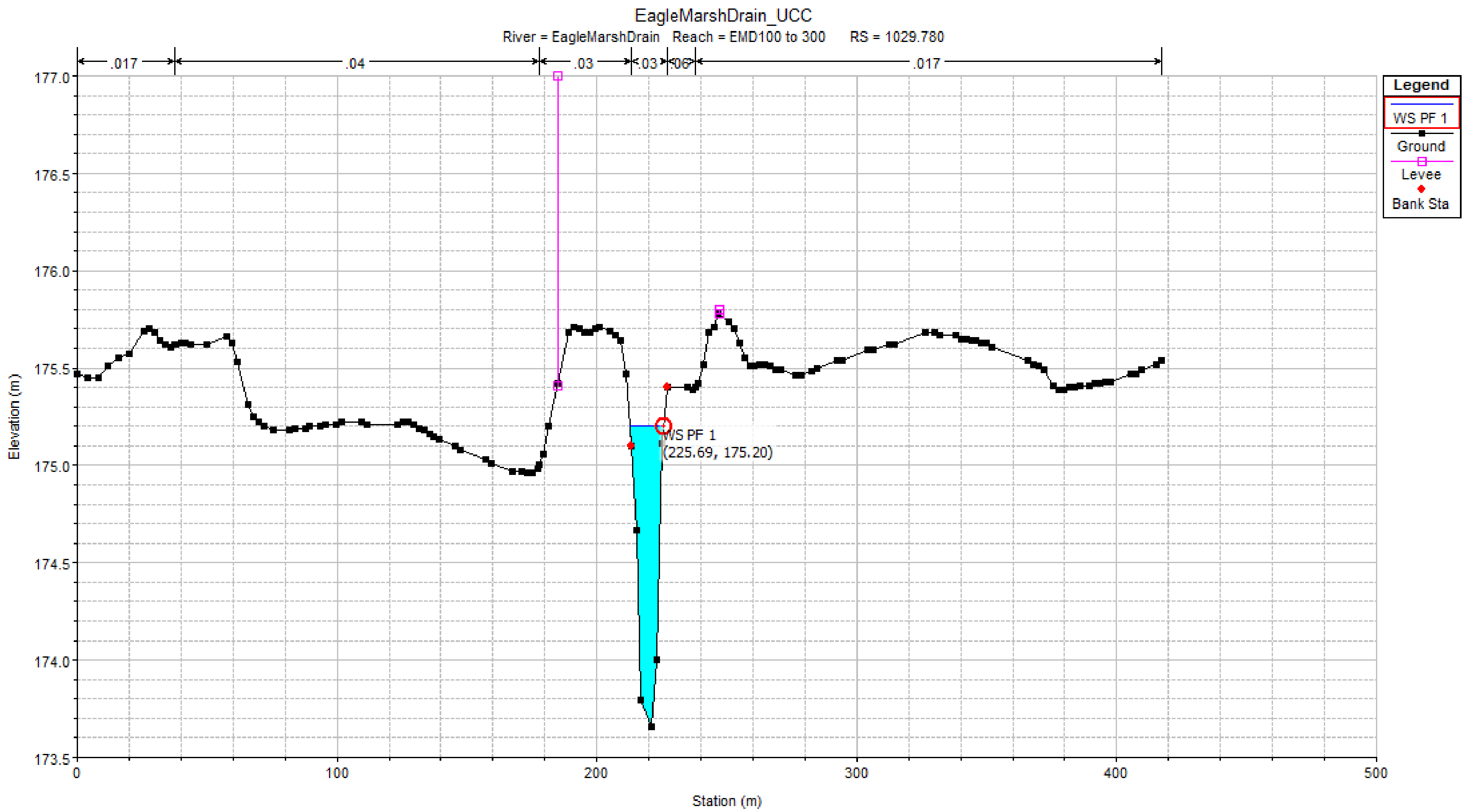

EagleMarshDrain_EX
River = EagleMarshDrain Reach = EMD100 to 300 RS = 964.9745
.04
.03
.03
0
3
.06
.04
.06
.04
.06
0
4
Legend
WS PF 1
Ground
Bank Sta
WS PF 1
(254.88, 175.13)
Elevation (m)
176.5
176.0
175.5
175.0
174.5
174.0
173.5
173.0
0
100
200
300
400
500
Station (m)


EagleMarshDrain_EX
River = EagleMarshDrain Reach = EMD100 to 300 RS = 917.2293
.04
.03
.03
.06
.04
.06
.04
Legend
WS PF 1
Ground
Bank Sta
WS PF 1
(254.88, 175.11)
Elevation (m)
Station (m)
177.0
176.5
176.0
175.5
175.0
174.5
174.0
173.5
173.0
172.5
0
100
200
300
400
500

