Functional Servicing and Stormwater Management Report 221 Fox Street Residential Development Queen's Court Homes Town of Penetanguishene

WMI 09-062
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Prepared by

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1.0 Introduction

1.1 General

WMI & Associates Limited has been retained by Queen's Court Homes to prepare a Functional Servicing and Stormwater Management Report in support of a draft plan of subdivision in the Town of Penetanguishene, Ontario. The proposed development is located east of Fox Street, south of Broad Street, and west of Church Street.

This Report has been based on our discussions with Town of Penetanguishene (Town) Staff. Our work conforms to the current Town Engineering Design Standards, and Ministry of the Environment (MOE) stormwater management design guidelines.

1.2 Background

The subject property comprises a total of 12.01ha and is legally described as part of Lots 104 to 113, West Side of Church Street, Registered Plan 70, Town of Penetanguishene, County of Simcoe.

This residential development portion of the property is 5.84ha in size and comprises 87 Single Family Residential Lots, and 28 units within a medium density residential block. The roadways, a SWM block, open space lands and environmental protection lands comprise the remaining 6.17ha. The site is irregular in shape, and is currently a wooded area. The lands to the north, east and west are developed with residential lots containing residential dwellings, as well as some vacant lots predominantly to the east along church street. The lands to south (Bay Moorings Development) are a private residential development comprising single family lots and townhouse units. A future extension of Beck Boulevard (Municipal Roadway) is also proposed as a part of that development although it has not yet been constructed at the time of writing this report.

This report is in support of a planning application and is based upon topographic information obtained from the Town and a topographic survey prepared by WMI & Associates Ltd., and a Draft Plan of Proposed Subdivision prepared by Lucas & Associates Ltd. Refer to **Appendix A** for the Site Location Plan (Figure 1), and the Draft Plan of Proposed Subdivision.

2.0 Existing Conditions

2.1 Topography and Drainage Patterns

There are currently no stormwater controls on the site, and all runoff is in the form of sheet flow. The site drains predominantly from east to west, towards the existing lots fronting onto Fox Street. There is an existing 975mm diameter concrete storm sewer located to the south west of this site which collects and conveys drainage from Fox Street, the subject lands, and external areas prior to outletting to Georgian Bay.

The predominant topographic feature within the site is a bluff which traverses the site in the north-south direction, within the east half of the site. Due to the steep topography of the ridge, the developed portion of the site is situated to the west of it.

The highest elevation within the site boundary is above the ridge along the boundary with lots fronting onto Church Street. The lowest elevation within the site is located at the south west corner of the site, within the proposed medium density residential block.

2.2 External Drainage

There is approximately 13.92ha of external area which drains into the subject site. The primary outlet for these lands is from a set of catchbasins and a 300mm diameter culvert from Church Street which outlets into the subject site at the north east end, into open space Block 92. Through the subject lands, this runoff is conveyed by a ditch which traverses the bluff then translates to sheet flow as the ditch flattens out and terminates partway through the site, at the toe of the bluff slope.

Smaller portions of these external lands sheet flow onto the subject site from existing and vacant residential lots fronting onto Church Street, further to the south, and along the east boundary.

For pre-development drainage details, refer to the Pre-Development Drainage Plan, **Figure 2** in **Appendix A**.

2.3 Existing Water and Sanitary Services

The subject site currently does not contain any water or sanitary services. However municipal sanitary sewers and watermains are existing on Fox Street, Broad Street, and Church Street which surround the site. There are new water and sanitary services that are to be constructed on the extension of Beck Boulevard from the existing development to the south. The subject development will connect to the Beck Boulevard sanitary sewer at the north boundary of the adjacent development. A watermain connection is also proposed at this location on Beck Boulevard, as well as to the Broad Street watermain at the north limit of the site.

2.4 Soil Conditions

According to the Soils Map of Simcoe County, Ontario, Soil Survey Report prepared for the Department of Agriculture, the subject site and external areas consists of Tioga loamy sand and Alliston sandy loam. These soils have been identified as being within hydrologic soils group 'A' and 'AB' respectively; and are considered to have good to imperfect drainage. This information has been used to determine the composite runoff Curve number for the drainage areas within and external to the 221 Fox Street Development, in order to define the hydrologic losses in the SWMHYMO model.

A Preliminary Geotechnical Investigation has also been prepared by Peto MacCallum Ltd. (PML) for the subject development. From the soils sampling and testing conducted from three boreholes, this report finds that the predominant soil deposit below the topsoil layer is sand, with some seams of clayey silt and till. The groundwater table is approximately 1.9m to 4.4m below existing grades (average of 2.0m in depth), as measured from standpipes installed at the borehole locations. This high groundwater table may require the need for trench dewatering in some locations to facilitate sewer construction.

The investigation also reveals that the native sand soils are in a loose to very loose state which will require 1.5m of engineered fill below house foundations, or deep pilings/ piers incorporated into footing designs to overcome low bearing pressures afforded by the native soils.

2.5 Hydrogeologic Conditions

A Hydrogeologic Function Analysis has been conducted by Ian D. Wilson & Associates, to determine the impacts that the development will have on the groundwater regime and the woodlot area that is to be preserved (Block 90).

The study indicates a westerly flow of groundwater towards Penetang Bay, with water table depths being within approximately 2.0m of the existing ground surface in the low-lowing western portion of the site (based on PML borehole records).

A water budget analysis that was completed as a part of this report identifies that the pre-development on-site infiltration for the 12.01ha site area is 3.9×10^7L/yr, using a water surplus of 466mm/yr, and based on runoff and infiltration coefficients they have determined are appropriate for the existing condition. The report further identifies that the post-development on-site infiltration is 2.7×10^7 L/yr.

To minimize the effects of urbanization of the groundwater regime and facilitate development, the report recommends that on-site infiltration and surface water retention be employed.

3.0 Post-Development Conditions

3.1 Sanitary Servicing

The development is to be provided with a network of 200mm diameter sanitary sewers and service laterals. Sanitary sewer drainage will flow southward and connect to the new sanitary manhole located in the new extension of Beck Boulevard, at the shared boundary with the development to the south. This sewer drains southward onto Hunter Road, then onto Fox Street and southward to a pumping station. It should be noted that trench dewatering will likely be required to facilitate construction of the sewer, based on available groundwater table information.

It is understood that the Town is currently assessing the capacity of the Fox St. sewer to determine if it can accommodate flows generated by the proposed development. A preliminary Sanitary Sewer Design sheet is contained in Appendix B for reference.

3.2 Water Servicing

The development is to be provided with a network of 150mm municipal watermains that will provide potable water and fire flow distribution. Municipally accepted fire hydrants will be provided for fire fighting. The watermain terminations at the ends of streets ‘A’ and ‘B’ will be looped onto each other. The medium density residential block will be provided with a 150mm stub and blow-off for future connection.

It is proposed to connect to the new watermain at the south limit of the site at the future extension of Beck Boulevard, and possibly connect to the existing watermain on Broad street at the proposed intersection with of Beck Boulevard. Watermain disinfection and pressure testing will be conducted in accordance with municipal criteria.

From recent fire hydrant service records provided by the Town of Penetanguishene, static pressures from existing fire hydrants to the south of the development area on Fox Street and Hunter Road are in the range of 70 - 80 P.S.I. On this basis, it is presumed that adequate fire flow pressures will be available in the watermains that are proposed to be extended into the subject development.

For further water and sanitary servicing details refer to the General Servicing Concept Plan contained in **Appendix D**.

3.3 Utilities

Since the development is situated within an existing residential community that is serviced with telephone, cable TV, hydro, and gas services, it is presumed that the various utilities servicing the area can service the proposed development without extensive area network upgrades.

3.4 Internal Grading & Drainage

To accommodate steep slopes across the east portion of the site, roads will be graded to a maximum of 7.0%. To achieve adequate drainage to the SWM facility from the north and south extremity areas of the site, a saw-toothed road grading pattern is proposed along certain sections of Beck Boulevard. This grading method keeps roadway slopes to a minimum of 0.5% and positive drainage to all catchbasins, and utilizes a series of declining 'peaks' along the road profile in order to keep overall slopes measured from 'peak' to 'peak' lower than 0.5% as needed to match site boundary grades and still provide an adequate overland flow route for major storm drainage.

The lots will be graded primarily by split drainage in low lying areas, with the front yards being sloped towards the proposed right-of-way and the backyards being directed towards the rear of the lots. For lots adjacent to the bluff, walk-up lots with Rear lot swales will be required. Rear lot catchbasins will be provided in certain critical areas to provide adequate rear to front drainage.

For further grading and drainage details refer to the Lot Grading Concept Plan contained in **Appendix D**.

3.5 Foundations & Groundwater Considerations

As noted in the Preliminary Geotechnical Investigation, it is noted that house footing grades should be kept to a minimum of 0.6m above the seasonally high groundwater table. In this regard, proposed grades shown on the Concept Lot Grading Plan have been set as high as possible in certain critical areas, while also taking into consideration the desire to cut/fill balance the site and provide positive drainage to the drainage outlet. Future groundwater monitoring and detailed lot grading during the detailed design phase will identify particular concern areas to address this issue.

Also, the Investigation notes that loose to very loose native sand soils are present throughout the site, which will not provide adequate bearing resistances for typical house footing construction methods. To rectify this, 1.5m of engineered fill could be placed beneath footing levels or a pier / piling system could be implemented to bear foundations onto more suitable soils deeper underground.

Depending on the grading of the roadways that are to be finalized during the detailed design phase, pavement subgrade will comprise native soils or engineered fill. A typical a road base cross section should be sufficient for the subdivision, with the exception of frost-susceptible areas which may require additional granular base thickness. Proof-rolling of the subgrade will be required to identify such areas.

For further details pertaining to the groundwater table and foundation/ pavement design recommendations, refer to the Preliminary Geotechnical Investigation prepared by Peto MacCallum Ltd.

4.0 Stormwater Management

4.1 Design Criteria

Internal storm sewers and a stormwater management pond are proposed for the site to ensure that drainage from the subject development is safely attenuated and conveyed to the existing downstream site outlet. Drainage from external lands will be routed through a separate drainage route and into the block 90 woodlot. Runoff from all external areas and the subject development will eventually drain into the downstream 975mm diameter Fox Street storm sewer outlet.

The stormwater management design for the site will incorporate the policies and criteria of a number of agencies, including the Ministry of the Environment (MOE), and the Town of Penetanguishene.

From these, the stormwater management design criteria for the subject site are summarized below:

- Stormwater Quality controls will be provided based on the guidelines described in the Ministry of the Environment 2003 Stormwater Management Planning and Design Manual at an Enhanced Level of Protection.
- The Town's Guidelines will be used as a reference for the design of the stormwater management system.
- The 'Orillia-Brain' rainfall intensity-duration-frequency (IDF) curves will be used to determine the peak flow rates and runoff volumes generated on the site.
- Post-development peak flows from the proposed development will be controlled to pre-development levels for up to the 2- year design storm event, which are based on the governing of the 24-hour SCS Type-II storm distribution and 4-hour Chicago storm distribution.
- Post-development peak flows from the proposed development for storms in excess of the 2-year design storm event, up to and including the 100-year storm event will be controlled to a level that is within the available capacity of the 975mm diameter storm sewer outlet on Fox Street.
- Storm flows from external lands will be routed through the block 90 woodlot and by-pass the proposed SWM facility to mimic existing conditions. Excess runoff not retained within the woodlot will be directed to a storm sewer which will also serve as an outlet for the SWM facility, and subsequently into the Fox Street storm sewer outlet.
- Storm sewers will be designed to convey minor system flows (up to the 5-year design storm event), and runoff from major storm events will be conveyed overland through municipal right-of-ways.
- Erosion and sediment control shall be provided during the construction phase and until the site is fully stabilized.

4.2 Proposed Drainage

Post-development drainage patterns on site will be generally consistent with that of the existing conditions. Runoff from the site will be conveyed to a centrally located stormwater management facility at the west end of the site, where peak flow attenuation and quality control will be provided. The subdivision will be drained by a new municipal storm sewer system and a curb-and gutter cross section to collect and convey minor (5-year) and major system (100-year) flows, respectively.

The subject site is identified as catchment 101 for the purposes of the stormwater modelling aspects containing in this report. This area includes all of the residential lots, roadways, Block 92 & 93 woodlots, as well as the Medium Density Block 88.

The upstream external lands are divided into two (2) separate post-development drainage catchments: EXT 1 and EXT 2. These areas are currently uncontrolled and outlet through a 300mm diameter culvert on Church Street then to a downstream ditch which runs through the north east end of the subject site, within a drainage easement.

To capture drainage from these external lands, an alternate conveyance route is proposed through the rear of lots 25-27 and 33-36, which will outlet directly to the block 90 woodlot immediately west of Beck Boulevard. To avoid flooding of the existing lots to the west of the woodlot which front onto Fox Street, an interceptor swale will be graded in along the west property boundary to direct runoff not retained by the woodlot into a ditch inlet catchbasin and subsequently to a storm sewer which will outlet to the new Fox street sewer.

External drainage from smaller parcels of land fronting onto the west side of Church Street and the south side of Broad Street will be conveyed through rear lot swales and catchbasins as required, and also connect to the external storm sewer system.

A third external drainage area, EXT 3 has also been considered to the west of the subject site (downstream) since this area is also tributary to the existing 975mm diameter storm sewer on Fox Street. EXT 3 also includes the block 90 woodlot which is internal to the site, since runoff this area will continue to flow towards Fox Street and not into the proposed SWM facility (as is the case for the remainder of EXT 3).

To drain outflows from the proposed SWM facility and external flows to the existing 975mm diameter storm sewer crossing Fox Street, a 205m long external storm sewer is proposed to be constructed on Fox Street. This will provide a safe outlet for the subject development and upstream external lands while minimizing flooding risk for existing properties along Fox Street.

For further post-development drainage details, refer to the Post-Development Drainage Plan, **Figure 3,** contained in **Appendix A**.

5.0 Hydrologic Analysis

5.1 Rainfall Data

The 24-hour SCS Type-II and the 4-hour Chicago Storm rainfall distributions were used for the 1:2, 1:5, 1:25, and 1:100 year storm event calculations. The Regional storm event modelled was based on the Timmins Regional Storm. The SCS and Chicago storms were developed from the recorded rainfall data from the Orillia-Brain-Intensity-Duration-Frequency (IDF) curves/values.

5.2 Time of Concentration

The Airport Formula was used to calculate the time of concentration. The time of concentration is a function of "time to peak," which represents the time from the beginning of rainfall to the peak of the runoff hydrograph. It is indicative of the basin's response to storm events. It depends on the physical characteristics of the watershed, such as length, slope, area and surface cover. Estimates of time to peak were determined using the area's time of concentration determined by computing a travel time of an overland flow component and, where applicable, a channel/pipe travel time and then adding the respective travel times together. Refer to **Appendix B** for related calculations.

5.3 Pre-Development Condition Modelling Results

Using the site drainage area as illustrated on **Figure 2** and the hydrologic modelling program SWMHYMO, the total flows were determined for the 2-year through to 100-year storm events.

The 4-hour Chicago Storm and 24-hour SCS Type-II pre-development peak flows for the North and South Catchments are summarized in **Table 1** below.

