Penta Properties Inc.
1200 King Road

City of Burlington

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

January 2014

By:

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MCI File: P10003

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1.0 INTRODUCTION

Metropolitan Consulting Incorporated (MCI) has been retained by Penta Properties Inc. (PPI) to provide engineering services and obtain regulatory agency approvals for the proposed development at 1200 King Road (The Site) in the City of Burlington.

This Functional Servicing/Stormwater Management Report (FSR/SWM) contains functional engineering criteria, parameters and design characteristics for the proposed water, storm and sanitary sewers as well as the Stormwater Management facilities within the Site. The report also includes conceptual road and lot design, conceptual grading, drainage, and SWM plans in support of an application for Draft Plan of Subdivision.

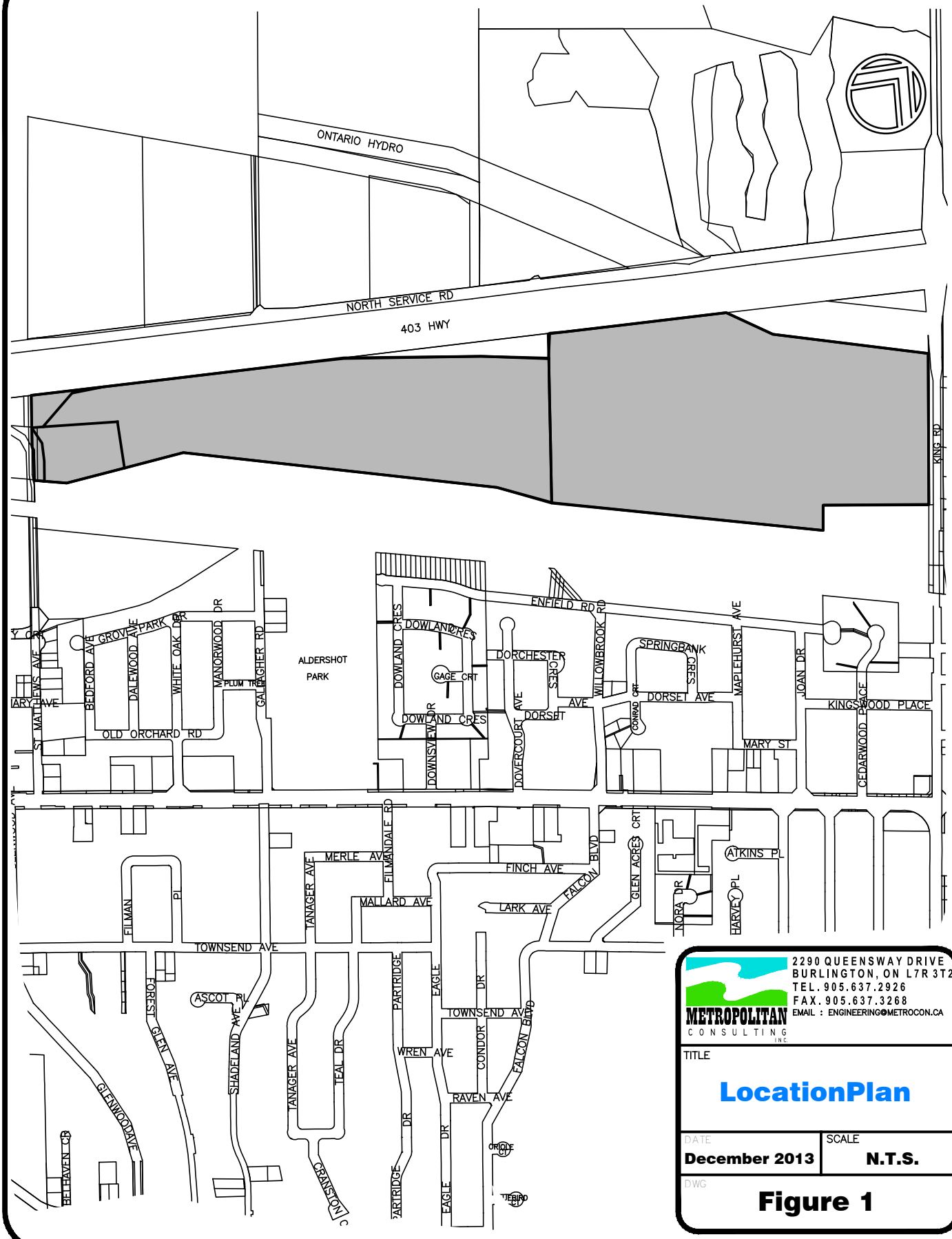
2.0 BACKGROUND

2.1 LOCATION AND DESCRIPTION

Penta Properties is proposing to develop a 50 hectare parcel of land between King Road to the east, the Aldershot Go Station to the west, the 403 to the north and CNR tracks to the south in the City of Burlington as shown in Figure 1.

The Site lies within three subwatersheds: Indian Creek, Falcon Creek and Grindstone Creek. A 2.2 ha portion of Hydro-One land north of the property along King Road will be re-graded along with the development of the Penta property. The Site east of Falcon Creek is open space. West of Falcon Creek the site is mainly brush with some trees. Further studies are being completed in this area to determine the development potential. The Site generally has a flat topography with a north to south slope. The central portion of the site has moderately steep valley sides along Falcon Creek.

The main drainage features within the Site are Indian Creek, Falcon Creek and tributaries of Grindstone Creek as shown in Figure 2: Existing Site Conditions (Back Pocket). The Indian Creek consists of two tributaries as it crosses the 403 which converge into one channel flowing from north to south through the Site parallel to King Road. At the property line of Penta land Indian Creek has been channelized. At the CNR tracks the channel bends eastward towards King Road crossing via an aqueduct constructed by the City as part of the King Road Grade Separation. At this point another branch of Indian Creek from



P:\Paletta\P10003 King Road\dwg\Engineering\Fig 1 - LocationPlan.dwg

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TITLE

LocationPlan

DATE	SCALE
December 2013	N.T.S.

DWG

Figure 1

the east side of King Road joins the channel and flows through a series of pipes to Burlington Bay.

Indian Creek has a history of flooding the Site and causing problems along King Road. A Natural Channel Design was completed by AMEC for the City of Burlington to resolve the flooding issues. AMEC's design includes realigning the creek south of Penta property and designing the aqueduct structure using natural channel design in order to cross King Road in conjunction with the CNR Grade Separation Project in which King Road will go under the creek and train tracks. AMEC's design also included a preliminary conceptual natural channel design of Indian Creek on Penta land which will be used for this submission. The Creek work south of Penta property, the aqueduct and grade separation work has been completed as of December 2013.

Falcon Creek flows through the central portion of the Penta land via a narrow valley on from the 403 south to the CNR tracks. South of the CNR tracks the area is urbanized and many sections of the creek run through submerged culverts as it flows south to Burlington Bay. The Falcon Creek Hydrology and Hydraulics Study (Valdor 2012) has recently been completed for the City of Burlington to address flooding issues downstream of the Site as well as along the northern side of the CNR tracks just south of the Site. The Falcon Creek Hydrology and Hydraulics Study sets out stormwater management controls for future development in the Falcon Creek Watershed which will be followed in this FSR/SWM report.

Three tributaries of Grindstone Creek cross under HWY 403 on the west side of the Penta land and join as they flow west towards the main branch of Grindstone Creek west of Waterdown Road. Grindstone Creek north of the Aldershot Go Station has undergone a natural channel design by AMEC as part of the waterdown road interchange work. The most easterly branch of the creek splits to flow south into a pond on Site which discharges through a shallow ditch along the CNR tracks.

Grindstone Creek will only be addressed in this FSR/SWM report for recommendation and design purposes of the proposed South Service Road and servicing. The area west of Falcon Creek is included in a mobility hub study for the Aldershot area which will determine zoning for development in this area.

The site is currently vacant land. The proposed land uses for the Site are discussed in the following sections.

2.2 PROPOSED DEVELOPMENT

East of Falcon Creek the property is proposed to be developed for employment purposes. The western portion of the property is proposed to be developed for mixed use purposes which will include residential, retail and commercial buildings. The South Service Road is proposed to run across the property to connect Waterdown Road to King Road. Services will be placed along the proposed South Service Road for the future development of the property. The proposed development is shown on Figure 3 (back pocket).

Mixed use, business corridor, and employment commercial lots are proposed for the development area east of Falcon Creek. An entertainment commercial facility is to be included in this area. This meets current land use designations for the property as per the Burlington Official Plan. Blocks are proposed for access roads and two stormwater management ponds. The remainder of the property is not the subject of the application for development at this time except for the proposed South Service Road and services.

2.3 RELATED REPORTS AND DOCUMENTS

The following documents were consulted during the completion of this report:

Geotechnical Investigation, Soil Mat Ltd., 2013

1200 King Road Terms of Reference, Savanta and MCI, August 2012

Falcon Creek Hydrology and Hydraulics Study, Valdor Engineering Inc, May 2012.

Stormwater Management Planning and Design Manual, Ontario Ministry of the Environment, 2003

Sustainable Halton Water and Wastewater Master Plan, Region of Halton, 2011

Northshore Watershed Study, Conservation Halton, 2006

AMEC Indian Creek/Grade Separation Design, 2013

3.0 DESIGN AND REGULATORY FRAMEWORK FOR SWM

3.1 1200 KING ROAD TERMS OF REFERENCE

A Terms of Reference (TOR) study of 1200 King Road (August, 2012) was completed by Savanta and MCI to identify environmental constraints, provide design guidelines and

establish mitigation objectives in support of a development application for 1200 King Road. Watershed studies which include 1200 King Road (North Shore Watershed Study, South Waterdown Subwatershed Study, and Grindstone Creek Subwatershed Study) do not specify SWM guidelines for this Site and as such the TOR was used.

3.2 MINISTRY OF THE ENVIRONMENT STORMWATER MANAGEMENT GUIDELINES

Where the TOR was not specific to 1200 King Road the technical guidelines of the Ministry of the Environment (MOE) Stormwater Management Planning and Design Manual (2003) were followed.

3.3 CONSERVATION HALTON REGULATIONS

Design considerations pertaining to the floodplain and environmental setbacks were based on Conservation Halton (CH) regulations and established drainage boundaries.

3.4 CITY OF BURLINGTON STANDARDS

When the design elements of this report were not explicitly guided by the TOR, MOE's SWM manual, HRCA Regulations or any other provincial legislation, City of Burlington Standards were followed. Adherence to City of Burlington standards is discussed in the applicable sections of this SWMR.

4.0 WATER SERVICING

4.1 EXISTING WATER DISTRIBUTION SYSTEM

1200 King Road is in pressure district B1A of the City water distribution system. The area is serviced by the Kingsway Drive Booster Pumping Station which has a firm capacity of 30ML/day. Storage is provided by the Waterdown Road Reservoir (Sustainable Halton Water and Wastewater Master Plan, 2011). The Waterdown Rd. Reservoir has a capacity of 7.5ML. The Sustainable Halton Water and Wastewater Master Plan projected future demand to include future development as set out in the Transportation Master Plan and the Burlington Official Plan. These projections extend to 2031 and include the 1200 King Road property. By 2031 it is expected that 15ML of storage will be required at the Waterdown Rd. Reservoir. A 7.5ML expansion is planned in the Region Capital Program

between 2017 and 2021 to accommodate the projected demand up to the year 2031 (Sustainable Halton Water and Wastewater Master Plan, 2011). The schedule for upgrades includes anticipated phasing projections for development and as such development can proceed prior to the expansion provided a service permit is issued by the Region of Halton. Based on the Sustainable Halton Water and Wastewater Master Plan there is considered to be sufficient supply capacity for the proposed development.

4.2 PROPOSED WATER DISTRIBUTION SYSTEM

The following options were considered in order to loop the watermain across the site and are depicted in Figure 4 (back pocket).

Option 1 Run twin mains from King Road across the site and loop back to King Road

Option 2 Connect the proposed watermain to the 600mm watermain at Waterdown Road and the 350mm watermain at King Road

Option 3 Connect the proposed watermain from King Road into the watermain servicing the Aldershot Go Station

Option 4 (preferred) Run the watermain from King Road across site and loop under the CNR tracks at St. Matthews Ave to the 300mm watermain at Masonry Court

Option 5 Run the watermain from King Road and loop under the CNR tracks to the watermain at Gallagher Rd.

Option 1 was considered but does not provide a fully looped system at all times. The Region of Halton does not allow connections to feeder mains and Option 2 was eliminated. Information on the watermain servicing the Aldershot Go Station for Option 3 was unavailable from the Region of Halton and the City of Burlington and as such this option could not be selected. Option 5 would connect the watermain loop south of Grindstone Creek at Gallagher Road. This option would require running the main under Grindstone Creek, west along the southern portion of the site, north to the Proposed South Service Road and then East along the Road to King Road. Option 4 was selected as the preferred option as it provides a fully looped system of the entire property with the most efficient use of space.

A 300mm Ø PVC watermain is proposed to run along the Proposed South Service Road from the existing 350mm Ductile Iron watermain on King Road. A 300mm Ø watermain

will be extended north from the 300mm Ø watermain on Masonry Court under the CNR tracks to meet the proposed 300mm Ø watermain at the South Service Road providing a fully looped system as shown on Figure 4.

4.3 HYDRANTS

Hydrant spacing and coverage will be provided such that it meets both Region of Halton and Fire Underwriters Survey Guidelines.

5.0 WASTEWATER

5.1 EXTERNAL WASTEWATER COLLECTION SYSTEM

Wastewater in Burlington drains through a gravity collection system to the Skyway Wastewater Treatment Plant (WWTP) located to the South-East of the Site at Hamilton Harbour. There are two main sanitary trunks which convey wastewater to the WWTP; the East Trunk and the West Trunk. 25 pumping stations pump wastewater to various areas within the collection system where gravity drainage is not possible (Sustainable Halton Water and Wastewater Master Plan, 2011).

1200 King Road is within the West Trunk drainage area. The West Trunk begins on Plains Road at the Royal Botanical Gardens and connects to the East Trunk at Northshore Boulevard and flows to the Skyway WWTP. There are 15 pumping stations within the West Trunk drainage area which pumps areas to the south and west of the West Trunk. The areas north of the West Trunk flow by gravity through local mains and four sub-trunk sewers which run along Francis Road, Falcon Boulevard, Shadeland Avenue and Glenwood Avenue into the West Trunk. The Sustainable Halton Water and Wastewater Master Plan (2011) assessed sanitary flows up until the year 2031 and considered an ultimate development scenario for Burlington. Under the ultimate development scenario no upgrades are recommended in the report for the sanitary sewers which the 1200 King Road property flows to and the property has been noted as an area with intensification potential.

The Skyway WWTP is undergoing an expansion to increase the capacity from 118 MLD to 140 MLD. This expansion is expected to be complete by 2015. The expansion of the Skyway WWTP considered future development up to the year 2031 and the Site was included in this ultimate development scenario as per the official plan as an employment

area. With the completion of this expansion there will be sufficient treatment capacity available in the Skyway WWTP for all flows generated by the 1200 King Road property.

5.2 EXISTING SANITARY SEWERS

There is an existing 450mm Ø vitrified clay sanitary sewer on King Road and an existing 450mm Ø concrete sanitary sewer on St Matthews Avenue.

The wastewater flowing to the St. Matthews Avenue sanitary sewer flows by gravity south through the St. Matthews Avenue local main to reach the West Trunk Sewer at Townsend Avenue. The sewage draining to the King Road sanitary sewer flows by gravity south through the King Road local main, east on Plains Road and then drains south via the Francis Road sub trunk sewer which connects to the West Trunk at Cedar Avenue and flows to the Skyway WWTP.

5.3 EXTERNAL FLOWS TO ST MATTHEWS SEWER

A shown on Figure 5 (back pocket), there are four areas north of HWY 403 draining to the St Matthews Ave. sewer.

EXT 1

Flow data for the closed Burlington Landfill Site (Area EXT 1) was provided by the Region of Halton. The maximum daily flow between January and September of 2013 was 812m^3/day which corresponds to 9.4L/s.

EXT 2

There are two buildings within Area EXT 2. One of the buildings is the headquarters for Ippolito Transportation Inc. which is a refrigerated produce processing, storage and warehousing facility. Building 2 is Cumis office space with a large amount of parking.

EXT 3

Area EXT 3 is part of the Sassafras Woods that are environmentally sensitive and will not be developed.

EXT 4

Area EXT 4 represents the North Aldershot Central Drainage area referred to on the Master Drainage plan (Appendix A). Flows for this area were calculated as part of the

Eagle Heights & Taylor Property Functional Servicing & SWM Report Addendum submitted in March 2013 by Metropolitan Consulting. From the sanitary design sheets in the FSR Addendum, the flow from the Eagle Heights subdivision and existing properties in the North Aldershot (central) Drainage area was calculated to be 86.4 L/s.

5.4 PROPOSED SANITARY SEWER SYSTEM

As shown on Figure 6 (back pocket), the property east of Falcon Creek is proposed to drain east along the South Service Road to the existing 450mm sewer on King Road as per the Master Drainage Plan.

The property west of Falcon Creek is proposed to drain west on the South Service Road and connect to the existing 450mm "St Matthews Avenue" sanitary sewer at the north side of the GO station parking lot.

The sanitary design calculations are attached in Appendix B.

6.0 ROADWAYS

6.1 PROPOSED ROADS

As shown on Figure 3, the proposed plan of subdivision includes the construction of a South Service Road across the site connecting King Road to the section of Service Road constructed by the City as part of the Waterdown Road Hwy 403 improvements. There will be a short cul-de-sac Road B.

The proposed South Service road will have a 20m ROW. Road B will have an 18m ROW with a typical cross section as per City standard drawing S-18. As shown on Figures 7-1 & 7-2, the South Service road will have a modified cross section to accommodate bike lanes on both sides.

Typical longitudinal gradients for the proposed roads are in the 0.5%-2% range. These gradients meet the City of Burlington standards. Vertical curves will be incorporated at changes of gradient to ease transitions.

6.2 FALCON CREEK CROSSING

Alternative locations for the crossing at Falcon Creek were considered and reviewed on site with geomorphology and environmental experts from Parish Geomorphic and Savanta respectively. These alternatives were assessed by MCI, Parish and Savanta based on environmental constraints, creek meander configuration, road and crossing configuration, and the topography. The alignment shown in Figure 3 was selected.

The bridge crossing Falcon Creek is to be designed and built by the City of Burlington as per the cost sharing agreement.

6.3 EXTERNAL ROADS

The South Service Road will connect to the existing South Service Road at Aldershot Go Station/ HWY 403 eastbound on ramp signalized intersection. The King Road/ South Service Road intersection will also be signalized.

King Road adjacent to the development has been reconstructed as part of the grade separation. It is proposed to extend the sidewalk on the west side from its present termination to the proposed South Service Road.

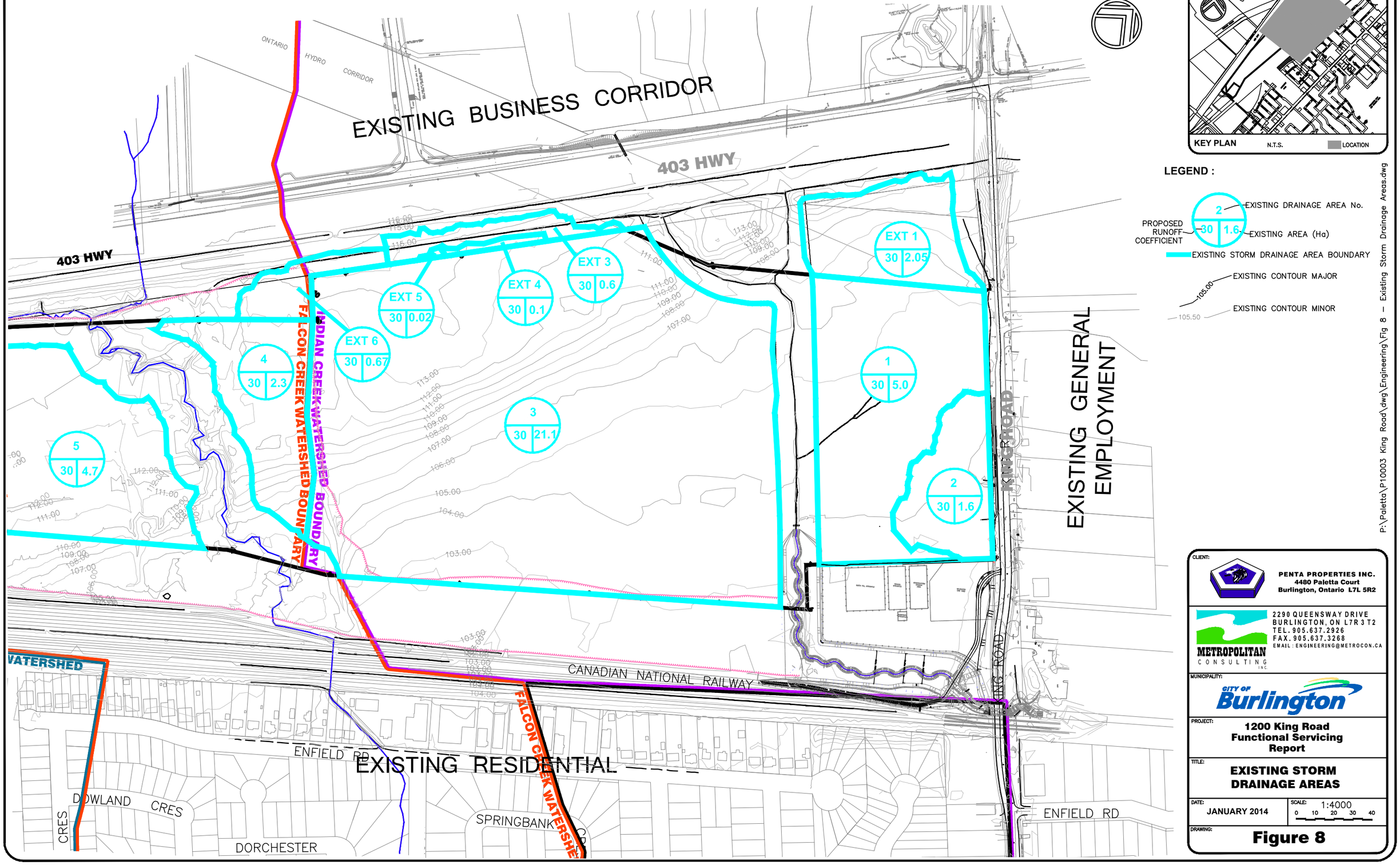
6.4 BLOCK 3 ACCESS

Access will be provided to block 3 via two 20m wide blocks.