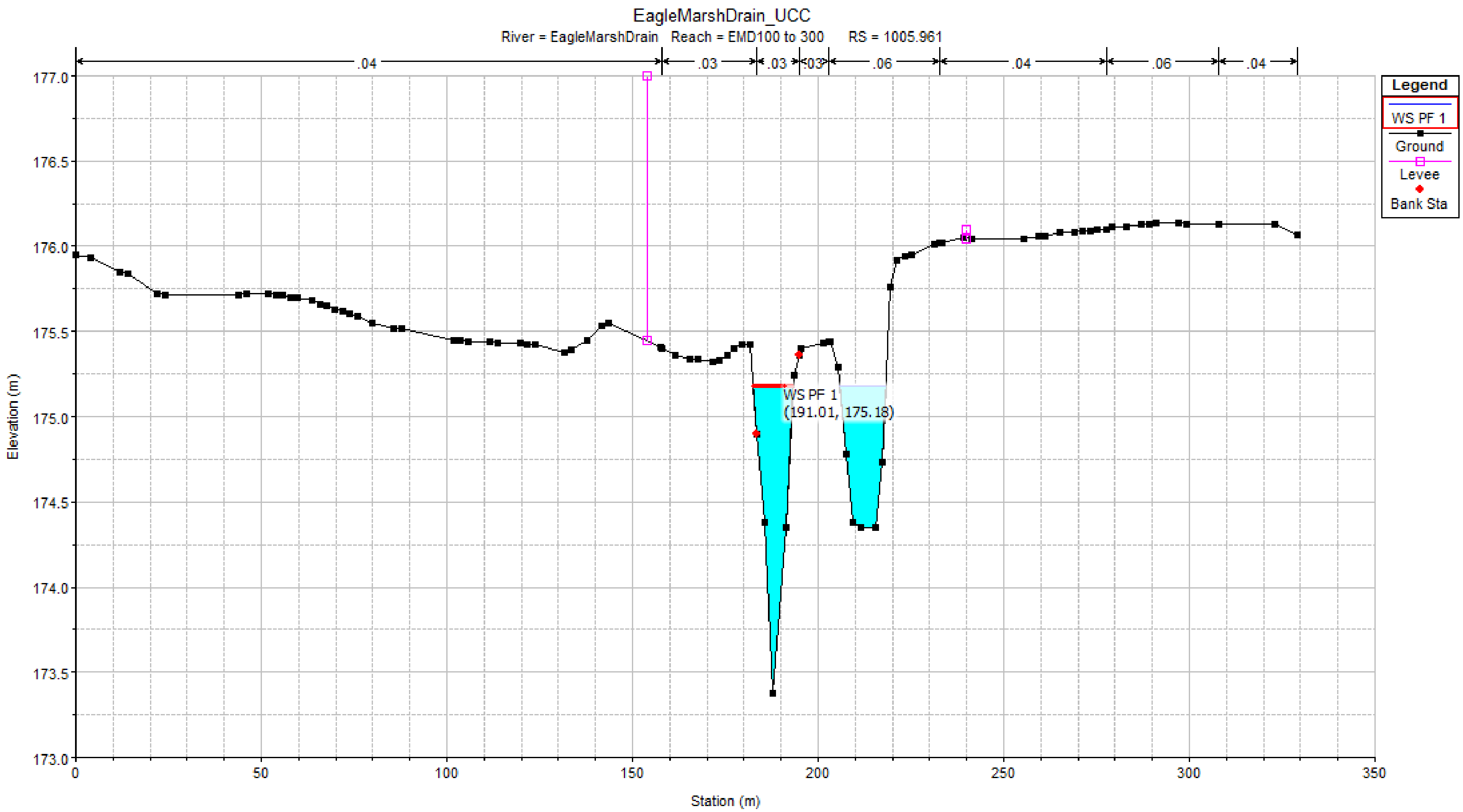

EagleMarshDrain_EX
River = EagleMarshDrain Reach = EMD100 to 300 RS = 863.8885
.04
.03
.03
.06
.04
0
3
0
1
5
Legend
WS PF 1
Ground
Bank Sta
WS PF 1
(343.27, 175.07)
Elevation (m)
176.0
175.5
175.0
174.5
174.0
173.5
173.0
172.5
Station (m)
0
100
200
300
400
500