Table 1: 4-Hour Chicago Storm Pre-Development Peak Flows

Design Storm	Area (ha)	Pre-Development Peak Flows			
		2 yr. m³/s	**5 yr. m³/s**	**25 yr. m³/s**	**100 yr. m³/s**
4-hr Chicago	29.30	0.064	0.138	0.292	0.458
24-hr SCS II	29.30	0.121	0.226	0.429	0.634

The pre-development hydrologic model runs for the 4-hour Chicago and SCS Type-II storm distributions can be found in **Appendix C**.

5.4 Post-Development Condition Modelling Results

The 4-hour Chicago Storm uncontrolled post-development peak flows are summarized in **Table 2** below.

Table 2: 4-Hour Chicago Storm Post-Development Uncontrolled Peak Flows

Catchment	Area (ha)	4-Hour Chicago Storm Distribution Uncontrolled Post-Development Peak Flows				
		25mm m^3/s	2 yr. m^3/s	5 yr. m^3/s	25 yr. m^3/s	100 yr. m^3/s
101	11.05	0.342	0.473	0.669	1.040	1.454
EXT1	7.78	0.021	0.046	0.096	0.197	0.304
EXT2	6.14	0.146	0.197	0.279	0.427	0.599
EXT3	4.36	0.009	0.019	0.038	0.075	0.115

The 24-hour SCS Type-II uncontrolled post-development peak flows are summarized in **Table 3** below.

Table 3: 24-Hr SCS Type-II Storm Post-Development Uncontrolled Peak Flows

Catchment	Area (ha)	24-Hour SCS Type-II Distribution Uncontrolled Post-Development Peak Flows				
		2 yr. m^3/s	5 yr. m^3/s	25 yr. m^3/s	100 yr. m^3/s	Timmins m^3/s
101	11.05	0.382	0.577	0.953	1.310	0.874
EXT1	7.78	0.090	0.159	0.289	0.417	0.488
EXT2	6.14	0.165	0.254	0.435	0.629	0.486
EXT3	4.36	0.034	0.060	0.108	0.156	0.239

The post-development hydrologic model runs for the SCS Type-II and 4-hour Chicago storm distributions can be found in **Appendix C**.

6.0 Quantity Control

6.1 Max Release Rate to Fox Street Sewer Outlet

Although peak flow attenuation to pre-development levels is not required for storm events in excess of the 2-year storm event, the release rate for 5-year through to 100-year storm events is required be within the allotted capacity of the existing 975mm diameter Fox Street outlet pipe.

The allotted capacity for the subject development is pipe's capacity less the storm flows from external lands which are tributary to this pipe.

The capacity of the 975mm diameter pipe is **2.338m^3/s** (as noted in the Functional Servicing Report completed by RJ Burnside & Associates Limited for the Village at Bay Moorings Residential Development Located to the south of the subject development).

The most critical/ governing storm flow that this pipe is to convey is the 100-year storm flow.

The existing 100-year flow from the development to the south is **0.933m^3/s** (referenced from the Village at Bay Moorings Development Phase 4 FSR prepared by WMI & Associates Ltd., September 2012).

The existing 100-year flow from the external lands to the east and west of the site is **1.071m^3/s** (combined flows from EXT 1, 2, 3 as detailed in this report). Therefore, the maximum allotted release rate for the subject site into the 975mm diameter Fox Street outlet pipe is **0.334m^3/s (**2.338 - 0.933 - 1.071).

From comparing the uncontrolled post development peak flows noted in Tables 2 & 3 for catchment 101, it can be seen that the uncontrolled post-development peak flows exceed the allowable release rate levels for the 2-year through to 100-year storm events, therefore some peak flow attenuation is required.

6.2 Preliminary SWM facility Design

In comparing the model run outputs from 24-hour SCS Type-II and 4-hour Chicago storm distributions, the 24-hour SCS Type-II Distribution consistently produced more conservative storage volumes, and therefore were used in establishing the size and preliminary design of the proposed Stormwater management facility.

The proposed stormwater management facility will be designed to incorporate quantity controls for the runoff generated on-site. **Table 4** below provides an overall release rate and stage-storage-discharge summary for the controlled discharge from a SWM facility that would be required to attenuate all storm events up to including the 100-year storm event to the allowable release rate levels.

Table 4: Release Rate & SWM Facility Stage-Storage-Discharge Summary

Storm Event (Year)	4-hr Chicago Storm Pre-Development Peak Flows (m3/s) (per Table 1)	Catchment 101 Post-Development Peak Flows-Uncontrolled (m3/s) (per Table 3)	Pond Outflow-Post Development Controlled Peak Flow - Catchment 101 (m3/s)	Estimated SWM Facility Active Storage Volume (m3)	Estimated SWM Facility Water Levels (MASL)
2	0.064	0.382	0.063	888	185.74
5	0.138	0.577	0.131	1183	185.91
25	0.292	0.953	0.251	1708	186.19
100	0.458	1.310	0.299	2258	186.47

From comparing the Total Post-development Peak Flows from table 3 to the allowable release flows noted previously, it can be seen that the SWM facility storage volumes and storage water levels are sufficient to attenuate peak flows to below allowable levels, for 5-year through to 100-year storm events. Also, it can be seen from table 4 that that the post development peak flow can be reduced to pre-development levels for the 2-year design storm event.

The proposed SWM facility illustrated in Figure 3 (Contained in Appendix A) is sized to provide adequate storage to attenuate flows to the permitted release rates noted previously, based on a permanent pool elevation of 185.10masl. The preliminary design is also in accordance with the summary of design guidance for Wet Pond facilities noted in the Ministry of the Environment's 2003 Stormwater Management Planning and Design Manual, table 4.6.

To meet the release rate requirements at various design storm events, multiple orifice and/or weir controls will be required to restrict flows are various stages within the pond. For the 2-year pre-development release rate target, a small diameter orifice control will likely be sufficient, however to accommodate larger release flows from larger storm events, a manhole cut-out weir will likely be required.

An earthen weir and associated overland flow channel will be incorporated into the SWM facility design to permit regional storm flows to pass without overtopping the facility or flooding adjacent properties.

A detailed analysis of the SWM facility, including the stage, storage and discharge, and inlet / outlet configuration will be provided during the detailed design phase.

Other Preliminary SWM facility Calculations are contained in Appendix B for reference.

7.0 Quality Control

The stormwater management requirements for this site were determined in consultation with the Town of Penetanguishene. The appropriate level of quality control was determined to be at an 'enhanced' level as defined by the MOE's Stormwater Management Planning & Design Manual (2003), which equates to the provision of 80% total suspended solids (TSS) removal.

An integrated treatment train approach will also be implemented to design the storm drainage system, which will help minimize any negative impacts the proposed development may have on the existing quality of stormwater runoff. The integrated treatment train approach is premised on providing quality control at the following three separate locations within the development:

i) Lot Level Control: Reduced lot grading and roof leaders discharging to pervious surfaces on the residential lots will encourage infiltration and ultimately groundwater recharge at the source within the development.

ii) Conveyance Control: Grassed swales will be utilized where necessary to convey stormwater runoff to either the storm sewer system or wet pond facility directly. The grassed swales within the development will not only provide stormwater conveyance but also aid in quality control enhancement of the stormwater before it enters the proposed wet pond facility and ultimately exits the subject lands. Also, due to the nature of the development which requires the use of an urban road cross-section, all proposed catchbasins will be equipped with sumps to help promote the removal of suspended solids travelling within the storm sewer system before being released into the end-of-pipe wet pond facility.

iii) End-of-pipe Control: The final element to the treatment train approach to stormwater quality control is the use of a wet pond facility consisting of a permanent pool and extended detention storage.

The preliminary calculations contained in this report provide end of pipe quality control calculations pertaining to storage volumes and release rates within the SWM facility in accordance with MOE criteria for the subject site area only (catchment 101). Some quality attenuation will inherently be provided for external areas draining into block 90, however, since this area acts as a natural attenuation buffer.

Preliminary SWM facility Calculations pertaining to quality control storage volumes are contained in Appendix B for reference.

8.0 Post-Development Hydrology

In an effort to minimize the loss in on-site infiltration expected due to development, soak-away pits are proposed for the lots and the medium density block 88.

To approximate the total rainfall volume that soak away pits could retain, a desktop analysis of rainfall events and native soils conditions were completed.

As identified in the PML Geotechnical report, the native soils are predominantly sand, which is ideal for infiltration, however soak-away pits should be constructed with shallow depths to avoid conflict with the high groundwater table in some locations. The native soils are considered to have percolation rates of at least 60mm/hr (for Loamy sand, as per MOE Stormwater Management Planning & Design Manual table 4.4).

From Rainfall Event Analysis Reports for the Orillia rainfall station (sourced from the PCSWMM program development by Imbrium Systems Corp.), it is estimated that the cumulative percentage of annual rainfall volume attributed from rainfall events with depths less than or equal to 19.05mm is 71.2%. Furthermore, the typical maximum rainfall depth used in the sizing of soak-away pits which accept rooftop runoff is 20mm.

For the subdivision lots the average rooftop area is assumed to be 1500ft^2 (140m^2). For a 20mm rainfall event, the required storage volume is 2.8m3 for each lot. Using a 1.2m soak-away pit depth, a clearstone medium with a 0.40 voids ratio, the dimensions of a soak away pit required to retain and infiltrate 20mm of rainfall over a rooftop area is approximately 2m (L) x 3m (W) x 1.2m (D) (2.0*3.0*1.2*0.4 = 2.88m^3 storage volume).

The total rooftop area proposed for the block 88 multi-residential buildings is 3464m^2, which would require a storage volume of 69.3m3 for all of the rooftops. Using the same parameters as above, twelve 3.5m (L) x 3.5m (W) x 1.2m (D) soak away pits could be employed (12*3.5*3.5*1.2*0.4 = 70.6m^3 storage volume).

Since the cumulative percentage of annual rainfall volume attributed from rainfall events with depths less than or equal to 19.05mm is 71.2%, the total annual volume of rainfall retained can be expressed by the following equation:

466mm/yr rainfall x 71.2% x (87 lots x 140m2 lot rooftop area + 3464m2 blk 88 rooftop area) = 5.19x10^{6}L/yr

Therefore, the increase in on-site infiltration as a result of the soak-away pits on each of the subdivision lots and within the medium density residential block is
(0.519 + 2.7) x10^7 L/yr = 3.22 x10^7 L/yr.

To provide surface water recharge, it is proposed to direct the existing flows from external lands located to the east of the site into the block 90 woodlot. This will be achieved by utilizing a shallow rear-lot storm sewer or overland flow channel to convey runoff through the rear of lots 25-27 and 33-36 and across Beck boulevard into the woodlot. This will be beneficial since it will provide significant surface water retention for block 90, and also because it can be drained by an overland conveyance route or shallow storm sewer that will be above the existing groundwater table and have minimal crossing conflicts with other sewers.

9.0 Sediment and Erosion Controls

In accordance with Town policy, effective erosion and sediment control must be established prior to construction commencement and maintained until the site has been stabilized. Exposure of the soil during construction should be minimized to avoid erosion and sedimentation. The sites erosion potential may be mitigated through the use of sound erosion and sedimentation control measures. The following measures must shall be carried out prior to construction and maintained until disturbed areas have regained a significant grass cover:

Topsoil Stripping: Topsoil stripping will be reduced as much as possible on-site. Where grading is necessary, the exposed soil will be stabilized by seeding immediately upon being set to grade. Should topsoil stockpiling be required, the stockpiles will be kept at manageable levels for grass/weed cutting purposes.

Silt Fence: Silt fence will be placed along the down slope of all excavated material and along the perimeter of the site to prevent sediment transport. Periodic inspections and repairs to the silt fence should be performed regularly, as well as after every rainfall event.

Mud Mat: Mud tracking from construction traffic must be controlled through the use of a mud-mat consisting of clear stone located at the site's construction entrances/ exits.

Vegetated Buffers: Existing grassland vegetation/wooded and lawn areas along the development limits are to be maintained wherever possible. These areas will provide a natural barrier to filter potentially sediment-laden overland flow before it is released from the site.

Finally, the Site Engineer will be responsible for completing routine inspections of the sediment and erosion control structures throughout the construction phase of the development, particularly after rainfall events. All damaged or clogged control devices or fencing must be repaired immediately.

10.0 Summary and Conclusions

This Functional Servicing and Stormwater Management Report demonstrates how the proposed development drainage can be serviced and how drainage can be accommodated. Specifically, we note the following:

- A storm sewer system will provide minor system drainage, and new municipal roadways will provide major storm conveyance to a new SWM facility located centrally within the site.
- A network of sanitary sewers will service the subject development and connect into the existing municipal sanitary drainage system to the south of the site. new watermains will also connect to existing mains to the south of the subject site, and will provide adequate potable water and fire flow service. A Permit to Take Water will likely be required to facilitate dewatering the sanitary sewer trench during construction.
- The preliminary grading design takes into consideration the high groundwater table by keeping proposed elevations as high as possible, drainage permitting. Engineered fill or pier/ piling equipped house foundations will need to be implemented to overcome low bearing pressures afforded by the native soils.
- The proposed SWM facility will provide quantity controls for the subject development to pre-development levels for up to the 2-year design storm event. Storm events greater in intensity than this, for up to and including the 100-year storm event, will be attenuated to less than or equal to the available capacity of the existing 975mm diameter outlet sewer on Fox Street.
- External areas upstream of the site will be conveyed directly to the block 90 woodlot via overland flow channels and storm sewers. Runoff from large, infrequent storm events not retained by the woodlot will be drained by an interceptor swale and connect to the SWM facility outlet sewer, and outlet to the existing 975mm diameter Fox Street outlet sewer.
- An integrated treatment train approach will be implemented into the design of the internal storm drainage system which will help minimize any negative impacts the proposed development may have on the existing quality of stormwater runoff. An 'enhanced' level of quality control, as defined in the MOE's Stormwater Management Planning & Design Manual will be provided through extended detention storage provided within the SWM facility.
- Soak away pits will be provided on each lot in an effort to increase infiltration and lessen the effects of a reduction in post-development water balance for the area. Further groundwater recharge will be provided for the environmentally sensitive Block 90 woodlot by routing an external drainage by-pass sewer directly to these lands, to mimic existing conditions.
- The use of silt fencing, existing vegetated buffers, and a construction mud mat will ensure downstream stormwater quality is maintained during construction.

The functional servicing and stormwater management strategy described in this report demonstrates that the site can be accommodated within the framework of existing / adjacent infrastructure, with minimal impacts on the surrounding environment.

Based on the above, we request that this report be received by the Municipality in support of draft plan approval of the proposed plan of subdivision and ultimately the construction of the proposed development.