7.0 GRADING AND DRAINAGE

7.1 EXISTING DRAINAGE CONDITIONS

The King Road property is located within three watersheds; Indian Creek, Falcon Creek and Grindstone Creek. Watershed boundaries were obtained from the Northshore Watershed Study. To refine the drainage boundaries within the Site an AutoCAD Civil 3D water drop analysis showing the path water will travel across a surface was completed from the topographic survey information. Watershed boundaries are shown on Figure 8: Existing Storm Drainage Areas.



LEGEND :

- EXISTING DRAINAGE AREA No.
- PROPOSED RUNOFF COEFFICIENT
- EXISTING AREA (Ha)
- EXISTING STORM DRAINAGE AREA BOUNDARY
- EXISTING CONTOUR MAJOR (105.00)
- EXISTING CONTOUR MINOR (105.50)

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MUNICIPALITY: City of Burlington

PROJECT: **1200 King Road Functional Servicing Report**

TITLE: **EXISTING STORM DRAINAGE AREAS**

DATE: JANUARY 2014

SCALE: 1:4000 (0 10 20 30 40)

DRAWING: **Figure 8**

P:\Paletta\P10003 King Road\dwg\Engineering\Fig 8 – Existing Storm Drainage Areas.dwg

7.2 PROPOSED GRADING AND DRAINAGE PLAN

Site grading and drainage have been designed to maintain existing drainage patterns as much as possible. The proposed grading and drainage is shown in Figures 7-1 & 7-2. The Site will be re-graded to drain water to swales, storm sewers and roadways leading to the proposed SWM ponds. Lots will be graded using City of Burlington Standards.

A Hydro One Corridor is north of the property between King Road and Indian Creek. Hydro One has agreed to this land being re-graded with the overall Site to prevent future flooding.

Construction methods will be used to ensure that environmentally sensitive areas are not encroached upon.

8.0 STORMWATER MANAGEMENT

8.1 STORMWATER MANAGEMENT DESIGN OBJECTIVES

The proposed Stormwater Management plan will be designed to meet the water quantity, erosion control and quality control objectives of the Terms of Reference, MOE SWM Design Manual, City of Burlington and Conservation Halton requirements.

The existing tributaries traversing the property for Falcon and Grindstone Creek are to be preserved in their natural condition.

The length of Indian Creek on Penta Land from the 403 to the north limit of the completed creek work will be the subject of a detailed natural channel design based on the work from AMEC's preliminary design to address current flooding on site in conjunction with the development of 1200 King Road. Grading and fill work will be completed along with the creek channelization to address flooding issues. Improvements to Indian Creek south of Penta property were completed as part of the King Road Grade Separation Project. The preliminary design for the proposed Indian Creek channel designed by AMEC for the grade separation will be used for this FSR/SWM report.

Erosion control requirements to protect the existing tributaries will be recommended in a site specific geomorphology study being carried out by Parish Geomorphic.

Water balance objectives for groundwater and surface water run-off will be established in the Hydrogeology Study currently underway by Terra Dynamics. Recommendations regarding erosion control and water balance objectives will be addressed at the detailed design stage.

8.2 PROPOSED STORMWATER MANAGEMENT PLAN

The proposed stormwater plan for Indian Creek is shown on Figure 10 (back pocket). Two extended detention wet ponds will serve the property east of Falcon Creek. Ponds will be located on both sides of Indian Creek. The SWM facilities at Indian Creek will be designed in conjunction with a detailed re-alignment design for the creek.

Stormwater management lands west of Falcon Creek will be addressed once the mobility hub study has been completed.

Storm sewers will be constructed on all proposed streets. Major system overland flows will be conveyed via the proposed streets or 100 year pipes.

8.3 PROPOSED STORM SEWERS

The storm sewers have been designed for the 5 year storm using City design criteria. A 100 year storm sewer is proposed to collect runoff from the Hydro One land and discharge to Pond 1. A Storage pipe (superpipe) is proposed for Blocks 11-14 and will discharge to the existing storm sewer on King Road. The proposed storm drainage areas are shown on Figure 9 and the proposed storm sewers are shown on Figure 10: Proposed Storm Servicing Plan (back pocket). Storm sewer design sheets can be found in Appendix C.

EXISTING BUSINESS CORRIDOR

403 HWY

NORTH SERVICE RD

403 HWY

EXT 1 30 2.05

EXT 4 30 0.12

EXT 6 0.3 0.67

EXT 5 30 0.02

EXT 2 30 0.05

C4 90 1.03

C1 90 4.60

C5 30 0.70

C3 90 18.3

C2 90 0.99

SWMP1 95 0.90

SWMP2 95 2.07

Lot 1 Lot 2 Lot 3 Lot 4 Lot 5 Lot 6 Lot 7 Lot 8 Lot 9 Lot 10 Lot 11 Lot 12 Lot 13 Lot 14 Lot 15 Lot 16 Lot 17 Lot 18 Lot 19 Lot 21 Lot 22 Lot 23 Lot 24 Lot 25 Lot 26 Lot 27

Block 3

KING ROAD

KING RD

EXISTING GENERAL EMPLOYMENT

CNR RAILWAY CANADIAN NATIONAL RAILWAY

ENFIELD RD

EXISTING RESIDENTIAL

DOWLAND CRES

DORCHESTER

SPRINGBANK CRES

ENFIELD RD

KEY PLAN N.T.S. LOCATION

LEGEND :

2 — PROPOSED DRAINAGE AREA No.

PROPOSED RUNOFF COEFFICIENT — 30 1.6 — PROPOSED AREA (Ha)

PROPOSED STORM DRAINAGE AREA BOUNDARY

P:\Paletta\P10003 King Road\dwg\Engineering\Fig 9 – Proposed Storm Drainage Areas.dwg

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MUNICIPALITY: CITY OF Burlington

PROJECT: **1200 King Road Functional Servicing Report**

TITLE: **PROPOSED STORM DRAINAGE AREAS**

DATE: JANUARY 2014

SCALE: 1:4000 (0 10 20 30 40)

DRAWING: **Figure 9**

8.4 WATER QUALITY CONTROL

Water quality control objectives have been set out in the Terms of Reference for 1200 King Road and the Falcon Creek Hydrology and Hydraulics Study (Valdor, 2012) and are outlined below.

Indian Creek

- Level one (Enhanced) 80% TSS removal as per MOE criteria.

Falcon Creek

- Level one (Enhanced) 80% TSS removal as per MOE criteria.

Grindstone Creek

- Level one (Enhanced) 80% TSS removal as per MOE criteria.

8.5 WATER QUANTITY CONTROL

Water quantity control objectives have been set out in the Terms of Reference for 1200 King Road and the Falcon Creek Hydrology and Hydraulics Study (Valdor, 2012) for the Indian Creek, Falcon Creek, and Grindstone Creek watersheds. Quantity control requirements are shown below.

Indian Creek

- Post-to-pre peak flow control for the 2 year to 100 year and Regional Storm

Falcon Creek

- Post-to-pre peak flow control for the 2 year to 100 year and Regional Storm
- Retain 5mm of runoff on site through the use of Low Impact Development (LID) practices for water balance management.

Grindstone Creek

- Post-to-pre peak flow control for the 2 year to 100 year and Regional Storm

8.6 EROSION CONTROL

Indian Creek

Parish Geomorphic is undergoing an erosion analysis for Indian Creek to determine the required erosion control volume and discharge for ponds discharging to Indian Creek as per the TOR. From previous work completed for this property, ponds were sized to hold an extended detention volume of runoff from a 38mm storm for erosion control. This criterion was used for pond sizing in this FSR/SWM report until Parish's recommendation has been completed.

Falcon Creek

An erosion analysis for Falcon Creek was completed by Parish Geomorphic as part of the Falcon Creek Hydrology and Hydraulics Study (Valdor, 2012). Parish's report specified the required erosion control volume for all development within the Falcon Creek watershed be based on the detention of the 25mm storm for a minimum of 24 hours.

Grindstone Creek

Parish Geomorphic is undergoing an erosion analysis for Grindstone Creek to determine the required erosion control volume and discharge for ponds discharging to Grindstone Creek. The erosion control volume for extended detention for all development within the Grindstone Creek watershed will be based on the detention of the 25mm storm for a minimum of 24 hours for pond sizing until Parish's recommendation has been completed.

8.7 PROPOSED SWM FACILITIES

Two SWM Ponds and a storage superpipe are proposed in for the development east of Falcon Creek. The proposed SWM Ponds will be extended detention wet ponds designed to provide quantity, erosion and quality control to the post-development runoff generated from the development area. The superpipe will provide quantity control. A stormceptor or approved equivalent will provide quality control in areas that do not drain to a SWM pond.

A conceptual design has been completed for the two SWM Ponds and Superpipe east of Falcon Creek (Ponds 1 and 2). SWM facilities to the west of Falcon will be designed once the mobility hub study has been completed and a concept plan is prepared.

The preliminary design and location of the facilities is shown on Figure 10. Ponds will each include a sediment forebay, a permanent wet pond, extended detention storage, quantity control storage, outlet control structures, emergency spillway, a decant area, landscaping and a maintenance access road.

Minor runoff will be conveyed to the SWM ponds via storm sewers draining to the sediment forebay. Major runoff will be conveyed to the main pond of the SWM pond via an overland flow route or 100 year pipe. For lots 11-14, major and minor runoff will be conveyed to the superpipe via total capture catch basins.

The proposed SWM facilities were sized in accordance with quality, quantity and erosion control guidelines as per the criteria mentioned above and MOE SWM design guidelines.

8.7.1 Pond 1

A comparison between required sizing and sizing provided in the conceptual design for each design criteria is presented in Table 1.

The final detail design will include landscaping compatible with the adjacent natural areas, thermal control measures for the outlet and erosion control at the outlet to the tributary designed in conjunction with the team geomorphologist and ecologist.

Table 1: SWM Facility Pond 1 Design Criteria

DESIGN FEATURE	REQUIRED	PROVIDED
Permanent Pool Volume (m^3)	1457	1664
Sediment Forebay Volume (m^3)	Max 20%perm=333	308
Sediment Forebay Length (m)	15	30
Sediment Forebay Width (m)	15	16
Sediment Forebay L/W Ratio	2:1	2:1
Sediment Forebay Depth (m)	1	1
Top of Permanent Pool (m)	1 to 2	1
Extended Detention (m^3)	2539	2669
Active Storage (m^3)	6061	6108
Decant Area Volume (m^3)	244	305

Table 2 shows the comparison of pre-development and post-development flows for the proposed pond 1 drainage area. It can be seen that for the 100 year and the Regional storm the post development controlled flows are less than the pre-development flows.

Table 2: Pond 1 Comparison of Pre-development and Post-development flows

Storm Event	Pre-development Flow (m^3/s)	Post-development Flow	
		Uncontrolled (m^3/s)	Controlled (m^3/s)
100-Year	0.212	2.630	0.208
Regional	0.821	1.092	0.80

The pond 1 design sheets are attached in Appendix D. The pond 1 SWMHYMO model results are shown in Appendix F.

8.7.2 Pond 2

A comparison between required sizing and sizing provided in the conceptual design for each design criteria is presented in Table 3.

The final detail design will include landscaping compatible with the adjacent natural areas, thermal control measures for the outlet and erosion control at the outlet to the tributary designed in conjunction with the team geomorphologist and ecologist.

Table 3: SWM Facility Pond 2 Design Criteria

DESIGN FEATURE	REQUIRED	PROVIDED
Permanent Pool Volume (m^3)	4482	4781
Sediment Forebay Volume (m^3)	Max 20%perm=956	693
Sediment Forebay Length (m)	48	50
Sediment Forebay Width (m)	25	25
Sediment Forebay L/W Ratio	2:1	2:1
Sediment Forebay Depth (m)	1	1
Top of Permanent Pool (m)	1 to 2	1
Extended Detention (m^3)	7443	7451
Active Storage (m^3)	18430	18524
Decant Area Volume (m^3)	664	714

Table 4 shows the comparison of pre-development and post-development flows for the proposed pond 2 drainage area. It can be seen that for the 100 year and the Regional storms the post development controlled flows are less than the pre-development flows.

Table 4 Pond 2 Comparison of Pre-development and Post-development flows

Storm Event	Pre-development Flow (m^3/s)	Post-development Flow	
		Uncontrolled (m^3/s)	Controlled (m3/s)
100-Year	0.502	7.509	0.499
Regional	2.268	3.000	2.234

The detail pond 2 design sheets are attached in Appendix D. The pond 2 SWMHYMO model results are shown in Appendix G.

8.7.3 Blocks 11-14

Quantity control for Blocks 11-14 will be provided through an 1800mm Ø storage pipe. The storage pipe will be designed to store up to the Regional storm post-development flow and release it at the pre-development peak flows for the full range of storms (2 year to Regional). The flow will be controlled by multiple orifices and will outlet via a 450mm Ø pipe.

Quality control of runoff will be provided by a Stormceptor before the 450mm Ø pipe connects to the existing storm sewer on King Road. The drainage area is 0.99ha which makes it suitable for a model 3000 Stormceptor treatment unit to provide Enhanced (80%) level treatment. The preliminary Stormceptor design report is attached in Appendix E.

The 100 year and Regional post development conditions were modeled in SWYMHYMO using an imperviousness of 90%.

The required storage volume was found by modeling the 100 year and Regional post development flow with a release rate from the pre-development peak flows. A rating curve showing storage with depth was created and entered into SWMHYMO. Table 5 shows the storage with depth in the storage pipe.

Table 5: Superpipe Storage

Stage (%)	Stage (mm)	Qout (m^3/s)	Total Storage (m^3)
100.00	1800	0.1848	330.8
95.00	1710	0.1472	324.6
94.00	1692	0.1377	322.7
90.00	1620	0.0587	313.6
85.00	1530	0.0570	299.7
80.00	1440	0.0553	283.7
75.00	1350	0.0535	266.1
70.00	1260	0.0517	247.3
60.00	1080	0.0479	207.2
50.00	900	0.0437	165.4
40.00	720	0.0391	123.6
30.00	540	0.0339	83.5
20.00	360	0.0276	47.1
10.00	180	0.0196	17.2
0.00	0	0.0000	0.0

The proposed design provides 330.8 m^3 of storage. From the SWMHYMO modelling results, it was found that a storage volume of 324.1 m^3 is required to control the outflow to the 100 year and Regional existing condition peak flows. Table 6 summarizes these results.

Table 6: Storage Requirements

Control	Storage Volume Required (m^3)	Storage Volume Provided (m^3)
100 yr Post to Pre	309	313.6
Regional Post to Pre	324.1	330.8

The SWMHYMO model results to the superpipe are shown in Appendix H. Table 7 shows a summary of flows generated from the model under existing and post-development conditions.

Table 7: Existing and Post Development Flows					
Conditions	**Imperviousness**	**100 Year**		**Regional**	
	(%)	**Uncontrolled Flow (m^3/s)**	**Controlled Flow (m^3/s)**	**Uncontrolled Flow (m^3/s)**	**Controlled Flow (m^3/s)**
Existing	30	0.058		0.200	
Post Development	90	0.478	0.058	0.145	0.145

An 1800 mm Ø pipe 130 m long will provide the storage required.

The detailed superpipe design sheet is attached in Appendix D.

8.7.4 Lot 1

Lot 1 is within the Falcon Creek watershed. On site SWM controls to meet the Falcon Creek design criteria are proposed. Final selection and detail design of the appropriate site controls will be completed at the Site Plan stage. Specific design criteria will be established in the Subdivision Agreement.

8.8 EROSION AND SEDIMENTATION CONTROL PLAN

Erosion and sedimentation control measures will be implemented during construction.

Erosion control measures will include:

- Sediment traps
- Silt fence around topsoil and fill stockpiles, along creeks and at limits of construction
- Gravel mud-mats at construction entrances
- Excavation of SWM ponds prior to pre-grading so that ponds can function as siltation ponds during grading & servicing

The erosion and sedimentation control measures will be retained in place during servicing, building construction and landscaping until the site is fully stabilized. Inspection and monitoring will be carried out to ensure erosion and sediment controls are maintained and where required, will be repaired by the developer/contractor.

9.0 FLOODLINES AND CULVERTS

9.1 MODELLING

A HEC-RAS model was completed by AMEC for Indian Creek as part of the Grade Separation and Indian Creek Realignment work which includes the 1200 King Road Site. This model includes a conceptual creek realignment on Penta property which will be used for this FSR/SWM report. The model and creek realignment will be modified by MCI for the final Creek Realignment Design and South Service Road crossing.

A HEC-RAS model was completed for the Falcon Creek Hydrology and Hydraulics Study by Valdor Engineering which shows existing floodlines. Development will occur outside of the existing Falcon Creek flood lines and setbacks. The proposed crossing at Falcon Creek will be incorporated into Valdor's HEC-RAS model at the final design stage.

The existing models by AMEC and Valdor will be used for this FSR.

9.2 EXISTING CONDITIONS FLOODLINES

The existing conditions Regional storm floodlines are shown on Figure 11 (back pocket). Flooding from Indian Creek extends over a substantial portion of the property within the Indian Creek Catchment with some spill flowing onto King Road. Indian Creek flood levels just south of the property are contained within the Phase 1 channel works completed as part of the King Road Grade Separation and Indian Creek Channelization work.

Flood levels in Falcon Creek within the property are generally confined to the valleys with some limited backwater effect at Falcon creek caused by the culvert at the CNR.

Flood levels in Grindstone Creek are being reviewed as part of the Hydrogeology work and will be included in the design once the mobility hub study is complete.

9.3 POST DEVELOPMENT CONDITIONS FLOODLINES AND CROSSING SIZE

The proposed post development Regional storm flood line for Indian Creek is shown on Figure 11 (back pocket).

The pre-development flood plain for Falcon Creek will be maintained post-development with the exception of the crossing.

Parish Geomorphic provided crossing recommendations for the proposed South Service Road across Indian and Falcon Creeks. A recommendation for Grindstone Creek will be provided once the mobility hub study is completed. Based on the geomorphological assessment, property constraints and economic considerations, it is recommended that an 8.4m x 1.5m box culvert be used for the Indian Creek crossing and a 17m clear span structure for the Falcon Creek crossing (to be designed and constructed by the City).

A HEC-RAS analysis will be run for the recommended crossings at Indian Creek, Falcon Creek, and Grindstone Creek at the detailed design stage to ensure they pass the Regional storm flows and do not overtop the proposed South Service Road or cause a significant backwater effect.

10.0 SUMMARY AND CONCLUSIONS

This report has demonstrated how the proposed development can be graded, serviced with roads, watermains, sanitary & storm sewers and stormwater management facilities in accordance with the requirements of the City of Burlington, the Region of Halton and other regulatory authorities.

Access to the development will be from King Road and Waterdown Road. A short cul-de-sac will serve the northern development area. Internal streets will be constructed to full City urban standards.

Grading for the development area will involve cutting and filling to create a north to south slope. Existing grades will be matched at the proposed property lines.

The proposed Stormwater Management plan includes two extended detention wet ponds and a superpipe to provide quantity, erosion and quality control to the post-development runoff from the development area draining to Indian Creek.

It is recommended that the South Service Road crossing at Indian Creek be an 8.4m x 1.5m clear span structure and at Falcon Creek, to be designed and constructed by the City, be a 17m clear span structure.

A fully looped watermain system will provide water from the City pressure district B1A for the development.

The proposed internal sanitary sewers will connect to the Skyway WWTP via the existing King Road and St. Matthews Avenue sewers. There is enough capacity in the sanitary sewers downstream of the site to carry the additional flow generated from site to the Skyway WWTP without any main upgrades.

In summary, the engineering design concepts in this report show that the proposed development of the Penta property can fully meet municipal standards and be in harmony with the natural features on the property.

Prepared by:	SWM Reviewed by:	Reviewed by:
Ashley Walker, M.Sc., P.Eng.	Jadran Jelin, P.hD, P.Eng	Karl Gonnsen, P.Eng.

APPENDIX A: MASTER DRAINAGE PLAN (BACK POCKET)

APPENDIX B: SANITARY SEWER DESIGN SHEET

METROPOLITAN CONSULTING INC.

