

**STORMWATER MANAGEMENT POND EC-4  
DESIGN REPORT**

**SCHAEFFERS CONSULTING ENGINEERS  
PROJECT 2011-3676**

**AUGUST 2012  
REVISED OCTOBER 2012**



**SCHAEFFERS**  
**CONSULTING ENGINEERS**

## Contents

1	Introduction .....	1
1.1	Background.....	1
1.2	Design Criteria .....	2
2	Stormwater Management Pond Design .....	5
2.1	General .....	5
2.2	Contributing Drainage Area .....	5
2.3	Water Quality Storage (Permanent Pool) .....	5
2.4	Erosion Control Release .....	6
2.4.1	Drawdown Time.....	7
2.5	Water Quantity Control.....	7
2.5.1	Target Release Rates.....	7
2.5.2	Outlet Controls.....	7
2.5.3	Emergency Overflow.....	9
2.5.4	Sediment Forebay Design .....	14
2.6	Emergency Outlet.....	14
2.7	Groundwater Considerations.....	14
2.8	Thermal Impacts Considerations .....	14
3	Closing Remarks.....	15
4	Appendices .....	16
	Table 2-1 Permanent Pool Requirements.....	6
	Table 2-2 Erosion Control Release .....	6
	Table 2-3 Target Release Rates for SWM Pond EC-4.....	7
	Table 2-4 Quantity Control Pond Performance .....	7
	Table 2-5 Orifice Sizing.....	8
	Table 2-6 Pond Stage Storage Discharge Characteristics (OTTHYMO Input) .....	9
	Figure 1-1 Subject Site Location.....	4
	Figure 2-1 Existing Drainage Condition.....	10
	Figure 2-2 SWM Pond EC-4 Tributary Area.....	11
	Figure 2-3 SWM Pond EC-4.....	12
	Figure 2-4 Development Stages for SWM Pond EC-4 .....	13

## Appendix A SWM Pond Design Calculations

Appendix B Post Development Visual OTTHYMO – Provided Storage & Outlet Structure Confirmation

Appendix C Soil Investigation Excerpt

Appendix D SWM Pond Design Drawings

# 1 INTRODUCTION

## 1.1 Background

This report is prepared in support of the application for approval SWM Pond EC-4 was presented to Toronto Region Conservation Authority (TRCA) in August 2012. The August 2012 submission has been approved by TRCA under permit C-120840/CFN47953. Subsequent updates to this report address the comments provided by the City of Brampton in May/June 2012, as well as discussions regarding the configuration of the overflow held in September 2012. The report is consistent with all previous design information submitted regarding the stormwater management facility as listed below, and it provides the most up to date values with respect to drainage areas, staging and external flows.

- *Countryside Villages Secondary Plan Area 48 –Phase II Master Environmental and Servicing Plan (MESP) - City of Brampton (TMIG December 2010);*
- *Mayfield West Industrial Lands – Functional Servicing and Stormwater Management Report (IBI – April 2010) as supplied by TRCA;*
- *Functional Servicing Report (FSR), Countryside Villages Employment Block, Part of Lots 16&17, Concession 3, E.H.S. between HWY 410 & Dixie Road, City of Brampton” dated October 2011 by Schaeffers Consulting Engineers.*
- *Countryside Employment Lands East – Stormwater Management Design Report – Schaeffers Consulting Engineers Project 2011-3676 – May 2012;*
- *Memo regarding: Regional Flows from A06 through Countryside Villages in Brampton (by Schaeffers Consulting Engineers to Metrus Developments dated June 20<sup>th</sup> 2012);*
- *Memo regarding: Staging Considerations for Countryside Drive Culvert (by Schaeffers Consulting Engineers to Metrus Developments dated August 9<sup>th</sup> 2012)*

SWM pond EC-4 is to be constructed as part of the Countryside Employment Lands East development within the City of Brampton’s Secondary Plan Area 48. The Countryside Villages Employment Block is located north of Countryside Drive, west of Dixie Road, south of Mayfield Road, and east of the Highway 410 extension (see Figure 1-1).

This report demonstrates that the SWM pond is constructed in accordance with the City of Brampton (the City), Toronto and Region Conservation Authority (TRCA), and the Ministry of Environment (MOE) stormwater management design criteria for stormwater quality, quantity control, and erosion control.

The SWM pond which is to be constructed in 2012, will exist in 3 principal stages. In order to be consistent with the 6 stages of the Countryside Drive Culvert, presented the memo of August 2012, the numbering below is provided for the stages presented in this report.



### **1. Stage 1 - Countryside Employment Lands**

This stage will exist after the completion of the Countryside Employment Lands, which are currently under construction. Under this condition, the SWM pond services an area of 69 ha and routes 47.9 ha of external drainage (Area A06 in existing condition). The ultimate flow targets are met for the erosion, quality, and quantity controls under this stage.

### **2. Stage 2, 3, 4, and 5 – Development of Block 48-1 Phase 1**

This stage will exist after the development of the lands to the East of Dixie Road. The phasing of these lands calls for an interim condition in the first phase of development during which an additional 6.37 ha of housing, as well as an additional 1.74 ha portion of Mayfield Road, is temporarily serviced by SWM Pond EC-4. This is the highest (worst case) condition in terms of drainage area directed to SWM Pond EC-4.

Under this condition, the SWM pond services an area of 141.7 ha and routes 47.9 ha of external drainage (Area A06 in existing condition). Depending on the timing of the development in the Mayfield Industrial lands, there may be a need to develop interim flow targets, this will be presented if necessary in the SWM plans for Block 48-1.

### **3. Stage 6 – Development of Block 48-1 Phase 2**

This stage will exist after the development of a SWM Pond on the Humber River tributary to the East, in which the interim area will be diverted to the new SWM pond.

After the removal of this area, the SWM pond will move to its ultimate service condition with 133.6 ha of service area, and routing of external flows.

## **1.2 Design Criteria**

Stormwater management design criteria is in accordance with the background reports and follow from the MOE Stormwater Management Planning and Design (SWMPD) Manual (March 2003) for controlling urban stormwater quality and quantity. Additional criteria, as recommended by the City of Brampton and TRCA are integrated into the design. A summary of the stormwater management design criteria follows:

- Enhanced (Level 1) water quality protection is proposed. The permanent pool storage should have a maximum depth limited to 2.5 m and be calculated using Table 3.2 from the MOE SWMPD Manual (March 2003);
- Allowable erosion release rate for SWM Pond EC-4 under the 25 mm storm event is 0.084 m<sup>3</sup>/s as per the Master Environmental Servicing Report;
- Water quantity control is required to control the post-development 2-year through the 100-year storm events to target release rates. The target release rates of SWM Pond EC-4 are based on the pre-development drainage area and the unit discharge rates provided in the TRCA's Etobicoke Creek Draft Hydrology Update Report;

- Quantity Controls are provided for the service area only, a composite target release rate is provided to account for routing of external flows outside the service area that are routed through the pond;
- Employment blocks within the development will provide on-site stormwater quantity control to limit runoff up to and including the 100 year storm, to the storm sewer capacity, i.e. the 10-year post development flow rates. This will be developed on a block by block basis at the time of site design and may include parking lot, underground, or rooftop storage as proposed by the Block owner at site plan application;
- The hydrologic modeling to size the required SWM Pond volumes utilizes the 2, 5, 10, 25, 50, 100 year return period 6 hour AES Distribution as established in the MESP storm for sizing of water quantity control volumes;

COUNTRYSIDE VILLAGES

LEGEND

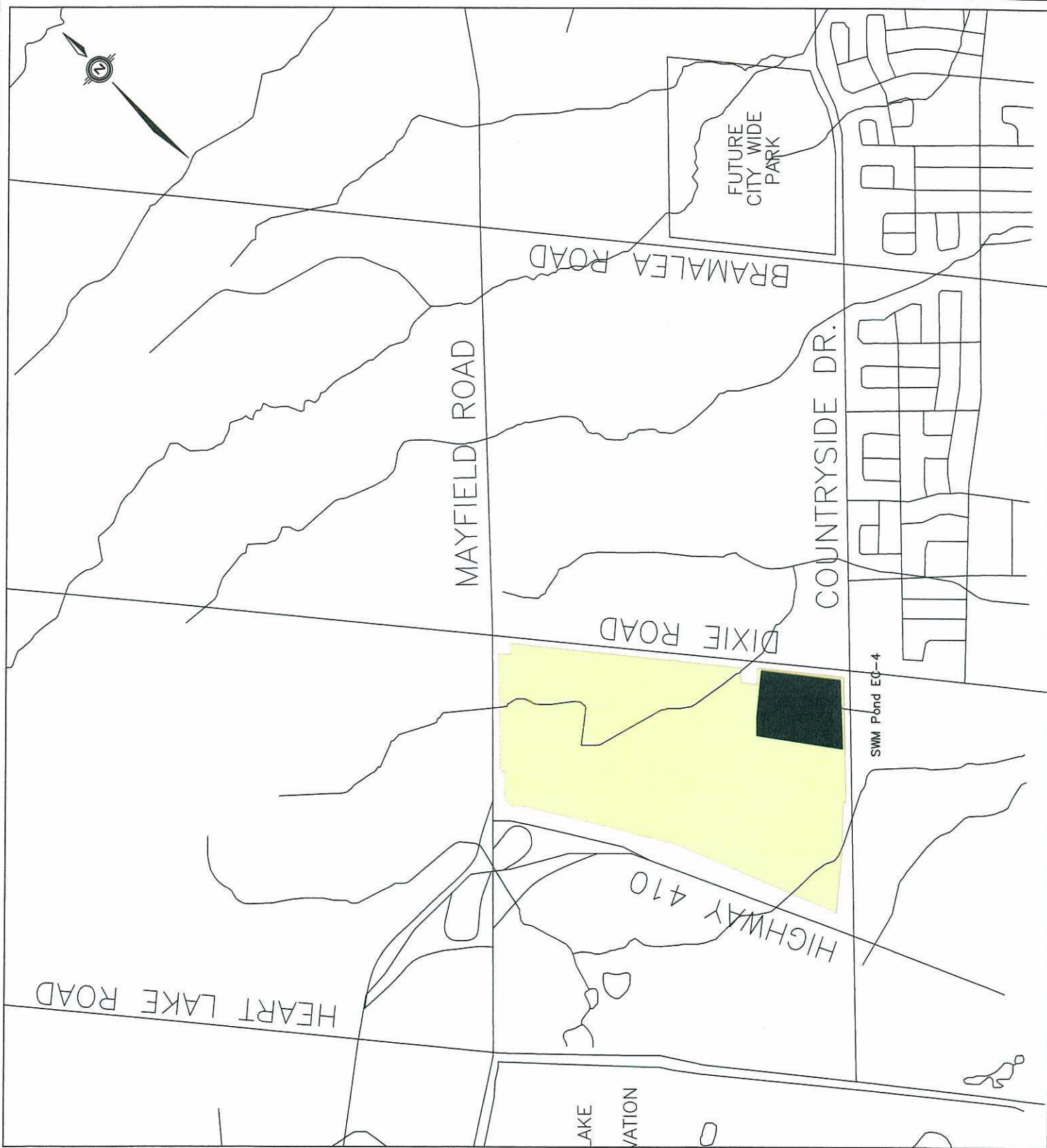
PROPOSED EMPLOYMENT  
LANDS



**SCHAEFFERS**  
CONSULTING ENGINEERS  
6 Ramona Drive, Concord, Ontario L4K 4B3  
tel. 905.736.6100 fax. 905.736.6075

FIGURE 1.1  
LOCATION PLAN

2008-2448 OCTOBER 2011 SCALE: N.T.S.





## 2 STORMWATER MANAGEMENT POND DESIGN

### 2.1 *General*

The design is consistent with the approved Functional Servicing Report of Countryside Villages Employment Block. SWM Pond EC-4 will treat the urban stormwater runoff from the site and is proposed in the southeast portion of the subject development. The flows from the pond will be conveyed to the realigned Spring Creek Tributary A. Simulations of post-development release rates and storage volumes were prepared using the computer model Visual OTTHYMO to demonstrate that post-development runoff would be controlled to pre-development levels during the 2-year through 100-year storm events.

### 2.2 *Contributing Drainage Area*

The contributing drainage area to SWM Pond EC-4 is illustrated in Figure 2-2.

The ultimate drainage area serviced by the SWM pond will be 133.6 ha with an imperviousness of 80% as presented in Table 2-1.

In the initial stage, the pond will service 69 ha and route 47.9 ha of external drainage.

### 2.3 *Water Quality Storage (Permanent Pool)*

The water quality storage requirements for the SWM Pond were determined in accordance with the MOE SWMPD Manual (March, 2003) for Enhanced protection (80 % long-term S.S. removal). The required and provided permanent pool volumes are summarized in Table 2-1. Detailed calculations are provided in Appendix A for reference.



Table 2-1 Permanent Pool Requirements

	Stage 1 - Employment Lands (Current Stage)	Stage 2,3,4,5 - Block 48 - 1 Phase 1 (Worst Case Interim)	Stage 6 - Block 48-1 Phase 2 (Ultimate Stage)
<b>Employment Lands</b>	<b>Area in ha</b>		
Block 1	12.3	12.3	12.3
Internal Roads + West side of Dixie	7.51	7.51	7.51
Block 2A	2.49	2.49	2.49
Block 2B	6.33	6.33	6.33
Block 6	9.16	9.16	9.16
Block 3	7.29	7.29	7.29
Block 4	7.85	7.85	7.85
Block 5	7.76	7.76	7.76
Block 7 (SWM Pond)	6.61	6.61	6.61
<b>Residential Lands</b>			
Block 48-1 Phase 1 (A+B) + Includes East portion of Dixie Road	NA	57.03	57.03
Temporary Area of 48-1 Phase 1	NA	6.37	NA
<b>External Road Right of Ways</b>			
Mayfield Road West	1.7	1.7	1.7
Mayfield Road East	NA	1.47	1.47
Temporary Area of Mayfield Road - Block 48-1 Phase 1	NA	1.74	NA
External Area Dixie Road - Caledon	NA	1.62	1.62
<b>External Permanent Road Right of Way</b>			
External Farm Field - Caledon	N/A	4.5	4.5
External Lands Mayfield West Industrial - Not included in Water Quality Calculation, Quality Control to be provided by Mayfield West Industrial Development	N/A	N/A	N/A
<b>Total Area for Water Quality Control</b>	<b>69.0</b>	<b>141.7</b>	<b>133.6</b>
<b>Water Quality Volume Requirements</b>			
Type of Facility	Wet Pond	Wet Pond	Wet Pond
Level of Protection	Enhanced	Enhanced	Enhanced
Drainage Area	69.0 ha	141.7 ha	133.6 ha
Weighted Imperviousness	100%	80%	80%
Total Storage Volume Requirement (From MOE Table 3.2)	275 m <sup>3</sup> /ha	242 m <sup>3</sup> /ha	242 m <sup>3</sup> /ha
Minimum Extended Detention Storage Volume Requirement	40 m <sup>3</sup> /ha	40 m <sup>3</sup> /ha	40 m <sup>3</sup> /ha
Permanent Pool Requirement	235 m <sup>3</sup> /ha	202 m <sup>3</sup> /ha	202 m <sup>3</sup> /ha
Required Permanent Pool Storage Volume	16,215 m <sup>3</sup>	28,582 m <sup>3</sup>	26,947 m <sup>3</sup>
Provided Permanent Pool Storage Volume	33,000 m <sup>3</sup>	33,000 m <sup>3</sup>	33,000 m <sup>3</sup>

## 2.4 Erosion Control Release

The erosion control release rate was estimated in the Phase II MESP based on a proposed conceptual design for modifications to Spring Creek Tributary A, the SWM Pond EC-4 receiving waters.

As established in the MESP (reference page included in Appendix A), the erosion threshold design flow for the proposed low flow channel of Spring Creek Tributary A is 0.25 m<sup>3</sup>/s, while allowable erosion release rate for SWM Pond EC-4 under the 25 mm storm event is 0.084 m<sup>3</sup>/s.