Respectfully submitted,

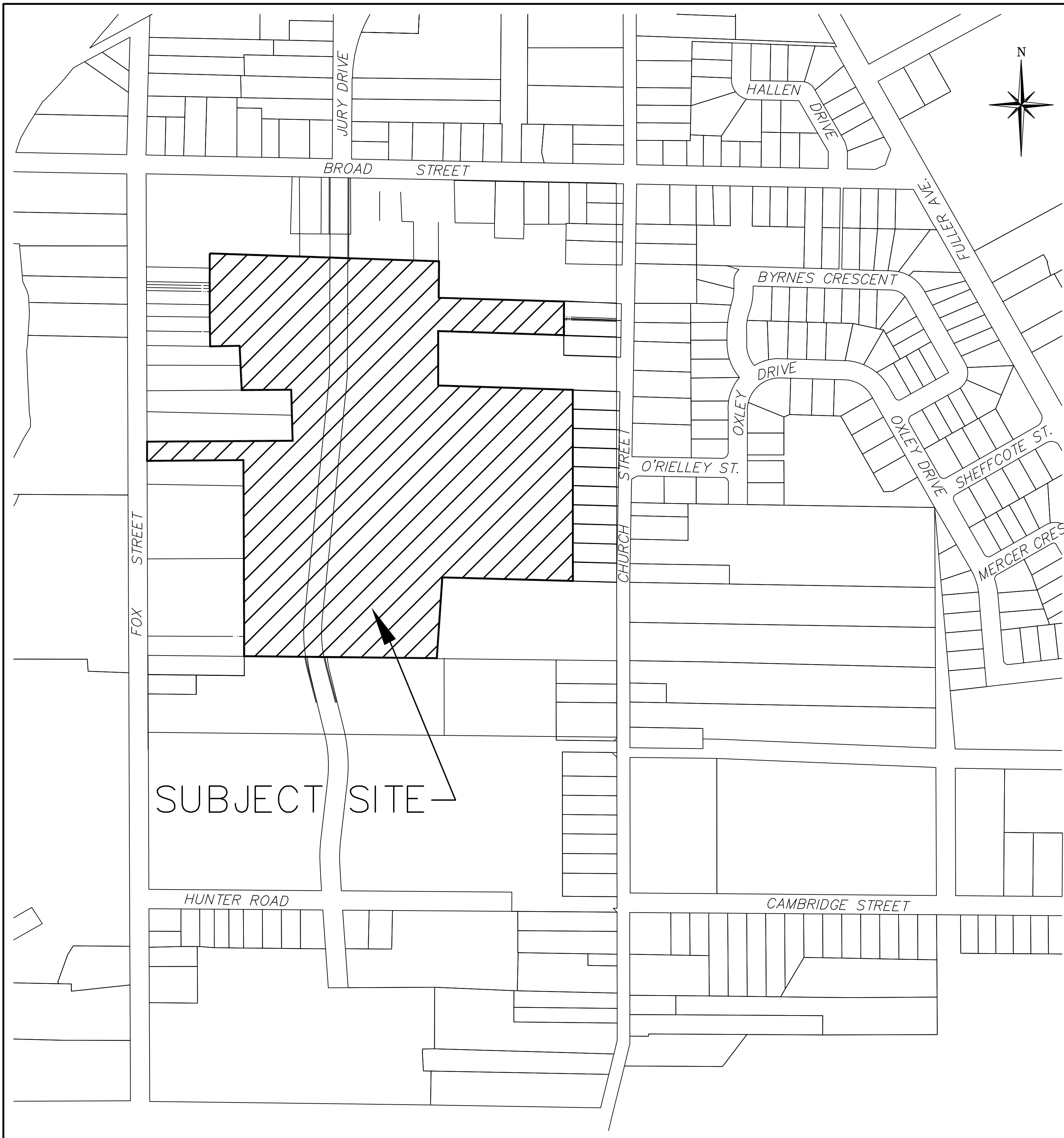
WMI & Associates Limited

Jonathan Reimer, P. Eng.

\\Wmi-server\wmi-server\Data\Projects\2009\09-062\Reports\FSR SWM\130201 FSR SWM Report.doc

Figures

Appendix A



Drawing Title

SITE LOCATION PLAN

Project Title

221 Fox Street Subdivision

WMI & Associates Limited
119 Collier Street
Barrie, Ontario
L4M 1H5
705-797-2027
www.wmiengineering.ca

Drawn By	Checked By	Figure No.
JR	DAI	FIG1
Scale: N.T.S.	Project No.: 09-062	

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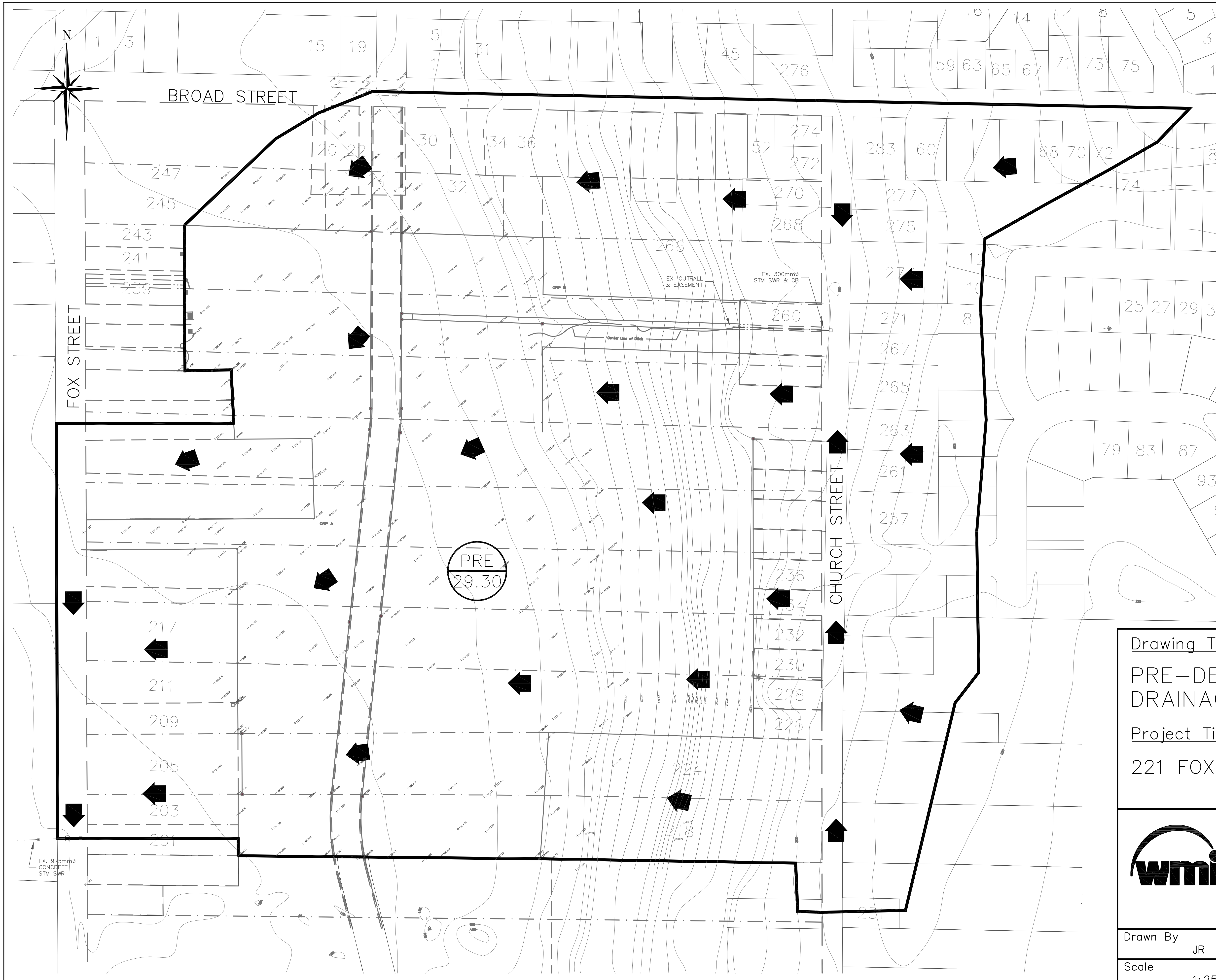


Legend:

0 / 0.00	D.A. IDENTIFICATION / D.A. (HA)
- - - -	LIMITS OF DRAINAGE AREA
⬅	DRAINAGE FLOW DIRECTION

Drawing Title

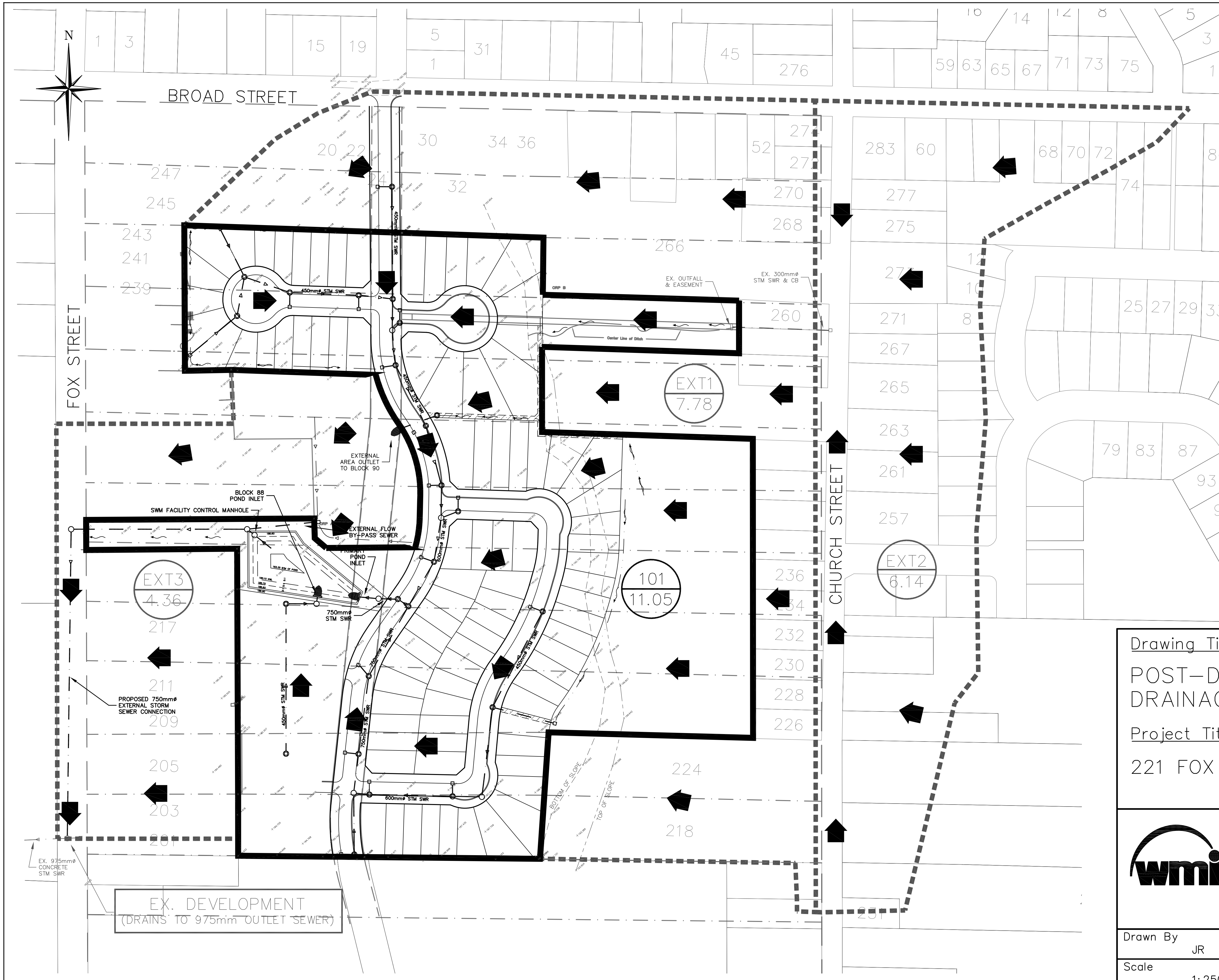
PRE-DEVELOPMENT DRAINAGE PLAN

Project Title

221 FOX STREET SUBDIVISION

WMI & Associates Limited
119 Collier Street
Barrie, Ontario
L4M 1H5
705-797-2027
www.wmiengineering.ca

Drawn By	Checked By	Figure No.
JR	DAI	FIG2
Scale 1:2500	Project No. 09-062	



Legend:

0 / 0.00	D.A. IDENTIFICATION / D.A. (HA)
- - - -	LIMITS OF DRAINAGE AREA
◀	DRAINAGE FLOW DIRECTION

TOTAL 100-YR FLOW INTO EX. 975mmø SEWER OUTLET:

C.A. 101 (POND OUTFLOW)	0.299m3/s
EXT 1 & 2	0.915m3/s
EXT 3	0.156m3/s
DEV FROM SOUTH	0.933m3/s
TOTAL	2.303m3/s

Drawing Title

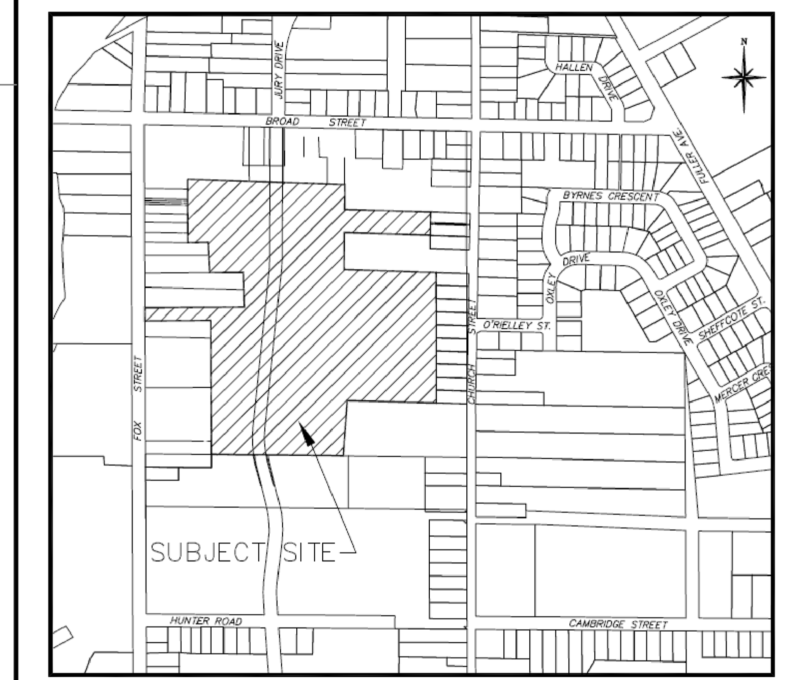
POST-DEVELOPMENT DRAINAGE PLAN

Project Title

221 FOX STREET SUBDIVISION

WMI & Associates Limited
119 Collier Street
Barrie, Ontario
L4M 1H5
705-797-2027
www.wmiengineering.ca

Drawn By	Checked By	Figure No.
JR	DAI	FIG3
Scale 1:2500	Project No. 09-062	



KEY PLAN N.T.S.

PROPOSED SUBDIVISION
221 FOX STREET
TOWN OF PENETANGUISHENE

COUNTY OF SIMCOE
SCALE 1 :1000

25 20 15 10 5 0 25 50 75metres

OWNERS' CERTIFICATE

WE, THE UNDERSIGNED, BEING THE REGISTERED OWNERS OF THE SUBJECT LANDS HEREBY AUTHORIZE LUCAS AND ASSOCIATES TO PREPARE THIS DRAFT PLAN OF SUBDIVISION AND TO SUBMIT SAME TO THE COUNTY OF SIMCOE FOR APPROVAL.

DATE

XXX

SURVEYOR'S CERTIFICATE

I CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO ADJACENT LANDS ARE ACCURATLEY AND CORRECTLY SHOWN.