Location:1200 King Road

SANITARY SEWER DESIGN

CITY OF BURLINGTON

flow factor: 275 l/day/cap from Halton Region standards

peaking factor: Non Res 0.80(1+ 14/(4+P_e^(1/2))

peaking factor: Res (1+ 14/(4+P_e^(1/2))

Date: January 12, 2014

Calculated by: Ashley Walker

Checked by: CP

Catch.	Location			Tributary Area [ha] Increment			Total	Population Tributary Increment			Total	Average Flow	Average Peaking	Peak Flow	Infil-Rate	Infil-tration	Max. Flow	Sewer Size	Slope	Capacity	Velocity [m/s]		Residual Capacity	Pipe	Manning's
ID	Street	From	To	Non Res. @0	Non Res. @125	Non Res @90	Area (ha)	Non Res. @0	Non Res. @125	Non Res @90	Pop.	[l/s]	Factor	[l/s]	[l/s/Ha]	[l/s]	[l/s]	[mm]	[%]	[l/s]	Full	Actual	[l/s]	Material	n
EAST OF FALCON TO KING ROAD																									
A1	S Service	13A	12A	0.00	0.00	2.14	2.14	0	0	193	193	0.61	3.32	**2.04**	0.29	0.61	**2.65**	300	0.50%	**68.39**	0.97	1.11		PVC	0.013
A2	S Service	12A	10A	0.00	0.00	2.40	4.54	0	0	216	409	1.30	3.21	**4.18**	0.29	1.30	**5.48**	300	1.00%	**96.72**	1.37	1.57		PVC	0.013
A3	Road B		11A	0.00	0.00	1.91	1.91	0	0	172	172			**0.00**											
A4	Road B	11A	10A	0.00	0.00	1.01	2.92	0	0	91	263	0.84	3.28	**2.75**	0.29	0.84	**3.58**	300	0.50%	**68.39**	0.97	0.46		PVC	0.013
A5	S Service	10A	9A	0.00	0.00	0.90	8.36	0	0	81	752	2.39	3.10	**7.43**	0.29	2.39	**9.82**	300	1.00%	**96.72**	1.37	0.78		PVC	0.013
A6	S Service	9A	8A	0.00	0.00	1.00	9.36	0	0	90	842	2.68	3.08	**8.25**	0.29	2.68	**10.93**	300	1.50%	**118.45**	1.68	0.90		PVC	0.013
A7	S Service	8A	7A	0.00	0.00	2.50	11.86	0	0	225	1067	3.40	3.03	**10.28**	0.29	3.39	**13.67**	300	1.50%	**118.45**	1.68	1.00		PVC	0.013
A8	S Service	7A	5A	0.00	0.00	1.90	13.76	0	0	171	1238	3.94	2.99	**11.79**	0.29	3.94	**15.72**	300	1.50%	**118.45**	1.68	1.04		PVC	0.013
A12	arena	6A	5A	0.00	6.20	0.00	6.20	0	775	0	775	2.47	3.09	**7.63**	0.29	1.77	**9.41**	300	0.50%	**68.39**	0.97	0.62		PVC	0.013
A9	S Service	5A	4A	0.00	0.00	0.70	20.66	0	0	63	2076	6.61	2.86	**18.89**	0.29	5.91	**24.80**	300	1.50%	**118.45**	1.68	1.21		PVC	0.013
		4A	3A				20.66				2076	6.61	2.86	**18.89**	0.29	5.91	**24.80**	300	0.40%	**61.17**	0.87	0.75		PVC	0.013
A10	S Service	3A	2A	0.00	0.00	3.38	24.04	0	0	304	2381	7.58	2.82	**21.37**	0.29	6.88	**28.25**	300	0.40%	**61.17**	0.87	0.75		PVC	0.013
A11	S Service	2A	1A	0.00	0.00	2.20	26.24	0	0	198	2579	8.21	2.80	**22.96**	0.29	7.50	**30.47**	300	0.40%	**61.17**	0.87	0.75		PVC	0.013
	King Rd			0	0	0	26.24	0	0	0	2579	8.21	2.80	**22.96**	0.29	7.50	**30.47**	450	1.42%	**294.49**	1.85	1.06		CONC	0.015
WEST OF FALCON TO ST MATTHEWS																									
EXT 4	N Service			0.00	0.00	0.00	126.20	0	0	0	4857	15.46	3.26	**50.35**	0.29	36.09	**86.44**	300	0.91%	**92.26**	1.31	1.31		PVC	0.013
EXT 3	N Service		NSR	20.70	0.00	0.00	20.70	0	0	0	0	0.00	4.50	**0.00**	0.29	5.92	**5.92**	300	0.91%	**92.26**	1.31	0.00		PVC	0.013
EXT 1	Landfill																**9.40**								
EXT 2	N Service			0.00	5.50	5.50	11.00	0	688	495	1183	3.76	3.00	**11.30**	0.29	3.15	**23.84**	300	0.90%	**91.75**	1.30	0.83		PVC	0.013
		NSR	SSR	0.00	0.00	0.00	157.90	0	0	0	6040	19.22	3.17	**60.90**	0.29	45.16	**115.46**	450	1.29%	**280.68**	1.76	1.38		CONC	0.015
							157.90	0	0	0	6040	19.22	3.17	**60.90**	0.29	45.16	**115.46**	450	0.79%	**219.65**	1.38	1.08		CONC	0.015
A13	S Service	25A	EX A15	0.00	0.00	13.60	13.60	0	0	1224	1224	3.90	2.99	**11.66**	0.29	3.89	**24.95**	300	1.00%	**96.72**	1.37	0.88		PVC	0.013
	St Matthews			0.00	0.00	0.00	171.50	0	0	0	7264	23.12	3.09	**71.46**	0.29	49.05	**129.91**	450	1.19%	**269.58**	1.70	1.32		CONC	0.015

APPENDIX C: STORM SEWER DESIGN SHEET

Return	**5**	**100**
a=	**697.4**	**1114.2**
b=	**5**	**5**
c=	**0.764**	**0.761**

City of Burlington
Storm Sewer Design

Contract Name: **1200 King Road - Pond 1 and Pond 2**
Location: Burlington
Contract No: P10003

STORM SEWER DESIGN

FIRST SUBMISSION TO BURLINGTON

METROPOLITAN CONSULTING INC.

Design by: F. Rukavina
Checked by: A. Walker

Date: January 20, 2014

FORMULAS
I =a/(t+b)^c

q = 2.778CiA

t = 10min (initial)

LOCATION				CONTRIBUTING AREA					FLOW						SEWER DESIGN								
Catch-ment I.D.	Street	From	To	Area [ha]	Runoff C	Section AR (4)x(5)	Accum. AR	Inlet Time [min]	Rainfall Intensity [mm/hr] 5yr	Flow 5yr	Rainfall Intensity [mm/hr] 100yr	Flow 100 yr [L/s] 2.778x(7)x(8)	TOTAL	Length [m]	Slope [%]	Dia. [mm]	Full Flow Capacity [L/s]	Pipe Area	Full Flow Velocity [m/s]	Flow Time in Pipe [min] (10)/(14)/60	Time of Concentration [min]	Pipe Fall [m] (10)x(11)	% full	mannings n
Pond 1																							
EXT.-1 , P1-1	Hydro, Back of Lots 8,9,10	TCB1	4	3.40	0.55	1.87	1.87	10.00	88.1	457.6	141.9	737.1	737.1	138.50	1.00%	825	1244.2	0.55	2.25	1.03	11.03	1.39	59.24	0.015
P1-3	South Service Road	5	4	0.47	0.90	0.42	0.42	10.00	88.1	103.5			103.5	44.20	0.50%	450	201.6	0.16	1.23	0.60	10.60	0.22	51.34	0.013
	South Service Road	4	3	0.00	0.90	0.00	2.29	11.03	83.7	533.4	134.9	859.4	859.4	7.20	0.50%	900	1109.5	0.66	1.68	0.07	11.10	0.04	77.45	0.015
P1-2	South Service Road	6	3	2.08	0.90	1.87	1.87	10.00	88.1	458.1			458.1	99.60	0.60%	675	564.4	0.37	1.53	1.08	11.08	0.60	81.18	0.015
P1-4	Back of Lots 15,16	3	2	0.70	0.90	0.63	4.80	11.10	83.5	1111.7	134.5	1791.0	1791.0	112.00	0.50%	1200	2389.4	1.16	2.06	0.91	12.01	0.56	74.96	0.015
	Pond 1	2	SP1	0.00			4.80	12.01	80.0	1111.7	129.0	1791.0	1791.0	21.0	0.50%	1200	2389.4	1.16	2.06	0.17	12.18	0.11	74.96	0.015
	Pond 1	SP1	1	0.00			4.80	12.18	79.4	1111.7	128.0	1791.0	1791.0	30.0	0.50%	1200	2389.4	1.16	2.06	0.24	12.42	0.15	74.96	0.015
100 yr	Pond 1	1	Headwall	0.00			4.80	12.42		1111.7	126.6	1791.0	1791.0	16.5	0.50%	1200	2389.4	1.16	2.06	0.13	12.55	0.08	74.96	0.015
5yr	Pond 1	SP1	HeadWall				4.80	12.18	79.4	1111.7			1111.7	16.30	0.70%	900	1312.8	0.66	1.99	0.14	12.31	0.11	84.68	0.015
Pond 2																							
P2-1, P2-2,P2-5, Ext 5&4	Road B	16	14	2.24	0.86	1.93	1.93	10.00	88.1	471.4				94.60	0.60%	675	564.4	0.37	1.53	1.03	11.03	0.57	83.53	0.015
P2-4	South Service Road	15	14	0.84	0.90	0.76	0.76	10.00	88.1	185.0				76.24	0.50%	525	263.6	0.22	1.18	1.08	11.08	0.38	70.19	0.015
P2-6	South Service Road	14	13	0.95	0.90	0.86	3.54	11.08	83.6	821.1				115.50	0.65%	825	1003.1	0.55	1.81	1.06	12.14	0.75	81.86	0.015
P2-7	South Service Road	13	11	2.19	0.90	1.97	5.51	12.14	79.6	1217.5				125.50	0.65%	975	1566.0	0.78	2.02	1.04	13.18	0.82	77.74	0.015
Ext2, P2-8	South Service Road	11	9	1.01	0.87	0.88	6.39	13.18	76.1	1349.8				60.30	0.50%	1050	1673.6	0.93	1.81	0.56	13.73	0.30	80.65	0.015
P2-9	South Service Road	10	9	0.60	0.90	0.54	0.54	10.00	88.1	132.2				45.30	0.50%	450	201.6	0.16	1.23	0.61	10.61	0.23	65.54	0.013
P2-10	Access "A"	9	8	0.52	0.90	0.47	7.40	13.73	74.3	1527.2				89.90	0.65%	1050	1908.2	0.93	2.06	0.73	14.46	0.58	80.04	0.015
P2-18	South Service Road	24	23	0.39	0.90	0.35	0.35	10.00	88.1	85.9				80.26	0.50%	375	124.0	0.11	1.09	1.23	11.23	0.40	69.28	0.013
P2-3	South Service Road	25	23	1.04	0.90	0.94	0.94	10.00	88.1	229.1				55.26	0.75%	525	322.8	0.22	1.45	0.64	10.64	0.41	70.96	0.015
P2-17	Access "B"	23	21	0.17	0.90	0.15	1.44	11.23	82.9	331.8				88.00	0.60%	600	412.2	0.29	1.41	1.04	12.27	0.53	80.49	0.015
P2-16	Block "3"	22	21	0.65	0.90	0.59	0.59	10.00	88.1	143.2				85.40	0.50%	450	201.6	0.16	1.23	1.15	11.15	0.43	71.00	0.013
P2-15	Block "3"	21	20	2.20	0.90	1.98	4.01	12.27	79.1	880.1				111.00	0.50%	900	1109.5	0.66	1.68	1.10	13.37	0.56	79.32	0.015
P2-14	Block "3"	20	19	2.06	0.90	1.85	5.86	13.37	75.5	1228.2				98.94	0.50%	1050	1673.6	0.93	1.81	0.91	14.28	0.49	73.39	0.015
P2-13	Block "3"	19	18	1.80	0.90	1.62	7.48	14.28	72.7	1510.8				96.86	0.60%	1050	1833.3	0.93	1.98	0.82	15.10	0.58	82.41	0.015
P2-12	Block "3"	18	17	1.20	0.90	1.08	8.56	15.10	70.5	1675.1				52.78	0.50%	1200	2389.4	1.16	2.06	0.43	15.52	0.26	70.11	0.015
P2-11	Block "3"	17	8	0.62	0.90	0.56	9.12	15.52	69.3	1755.9				65.29	0.50%	1200	2389.4	1.16	2.06	0.53	16.05	0.33	73.48	0.015
	SWM Pond	8	7				16.51	16.05	68.0	3118.9				12.90	0.50%	1500	4332.3	1.83	2.37	0.09	16.14	0.06	71.99	0.015
	SWM Pond	7	Headwall				16.51	16.14	67.8	3108.7				28.30	0.50%	1500	4332.3	1.83	2.37	0.20	16.34	0.14	71.76	0.015

APPENDIX D: POND AND SUPERPIPE DESIGN SHEETS

P10003 - 1200 King Road
Stage-Storage-Discharge Relationships

POND 1

Design By: Ashley Walker
Date: January 20, 2014
Reviewed By: Jadran Jelin

Equations and Constants:

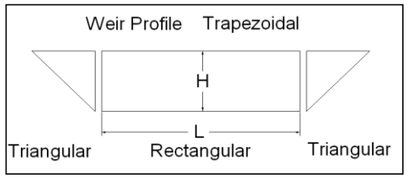
Pipe Flow: $Q_{pipe} = C_{pipe} A \sqrt{2gH}$

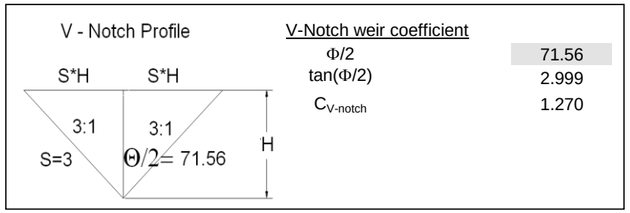
Broad-crested Weir Flow: $Q_{weir} = C_{weir} L H^{1.5}$

V-notch Weir Flow: $Q_{V\text{-}notch} = C_{V\text{-}notch} * \tan(\Phi/2) * H^{2.5}$

Sharp-Crested Weir Flow (DICB): $Q_{DICB} = C_{DICB} L (2g)^{0.5} H^{1.5}$

Incremental Time: Inc. Time = Inc. Storage/Q_{out}





V-Notch weir coefficient	
Φ/2	71.56
tan(Φ/2)	2.999
$C_{V\text{-}notch}$	1.270

C_{pipe} =	0.63
C_{weir} =	1.48
C_{DICB} =	1.71

Designer Inputs:

	Orifice	Outlet Pipe	DICB	Emergency Weir
Pipe diameter (m)	0.100	0.320		
L = Weir Width (m)			0.60	0.75
A = Area of pipe (m^2)	0.008	0.080		

									Main Body of Pond 1				**Sediment Forebay**							
	Stage (m)	Depth to perm. Pond (m)	Qout Emergency weir (m^3/s)	Q_{out} DICB (m^3/s)	Q_{out} pipe (m^3/s)	Flow Control	Q_{out} Orifice (m^3/s)	$Qout_{TOTAL}$ (m^3/s)	Surface Area (m^2)	Inc. Storage (m^3)	Total Active Storage (m^3)	Required	Surface Area (m^2)	Incremental Storage (m^3)	Total Sediment Forebay Storage (m^3)	Total Dead Storage (m^3)	Total Storage (m^3)	Inc. Time (s)	Cum. Time (s)	Cum. Time (hr)
Freeboard	105.65	1.95	1.88	5.24	0.32	Pipe	0.03	2.2279	5285.83	1521	7628						9293	682.60	100632.04	27.95
Top of Pond/ Reg	105.35	1.65	0.51	3.25	0.29	Pipe	0.03	0.8275	4852.65	241	6108	**Reg V=6061m^3 Q=0.80m^3/s < 0.821m^3/s**					7772	291.07	102172.36	28.38
	105.30	1.60	0.37	2.95	0.29	Pipe	0.03	0.6870	4781.73	928	5867						7531	1351.23	99949.44	27.76
	105.10	1.40	0.05	1.85	0.27	Pipe	0.03	0.3443	4501.62	443	4938						6603	1287.63	101881.30	28.30
	105.00	1.30	0.00	1.37	0.26	Pipe	0.02	0.2867	4363.89	429	4495						6159	1497.77	98598.21	27.39
	104.90	1.20		0.94	0.25	Pipe	0.02	0.2759	4224.84	818	4066						5730	2964.69	100593.67	27.94
100yr	104.70	1.00		0.26	0.23	Pipe	0.02	0.2530	3955.64	579	3248	**100yr V=3137m^3 Q=0.208m^3/s < 0.212m^3/s**					4912	2286.81	97100.44	26.97
Extend Det.	104.55	0.85		0.00	0.00	DICB	0.02	0.0202	3757.96	186	2669	**ext det V=2539m^3/s Q=0.020m^3/s**					4333	9219.59	97628.98	27.12
	104.50	0.80					0.02	0.0196	3693.84	713	2483						4147	36349.81	94813.63	26.34
	104.30	0.60					0.02	0.0170	3431.85	659	1770						3434	38846.81	88409.39	24.56
	104.10	0.40					0.01	0.0139	3163.09	596	1111						2775	42985.17	58463.82	16.24
Top of 7:1/bottom extended 5:1	103.90	0.20					0.01	0.0098	2795.30	137	515						2179	13970.11	49562.58	13.77
	103.85	0.15					0.01	0.0085	2681.86	131	378						2042	15478.65	15478.65	4.30
	103.80	0.10					0.01	0.0069	2573.70	247	247						1911	35592.46	35592.46	9.89
Bottom Extended Detention	103.70	0.00					0.00	0.0000	2359.95	0	0						1664			
Top of Perm	**103.70**	**0.00**							**1839.17**	177	1356	**PermV=1457m^3**	**520.78**	**49**	**308**	**1664**	**1664**			**-**
	103.60	-0.10							1699.05	163	1179		454.98	42	259	1438	1438			
Bottom of 7:1	103.50	-0.20							1562.86	298	1016		393.10	72	217	1233	1233			-
	103.30	-0.40							1412.22	268	719		327.83	59	145	863	863			
	103.10	-0.60							1266.49	239	451		267.03	48	85	536	536	-	-	-
	102.90	-0.80							1125.88	212	212		211.35	37	37	249	249	-	-	-
Bottom of Perm (4:1)	102.70	-1.00							990.39	0	0		160.79	0	0	0	0	-	-	-
																		-	**-**	**-**

P10003 - 1200 King Road
Stage-Storage-Discharge Relationships

POND 2

Design By: Ashley Walker
Date: January 20, 2014
Reviewed By: Jadran Jelin

Equations and Constants:

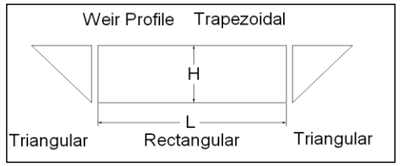
Pipe Flow: $Q_{pipe} = C_{pipe} A \sqrt{2gH}$

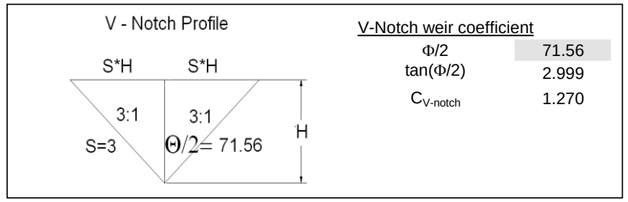
Broad-crested Weir Flow: $Q_{weir} = C_{weir} L H^{1.5}$

V-notch Weir Flow: $Q_{V\text{-}notch} = C_{V\text{-}notch} * \tan(\Phi/2) * H^{2.5}$

Sharp-Crested Weir Flow (DICB): $Q_{DICB} = C_{DICB} L (2g)^{0.5} H^{1.5}$

Incremental Time: Inc. Time = Inc. Storage/Q_{out}





V-Notch weir coefficient	
Φ/2	71.56
tan(Φ/2)	2.999
$C_{V\text{-}notch}$	1.270

C_{pipe} =	0.63
C_{weir} =	1.48
C_{DICB} =	1.71

Designer Inputs:

	Orifice	Outlet Pipe	DICB	Emergency Weir
Pipe diameter (m)	0.240	0.41		
L = Weir Width (m)			0.60	0.35
A = Area of pipe (m^2)	0.045	0.132		