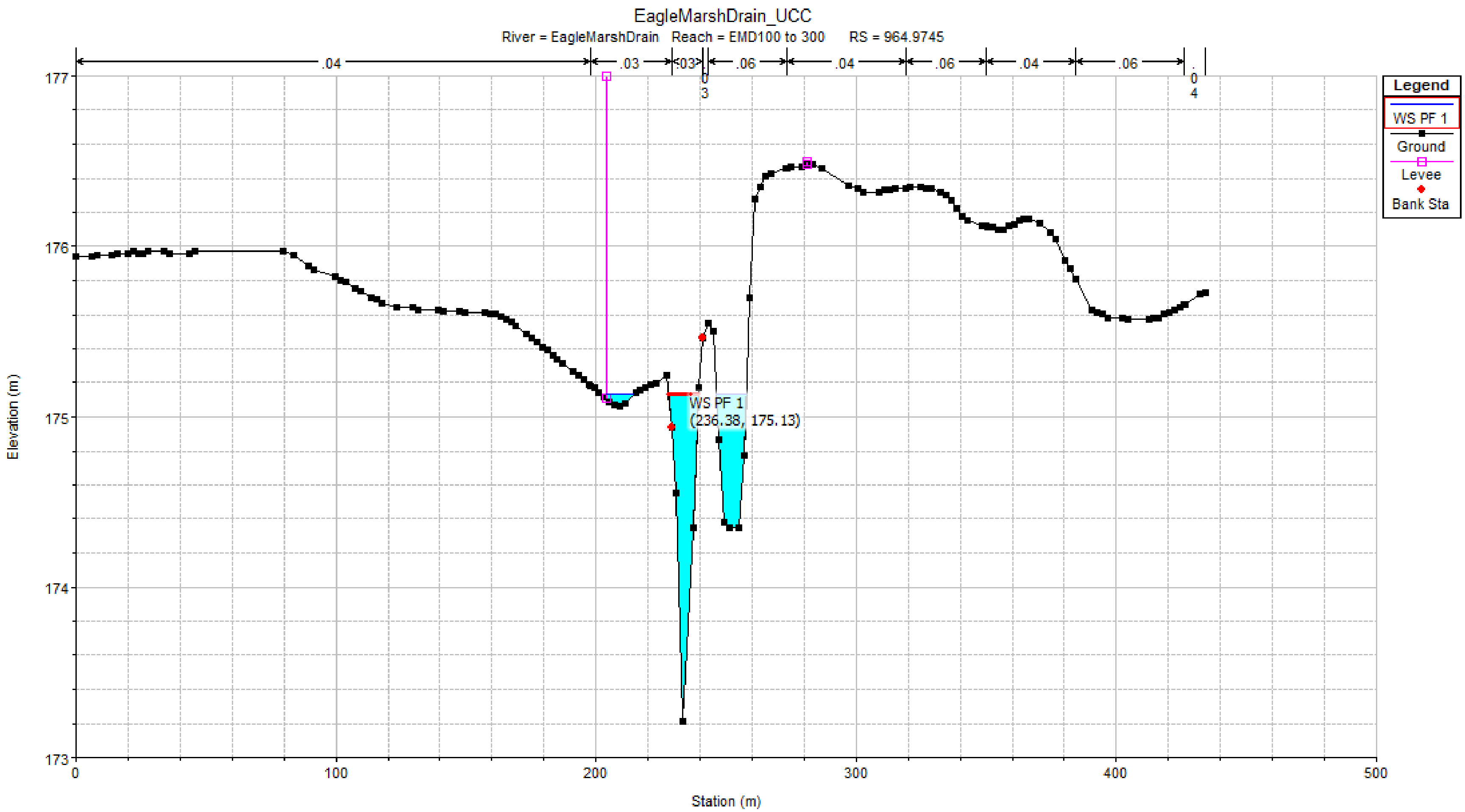
APPENDIX E

Future HEC-RAS Cross Sections (with Levee)