DATE

PETER RAIKES, OLS

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT

a) SHOWN ON PLAN
b) SHOWN ON PLAN
c) SEE KEY PLAN
d) RESIDENTIAL, OPEN SPACE
e) SHOWN ON PLAN
f) SHOWN ON PLAN
g) SHOWN ON PLAN
h) MUNICIPAL WATER
i) SILTY SAND
j) SHOWN ON PLAN
k) PRIVATE SEWAGE DISPOSAL
l) SHOWN ON PLAN

METRIC

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED BY DIVIDING BY 0.3048.

STATISTICS

	AREA	%	RESIDENTIAL UNITS
SINGLE FAMILY RESIDENTIAL (12m) (LOTS 1-87)	4.64 ha.	38.63%	87
MEDIUM DENSITY TOWNHOUSE (BLOCK 88)	1.20 ha.	9.99%	28
OPEN SPACE (PARKLAND) (BLOCKS 91 & 92)	0.48 ha.	4.00%	
OPEN SPACE (SWM POND) (BLOCKS 89)	0.58 ha.	4.83%	
ENVIRONMENTAL PROTECTION (BLOCKS 90 & 93)	3.07 ha.	25.56%	
ROADS	2.04 ha.	1699%	
TOTAL	12.01 ha.	100.00%.	115

Lucas & Associates
Consultants in Planning and Land Development

24 Debra Crescent, Barrie, Ontario L4N 3T1
(705) 721-9635 Fax (705) 721-7367

DATE : January 30, 2013 | DRAWN BY : G.J.L.

DWG NAME : DRAFT PLAN OF SUBDIVISION FIRST SUBMISSION.DWG

Design Calculations

Appendix B

WMI & Associates Limited
119 Collier Street, Barrie, Ontario L4M 1H5
p (705) 797-2027 f (705) 797-2028

Preliminary Sanitary Sewer Design Sheet
221 Fox St. Development

<<< **Elements Requiring Input Information**

q = **average** sewage flow rate
i = **peak** extraneous (i.e. infiltration) flow rate
M = Ultimate Flow Factor (peaking factor)
Q_p = peak population flow (L/s)
Q_i = peak extraneous (i.e. infiltration) flow (L/s)
Q_d = peak design flow (L/s)

MOE Velocity Requirements: 0.6m/s - 3.0m/s

Average Sewage Flow Rates:
Residential (L/cap./day), q: 450
(for Industrial/Commercial/Institutional sewage flow calculations, see Notes below)

Peak Infiltration Flow Rate:
Infiltration (L/s/ha), i: 0.19

Ultimate Flow Peaking Factor:
(Harmon) $M=1+(14/(4+P^{0.5}))$
where, P is population in 1000's

Population Density:
Population Density: 2.5

Peak Flow Formulaes:
$Q_p = (P*q*M)/86.4$ (L/s)
$Q_i = i*A$ (L/s), where A = Area (ha)
$Q_d = Q_p + Q_i$ (L/s)

Mannings Coefficient, 'n': 0.013

Date: 01-Feb-13
Project No: 09-062
Prepared by: JR

Location			Sewage Flow Calculation Data										Sewer Calculation Data					Sewer Profile Data						
Street	Upstream NODE	Downstream NODE	No. of Units OR Area (ha)	People per Unit OR People per ha	Individual Number of People	Cumulative Number of People	Ultimate Flow Factor (Harmon)	Sewage Flow (L/s)	Infiltration Individual Area (ha)	Infiltration Cumulative Area (ha)	Infiltration Flow (L/s)	Total Flow (L/s)	Dia. (mm)	Slope (%)	Length (m)	Capacity (L/s)	Velocity (m/s)	Fall in Sewer (m)	Drop in MH (m) DS	Top of Grate Elevation (m) US	Top of Grate Elevation (m) DS	Invert Elevation (m) US	Invert Elevation (m) DS
Streets A & B	**5**	**3**	**30**	2.5	75	75	4.28	1.67	**2.28**	2.28	0.43	2.10	**200**	**0.50**	**234.0**	24.19	0.75	1.17					
Street C	**4**	**3**	**11**	2.5	28	28	4.36	0.64	**1.14**	1.14	0.22	0.85	**200**	**6.50**	**81.0**	87.24	2.69	5.27					
Street E & D	**4**	**1**	**34**	2.5	85	85	4.26	1.89	**1.14**	1.14	0.22	2.10	**200**	**2.00**	**286.0**	48.39	1.49	5.72					
Beck Blvd.	**3**	**2**	**7**	2.5	18	121	4.22	2.66	**1.14**	4.56	0.87	3.53	**200**	**0.50**	**129.0**	24.19	0.75	0.65					
Block 79	**Block 79**	**2**	**28**	2.5	70	70	4.28	1.56	**1.14**	1.14	0.22	1.78	**200**	**0.50**	**102.0**	24.19	0.75	0.51					
Beck Blvd.	**2**	**1**	**5**	2.5	13	204	4.14	4.40	**1.14**	6.84	1.30	5.70	**200**	**0.50**	**74.0**	24.19	0.75	0.37					
Beck Blvd.	**1**	**MH GG**	**0**	2.5	0	289	4.09	6.15	**0.00**	7.98	1.52	7.67	**200**	**0.50**	**48.0**	24.19	0.75	0.24					

Total No. of Units/Area (ha): 115

Total Area (ha): 7.98

NOTES:

-To determine approximate pipe sizes, each node is assumed to accept 1/7 of the internal developed area (7.99 / 7 = 1.14 ha)

- Industrial/Commercial/Institutional sewage flows can be inserted as hard values under the **Sewage Flow** column or calculated based on an equivalent **No. of Units** OR **Area (ha)** considering the **Average Residential Sewage Flow Rate** & **Population Density** provided above).

WMI & Associates Limited
119 Collier Street, Barrie, Ontario L4M 1H5
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Preliminary Storm Sewer Design Sheet
221 Fox St. Development & External Areas

<<< **Elements Requiring Input Information**

Rational Method Calculation:

$Q = 2.78*(C_F*C*I*A)$

where,
Q = peak flow rate (L/s)
C_F = runoff coefficient factor for storms **> 10-yr** (C_F = 1.0 for the 2, 5 & 10-yr storm events and C_F = 1.1, 1.2 & 1.25 for the 25, 50 & 100-yr storm events respectively)
C = runoff coefficient
I = rainfall intensity (mm/hr)
A = area (ha)

Manning's Formula Calculation:

$V = (k*R^{2/3}*S^{1/2}) / n$ $Q = V*A$

MOE Velocity Requirements: 0.8m/s - 6.0m/s

where,
V = mean velocity (m/s)
k = 1.0 for SI units
R = hydraulic radius (m)
S = friction slope (m/m)
n = Mannings Coefficient **0.013**

Rainfall Intensity Calculation:

$I = A*T_C^B$

where,
T_C = Time of Concentration (hr)
A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient

Rainfall IDF Data:	**Orillia, ON.**	
	5-year	**100-year**
A =	**29.7**	**49.9**
B =	**-0.728**	**-0.726**
Runoff Coeff. Factors, C_F =	1.00	1.25

Date: **01-Feb-13**
Project No: **09-062**
Prepared by: **JR**

Location			Runoff Calculation Data										Sewer Calculation Data							Sewer Profile Data					
Street	Upstream NODE	Downstream NODE	Drainage Areas (ha) C = 0.20	C = 0.40	C = 0.60	C = 0.75	Individual 2.78CA	Accumulated 2.78CA	Time of Concentration (mins)	Storm Event	Rainfall Intensity (mm/hr)	Peak Runoff Flow (L/s)	Diameter (mm)	Slope (%)	Length (m)	Capacity (L/s)	Velocity (m/s)	Pipe Flow Time (mins)	Pipe Storage Volume (m^3)	Fall in Sewer (m)	Drop in MH (m) DS	Top of Grate Elevation (m) US	Top of Grate Elevation (m) DS	Invert Elevation (m) US	Invert Elevation (m) DS
EXT FLOW*	**EXT 1 & 2**	**blk 90**								**5-year**		405.00	**450**	**2.00**	**30.00**	420.63	2.56	0.20	4.9	0.60					**INPUT VALUE**
ST. A, B & BECK BLVD	**3**	**2**			**1.84**		3.07	3.07	20.00	**5-year**	66.08	203.04	**450**	**0.50**	**100.00**	210.32	1.28	1.30	16.4	0.50					
BECK BLVD - POND	**2**	**1**			**1.84**		3.07	6.14	21.30	**5-year**	63.12	387.87	**600**	**0.50**	**100.00**	452.94	1.55	1.07	29.2	0.50					
ST. E - ST. D	**6**	**5**			**1.84**		3.07	3.07	15.00	**5-year**	81.48	250.35	**450**	**1.00**	**100.00**	297.43	1.81	0.92	16.4	1.00					
ST.D - BECK BLVD.	**5**	**4**			**1.84**		3.07	6.14	15.92	**5-year**	78.03	479.46	**600**	**1.00**	**100.00**	640.56	2.19	0.76	29.2	1.00					
BECK BLVD - POND.	**4**	**1**			**1.84**		3.07	9.22	16.68	**5-year**	75.42	695.20	**750**	**0.50**	**100.00**	821.24	1.80	0.93	45.6	0.50					
PRIMARY POND INLET**	**1**	**POND1**			**0.00**		0.00	15.36	22.37	**5-year**	60.90	935.58	**750**	**0.75**	**100.00**	1005.81	2.21	0.76	45.6	0.75					
BLOCK 79 POND INLET	**7**	**POND2**			**1.84**		3.07	3.07	15.00	**5-year**	81.48	250.35	**450**	**0.75**	**100.00**	257.58	1.57	1.06	16.4	0.75					

Sum of Drainage Areas (ha):	0.00	0.00	11.05	0.00
Total Drainage Area (ha):	11.05			

NOTES: To determine approximate pipe sizes, each node is assumed to accept 1/6 of the internal site area's internal drainage area (11.05 / 6 = 1.84 ha)
* 5-year flow for catchment EXT 1 & 2 determined from SWMHYMO model added in as hard value.

WMI & Associates Limited
119 Collier Street, Barrie, Ontario L4M 1H5
p (705) 797-2027 f (705) 797-2028

RUNOFF COEFFICIENT CALCULATIONS
"C" SPREADSHEET

Date: 07-Jan-13 **Project No.:** 09-062

Project: 221 Fox St. FSR **Prepared By:** JR

RUNOFF COEFFICIENT NUMBERS

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade	0.22	0.35	0.55
	5 - 10% grade	0.3	0.45	0.6
	10 - 30% grade	0.4	0.65	0.7
Pasture Land	0 - 5% grade	0.1	0.28	0.4
	5 - 10% grade	0.15	0.35	0.45
	10 - 30% grade	0.22	0.4	0.55
Woodlot or Cutover	0 - 5% grade	0.08	0.25	0.35
	5 - 10% grade	0.12	0.3	0.42
	10 - 30% grade	0.18	0.35	0.52
Lakes and Wetlands		0.05	0.05	0.05
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.95	0.95	0.95
Gravel	(not used for proposed parking or storage areas)	0.4	0.5	0.6
Residential	Single Family	0.3	0.4	0.5
	Multiple (i.e. semi, townhouse, apartment, etc.)	0.5	0.6	0.7
Industrial	Light	0.55	0.65	0.75
	Heavy	0.65	0.75	0.85
Commercial		0.6	0.7	0.8
Unimproved Areas		0.1	0.2	0.3
Lawn	< 2% grade	0.05	0.11	0.17
	2 - 7% grade	0.1	0.16	0.22
	> 7% grade	0.15	0.25	0.35

Ref: Runoff Coefficient Numbers - Adapted from Design Chart 1.07, Ontario Ministry of Transportation, "MTO Drainage Management Manual", MTO. (1997)

<<< **Elements Requiring Input Information**

PRE-DEVELOPMENT CONDITION - PRE (existing)

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Pasture Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Woodlot or Cutover	0 - 5% grade	13.30		
	5 - 10% grade	13.30		
	10 - 30% grade			
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	2.71		
Gravel	(not used for proposed parking or storage areas)			
Residential	Single Family			
	Multiple (i.e. semi, townhouse, apartment, etc.)			
Industrial	Light			
	Heavy			
Commercial				
Unimproved Areas				
Lawn	< 2% grade			
	2 - 7% grade			
	> 7% grade			

Total Area (ha) = 29.30 **Runoff Coefficient, C =** **0.18**

WMI & Associates Limited
119 Collier Street, Barrie, Ontario L4M 1H5
p (705) 797-2027 f (705) 797-2028

RUNOFF COEFFICIENT CALCULATIONS
"C" SPREADSHEET

Date: 07-Jan-13 **Project No.:** 09-062

Project: 221 Fox St. FSR **Prepared By:** JR

RUNOFF COEFFICIENT NUMBERS

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade	0.22	0.35	0.55
	5 - 10% grade	0.3	0.45	0.6
	10 - 30% grade	0.4	0.65	0.7
Pasture Land	0 - 5% grade	0.1	0.28	0.4
	5 - 10% grade	0.15	0.35	0.45
	10 - 30% grade	0.22	0.4	0.55
Woodlot or Cutover	0 - 5% grade	0.08	0.25	0.35
	5 - 10% grade	0.12	0.3	0.42
	10 - 30% grade	0.18	0.35	0.52
Lakes and Wetlands		0.05	0.05	0.05
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.95	0.95	0.95
Gravel	(not used for proposed parking or storage areas)	0.4	0.5	0.6
Residential	Single Family	0.3	0.4	0.5
	Multiple (i.e. semi, townhouse, apartment, etc.)	0.5	0.6	0.7
Industrial	Light	0.55	0.65	0.75
	Heavy	0.65	0.75	0.85
Commercial		0.6	0.7	0.8
Unimproved Areas		0.1	0.2	0.3
Lawn	< 2% grade	0.05	0.11	0.17
	2 - 7% grade	0.1	0.16	0.22
	> 7% grade	0.15	0.25	0.35

Ref: Runoff Coefficient Numbers - Adapted from Design Chart 1.07, Ontario Ministry of Transportation, "MTO Drainage Management Manual", MTO. (1997)

<<< **Elements Requiring Input Information**

EXTERNAL AREA - EXT1

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Pasture Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Woodlot or Cutover	0 - 5% grade			
	5 - 10% grade	3.90		
	10 - 30% grade			
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.73		
Gravel	(not used for proposed parking or storage areas)			
Residential	Single Family			
	Multiple (i.e. semi, townhouse, apartment, etc.)			
Industrial	Light			
	Heavy			
Commercial				
Unimproved Areas				
Lawn	< 2% grade			
	2 - 7% grade			
	> 7% grade	3.15		

Total Area (ha) = 7.78 **Runoff Coefficient, C =** **0.21**

EXTERNAL AREA - EXT3

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Pasture Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Woodlot or Cutover	0 - 5% grade	1.96		
	5 - 10% grade			
	10 - 30% grade			
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.45		
Gravel	(not used for proposed parking or storage areas)			
Residential	Single Family			
	Multiple (i.e. semi, townhouse, apartment, etc.)			
Industrial	Light			
	Heavy			
Commercial				
Unimproved Areas				
Lawn	< 2% grade	1.96		
	2 - 7% grade			
	> 7% grade			

Total Area (ha) = 4.36 **Runoff Coefficient, C =** **0.16**

WMI & Associates Limited
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p (705) 797-2027 f (705) 797-2028

CURVE NUMBER & INITIAL ABSTRACTION CALCULATIONS
CN & IA SPREADSHEET

Date: 07-Jan-13 **Project No.:** 09-062

Project: 221 Fox St. FSR **Prepared By:** JR

SCS CURVE NUMBERS (AMC II (NORMAL) CONDITION) **INITIAL RAINFALL ABSTRACTION**

	Hydrologic Soil Groups							IA
Land Cover	**A**	**AB**	**B**	**BC**	**C**	**CD**	**D**	**(mm)**
Wetlands/Lakes/SWMF's	50	50	50	50	50	50	50	
Woods	32	46	60	67	73	76	79	10
Meadows	38	51	65	71	76	79	81	8
Pasture/Lawn	49	59	69	74	79	82	84	5
Cultivated	62	68	74	78	82	84	86	7
Impervious Areas	100	100	100	100	100	100	100	2

Ref: SCS Curve Numbers - Adapted from Design Chart 1.09, Ontario Ministry of Transportation, "MTO Drainage Management Manual", MTO.(1997)
Ref: Initial Rainfall Abstraction Values - UNESCO, Manual on Drainage in Urbanized Areas, (1987)
Ref: AMC I & III Condition SCS Curve Number Values - Modern Sewer Design, Third Edition (Canadian), pg. 69, Table 3.6, (1996)

NOTES:
- **AMC II Condition** SCS Curve Number values are not applicable to frozen soils or to the period where snowmelt contributes to stormwater runoff.
- **STANDHYD COMMANDS** (Swmhymo) - CN values are based solely on the **pervious surfaces** within the catchment.
- **NASHYD COMMANDS** (Swmhymo) - CN values are based on both the **pervious and impervious surfaces** within the catchment (composite CN value).