									Main Body of Pond 2				Sediment Forebay							
	Stage (m)	Depth to perm. Pond (m)	Qout Emergency weir (m^3/s)	Q_{out} DICB (m^3/s)	Q_{out} pipe (m^3/s)	Flow Control	Q_{out} Orifice (m^3/s)	$Qout_{TOTAL}$ (m^3/s)	Surface Area (m^2)	Inc. Storage (m^3)	Total Active Storage (m3)	required	Surface Area (m^2)	Incremental Storage (m^3)	Total Sediment Forebay Storage (m^3)	Total Dead Storage	Total Storage (m^3)	Inc. Time (s)	Cum. Time (s)	Cum. Time (hr)
Freeboard	105.65	2.55	3.83	8.35	0.56	Pipe	0.20	4.596	10960.67	3199	21723						26505	695.95	101155.72	28.10
top of pond/reg	105.35	2.25	1.57	5.97	0.53	Pipe	0.19	2.286	10365.63	516	18524	**Reg V=18430m^3 Q=2.234m^3/s < 2.268 m^3/s**					23306	225.68	100459.77	27.91
	105.30	2.20	1.30	5.60	0.52	Pipe	0.19	2.011	10267.83	2015	18009						22790	1001.84	100234.09	27.84
	105.10	2.00	0.52	4.21	0.49	Pipe	0.18	1.189	9880.57	1938	15994						20775	1629.54	99232.26	27.56
	104.90	1.80	0.11	2.95	0.47	Pipe	0.17	0.750	9499.59	1862	14056						18837	2483.73	97602.72	27.11
	104.70	1.60	0.00	1.85	0.44	Pipe	0.16	0.596	9124.90	1788	12193						16975	3002.20	95118.99	26.42
	104.50	1.40		0.94	0.40	Pipe	0.15	0.553	8756.49	436	10405						15187	787.66	92116.79	25.59
100yr	104.45	1.35		0.75	0.40	Pipe	0.15	0.542	8665.37	1279	9970	**100yr V=9581m^3 Q=0.499m^3/s < 0.502m^3/s**					14751	2361.67	91329.12	25.37
	104.30	1.20		0.26	0.37	DICB	0.14	0.402	8394.36	1239	8690						13472	3079.96	88967.46	24.71
ext det	104.15	1.05		0.00	0.34	DICB	0.13	0.129	8126.89	404	7451	**ext det V=7443m^3 Q=0.129m^3/s**					12232	3124.13	85887.50	23.86
	104.10	1.00					0.13	0.126	8038.52	1573	7047						11828	12458.25	82763.37	22.99
	103.90	0.80					0.11	0.113	7688.97	1503	5474						10256	13315.16	70305.12	19.53
	103.70	0.60					0.10	0.098	7345.70	1435	3971						8752	14679.37	56989.95	15.83
	103.50	0.40					0.08	0.080	7008.72	1331	2535						7317	16674.50	42310.58	11.75
Top of 7:1/bottom 5:1	103.30	0.20					0.06	0.056	6304.57	616	1204						5985	10913.12	25636.08	7.12
	103.20	0.10					0.04	0.040	6017.85	588	588						5369	14722.96	14722.96	4.09
Bottom ext detention	**103.10**	**0.00**					**0.00**	**0.000**	**5737.29**	**0**	**0**						**4781**			
Top of Perm	**103.10**	**0.00**							**4760.31**	**467**	**4089**	**PermV=4482m^3**	**976.97**	**94**	**693**	**4781**	**4781**			
	103.00	-0.10							4569.73	448	3622		893.15	85	599	4221	4221			
Bottom of 7:1	102.90	-0.20							4382.23	855	3175		812.41	154	514	3689	3689			-
	102.70	-0.40							4171.71	814	2319		723.90	136	360	2680	2680			
	102.50	-0.60							3965.22	773	1506		639.41	120	224	1729	1729			
	102.30	-0.80							3762.75	733	733		558.95	104	104	837	837	-	-	-
Bottom of Perm (4:1)	102.10	-1.00							3564.30	0	0		482.51	0	0	0	0	-	-	-
																	-	-	-	-

P10003 - 1200 King Road

Stage-Storage-Discharge Relationships

SUPERPIPE

Date: January 20, 2014

Design by: Ashley Walker
Reviewed by: Jadran Jelin

Equations and Constants:

Pipe Flow: $Q_{pipe} = C_{pipe} A \sqrt{2gH}$
C_{pipe} = 0.63

Designer Inputs:

Circular superpipe

	Orifice	orifficex3					
			D=	1800	mm	L= 130.0	m
Pipe diameter (m)	0.145	0.210		1.80	m		
A = Area of pipe (m^2)	0.017	0.035					
			n=	0.015		S= 0.005	

100yr Req V=309m^3 Q=0.058m^3/s ≤ 0.058m^3/s
Reg Req V=324.1m^3 Q=0.145m^3/s < 0.200m^3/s

	Stage (%)	stage (mm)	Stage (m)	Depth to bottom Orifice (m)	Q_{out} Orifice (m^3/s)	Flow Control	Q_{OUT} Orifice x3	$Qout_{Tot}$ (m^3/s)	Qout (L/s)	Inc X-Secn Area (m^2)	Total Storage (m^3)	Total Storage (m.ha)	Inc. Time (s)	Cum. Time (s)	Cum. Time (hr)
top of pipe	100.00	1800	1.800	1.800	0.062	Orifice	0.123	0.1848	184.843	2.54	330.8	0.03308	1789.68	48145.81	13.37
Regional	95.00	1710	1.710	1.710	0.060	Orifice	0.087	0.1472	147.246	2.50	324.6	0.03246	2204.65	46356.13	12.88
	94.00	1692	1.692	1.692	0.060	Orifice	0.078	0.1377	137.745	2.48	322.7	0.03227	2342.79	44151.48	12.26
100yr	90.00	1620	1.620	1.620	0.059	Orifice	0.000	0.0587	58.651	2.41	313.6	0.03136	5346.79	41808.70	11.61
	85.00	1530	1.530	1.530	0.057	Orifice		0.0570	56.998	2.31	299.7	0.02997	5257.94	36461.91	10.13
	80.00	1440	1.440	1.440	0.055	Orifice		0.0553	55.296	2.18	283.7	0.02837	5130.70	31203.97	8.67
	75.00	1350	1.350	1.350	0.054	Orifice		0.0535	53.541	2.05	266.1	0.02661	4970.74	26073.27	7.24
	70.00	1260	1.260	1.260	0.052	Orifice		0.0517	51.725	1.90	247.3	0.02473	4781.84	21102.53	5.86
	60.00	1080	1.080	1.080	0.048	Orifice		0.0479	47.888	1.59	207.2	0.02072	4327.64	16320.69	4.53
	50.00	900	0.900	0.900	0.044	Orifice		0.0437	43.716	1.27	165.4	0.01654	3783.65	11993.05	3.33
	40.00	720	0.720	0.720	0.039	Orifice		0.0391	39.100	0.95	123.6	0.01236	3160.25	8209.40	2.28
	30.00	540	0.540	0.540	0.034	Orifice		0.0339	33.862	0.64	83.5	0.00835	2464.96	5049.15	1.40
	20.00	360	0.360	0.360	0.028	Orifice		0.0276	27.648	0.36	47.1	0.00471	1703.55	2584.19	0.72
	10.00	180	0.180	0.180	0.020	Orifice		0.0196	19.550	0.13	17.2	0.00172	880.64	880.64	0.24
bottom of pipe	0.00	0	0.000	0.000	0.000	Orifice		0.0000	0.000	0.00	0.0	0.00000	0.00	0.00	0.00

APPENDIX E: STORMCEPTOR REPORT

Stormceptor Sizing Detailed Report

PCSWMM for Stormceptor

Project Information

Date	15/11/2013
Project Name	1200 King Road
Project Number	P10003
Location	Burlington

Stormwater Quality Objective

This report outlines how Stormceptor System can achieve a defined water quality objective through the removal of total suspended solids (TSS). Attached to this report is the Stormceptor Sizing Summary.

Stormceptor System Recommendation

The Stormceptor System model STC 3000 achieves the water quality objective removing 80% TSS for a City of Toronto (clay, silt and sand) particle size distribution.

The Stormceptor System

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for all rainfall events, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.

Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Stormceptor is the only oil and sediment separator on the market sized to remove TSS for a wide range of particle sizes, including fine sediments (clays and silts), that are often overlooked in the design of other stormwater treatment devices.

Small storms dominate hydrologic activity, US EPA reports

"*Early efforts in stormwater management focused on flood events ranging from the 2-yr to the 100-yr storm. Increasingly stormwater professionals have come to realize that small storms (i.e. < 1 in. rainfall) dominate watershed hydrologic parameters typically associated with water quality management issues and BMP design. These small storms are responsible for most annual urban runoff and groundwater recharge. Likewise, with the exception of eroded sediment, they are responsible for most pollutant washoff from urban surfaces. Therefore, the small storms are of most concern for the stormwater management objectives of ground water recharge, water quality resource protection and thermal impacts control.*"

"*Most rainfall events are much smaller than design storms used for urban drainage models. In any given area, most frequently recurrent rainfall events are small (less than 1 in. of daily rainfall).*"

"Continuous simulation offers possibilities for designing and managing BMPs on an individual site-by-site basis that are not provided by other widely used simpler analysis methods. Therefore its application and use should be encouraged."

– US EPA Stormwater Best Management Practice Design Guide, Volume 1 – General Considerations, 2004

Design Methodology

Each Stormceptor system is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology from up-to-date local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective.

The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing (summary of analysis presented in Appendix 2):

- Site parameters
- Continuous historical rainfall, including duration, distribution, peaks (Figure 1)
- Interevent periods
- Particle size distribution
- Particle settling velocities (Stokes Law, corrected for drag)
- TSS load (Figure 2)
- Detention time of the system

The Stormceptor System maintains continuous positive TSS removal for all influent flow rates. Figure 3 illustrates the continuous treatment by Stormceptor throughout the full range of storm events analyzed. It is clear that large events do not significantly impact the average annual TSS removal. There is no decline in cumulative TSS removal, indicating scour does not occur as the flow rate increases.

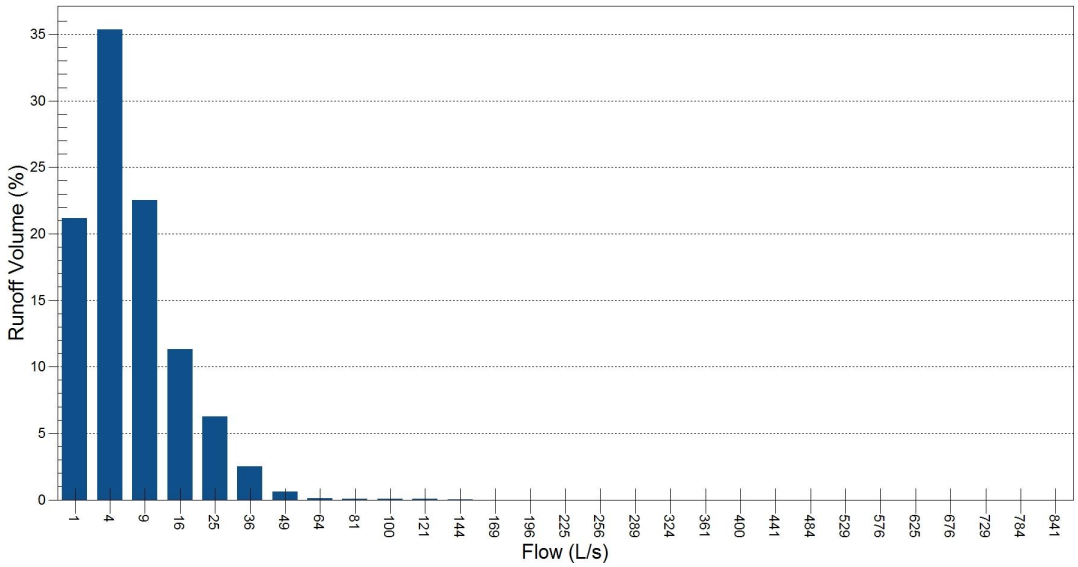


Figure 1. Runoff Volume by Flow Rate for HAMILTON A – ON 3194, 1970 to 2003 for 0.99 ha, 90% impervious. Small frequent storm events represent the majority of annual rainfall volume. Large infrequent events have little impact on the average annual TSS removal, as they represent a small percentage of the total annual volume of runoff.

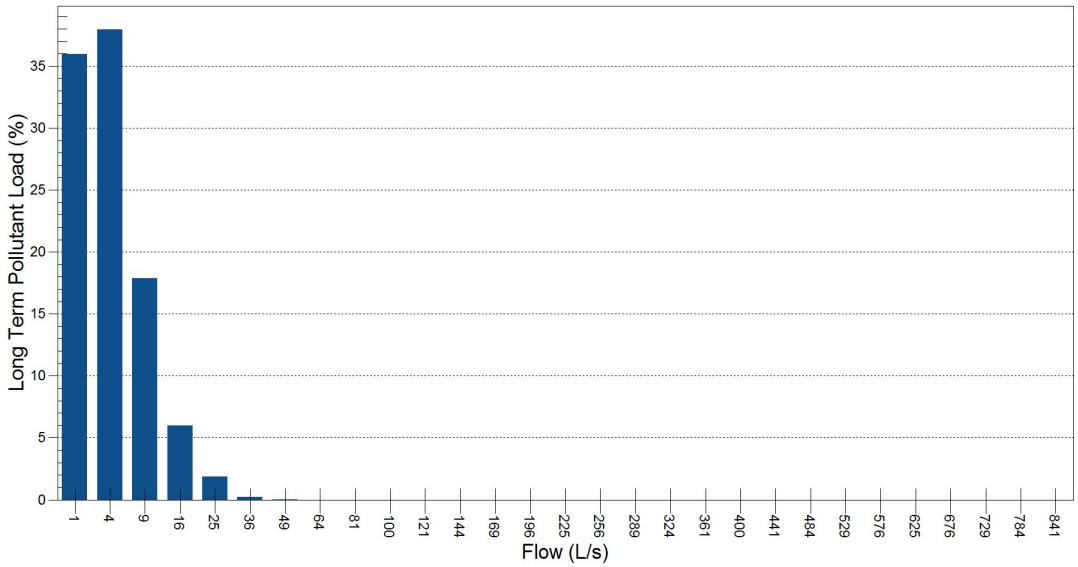
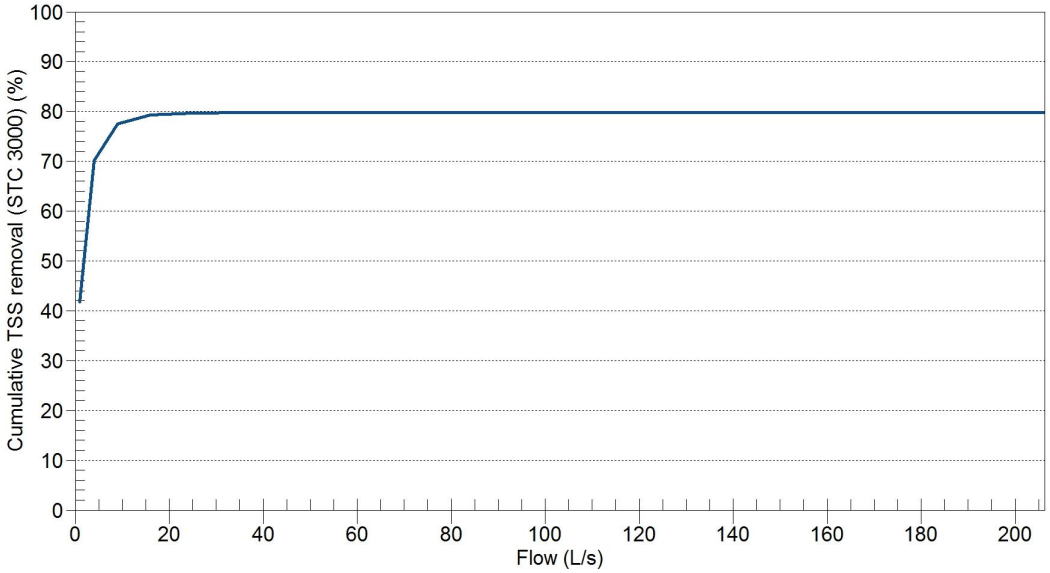


Figure 2. Long Term Pollutant Load by Flow Rate for HAMILTON A – 3194, 1970 to 2003 for 0.99 ha, 90% impervious. The majority of the annual pollutant load is transported by small frequent storm events. Conversely, large infrequent events carry an insignificant percentage of the total annual pollutant load.



Stormceptor Model	STC 3000	Drainage Area (ha)	0.99
TSS Removal (%)	80	Impervious (%)	90

Figure 3. Cumulative TSS Removal by Flow Rate for HAMILTON A – 3194, 1970 to 2003.
Stormceptor continuously removes TSS throughout the full range of storm events analyzed. Note that large events do not significantly impact the average annual TSS removal. Therefore no decline in cumulative TSS removal indicates scour does not occur as the flow rate increases.

Stormceptor®

Appendix 1
Stormceptor Design Summary

Project Information

Date	15/11/2013
Project Name	1200 King Road
Project Number	P10003
Location	Burlington

Designer Information

Company	Metropolitan Consulting
Contact	Ashley

Notes

N/A

Drainage Area

Total Area (ha)	0.99
Imperviousness (%)	90

The Stormceptor System model STC 3000 achieves the water quality objective removing 80% TSS for a City of Toronto (clay, silt and sand) particle size distribution.

Rainfall

Name	HAMILTON A
State	ON
ID	3194
Years of Records	1970 to 2003
Latitude	43°10'N
Longitude	79°56'W

Water Quality Objective

TSS Removal (%)	80

Upstream Storage

Storage (ha-m)	Discharge (L/s)
0.000	00.000
0.002	23.804
0.005	33.664
0.008	41.230

Partial Listing

Stormceptor Sizing Summary

Stormceptor Model	TSS Removal %
STC 300	64
STC 750	73
STC 1000	74
STC 1500	74
STC 2000	79
STC 3000	**80**
STC 4000	83
STC 5000	84
STC 6000	86
STC 9000	89
STC 10000	89
STC 14000	91

Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

City of Toronto (clay, silt and sand)

Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
10	20	2.65	0.0004					
30	10	2.65	0.0008					
50	10	2.65	0.0022					
95	20	2.65	0.0063					
265	20	2.65	0.0366					
1000	20	2.65	0.1691					

Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor version 1.0
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 300 is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 750 to STC 6000 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 300	STC 750 to STC 6000	STC 9000 to STC 14000
Single inlet pipe	75 mm	25 mm	75 mm
Multiple inlet pipes	75 mm	75 mm	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Imbrium Systems Inc., 1-800-565-4801.

Stormceptor®

Appendix 2
Summary of Design Assumptions

SITE DETAILS

Site Drainage Area

Total Area (ha)	0.99	Imperviousness (%)	90

Surface Characteristics

Width (m)	199
Slope (%)	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Infiltration Parameters

Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (mm/h)	61.98
Min. Infiltration Rate (mm/h)	10.16
Decay Rate (s^{-1})	0.00055
Regeneration Rate (s^{-1})	0.01

Maintenance Frequency

Sediment build-up reduces the storage volume for sedimentation. Frequency of maintenance is assumed for TSS removal calculations.	
Maintenance Frequency (months)	12

Evaporation

Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow

Dry Weather Flow (L/s)	No

Upstream Attenuation

Stage-storage and stage-discharge relationship used to model attenuation upstream of the Stormceptor System is identified in the table below.

Storage ha-m	Discharge L/s
0.000	00.000
0.002	23.804
0.005	33.664
0.008	41.230

Partial Listing

PARTICLE SIZE DISTRIBUTION

Particle Size Distribution

Removing fine particles from runoff ensures the majority of pollutants, such as heavy metals, hydrocarbons, free oils and nutrients are not discharged into natural water resources. The table below identifies the particle size distribution selected to define TSS removal for the design of the Stormceptor System.

City of Toronto (clay, silt and sand)

Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
10	20	2.65	0.0004					
30	10	2.65	0.0008					
50	10	2.65	0.0022					
95	20	2.65	0.0063					
265	20	2.65	0.0366					
1000	20	2.65	0.1691					

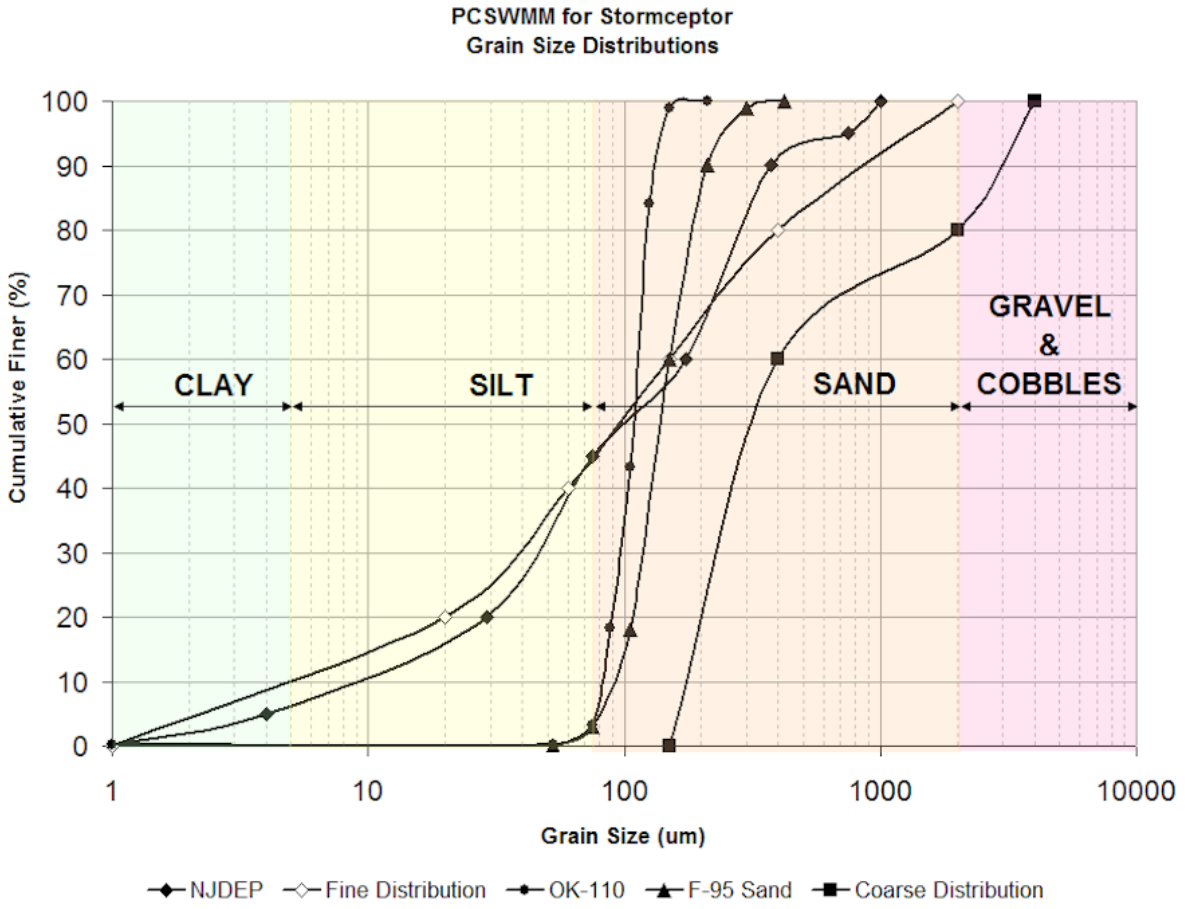


Figure 1. PCSWMM for Stormceptor standard design grain size distributions.