The model indicates the following performance under the proposed conditions:

Table 2-2 Erosion Control Release

25 mm Storm Release rates	
Target	0.084 m <sup>3</sup> /s
Stage 1 Conditions	0.049 m <sup>3</sup> /s
Ultimate Conditions	0.075 m <sup>3</sup> /s

### 2.4.1 Drawdown Time

The drawdown time for the erosion control volume is calculated to be 183 hours using the drawdown time equation in the SWMPD Manual (MOE, 2003). This is greater than the minimum recommended 48 hour detention time. Supporting calculations are provided in Appendix A for reference. A review of the hydrograph indicates that 50% of the erosion control volume is drawn down in 48 hours and 70% in the first 72 hours.

## 2.5 Water Quantity Control

### 2.5.1 Target Release Rates

The target release rate is a composite rate based on controlling the service area and routing the external area. The service area is controlled to a release rate based on the pre-development area (42.9 ha) draining to this point. The composite release rate is based on the ultimate condition, i.e. conveying the controlled flow rate from SWM Pond.

The release rates for SWM Pond EC-4 are summarized in Table 2-3 and calculated as per the following example.

Prorated Target Release Rate (2 year – sample)

$$42.9 \text{ ha (Existing Drainage Area)} - 7.17 \text{ ha (Wetland Area)} \times \frac{7.5 \frac{\text{l}}{\text{s}}}{\text{ha}} \times .001 \frac{\text{m}^3}{\text{l}} = 0.27 \text{ m}^3/\text{s}$$

Composite Release Rate (2 yr- sample)

$$0.27 \frac{\text{m}^3}{\text{s}} (\text{Prorated Target}) + .09 \frac{\text{m}^3}{\text{s}} (\text{E7 Outflow}) = 0.36 \text{ m}^3/\text{s}$$

Table 2-3 Target Release Rates for SWM Pond EC-4

Design Storm Event	Etobicoke Creek Unit Flow (l/s/ha)	Pro-rated Target Release Rate (m <sup>3</sup> /s)	External SWM Pond E-7 Outflow (m <sup>3</sup> /s)	Composite Release Rates (m <sup>3</sup> /s)
2 yr	7.5	0.27	0.09	0.36
5 yr	13.3	0.48	0.17	0.65
10 yr	18.7	0.67	0.24	0.90
25 yr	27.0	0.97	0.33	1.29
50 yr	35.2	1.26	0.42	1.67
100 yr	42.1	1.50	0.49	1.99

The pond performance is modeled under stage 1 and ultimate conditions. The results are as follows:

Table 2-4 Quantity Control Pond Performance

	Target	Stage 1	Ultimate
2 yr	0.36 m <sup>3</sup> /s	0.08 m <sup>3</sup> /s	0.30 m <sup>3</sup> /s
5 yr	0.65 m <sup>3</sup> /s	0.26 m <sup>3</sup> /s	0.57 m <sup>3</sup> /s
10 yr	0.90 m <sup>3</sup> /s	0.42 m <sup>3</sup> /s	0.62 m <sup>3</sup> /s
25 yr	1.29 m <sup>3</sup> /s	0.57 m <sup>3</sup> /s	1.06 m <sup>3</sup> /s
50 yr	1.67 m <sup>3</sup> /s	0.60 m <sup>3</sup> /s	1.23 m <sup>3</sup> /s
100 yr	2.00 m <sup>3</sup> /s	0.65 m <sup>3</sup> /s	1.39 m <sup>3</sup> /s

### 2.5.2 Outlet Controls

The SWM facility achieves the quantity, erosion control, and quality control release rates with a multi orifice control system.

A 300 mm diameter pipe with a 205 mm diameter orifice plate is designed to provide water quality control. The submerged end of the pipe will be installed with a Hickenbottom



(perforated) pipe (with 25 mm diameter holes spaced at 75mm) and surrounded with a gravel jacket to prevent blockage of the perforated pipe. The orifice plate placed at an invert of 242.20 m controls outflow from the pond to below the erosion target release rate.

Water quantity control for run-off from the 2-year design storm event up to the 10-year design storm event will be provided by a ditch inlet catchbasin installed at a lip elevation of 243.10 m, just above the erosion control water surface elevation. Flows entering the ditch inlet catchbasin will be controlled by a 450 mm diameter orifice plate installed in the outlet of the ditch inlet catchbasin at an invert elevation of 242.25 m.

Water quantity control for run-off from the 2-year design storm event up to the 10-year design storm event will be provided by a ditch inlet catchbasin installed at a lip elevation of 243.10 m, just above the erosion control water surface elevation. Flows entering the ditch inlet catchbasin will be controlled by a 450 mm diameter orifice plate installed in the outlet of the ditch inlet catchbasin at an invert elevation of 242.25 m.

In combination with the above control structures, water quantity control for run-off from the 25-year design storm event up to the 100-year storm event will be provided by a ditch inlet catchbasin installed at a lip elevation of 243.90 m, just above the 10-year storm water surface elevation. Flows entering the ditch inlet catchbasin will be controlled by a 500 mm diameter orifice plate installed on the outlet pipe of the ditch inlet catchbasin at an invert elevation of 243.15 m.

The top of quantity control level is 244.60 with a total extended detention volume of 88,544 m<sup>3</sup>. Table 2-5 provides the details of each component of the outlet structure for the proposed SWM Pond.

Table 2-5 Orifice Sizing

Interval	Aperture Description	Size	Invert/Lip Elevation (m)
Erosion Control	Orifice Plate	205 mm $\phi$	242.20
2-year to 10-year	Orifice Plate	450 mm $\phi$	242.25
	DICB	2 x (1.8m x 0.9m)	243.10
25-year to 100-year	Orifice Plate	500 mm $\phi$	243.15
	DICB	3 x (1.8m x 0.9m)	243.9
Emergency	Top of Quantity Control	3.0 m x 3.9m Box	244.60

The stage storage discharge relationship for the pond is provided in the following table. Stage storage is provided for the 100 year storm service level only. Additional storage above the 100 year level is discussed in section 2.5.3.

Table 2-6 Pond Stage Storage Discharge Characteristics (OTTHYMO Input)

Stage	Storage	Discharge
242.20	0 m <sup>3</sup>	0.000 m <sup>3</sup> /s
243.00	27,669 m <sup>3</sup>	0.075 m <sup>3</sup> /s
243.30	38,893 m <sup>3</sup>	0.28 m <sup>3</sup> /s
243.55	48,566 m <sup>3</sup>	0.55 m <sup>3</sup> /s
243.65	52,421 m <sup>3</sup>	0.58 m <sup>3</sup> /s
243.95	64,852 m <sup>3</sup>	0.64 m <sup>3</sup> /s
244.15	73,500 m <sup>3</sup>	1.15 m <sup>3</sup> /s
244.35	81,492 m <sup>3</sup>	1.25 m <sup>3</sup> /s
244.60	88,544 m <sup>3</sup>	1.40 m <sup>3</sup> /s

### 2.5.3 Emergency Overflow

An emergency overflow spillway exists in the event that the water level in the pond exceeds 245.50. The emergency outflow utilizes Ace Drive to the West of the Pond as a Spillway. The configuration of the spillway is such that it maximizes the flow that is directed through the Box Culvert Crossing. In the worst case, the Regional Flow to the pond peaks at 25 m<sup>3</sup>/s and is attenuated to 17 m<sup>3</sup>/s with the volume in the pond up to 245.98. It is estimated that during Regional flow conditions approximately 1.0 m<sup>3</sup>/s of flow crosses Ace drive with the remainder of the flow passing through the culvert.

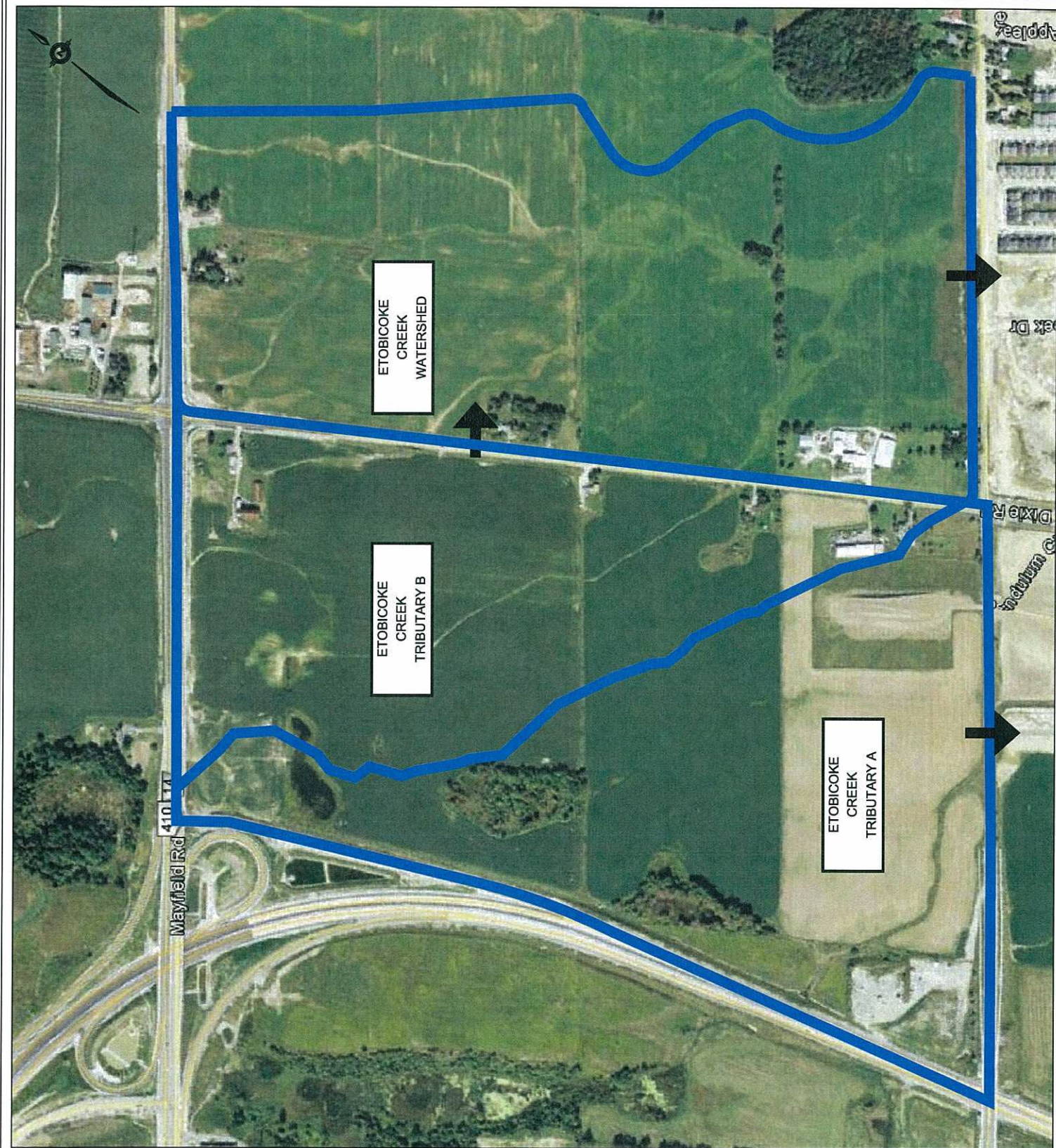
### 2.5.4 Downstream Considerations – Countryside Drive Culvert

TRCA and MNR require that watercourses be designed to convey a Regional Storm design flow that is evaluated based on an assumption that there are no functioning stormwater management controls during an event equal to the largest rainfall event in recorded history in the Toronto Region (Hurricane Hazel).

Currently, the uncontrolled regional storm flows in the ultimate build-out scenario exceed the capacity of the Countryside Drive Culvert. The rest of the realigned Creek conveyance system has sufficient hydraulic capacity to convey this design flow. If the culvert is not upgraded prior to the diversion of flows from Block 48-1, the uncontrolled Regional Flow causes a head water elevation of approximately 245.90 upstream of the Countryside Drive Culvert, which would restrict the flow from the pond, and flood a small area at the intersection of Ace Drive – flooding in these areas may come from surface overflows from the Channel and/or upwelling through some of the low catchbasins. A solution to this issue is required as a condition of approval of the Block 48-1 lands to the East.

This situation does not affect the design of the SWM pond. The extent of the flooding potential will be clarified in the technical studies conducted for Block 48-1.





COUNTRYSIDE VILLAGES

LEGEND

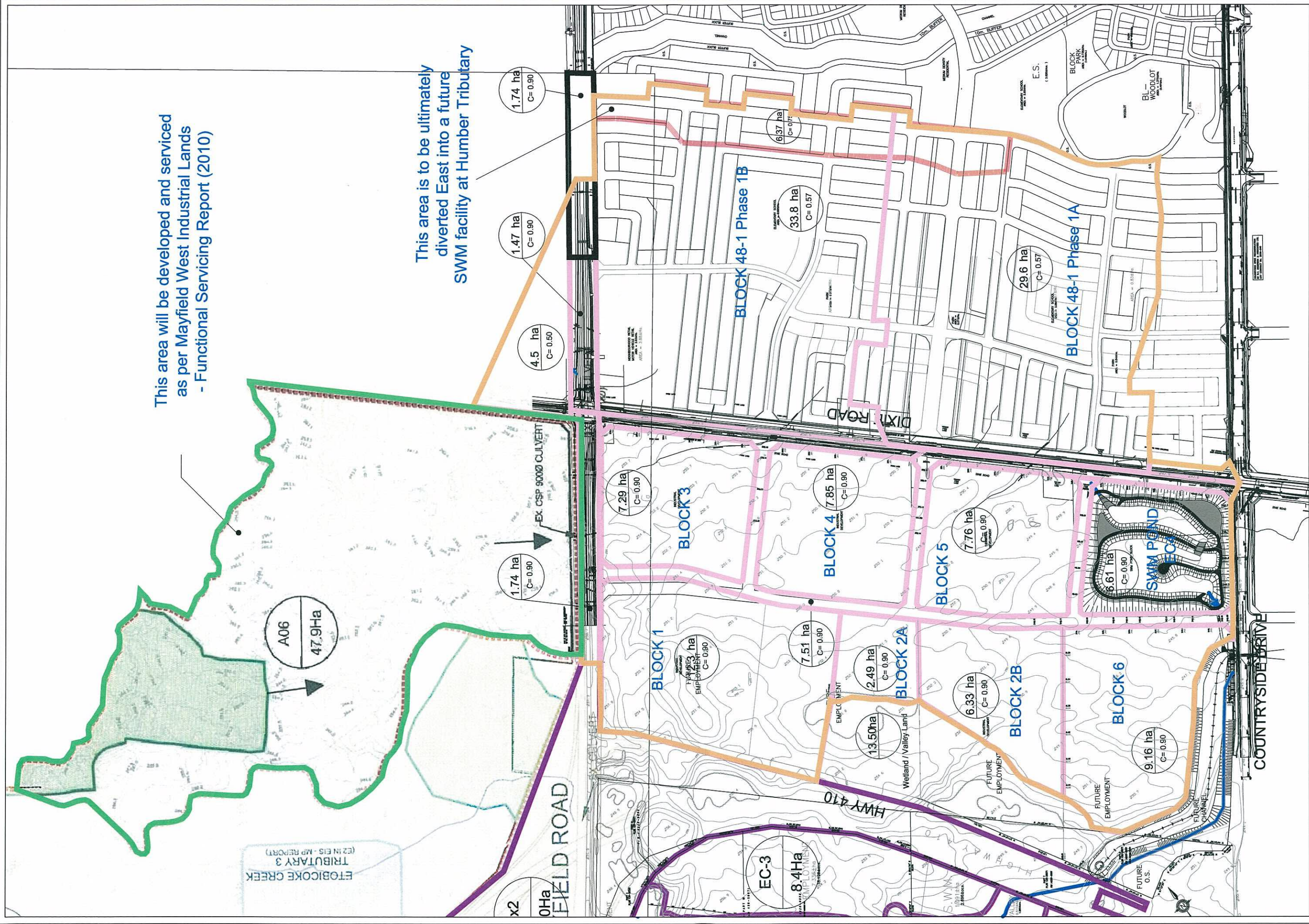
WATERSHED BOUNDARY

DRAINAGE DIRECTION



FIGURE 2-1  
PRE DEVELOPMENT DRAINAGE







DESCRIPTION	PROVIDED STORAGE	REQUIRED STORAGE
PERMANENT POOL EL.239.70 - EL.242.20	28,088m <sup>3</sup>	27,794m <sup>3</sup>
EROSION EL.242.20 - EL.243.00	27,669m <sup>3</sup>	26,911m <sup>3</sup>
2YR. W.L. EL.242.20 - EL.243.30	38,893m <sup>3</sup>	38,283m <sup>3</sup>
5YR. W.L. EL.242.20 - EL.243.65	52,421m <sup>3</sup>	52,009m <sup>3</sup>
10YR. W.L. EL.242.20 - EL.243.90	62,690m <sup>3</sup>	62,150m <sup>3</sup>
25YR. W.L. EL.242.20 - EL.244.15	73,500m <sup>3</sup>	71,788m <sup>3</sup>
50YR. W.L. EL.242.20 - EL.244.30	80,082m <sup>3</sup>	79,410m <sup>3</sup>
100 YR. W.L. EL.242.20 - EL.244.60	88,544m <sup>3</sup>	88,191m <sup>3</sup>

2yr to 10yr control  
INV. 243.10

Emergency Spillway

2400x1500  
Culvert

OVERLAND FLOW ROUTE  
FLEXIDRETE CONC. BLOCKS COVERED  
WITH 150mm TOPSOIL AND 500  
PRI APPROVED EQUAL

STORM OUTFALL #1-  
SEE DETAIL ON DWG. NO. SWM-8  
OPS 804.02 (MODIFIED)

500mm DEPTH OF RIP-RAP  
STONES (CL1) EMBEDDED  
ON SOLID GROUND

FOREBAY

DEWATERING SUMP  
(SEE DETAIL THIS DWG.)