<<< **Elements Requiring Input Information**

PRE-DEVELOPMENT CONDITION - PRE (existing)

Area per Land Cover Type and Hydrologic Soil Group

	Hydrologic Soil Groups						
Land Cover	**A**	**AB**	**B**	**BC**	**C**	**CD**	**D**
Wetlands/Lakes/SWMF's							
Woods		26.6					
Meadows							
Pasture/Lawn							
Cultivated							
Impervious Areas		2.71					

(for Nashyd Command)

Total Area (ha) =	29.31
CN(I) =	31
CN(II) =	51
CN(III) =	70
IA (mm) =	9.3

WMI & Associates Limited
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CURVE NUMBER & INITIAL ABSTRACTION CALCULATIONS
CN & IA SPREADSHEET

Date: 07-Jan-13 **Project No.:** 09-062

Project: 221 Fox St. FSR **Prepared By:** JR

SCS CURVE NUMBERS (AMC II (NORMAL) CONDITION)

	Hydrologic Soil Groups							INITIAL RAINFALL ABSTRACTION IA
Land Cover	**A**	**AB**	**B**	**BC**	**C**	**CD**	**D**	**(mm)**
Wetlands/Lakes/SWMF's	50	50	50	50	50	50	50	
Woods	32	46	60	67	73	76	79	10
Meadows	38	51	65	71	76	79	81	8
Pasture/Lawn	49	59	69	74	79	82	84	5
Cultivated	62	68	74	78	82	84	86	7
Impervious Areas	100	100	100	100	100	100	100	2

Ref: SCS Curve Numbers - Adapted from Design Chart 1.09, Ontario Ministry of Transportation, "MTO Drainage Management Manual", MTO.(1997)
Ref: Initial Rainfall Abstraction Values - UNESCO, Manual on Drainage in Urbanized Areas, (1987)
Ref: AMC I & III Condition SCS Curve Number Values - Modern Sewer Design, Third Edition (Canadian), pg. 69, Table 3.6, (1996)

NOTES:
- **AMC II Condition** SCS Curve Number values are not applicable to frozen soils or to the period where snowmelt contributes to stormwater runoff.
- **STANDHYD COMMANDS** (Swmhymo) - CN values are based solely on the **pervious surfaces** within the catchment.
- **NASHYD COMMANDS** (Swmhymo) - CN values are based on both the **pervious and impervious surfaces** within the catchment (composite CN value).

<<< **Elements Requiring Input Information**

EXTERNAL AREA - EXT1

Area per Land Cover Type and Hydrologic Soil Group

	Hydrologic Soil Groups						
Land Cover	**A**	**AB**	**B**	**BC**	**C**	**CD**	**D**
Wetlands/Lakes/SWMF's							
Woods		3.904					
Meadows							
Pasture/Lawn		3.148					
Cultivated							
Impervious Areas		0.726					

(for Nashyd Command)
Total Area (ha) = 7.78
CN(I) = 36
CN(II) = 56
CN(III) = 75
IA (mm) = 7.2

EXTERNAL AREA - EXT2

Area per Land Cover Type and Hydrologic Soil Group

	Hydrologic Soil Groups						
Land Cover	**A**	**AB**	**B**	**BC**	**C**	**CD**	**D**
Wetlands/Lakes/SWMF's							
Woods							
Meadows							
Pasture/Lawn		4.596					
Cultivated							
Impervious Areas							

(for Standhyd Command)
Pervious Area (ha) = 4.60
CN(I) = 39
CN(II) = 59
CN(III) = 77
IA (mm) = 5.0

EXTERNAL AREA - EXT 3

Area per Land Cover Type and Hydrologic Soil Group

	Hydrologic Soil Groups						
Land Cover	**A**	**AB**	**B**	**BC**	**C**	**CD**	**D**
Wetlands/Lakes/SWMF's							
Woods		1.96					
Meadows							
Pasture/Lawn		1.96					
Cultivated							
Impervious Areas		0.45					

(for Nashyd Command)
Total Area (ha) = 4.37
CN(I) = 37
CN(II) = 57
CN(III) = 75
IA (mm) = 6.9

POST-DEVELOPMENT CONDITION - C.A. 101

Area per Land Cover Type and Hydrologic Soil Group

	Hydrologic Soil Groups						
Land Cover	**A**	**AB**	**B**	**BC**	**C**	**CD**	**D**
Wetlands/Lakes/SWMF's							
Woods		2.5					
Meadows							
Pasture/Lawn		4.69					
Cultivated							
Impervious Areas							

(for Standhyd Command)
Pervious Area (ha) = 7.19
CN(I) = 34
CN(II) = 54
CN(III) = 73
IA (mm) = 6.7

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TIME OF CONCENTRATION & TIME TO PEAK CALCULATIONS
T_C & T_P SPREADSHEET

Date: 07-Jan-13 **Project No.:** 09-062

Project: 221 Fox St. FSR **Prepared By:** JR

OVERLAND SHEET FLOW TIME OF CONCENTRATION (T_C) CALCULATION, $T_{C, OVER}$
The Runoff Coefficient 'C' governs which Time of Concentration Formula is used:
C >= 0.40 Bransby Williams Formula
C < 0.40 Airport Formula (FAA Equation)
Ref: MTO, Drainage Management Manual, pg 28, Ch. 8, 1997

[ ] <<< **Elements Requiring Input Information**

Catchment I.D.	Area (ha)	h_1 (m)	h_2 (m)	Length (m)	Runoff Coefficient	h_{DELTA} (m)	Slope (%)
**PRE (a)	14.65	188	182	330	0.18	6.0	1.8
**PRE (b)	14.65	226	188	380	0.18	38.0	10.0

$T_{C, OVER}$ (min.)	
Airport Formula	Bransby Williams Formula
44.7	
27.3	

Airport Formula (FAA Equation)

$$T_{C, OVER} = \frac{3.26\,(1.1-C)\,(L)^{0.5}}{(S)^{0.33}} \quad \text{(min.)}$$

where, C = Runoff Coefficient
L = Length of Overland Flow Path, (m)
S = Avg. Slope of Overland Flow Path, (%)

Bransby Williams Formula

$$T_{C, OVER} = \frac{0.057\,(L)}{(S)^{0.2}\,(A)^{0.1}} \quad \text{(min.)}$$

where, L = Length of Overland Flow Path, (m)
S = Avg. Slope of Overland Flow Path, (%)
A = Catchment Area, (ha)

CHANNELIZED FLOW TIME OF CONCENTRATION (T_C) CALCULATION, $T_{C, CHAN}$
Refer to separate sheet attached for the calculation of the Velocity values (i.e. Flow Master Output, Manning's Channel Spreadsheet, etc.).

Catchment I.D.	Length (m)	Velocity (m/s)

$T_{C, CHAN}$ (min.)

$$T_{C, CHAN} = \frac{L}{V} \quad \text{(min.)}$$

where, L = Length of Channel, (m)
V = Flow Velocity in Channel, (m/s)

PIPED FLOW TIME OF CONCENTRATION (T_C) CALCULATION, $T_{C, PIPE}$
Refer to separate sheet attached for the calculation of the Velocity values (i.e. Culvert Master Output, Manning's Pipe Spreadsheet, etc.).

Catchment I.D.	Length (m)	Velocity (m/s)

$T_{C, PIPE}$ (min.)

$$T_{C, PIPE} = \frac{L}{V} \quad \text{(min.)}$$

where, L = Length of Pipe, (m)
V = Flow Velocity in Pipe, (m/s)

TOTAL TIME OF CONCENTRATION (T_C) AND TIME TO PEAK (T_P) CALCULATION, $T_{C, TOTAL}$, $T_{P, TOTAL}$
The Total Time of Concentration and Time to Peak values consist of a combination of the Overland, Channel and/or Pipe travel times.

Catchment I.D.	$T_{C, OVER}$ (min.)	$T_{C, CHAN}$ (min.)	$T_{C, PIPE}$ (min.)
**PRE (a)	44.7		
**PRE (b)	27.3		

$T_{C, TOTAL}$ (min.)	$T_{P, TOTAL}$ (min.)
44.7	**29.9**
27.3	**18.3**

$$T_{C, TOTAL} = T_{C, OVER} + T_{C, CHAN} + T_{C, PIPE} \quad \text{(min.)}$$

$$T_{P, TOTAL} = 0.67 \times T_{C, TOTAL} \quad \text{(min.)}$$

**Note: The flow paths for the pre-development catchments have been broken up into 2 segments - (a) representing the flat section, and (b) representing the steep section, to give a more realistic Tc Value.
*Note: the "PRE undv" case refers to the condition which assumes that all areas surrounding the subject site are undeveloped (less impervious area)

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TIME OF CONCENTRATION & TIME TO PEAK CALCULATIONS
T_C & T_P SPREADSHEET

Date: 07-Jan-13 **Project No.:** 09-062

Project: 221 Fox St. FSR **Prepared By:** JR

OVERLAND SHEET FLOW TIME OF CONCENTRATION (T_C) CALCULATION, $T_{C, OVER}$

The Runoff Coefficient 'C' governs which Time of Concentration Formula is used: C >= 0.40 Bransby Williams Formula; C < 0.40 Airport Formula (FAA Equation)

Ref: MTO, Drainage Management Manual, pg 28, Ch. 8, 1997

<<< **Elements Requiring Input Information**

Catchment I.D.	Area (ha)	h_1 (m)	h_2 (m)	Length (m)	Runoff Coefficient	h_{DELTA} (m)	Slope (%)
EXT1	7.78	214	189	267	0.21	25.0	9.4
EXT3	4.36	187.5	186.5	160	0.16	1.0	0.6

$T_{C, OVER}$ (min.)	
Airport Formula	**Bransby Williams Formula**
22.7	
45.3	

Airport Formula (FAA Equation)

$$T_{C, OVER} = \frac{3.26\,(1.1-C)\,(L)^{0.5}}{(S)^{0.33}} \quad \text{(min.)}$$

where, C = Runoff Coefficient
L = Length of Overland Flow Path, (m)
S = Avg. Slope of Overland Flow Path, (%)

Bransby Williams Formula

$$T_{C, OVER} = \frac{0.057\,(L)}{(S)^{0.2}\,(A)^{0.1}} \quad \text{(min.)}$$

where, L = Length of Overland Flow Path, (m)
S = Avg. Slope of Overland Flow Path, (%)
A = Catchment Area, (ha)

CHANNELIZED FLOW TIME OF CONCENTRATION (T_C) CALCULATION, $T_{C, CHAN}$

Refer to separate sheet attached for the calculation of the Velocity values (i.e. Flow Master Output, Manning's Channel Spreadsheet, etc.).

Catchment I.D.	Length (m)	Velocity (m/s)
EXT1		
EXT3	200	0.8

$T_{C, CHAN}$ (min.)
4.2

$$T_{C, CHAN} = \frac{L}{V} \quad \text{(min.)}$$

where, L = Length of Channel, (m)
V = Flow Velocity in Channel, (m/s)

PIPED FLOW TIME OF CONCENTRATION (T_C) CALCULATION, $T_{C, PIPE}$

Refer to separate sheet attached for the calculation of the Velocity values (i.e. Culvert Master Output, Manning's Pipe Spreadsheet, etc.).

Catchment I.D.	Length (m)	Velocity (m/s)
EXT1	171	0.9
EXT3		

$T_{C, PIPE}$ (min.)
3.2

$$T_{C, PIPE} = \frac{L}{V} \quad \text{(min.)}$$

where, L = Length of Pipe, (m)
V = Flow Velocity in Pipe, (m/s)

TOTAL TIME OF CONCENTRATION (T_C) AND TIME TO PEAK (T_P) CALCULATION, $T_{C, TOTAL}$, $T_{P, TOTAL}$

The Total Time of Concentration and Time to Peak values consist of a combination of the Overland, Channel and/or Pipe travel times.