Stormceptor®

TSS LOADING

TSS Loading Parameters

TSS Loading Function	Buildup / Washoff

Parameters

Target Event Mean Concentration (EMC) (mg/L)	125
Exponential Buildup Power	0.4
Exponential Washoff Exponential	0.2

HYDROLOGY ANALYSIS

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of the Stormceptor System are based on the average annual removal of TSS for the selected site parameters. The Stormceptor System is engineered to capture fine particles (silts and sands) by focusing on average annual runoff volume ensuring positive removal efficiency is maintained during all rainfall events, while preventing the opportunity for negative removal efficiency (scour).

Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

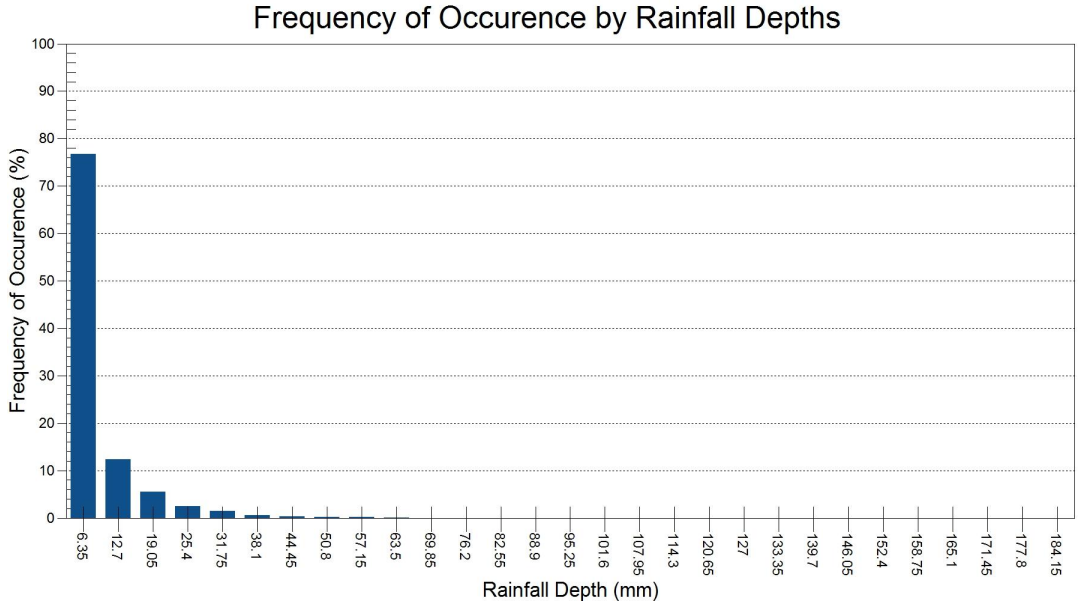
Rainfall Station

Rainfall Station	HAMILTON A		
Rainfall File Name	ON3194.NDC	Total Number of Events	4310
Latitude	43°10'N	Total Rainfall (mm)	20907.2
Longitude	79°56'W	Average Annual Rainfall (mm)	614.9
Elevation (m)		Total Evaporation (mm)	1724.3
Rainfall Period of Record (y)	34	Total Infiltration (mm)	2076.6
Total Rainfall Period (y)	34	Percentage of Rainfall that is Runoff (%)	82.2

Stormceptor®

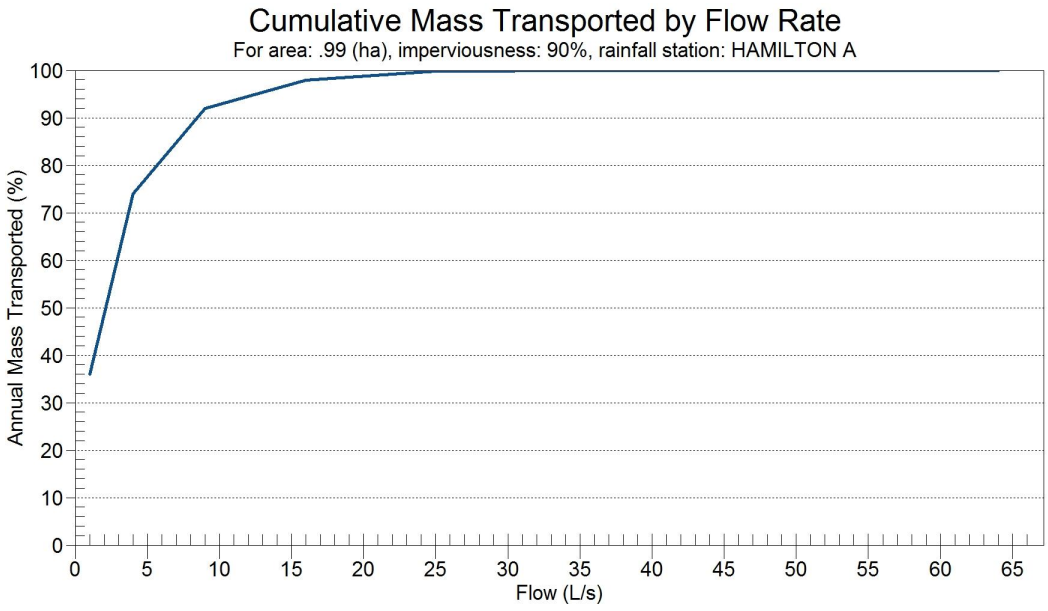
Rainfall Event Analysis

Rainfall Depth mm	No. of Events	Percentage of Total Events %	Total Volume mm	Percentage of Annual Volume %
6.35	3311	76.8	5300	25.3
12.70	529	12.3	4846	23.2
19.05	238	5.5	3697	17.7
25.40	106	2.5	2332	11.2
31.75	61	1.4	1732	8.3
38.10	24	0.6	842	4.0
44.45	14	0.3	587	2.8
50.80	8	0.2	372	1.8
57.15	10	0.2	546	2.6
63.50	6	0.1	361	1.7
69.85	0	0.0	0	0.0
76.20	0	0.0	0	0.0
82.55	0	0.0	0	0.0
88.90	0	0.0	0	0.0
95.25	1	0.0	90	0.4
101.60	1	0.0	96	0.5
107.95	1	0.0	106	0.5
114.30	0	0.0	0	0.0
120.65	0	0.0	0	0.0
127.00	0	0.0	0	0.0
133.35	0	0.0	0	0.0
139.70	0	0.0	0	0.0
146.05	0	0.0	0	0.0
152.40	0	0.0	0	0.0
158.75	0	0.0	0	0.0
165.10	0	0.0	0	0.0
171.45	0	0.0	0	0.0
177.80	0	0.0	0	0.0
184.15	0	0.0	0	0.0
190.50	0	0.0	0	0.0
196.85	0	0.0	0	0.0
203.20	0	0.0	0	0.0
209.55	0	0.0	0	0.0
>209.55	0	0.0	0	0.0



Pollutograph

Flow Rate L/s	Cumulative Mass %
1	36.0
4	74.0
9	91.9
16	97.9
25	99.8
36	100.0
49	100.0
64	100.0
81	100.0
100	100.0
121	100.0
144	100.0
169	100.0
196	100.0
225	100.0
256	100.0
289	100.0
324	100.0
361	100.0
400	100.0
441	100.0
484	100.0
529	100.0
576	100.0
625	100.0
676	100.0
729	100.0
784	100.0
841	100.0
900	100.0



APPENDIX F: SWMHYMO MODELLING RESULTS

POND 1

```
2     Metric units
*#*************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : January 10, 2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                    [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%      The following is the 38mm post-development flow from Ind Ck watershed
*%      east of Ind CK To POND 1
*%-----------------|-------------------------------------------------------|
READ STORM           STORM_FILENAME=["38mm.stm"]
*%-----------------|-------------------------------------------------------|
DESIGN STANDHYD      ID=[1], NHYD=["Area to pond 1"], DT=[1]min, AREA=[7.55](ha),
                     XIMP=[.74], TIMP=[.74], DWF=[0](cms), LOSS=[2], CN=[75],
                     SLOPE=[2.0](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|
ROUTE RESERVOIR      IDout=[2],   NHYD=["route through pond 1"],  IDin=[1],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [  0.0    , 0.0    ]
                                    [  0.0069 , 0.0247 ]
                                    [  0.0085 , 0.0378 ]
                                    [  0.0098 , 0.0515 ]
                                    [  0.0139 , 0.1111 ]
                                    [  0.0170 , 0.1770 ]
                                    [  0.0196 , 0.2483 ]
                                    [  0.0202 , 0.2669 ]
                                    [  -1     , -1     ]
*%-----------------|-------------------------------------------------------|

FINISH
```

```
   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                        9   9  9   9   # 5848278
         StormWater Management HYdrologic Model          999    999    =========

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

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington          SERIAL#:5848278         +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 ***********************   D E T A I L E D   O U T P U T   ************************
 ********************************************************************************
 *         DATE: 2014-01-21     TIME: 10:13:05     RUN COUNTER: 000385          *
 ********************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\38MMPO~1.DAT      *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\38MMPO~1.out      *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\38MMPO~1.sum      *
 * User comments:                                                               *
 * 1:_____________________________________________________________________      *
 * 2:_____________________________________________________________________      *
 * 3:_____________________________________________________________________      *
 ********************************************************************************

--------------------------------------------------------------------------------
--
001:0001----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : January 10, 2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*****************************************************************************
-------------------
| START           |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\

-------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| READ STORM       |    Filename: 3hr 38mm storm
| Ptotal=  43.77 mm|    Comments: 3hr 38mm storm
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	4.110	.83	6.080	1.58	90.460	2.33	5.470
.17	4.100	.92	6.660	1.67	13.680	2.42	5.470
.25	4.100	1.00	8.060	1.75	9.120	2.50	3.650
.33	3.900	1.08	9.120	1.83	9.120	2.58	3.650
.42	3.900	1.17	10.640	1.92	9.120	2.67	3.650
.50	4.860	1.25	15.200	2.00	5.470	2.75	3.650
.58	4.860	1.33	24.020	2.08	5.470	2.83	3.650
.67	4.860	1.42	180.576	2.17	5.470	2.92	3.650
.75	5.470	1.50	38.460	2.25	5.470		

```
--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN STANDHYD    |   Area    (ha)=    7.55
| 01:Area t DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
```

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	5.59	1.96	
Dep. Storage	(mm)=	.80	1.50	
Average Slope	(%)=	2.00	2.00	
Length	(m)=	224.35	40.00	
Mannings n	=	.013	.250	
Max.eff.Inten.(mm/hr)=		180.58	35.87	
over	(min)	3.00	13.00	
Storage Coeff.	(min)=	2.66 (ii)	13.30 (ii)	
Unit Hyd. Tpeak	(min)=	3.00	13.00	
Unit Hyd. peak	(cms)=	.41	.09	
				TOTALS
PEAK FLOW	(cms)=	2.21	.11	2.241 (iii)
TIME TO PEAK	(hrs)=	1.43	1.72	1.433
RUNOFF VOLUME	(mm)=	42.97	14.07	35.454
TOTAL RAINFALL	(mm)=	43.77	43.77	43.766
RUNOFF COEFFICIENT	=	.98	.32	.810

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

--------------------------------------------------------------------------------
--
001:0004--------------------------------------------------------------------------
--
--------------------
```

ROUTE RESERVOIR IN>01:(Area t) OUT<02:(route)

Requested routing time step = 1.0 min.

========= OUTLFOW STORAGE TABLE =========

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
.000	.0000E+00	.014	.1111E+00
.007	.2470E-01	.017	.1770E+00
.009	.3780E-01	.020	.2483E+00
.010	.5150E-01	.020	.2669E+00

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >01: (Area t)	7.55	2.241	1.433	35.454
OUTFLOW<02: (route)	7.55	.020	3.017	35.454

PEAK FLOW REDUCTION [Qout/Qin](%)= .883
TIME SHIFT OF PEAK FLOW (min)= 95.00
MAXIMUM STORAGE USED (ha.m.)=.2539E+00

001:0005---

FINISH

****

WARNINGS / ERRORS / NOTES

Simulation ended on 2014-01-21 at 10:13:05

==========

```
2     Metric units
*#*************************************************************************
*#  Project Name: [1200 King Road]    Project Number: [P10003]
*#  Date        : 01-20-2014
*#  Modeller    : [ Ashley Walker ]
*#  Company     : Metropolitan Planning and Engineering
*#  License #   : 5848278
*#*************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                    [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%           100-year pre-development flow Ind Ck watershed east of Ind Ck
*%-----------------|-------------------------------------------------------|
CHICAGO STORM        IUNITS=[2],  TD=[3](hrs), RTP=[.46],  CSDT=[5](min),
                     ICASEcs=[1],
                      A=[1114.2],  B=[5], and C=[.761],

*%                   IDF Burlington
*%      Year    A        B      C
*%      2       592.6    6      0.780
*%      5       697.45   5      0.764
*%      10      798.5    5      0.763
*%      25      926.9    5      0.762
*%      50      1019.4   5      0.761
*%      100     1114.2   5      0.761
*%-----------------|-------------------------------------------------------|
DESIGN NASHYD        ID=[1], NHYD=["Area 1"], DT=[1]min, AREA=[7.05](ha),
                     DWF=[0](cms), CN/C=[65], TP=[0.53]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|

CALIB NASHYD         ID=[2], NHYD=["Area 1"], DT=[1]min, AREA=[7.05](ha),
                     DWF=[0](cms),  CN/C=[65], IA=[8](mm),
                     N=[3], TP=[0.53]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-------------------------------------------------------|


FINISH
```

```
   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO         999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                        9   9  9   9   # 5848278
         StormWater Management HYdrologic Model          999    999    =========

 ********************************************************************************
 ***************************** SWMHYMO Ver/4.05  ********************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                  OTTHYMO-83 and OTTHYMO-89.                  *********
 ********************************************************************************
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 *********                   Gatineau, Quebec: (819) 243-6858           *********
 *********                   E-Mail: swmhymo@jfsa.Com                   *********
 ********************************************************************************

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington           SERIAL#:5848278        +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 **********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2014-01-21     TIME: 10:14:05     RUN COUNTER: 000388          *
 ********************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\100YRP~1.DAT     *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\100YRP~1.out     *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\100YRP~1.sum     *
 * User comments:                                                               *
 * 1:_____________________________________________________________________      *
 * 2:_____________________________________________________________________      *
 * 3:_____________________________________________________________________      *
 ********************************************************************************

--------------------------------------------------------------------------------
--
001:0001-----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road]    Project Number: [P10003]
*#  Date        : 01-20-2014
*#  Modeller    : [ Ashley Walker ]
*#  Company     : Metropolitan Planning and Engineering
*#  License #   : 5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\

--------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\
```

```
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1114.200
| Ptotal= 62.92 mm |                          B=   5.000
--------------------                          C=    .761
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =   .46

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .08   5.612 |    .83  11.306 |   1.58  40.362 |   2.33   8.723
               .17   5.918 |    .92  12.954 |   1.67  27.681 |   2.42   8.105
               .25   6.266 |   1.00  15.255 |   1.75  21.248 |   2.50   7.579
               .33   6.664 |   1.08  18.707 |   1.83  17.359 |   2.58   7.124
               .42   7.125 |   1.17  24.489 |   1.92  14.751 |   2.67   6.727
               .50   7.666 |   1.25  36.200 |   2.00  12.876 |   2.75   6.378
               .58   8.310 |   1.33  72.263 |   2.08  11.461 |   2.83   6.067
               .67   9.093 |   1.42 193.180 |   2.17  10.352 |   2.92   5.789
               .75  10.064 |   1.50  76.347 |   2.25   9.459 |   3.00   5.538

--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN NASHYD      |   Area    (ha)=    7.05   Curve Number   (CN)=65.00
| 01:Area 1 DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .530

     Unit Hyd Qpeak  (cms)=     .508

     PEAK FLOW       (cms)=     .259 (i)
     TIME TO PEAK    (hrs)=    2.050
     RUNOFF VOLUME    (mm)=   19.033
     TOTAL RAINFALL   (mm)=   62.917
     RUNOFF COEFFICIENT   =     .303

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

--------------------------------------------------------------------------------
--
001:0004--------------------------------------------------------------------------
--
----------------------
| CALIB NASHYD       |   Area    (ha)=    7.05   Curve Number   (CN)=65.00
| 02:Area 1 DT= 1.00 |   Ia      (mm)=   8.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .530

     Unit Hyd Qpeak  (cms)=     .508

     PEAK FLOW       (cms)=     .212 (i)
     TIME TO PEAK    (hrs)=    2.100
```

```
     RUNOFF VOLUME     (mm)=   15.733
     TOTAL RAINFALL    (mm)=   62.917
     RUNOFF COEFFICIENT    =     .250

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

---------------------------------------------------------------------------------
--
001:0005-----------------------------------------------------------------------
--
      FINISH
---------------------------------------------------------------------------------
--
*********************************************************************************
**
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2014-01-21     at 10:14:05
=================================================================================
==
```

```
                                    100 post to Pond1.dat
2     Metric units
*#************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : January 20, 2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                    [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%      The following is the 100-year post-development flow from Ind Ck watershed
*%      east of Ind CK To POND 1
*%-----------------|-------------------------------------------------------|
CHICAGO STORM        IUNITS=[2],  TD=[3](hrs), TPRAT=[0.46], CSDT=[5](min),
                     ICASEcs=[1],
                      A=[1114.2],  B=[5], and C=[0.761],

*%                   IDF Burlington
*%      Year    A         B      C
*%      2       592.6     6      0.780
*%      5       697.45    5      0.764
*%      10      798.5     5      0.763
*%      25      926.9     5      0.762
*%      50      1019.4    5      0.761
*%      100     1114.2    5      0.761
*%-----------------|-------------------------------------------------------|
DESIGN STANDHYD      ID=[2], NHYD=["Area to pond 1"], DT=[1]min, AREA=[7.55](ha),
                     XIMP=[.74], TIMP=[.74], DWF=[0](cms), LOSS=[2], CN=[75],
                     SLOPE=[2.0](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|
ROUTE RESERVOIR      IDout=[3],   NHYD=["route through pond 1"],  IDin=[2],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [  0.0    , 0.0     ]
                                    [  0.0069 , 0.0247  ]
                                    [  0.0085 , 0.0378  ]
                                    [  0.0098 , 0.0515  ]
                                    [  0.0139 , 0.1111  ]
                                    [  0.0170 , 0.1770  ]
                                    [  0.0196 , 0.2483  ]
                                    [  0.0202 , 0.2669  ]
                                    [  0.2530 , 0.3248  ]
                                    [  -1     , -1      ]
*%-----------------|-------------------------------------------------------|

FINISH
```

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

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                        9   9  9   9   # 5848278
        StormWater Management HYdrologic Model          999    999    =========

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

+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
+++++++++                Burlington           SERIAL#:5848278        +++++++++
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


**********************   D E T A I L E D   O U T P U T   **********************
*******************************************************************************
*         DATE: 2014-01-20     TIME: 16:07:09     RUN COUNTER: 000367         *
*******************************************************************************
* Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\100POS~1.DAT     *
* Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\100POS~1.out     *
* Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\100POS~1.sum     *
* User comments:                                                              *
* 1:_____________________________________________________________________     *
* 2:_____________________________________________________________________     *
* 3:_____________________________________________________________________     *
*******************************************************************************

------------------------------------------------------------------------------
--
001:0001----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : January 20, 2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\

--------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| CHICAGO STORM    |     IDF curve parameters: A=1114.200
| Ptotal= 62.92 mm |                           B=   5.000
--------------------                           C=    .761
                          used in:   INTENSITY =  A / (t + B)^C

                          Duration of storm  =  3.00 hrs
                          Storm time step    =  5.00 min
                          Time to peak ratio =   .46

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .08   5.612 |    .83  11.306 |   1.58  40.362 |   2.33   8.723
               .17   5.918 |    .92  12.954 |   1.67  27.681 |   2.42   8.105
               .25   6.266 |   1.00  15.255 |   1.75  21.248 |   2.50   7.579
               .33   6.664 |   1.08  18.707 |   1.83  17.359 |   2.58   7.124
               .42   7.125 |   1.17  24.489 |   1.92  14.751 |   2.67   6.727
               .50   7.666 |   1.25  36.200 |   2.00  12.876 |   2.75   6.378
               .58   8.310 |   1.33  72.263 |   2.08  11.461 |   2.83   6.067
               .67   9.093 |   1.42 193.180 |   2.17  10.352 |   2.92   5.789
               .75  10.064 |   1.50  76.347 |   2.25   9.459 |   3.00   5.538

--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN STANDHYD    |   Area    (ha)=    7.55
| 02:Area t DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------