SPILLWAY  
FLEXIDRETE CONC. BLOCKS  
OR APPROVED EQUAL  
SEE DETAIL THIS DWG.

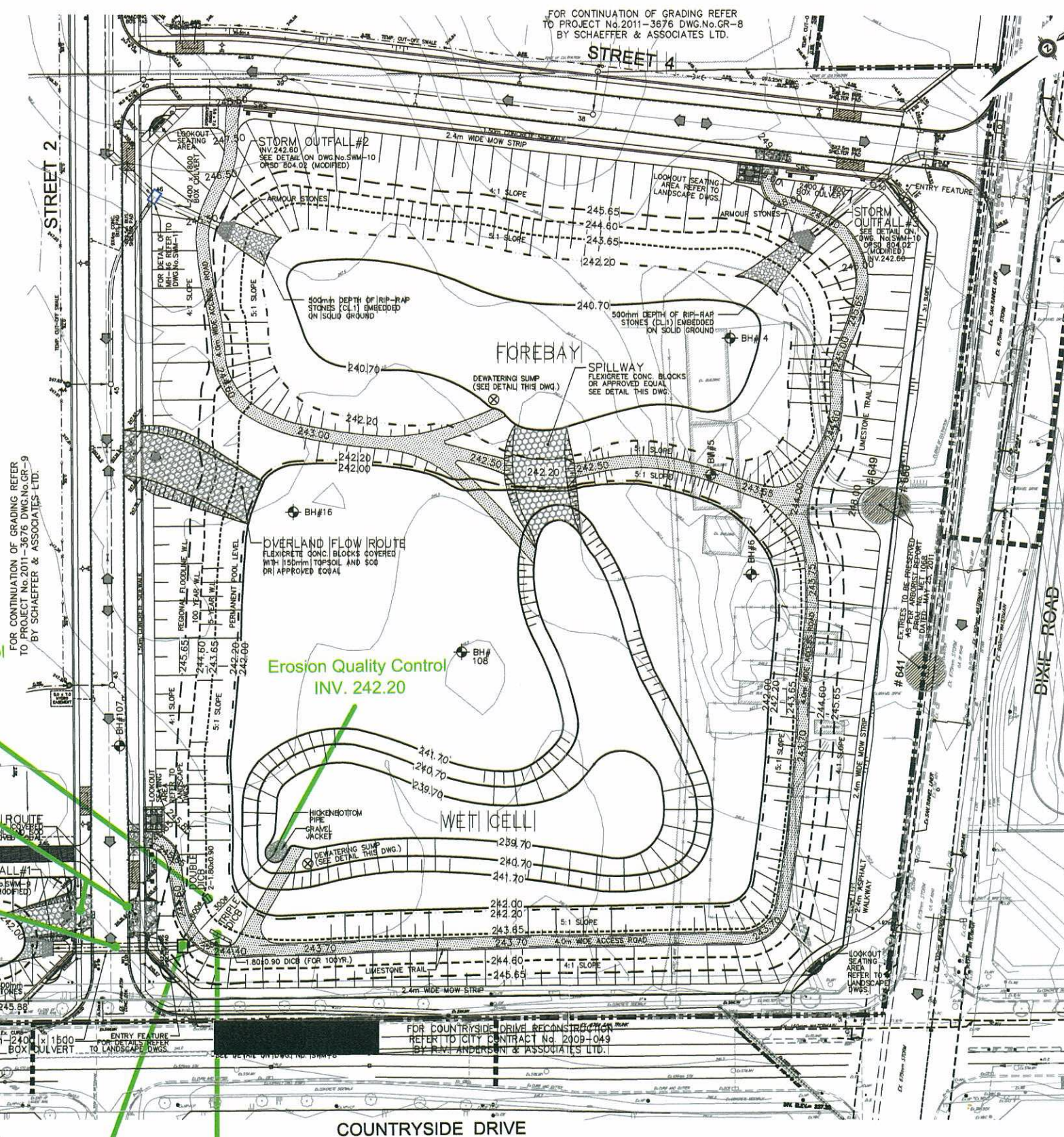
EROSION QUALITY CONTROL  
INV. 242.20

WET CELL

1800 x 90 DCS (FOR 100YR.)

1.0 m x 3.9 m opentop manhole  
INV. 244.60

25yr to 100yr control  
INV. 243.90



FOR CONTINUATION OF GRADING REFER  
TO PROJECT No.2011-3676 DWG.No.GR-8  
BY SCHAEFFER & ASSOCIATES LTD.

FOR COUNTRYSIDE DRIVE RECONSTRUCTION  
REFER TO CITY CONTRACT No. 2009-049  
BY R.V. ANDERSON & ASSOCIATES LTD.

# COUNTRYSIDE VILLAGES EMPLOYMENT BLOCK

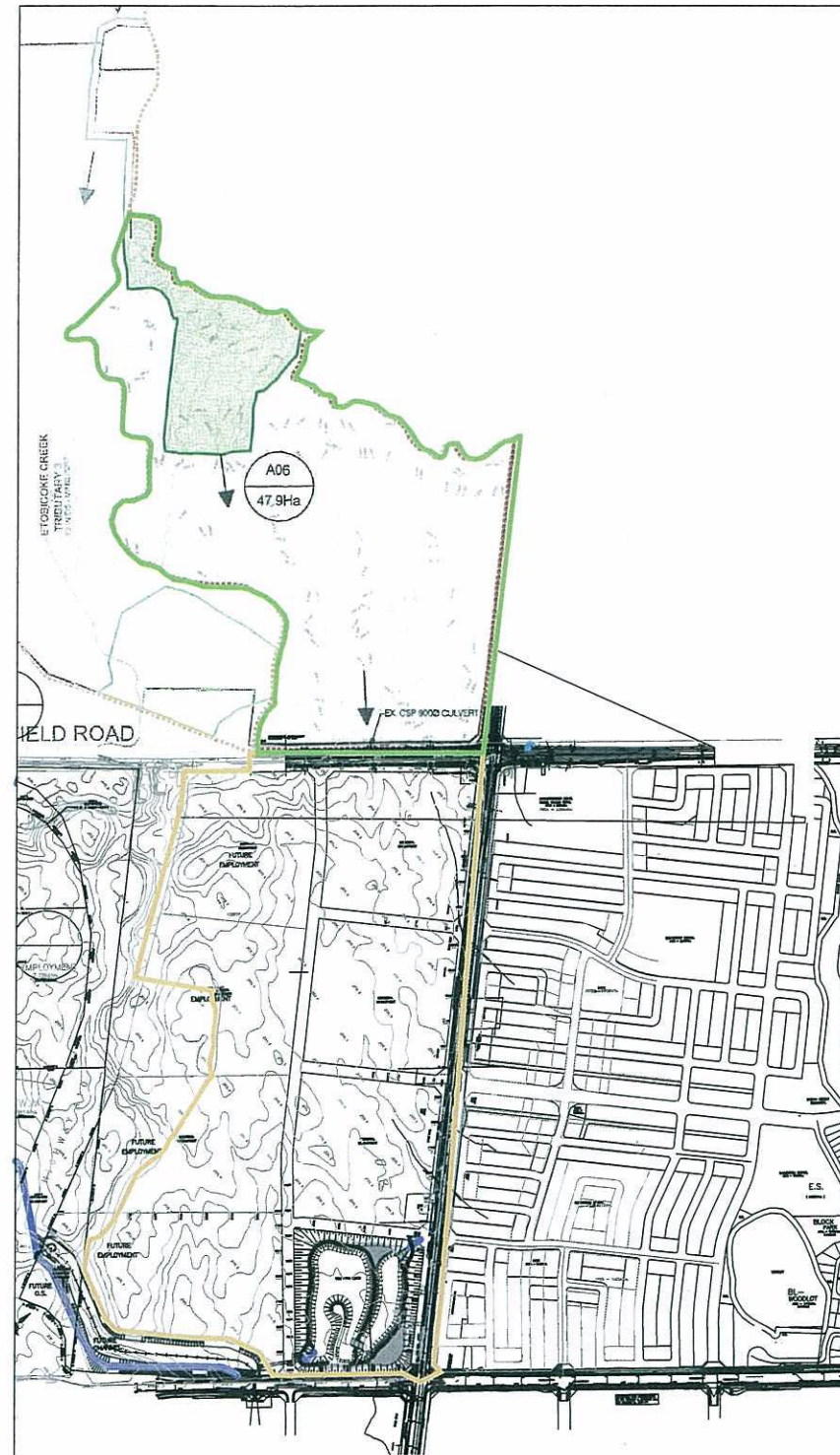
- LEGEND**
- DENOTES PERMANENT POOL LEVEL
  - DENOTES 5 YR. WATER LEVEL
  - DENOTES 100 YR. WATER LEVEL
  - DENOTES PROPOSED POND CONTOUR LINE
  - DENOTES PROPOSED REGIONAL FLOODLINE
  - DENOTES DEVELOPMENT LIMIT

**SCHAEFFERS**  
CONSULTING ENGINEERS

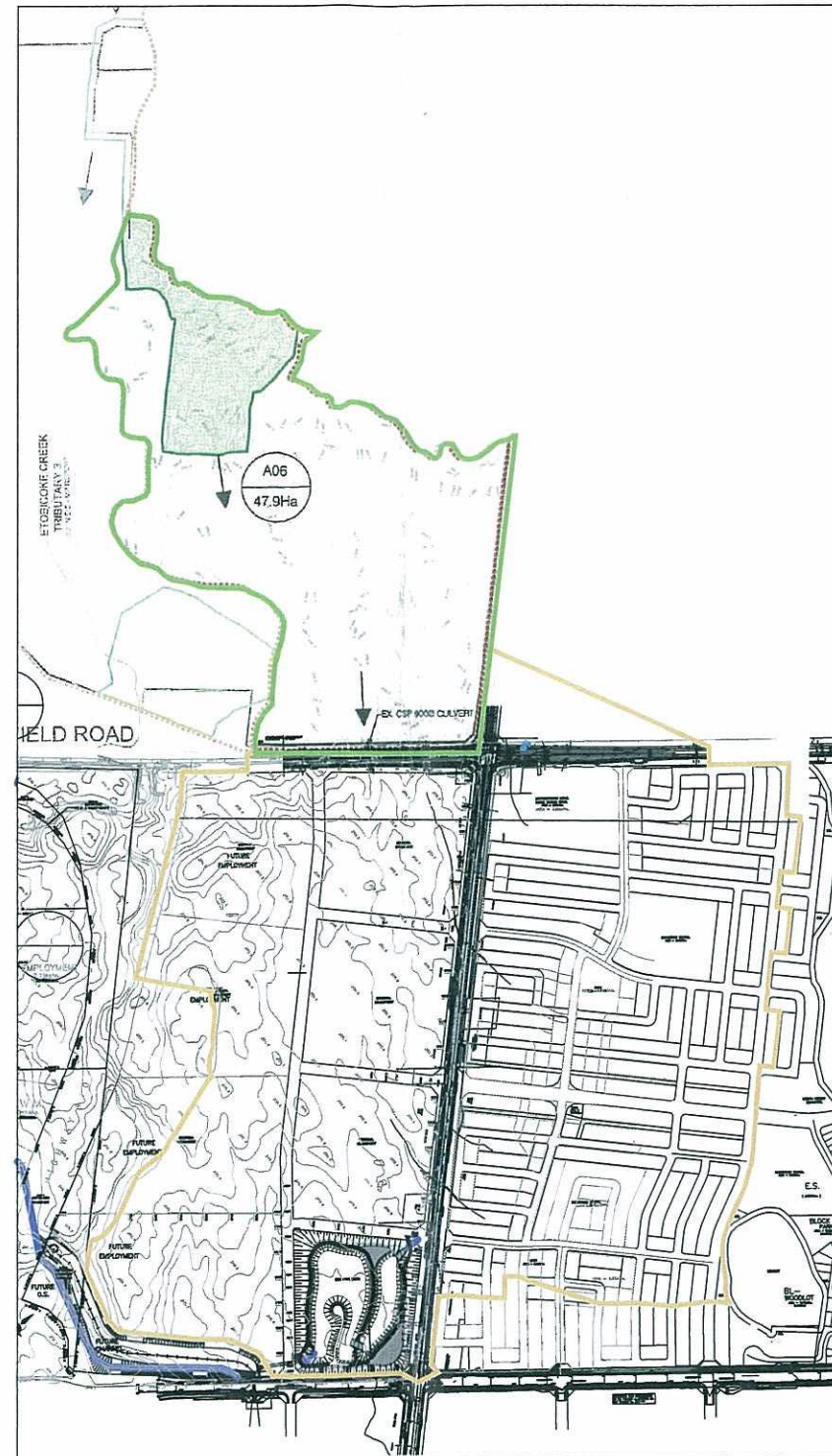
6 Ronrose Drive, Concord, Ontario L4K 4R3  
tel. 905.738.6100 fax. 905.738.6875

FIGURE 2-3  
EC-4 SWM Pond

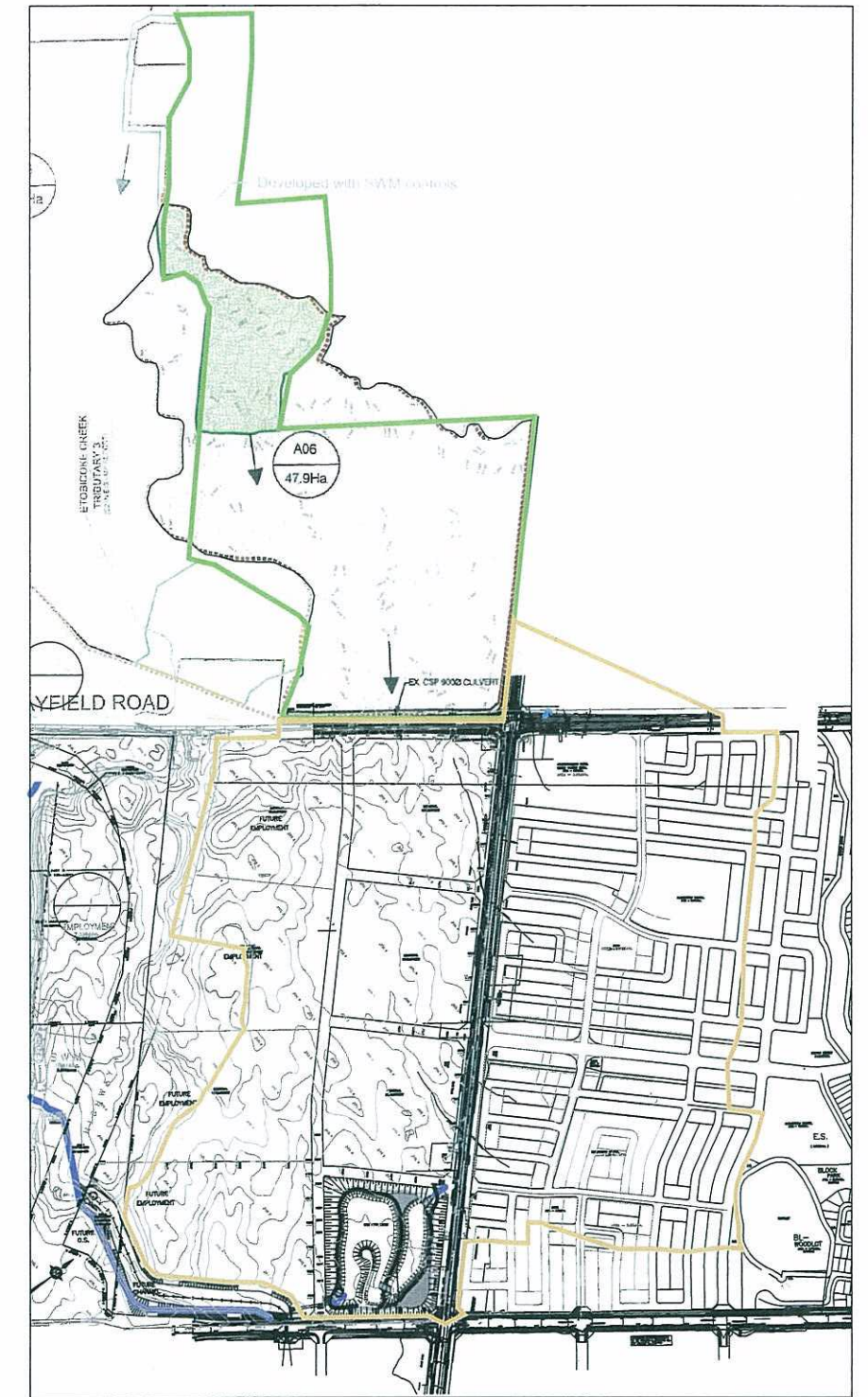




Stage 1



Stage 2-5



Stage 6

LEGEND

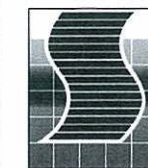
- Service areas - SWM controls in EC-4
- External areas - routed through EC-4

Figure 2-4  
SWM Pond EC-4 Development  
Stages

2011-3676

AUGUST 2012

SCALE: N.T.S.