Catchment I.D.	$T_{C, OVER}$ (min.)	$T_{C, CHAN}$ (min.)	$T_{C, PIPE}$ (min.)
EXT1	22.7		3.2
EXT3	45.3	4.2	

$T_{C, TOTAL}$ (min.)	$T_{P, TOTAL}$ (min.)
25.9	**17.4**
49.5	**33.2**

$$T_{C, TOTAL} = T_{C, OVER} + T_{C, CHAN} + T_{C, PIPE} \quad \text{(min.)}$$

$$T_{P, TOTAL} = 0.67 \times T_{C, TOTAL} \quad \text{(min.)}$$

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STAGE-STORAGE-DISCHARGE (S-S-D) CALCULATIONS
SWM FACILITY

Date: 06-Jan-13 **Project No.:** 09-062

Project: 221 Fox St. FSR **Prepared By:** JR

[ ] <<< **Elements Requiring Input Information**

Unsubmerged Orifice (Weir Flow)

$Q = C_W L H^{3/2}$ (m^3/s)

where,
- Q = Flow through unsubmerged orifice (m^3/s)
- C_W = Weir Coefficient
- H = Head/Depth of water acting on weir measured from above the crest/invert of orifice (m)
- L = Length of weir (m)
- D = Diameter of Pipe/Orifice (m)

For circular vertical weir,
- L = Wetted Perimeter
- L = D x $\cos^{-1}$((D/2 - H)/(D/2))

For circular horizontal weir,
- L = Circumference
- L = 3.14 x D

Submerged Orifice (Orifice Flow)

$Q = C_O A_O (2gH)^{1/2}$ (m^3/s)

where,
- Q = Flow through submerged orifice (m^3/s)
- C_O = Orifice Discharge Coefficient
- A_O = Cross-sectional area of orifice (m^2)
- g = Gravitational acceleration ($9.81 m^2/s$)

For circular vertical orifice,
- H = Head/Depth of water acting on orifice measured from centroid of the opening (m)

For circular horizontal orifice,
- H = Head/Depth of water acting on orifice measured from above the invert (m)

Unsubmerged Weir (Weir Flow)

Rectangular Broad- & Sharp-Crested Weirs
$Q = C_W L H^{3/2}$ (m^3/s)

Triangular Broad-Crested Weirs
$Q = 1.225 H^{5/2} \tan(\text{Theta}/2)$ (m^3/s)

Triangular Sharp-Crested Weirs
$Q = 0.581(8/15)(2g)^{1/2} \tan(\text{Theta}/2) H^{5/2}$ (m^3/s)

Trapezoidal Broad- & Sharp-Crested Weirs
$Q_{TRAPEZOIDAL} = Q_{RECTANGULAR} + Q_{TRIANGULAR}$ (m^3/s)

where,
- Q = Flow through unsubmerged weir (m^3/s)
- C_W = Weir Coefficient (1.65 for Broad-Crested) (1.80 for Sharp-Crested)
- H = Head/Depth of water acting on weir measured from above the crest (m)
- L = Length of weir measured perpendicular to flow direction (m)
- Theta/2 = Angle of side slope measured from vertical axis (degrees)
- g = Gravitational acceleration ($9.81 m^2/s$)

Submerged Weir (Orifice Flow)

Submerged Sharp-Crested Weirs
$Q = C_O A_O (2gH)^{1/2}$ (m^3/s)

where,
- Q = Flow through submerged weir opening (m^3/s)
- C_O = Orifice Discharge Coefficient
- A_O = Cross-sectional area of opening (m^2)
- g = Gravitational acceleration ($9.81 m^2/s$)
- H = Head/Depth of water acting on orifice measured from centroid of the opening (m)

NOTES:

Orifice Flow Notes
- **Vertical Orifice Flow** calculations assume weir flow up to the centroid/center of orifice and then orifice flow above the crown/top of the orifice. Between the centroid and crown of the orifice is a flow transition stage from weir to orifice flow and is calculated based on a linear interpolation between the known weir flow at the centroid of the orifice and the known orifice flow at the crown.
- **Horizontal Orifice Flow** calculations assume weir flow up to one-quarter of the orifices diameter (0.25xD) and then orifice flow above three-quarters of the orifices diameter (0.75xD). Between (0.25xD) and (0.75xD) exists a flow transition stage which is calculated based on a linear interpolation between the known weir flow at (0.25xD) and the known orifice flow at (0.75xD).

Weir Flow Notes
- **Orifice control** is only applicable if the weir opening is submerged and not exposed to atmospheric pressure for all ranges of water elevations.
- For all Weir Types, **orifice control** occurs when the water surface elevation is equal to or greater than the crown/top of the opening.

\\Wmi-server\wmi-server\Data\Projects\2009\09-062\Spreadsheets\SWM\[130106 Detailed S-S-D Table .xls]S-S-D Table

Starting Water Elevation, m = **185.100**
Incremental Depth, m = **0.100**

	Orifice 1	Orifice 2	Orifice 3	Weir 1	Weir 2	Weir 3	
Orifice Type =	**Vertical**	**Horizontal**	**Horizontal**	**Rectangular Sharp-Crested**	**Rectangular Sharp-Crested**	**Trapezoidal Broad-Crested**	= Weir Type
Orifice Invert Elev., m =	**185.100**	**185.600**		**186.600**			= Weir Crest Elev., m
Incremental Depth, m =	0.100	0.100	0.100	0.100	0.100	0.100	= Incremental Depth, m
Water Elev. @ Inflow, m =	**185.100**	**185.100**		**187.000**			= Weir Openings Crown Elev., m (if appl.)
Orifice Diameter, m =	**0.075**	**0.375**		**8.00**			= Weir Length, m
Centroid of Orifice, m =	185.138	185.600		**1.80**	**1.80**	**1.65**	= Weir Coefficient
Orifice Area, m^2 =	0.0044	0.1104	0.0000				= Side Slope (H:1)
Orifice Coefficient =	**0.63**	**0.63**		0	0	0	= Theta/2, Degrees
Weir Coefficient =	**1.80**	**1.80**		186.800			= Centroid of Orifice, m (if appl.)
				3.20			= Orifice Area, m^2 (if appl.)
							= Orifice Coefficient (if appl.)

Elevation (m)	Surface Area (m^2)	Storage Volume (m^3)
185.100	1120	**0.0**
185.70	1645	829.5
186.60	2175	2548.5
186.90	2365	3229.5

Description	Elevation (m)	Orifice 1 Flow (m^3/s)	Orifice 2 Flow (m^3/s)	Orifice 3 Flow (m^3/s)	Weir 1 Flow (m^3/s)	Weir 2 Flow (m^3/s)	Weir 3 Flow (m^3/s)	Total Flow (m^3/s)	Total Storage Volume (m^3)	Notes
NWL	**185.100**	0.000		0.000		0.000	0.000	**0.000**	**0**	
	185.200	0.003		0.000		0.000	0.000	**0.003**	**116**	
	185.300	0.005		0.000		0.000	0.000	**0.005**	**228**	
	185.400	0.006		0.000		0.000	0.000	**0.006**	**360**	
	185.500	0.007		0.000		0.000	0.000	**0.007**	**501**	
	185.600	0.008	0.000	0.000		0.000	0.000	**0.008**	**652**	**Extended Detention (Q=X.XXXm3/s, V=671m3 at 185.60m)**
	185.700	0.009	0.056	0.000		0.000	0.000	**0.066**	**813**	**2-year storm (Q=0.382m3/s, V=888m3 at 185.74m)**
	185.800	0.010	0.113	0.000		0.000	0.000	**0.123**	**980**	
	185.900	0.011	0.169	0.000		0.000	0.000	**0.180**	**1152**	**5-year storm (Q=0.577m3/s, V=1183m3 at 185.91m)**
	186.000	0.011	0.195	0.000		0.000	0.000	**0.206**	**1330**	
	186.100	0.012	0.218	0.000		0.000	0.000	**0.230**	**1514**	
	186.200	0.013	0.239	0.000		0.000	0.000	**0.251**	**1704**	**25-year storm (Q=0.953m3/s, V=1708m3 at 186.19m)**
	186.300	0.013	0.258	0.000		0.000	0.000	**0.271**	**1900**	
	186.400	0.014	0.276	0.000		0.000	0.000	**0.290**	**2102**	
	186.500	0.014	0.292	0.000		0.000	0.000	**0.307**	**2311**	**100-year storm (Q=1.310m3/s, V=2258m3 at 186.47m)**
Freeboard	**186.600**	0.015	0.308	0.000	0.000	0.000	0.000	**0.323**	**2527**	
	186.700	0.015	0.323	0.000	0.455	0.000	0.000	**0.794**	**2747**	**Regional storm (Q=0.874m3/s, V=2701m3 at 186.67m)**
	186.800	0.016	0.338	0.000	1.288	0.000	0.000	**1.641**	**2973**	
Top of Pond	**186.900**	0.016	0.351	0.000	2.366	0.000	0.000	**2.734**	**3206**	
	187.000	0.017	0.365	0.000	0.000	0.000	0.000	**0.382**	**3230**	
	187.100	0.017	0.377	0.000	0.000	0.000	0.000	**0.395**	**3230**	
	187.200	0.018	0.390	0.000	0.000	0.000	0.000	**0.408**	**3230**	

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QUALITY CONTROL STORAGE CALCULATIONS
SWM FACILITY DESIGN SPREADSHEET

Date: 07-Jan-13 **Project No.:** 09-062

Project: 221 Fox St. FSR **Prepared By:** JR

<<< **Elements Requiring Input Information**

Catchment I.D.'s	Drainage Area (ha)	Imperviousness (%)
101	11.05	35

Total Drainage Area (ha) = **11.05**

Total Imperviousness (%) = **35**

NOTE: For catchment areas consisting of a Total Imperviousness value less than 35% and greater than 85%, the corresponding Water Quality Storage Volume Requirement based on Table 3.2 of the 2003 MOE SWMP manual has been extrapolated from the values provided in Table 3.2.

SWM Facility Characteristics (based on 2003 MOE Guidelines, Table 3.2):

Protection Level = **Enhanced** (Options are Enhanced, Normal or Basic)
SWMP Type = **Wet Pond** (Options are Infiltration, Wetland, Hybrid, Wet Pond or Dry Pond **BUT** the Dry Pond Facility is only capable of providing a **Basic** Level of Protection)

2003 MOE Table 3.2 Water Quality Storage Requirements based on Receiving Waters:

Total Storage Volume = 140 m^3/ha
= **1547** $\mathbf{m^3}$

Permanent Pool Volume = 100 m^3/ha (for wet facilities only, i.e. Wetland, Hybrid <u>OR</u> Wet Pond)
= **1105** $\mathbf{m^3}$

Extended Detention Volume = 40 m^3/ha (Water Quality Control Volume (40m^3/ha), MOE Guidelines)
= 442 m^3
<u>OR</u>
= 671 m^3 (Erosion Control Volume (25mm 4-hr Chicago Storm runoff volume), MOE Guidelines)

Extended Detention Volume = **671** $\mathbf{m^3}$ (greater of the Water Quality & Erosion Control Volume)

NOTE: - The Extended Detention Volume is to be the greater of the Water Quality Control Volume and the Erosion Control Volume.

\\Wmi-server\wmi-server\Data\Projects\2009\09-062\Spreadsheets\SWM\[130106 SWM_Facility_Design.xls]Stage-Storage

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STAGE-STORAGE CALCULATIONS
SWM FACILITY DESIGN SPREADSHEET

Date: 07-Jan-13 **Project No.:** 09-062

Project: 221 Fox St. FSR **Prepared By:** JR

<<< **Elements Requiring Input Information**

Required Permanent Pool Volume	=	1105.0	m^3
Provided Permanent Pool Volume	=	1111.3	m^3
Bottom Elevation, Base	=	183.35	m
Normal Water Level Elevation, NWL	=	185.10	m (for dry facilities, NWL is assumed at Base)
Top Elevation, Top	=	186.90	m

Stage-Storage Information:

	Elevation (m)	Stage (m)	Surface Area 1 (m^2)	Surface Area 2 (m^2)	Total Surface Area (m^2)	Avg. Surface Area (m^2)	Incremental Storage Volume (m^3)	Total Storage Volume (m^3)	Total Storage Volume Above NWL (m^3)
Base	183.35	0.00	150.0		150.0	-	-	0.0	0.0
NWL	185.10	1.75	1120.0		1120.0	635.0	1111.3	1111.3	0.0
	185.70	2.35	1645.0		1645.0	1382.5	829.5	1940.7	829.5
Freeboard	186.60	3.25	2175.0		2175.0	1910.0	1719.0	3659.8	2548.5
Top	186.90	3.55	2365.0		2365.0	2270.0	681.0	4340.8	3229.5

Determining the Water Surface Elevation of a known Storage Volume:

		Total Storage Incl. P.P.	Active Storage Only
Extended Detention	Storage Volume =		671
	W.S. Elevation =		185.60
2-year	Storage Volume =		888
	W.S. Elevation =		185.74
5-year	Storage Volume =		1183
	W.S. Elevation =		185.91
10-year	Storage Volume =		
	W.S. Elevation =		
25-year	Storage Volume =		1708
	W.S. Elevation =		186.19
50-year	Storage Volume =		
	W.S. Elevation =		
100-year	Storage Volume =		2258
	W.S. Elevation =		186.46
Regional	Storage Volume =		2701
	W.S. Elevation =		186.67

Determining the Storage Volume at a known Water Surface Elevation:

		Total Storage Incl. P.P.	Active Storage Only
Description	W.S. Elevation =		
	Storage Volume =		

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EXTENDED DETENTION VOLUME DRAWDOWN TIME & PEAK FLOW CALCULATIONS
SWM FACILITY DESIGN SPREADSHEET

Date: 07-Jan-13 **Project No.:** 09-062

Project: 221 Fox St. FSR **Prepared By:** JR

[ ] <<< **Elements Requiring Input Information**

Active Storage Stage-Area Relationship (from Table above):

	Elevation (m)	Stage (m)	Total Surface Area (m^2)
NWL	185.10	0.00	1120.0
	185.70	0.60	1645.0
	186.60	1.50	2175.0
Top	186.90	1.80	2365.0

Extended Detention Drawdown Time:

t = $0.66C_2h^{1.5}+2C_3h^{0.5}/2.75Ao$ (MOE Equation 4.11)

where,
- t = drawdown time (sec)
- C_2 = slope coeff. from area-depth linear regression
- C_3 = intercept from area-depth linear regression
- h_{CL} = maximum head (extended detention volume) acting on centroid of orifice (m)
- Extended Detention Elev = extended detention water surface elevation (m)
- Orifice Invert Elev = control orifice invert elevation (m)
- A_O = orifice cross-sectional area (m^2)

Orifice Coefficient, C	=	0.63	(typically C=0.63 for orifice plate design)
Orifice Plate Diameter, D_O	=	75	mm (minimum recommended orifice size is a **75mm** diameter)
A_O	=	0.00442	m^2
Extended Detention Elev	=	185.60	m
Orifice Invert Elev	=	185	m
h_{CL}	=	0.563	m
C_2	=	875.00	<<<
C_3	=	1120.00	<<<
t	=	158335	sec
t	=	**44.0**	hr

within each of these two (2) formulas the arrays must be changed to match the range of values listed in the table above (i.e. Stage & Total Surface Area columns)

NOTE: The recommended drawdown time is 24hr but if an orifice size smaller than the required minimum (75mm dia.) is necessary to achieve the 24hr drawdown time than a minimum 12hr drawdown time is considered to be acceptable).