                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         5.59          1.96
     Dep. Storage     (mm)=          .80          1.50
     Average Slope     (%)=         2.00          2.00
     Length            (m)=       224.35         40.00
     Mannings n           =         .013          .250

     Max.eff.Inten.(mm/hr)=       193.18         58.72
               over (min)           3.00         11.00
     Storage Coeff.  (min)=         2.59 (ii)    11.32 (ii)
     Unit Hyd. Tpeak (min)=         3.00         11.00
     Unit Hyd. peak  (cms)=          .41           .10
                                                          *TOTALS*
     PEAK FLOW       (cms)=         2.53           .20      2.630 (iii)
     TIME TO PEAK    (hrs)=         1.43          1.58      1.433
     RUNOFF VOLUME    (mm)=        62.12         25.82     52.680
     TOTAL RAINFALL   (mm)=        62.92         62.92     62.917
     RUNOFF COEFFICIENT   =          .99           .41       .837

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

```
--------------------------------------------------------------------------------
--
001:0004--------------------------------------------------------------------------
--
---------------------
| ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
|  IN>02:(Area t)   |
| OUT<03:(route )   |     =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW     STORAGE    |  OUTFLOW     STORAGE
                            (cms)      (ha.m.)   |    (cms)     (ha.m.)
                            .000   .0000E+00     |     .017   .1770E+00
                            .007   .2470E-01     |     .020   .2483E+00
                            .009   .3780E-01     |     .020   .2669E+00
                            .010   .5150E-01     |     .253   .3248E+00
                            .014   .1111E+00     |     .000   .0000E+00

     ROUTING RESULTS              AREA      QPEAK      TPEAK        R.V.
     ---------------              (ha)      (cms)      (hrs)        (mm)
     INFLOW >02: (Area t)         7.55      2.630      1.433      52.680
     OUTFLOW<03: (route )         7.55       .208      2.217      52.679

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=    7.917
                   TIME SHIFT OF PEAK FLOW          (min)=    47.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3137E+00

--------------------------------------------------------------------------------
--
001:0005--------------------------------------------------------------------------
--
      FINISH
--------------------------------------------------------------------------------
--
********************************************************************************
**
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2014-01-20     at 16:07:09
================================================================================
==
```

```
2     Metric units
*#*************************************************************************
*#  Project Name: [1200 King Road]    Project Number: [P10003]
*#  Date        : 01-20-2014
*#  Modeller    : [ Ashley Walker ]
*#  Company     : Metropolitan Planning and Engineering
*#  License #   : 5848278
*#*************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                    [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%          Regional pre-development flow Ind Ck watershed east of Ind Ck
*%-----------------|-------------------------------------------------------|
READ STORM           STORM_FILENAME=["burreg.stm"]
*%-----------------|-------------------------------------------------------|
DESIGN NASHYD        ID=[1], NHYD=["Area 1"], DT=[1]min, AREA=[7.05](ha),
                     DWF=[0](cms), CN/C=[82], TP=[0.53]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|

CALIB NASHYD         ID=[2], NHYD=["Area 1"], DT=[1]min, AREA=[7.05](ha),
                     DWF=[0](cms),  CN/C=[82], IA=[8](mm),
                     N=[3], TP=[0.53]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-------------------------------------------------------|

FINISH
```

```
   SSSSS  W    W  M    M  H    H  Y    Y  M    M    OOO          999     999     =========
   S      W W W  MM MM  H    H   Y Y     MM MM  O   O       9   9   9   9
   SSSSS  W W W  M M M  HHHHH    Y      M M M  O   O  ##   9   9   9   9    Ver  4.05
       S   W W   M    M  H    H   Y      M    M  O   O       9999    9999    Sept 2011
   SSSSS   W W   M    M  H    H   Y      M    M   OOO           9       9     =========
                                                           9   9   9   9     # 5848278
         StormWater Management HYdrologic Model             999     999     =========

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

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington           SERIAL#:5848278        +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 ***********************   D E T A I L E D   O U T P U T   ***********************
 ********************************************************************************
 *         DATE: 2014-01-21     TIME: 10:13:52     RUN COUNTER: 000387          *
 ********************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\REGPRE~1.DAT     *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\REGPRE~1.out     *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\REGPRE~1.sum     *
 * User comments:                                                               *
 * 1:_____________________________________________________________________      *
 * 2:_____________________________________________________________________      *
 * 3:_____________________________________________________________________      *
 ********************************************************************************

--------------------------------------------------------------------------------
--
001:0001----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road]    Project Number: [P10003]
*#  Date        : 01-20-2014
*#  Modeller    : [ Ashley Walker ]
*#  Company     : Metropolitan Planning and Engineering
*#  License #   : 5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\

-------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\
```

```
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| READ STORM       |    Filename: CITY OF BURLINGTON REGIONAL DESIGN STORM
| Ptotal= 212.34 mm|    Comments: CITY OF BURLINGTON REGIONAL DESIGN STORM
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	6.350	3.17	12.700	6.17	23.110	9.17	52.830
.33	6.350	3.33	12.700	6.33	23.110	9.33	52.830
.50	6.350	3.50	12.700	6.50	23.110	9.50	52.830
.67	6.350	3.67	12.700	6.67	23.110	9.67	52.830
.83	6.350	3.83	12.700	6.83	23.110	9.83	52.830
1.00	6.350	4.00	12.700	7.00	23.110	10.00	52.830
1.17	4.320	4.17	16.760	7.17	12.700	10.17	37.850
1.33	4.320	4.33	16.760	7.33	12.700	10.33	37.850
1.50	4.320	4.50	16.760	7.50	12.700	10.50	37.850
1.67	4.320	4.67	16.760	7.67	12.700	10.67	37.850
1.83	4.320	4.83	16.760	7.83	12.700	10.83	37.850
2.00	4.320	5.00	16.760	8.00	12.700	11.00	37.850
2.17	6.350	5.17	13.970	8.17	12.700	11.17	12.700
2.33	6.350	5.33	13.970	8.33	12.700	11.33	12.700
2.50	6.350	5.50	13.970	8.50	12.700	11.50	12.700
2.67	6.350	5.67	13.970	8.67	12.700	11.67	12.700
2.83	6.350	5.83	13.970	8.83	12.700	11.83	12.700
3.00	6.350	6.00	13.970	9.00	12.700	12.00	12.700

```
--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN NASHYD      |   Area    (ha)=    7.05   Curve Number   (CN)=82.00
| 01:Area 1 DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .530

     Unit Hyd Qpeak  (cms)=     .508

     PEAK FLOW       (cms)=     .826 (i)
     TIME TO PEAK    (hrs)=   10.350
     RUNOFF VOLUME    (mm)=  166.745
     TOTAL RAINFALL   (mm)=  212.341
     RUNOFF COEFFICIENT   =     .785

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

--------------------------------------------------------------------------------
--
001:0004--------------------------------------------------------------------------
--
----------------------
| CALIB NASHYD       |   Area    (ha)=    7.05   Curve Number   (CN)=82.00
| 02:Area 1 DT= 1.00 |   Ia      (mm)=   8.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .530

     Unit Hyd Qpeak  (cms)=     .508
```

```
     PEAK FLOW        (cms)=      .821 (i)
     TIME TO PEAK     (hrs)=    10.350
     RUNOFF VOLUME     (mm)=   160.537
     TOTAL RAINFALL    (mm)=   212.341
     RUNOFF COEFFICIENT   =      .756

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

--------------------------------------------------------------------------------
--
001:0005--------------------------------------------------------------------------
--
      FINISH
--------------------------------------------------------------------------------
--
********************************************************************************
**
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2014-01-21     at 10:13:52
================================================================================
==
```

```
2     Metric units
*#*************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : January 20, 2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                    [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%      The following is the Regional post-development flow from Ind Ck watershed
*%      east of Ind CK To POND 1
*%-----------------|-------------------------------------------------------|
READ STORM           STORM_FILENAME=["burreg.stm"]
*%-----------------|-------------------------------------------------------|
DESIGN STANDHYD      ID=[2], NHYD=["Area to pond 1"], DT=[1]min, AREA=[7.55](ha),
                     XIMP=[.74], TIMP=[.74], DWF=[0](cms), LOSS=[2], CN=[88],
                     SLOPE=[2.0](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|
ROUTE RESERVOIR      IDout=[3],   NHYD=["route through pond 1"],  IDin=[2],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [  0.0    , 0.0    ]
                                    [  0.0069 , 0.0247 ]
                                    [  0.0085 , 0.0378 ]
                                    [  0.0098 , 0.0515 ]
                                    [  0.0139 , 0.1111 ]
                                    [  0.0170 , 0.1770 ]
                                    [  0.0196 , 0.2483 ]
                                    [  0.0202 , 0.2669 ]
                                    [  0.2530 , 0.3248 ]
                                    [  0.2759 , 0.4066 ]
                                    [  0.2867 , 0.4495 ]
                                    [  0.3443 , 0.4938 ]
                                    [  0.6870 , 0.5867 ]
                                    [  0.8275 , 0.6108 ]
                                    [  -1     , -1     ]
*%-----------------|-------------------------------------------------------|

FINISH
```

```
   SSSSS  W    W  M    M  H    H  Y    Y  M    M   OOO         999     999    =========
   S      W W W  MM MM  H    H   Y Y   MM MM  O   O       9   9   9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##   9   9   9   9    Ver  4.05
       S   W W   M    M  H    H   Y    M    M  O   O       9999    9999    Sept 2011
   SSSSS   W W   M    M  H    H   Y    M    M   OOO            9       9    =========
                                                          9   9   9   9    # 5848278
         StormWater Management HYdrologic Model           999     999    =========

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

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington           SERIAL#:5848278        +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 ***********************   D E T A I L E D   O U T P U T   ***********************
 ********************************************************************************
 *         DATE: 2014-01-21     TIME: 09:48:45     RUN COUNTER: 000384          *
 ********************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\REGTOP~1.DAT     *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\REGTOP~1.out     *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\REGTOP~1.sum     *
 * User comments:                                                               *
 * 1:_____________________________________________________________________      *
 * 2:_____________________________________________________________________      *
 * 3:_____________________________________________________________________      *
 ********************************************************************************

--------------------------------------------------------------------------------
--
001:0001----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : January 20, 2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\

--------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND1~1\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| READ STORM       |    Filename: CITY OF BURLINGTON REGIONAL DESIGN STORM
| Ptotal= 212.34 mm|    Comments: CITY OF BURLINGTON REGIONAL DESIGN STORM
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	6.350	3.17	12.700	6.17	23.110	9.17	52.830
.33	6.350	3.33	12.700	6.33	23.110	9.33	52.830
.50	6.350	3.50	12.700	6.50	23.110	9.50	52.830
.67	6.350	3.67	12.700	6.67	23.110	9.67	52.830
.83	6.350	3.83	12.700	6.83	23.110	9.83	52.830
1.00	6.350	4.00	12.700	7.00	23.110	10.00	52.830
1.17	4.320	4.17	16.760	7.17	12.700	10.17	37.850
1.33	4.320	4.33	16.760	7.33	12.700	10.33	37.850
1.50	4.320	4.50	16.760	7.50	12.700	10.50	37.850
1.67	4.320	4.67	16.760	7.67	12.700	10.67	37.850
1.83	4.320	4.83	16.760	7.83	12.700	10.83	37.850
2.00	4.320	5.00	16.760	8.00	12.700	11.00	37.850
2.17	6.350	5.17	13.970	8.17	12.700	11.17	12.700
2.33	6.350	5.33	13.970	8.33	12.700	11.33	12.700
2.50	6.350	5.50	13.970	8.50	12.700	11.50	12.700
2.67	6.350	5.67	13.970	8.67	12.700	11.67	12.700
2.83	6.350	5.83	13.970	8.83	12.700	11.83	12.700
3.00	6.350	6.00	13.970	9.00	12.700	12.00	12.700

```
--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN STANDHYD    |   Area    (ha)=    7.55
| 02:Area t DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
```

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	5.59	1.96	
Dep. Storage	(mm)=	.80	1.50	
Average Slope	(%)=	2.00	2.00	
Length	(m)=	224.35	40.00	
Mannings n	=	.013	.250	
Max.eff.Inten.(mm/hr)=		52.83	51.05	
over (min)		4.00	14.00	
Storage Coeff.	(min)=	4.35 (ii)	13.59 (ii)	
Unit Hyd. Tpeak	(min)=	4.00	14.00	
Unit Hyd. peak	(cms)=	.27	.08	
				TOTALS
PEAK FLOW	(cms)=	.82	.27	1.092 (iii)
TIME TO PEAK	(hrs)=	10.00	10.02	10.000
RUNOFF VOLUME	(mm)=	211.53	181.07	203.624
TOTAL RAINFALL	(mm)=	212.34	212.34	212.341
RUNOFF COEFFICIENT	=	1.00	.85	.959

```
  (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
      CN* =  88.0    Ia = Dep. Storage  (Above)
```

(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

001:0004

| ROUTE RESERVOIR |
| IN>02:(Area t) |
| OUT<03:(route) |

Requested routing time step = 1.0 min.

========= OUTLFOW STORAGE TABLE =========

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
.000	.0000E+00	.020	.2669E+00
.007	.2470E-01	.253	.3248E+00
.009	.3780E-01	.276	.4066E+00
.010	.5150E-01	.287	.4495E+00
.014	.1111E+00	.344	.4938E+00
.017	.1770E+00	.687	.5867E+00
.020	.2483E+00	.827	.6108E+00

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >02: (Area t)	7.55	1.092	10.000	203.624
OUTFLOW<03: (route)	7.55	.800	10.550	203.620

PEAK FLOW REDUCTION [Qout/Qin](%)= 73.234
TIME SHIFT OF PEAK FLOW (min)= 33.00
MAXIMUM STORAGE USED (ha.m.)=.6061E+00

001:0005

FINISH

****

**

WARNINGS / ERRORS / NOTES

Simulation ended on 2014-01-21 at 09:48:45

==========

==

APPENDIX G: SWMHYMO MODELLING RESULTS

POND 2

```
2     Metric units
*#*************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : January 20, 2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                    [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%      The following is the Regional post-development flow from Ind Ck watershed
*%      west of Ind CK To POND 2
*%-----------------|-------------------------------------------------------|
READ STORM           STORM_FILENAME=["38mm.stm"]
*%-----------------|-------------------------------------------------------|
DESIGN STANDHYD      ID=[2], NHYD=["Area to pond 2"], DT=[1]min, AREA=[20.56](ha),
                     XIMP=[.90], TIMP=[.90], DWF=[0](cms), LOSS=[2], CN=[80],
                     SLOPE=[1.5](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|
ROUTE RESERVOIR      IDout=[3],   NHYD=["route through pond 2"],  IDin=[2],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [  0.0   , 0.0     ]
                                    [  0.040 , 0.0588  ]
                                    [  0.056 , 0.1204  ]
                                    [  0.080 , 0.2535  ]
                                    [  0.098 , 0.3971  ]
                                    [  0.113 , 0.5474  ]
                                    [  0.126 , 0.7047  ]
                                    [  0.129 , 0.7451  ]
                                    [  -1    , -1      ]
*%-----------------|-------------------------------------------------------|

FINISH
```

```
   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                        9   9  9   9   # 5848278
         StormWater Management HYdrologic Model          999    999    =========

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

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington           SERIAL#:5848278        +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 ***********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2014-01-21     TIME: 10:17:09     RUN COUNTER: 000391          *
 ********************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\38MMPO~1.DAT     *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\38MMPO~1.out     *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\38MMPO~1.sum     *
 * User comments:                                                               *
 * 1:_____________________________________________________________________      *
 * 2:_____________________________________________________________________      *
 * 3:_____________________________________________________________________      *
 ********************************************************************************

--------------------------------------------------------------------------------
--
001:0001-----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : January 20, 2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\

--------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| READ STORM       |    Filename: 3hr 38mm storm
| Ptotal=  43.77 mm|    Comments: 3hr 38mm storm
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	4.110	.83	6.080	1.58	90.460	2.33	5.470
.17	4.100	.92	6.660	1.67	13.680	2.42	5.470
.25	4.100	1.00	8.060	1.75	9.120	2.50	3.650
.33	3.900	1.08	9.120	1.83	9.120	2.58	3.650
.42	3.900	1.17	10.640	1.92	9.120	2.67	3.650
.50	4.860	1.25	15.200	2.00	5.470	2.75	3.650
.58	4.860	1.33	24.020	2.08	5.470	2.83	3.650
.67	4.860	1.42	180.576	2.17	5.470	2.92	3.650
.75	5.470	1.50	38.460	2.25	5.470		

```
--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN STANDHYD    |   Area    (ha)=   20.56
| 02:Area t DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
```

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	18.50	2.06	
Dep. Storage	(mm)=	.80	1.50	
Average Slope	(%)=	1.50	1.50	
Length	(m)=	370.23	40.00	
Mannings n	=	.013	.250	
Max.eff.Inten.	(mm/hr)=	180.58	44.08	
over	(min)	4.00	15.00	
Storage Coeff.	(min)=	3.92 (ii)	14.59 (ii)	
Unit Hyd. Tpeak	(min)=	4.00	15.00	
Unit Hyd. peak	(cms)=	.29	.08	
				TOTALS
PEAK FLOW	(cms)=	6.15	.14	6.190 (iii)
TIME TO PEAK	(hrs)=	1.45	1.75	1.450
RUNOFF VOLUME	(mm)=	42.97	16.89	40.359
TOTAL RAINFALL	(mm)=	43.77	43.77	43.766
RUNOFF COEFFICIENT	=	.98	.39	.922

```
  (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
      CN* =  80.0    Ia = Dep. Storage  (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
      THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--
001:0004--------------------------------------------------------------------------
--
---------------------
```

```
| ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
|  IN>02:(Area t)    |
| OUT<03:(route )    |     =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW     STORAGE    |  OUTFLOW     STORAGE
                            (cms)     (ha.m.)    |    (cms)     (ha.m.)
                             .000   .0000E+00    |     .098   .3971E+00
                             .040   .5880E-01    |     .113   .5474E+00
                             .056   .1204E+00    |     .126   .7047E+00
                             .080   .2535E+00    |     .129   .7451E+00

     ROUTING RESULTS            AREA      QPEAK      TPEAK       R.V.
     --------------------       (ha)      (cms)      (hrs)       (mm)
     INFLOW >02: (Area t)      20.56      6.190      1.450     40.359
     OUTFLOW<03: (route )      20.56       .129      2.983     40.358

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=    2.083
                    TIME SHIFT OF PEAK FLOW          (min)=    92.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.7443E+00

--------------------------------------------------------------------------------
--
001:0005-----------------------------------------------------------------------
--
      FINISH
--------------------------------------------------------------------------------
--
********************************************************************************
**
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2014-01-21     at 10:17:09
================================================================================
==
```

```
2     Metric units
*#************************************************************************
*#  Project Name: [1200 King Road]    Project Number: [P10003]
*#  Date        : 01-20-2014
*#  Modeller    : [ Ashley Walker ]
*#  Company     : Metropolitan Planning and Engineering
*#  License #   : 5848278
*#************************************************************************
START                 TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                     [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%           100-year pre-development flow Ind Ck watershed Area 2
*%-----------------|-------------------------------------------------------|
CHICAGO STORM         IUNITS=[2],  TD=[3](hrs), RTP=[.46],  CSDT=[5](min),
                      ICASEcs=[1],
                       A=[1114.2],  B=[5], and C=[.761],

*%                    IDF Burlington
*%      Year    A         B      C
*%      2       592.6     6      0.780
*%      5       697.45    5      0.764
*%      10      798.5     5      0.763
*%      25      926.9     5      0.762
*%      50      1019.4    5      0.761
*%      100     1114.2    5      0.761
*%-----------------|-------------------------------------------------------|
DESIGN NASHYD         ID=[1], NHYD=["Area 3"], DT=[5]min, AREA=[21.1](ha),
                      DWF=[0](cms), CN/C=[62], TP=[0.64]hrs,
                      RAINFALL=[ ,  ,  ,  , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|

CALIB NASHYD          ID=[2], NHYD=["Area 3"], DT=[5]min, AREA=[21.1](ha),
                      DWF=[0](cms),  CN/C=[62], IA=[8](mm),
                      N=[3], TP=[0.64]hrs,
                      RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-------------------------------------------------------|

FINISH
```

```
   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                        9   9  9   9   # 5848278
         StormWater Management HYdrologic Model          999    999    =========

 ********************************************************************************
 ***************************** SWMHYMO Ver/4.05  ********************************
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 *********                    OTTHYMO-83 and OTTHYMO-89.                *********
 ********************************************************************************
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 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ********************************************************************************

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington            SERIAL#:5848278       +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 ***********************   D E T A I L E D   O U T P U T   ***********************
 ********************************************************************************
 *         DATE: 2014-01-21     TIME: 10:17:22     RUN COUNTER: 000392          *
 ********************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\100YRP~1.DAT     *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\100YRP~1.out     *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\100YRP~1.sum     *
 * User comments:                                                               *
 * 1:_____________________________________________________________________      *
 * 2:_____________________________________________________________________      *
 * 3:_____________________________________________________________________      *
 ********************************************************************************

--------------------------------------------------------------------------------
--
001:0001----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road]    Project Number: [P10003]
*#  Date        : 01-20-2014
*#  Modeller    : [ Ashley Walker ]
*#  Company     : Metropolitan Planning and Engineering
*#  License #   : 5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\

--------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\
```

```
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1114.200
| Ptotal= 62.92 mm |                          B=   5.000
--------------------                          C=    .761
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =   .46