**SCHAEFFERS**  
CONSULTING ENGINEERS

6 Ronrose Drive, Concord  
Ontario L4K 4R3  
Tel: (905) 738-6100  
Fax: (905) 738-6875  
E-mail: design@schaeffers.com  
SCHAEFFER & ASSOCIATES LTD.



#### **2.5.4 Sediment Forebay Design**

The function of the sediment forebay is to facilitate maintenance and improve pollutant removal by trapping larger particles from stormwater runoff near the inlet of the pond. The sizing of the sediment forebay is based on the settling length and dispersion length calculations provided in the MOE SWMPD Manual (March 2003). The forebay length should be greater than or equal to the larger of the settling and dispersion lengths.

There are two inlets entering into the forebay. The proposed forebay lengths from the east and west inlets are approximately 110 m and 130 m respectively, which are greater than the required lengths of 63 m and 73 m respectively. Detailed forebay sizing calculations are provided in Appendix A for reference.

#### **2.6 Emergency Outlet**

The SWM Pond has been designed with an emergency outlet to allow storm drainage to safely exit the facility in the event that the control mechanisms fail to function or the storm event is greater than the facility design 100-year storm return period. The emergency outlet is an open-top manhole at an elevation of 244.60 m. This elevation allows the uncontrolled 100-year inflow and the Regional storm event runoff to be attenuated before safely exiting through the overflow structure. Detailed calculations are provided in Appendix A for reference.

#### **2.7 Groundwater Considerations**

A soil investigation performed by exp Services Inc. in August 2011 indicates that the material at the base and sides of the pond will primarily comprise sandy silt till and/or silt till. The till material will exhibit coefficient of hydraulic conductivities in the order of  $10^{-5}$  to  $10^{-6}$  cm/s (.04 to 0.4 mm/hr) which is considered relatively low. As such no clay liner is required for the pond.

An excerpt of the Soil Engineer soil investigation report is included in Appendix C for reference.

#### **2.8 Thermal Impacts Considerations**

Thermal considerations are implemented in the proposed SWM Pond EC-4 design to minimize the thermal affects of the SWM facility towards the Spring Creek. Thermal impacts from the SWM Pond are mitigated through landscaping of the SWM Pond and appropriate outlet structure design. Landscaping of the SWM Pond (i.e. high density planting of trees and shrubs) will provide shade and protection from the sun. The outlet design thermal measures that are proposed are a reverse slope pipe and Hickenbottom pipe extending into the permanent pool of the pond. The Hickenbottom pipe will draw water from the base of the permanent pool, which is generally cooler than at shallower depths.

### 3 CLOSING REMARKS

This report provides the City of Brampton and TRCA, with a stormwater management design for the EC-4 SWM Facility in the City of Brampton. It demonstrates the following:

1. Sufficient water quality, erosion, and water quantity control is provided for the development area under the employment lands only, and ultimate conditions;

Please contact the undersigned if you have any additional questions.

Respectfully Submitted,

**Schaeffer & Associates Ltd.**



E. André Poirer, P. Eng.

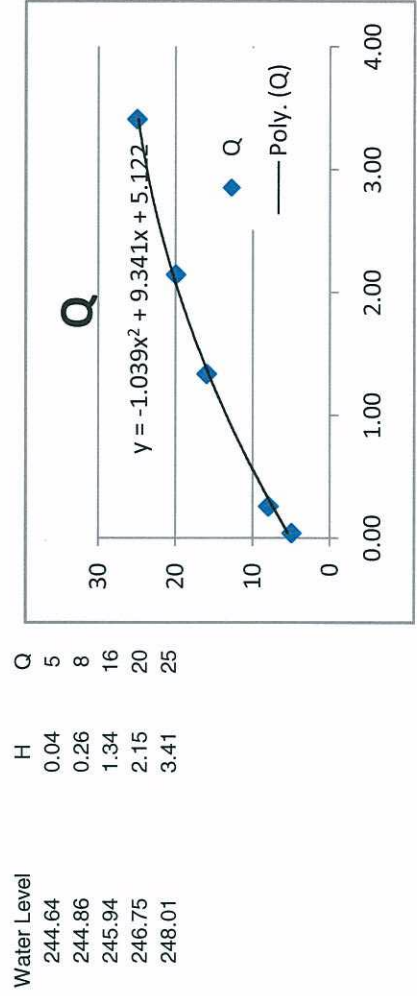


## 4 APPENDICES

## **Appendix A SWM Pond Design Calculations**



		Outlet Culvert		2.44	1.52	42				
		Overflow Structure Box		3.05	3.96					
a	Exit Losses	0.10	Q	A	V	V2/2g	K			
b	Horizontal Culvert Friction	0.37	Q	A	V	n	WP	R	Sf	L
c	90 deg bend in pipe	0.97	Q	A	V	V2/2g	K			
d	Vertical Open Top Section	0.00	Q	A	V	n	WP	R	Sf	L
e	Entrance Losses through 50% blocked area	0.04	Q	A	V	V2/2g	K			
	Total head Losses	1.48								
	<b>Tailwater Level</b> (Assumed Regional Level upstream of CS Drive with conveyance mitigation - Based on regional level DS of CS Drive + headloss across improved CS Drive conveyance system)	244.50								
	<b>Level in Pond</b>	245.98								





**Countryside Village Employment Block**  
**Stage Storage Discharge Above 100 year Level**  
**SWM Pond EC-4**

**Weir Parameters Pond Outlet**

Weir Length (L)	(Longitudinal)	10.0 m
Crest Width (B)	(Perp. to Flow)	<b>2.0 m</b>
Crest Elevation		245.50 m

	Weir Calculations ( $Q = C_d * b * H^{3/2}$ ) Pond Outlet				Box Culvert Flow		Storage Discharge	
Pond Water Level	H weir	H/L	$C_d$ (Design Chart 2.43)	Q weir	H Box	Q Box + Culvert	Total Flow	Storage Volume
245.50 m	0.00 m	0.000	0.00	0.00 m <sup>3</sup> /s	0.90	12.7	12.69	135,087
245.60 m	0.10 m	0.010	1.37	0.09 m <sup>3</sup> /s	1.00	13.4	13.51	140,258
245.70 m	0.20 m	0.020	1.43	0.26 m <sup>3</sup> /s	1.10	14.1	14.40	145,430
245.80 m	0.30 m	0.030	1.46	0.48 m <sup>3</sup> /s	1.20	14.8	15.31	150,601
245.90 m	0.40 m	0.040	1.48	0.75 m <sup>3</sup> /s	1.30	15.5	16.26	155,773
246.00 m	0.50 m	0.050	1.50	1.06 m <sup>3</sup> /s	1.40	16.2	17.22	160,944

**Weir Parameters - Across Ace Drive**

Weir Length (L)	(Longitudinal)	23.0 m
Crest Width (B)	(Perp. to Flow)	<b>12.0 m</b>
Crest Elevation (Curb)		245.40 m
Gutter Elevation		245.25 m

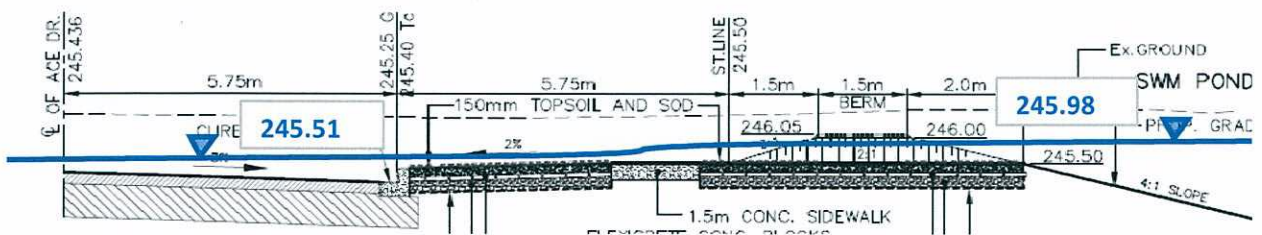
**Weir Calculations ( $Q = C_d * b * H^{3/2}$ ) - Across Ace Drive**

Water Level	H weir	H/L	$C_d$ (Design Chart 2.43)	Q weir
245.40 m	0.00 m	0.000	0.00	0.00 m <sup>3</sup> /s
245.51 m	0.11 m	0.005	1.32	1.11 m <sup>3</sup> /s
245.55 m	0.15 m	0.007	1.34	1.80 m <sup>3</sup> /s

See MTO Drainage Manual - Chapter 8 - Pp 121-123

SCE File: 3676

Revised: 4-Sep-12



## **Stage-Storage Discharge Relationship Calculations**

### ***Orifice Controls (242.0 to 244.60)***

The flow ( $Q$  in  $\text{m}^3/\text{s}$ ) through an orifice is based on the orifice equation:

$$Q_{\text{Orifice}} = A \cdot C_d \cdot \sqrt{2 \cdot g \Delta H}$$

The discharge coefficient  $C_d = 0.62$  is taken from literature review.

$\Delta H$  is the head difference in meters from the hydraulic grade upstream of the orifice to the centre of the orifice.

$g$  is the acceleration from gravity near the surface of the earth of  $9.81 \text{ m/s}^2$ .

$A$  is the area of the orifice in  $\text{m}^2$ .

The flow from 242.0 to 244.60 is controlled by one, two or 3 orifices and the total flow is

$$Q_{\text{Total}} = \sum Q_{(\text{all\_orifices})} = Q_{\text{lowFlowOrifice}} + Q_{2-10\text{yearsOrifice}} + Q_{10-100\text{yearsOrifice}}$$

### ***Inlet Basins***

Flow through the inlet basins is estimated based on MTO's table 4.20. In general, once the flow is above the inlet basins, the orifice govern the flow.

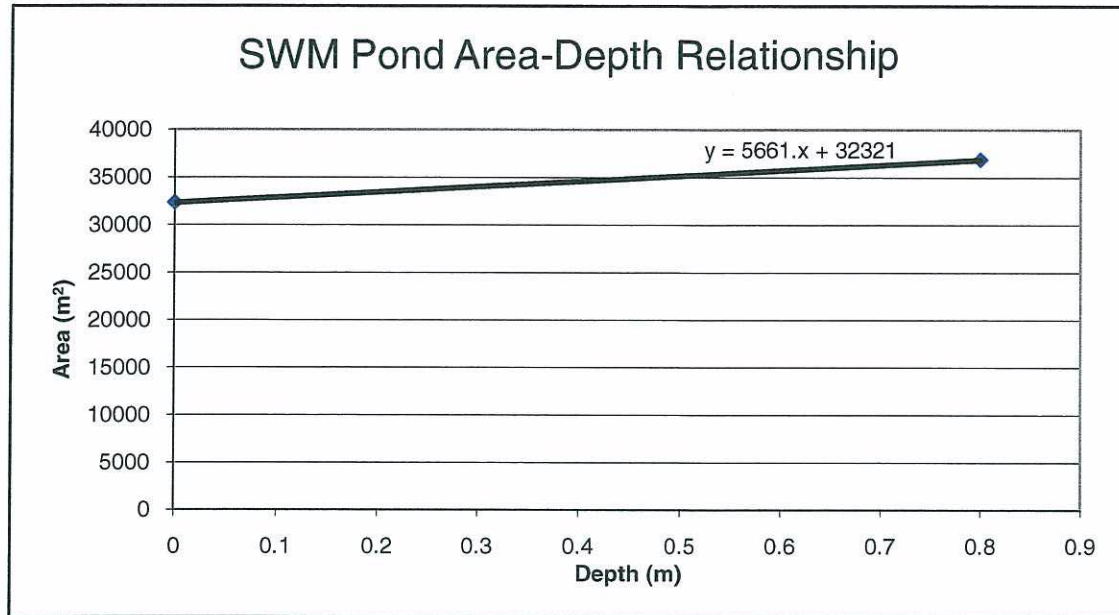


COUNTRYSIDE VILLAGES EMPLOYMENT BLOCK  
EROSION DETENTION DRAWDOWN TIME CALCULATION

POND EC-4

SWM Pond Area-Depth Relationship

Depth	Surface Area (m <sup>2</sup> )
0	32321
0.8	36850



Drawdown Time Equation 4.11 from MOE SWM Manual

$$t = \frac{0.66 C_2 h^{1.5} + 2 C_3 h^{0.5}}{2.75 A_o}$$

where

- t = drawdown time in seconds
- A<sub>o</sub> = cross-sectional area of the orifice (m<sup>2</sup>)
- h = maximum water elevation above the orifice (m)
- C<sub>2</sub> = slope coefficient from the area-depth linear regression
- C<sub>3</sub> = intercept from the area-depth linear regression

**Input**

A<sub>o</sub> = 0.033 m<sup>2</sup> ( 205 mm diameter)  
h = 0.8 m  
C<sub>2</sub> = 5661  
C<sub>3</sub> = 32321

**Output**

t = 659247 s  
= 183 hours

*Note drawdown time cannot be reduced practically due to constraints at level of receiving waters.*

## FOREBAY SETTLING LENGTH

ref: SWM Planning & Design Manual (MOE, March 2003)

Dist =  $(rQ_p / V_s)^{1/2}$ , where

Dist = forebay length (m)

r = Length to width ratio of forebay (>2:1)

$Q_p$  = peak flowrate from the pond during design quality storm ( $m^3/s$ )

$V_s$  = settling velocity in the forebay (m/s)

East Inlet:

r = 2 :1  
 $Q_p$  = 0.130  $m^3/s$  (required erosion outflow rate)  
 $V_s$  = 0.0003 m (based on 150 $\mu$ m particles)

**Dist = 29 metres**

West Inlet:

r = 2 :1  
 $Q_p$  = 0.130  $m^3/s$  (required erosion outflow rate)  
 $V_s$  = 0.0003 m (based on 150 $\mu$ m particles)

**Dist = 29 metres**

## DISPERSION LENGTH

ref: SWM Planning & Design Manual (MOE, March 2003)

D =  $8Q / dV_f$ , where

D = length of dispersion (m)

Q = 10 year inlet flowrate ( $m^3/s$ )

d = depth of permanent pool in forebay (m)

$V_f$  = desired velocity in the forebay (m/s)

East Inlet:

Q = 5.870  $m^3/s$   
d = 1.50 m  
 $V_f$  = 0.5 m/s (MOEE empirical value)