Quality Storm Peak Release Rate from Facility:

Q_P = $CA_O(2gh_{CL})^{0.5}$ (Orifice Flow Equation)

where,
- g = acceleration due to gravity (m/s^2)
- h_{CL} = maximum head (extended detention volume) acting on centroid of orifice (m)

g = 9.81 m/s^2

Q_P = **0.0092** m^3/s

Hydrologic Modelling (SWMHYMO)

Appendix C

```
2     Metric units
*#****************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date         : 01-04-2013
*#  Modeller     : [JR]
*#  Company      : WMI & Associates Ltd.
*#  License #    :  2880720
*#****************************************************************************
*%
*%  PRE-DEVELOPMENT CONDITION
*%
*% 2-YEAR 24hr SCS TYPE-II STORM DISTRIBUTION ORILLIA IDF DATA
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[1]
*%                    ["2SCS24.stm"] <--storm filename, one per line for NSTORM time
*%-----------------|-------------------------------------------------------------|
READ STORM           STORM_FILENAME=["STORM.001"]
*%-----------------|-------------------------------------------------------------|
* PRE-DEVELOPMENT (EXISTING)
CALIB NASHYD         ID=[1], NHYD=["PRE"], DT=[1]min, AREA=[29.3](ha),
                     DWF=[0](cms),  CN/C=[51], IA=[9.3](mm),
                     N=[3], TP=[0.803]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-------------------------------------------------------------|
*% 5-YEAR 24hr SCS TYPE-II STORM DISTRIBUTION ORILLIA IDF DATA
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[2]
*%                    ["5SCS24.stm"] <--storm filename
*%-----------------|-------------------------------------------------------------|
*% 25-YEAR 24hr SCS TYPE-II STORM DISTRIBUTION ORILLIA IDF DATA
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[4]
*%                    ["25SCS24.stm"] <--storm filename
*%-----------------|-------------------------------------------------------------|
*% 100-YEAR 24hr SCS TYPE-II STORM DISTRIBUTION ORILLIA IDF DATA
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[6]
*%                    ["100SCS24.stm"] <--storm filename
*%-----------------|-------------------------------------------------------------|
*% TIMMINS REGIONAL STORM (12-HR)
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[7]
*%                    ["12REGTIM.089"] <--storm filename
*%-----------------|-------------------------------------------------------------|
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    # 2880720
        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: WMI & Associates Ltd.                        +++++++++
+++++++++                Barrie               SERIAL#:2880720         +++++++++
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

*******************************************************************************
*********            ++++++ 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: 2013-01-04     TIME: 19:34:10     RUN COUNTER: 000324          *
*******************************************************************************
* Input   filename: C:\09-062\SWMHYMO\PRE\SCS\PRE.dat                         *
* Output  filename: C:\09-062\SWMHYMO\PRE\SCS\PRE.out                         *
* Summary filename: C:\09-062\SWMHYMO\PRE\SCS\PRE.sum                         *
* User comments:                                                              *
* 1:__________________________________________________________________________*
* 2:__________________________________________________________________________*
* 3:__________________________________________________________________________*
*******************************************************************************

---------------------------------------------------------------------------------
001:0001-------------------------------------------------------------------------
*#*****************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]     Project Number: [09-062]
*#  Date         : 01-04-2013
```



```
*#  Modeller    : [JR]
*#  Company     : WMI & Associates Ltd.
*#  License #   :  2880720
*#*****************************************************************************
--------------------
| START             |  Project  dir.: C:\09-062\SWMHYMO\PRE\SCS\
--------------------  Rainfall dir.: C:\09-062\SWMHYMO\PRE\SCS\

    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    1
           #   1=2SCS24.stm
---------------------------------------------------------------------------------
001:0002-------------------------------------------------------------------------
--------------------
| READ STORM        |    Filename: 2-Year SCS Type-II Storm Distribution (2
| Ptotal=  46.70 mm|     Comments: 2-Year SCS Type-II Storm Distribution (2
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.20	.467	6.20	.934	12.20	9.340	18.20	.701
.40	.467	6.40	.934	12.40	5.838	18.40	.700
.60	.467	6.60	.934	12.60	4.203	18.60	.934
.80	.467	6.80	.934	12.80	3.970	18.80	.701
1.00	.467	7.00	.934	13.00	2.802	19.00	.701
1.20	.467	7.20	.934	13.20	2.335	19.20	.934
1.40	.467	7.40	.934	13.40	2.335	19.40	.701
1.60	.467	7.60	.934	13.60	2.335	19.60	.934
1.80	.467	7.80	.934	13.80	2.335	19.80	.701
2.00	.467	8.00	.934	14.00	2.335	20.00	.934
2.20	.467	8.20	1.401	14.20	1.401	20.20	.701
2.40	.467	8.40	1.401	14.40	1.401	20.40	.701
2.60	.467	8.60	1.401	14.60	1.401	20.60	.467
2.80	.467	8.80	1.401	14.80	1.401	20.80	.701
3.00	.467	9.00	1.401	15.00	1.401	21.00	.700
3.20	.467	9.20	1.401	15.20	1.167	21.20	.467
3.40	.467	9.40	1.401	15.40	1.167	21.40	.701
3.60	.467	9.60	1.401	15.60	1.167	21.60	.467
3.80	.467	9.80	1.401	15.80	1.167	21.80	.701
4.00	.467	10.00	1.401	16.00	1.167	22.00	.467
4.20	.934	10.20	2.568	16.20	1.168	22.20	.467
4.40	.934	10.40	2.569	16.40	1.167	22.40	.701
4.60	.934	10.60	2.568	16.60	1.167	22.60	.467
4.80	.934	10.80	2.569	16.80	1.167	22.80	.700
5.00	.934	11.00	2.568	17.00	.700	23.00	.467
5.20	.934	11.20	3.503	17.20	.701	23.20	.467
5.40	.934	11.40	5.137	17.40	.934	23.40	.467
5.60	.934	11.60	12.375	17.60	.701	23.60	.701
5.80	.934	11.80	25.685	17.80	.934	23.80	.467
6.00	.934	12.00	52.538	18.00	.701	24.00	.467

```
--------------------------------------------------------------------------------------
001:0003------------------------------------------------------------------------------
* PRE-DEVELOPMENT (EXISTING)
----------------------
| CALIB NASHYD        |   Area     (ha)=   29.30   Curve Number    (CN)=51.00
| 01:PRE    DT= 1.00  |   Ia       (mm)=   9.300   # of Linear Res.(N)= 3.00
----------------------    U.H. Tp(hrs)=     .803

     Unit Hyd Qpeak  (cms)=    1.394

     PEAK FLOW       (cms)=     .121 (i)
     TIME TO PEAK    (hrs)=   12.867
     RUNOFF VOLUME    (mm)=    4.970
     TOTAL RAINFALL   (mm)=   46.701
     RUNOFF COEFFICIENT   =     .106

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

--------------------------------------------------------------------------------------
001:0004------------------------------------------------------------------------------
  ** END OF RUN :   1

*******************************************************************************



--------------------
| START             |  Project  dir.: C:\09-062\SWMHYMO\PRE\SCS\

--------------------  Rainfall dir.: C:\09-062\SWMHYMO\PRE\SCS\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 002
    NSTORM=   1
           #  1=5SCS24.stm
--------------------------------------------------------------------------------------
002:0002------------------------------------------------------------------------------
*#****************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date         : 01-04-2013
*#  Modeller     : [JR]
*#  Company      : WMI & Associates Ltd.
*#  License #    :  2880720
*#****************************************************************************
--------------------------------------------------------------------------------------
002:0002------------------------------------------------------------------------------
--------------------
| READ STORM        |    Filename: 5-Year SCS Type-II Storm Distribution (2
| Ptotal=  60.60 mm|    Comments: 5-Year SCS Type-II Storm Distribution (2
--------------------
```


TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.20	.606	6.20	1.212	12.20	12.120	18.20	.909
.40	.606	6.40	1.212	12.40	7.575	18.40	.909
.60	.606	6.60	1.212	12.60	5.454	18.60	1.212
.80	.606	6.80	1.212	12.80	5.151	18.80	.909
1.00	.606	7.00	1.212	13.00	3.636	19.00	.909
1.20	.606	7.20	1.212	13.20	3.030	19.20	1.212
1.40	.606	7.40	1.212	13.40	3.030	19.40	.909
1.60	.606	7.60	1.212	13.60	3.030	19.60	1.212
1.80	.606	7.80	1.212	13.80	3.030	19.80	.909
2.00	.606	8.00	1.212	14.00	3.030	20.00	1.212
2.20	.606	8.20	1.818	14.20	1.818	20.20	.909
2.40	.606	8.40	1.818	14.40	1.818	20.40	.909
2.60	.606	8.60	1.818	14.60	1.818	20.60	.606
2.80	.606	8.80	1.818	14.80	1.818	20.80	.909
3.00	.606	9.00	1.818	15.00	1.818	21.00	.909
3.20	.606	9.20	1.818	15.20	1.515	21.20	.606
3.40	.606	9.40	1.818	15.40	1.515	21.40	.909
3.60	.606	9.60	1.818	15.60	1.515	21.60	.606
3.80	.606	9.80	1.818	15.80	1.515	21.80	.909
4.00	.606	10.00	1.818	16.00	1.515	22.00	.606
4.20	1.212	10.20	3.333	16.20	1.515	22.20	.606
4.40	1.212	10.40	3.333	16.40	1.515	22.40	.909
4.60	1.212	10.60	3.333	16.60	1.515	22.60	.606
4.80	1.212	10.80	3.333	16.80	1.515	22.80	.909
5.00	1.212	11.00	3.333	17.00	.909	23.00	.606
5.20	1.212	11.20	4.545	17.20	.909	23.20	.606
5.40	1.212	11.40	6.666	17.40	1.212	23.40	.606
5.60	1.212	11.60	16.059	17.60	.909	23.60	.909
5.80	1.212	11.80	33.330	17.80	1.212	23.80	.606
6.00	1.212	12.00	68.175	18.00	.909	24.00	.606

```
--------------------------------------------------------------------------------------
002:0003------------------------------------------------------------------------------
* PRE-DEVELOPMENT (EXISTING)
----------------------
| CALIB NASHYD        |   Area     (ha)=   29.30   Curve Number    (CN)=51.00
| 01:PRE    DT= 1.00  |   Ia       (mm)=   9.300   # of Linear Res.(N)= 3.00
----------------------    U.H. Tp(hrs)=     .803

     Unit Hyd Qpeak  (cms)=    1.394

     PEAK FLOW       (cms)=     .226 (i)
     TIME TO PEAK    (hrs)=   12.833
     RUNOFF VOLUME    (mm)=    8.911
     TOTAL RAINFALL   (mm)=   60.601
     RUNOFF COEFFICIENT   =     .147

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

--------------------------------------------------------------------------------------
002:0004------------------------------------------------------------------------------
```

```
-----------------------------------------------------------------------------------
002:0002---------------------------------------------------------------------------
  ** END OF RUN :   3

*******************************************************************************


--------------------
| START              |  Project  dir.: C:\09-062\SWMHYMO\PRE\SCS\
--------------------   Rainfall dir.: C:\09-062\SWMHYMO\PRE\SCS\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 004
    NSTORM=   1
           #  1=25SCS24.stm
-----------------------------------------------------------------------------------
004:0002---------------------------------------------------------------------------
*#*****************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date         : 01-04-2013
*#  Modeller     : [JR]
*#  Company      : WMI & Associates Ltd.
*#  License #    :  2880720
*#*****************************************************************************
-----------------------------------------------------------------------------------
004:0002---------------------------------------------------------------------------
--------------------
| READ STORM         |    Filename: 25-Year SCS Type-II Storm Distribution (
| Ptotal=  81.40 mm|    Comments: 25-Year SCS Type-II Storm Distribution (
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.20	.814	6.20	1.628	12.20	16.280	18.20	1.221
.40	.814	6.40	1.628	12.40	10.175	18.40	1.221
.60	.814	6.60	1.628	12.60	7.326	18.60	1.628
.80	.814	6.80	1.628	12.80	6.919	18.80	1.221
1.00	.814	7.00	1.628	13.00	4.884	19.00	1.221
1.20	.814	7.20	1.628	13.20	4.070	19.20	1.628
1.40	.814	7.40	1.628	13.40	4.070	19.40	1.221
1.60	.814	7.60	1.628	13.60	4.070	19.60	1.628
1.80	.814	7.80	1.628	13.80	4.070	19.80	1.221
2.00	.814	8.00	1.628	14.00	4.070	20.00	1.628
2.20	.814	8.20	2.442	14.20	2.442	20.20	1.221
2.40	.814	8.40	2.442	14.40	2.442	20.40	1.221
2.60	.814	8.60	2.442	14.60	2.442	20.60	.814
2.80	.814	8.80	2.442	14.80	2.442	20.80	1.221
3.00	.814	9.00	2.442	15.00	2.442	21.00	1.221
3.20	.814	9.20	2.442	15.20	2.035	21.20	.814

3.40	.814	9.40	2.442	15.40	2.035	21.40	1.221
3.60	.814	9.60	2.442	15.60	2.035	21.60	.814
3.80	.814	9.80	2.442	15.80	2.035	21.80	1.221
4.00	.814	10.00	2.442	16.00	2.035	22.00	.814
4.20	1.628	10.20	4.477	16.20	2.035	22.20	.814
4.40	1.628	10.40	4.477	16.40	2.035	22.40	1.221
4.60	1.628	10.60	4.477	16.60	2.035	22.60	.814
4.80	1.628	10.80	4.477	16.80	2.035	22.80	1.221
5.00	1.628	11.00	4.477	17.00	1.221	23.00	.814
5.20	1.628	11.20	6.105	17.20	1.221	23.20	.814
5.40	1.628	11.40	8.954	17.40	1.628	23.40	.814
5.60	1.628	11.60	21.571	17.60	1.221	23.60	1.221
5.80	1.628	11.80	44.770	17.80	1.628	23.80	.814
6.00	1.628	12.00	91.575	18.00	1.221	24.00	.814

```
-----------------------------------------------------------------------------------
004:0003---------------------------------------------------------------------------
* PRE-DEVELOPMENT (EXISTING)
----------------------
| CALIB NASHYD        |   Area     (ha)=    29.30   Curve Number    (CN)=51.00
| 01:PRE    DT= 1.00 |   Ia       (mm)=    9.300   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=     .803

     Unit Hyd Qpeak  (cms)=     1.394

     PEAK FLOW       (cms)=      .429 (i)
     TIME TO PEAK    (hrs)=    12.800
     RUNOFF VOLUME    (mm)=    16.443
     TOTAL RAINFALL   (mm)=    81.400
     RUNOFF COEFFICIENT   =      .202

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

-----------------------------------------------------------------------------------
004:0004---------------------------------------------------------------------------
-----------------------------------------------------------------------------------
004:0002---------------------------------------------------------------------------
-----------------------------------------------------------------------------------
004:0002---------------------------------------------------------------------------
  ** END OF RUN :   5

*******************************************************************************


--------------------
| START              |  Project  dir.: C:\09-062\SWMHYMO\PRE\SCS\
--------------------   Rainfall dir.: C:\09-062\SWMHYMO\PRE\SCS\

    TZERO =   .00 hrs on        0
```

```
    METOUT=   2 (output = METRIC)
    NRUN  = 006
    NSTORM=   1
          #  1=100SCS24.stm
---------------------------------------------------------------------------------------
006:0002-------------------------------------------------------------------------------
*#*************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date          : 01-04-2013
*#  Modeller      : [JR]
*#  Company       : WMI & Associates Ltd.
*#  License #     :  2880720
*#*************************************************************************
---------------------------------------------------------------------------------------
006:0002-------------------------------------------------------------------------------
--------------------
| READ STORM        |     Filename: 100-Year SCS Type-II Storm Distribution
| Ptotal=  98.70 mm|     Comments: 100-Year SCS Type-II Storm Distribution
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.20	.987	6.20	1.974	12.20	19.740	18.20	1.481
.40	.987	6.40	1.974	12.40	12.338	18.40	1.480
.60	.987	6.60	1.974	12.60	8.883	18.60	1.974
.80	.987	6.80	1.974	12.80	8.390	18.80	1.481
1.00	.987	7.00	1.974	13.00	5.922	19.00	1.481
1.20	.987	7.20	1.974	13.20	4.935	19.20	1.974
1.40	.987	7.40	1.974	13.40	4.935	19.40	1.481
1.60	.987	7.60	1.974	13.60	4.935	19.60	1.974
1.80	.987	7.80	1.974	13.80	4.935	19.80	1.481
2.00	.987	8.00	1.974	14.00	4.935	20.00	1.974
2.20	.987	8.20	2.961	14.20	2.961	20.20	1.481
2.40	.987	8.40	2.961	14.40	2.961	20.40	1.481
2.60	.987	8.60	2.961	14.60	2.961	20.60	.987
2.80	.987	8.80	2.961	14.80	2.961	20.80	1.481
3.00	.987	9.00	2.961	15.00	2.961	21.00	1.480
3.20	.987	9.20	2.961	15.20	2.467	21.20	.987
3.40	.987	9.40	2.961	15.40	2.467	21.40	1.481
3.60	.987	9.60	2.961	15.60	2.467	21.60	.987
3.80	.987	9.80	2.961	15.80	2.467	21.80	1.481
4.00	.987	10.00	2.961	16.00	2.467	22.00	.987
4.20	1.974	10.20	5.428	16.20	2.468	22.20	.987
4.40	1.974	10.40	5.429	16.40	2.467	22.40	1.481
4.60	1.974	10.60	5.428	16.60	2.467	22.60	.987
4.80	1.974	10.80	5.429	16.80	2.467	22.80	1.480
5.00	1.974	11.00	5.428	17.00	1.480	23.00	.987
5.20	1.974	11.20	7.403	17.20	1.481	23.20	.987
5.40	1.974	11.40	10.857	17.40	1.974	23.40	.987
5.60	1.974	11.60	26.155	17.60	1.481	23.60	1.481
5.80	1.974	11.80	54.285	17.80	1.974	23.80	.987
6.00	1.974	12.00	111.038	18.00	1.481	24.00	.987