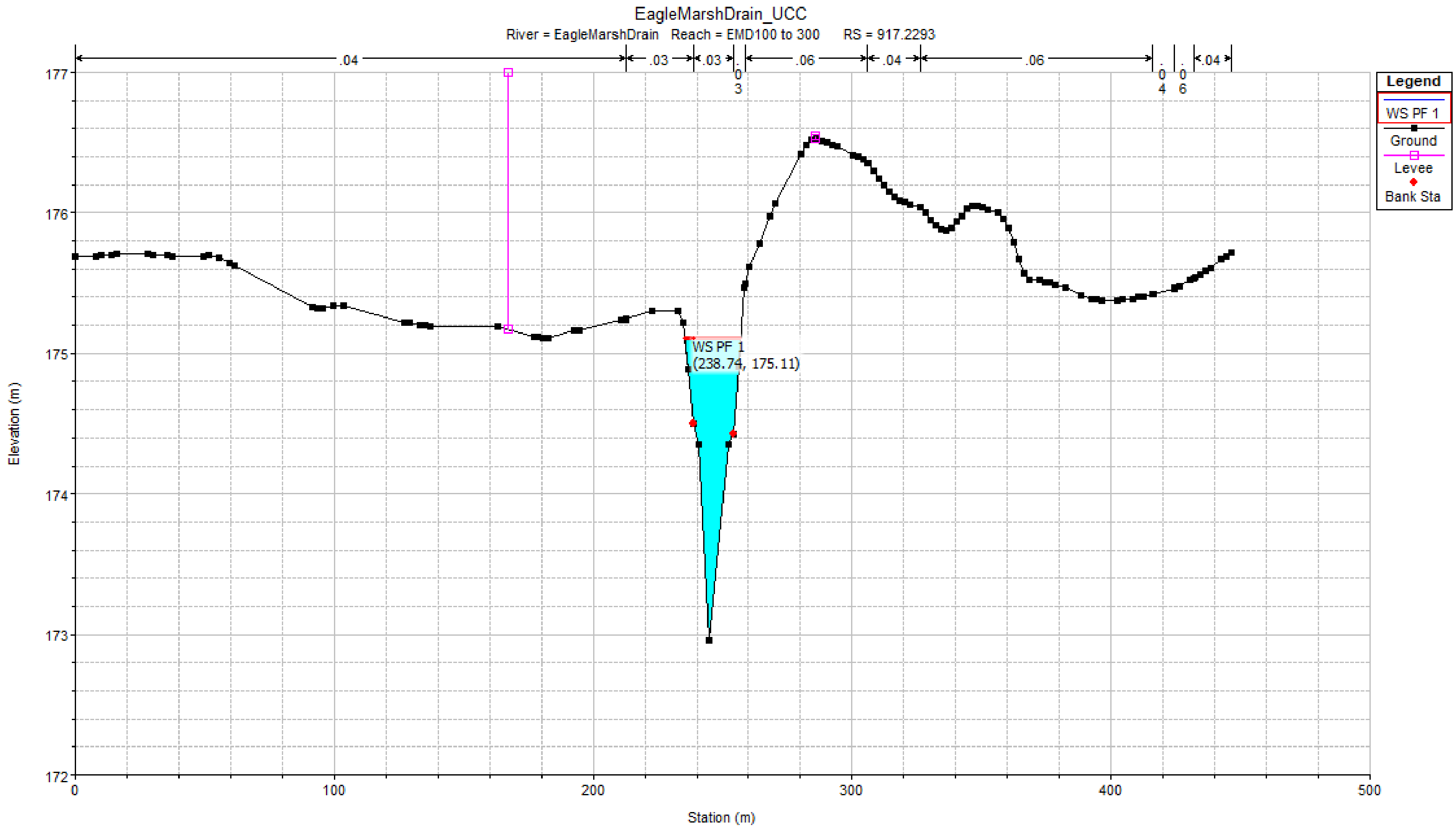


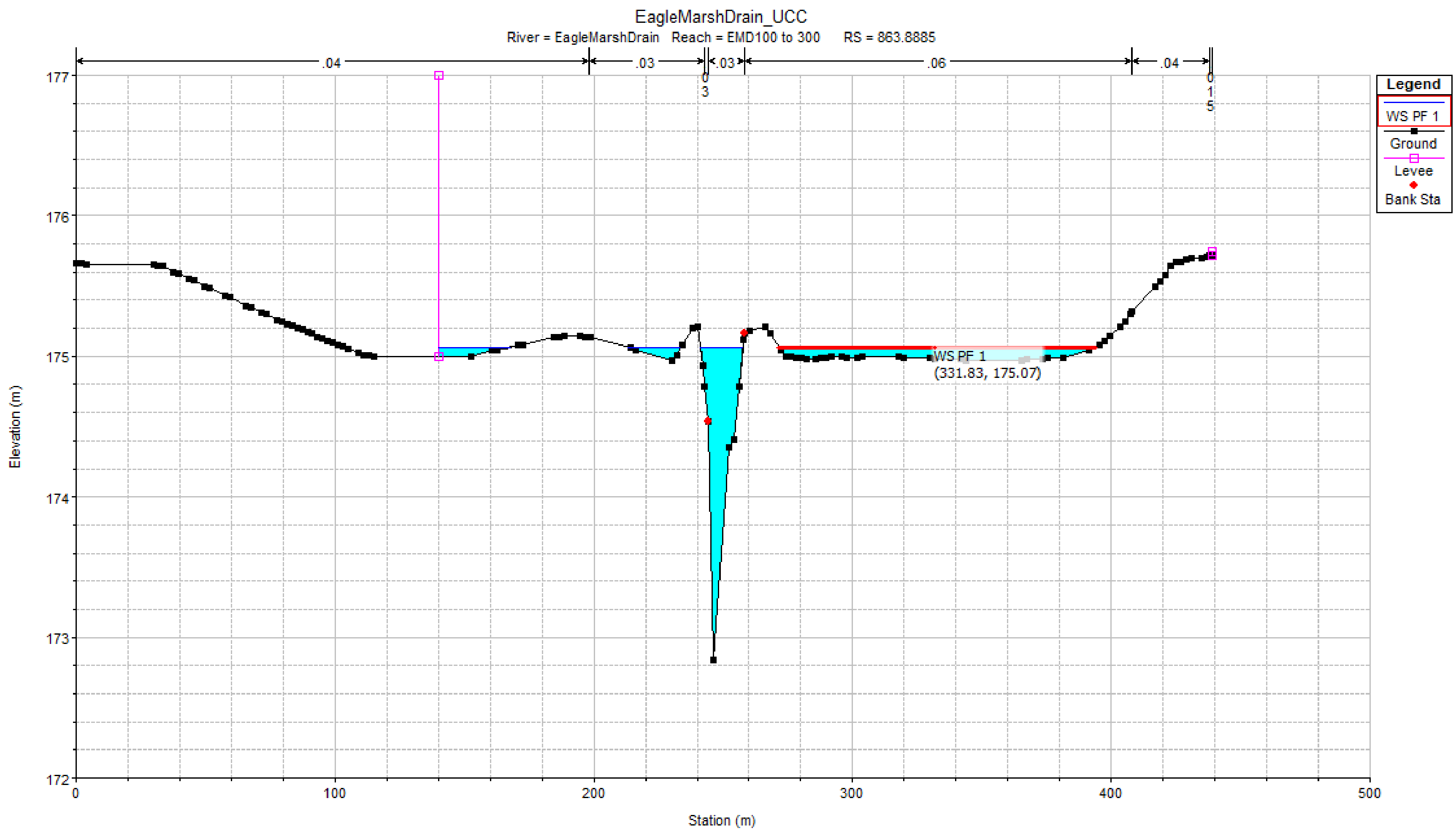
EagleMarshDrain_UCC
River = EagleMarshDrain Reach = EMD100 to 300 RS = 1029.780
.017
.04
.03
.03
.06
.017
Legend
WS PF 1
Ground
Levee
Bank Sta
WS PF 1
(225.69, 175.20)
Elevation (m)
Station (m)
177.0
176.5
176.0
175.5
175.0
174.5
174.0
173.5
0
100
200
300
400
500


EagleMarshDrain_UCC
River = EagleMarshDrain Reach = EMD100 to 300 RS = 1005.961
.04
.03
.03
.03
.06
.04
.06
.04
Legend
WS PF 1
Ground
Levee
Bank Sta
WS PF 1
(191.01, 175.18)
Elevation (m)
Station (m)
177.0
176.5
176.0
175.5
175.0
174.5
174.0
173.5
173.0
0
50
100
150
200
250
300
350



EagleMarshDrain_UCC
River = EagleMarshDrain Reach = EMD100 to 300 RS = 964.9745
.04
.03
.03
0
3
.06
.04
.06
.04
.06
0
4
Legend
WS PF 1
Ground
Levee
Bank Sta
WS PF 1
(236.38, 175.13)
Elevation (m)
177
176
175
174
173
Station (m)
0
100
200
300
400
500


EagleMarshDrain_UCC
River = EagleMarshDrain Reach = EMD100 to 300 RS = 917.2293
.04
.03
.03
0
3
.06
.04
.06
0
4
0
6
.04
Legend
WS PF 1
Ground
Levee
Bank Sta
WS PF 1
(238.74, 175.11)
Elevation (m)
Station (m)
177
176
175
174
173
172
0
100
200
300
400
500



EagleMarshDrain_UCC
River = EagleMarshDrain Reach = EMD100 to 300 RS = 863.8885
.04
.03
.03
.06
.04
Legend
WS PF 1
Ground
Levee
Bank Sta
WS PF 1
(331.83, 175.07)
Elevation (m)
Station (m)
177
176
175
174
173
172
0
100
200
300
400
500