**D = 63 m**

West Inlet:

Q = 6.810  $m^3/s$   
d = 1.50 m  
 $V_f$  = 0.5 m/s (MOEE empirical value)

**D = 73 m**

### Forebay Length Required:

East Inlet: **63 m**

West Inlet: **73 m**

### Forebay Length Provided:

East Inlet: **110 m**

West Inlet: **130 m**



# COUNTRYSIDE VILLAGES EMPLOYMENT LANDS - SWM POND EC4

## MULTIPLE ORIFICE OUTLET CONTROL

	Extended Detention*	Outlet 1	DICB 1	Outlet 2	DICB 2
Invert Elevation / Lip Elevation	242.20	242.25	243.10	243.15	243.90
Diameter (mm) / Length (m)	205	450	1.8	500	5.4
Max Area (m <sup>2</sup> )	0.033	0.159	3.240	0.196	4.860
Coefficient	0.62	0.62	-	0.62	-
Starting Flow Elevation.(m)	242.20	243.00	-	243.95	-
Top Elevation (m)	244.60	244.60	244.60	244.60	244.60

\* Extended Detention Orifice is submerged below 242, head limitation is in outlet structure, i.e. invert of outlet culvert at 242.20

### Stage-Storage-Discharge:

Stage		Extended Detention*		Outlet 1		DICB 1			Outlet 2		DICB 2			Pond Storage	Total Flow
Water Elevation (m)	Water Elevation Above Perm. Pool (m)	Head (m)	Q (m <sup>3</sup> /s)	Head (m)	Q (m <sup>3</sup> /s)	Head (m)	Q / m width* (m <sup>3</sup> /s/m)	Q (m <sup>3</sup> /s)	Head (m)	Q (m <sup>3</sup> /s)	Head (m)	Q / m width* (m <sup>3</sup> /s/m)	Q (m <sup>3</sup> /s)	(m <sup>3</sup> )	(m <sup>3</sup> /s)
242.20	0.00	0.00	0.000	na	na	na	na	na	na	na	na	na	na	0	0.00
242.25	0.05	0.05	0.020	na	na	na	na	na	na	na	na	na	na	1,729	0.02
242.30	0.10	0.10	0.028	na	na	na	na	na	na	na	na	na	na	3,459	0.03
242.35	0.15	0.15	0.035	na	na	na	na	na	na	na	na	na	na	5,188	0.03
242.40	0.20	0.20	0.040	na	na	na	na	na	na	na	na	na	na	6,917	0.04
242.45	0.25	0.25	0.045	na	na	na	na	na	na	na	na	na	na	8,647	0.04
242.50	0.30	0.30	0.049	na	na	na	na	na	na	na	na	na	na	10,376	0.05
242.55	0.35	0.35	0.053	na	na	na	na	na	na	na	na	na	na	12,105	0.05
242.60	0.40	0.40	0.057	na	na	na	na	na	na	na	na	na	na	13,835	0.06
242.65	0.45	0.45	0.060	na	na	na	na	na	na	na	na	na	na	15,564	0.06
242.70	0.50	0.50	0.064	na	na	na	na	na	na	na	na	na	na	17,293	0.06
242.75	0.55	0.55	0.067	na	na	na	na	na	na	na	na	na	na	19,022	0.07
242.80	0.60	0.60	0.070	na	na	na	na	na	na	na	na	na	na	20,752	0.07
242.85	0.65	0.65	0.072	na	na	na	na	na	na	na	na	na	na	22,481	0.07
242.90	0.70	0.70	0.075	na	na	na	na	na	na	na	na	na	na	24,210	0.08
242.95	0.75	0.75	0.078	na	na	na	na	na	na	na	na	na	na	25,940	0.08
243.00	0.80	0.80	0.080	na	na	na	na	na	na	na	na	na	na	27,669	0.08
243.05	0.85	0.85	0.083	na	na	na	na	na	na	na	na	na	na	29,540	0.08
243.10	0.90	0.90	0.085	na	na	na	na	na	na	na	na	na	na	31,410	0.09
243.15	0.95	0.95	0.088	0.67	0.359	0.00	0.004	0.004	na	na	na	na	na	33,281	0.09
243.20	1.00	1.00	0.090	0.72	0.372	0.05	0.044	0.039	na	na	na	na	na	35,152	0.13
243.25	1.05	1.05	0.092	0.78	0.385	0.10	0.114	0.102	na	na	na	na	na	37,022	0.19
243.30	1.10	1.10	0.094	0.82	0.397	0.15	0.214	0.193	na	na	na	na	na	38,893	0.29
243.35	1.15	1.15	0.096	0.87	0.409	0.20	0.345	0.310	na	na	na	na	na	40,826	0.41
243.40	1.20	1.20	0.098	0.92	0.420	0.25	0.506	0.456	na	na	na	na	na	42,758	0.52
243.45	1.25	1.25	0.101	0.97	0.431	0.30	0.698	0.628	na	na	na	na	na	44,691	0.53
243.50	1.30	1.30	0.103	1.03	0.442	0.35	0.920	0.828	na	na	na	na	na	46,623	0.54
243.55	1.35	1.35	0.104	1.07	0.453	0.40	1.173	1.055	na	na	na	na	na	48,556	0.56
243.60	1.40	1.40	0.106	1.12	0.463	0.45	1.456	1.310	na	na	na	na	na	50,488	0.57
243.65	1.45	1.45	0.108	1.17	0.473	0.50	1.769	1.592	na	na	na	na	na	52,421	0.58
243.70	1.50	1.50	0.110	1.22	0.483	0.55	2.113	1.902	na	na	na	na	na	54,475	0.59
243.75	1.55	1.55	0.112	1.28	0.493	0.60	2.487	2.238	na	na	na	na	na	56,529	0.61
243.80	1.60	1.60	0.114	1.32	0.503	0.65	2.892	2.603	na	na	na	na	na	58,582	0.62
243.85	1.65	1.65	0.115	1.37	0.512	0.70	3.327	2.994	na	na	na	na	na	60,636	0.63
243.90	1.70	1.70	0.117	1.42	0.521	0.75	3.792	3.413	na	na	na	na	na	62,690	0.64
243.95	1.75	1.75	0.119	1.47	0.530	0.80	4.288	3.859	0.55	0.400	0.00	0.004	0.011	64,852	0.66
244.00	1.80	1.80	0.121	1.53	0.539	0.85	4.815	4.333	0.60	0.418	0.05	0.044	0.118	67,014	0.78
244.05	1.85	1.85	0.122	1.57	0.548	0.90	5.371	4.834	0.65	0.435	0.10	0.114	0.307	69,176	0.98
244.10	1.90	1.90	0.124	1.62	0.557	0.95	5.959	5.363	0.70	0.451	0.15	0.214	0.578	71,338	1.13
244.15	1.95	1.95	0.126	1.67	0.565	1.00	6.576	5.919	0.75	0.467	0.20	0.345	0.931	73,500	1.16
244.20	2.00	2.00	0.127	1.72	0.574	1.05	7.224	6.502	0.80	0.482	0.25	0.506	1.367	75,694	1.18
244.25	2.05	2.05	0.129	1.78	0.582	1.10	7.903	7.112	0.85	0.497	0.30	0.698	1.885	77,888	1.21
244.30	2.10	2.10	0.130	1.82	0.590	1.15	8.612	7.750	0.90	0.512	0.35	0.920	2.484	80,082	1.23
244.35	2.15	2.15	0.132	1.87	0.598	1.20	9.351	8.416	0.95	0.526	0.40	1.173	3.166	81,492	1.26
244.40	2.20	2.20	0.133	1.92	0.606	1.25	10.121	9.109	1.00	0.539	0.45	1.456	3.930	82,903	1.28
244.45	2.25	2.25	0.135	1.97	0.614	1.30	10.921	9.829	1.05	0.553	0.50	1.769	4.776	84,313	1.30
244.50	2.30	2.30	0.136	2.03	0.622	1.35	11.751	10.576	1.10	0.566	0.55	2.113	5.705	85,723	1.32
244.55	2.35	2.35	0.138	2.07	0.629	1.40	12.612	11.351	1.15	0.578	0.60	2.487	6.715	87,134	1.35
244.60	2.40	2.40	0.139	2.12	0.637	1.45	13.504	12.153	1.20	0.591	0.65	2.892	7.808	88,544	1.37

Note:

na - not applicable

\* - from MTO Design Chart 4.20 for grate slope of 5 :1

\*\* 3.0 x 3.0 Open Top manhole considered as 4 weirs with total length 12 m

SCE File:

Revised:



## EROSION CONTROL

Within the Etobicoke Creek watershed, a discharge for the erosion threshold was determined for the downstream end of the Spring Creek tributary channel using standard modeling techniques. The erosion threshold was based on the approved channel design at Rosedale Village immediately downstream of Countryside Drive. The steeper riffle part of the channel is trapezoidal with 1:1 sloping banks, a bottom width of 1 m, depth of 0.25 m and total width of 1.5 m. The design includes aggressive riparian planting and bioengineering to ensure a stable planform at the design bankfull discharge of 0.25 m<sup>3</sup>/s. It should be noted that the design bankfull discharge is a small portion of the uncalibrated 2-year flow. The erosion threshold discharge for the Spring Creek tributary is 0.25m<sup>3</sup>/s since this is the maximum stable discharge for the downstream channel. The reason for the lower design discharge is that the channel was purposefully sized for regular inundation of the floodplain to provide retention and detention of water and sediment within the corridor. Additionally, lot-level storage and conveyance controls implemented within the Spring Creek drainage area could aid in reducing potential erosive flows in the channel.

The Distributed Runoff Control (DRC) approach was used within the Humber River watershed to establish the erosion control targets. The intent of the DRC approach is the control of in-stream erosion potential for the range of flows exceeding the critical flow, up to the bankfull stage, with the highest level of control focused on flows in the mid-bankfull range. As such the DRC approach overcontrols the 2-year peak flows based on the sensitivity of the receiving channel. For the Humber River tributaries within Countryside Villages 85% overcontrol has been applied.

Table 4.4 summarizes the erosion control requirements.

Table 4.4: Erosion Control Requirements

SWM Pond	Drainage Area (ha)	Target Release Rate (m <sup>3</sup> /s)	Storage Volume (m <sup>3</sup> )
EC-1	29.3	0.056	6,395
EC-2	7.7	0.015	1,660
EC-3	8.9	0.017	1,915
EC-4	142.5	0.084	28,755
H2-1	33.1	0.035	5,325
H2-2	53.0	0.053	9,481
H3-1	115.6	0.106	20,306
WB-1	20.3	0.022	3,444
WB-2	20.5	0.023	3,330
WB-3	70.2	0.068	12,309



**Appendix B Post Development Visual OTTHYMO – Provided Storage & Outlet Structure Confirmation**

**SWM POND EC-4  
HYDROLOGIC MODEL**

**STAGE 1 - EMPLOYMENT LANDS ONLY**

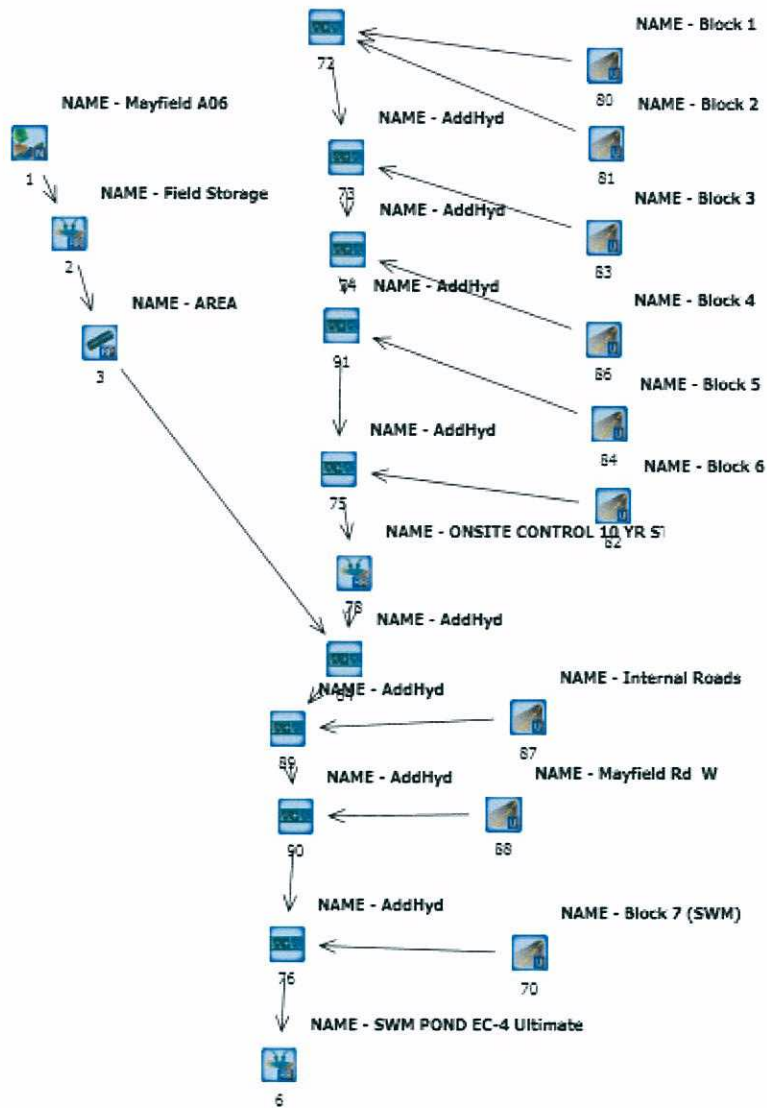
**STAGE 6 - ULTIMATE BUILDOUT**



**SCHAEFFERS**  
CONSULTING ENGINEERS



## Employment Lands only Model Schematic



## External Area Parameters

External Area A06													
Time of Concentration (Airport formula for C<0.4)													
C	L	Sw	Tc (min)	N	Tp								
0.25	1169	0.0094	96.7	3	64.44 min	1.07 hrs							
	Area	HSG	Land Use	CN (AMC II)	CN (AMC III)	S (AMC 2)	Selected Ia	P total 100	S (AMC 3)	0.2 x S	Q 100 depth (mm)	S *	CN *
	40.7	C	Cultivated with Partial Conservation Treatemt	78	92.5								
	7.2	C	Forest Brush Covers Ground	70	87.2								
Total Weighted	47.9			76.8	91.7	76.7 mm	5.0 mm	80.3 mm	23.1 mm	4.6 mm	58.0 mm	50.2 mm	83.5



## Sample Output – 100 year storm

```

V   V   I   SSSSS U   U   A   L
V   V   I   SS   U   U   A A L
V   V   I   SS   U   U   A A A L
V   V   I   SS   U   U   A   A L
VV    I   SSSSS UUUUU A   A LLLLL

OOO   TTTT   TTTT   H   H   Y   Y   M   M   OOO   TM
O   O   T   T   H   H   Y   Y   MM MM   O   O
O   O   T   T   H   H   Y   M   M   O   O   Company
OOO   T   T   H   H   Y   M   M   OOO   Serial

```

Developed and Distributed by Clarifica Inc.  
 Copyright 1996, 2007 Clarifica Inc.  
 All rights reserved.