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .08   5.612 |    .83  11.306 |   1.58  40.362 |   2.33   8.723
               .17   5.918 |    .92  12.954 |   1.67  27.681 |   2.42   8.105
               .25   6.266 |   1.00  15.255 |   1.75  21.248 |   2.50   7.579
               .33   6.664 |   1.08  18.707 |   1.83  17.359 |   2.58   7.124
               .42   7.125 |   1.17  24.489 |   1.92  14.751 |   2.67   6.727
               .50   7.666 |   1.25  36.200 |   2.00  12.876 |   2.75   6.378
               .58   8.310 |   1.33  72.263 |   2.08  11.461 |   2.83   6.067
               .67   9.093 |   1.42 193.180 |   2.17  10.352 |   2.92   5.789
               .75  10.064 |   1.50  76.347 |   2.25   9.459 |   3.00   5.538

--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN NASHYD      |   Area    (ha)=   21.10   Curve Number   (CN)=62.00
| 01:Area 3 DT= 5.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .640

     Unit Hyd Qpeak  (cms)=    1.259

     PEAK FLOW       (cms)=     .617 (i)
     TIME TO PEAK    (hrs)=    2.167
     RUNOFF VOLUME    (mm)=   17.375
     TOTAL RAINFALL   (mm)=   62.917
     RUNOFF COEFFICIENT   =     .276

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

--------------------------------------------------------------------------------
--
001:0004--------------------------------------------------------------------------
--
----------------------
| CALIB NASHYD       |   Area    (ha)=   21.10   Curve Number   (CN)=62.00
| 02:Area 3 DT= 5.00 |   Ia      (mm)=   8.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .640

     Unit Hyd Qpeak  (cms)=    1.259

     PEAK FLOW       (cms)=     .502 (i)
     TIME TO PEAK    (hrs)=    2.250
```

```
     RUNOFF VOLUME     (mm)=   14.321
     TOTAL RAINFALL    (mm)=   62.917
     RUNOFF COEFFICIENT    =     .228

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

--------------------------------------------------------------------------------
--
001:0005----------------------------------------------------------------------
--
      FINISH
--------------------------------------------------------------------------------
--
********************************************************************************
**
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2014-01-21     at 10:17:22
================================================================================
==
```

```
                                    100 post to Pond2.dat
2     Metric units
*#**************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : January 20, 2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#**************************************************************************
START                 TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                     [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%      The following is the 100-year post-development flow from Ind Ck watershed
*%      west of Ind CK To POND 2
*%-----------------|-------------------------------------------------------|
CHICAGO STORM         IUNITS=[2],  TD=[3](hrs), TPRAT=[0.46], CSDT=[5](min),
                      ICASEcs=[1],
                       A=[1114.2],  B=[5], and C=[0.761],

*%                    IDF Burlington
*%      Year    A         B      C
*%      2       592.6     6      0.780
*%      5       697.45    5      0.764
*%      10      798.5     5      0.763
*%      25      926.9     5      0.762
*%      50      1019.4    5      0.761
*%      100     1114.2    5      0.761
*%-----------------|-------------------------------------------------------|
DESIGN STANDHYD       ID=[2], NHYD=["Area to pond 2"], DT=[1]min, AREA=[20.56](ha),
                      XIMP=[.90], TIMP=[.90], DWF=[0](cms), LOSS=[2], CN=[80],
                      SLOPE=[1.5](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|
ROUTE RESERVOIR       IDout=[3],   NHYD=["route through pond 2"],  IDin=[2],
                      RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                 (cms) - (ha-m)
                                [  0.0   , 0.0     ]
                                [  0.040 , 0.0588  ]
                                [  0.056 , 0.1204  ]
                                [  0.080 , 0.2535  ]
                                [  0.098 , 0.3971  ]
                                [  0.113 , 0.5474  ]
                                [  0.126 , 0.7047  ]
                                [  0.129 , 0.7451  ]
                                [  0.402 , 0.8690  ]
                                [  0.542 , 0.9970  ]
                                [  -1    , -1      ]
*%-----------------|-------------------------------------------------------|

FINISH
```

```
   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                        9   9  9   9   # 5848278
         StormWater Management HYdrologic Model          999    999    =========

 ********************************************************************************
 ***************************** SWMHYMO Ver/4.05  ********************************
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 *********     based on the principles of HYMO and its successors      *********
 *********                  OTTHYMO-83 and OTTHYMO-89.                  *********
 ********************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.           *********
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 *********                  E-Mail: swmhymo@jfsa.Com                    *********
 ********************************************************************************

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington            SERIAL#:5848278       +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 ***********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2014-01-21     TIME: 10:17:33     RUN COUNTER: 000393          *
 ********************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\100POS~1.DAT     *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\100POS~1.out     *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\100POS~1.sum     *
 * User comments:                                                               *
 * 1:_____________________________________________________________________      *
 * 2:_____________________________________________________________________      *
 * 3:_____________________________________________________________________      *
 ********************************************************************************

--------------------------------------------------------------------------------
--
001:0001-----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : January 20, 2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\

--------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| CHICAGO STORM    |     IDF curve parameters: A=1114.200
| Ptotal= 62.92 mm |                           B=   5.000
--------------------                           C=    .761
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =   .46

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .08   5.612 |    .83  11.306 |   1.58  40.362 |   2.33   8.723
               .17   5.918 |    .92  12.954 |   1.67  27.681 |   2.42   8.105
               .25   6.266 |   1.00  15.255 |   1.75  21.248 |   2.50   7.579
               .33   6.664 |   1.08  18.707 |   1.83  17.359 |   2.58   7.124
               .42   7.125 |   1.17  24.489 |   1.92  14.751 |   2.67   6.727
               .50   7.666 |   1.25  36.200 |   2.00  12.876 |   2.75   6.378
               .58   8.310 |   1.33  72.263 |   2.08  11.461 |   2.83   6.067
               .67   9.093 |   1.42 193.180 |   2.17  10.352 |   2.92   5.789
               .75  10.064 |   1.50  76.347 |   2.25   9.459 |   3.00   5.538

--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN STANDHYD    |   Area    (ha)=   20.56
| 02:Area t DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      18.50          2.06
     Dep. Storage     (mm)=        .80          1.50
     Average Slope     (%)=       1.50          1.50
     Length            (m)=     370.23         40.00
     Mannings n           =       .013          .250

     Max.eff.Inten.(mm/hr)=     193.18         63.00
               over (min)         4.00         13.00
     Storage Coeff.  (min)=       3.81 (ii)    13.07 (ii)
     Unit Hyd. Tpeak (min)=       4.00         13.00
     Unit Hyd. peak  (cms)=        .29           .09
                                                          *TOTALS*
     PEAK FLOW       (cms)=       7.40           .23        7.509 (iii)
     TIME TO PEAK    (hrs)=       1.45          1.62        1.450
     RUNOFF VOLUME    (mm)=      62.12         30.20       58.925
     TOTAL RAINFALL   (mm)=      62.92         62.92       62.917
     RUNOFF COEFFICIENT   =        .99           .48         .937

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
--------------------------------------------------------------------------------
--
001:0004--------------------------------------------------------------------------
--
---------------------
| ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
|  IN>02:(Area t)   |
| OUT<03:(route )   |     =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW     STORAGE    |  OUTFLOW     STORAGE
                            (cms)     (ha.m.)    |    (cms)     (ha.m.)
                             .000   .0000E+00    |     .113   .5474E+00
                             .040   .5880E-01    |     .126   .7047E+00
                             .056   .1204E+00    |     .129   .7451E+00
                             .080   .2535E+00    |     .402   .8690E+00
                             .098   .3971E+00    |     .542   .9970E+00

     ROUTING RESULTS            AREA      QPEAK      TPEAK        R.V.
     --------------------       (ha)      (cms)      (hrs)        (mm)
     INFLOW >02: (Area t)      20.56      7.509      1.450      58.925
     OUTFLOW<03: (route )      20.56       .499      2.400      58.924

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=     6.651
                   TIME SHIFT OF PEAK FLOW         (min)=     57.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.9581E+00

--------------------------------------------------------------------------------
--
001:0005--------------------------------------------------------------------------
--
      FINISH
--------------------------------------------------------------------------------
--
********************************************************************************
**
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2014-01-21     at 10:17:33
================================================================================
==
```

```
2     Metric units
*#************************************************************************
*#  Project Name: [1200 King Road]    Project Number: [P10003]
*#  Date        : 01-20-2014
*#  Modeller    : [ Ashley Walker ]
*#  Company     : Metropolitan Planning and Engineering
*#  License #   : 5848278
*#************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                    [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%           REGIONAL pre-development flow Ind Ck watershed Area 2
*%-----------------|-------------------------------------------------------|
READ STORM           STORM_FILENAME=["burreg.stm"]
*%-----------------|-------------------------------------------------------|
DESIGN NASHYD        ID=[1], NHYD=["Area 3"], DT=[5]min, AREA=[21.1](ha),
                     DWF=[0](cms), CN/C=[79], TP=[0.64]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|

CALIB NASHYD         ID=[2], NHYD=["Area 3"], DT=[5]min, AREA=[21.1](ha),
                     DWF=[0](cms),  CN/C=[79], IA=[8](mm),
                     N=[3], TP=[0.64]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-------------------------------------------------------|

FINISH
```

```
   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9    =========
                                                       9   9  9   9   # 5848278
         StormWater Management HYdrologic Model         999    999    =========

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

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington           SERIAL#:5848278        +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 ***********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2014-01-21     TIME: 10:17:46     RUN COUNTER: 000394          *
 ********************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\REGPRE~1.DAT      *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\REGPRE~1.out      *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\REGPRE~1.sum      *
 * User comments:                                                               *
 * 1:_____________________________________________________________________      *
 * 2:_____________________________________________________________________      *
 * 3:_____________________________________________________________________      *
 ********************************************************************************

--------------------------------------------------------------------------------
--
001:0001-----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road]    Project Number: [P10003]
*#  Date        : 01-20-2014
*#  Modeller    : [ Ashley Walker ]
*#  Company     : Metropolitan Planning and Engineering
*#  License #   : 5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\

--------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| READ STORM       |    Filename: CITY OF BURLINGTON REGIONAL DESIGN STORM
| Ptotal= 212.34 mm|    Comments: CITY OF BURLINGTON REGIONAL DESIGN STORM
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	6.350	3.17	12.700	6.17	23.110	9.17	52.830
.33	6.350	3.33	12.700	6.33	23.110	9.33	52.830
.50	6.350	3.50	12.700	6.50	23.110	9.50	52.830
.67	6.350	3.67	12.700	6.67	23.110	9.67	52.830
.83	6.350	3.83	12.700	6.83	23.110	9.83	52.830
1.00	6.350	4.00	12.700	7.00	23.110	10.00	52.830
1.17	4.320	4.17	16.760	7.17	12.700	10.17	37.850
1.33	4.320	4.33	16.760	7.33	12.700	10.33	37.850
1.50	4.320	4.50	16.760	7.50	12.700	10.50	37.850
1.67	4.320	4.67	16.760	7.67	12.700	10.67	37.850
1.83	4.320	4.83	16.760	7.83	12.700	10.83	37.850
2.00	4.320	5.00	16.760	8.00	12.700	11.00	37.850
2.17	6.350	5.17	13.970	8.17	12.700	11.17	12.700
2.33	6.350	5.33	13.970	8.33	12.700	11.33	12.700
2.50	6.350	5.50	13.970	8.50	12.700	11.50	12.700
2.67	6.350	5.67	13.970	8.67	12.700	11.67	12.700
2.83	6.350	5.83	13.970	8.83	12.700	11.83	12.700
3.00	6.350	6.00	13.970	9.00	12.700	12.00	12.700

```
--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN NASHYD      |   Area    (ha)=   21.10   Curve Number   (CN)=79.00
| 01:Area 3 DT= 5.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .640

     Unit Hyd Qpeak  (cms)=    1.259

     PEAK FLOW       (cms)=    2.286 (i)
     TIME TO PEAK    (hrs)=   10.500
     RUNOFF VOLUME    (mm)=  159.699
     TOTAL RAINFALL   (mm)=  212.340
     RUNOFF COEFFICIENT   =     .752

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

--------------------------------------------------------------------------------
--
001:0004--------------------------------------------------------------------------
--
----------------------
| CALIB NASHYD       |   Area    (ha)=   21.10   Curve Number   (CN)=79.00
| 02:Area 3 DT= 5.00 |   Ia      (mm)=   8.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .640

     Unit Hyd Qpeak  (cms)=    1.259
```

```
     PEAK FLOW        (cms)=    2.268 (i)
     TIME TO PEAK     (hrs)=   10.583
     RUNOFF VOLUME     (mm)=  153.590
     TOTAL RAINFALL    (mm)=  212.340
     RUNOFF COEFFICIENT   =     .723

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

--------------------------------------------------------------------------------
--
001:0005--------------------------------------------------------------------------
--
      FINISH
--------------------------------------------------------------------------------
--
********************************************************************************
**
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2014-01-21     at 10:17:46
================================================================================
==
```

```
2     Metric units
*#*************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : January 20, 2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                    [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%      The following is the Regional post-development flow from Ind Ck watershed
*%      west of Ind CK To POND 2
*%-----------------|-------------------------------------------------------|
READ STORM           STORM_FILENAME=["burreg.stm"]
*%-----------------|-------------------------------------------------------|
DESIGN STANDHYD      ID=[2], NHYD=["Area to pond 2"], DT=[1]min, AREA=[20.56](ha),
                     XIMP=[.90], TIMP=[.90], DWF=[0](cms), LOSS=[2], CN=[91],
                     SLOPE=[1.5](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|
ROUTE RESERVOIR      IDout=[3],   NHYD=["route through pond 2"],  IDin=[2],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [  0.0   , 0.0     ]
                                    [  0.040 , 0.0588  ]
                                    [  0.056 , 0.1204  ]
                                    [  0.080 , 0.2535  ]
                                    [  0.098 , 0.3971  ]
                                    [  0.113 , 0.5474  ]
                                    [  0.126 , 0.7047  ]
                                    [  0.129 , 0.7451  ]
                                    [  0.402 , 0.8690  ]
                                    [  0.542 , 0.9970  ]
                                    [  0.553 , 1.0405  ]
                                    [  0.596 , 1.2193  ]
                                    [  0.750 , 1.4056  ]
                                    [  1.189 , 1.5994  ]
                                    [  2.011 , 1.8008  ]
                                    [  2.286 , 1.8524  ]
                                    [  -1    , -1      ]
*%-----------------|-------------------------------------------------------|

FINISH
```

```
   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                        9   9  9   9   # 5848278
         StormWater Management HYdrologic Model          999    999    =========

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

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington            SERIAL#:5848278       +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 ***********************   D E T A I L E D   O U T P U T   ***********************
 ********************************************************************************
 *         DATE: 2014-01-21     TIME: 10:17:53     RUN COUNTER: 000395          *
 ********************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\REGTOP~1.DAT     *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\REGTOP~1.out     *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\REGTOP~1.sum     *
 * User comments:                                                               *
 * 1:_____________________________________________________________________     *
 * 2:_____________________________________________________________________     *
 * 3:_____________________________________________________________________     *
 ********************************************************************************

--------------------------------------------------------------------------------
--
001:0001----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date         : January 20, 2014
*#  Modeller     : [Ashley Walker]
*#  Company      : Metropolitan Planning and Engineering Ltd
*#  License #    :  5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\

--------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\POND2~1\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| READ STORM       |    Filename: CITY OF BURLINGTON REGIONAL DESIGN STORM
| Ptotal= 212.34 mm|    Comments: CITY OF BURLINGTON REGIONAL DESIGN STORM
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	6.350	3.17	12.700	6.17	23.110	9.17	52.830
.33	6.350	3.33	12.700	6.33	23.110	9.33	52.830
.50	6.350	3.50	12.700	6.50	23.110	9.50	52.830
.67	6.350	3.67	12.700	6.67	23.110	9.67	52.830
.83	6.350	3.83	12.700	6.83	23.110	9.83	52.830
1.00	6.350	4.00	12.700	7.00	23.110	10.00	52.830
1.17	4.320	4.17	16.760	7.17	12.700	10.17	37.850
1.33	4.320	4.33	16.760	7.33	12.700	10.33	37.850
1.50	4.320	4.50	16.760	7.50	12.700	10.50	37.850
1.67	4.320	4.67	16.760	7.67	12.700	10.67	37.850
1.83	4.320	4.83	16.760	7.83	12.700	10.83	37.850
2.00	4.320	5.00	16.760	8.00	12.700	11.00	37.850
2.17	6.350	5.17	13.970	8.17	12.700	11.17	12.700
2.33	6.350	5.33	13.970	8.33	12.700	11.33	12.700
2.50	6.350	5.50	13.970	8.50	12.700	11.50	12.700
2.67	6.350	5.67	13.970	8.67	12.700	11.67	12.700
2.83	6.350	5.83	13.970	8.83	12.700	11.83	12.700
3.00	6.350	6.00	13.970	9.00	12.700	12.00	12.700

```
--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN STANDHYD    |   Area    (ha)=   20.56
| 02:Area t DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
```

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	18.50	2.06	
Dep. Storage	(mm)=	.80	1.50	
Average Slope	(%)=	1.50	1.50	
Length	(m)=	370.23	40.00	
Mannings n	=	.013	.250	
Max.eff.Inten.	(mm/hr)=	52.83	51.78	
over	(min)	6.00	16.00	
Storage Coeff.	(min)=	6.40 (ii)	16.41 (ii)	
Unit Hyd. Tpeak	(min)=	6.00	16.00	
Unit Hyd. peak	(cms)=	.18	.07	
				TOTALS
PEAK FLOW	(cms)=	2.72	.29	3.000 (iii)
TIME TO PEAK	(hrs)=	10.00	10.03	10.000
RUNOFF VOLUME	(mm)=	211.53	188.37	209.226
TOTAL RAINFALL	(mm)=	212.34	212.34	212.341
RUNOFF COEFFICIENT	=	1.00	.89	.985

```
  (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
      CN* =  91.0    Ia = Dep. Storage  (Above)
```

(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--
001:0004---
--

| ROUTE RESERVOIR |
| IN>02:(Area t) |
| OUT<03:(route) |

Requested routing time step = 1.0 min.

========= OUTLFOW STORAGE TABLE =========

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
.000	.0000E+00	.402	.8690E+00
.040	.5880E-01	.542	.9970E+00
.056	.1204E+00	.553	.1041E+01
.080	.2535E+00	.596	.1219E+01
.098	.3971E+00	.750	.1406E+01
.113	.5474E+00	1.189	.1599E+01
.126	.7047E+00	2.011	.1801E+01
.129	.7451E+00	2.286	.1852E+01

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >02: (Area t)	20.56	3.000	10.000	209.226
OUTFLOW<03: (route)	20.56	2.234	10.367	209.225

PEAK FLOW REDUCTION [Qout/Qin](%)= 74.479
TIME SHIFT OF PEAK FLOW (min)= 22.00
MAXIMUM STORAGE USED (ha.m.)=.1843E+01

--
001:0005---
--

FINISH

--
****
**

WARNINGS / ERRORS / NOTES

Simulation ended on 2014-01-21 at 10:17:53

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

APPENDIX H: SWMHYMO MODELLING RESULTS

SUPERPIPE

```
2     Metric units
*#*************************************************************************
*#  Project Name: [1200 King Road]    Project Number: [P10003]
*#  Date        : 01-20-2014
*#  Modeller    : [ Ashley Walker ]
*#  Company     : Metropolitan Planning and Engineering
*#  License #   : 5848278
*#*************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                    [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-----------------------------------------------------------|
*%           100-year pre-development flow Ind Ck watershed east of Ind Ck To King
Rd
*%-----------------|-----------------------------------------------------------|
CHICAGO STORM        IUNITS=[2],  TD=[3](hrs), RTP=[.46],  CSDT=[5](min),
                     ICASEcs=[1],
                      A=[1114.2],  B=[5], and C=[.761],

*%                   IDF Burlington
*%      Year    A         B      C
*%      2       592.6     6      0.780
*%      5       697.45    5      0.764
*%      10      798.5     5      0.763
*%      25      926.9     5      0.762
*%      50      1019.4    5      0.761
*%      100     1114.2    5      0.761
*%-----------------|-----------------------------------------------------------|
DESIGN NASHYD        ID=[1], NHYD=["Area 2"], DT=[1]min, AREA=[1.6](ha),
                     DWF=[0](cms), CN/C=[65], TP=[0.40]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr), END=-1
*%-----------------|-----------------------------------------------------------|

CALIB NASHYD         ID=[2], NHYD=["Area 2"], DT=[1]min, AREA=[1.6](ha),
                     DWF=[0](cms),  CN/C=[65], IA=[8](mm),
                     N=[3], TP=[0.40]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-----------------------------------------------------------|
COMPUTE VOLUME       ID=[1], STRATE=[-100](cms), RELRATE=[0.00](cms)
*%-----------------|-----------------------------------------------------------|