## \*\*\*\*\* D E T A I L E D O U T P U T \*\*\*\*\*

Input filename: C:\Program Files\Visual Otthymo 2.4\VO2\voin.dat  
 Output filename: C:\Documents and Settings\apoirier\Local Settings\Temp\29ef0aaf-562a-45e1-9168-37a4031d1fd8\Scenario.out  
 Summary filename: C:\Documents and Settings\apoirier\Local Settings\Temp\29ef0aaf-562a-45e1-9168-37a4031d1fd8\Scenario.sum

DATE: 08/17/2012

TIME: 05:03:17

USER:

COMMENTS: \_\_\_\_\_

\*\*\*\*\*  
 \*\* SIMULATION NUMBER: 7 \*\*  
 \*\*\*\*\*

READ STORM		Filename: C:\Documents and Settings\apoirier\Local Settings\Temp\29ef0aaf-562a-45e1-9168-37a4031d1fd8\74a431ab	
Ptotal= 80.31 mm		Comments: 100yr/6hr	

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.25	0.00	2.00	27.30	3.75	11.24	5.50	1.61
0.50	1.61	2.25	27.30	4.00	6.42	5.75	1.61
0.75	1.61	2.50	73.88	4.25	6.42	6.00	1.61
1.00	1.61	2.75	73.88	4.50	3.21	6.25	1.61
1.25	1.61	3.00	20.88	4.75	3.21		
1.50	9.64	3.25	20.88	5.00	1.61		
1.75	9.64	3.50	11.24	5.25	1.61		

CALIB		Area (ha)= 6.78	
STANDHYD (0070)		Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00	
ID= 1 DT= 5.0 min			

IMPERVIOUS		PERVIOUS (i)	
Surface Area (ha)=	6.71		0.07
Dep. Storage (mm)=	1.00		1.50
Average Slope (%)=	1.00		2.00
Length (m)=	212.60		40.00
Mannings n	0.013		0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	1.667	9.64	3.250	20.88	4.83	1.61
0.167	0.00	1.750	9.64	3.333	11.24	4.92	1.61

# SWM POND EC-4 HYDROLOGIC MODEL

0.250	0.00	1.833	27.30	3.417	11.24	5.00	1.61
0.333	1.61	1.917	27.30	3.500	11.24	5.08	1.61
0.417	1.61	2.000	27.30	3.583	11.24	5.17	1.61
0.500	1.61	2.083	27.30	3.667	11.24	5.25	1.61
0.583	1.61	2.167	27.30	3.750	11.24	5.33	1.61
0.667	1.61	2.250	27.30	3.833	6.42	5.42	1.61
0.750	1.61	2.333	73.88	3.917	6.42	5.50	1.61
0.833	1.61	2.417	73.88	4.000	6.42	5.58	1.61
0.917	1.61	2.500	73.88	4.083	6.42	5.67	1.61
1.000	1.61	2.583	73.88	4.167	6.42	5.75	1.61
1.083	1.61	2.667	73.88	4.250	6.42	5.83	1.61
1.167	1.61	2.750	73.88	4.333	3.21	5.92	1.61
1.250	1.61	2.833	20.88	4.417	3.21	6.00	1.61
1.333	9.64	2.917	20.88	4.500	3.21	6.08	1.61
1.417	9.64	3.000	20.88	4.583	3.21	6.17	1.61
1.500	9.64	3.083	20.88	4.667	3.21	6.25	1.61
1.583	9.64	3.167	20.88	4.750	3.21		

Max.Eff.Inten.(mm/hr)= 73.88 51.71  
over (min) 5.00 10.00  
Storage Coeff. (min)= 4.53 (ii) 5.80 (ii)  
Unit Hyd. Tpeak (min)= 5.00 10.00  
Unit Hyd. peak (cms)= 0.23 0.15

\*TOTALS\*

PEAK FLOW (cms)= 1.38 0.01 1.386 (iii)  
TIME TO PEAK (hrs)= 2.75 2.75 2.75  
RUNOFF VOLUME (mm)= 79.31 44.88 78.97  
TOTAL RAINFALL (mm)= 80.31 80.31 80.31  
RUNOFF COEFFICIENT = 0.99 0.56 0.98

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)  
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.  
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB  
STANDHYD (0088)  
ID= 1 DT= 5.0 min

Area (ha)= 1.70  
Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.68	0.02
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	106.46	40.00
Mannings n	=	0.013	0.250
Max.Eff.Inten.(mm/hr)=		73.88	*****
over (min)		5.00	5.00
Storage Coeff. (min)=		2.99 (ii)	4.26 (ii)
Unit Hyd. Tpeak (min)=		5.00	5.00
Unit Hyd. peak (cms)=		0.28	0.23
PEAK FLOW (cms)=		0.35	0.00
TIME TO PEAK (hrs)=		2.75	2.75
RUNOFF VOLUME (mm)=		79.31	44.88
TOTAL RAINFALL (mm)=		80.31	80.31
RUNOFF COEFFICIENT =		0.99	0.56

\*TOTALS\*  
0.348 (iii)

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)  
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.  
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB  
STANDHYD (0082)  
ID= 1 DT= 5.0 min

Area (ha)= 9.16  
Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	9.07	0.09
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	247.12	40.00
Mannings n	=	0.013	0.250
Max.Eff.Inten.(mm/hr)=		73.88	*****



# **SWM POND EC-4 HYDROLOGIC MODEL**

over (min)	5.00	10.00	
Storage Coeff. (min)=	4.96 (ii)	6.23 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.22	0.15	
			<b>*TOTALS*</b>
PEAK FLOW (cms)=	1.86	0.01	1.871 (iii)
TIME TO PEAK (hrs)=	2.75	2.75	2.75
RUNOFF VOLUME (mm)=	79.31	44.88	78.97
TOTAL RAINFALL (mm)=	80.31	80.31	80.31
RUNOFF COEFFICIENT =	0.99	0.56	0.98

- (i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

<b>CALIB</b>			
STANDHYD (0080)	Area (ha)= 12.29		
ID= 1 DT= 5.0 min	Total Imp(%)= 99.00	Dir. Conn.(%)= 99.00	

	IMPERVIOUS	PVIOUS (i)	
Surface Area (ha)=	12.17	0.12	
Dep. Storage (mm)=	1.00	1.50	
Average Slope (%)=	1.00	2.00	
Length (m)=	286.24	40.00	
Mannings n =	0.013	0.250	
Max.Eff.Inten. (mm/hr)=	73.88	*****	
over (min)	5.00	10.00	
Storage Coeff. (min)=	5.42 (ii)	6.69 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.20	0.14	
			<b>*TOTALS*</b>
PEAK FLOW (cms)=	2.49	0.02	2.507 (iii)
TIME TO PEAK (hrs)=	2.75	2.75	2.75
RUNOFF VOLUME (mm)=	79.31	44.88	78.97
TOTAL RAINFALL (mm)=	80.31	80.31	80.31
RUNOFF COEFFICIENT =	0.99	0.56	0.98

- (i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

<b>CALIB</b>			
STANDHYD (0081)	Area (ha)= 8.82		
ID= 1 DT= 5.0 min	Total Imp(%)= 99.00	Dir. Conn.(%)= 99.00	

	IMPERVIOUS	PVIOUS (i)	
Surface Area (ha)=	8.73	0.09	
Dep. Storage (mm)=	1.00	1.50	
Average Slope (%)=	1.00	2.00	
Length (m)=	242.49	40.00	
Mannings n =	0.013	0.250	
Max.Eff.Inten. (mm/hr)=	73.88	*****	
over (min)	5.00	10.00	
Storage Coeff. (min)=	4.91 (ii)	6.17 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.22	0.15	
			<b>*TOTALS*</b>
PEAK FLOW (cms)=	1.79	0.01	1.801 (iii)
TIME TO PEAK (hrs)=	2.75	2.75	2.75
RUNOFF VOLUME (mm)=	79.31	44.88	78.97
TOTAL RAINFALL (mm)=	80.31	80.31	80.31
RUNOFF COEFFICIENT =	0.99	0.56	0.98

- (i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

# SWM POND EC-4 HYDROLOGIC MODEL

ADD HYD (0072)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0080):		12.29	2.507	2.75	78.97
+ ID2= 2 (0081):		8.82	1.801	2.75	78.97
=====					
ID = 3 (0072):		21.11	4.309	2.75	78.97

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB		Area	(ha)=	7.29	
STANDHYD (0083)		Total Imp(%)=	99.00	Dir. Conn.(%)=	99.00
ID= 1 DT= 5.0 min					
		IMPERVIOUS	PERVIOUS (i)		
Surface Area	(ha)=	7.22	0.07		
Dep. Storage	(mm)=	1.00	1.50		
Average Slope	(%)=	1.00	2.00		
Length	(m)=	220.45	40.00		
Mannings n	=	0.013	0.250		
Max.Eff.Inten.(mm/hr)=		73.88	51.71		
	over (min)	5.00	10.00		
Storage Coeff.	(min)=	4.63	(ii)	5.90	(ii)
Unit Hyd. Tpeak	(min)=	5.00	10.00		
Unit Hyd. peak	(cms)=	0.22	0.15		
PEAK FLOW	(cms)=	1.48	0.01		
TIME TO PEAK	(hrs)=	2.75	2.75		
RUNOFF VOLUME	(mm)=	79.31	44.88		
TOTAL RAINFALL	(mm)=	80.31	80.31		
RUNOFF COEFFICIENT	=	0.99	0.56		
*TOTALS*					
			1.490		
			2.75		
			78.97		
			80.31		
			0.98		

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0073)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0072):		21.11	4.309	2.75	78.97
+ ID2= 2 (0083):		7.29	1.490	2.75	78.97
=====					
ID = 3 (0073):		28.40	5.798	2.75	78.97

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB		Area	(ha)=	7.85	
STANDHYD (0086)		Total Imp(%)=	99.00	Dir. Conn.(%)=	99.00
ID= 1 DT= 5.0 min					
		IMPERVIOUS	PERVIOUS (i)		
Surface Area	(ha)=	7.77	0.08		
Dep. Storage	(mm)=	1.00	1.50		
Average Slope	(%)=	1.00	2.00		
Length	(m)=	228.76	40.00		
Mannings n	=	0.013	0.250		
Max.Eff.Inten.(mm/hr)=		73.88	51.71		
over (min)		5.00	10.00		
Storage Coeff. (min)=		4.74 (ii)	6.01 (ii)		
Unit Hyd. Tpeak (min)=		5.00	10.00		
Unit Hyd. peak (cms)=		0.22	0.15		
*TOTALS*					
PEAK FLOW (cms)=		1.59	0.01	1.604 (iii)	
TIME TO PEAK (hrs)=		2.75	2.75	2.75	
RUNOFF VOLUME (mm)=		79.31	44.88	78.97	
TOTAL RAINFALL (mm)=		80.31	80.31	80.31	
RUNOFF COEFFICIENT =		0.99	0.56	0.98	



# **SWM POND EC-4 HYDROLOGIC MODEL**

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0074)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
ID1= 1	(0073):	28.40	5.798	2.75	78.97
+ ID2= 2	(0086):	7.85	1.604	2.75	78.97
=====					
ID = 3	(0074):	36.25	7.402	2.75	78.97

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB		Area	(ha)=	7.75		
STANDHYD (0084)		Total	Imp(%)=	99.00	Dir. Conn.(%)=	99.00
ID= 1 DT= 5.0 min						
		IMPERVIOUS		PERVIOUS (i)		
Surface Area	(ha)=	7.67		0.08		
Dep. Storage	(mm)=	1.00		1.50		
Average Slope	(%)=	1.00		2.00		
Length	(m)=	227.30		40.00		
Mannings n	=	0.013		0.250		
Max.Eff.Inten.(mm/hr)=		73.88		51.71		
over (min)		5.00		10.00		
Storage Coeff. (min)=		4.72 (ii)		5.99 (ii)		
Unit Hyd. Tpeak (min)=		5.00		10.00		
Unit Hyd. peak (cms)=		0.22		0.15		
PEAK FLOW	(cms)=	1.57		0.01		*TOTALS*
TIME TO PEAK	(hrs)=	2.75		2.75		1.583
RUNOFF VOLUME	(mm)=	79.31		44.88		2.75
TOTAL RAINFALL	(mm)=	80.31		80.31		78.97
RUNOFF COEFFICIENT	=	0.99		0.56		80.31
						0.98

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0091)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
ID1= 1	(0074):	36.25	7.402	2.75	78.97
+ ID2= 2	(0084):	7.75	1.583	2.75	78.97
=====					
ID = 3	(0091):	44.00	8.985	2.75	78.97

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0075)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
ID1= 1	(0082):	9.16	1.871	2.75	78.97
+ ID2= 2	(0091):	44.00	8.985	2.75	78.97
=====					
ID = 3	(0075):	53.16	10.856	2.75	78.97

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR (0078)	
IN= 2--> OUT= 1	

# **SWM POND EC-4 HYDROLOGIC MODEL**

DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	7.5100	10.0000
	7.5000	0.0500	7.5200	20.0000
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0075)	53.160	10.856	2.75	78.97
OUTFLOW: ID= 1 (0078)	53.160	7.500	2.83	78.97
PEAK FLOW REDUCTION [Qout/Qin] (%) = 69.09				
TIME SHIFT OF PEAK FLOW (min) = 5.00				
MAXIMUM STORAGE USED (ha.m.) = 0.5281				

CALIB			
NASHYD (0001)	Area (ha) = 47.90	Curve Number (CN) = 83.5	
ID= 1 DT=10.0 min	Ia (mm) = 5.00	# of Linear Res. (N) = 3.00	
	U.H. Tp (hrs) = 1.07		

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----							
TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.167	0.00	1.833	18.47	3.500	11.24	5.17	1.61
0.333	0.81	2.000	27.30	3.667	11.24	5.33	1.61
0.500	1.61	2.167	27.30	3.833	8.83	5.50	1.61
0.667	1.61	2.333	50.59	4.000	6.42	5.67	1.61
0.833	1.61	2.500	73.88	4.167	6.42	5.83	1.61
1.000	1.61	2.667	73.88	4.333	4.81	6.00	1.61
1.167	1.61	2.833	47.38	4.500	3.21	6.17	1.61
1.333	5.62	3.000	20.88	4.667	3.21	6.33	0.81
1.500	9.64	3.167	20.88	4.833	2.41		
1.667	9.64	3.333	16.06	5.000	1.61		

Unit Hyd Qpeak (cms) = 1.703

PEAK FLOW (cms) = 2.253 (i)  
 TIME TO PEAK (hrs) = 3.833  
 RUNOFF VOLUME (mm) = 45.190  
 TOTAL RAINFALL (mm) = 80.310  
 RUNOFF COEFFICIENT = 0.563

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

RESERVOIR (0002) IN= 2---> OUT= 1 DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	2.2500	0.7300
	1.2000	0.2500	5.0000	0.8000
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0001)	47.900	2.253	3.83	45.19
OUTFLOW: ID= 1 (0002)	47.900	1.734	4.67	45.19
PEAK FLOW REDUCTION [Qout/Qin] (%) = 76.94				
TIME SHIFT OF PEAK FLOW (min) = 50.00				
MAXIMUM STORAGE USED (ha.m.) = 0.4940				

ROUTE PIPE (0003)	PIPE Number = 1.00
IN= 2---> OUT= 1	Diameter (mm) = 1650.00
DT= 5.0 min	Length (m) = 1070.00
	Slope (m/m) = 0.007
	Manning n = 0.013

<----- TRAVEL TIME TABLE ----->				
DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV. TIME min
0.09	.462E+02	0.0	0.95	18.81
0.17	.128E+03	0.2	1.48	12.06
0.26	.232E+03	0.4	1.90	9.37
0.35	.351E+03	0.7	2.26	7.88
0.43	.481E+03	1.2	2.57	6.93
0.52	.620E+03	1.6	2.85	6.26
0.61	.765E+03	2.2	3.09	5.77



# SWM POND EC-4 HYDROLOGIC MODEL

0.69	.915E+03	2.8	3.30	5.40
0.78	.107E+04	3.5	3.49	5.12
0.87	.122E+04	4.2	3.65	4.89
0.96	.137E+04	4.9	3.78	4.72
1.04	.152E+04	5.5	3.89	4.58
1.13	.167E+04	6.2	3.98	4.49
1.22	.181E+04	6.8	4.03	4.42
1.30	.194E+04	7.4	4.07	4.39
1.39	.206E+04	7.8	4.06	4.39
1.48	.216E+04	8.1	4.02	4.44
1.56	.224E+04	8.2	3.92	4.55
1.65	.229E+04	7.6	3.57	5.00
<---- hydrograph ----> <-pipe / channel-->				
	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0002)	47.90	1.73	4.67	45.19
OUTFLOW: ID= 1 (0003)	47.90	1.73	4.75	45.19
				MAX DEPTH (m)
				MAX VEL (m/s)
				0.53 2.88
				0.53 2.88

ADD HYD (0064)				
1 + 2 = 3				
	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0003):	47.90	1.732	4.75	45.19
+ ID2= 2 (0078):	53.16	7.500	2.83	78.97
=====				
ID = 3 (0064):	101.06	8.116	3.17	62.96

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB				
STANDHYD (0087)				
ID= 1 DT= 5.0 min				
	Area (ha)=	7.51		
	Total Imp(%)=	99.00	Dir. Conn.(%)=	99.00
	IMPERVIOUS	PERVIOUS (i)		
Surface Area (ha)=	7.43	0.08		
Dep. Storage (mm)=	1.00	1.50		
Average Slope (%)=	1.00	2.00		
Length (m)=	223.76	40.00		
Mannings n =	0.013	0.250		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	1.667	9.64	3.250	20.88	4.83	1.61
0.167	0.00	1.750	9.64	3.333	11.24	4.92	1.61
0.250	0.00	1.833	27.30	3.417	11.24	5.00	1.61
0.333	1.61	1.917	27.30	3.500	11.24	5.08	1.61
0.417	1.61	2.000	27.30	3.583	11.24	5.17	1.61
0.500	1.61	2.083	27.30	3.667	11.24	5.25	1.61
0.583	1.61	2.167	27.30	3.750	11.24	5.33	1.61
0.667	1.61	2.250	27.30	3.833	6.42	5.42	1.61
0.750	1.61	2.333	73.88	3.917	6.42	5.50	1.61
0.833	1.61	2.417	73.88	4.000	6.42	5.58	1.61
0.917	1.61	2.500	73.88	4.083	6.42	5.67	1.61
1.000	1.61	2.583	73.88	4.167	6.42	5.75	1.61
1.083	1.61	2.667	73.88	4.250	6.42	5.83	1.61
1.167	1.61	2.750	73.88	4.333	3.21	5.92	1.61
1.250	1.61	2.833	20.88	4.417	3.21	6.00	1.61
1.333	9.64	2.917	20.88	4.500	3.21	6.08	1.61
1.417	9.64	3.000	20.88	4.583	3.21	6.17	1.61
1.500	9.64	3.083	20.88	4.667	3.21	6.25	1.61
1.583	9.64	3.167	20.88	4.750	3.21		

Max.Eff.Inten. (mm/hr)=	73.88	51.71
over (min)	5.00	10.00
Storage Coeff. (min)=	4.68 (ii)	5.94 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.22	0.15

\*TOTALS\*

PEAK FLOW (cms)=	1.52	0.01	1.534 (iii)
TIME TO PEAK (hrs)=	2.75	2.75	2.75
RUNOFF VOLUME (mm)=	79.31	44.88	78.97
TOTAL RAINFALL (mm)=	80.31	80.31	80.31
RUNOFF COEFFICIENT =	0.99	0.56	0.98

# SWM POND EC-4 HYDROLOGIC MODEL

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0089)		AREA	QPEAK	TPEAK	R.V.
1	2 = 3	(ha)	(cms)	(hrs)	(mm)
ID1= 1	(0064):	101.06	8.116	3.17	62.96
+ ID2= 2	(0087):	7.51	1.534	2.75	78.97
=====					
ID = 3	(0089):	108.57	9.154	2.75	64.06

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0090)		AREA	QPEAK	TPEAK	R.V.
1	2 = 3	(ha)	(cms)	(hrs)	(mm)
ID1= 1	(0088):	1.70	0.348	2.75	78.96
+ ID2= 2	(0089):	108.57	9.154	2.75	64.06
=====					
ID = 3	(0090):	110.27	9.502	2.75	64.29

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0076)		AREA	QPEAK	TPEAK	R.V.
1	2 = 3	(ha)	(cms)	(hrs)	(mm)
ID1= 1	(0070):	6.78	1.386	2.75	78.97
+ ID2= 2	(0090):	110.27	9.502	2.75	64.29
=====					
ID = 3	(0076):	117.05	10.887	2.75	65.14

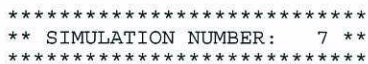
NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR (0006)		OUTFLOW		STORAGE	
IN= 2---	OUT= 1	(cms)	(ha.m.)	(cms)	(ha.m.)
DT= 10.0 min		0.0000	0.0000	0.6400	6.4900
		0.0750	2.7700	1.1500	7.3500
		0.2830	3.8900	1.2500	8.1500
		0.5500	4.8600	1.3900	8.5400
		0.5800	5.2400	20.0000	14.0000
		AREA	QPEAK	TPEAK	R.V.
		(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0076)		117.050	10.887	2.75	65.14
OUTFLOW: ID= 1 (0006)		117.050	0.650	7.00	58.10

PEAK FLOW REDUCTION [Qout/Qin] (%) = 5.97  
TIME SHIFT OF PEAK FLOW (min) = 255.00  
MAXIMUM STORAGE USED (ha.m.) = 6.5063

FINISH





Filename: C:\Documents and Settings\apoirier\  
Local Settings\Temp\  
f402b7b3-aef3-48d7-bebe-c584bf6878ca\ebd070c0  
Comments: 100yr/6hr

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.25	0.00	2.00	27.30	3.75	11.24	5.50	1.61
0.50	1.61	2.25	27.30	4.00	6.42	5.75	1.61
0.75	1.61	2.50	73.88	4.25	6.42	6.00	1.61
1.00	1.61	2.75	73.88	4.50	3.21	6.25	1.61
1.25	1.61	3.00	20.88	4.75	3.21		
1.50	9.64	3.25	20.88	5.00	1.61		
1.75	9.64	3.50	11.24	5.25	1.61		

Area (ha) = 6.78  
Total Imp(%) = 99.00 Dir. Conn.(%) = 99.00



**SCHAEFFERS**  
CONSULTING ENGINEERS

# SWM POND EC-4 HYDROLOGIC MODEL

Dep. Storage (mm)= 1.00 1.50  
Average Slope (%)= 1.00 2.00  
Length (m)= 212.60 40.00  
Mannings n = 0.013 0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	1.667	9.64	3.250	20.88	4.83	1.61
0.167	0.00	1.750	9.64	3.333	11.24	4.92	1.61
0.250	0.00	1.833	27.30	3.417	11.24	5.00	1.61
0.333	1.61	1.917	27.30	3.500	11.24	5.08	1.61
0.417	1.61	2.000	27.30	3.583	11.24	5.17	1.61
0.500	1.61	2.083	27.30	3.667	11.24	5.25	1.61
0.583	1.61	2.167	27.30	3.750	11.24	5.33	1.61
0.667	1.61	2.250	27.30	3.833	6.42	5.42	1.61
0.750	1.61	2.333	73.88	3.917	6.42	5.50	1.61
0.833	1.61	2.417	73.88	4.000	6.42	5.58	1.61
0.917	1.61	2.500	73.88	4.083	6.42	5.67	1.61
1.000	1.61	2.583	73.88	4.167	6.42	5.75	1.61
1.083	1.61	2.667	73.88	4.250	6.42	5.83	1.61
1.167	1.61	2.750	73.88	4.333	3.21	5.92	1.61
1.250	1.61	2.833	20.88	4.417	3.21	6.00	1.61
1.333	9.64	2.917	20.88	4.500	3.21	6.08	1.61
1.417	9.64	3.000	20.88	4.583	3.21	6.17	1.61
1.500	9.64	3.083	20.88	4.667	3.21	6.25	1.61
1.583	9.64	3.167	20.88	4.750	3.21		
Max.Eff.Inten.(mm/hr)= 73.88 *****							
over (min) 5.00 10.00							
Storage Coeff. (min)= 4.53 (ii) 5.80 (iii)							
Unit Hyd. Tpeak (min)= 5.00 10.00							
Unit Hyd. peak (cms)= 0.23 0.15							
PEAK FLOW (cms)= 1.38 0.01 *TOTALS*							
TIME TO PEAK (hrs)= 2.75 2.75 1.386 (iii)							
RUNOFF VOLUME (mm)= 79.31 44.88 78.97							
TOTAL RAINFALL (mm)= 80.31 80.31 80.31							
RUNOFF COEFFICIENT = 0.99 0.56 0.98							

- (i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)  
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.  
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB  
STANDHYD (0087)  
ID= 1 DT= 5.0 min

Area (ha)= 7.51			
Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00			
IMPERVIOUS PVIOUS (i)			
Surface Area (ha)=	7.43	0.08	
Dep. Storage (mm)=	1.00	1.50	
Average Slope (%)=	1.00	2.00	
Length (m)=	223.76	40.00	
Mannings n =	0.013	0.250	
Max.Eff.Inten.(mm/hr)= 73.88 51.71			
over (min) 5.00 10.00			
Storage Coeff. (min)= 4.68 (ii) 5.94 (ii)			
Unit Hyd. Tpeak (min)= 5.00 10.00			
Unit Hyd. peak (cms)= 0.22 0.15			
PEAK FLOW (cms)= 1.52 0.01 *TOTALS*			
TIME TO PEAK (hrs)= 2.75 2.75 1.534 (iii)			
RUNOFF VOLUME (mm)= 79.31 44.88 78.97			
TOTAL RAINFALL (mm)= 80.31 80.31 80.31			
RUNOFF COEFFICIENT = 0.99 0.56 0.98			

- (i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)  
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.  
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.



# **SWM POND EC-4 HYDROLOGIC MODEL**

CALIB			
NASHYD (0017)	Area (ha)=	7.20	Curve Number (CN)= 73.0
ID= 1 DT=10.0 min	Ia (mm)=	4.70	# of Linear Res. (N)= 3.00
	U.H. Tp(hrs)=	0.20	

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.167	0.00	1.833	18.47	3.500	11.24	5.17	1.61
0.333	0.81	2.000	27.30	3.667	11.24	5.33	1.61
0.500	1.61	2.167	27.30	3.833	8.83	5.50	1.61
0.667	1.61	2.333	50.59	4.000	6.42	5.67	1.61
0.833	1.61	2.500	73.88	4.167	6.42	5.83	1.61
1.000	1.61	2.667	73.88	4.333	4.81	6.00	1.61
1.167	1.61	2.833	47.38	4.500	3.21	6.17	1.61
1.333	5.62	3.000	20.88	4.667	3.21	6.33	0.81
1.500	9.64	3.167	20.88	4.833	2.41		
1.667	9.64	3.333	16.06	5.000	1.61		

Unit Hyd Qpeak (cms)= 1.355

PEAK FLOW (cms)= 0.584 (i)  
TIME TO PEAK (hrs)= 2.833  
RUNOFF VOLUME (mm)= 32.886  
TOTAL RAINFALL (mm)= 80.310  
RUNOFF COEFFICIENT = 0.409

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

CALIB			
STANDHYD (0018)	Area (ha)=	33.30	
ID= 1 DT=10.0 min	Total Imp(%)=	90.00	Dir. Conn.(%)= 90.00

	IMPERVIOUS	PERVIOUS (i)	
Surface Area (ha)=	29.97	3.33	
Dep. Storage (mm)=	1.00	1.00	
Average Slope (%)=	1.00	1.00	
Length (m)=	471.17	40.00	
Mannings n =	0.013	0.250	
Max.Eff.Inten. (mm/hr)=	73.88	40.55	
over (min)	10.00	20.00	
Storage Coeff. (min)=	7.31 (ii)	19.78 (ii)	
Unit Hyd. Tpeak (min)=	10.00	20.00	
Unit Hyd. peak (cms)=	0.13	0.06	
			*TOTALS*
PEAK FLOW (cms)=	5.99	0.28	6.223 (iii)
TIME TO PEAK (hrs)=	2.67	2.83	2.67
RUNOFF VOLUME (mm)=	79.31	40.65	75.44
TOTAL RAINFALL (mm)=	80.31	80.31	80.31
RUNOFF COEFFICIENT =	0.99	0.51	0.94

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 77.1 Ia = Dep. Storage (Above)  
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.  
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0014)				
1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0017):	7.20	0.584	2.83	32.89
+ ID2= 2 (0018):	33.30	6.223	2.67	75.44
=====				
ID = 3 (0014):	40.50	6.790	2.67	67.88

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB			
STANDHYD (0019)	Area (ha)=	5.50	
ID= 1 DT=10.0 min	Total Imp(%)=	85.00	Dir. Conn.(%)= 85.00

IMPERVIOUS PERVIOUS (i)

# **SWM POND EC-4 HYDROLOGIC MODEL**

Surface Area	(ha)=	4.68	0.82	
Dep. Storage	(mm)=	1.00	1.00	
Average Slope	(%)=	1.00	1.00	
Length	(m)=	191.49	40.00	
Mannings n	=	0.013	0.250	
Max.Eff.Inten. (mm/hr)=		73.88	40.55	
over (min)		10.00	20.00	
Storage Coeff. (min)=		4.26 (ii)	16.73 (ii)	
Unit Hyd. Tpeak (min)=		10.00	20.00	
Unit Hyd. peak (cms)=		0.15	0.06	
				<b>*TOTALS*</b>
PEAK FLOW (cms)=		0.96	0.07	1.018 (iii)
TIME TO PEAK (hrs)=		2.67	2.83	2.67
RUNOFF VOLUME (mm)=		79.31	40.65	73.51
TOTAL RAINFALL (mm)=		80.31	80.31	80.31
RUNOFF COEFFICIENT =		0.99	0.51	0.92

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
 CN\* = 77.1 Ia = Dep. Storage (Above)  
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
 THAN THE STORAGE COEFFICIENT.  
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0013)		AREA	QPEAK	TPEAK	R.V.
1 +	2 = 3	(ha)	(cms)	(hrs)	(mm)
ID1= 1	(0014):	40.50	6.790	2.67	67.88
+ ID2= 2	(0019):	5.50	1.018	2.67	73.51
=====					
ID = 3	(0013):	46.00	7.808	2.67	68.55

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR (0012)		OUTFLOW	STORAGE	OUTFLOW	STORAGE
IN= 2---> OUT= 1	DT= 10.0 min	(cms)	(ha.m.)	(cms)	(ha.m.)
		0.0000	0.0000	0.3270	2.3590
		0.0910	1.2810	0.4150	2.6210
		0.1700	1.7150	0.4950	2.8800
		0.2350	2.0030	20.0000	4.0000
		AREA	QPEAK	TPEAK	R.V.
		(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2	(0013)	46.000	7.808	2.67	68.55
OUTFLOW: ID= 1	(0012)	46.000	0.450	4.50	68.47
PEAK FLOW REDUCTION [Qout/Qin] (%)= 5.76					
TIME SHIFT OF PEAK FLOW (min)=110.00					
MAXIMUM STORAGE USED (ha.m.)= 2.7335					

ROUTE PIPE (8118)		PIPE Number	=	1.00
IN= 2---> OUT= 1		Diameter	(mm)=	1650.00
DT= 5.0 min		Length	(m)=	1070.00
		Slope	(m/m)=	0.007
		Manning n	=	0.013

TRAVEL TIME TABLE				
DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV. TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.462E+02	0.0	0.95	18.81
0.17	.128E+03	0.2	1.48	12.06
0.26	.232E+03	0.4	1.90	9.37
0.35	.351E+03	0.7	2.26	7.88
0.43	.481E+03	1.2	2.57	6.93
0.52	.620E+03	1.6	2.85	6.26
0.61	.765E+03	2.2	3.09	5.77
0.69	.915E+03	2.8	3.30	5.40
0.78	.107E+04	3.5	3.49	5.12
0.87	.122E+04	4.2	3.65	4.89
0.96	.137E+04	4.9	3.78	4.72
1.04	.152E+04	5.5	3.89	4.58
1.13	.167E+04	6.2	3.98	4.49
1.22	.181E+04	6.8	4.03	4.42
1.30	.194E+04	7.4	4.07	4.39



**SWM POND EC-4 HYDROLOGIC MODEL**

1.39	.206E+04	7.8	4.06	4.39		
1.48	.216E+04	8.1	4.02	4.44		
1.56	.224E+04	8.2	3.92	4.55		
1.65	.229E+04	7.6	3.57	5.00		
<---- hydrograph ----> <-pipe / channel->						
	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0012)	46.00	0.45	4.50	68.47	0.27	1.94
OUTFLOW: ID= 1 (8118)	46.00	0.45	4.75	67.79	0.27	1.94