FINISH
```

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

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                        9   9  9   9   # 5848278
        StormWater Management HYdrologic Model           999    999    =========

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

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington            SERIAL#:5848278       +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 ***********************   D E T A I L E D   O U T P U T   ***********************
 ******************************************************************************
 *         DATE: 2013-12-19     TIME: 09:33:44     RUN COUNTER: 000232         *
 ******************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\100YRP~1.DAT   *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\100YRP~1.out   *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\100YRP~1.sum   *
 * User comments:                                                             *
 * 1:_____________________________________________________________________    *
 * 2:_____________________________________________________________________    *
 * 3:_____________________________________________________________________    *
 ******************************************************************************

--------------------------------------------------------------------------------
--
001:0001----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road]    Project Number: [P10003]
*#  Date        : 11-30-2013
*#  Modeller    : [ Ashley Walker ]
*#  Company     : Metropolitan Planning and Engineering
*#  License #   : 5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\

--------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| CHICAGO STORM    |     IDF curve parameters: A=1114.200
| Ptotal= 62.92 mm |                           B=   5.000
--------------------                           C=    .761
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =   .46

              TIME     RAIN |   TIME     RAIN |   TIME     RAIN |   TIME     RAIN
               hrs    mm/hr |    hrs    mm/hr |    hrs    mm/hr |    hrs    mm/hr
               .08    5.612 |    .83   11.306 |   1.58   40.362 |   2.33    8.723
               .17    5.918 |    .92   12.954 |   1.67   27.681 |   2.42    8.105
               .25    6.266 |   1.00   15.255 |   1.75   21.248 |   2.50    7.579
               .33    6.664 |   1.08   18.707 |   1.83   17.359 |   2.58    7.124
               .42    7.125 |   1.17   24.489 |   1.92   14.751 |   2.67    6.727
               .50    7.666 |   1.25   36.200 |   2.00   12.876 |   2.75    6.378
               .58    8.310 |   1.33   72.263 |   2.08   11.461 |   2.83    6.067
               .67    9.093 |   1.42  193.180 |   2.17   10.352 |   2.92    5.789
               .75   10.064 |   1.50   76.347 |   2.25    9.459 |   3.00    5.538

--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN NASHYD      |   Area    (ha)=    1.60   Curve Number   (CN)=65.00
| 01:Area 2 DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .400

     Unit Hyd Qpeak  (cms)=     .153

     PEAK FLOW       (cms)=     .071 (i)
     TIME TO PEAK    (hrs)=    1.883
     RUNOFF VOLUME    (mm)=   19.033
     TOTAL RAINFALL   (mm)=   62.917
     RUNOFF COEFFICIENT   =     .303

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

--------------------------------------------------------------------------------
--
001:0004--------------------------------------------------------------------------
--
----------------------
| CALIB NASHYD       |   Area    (ha)=    1.60   Curve Number   (CN)=65.00
| 02:Area 2 DT= 1.00 |   Ia      (mm)=   8.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .400

     Unit Hyd Qpeak  (cms)=     .153

     PEAK FLOW       (cms)=     .058 (i)
     TIME TO PEAK    (hrs)=    1.917
```

```
     RUNOFF VOLUME     (mm)=   15.733
     TOTAL RAINFALL    (mm)=   62.917
     RUNOFF COEFFICIENT    =     .250

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

--------------------------------------------------------------------------------
--
001:0005--------------------------------------------------------------------------
--
--------------------
| COMPUTE VOLUME   |
| ID:01  (Area 2)  |                DISCHARGE      TIME
--------------------                  (cms)       (hrs)
           START CONTROLLING AT        .000        .250
           INFLOW HYD. PEAKS AT        .071       1.883
           STOP  CONTROLLING AT        .000        .000

           REQUIRED STORAGE VOLUME (ha.m.)=     .0305
           TOTAL HYDROGRAPH VOLUME (ha.m.)=     .0305
           % OF HYDROGRAPH TO STORE       =   99.9996

           NOTE:  Storage was computed to reduce the Inflow

--------------------------------------------------------------------------------
--
001:0006--------------------------------------------------------------------------
--
      FINISH
--------------------------------------------------------------------------------
--
********************************************************************************
**
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2013-12-19     at 09:33:44
================================================================================
==
```

```
2     Metric units
*#*************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : January 20, 2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*************************************************************************
START                 TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                     [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%      The following is the 100-year post-development flow from Ind Ck watershed
*%      to Superpipe
*%-----------------|-------------------------------------------------------|
CHICAGO STORM         IUNITS=[2],  TD=[3](hrs), TPRAT=[0.46], CSDT=[5](min),
                      ICASEcs=[1],
                       A=[1114.2],  B=[5], and C=[0.761],

*%                    IDF Burlington
*%      Year    A         B      C
*%      2       592.6     6      0.780
*%      5       697.45    5      0.764
*%      10      798.5     5      0.763
*%      25      926.9     5      0.762
*%      50      1019.4    5      0.761
*%      100     1114.2    5      0.761
*%-----------------|-------------------------------------------------------|
DESIGN STANDHYD       ID=[2], NHYD=["Area to superpipe"], DT=[1]min, AREA=[0.99](ha),

                      XIMP=[.90], TIMP=[.90], DWF=[0](cms), LOSS=[2], CN=[80],
                      SLOPE=[2.5](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|
ROUTE RESERVOIR       IDout=[3],   NHYD=["route through superpipe"],  IDin=[2],
                      RDT=[1](min),
                            TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [  0.0    , 0.0      ]
                                    [  0.0196 , 0.00172  ]
                                    [  0.0276 , 0.00471  ]
                                    [  0.0339 , 0.00835  ]
                                    [  0.0391 , 0.01236  ]
                                    [  0.0437 , 0.01654  ]
                                    [  0.0479 , 0.02072  ]
                                    [  0.0517 , 0.02473  ]
                                    [  0.0535 , 0.02661  ]
                                    [  0.0553 , 0.02837  ]
                                    [  0.0570 , 0.02997  ]
                                    [  0.0587 , 0.03136  ]
                                    [  -1     , -1       ]
*%-----------------|-------------------------------------------------------|

FINISH
```

```
   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999    Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9    =========
                                                       9   9  9   9   # 5848278
         StormWater Management HYdrologic Model         999    999    =========

 ********************************************************************************
 ***************************** SWMHYMO Ver/4.05  ********************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                  OTTHYMO-83 and OTTHYMO-89.                  *********
 ********************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
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 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ********************************************************************************

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington            SERIAL#:5848278       +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 ***********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2013-12-19     TIME: 10:28:59     RUN COUNTER: 000239          *
 ********************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\100POS~1.DAT    *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\100POS~1.out    *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\100POS~1.sum    *
 * User comments:                                                               *
 * 1:_____________________________________________________________________      *
 * 2:_____________________________________________________________________      *
 * 3:_____________________________________________________________________      *
 ********************************************************************************

--------------------------------------------------------------------------------
--
001:0001----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : November 30, 2013
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\

--------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1114.200
| Ptotal= 62.92 mm |                          B=   5.000
--------------------                          C=    .761
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =   .46

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .08   5.612 |    .83  11.306 |   1.58  40.362 |   2.33   8.723
               .17   5.918 |    .92  12.954 |   1.67  27.681 |   2.42   8.105
               .25   6.266 |   1.00  15.255 |   1.75  21.248 |   2.50   7.579
               .33   6.664 |   1.08  18.707 |   1.83  17.359 |   2.58   7.124
               .42   7.125 |   1.17  24.489 |   1.92  14.751 |   2.67   6.727
               .50   7.666 |   1.25  36.200 |   2.00  12.876 |   2.75   6.378
               .58   8.310 |   1.33  72.263 |   2.08  11.461 |   2.83   6.067
               .67   9.093 |   1.42 193.180 |   2.17  10.352 |   2.92   5.789
               .75  10.064 |   1.50  76.347 |   2.25   9.459 |   3.00   5.538

--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN STANDHYD    |   Area    (ha)=     .99
| 02:Area t DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .89          .10
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=       2.50         2.50
     Length            (m)=      81.24        40.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     193.18        76.08
               over (min)          1.00         9.00
     Storage Coeff.  (min)=       1.32 (ii)    8.68 (ii)
     Unit Hyd. Tpeak (min)=       1.00         9.00
     Unit Hyd. peak  (cms)=        .90          .13
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .47          .01        .478 (iii)
     TIME TO PEAK    (hrs)=       1.42         1.55       1.417
     RUNOFF VOLUME    (mm)=      62.12        30.20      58.925
     TOTAL RAINFALL   (mm)=      62.92        62.92      62.917
     RUNOFF COEFFICIENT   =        .99          .48        .937

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
--------------------------------------------------------------------------------
--
001:0004----------------------------------------------------------------------
--
---------------------
| ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
|  IN>02:(Area t)   |
| OUT<03:(route )   |     =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW     STORAGE    |  OUTFLOW     STORAGE
                            (cms)     (ha.m.)    |    (cms)     (ha.m.)
                            .000   .0000E+00     |     .048   .2072E-01
                            .020   .1720E-02     |     .052   .2473E-01
                            .028   .4710E-02     |     .054   .2661E-01
                            .034   .8350E-02     |     .055   .2837E-01
                            .039   .1236E-01     |     .057   .2997E-01
                            .044   .1654E-01     |     .059   .3136E-01

     ROUTING RESULTS            AREA      QPEAK      TPEAK        R.V.
     --------------------       (ha)      (cms)      (hrs)        (mm)
     INFLOW >02: (Area t)        .99       .478      1.417      58.925
     OUTFLOW<03: (route )        .99       .058      1.767      58.925

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=    12.156
                    TIME SHIFT OF PEAK FLOW          (min)=     21.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.3090E-01

--------------------------------------------------------------------------------
--
001:0005----------------------------------------------------------------------
--
      FINISH
--------------------------------------------------------------------------------
--
********************************************************************************
**
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2013-12-19     at 10:28:59
================================================================================
==
```

```
2     Metric units
*#*************************************************************************
*#  Project Name: [1200 King Road]    Project Number: [P10003]
*#  Date        : 01-20-2014
*#  Modeller    : [ Ashley Walker ]
*#  Company     : Metropolitan Planning and Engineering
*#  License #   : 5848278
*#*************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                    [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%          Regional pre-development flow to King Rd
*%-----------------|-------------------------------------------------------|
READ STORM           STORM_FILENAME=["burreg.stm"]
*%-----------------|-------------------------------------------------------|
DESIGN NASHYD        ID=[1], NHYD=["Area 2"], DT=[1]min, AREA=[1.6](ha),
                     DWF=[0](cms), CN/C=[82], TP=[0.4]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|

CALIB NASHYD         ID=[2], NHYD=["Area 2"], DT=[1]min, AREA=[1.6](ha),
                     DWF=[0](cms),  CN/C=[82], IA=[8](mm),
                     N=[3], TP=[0.4]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-------------------------------------------------------|
COMPUTE VOLUME       ID=[1], STRATE=[-100](cms), RELRATE=[0.00](cms)
*%-----------------|-------------------------------------------------------|

FINISH
```

```
   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                        9   9  9   9   # 5848278
         StormWater Management HYdrologic Model          999    999    =========

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

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington           SERIAL#:5848278        +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 ***********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2013-12-19     TIME: 09:33:50     RUN COUNTER: 000233          *
 ********************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\REGPRE~1.DAT    *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\REGPRE~1.out    *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\REGPRE~1.sum    *
 * User comments:                                                               *
 * 1:_____________________________________________________________________     *
 * 2:_____________________________________________________________________     *
 * 3:_____________________________________________________________________     *
 ********************************************************************************

--------------------------------------------------------------------------------
--
001:0001----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road]    Project Number: [P10003]
*#  Date        : 11-30-2013
*#  Modeller    : [ Ashley Walker ]
*#  Company     : Metropolitan Planning and Engineering
*#  License #   : 5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\

--------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
--
--------------------
| READ STORM       |    Filename: CITY OF BURLINGTON REGIONAL DESIGN STORM
| Ptotal= 212.34 mm|    Comments: CITY OF BURLINGTON REGIONAL DESIGN STORM
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	6.350	3.17	12.700	6.17	23.110	9.17	52.830
.33	6.350	3.33	12.700	6.33	23.110	9.33	52.830
.50	6.350	3.50	12.700	6.50	23.110	9.50	52.830
.67	6.350	3.67	12.700	6.67	23.110	9.67	52.830
.83	6.350	3.83	12.700	6.83	23.110	9.83	52.830
1.00	6.350	4.00	12.700	7.00	23.110	10.00	52.830
1.17	4.320	4.17	16.760	7.17	12.700	10.17	37.850
1.33	4.320	4.33	16.760	7.33	12.700	10.33	37.850
1.50	4.320	4.50	16.760	7.50	12.700	10.50	37.850
1.67	4.320	4.67	16.760	7.67	12.700	10.67	37.850
1.83	4.320	4.83	16.760	7.83	12.700	10.83	37.850
2.00	4.320	5.00	16.760	8.00	12.700	11.00	37.850
2.17	6.350	5.17	13.970	8.17	12.700	11.17	12.700
2.33	6.350	5.33	13.970	8.33	12.700	11.33	12.700
2.50	6.350	5.50	13.970	8.50	12.700	11.50	12.700
2.67	6.350	5.67	13.970	8.67	12.700	11.67	12.700
2.83	6.350	5.83	13.970	8.83	12.700	11.83	12.700
3.00	6.350	6.00	13.970	9.00	12.700	12.00	12.700

```
--------------------------------------------------------------------------------
--
001:0003--------------------------------------------------------------------------
--
----------------------
| DESIGN NASHYD      |   Area     (ha)=    1.60   Curve Number    (CN)=82.00
| 01:Area 2 DT= 1.00 |   Ia       (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .400

     Unit Hyd Qpeak  (cms)=     .153

     PEAK FLOW       (cms)=     .201 (i)
     TIME TO PEAK    (hrs)=   10.167
     RUNOFF VOLUME    (mm)=  166.745
     TOTAL RAINFALL   (mm)=  212.341
     RUNOFF COEFFICIENT   =     .785

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

--------------------------------------------------------------------------------
--
001:0004--------------------------------------------------------------------------
--
----------------------
| CALIB NASHYD       |   Area     (ha)=    1.60   Curve Number    (CN)=82.00
| 02:Area 2 DT= 1.00 |   Ia       (mm)=   8.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .400

     Unit Hyd Qpeak  (cms)=     .153
```

```
     PEAK FLOW       (cms)=     .200 (i)
     TIME TO PEAK    (hrs)=   10.167
     RUNOFF VOLUME    (mm)=  160.537
     TOTAL RAINFALL   (mm)=  212.341
     RUNOFF COEFFICIENT   =     .756

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

--------------------------------------------------------------------------------
--
001:0005--------------------------------------------------------------------------
--
--------------------
| COMPUTE VOLUME   |
| ID:01  (Area 2)  |              DISCHARGE      TIME
--------------------                (cms)       (hrs)
           START CONTROLLING AT      .000        .233
           INFLOW HYD. PEAKS AT      .201      10.167
           STOP  CONTROLLING AT      .000        .000

           REQUIRED STORAGE VOLUME (ha.m.)=    .2668
           TOTAL HYDROGRAPH VOLUME (ha.m.)=    .2668
           % OF HYDROGRAPH TO STORE       =  99.9996

           NOTE:  Storage was computed to reduce the Inflow

--------------------------------------------------------------------------------
--
001:0006--------------------------------------------------------------------------
--
      FINISH
--------------------------------------------------------------------------------
--
********************************************************************************
**
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2013-12-19     at 09:33:50
================================================================================
==
```

```
                                Reg Post to superpipe.dat
2     Metric units
*#*************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : 01-20-2014
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[0],  NRUN=[0]
*%                    [  ] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------|
*%      The following is the Regional post-development flow from Ind Ck watershed
*%      to Superpipe
*%-----------------|-------------------------------------------------------|
READ STORM           STORM_FILENAME=["burreg.stm"]
*%-----------------|-------------------------------------------------------|
DESIGN STANDHYD      ID=[2], NHYD=["Area to superpipe"], DT=[1]min, AREA=[0.99](ha),

                     XIMP=[.90], TIMP=[.90], DWF=[0](cms), LOSS=[2], CN=[91],
                     SLOPE=[2.5](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------|
ROUTE RESERVOIR      IDout=[3],   NHYD=["route through superpipe"],  IDin=[2],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [  0.0    , 0.0      ]
                                    [  0.0196 , 0.00172  ]
                                    [  0.0276 , 0.00471  ]
                                    [  0.0339 , 0.00835  ]
                                    [  0.0391 , 0.01236  ]
                                    [  0.0437 , 0.01654  ]
                                    [  0.0479 , 0.02072  ]
                                    [  0.0517 , 0.02473  ]
                                    [  0.0535 , 0.02661  ]
                                    [  0.0553 , 0.02837  ]
                                    [  0.0570 , 0.02997  ]
                                    [  0.0587 , 0.03136  ]
                                    [  0.1377 , 0.03227  ]
                                    [  0.1472 , 0.03246  ]
                                    [  -1     , -1       ]
*%-----------------|-------------------------------------------------------|

FINISH
```

```
   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                        9   9  9   9   # 5848278
         StormWater Management HYdrologic Model          999    999    =========

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

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Metropolitan Planning and Engineering Ltd    +++++++++
 +++++++++                Burlington           SERIAL#:5848278        +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


 ***********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2013-12-19     TIME: 10:35:34     RUN COUNTER: 000240          *
 ********************************************************************************
 * Input   filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\REGPOS~1.DAT    *
 * Output  filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\REGPOS~1.out    *
 * Summary filename: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\REGPOS~1.sum    *
 * User comments:                                                               *
 * 1:_____________________________________________________________________     *
 * 2:_____________________________________________________________________     *
 * 3:_____________________________________________________________________     *
 ********************************************************************************

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--
001:0001----------------------------------------------------------------------
--
*#*****************************************************************************
*#  Project Name: [1200 King Road ]    Project Number: [P10003]
*#  Date        : 11-30-2013
*#  Modeller    : [Ashley Walker]
*#  Company     : Metropolitan Planning and Engineering Ltd
*#  License #   :  5848278
*#*****************************************************************************
--------------------
| START            |  Project  dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\

--------------------  Rainfall dir.: C:\USERS\AWALKER\DESKTOP\SWMHYM~1\SUPERP~1\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------
--
001:0002--------------------------------------------------------------------------
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--------------------
| READ STORM       |    Filename: CITY OF BURLINGTON REGIONAL DESIGN STORM
| Ptotal= 212.34 mm|    Comments: CITY OF BURLINGTON REGIONAL DESIGN STORM
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	6.350	3.17	12.700	6.17	23.110	9.17	52.830
.33	6.350	3.33	12.700	6.33	23.110	9.33	52.830
.50	6.350	3.50	12.700	6.50	23.110	9.50	52.830
.67	6.350	3.67	12.700	6.67	23.110	9.67	52.830
.83	6.350	3.83	12.700	6.83	23.110	9.83	52.830
1.00	6.350	4.00	12.700	7.00	23.110	10.00	52.830
1.17	4.320	4.17	16.760	7.17	12.700	10.17	37.850
1.33	4.320	4.33	16.760	7.33	12.700	10.33	37.850
1.50	4.320	4.50	16.760	7.50	12.700	10.50	37.850
1.67	4.320	4.67	16.760	7.67	12.700	10.67	37.850
1.83	4.320	4.83	16.760	7.83	12.700	10.83	37.850
2.00	4.320	5.00	16.760	8.00	12.700	11.00	37.850
2.17	6.350	5.17	13.970	8.17	12.700	11.17	12.700
2.33	6.350	5.33	13.970	8.33	12.700	11.33	12.700
2.50	6.350	5.50	13.970	8.50	12.700	11.50	12.700
2.67	6.350	5.67	13.970	8.67	12.700	11.67	12.700
2.83	6.350	5.83	13.970	8.83	12.700	11.83	12.700
3.00	6.350	6.00	13.970	9.00	12.700	12.00	12.700

```
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001:0003--------------------------------------------------------------------------
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----------------------
| DESIGN STANDHYD    |   Area    (ha)=     .99
| 02:Area t DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
```

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	.89	.10	
Dep. Storage	(mm)=	.80	1.50	
Average Slope	(%)=	2.50	2.50	
Length	(m)=	81.24	40.00	
Mannings n	=	.013	.250	
Max.eff.Inten.	(mm/hr)=	52.83	51.81	
over	(min)	2.00	11.00	
Storage Coeff.	(min)=	2.21 (ii)	10.80 (ii)	
Unit Hyd. Tpeak	(min)=	2.00	11.00	
Unit Hyd. peak	(cms)=	.52	.10	
				TOTALS
PEAK FLOW	(cms)=	.13	.01	.145 (iii)
TIME TO PEAK	(hrs)=	9.55	10.00	10.000
RUNOFF VOLUME	(mm)=	211.54	188.39	209.226
TOTAL RAINFALL	(mm)=	212.34	212.34	212.341
RUNOFF COEFFICIENT	=	1.00	.89	.985

```
  (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
      CN* =  91.0    Ia = Dep. Storage  (Above)
```

(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

001:0004

| ROUTE RESERVOIR |
| IN>02:(Area t) |
| OUT<03:(route) |

Requested routing time step = 1.0 min.

========= OUTLFOW STORAGE TABLE =========

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
.000	.0000E+00	.052	.2473E-01
.020	.1720E-02	.054	.2661E-01
.028	.4710E-02	.055	.2837E-01
.034	.8350E-02	.057	.2997E-01
.039	.1236E-01	.059	.3136E-01
.044	.1654E-01	.138	.3227E-01
.048	.2072E-01	.147	.3246E-01

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >02: (Area t)	.99	.145	10.000	209.226
OUTFLOW<03: (route)	.99	.145	10.000	209.226

PEAK FLOW REDUCTION [Qout/Qin](%)= 99.954
TIME SHIFT OF PEAK FLOW (min)= .00
MAXIMUM STORAGE USED (ha.m.)=.3241E-01

001:0005

FINISH

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WARNINGS / ERRORS / NOTES

Simulation ended on 2013-12-19 at 10:35:35

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