CALIB				
STANDHYD (8093)	Area (ha)=	4.50		
ID= 1 DT= 5.0 min	Total Imp(%)=	75.00	Dir. Conn.(%)=	60.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	3.38	1.12
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	1.00
Length	(m)=	173.21	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	1.667	9.64	3.250	20.88	4.83	1.61
0.167	0.00	1.750	9.64	3.333	11.24	4.92	1.61
0.250	0.00	1.833	27.30	3.417	11.24	5.00	1.61
0.333	1.61	1.917	27.30	3.500	11.24	5.08	1.61
0.417	1.61	2.000	27.30	3.583	11.24	5.17	1.61
0.500	1.61	2.083	27.30	3.667	11.24	5.25	1.61
0.583	1.61	2.167	27.30	3.750	11.24	5.33	1.61
0.667	1.61	2.250	27.30	3.833	6.42	5.42	1.61
0.750	1.61	2.333	73.88	3.917	6.42	5.50	1.61
0.833	1.61	2.417	73.88	4.000	6.42	5.58	1.61
0.917	1.61	2.500	73.88	4.083	6.42	5.67	1.61
1.000	1.61	2.583	73.88	4.167	6.42	5.75	1.61
1.083	1.61	2.667	73.88	4.250	6.42	5.83	1.61
1.167	1.61	2.750	73.88	4.333	3.21	5.92	1.61
1.250	1.61	2.833	20.88	4.417	3.21	6.00	1.61
1.333	9.64	2.917	20.88	4.500	3.21	6.08	1.61
1.417	9.64	3.000	20.88	4.583	3.21	6.17	1.61
1.500	9.64	3.083	20.88	4.667	3.21	6.25	1.61
1.583	9.64	3.167	20.88	4.750	3.21		

Max.Eff.Inten.(mm/hr)=	73.88	54.19	
over (min)	5.00	20.00	
Storage Coeff. (min)=	4.01 (ii)	15.11 (ii)	
Unit Hyd. Tpeak (min)=	5.00	20.00	
Unit Hyd. peak (cms)=	0.24	0.07	
PEAK FLOW (cms)=	0.55	0.12	*TOTALS*
TIME TO PEAK (hrs)=	2.75	2.92	0.664 (iii)
RUNOFF VOLUME (mm)=	79.31	30.11	59.63
TOTAL RAINFALL (mm)=	80.31	80.31	80.31
RUNOFF COEFFICIENT =	0.99	0.37	0.74

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
 CN\* = 55.0 Ia = Dep. Storage (Above)  
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
 THAN THE STORAGE COEFFICIENT.  
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB				
STANDHYD (6534)	Area (ha)=	1.47		
ID= 1 DT= 5.0 min	Total Imp(%)=	99.00	Dir. Conn.(%)=	99.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.46	0.01
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	98.99	40.00
Mannings n	=	0.013	0.250

Max.Eff.Inten.(mm/hr)=	73.88	51.71	
over (min)	5.00	5.00	
Storage Coeff. (min)=	2.87 (ii)	4.13 (ii)	

# **SWM POND EC-4 HYDROLOGIC MODEL**

Unit Hyd. Tpeak (min)=	5.00	5.00	
Unit Hyd. peak (cms)=	0.28	0.24	
			<b>*TOTALS*</b>
PEAK FLOW (cms)=	0.30	0.00	0.301 (iii)
TIME TO PEAK (hrs)=	2.75	2.75	2.75
RUNOFF VOLUME (mm)=	79.31	44.88	78.96
TOTAL RAINFALL (mm)=	80.31	80.31	80.31
RUNOFF COEFFICIENT =	0.99	0.56	0.98

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (8098)					
1 + 2 = 3		AREA	QPEAK	TPEAK	R.V.
		(ha)	(cms)	(hrs)	(mm)
ID1= 1 (6534):		1.47	0.301	2.75	78.96
+ ID2= 2 (8093):		4.50	0.664	2.75	59.63
=====					
ID = 3 (8098):		5.97	0.964	2.75	64.39

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ROUTE PIPE (8125)	PIPE Number = 1.00
IN= 2---> OUT= 1	Diameter (mm)=1800.00
DT= 5.0 min	Length (m)=1130.00
	Slope (m/m)= 0.007
	Manning n = 0.013

## <----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.580E+02	0.1	1.00	18.75
0.19	.161E+03	0.2	1.57	12.02
0.28	.291E+03	0.5	2.02	9.34
0.38	.441E+03	0.9	2.40	7.85
0.47	.604E+03	1.5	2.73	6.90
0.57	.779E+03	2.1	3.02	6.24
0.66	.962E+03	2.8	3.27	5.75
0.76	.115E+04	3.6	3.50	5.38
0.85	.134E+04	4.4	3.69	5.10
0.95	.153E+04	5.2	3.86	4.87
1.04	.173E+04	6.1	4.01	4.70
1.14	.191E+04	7.0	4.12	4.57
1.23	.210E+04	7.8	4.21	4.47
1.33	.227E+04	8.6	4.28	4.40
1.42	.244E+04	9.3	4.31	4.37
1.52	.258E+04	9.8	4.31	4.37
1.61	.271E+04	10.2	4.26	4.42
1.71	.282E+04	10.3	4.15	4.54
1.80	.288E+04	9.6	3.78	4.98

	<---- hydrograph ---->				<-pipe / channel->	
	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (8098)	5.97	0.96	2.75	64.39	0.38	2.41
OUTFLOW: ID= 1 (8125)	5.97	0.94	2.75	64.37	0.38	2.40

CALIB			
STANDHYD (0078)	Area (ha)= 57.04		
ID= 1 DT=10.0 min	Total Imp(%)= 66.00	Dir. Conn.(%)= 66.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	37.65	19.39
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	616.66	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
------	------	------	------	------	------	------	------



# SWM POND EC-4 HYDROLOGIC MODEL

hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.167	0.00	1.833	18.47	3.500	11.24	5.17	1.61
0.333	0.81	2.000	27.30	3.667	11.24	5.33	1.61
0.500	1.61	2.167	27.30	3.833	8.83	5.50	1.61
0.667	1.61	2.333	50.59	4.000	6.42	5.67	1.61
0.833	1.61	2.500	73.88	4.167	6.42	5.83	1.61
1.000	1.61	2.667	73.88	4.333	4.81	6.00	1.61
1.167	1.61	2.833	47.38	4.500	3.21	6.17	1.61
1.333	5.62	3.000	20.88	4.667	3.21	6.33	0.81
1.500	9.64	3.167	20.88	4.833	2.41		
1.667	9.64	3.333	16.06	5.000	1.61		

Max.Eff.Inten.(mm/hr)= 73.88 56.12  
over (min) 10.00 20.00  
Storage Coeff. (min)= 8.59 (ii) 17.48 (ii)  
Unit Hyd. Tpeak (min)= 10.00 20.00  
Unit Hyd. peak (cms)= 0.12 0.06

\*TOTALS\*

PEAK FLOW (cms)= 7.41 2.23 9.325 (iii)  
TIME TO PEAK (hrs)= 2.67 2.83 2.67  
RUNOFF VOLUME (mm)= 79.31 51.69 69.92  
TOTAL RAINFALL (mm)= 80.31 80.31 80.31  
RUNOFF COEFFICIENT = 0.99 0.64 0.87

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 86.0 Ia = Dep. Storage (Above)  
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.  
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (8124)		AREA	QPEAK	TPEAK	R.V.
1	2 = 3	(ha)	(cms)	(hrs)	(mm)
ID1= 1	(0078):	57.04	9.325	2.67	69.92
+ ID2= 2	(8125):	5.97	0.938	2.75	64.37
=====					
ID = 3	(8124):	63.01	10.231	2.67	69.39

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0076)		AREA	QPEAK	TPEAK	R.V.
1	2 = 3	(ha)	(cms)	(hrs)	(mm)
ID1= 1	(8118):	46.00	0.449	4.75	67.79
+ ID2= 2	(8124):	63.01	10.231	2.67	69.39
=====					
ID = 3	(0076):	109.01	10.304	2.67	68.72

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB STANDHYD (0088)		Area	(ha)=	1.70
ID= 1	DT= 5.0 min	Total Imp(%)=	99.00	Dir. Conn.(%)= 99.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.68	0.02
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	106.46	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	1.667	9.64	3.250	20.88	4.83	1.61
0.167	0.00	1.750	9.64	3.333	11.24	4.92	1.61
0.250	0.00	1.833	27.30	3.417	11.24	5.00	1.61
0.333	1.61	1.917	27.30	3.500	11.24	5.08	1.61
0.417	1.61	2.000	27.30	3.583	11.24	5.17	1.61
0.500	1.61	2.083	27.30	3.667	11.24	5.25	1.61
0.583	1.61	2.167	27.30	3.750	11.24	5.33	1.61
0.667	1.61	2.250	27.30	3.833	6.42	5.42	1.61

# SWM POND EC-4 HYDROLOGIC MODEL

0.750	1.61	2.333	73.88	3.917	6.42	5.50	1.61
0.833	1.61	2.417	73.88	4.000	6.42	5.58	1.61
0.917	1.61	2.500	73.88	4.083	6.42	5.67	1.61
1.000	1.61	2.583	73.88	4.167	6.42	5.75	1.61
1.083	1.61	2.667	73.88	4.250	6.42	5.83	1.61
1.167	1.61	2.750	73.88	4.333	3.21	5.92	1.61
1.250	1.61	2.833	20.88	4.417	3.21	6.00	1.61
1.333	9.64	2.917	20.88	4.500	3.21	6.08	1.61
1.417	9.64	3.000	20.88	4.583	3.21	6.17	1.61
1.500	9.64	3.083	20.88	4.667	3.21	6.25	1.61
1.583	9.64	3.167	20.88	4.750	3.21		

Max.Eff.Inten.(mm/hr)=	73.88	51.71	
over (min)	5.00	5.00	
Storage Coeff. (min)=	2.99 (ii)	4.26 (ii)	
Unit Hyd. Tpeak (min)=	5.00	5.00	
Unit Hyd. peak (cms)=	0.28	0.23	
*TOTALS*			
PEAK FLOW (cms)=	0.35	0.00	0.348 (iii)
TIME TO PEAK (hrs)=	2.75	2.75	2.75
RUNOFF VOLUME (mm)=	79.31	44.88	78.96
TOTAL RAINFALL (mm)=	80.31	80.31	80.31
RUNOFF COEFFICIENT =	0.99	0.56	0.98

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 81.0 Ia = Dep. Storage (Above)  
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.  
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (6527)					
1 + 2 = 3					
	AREA	QPEAK	TPEAK	R.V.	
	(ha)	(cms)	(hrs)	(mm)	
ID1= 1 (0076):	109.01	10.304	2.67	68.72	
+ ID2= 2 (0088):	1.70	0.348	2.75	78.96	
=====					
ID = 3 (6527):	110.71	10.651	2.67	68.88	

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB			
STANDHYD (8097)			
ID= 1 DT=10.0 min			
Area (ha)=	53.18		
Total Imp(%)=	99.00	Dir. Conn.(%)=	99.00
IMPERVIOUS			
PERVIOUS (i)			
Surface Area (ha)=	52.65	0.53	
Dep. Storage (mm)=	1.00	1.50	
Average Slope (%)=	1.00	2.00	
Length (m)=	595.43	40.00	
Mannings n =	0.013	0.250	

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.167	0.00	1.833	18.47	3.500	11.24	5.17	1.61
0.333	0.81	2.000	27.30	3.667	11.24	5.33	1.61
0.500	1.61	2.167	27.30	3.833	8.83	5.50	1.61
0.667	1.61	2.333	50.59	4.000	6.42	5.67	1.61
0.833	1.61	2.500	73.88	4.167	6.42	5.83	1.61
1.000	1.61	2.667	73.88	4.333	4.81	6.00	1.61
1.167	1.61	2.833	47.38	4.500	3.21	6.17	1.61
1.333	5.62	3.000	20.88	4.667	3.21	6.33	0.81
1.500	9.64	3.167	20.88	4.833	2.41		
1.667	9.64	3.333	16.06	5.000	1.61		

Max.Eff.Inten.(mm/hr)=	73.88	51.74	
over (min)	10.00	20.00	
Storage Coeff. (min)=	8.41 (ii)	17.60 (ii)	
Unit Hyd. Tpeak (min)=	10.00	20.00	
Unit Hyd. peak (cms)=	0.12	0.06	
*TOTALS*			
PEAK FLOW (cms)=	10.39	0.06	10.435 (iii)
TIME TO PEAK (hrs)=	2.67	2.83	2.67
RUNOFF VOLUME (mm)=	79.31	47.47	78.99
TOTAL RAINFALL (mm)=	80.31	80.31	80.31



# **SWM POND EC-4 HYDROLOGIC MODEL**

RUNOFF COEFFICIENT = 0.99 0.59 0.98

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 83.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR (6530)  
IN= 2--> OUT= 1  
DT= 5.0 min

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	7.5100	10.0000
7.5000	0.0500	7.5200	20.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (8097)	53.180	10.435	2.67	78.99
OUTFLOW: ID= 1 (6530)	53.180	7.500	2.83	78.99

PEAK FLOW REDUCTION [Qout/Qin] (%) = 71.87  
TIME SHIFT OF PEAK FLOW (min) = 10.00  
MAXIMUM STORAGE USED (ha.m.) = 0.3449

ADD HYD (8094)  
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (6527):	110.71	10.651	2.67	68.88
+ ID2= 2 (6530):	53.18	7.500	2.83	78.99
=====				
ID = 3 (8094):	163.89	18.152	2.67	72.16

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (8095)  
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0087):	7.51	1.534	2.75	78.97
+ ID2= 2 (8094):	163.89	18.152	2.67	72.16
=====				
ID = 3 (8095):	171.40	19.682	2.67	72.46

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (8096)  
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0070):	6.78	1.386	2.75	78.97
+ ID2= 2 (8095):	171.40	19.682	2.67	72.46
=====				
ID = 3 (8096):	178.18	21.065	2.67	72.70

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR (0042)  
IN= 2--> OUT= 1  
DT= 5.0 min

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.6400	6.4900
0.0750	2.7700	1.1500	7.3500
0.2800	3.8900	1.2500	8.1500
0.5500	4.8500	1.4000	8.8540
0.5800	5.2400	16.0000	13.9000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (8096)	178.180	21.065	2.67	72.70
OUTFLOW: ID= 1 (0042)	178.180	1.393	4.92	65.70

PEAK FLOW REDUCTION [Qout/Qin] (%) = 6.61  
TIME SHIFT OF PEAK FLOW (min) = 135.00  
MAXIMUM STORAGE USED (ha.m.) = 8.8196

## **Appendix C Soil Investigation Excerpt**



exp

Lantringham Place Inc.  
c/o Mehra Development Inc.

Preliminary Geotechnical Investigation  
Countryside Villages Employment Lands  
Dixie Road & Countryside Drive  
Brampton, Ontario

BRM00396886-B0

exp  
1595 Clark Boulevard  
Brampton, ON L6T 4V1  
Canada,

August 11, 2011

2. In view of the silty nature of the subgrade soils, we recommend perimeter subdrains be provided on both sides of the roadway at least 300 mm below the granular subbase.
3. To minimize the problems of differential movement between the pavement and catchbasins/manholes due to frost action, the backfill around the structures should consist of free-draining granular. In addition, the catchbasin should be perforated just above the drain and the holes screened with filter cloth.
4. The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted lanes, half-loads during paving, etc., may be required, especially if construction is carried out during unfavorable weather.

#### 5.6 Storm Water Management Pond

A storm water management pond is to be constructed at the southeast corner of the site. The base elevation of the pond has not been established. However, it is anticipated the invert of the pond will be less than 8 m below existing grade.

Boreholes 4, 5, 6, 16 and 108 were put down in the proposed pond area and encountered native compact to very dense sandy silt till and silt till to a depth of about 11 m below existing grade. Below that level, a deposit of wet sand was encountered to a depth of 13.5 m below existing grade. A lower silt till deposit was encountered below the sand unit extending to the termination depth of Borehole 108.

Free ground water level recorded in the monitoring wells installed in Boreholes 4 and 6 were at depths of about 1.94 m and 2.52 m below existing grade, respectively. The water primarily originated from wet sand seams/layers within the till deposits. In Borehole 108, the water appeared to come from the underlying wet sand deposit. Based on the above information and the colour of the recovered soil samples (brown to grey), it is our opinion that the long-term groundwater level at the site lies at depths of about 3 to 4.5 m below existing grade (approximately Elevations 244 to 244.5 m).

Based on the results of the boreholes, it is our opinion that the site is suitable for construction of the storm water management pond. The material at the base and sides of the pond will primarily comprise sandy silt till and/or silt till. The till material will exhibit coefficient of hydraulic conductivities in the order of  $10^{-5}$  to  $10^{-6}$  cm/sec which is considered relatively low.

It is recommended to form the pond base at least 3 m above the underlying wet sand layer to prevent base heave.



## **Appendix D SWM Pond Design Drawings**