```
006:0003-------------------------------------------------------------------------------
* PRE-DEVELOPMENT (EXISTING)
----------------------
| CALIB NASHYD        |   Area      (ha)=    29.30   Curve Number    (CN)=51.00
| 01:PRE    DT= 1.00 |   Ia        (mm)=    9.300   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=      .803

     Unit Hyd Qpeak   (cms)=     1.394

     PEAK FLOW        (cms)=      .634 (i)
     TIME TO PEAK     (hrs)=    12.800
     RUNOFF VOLUME     (mm)=    23.970
     TOTAL RAINFALL    (mm)=    98.701
     RUNOFF COEFFICIENT    =      .243

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

---------------------------------------------------------------------------------------
006:0004-------------------------------------------------------------------------------
---------------------------------------------------------------------------------------
006:0002-------------------------------------------------------------------------------
---------------------------------------------------------------------------------------
006:0002-------------------------------------------------------------------------------
---------------------------------------------------------------------------------------
006:0002-------------------------------------------------------------------------------
  ** END OF RUN :    6

*******************************************************************************


--------------------
| START              |  Project  dir.: C:\09-062\SWMHYMO\PRE\SCS\
--------------------   Rainfall dir.: C:\09-062\SWMHYMO\PRE\SCS\

    TZERO =    .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 007
    NSTORM=   1
          #  1=12REGTIM.089
---------------------------------------------------------------------------------------
007:0002-------------------------------------------------------------------------------
*#*************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date          : 01-04-2013
*#  Modeller      : [JR]
*#  Company       : WMI & Associates Ltd.
*#  License #     :  2880720
*#*************************************************************************
---------------------------------------------------------------------------------------
```

```
007:0002-----------------------------------------------------------------------------
--------------------
| READ STORM        |    Filename: TIMMINS REGIONAL STORM (12-hour)
| Ptotal= 193.00 mm|    Comments: TIMMINS REGIONAL STORM (12-hour)
--------------------
              TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
              1.00  15.000 |  4.00   3.000 |  7.00  43.000 | 10.00  13.000
              2.00  20.000 |  5.00   5.000 |  8.00  20.000 | 11.00  13.000
              3.00  10.000 |  6.00  20.000 |  9.00  23.000 | 12.00   8.000

-------------------------------------------------------------------------------------
007:0003-----------------------------------------------------------------------------
* PRE-DEVELOPMENT (EXISTING)
----------------------
| CALIB NASHYD      |   Area    (ha)=   29.30   Curve Number   (CN)=51.00
| 01:PRE    DT= 1.00 |   Ia      (mm)=   9.300   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .803

     Unit Hyd Qpeak  (cms)=    1.394

     PEAK FLOW       (cms)=    1.186 (i)
     TIME TO PEAK    (hrs)=    7.600
     RUNOFF VOLUME    (mm)=   78.893
     TOTAL RAINFALL   (mm)=  193.000
     RUNOFF COEFFICIENT   =     .409

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

-------------------------------------------------------------------------------------
007:0004-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
007:0002-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
007:0002-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
007:0002-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
007:0002-----------------------------------------------------------------------------
      FINISH
-------------------------------------------------------------------------------------
*************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2013-01-04     at 19:34:10
=====================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date         : 01-04-2013
*#  Modeller     : [JR]
*#  Company      : WMI & Associates Ltd.
*#  License #    :  2880720
*#*****************************************************************************
*%
*%  PRE-DEVELOPMENT CONDITION (4-HOUR CHICAGO STORM)
*%
*% 25mm CHICAGO STORM DISTRIBUTION ORILLIA IDF DATA (4 HOUR)
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[1]
*%                   ["25mm4hr.stm"] <--storm filename,
*%-----------------|-----------------------------------------------------------|
READ STORM          STORM_FILENAME=["STORM.001"]
*%-----------------|-----------------------------------------------------------|
* PRE-DEVELOPMENT (EXISTING)
CALIB NASHYD        ID=[1], NHYD=["PRE"], DT=[1]min, AREA=[29.3](ha),
                    DWF=[0](cms),  CN/C=[51], IA=[9.3](mm),
                    N=[3], TP=[0.803]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-----------------------------------------------------------|
*% 2-YEAR CHICAGO STORM DISTRIBUTION ORILLIA IDF DATA (4 HOUR)
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[2]
*%                   ["2CHI4.stm"] <--storm filename
*%-----------------|-----------------------------------------------------------|
*% 5-YEAR CHICAGO STORM DISTRIBUTION ORILLIA IDF DATA (4 HOUR)
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[3]
*%                   ["5CHI4.stm"] <--storm filename
*%-----------------|-----------------------------------------------------------|
*% 25-YEAR CHICAGO STORM DISTRIBUTION ORILLIA IDF DATA (4 HOUR)
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[4]
*%                   ["25CHI4.stm"] <--storm filename
*%-----------------|-----------------------------------------------------------|
*% 100-YEAR CHICAGO STORM DISTRIBUTION ORILLIA IDF DATA (4 HOUR)
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[5]
*%                   ["100CHI4.stm"] <--storm filename
*%-----------------|-----------------------------------------------------------|
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     # 2880720
       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: WMI & Associates Ltd.                          +++++++++
+++++++++                Barrie                  SERIAL#:2880720        +++++++++
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

*********************************************************************************
*********            ++++++ 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: 2013-01-04     TIME: 19:32:55     RUN COUNTER: 000323             *
*********************************************************************************
* Input   filename: C:\09-062\SWMHYMO\PRE\CHI\PRE.dat                           *
* Output  filename: C:\09-062\SWMHYMO\PRE\CHI\PRE.out                           *
* Summary filename: C:\09-062\SWMHYMO\PRE\CHI\PRE.sum                           *
* User comments:                                                                *
* 1:____________________________________________________________________________*
* 2:____________________________________________________________________________*
* 3:____________________________________________________________________________*
*********************************************************************************

---------------------------------------------------------------------------------------
001:0001--------------------------------------------------------------------------------
*#*******************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]     Project Number: [09-062]
*#  Date         : 01-04-2013
```



```
*#  Modeller     : [JR]
*#  Company      : WMI & Associates Ltd.
*#  License #    :  2880720
*#*******************************************************************************
 --------------------
 | START            |   Project  dir.: C:\09-062\SWMHYMO\PRE\CHI\
 --------------------   Rainfall dir.: C:\09-062\SWMHYMO\PRE\CHI\

    TZERO =    .00 hrs on          0
    METOUT=    2 (output = METRIC)
    NRUN  =  001
    NSTORM=    1
           #  1=25mm4hr.stm
---------------------------------------------------------------------------------------
001:0002--------------------------------------------------------------------------------
 --------------------
 | READ STORM        |    Filename: 25mm Chicago Storm Distribution (4-hour)
 | Ptotal=  25.00 mm|    Comments: 25mm Chicago Storm Distribution (4-hour)
 --------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   1.740 |   1.17  10.720 |   2.17   3.750 |   3.17   2.040
              .33   1.970 |   1.33  62.850 |   2.33   3.250 |   3.33   1.910
              .50   2.290 |   1.50  13.740 |   2.50   2.890 |   3.50   1.790
              .67   2.740 |   1.67   7.730 |   2.67   2.610 |   3.67   1.700
              .83   3.500 |   1.83   5.590 |   2.83   2.380 |   3.83   1.610
             1.00   5.020 |   2.00   4.460 |   3.00   2.190 |   4.00   1.530

---------------------------------------------------------------------------------------
001:0003--------------------------------------------------------------------------------
* PRE-DEVELOPMENT (EXISTING)
 ----------------------
 | CALIB NASHYD        |   Area    (ha)=   29.30   Curve Number   (CN)=51.00
 | 01:PRE    DT= 1.00  |   Ia      (mm)=   9.300   # of Linear Res.(N)= 3.00
 ----------------------    U.H. Tp(hrs)=    .803

     Unit Hyd Qpeak  (cms)=    1.394

     PEAK FLOW       (cms)=     .028 (i)
     TIME TO PEAK    (hrs)=    2.717
     RUNOFF VOLUME    (mm)=     .949
     TOTAL RAINFALL   (mm)=   25.000
     RUNOFF COEFFICIENT   =     .038

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

---------------------------------------------------------------------------------------
001:0004--------------------------------------------------------------------------------
  ** END OF RUN :   1

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

```
---------------------
| START              |  Project  dir.: C:\09-062\SWMHYMO\PRE\CHI\
---------------------  Rainfall dir.: C:\09-062\SWMHYMO\PRE\CHI\

    TZERO =    .00 hrs on         0
    METOUT=    2 (output = METRIC)
    NRUN  = 002
    NSTORM=    1
           #  1=2CHI4.stm
--------------------------------------------------------------------------------------
002:0002------------------------------------------------------------------------------
*#****************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date          : 01-04-2013
*#  Modeller      : [JR]
*#  Company       : WMI & Associates Ltd.
*#  License #     :  2880720
*#****************************************************************************
--------------------------------------------------------------------------------------
002:0002------------------------------------------------------------------------------
---------------------
| READ STORM         |   Filename: 2-Year Chicago Storm Distribution (4-hou
| Ptotal=  32.77 mm|   Comments: 2-Year Chicago Storm Distribution (4-hou
---------------------
              TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .17   2.285 |  1.17  14.057 |  2.17   4.915 |  3.17   2.674
               .33   2.585 |  1.33  82.380 |  2.33   4.266 |  3.33   2.501
               .50   2.995 |  1.50  18.005 |  2.50   3.787 |  3.50   2.353
               .67   3.598 |  1.67  10.127 |  2.67   3.416 |  3.67   2.223
               .83   4.586 |  1.83   7.331 |  2.83   3.120 |  3.83   2.109
              1.00   6.583 |  2.00   5.849 |  3.00   2.877 |  4.00   2.007

--------------------------------------------------------------------------------------
002:0003------------------------------------------------------------------------------
* PRE-DEVELOPMENT (EXISTING)
---------------------
| CALIB NASHYD       |   Area     (ha)=   29.30   Curve Number    (CN)=51.00
| 01:PRE     DT= 1.00 |   Ia       (mm)=   9.300   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=     .803

     Unit Hyd Qpeak  (cms)=    1.394

     PEAK FLOW       (cms)=     .064 (i)
     TIME TO PEAK    (hrs)=    2.567
     RUNOFF VOLUME    (mm)=    2.059
     TOTAL RAINFALL   (mm)=   32.772
     RUNOFF COEFFICIENT    =     .063
```



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

--------------------------------------------------------------------------------------
002:0004------------------------------------------------------------------------------
--------------------------------------------------------------------------------------
002:0002------------------------------------------------------------------------------
  ** END OF RUN :    2

******************************************************************************

---------------------
| START              |  Project  dir.: C:\09-062\SWMHYMO\PRE\CHI\
---------------------  Rainfall dir.: C:\09-062\SWMHYMO\PRE\CHI\

    TZERO =    .00 hrs on         0
    METOUT=    2 (output = METRIC)
    NRUN  = 003
    NSTORM=    1
           #  1=5CHI4.stm
--------------------------------------------------------------------------------------
003:0002------------------------------------------------------------------------------
*#****************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date          : 01-04-2013
*#  Modeller      : [JR]
*#  Company       : WMI & Associates Ltd.
*#  License #     :  2880720
*#****************************************************************************
--------------------------------------------------------------------------------------
003:0002------------------------------------------------------------------------------
---------------------
| READ STORM         |   Filename: 5-Year Chicago Storm Distribution (4-hou
| Ptotal=  43.79 mm|   Comments: 5-Year Chicago Storm Distribution (4-hou
---------------------
              TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .17   3.077 |  1.17  18.812 |  2.17   6.603 |  3.17   3.599
               .33   3.479 |  1.33 109.412 |  2.33   5.734 |  3.33   3.367
               .50   4.030 |  1.50  24.075 |  2.50   5.091 |  3.50   3.168
               .67   4.838 |  1.67  13.572 |  2.67   4.594 |  3.67   2.993
               .83   6.162 |  1.83   9.837 |  2.83   4.197 |  3.83   2.840
              1.00   8.836 |  2.00   7.853 |  3.00   3.872 |  4.00   2.703

--------------------------------------------------------------------------------------
003:0003------------------------------------------------------------------------------
* PRE-DEVELOPMENT (EXISTING)
---------------------
```

```
| CALIB NASHYD        |   Area     (ha)=    29.30   Curve Number    (CN)=51.00
| 01:PRE    DT= 1.00 |   Ia       (mm)=    9.300   # of Linear Res.(N)= 3.00
---------------------    U.H. Tp(hrs)=     .803

     Unit Hyd Qpeak  (cms)=     1.394

     PEAK FLOW       (cms)=      .138 (i)
     TIME TO PEAK    (hrs)=     2.483
     RUNOFF VOLUME    (mm)=     4.271
     TOTAL RAINFALL   (mm)=    43.791
     RUNOFF COEFFICIENT   =      .098

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

-------------------------------------------------------------------------------------
003:0004-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
003:0002-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
003:0002-----------------------------------------------------------------------------
  ** END OF RUN :   3

*******************************************************************************



--------------------
| START             |  Project  dir.: C:\09-062\SWMHYMO\PRE\CHI\

--------------------  Rainfall dir.: C:\09-062\SWMHYMO\PRE\CHI\

    TZERO =    .00 hrs on         0
    METOUT=    2 (output = METRIC)
    NRUN  = 004
    NSTORM=    1
           #  1=25CHI4.stm
-------------------------------------------------------------------------------------
004:0002-----------------------------------------------------------------------------
*#******************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]     Project Number: [09-062]
*#  Date         : 01-04-2013
*#  Modeller     : [JR]
*#  Company      : WMI & Associates Ltd.
*#  License #    :  2880720
*#******************************************************************************
-------------------------------------------------------------------------------------
004:0002-----------------------------------------------------------------------------
--------------------
| READ STORM        |    Filename: 25-Year Chicago Storm Distribution (4-ho
| Ptotal=  60.08 mm|    Comments: 25-Year Chicago Storm Distribution (4-ho
--------------------
```


TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	4.238	1.17	25.827	2.17	9.082	3.17	4.956
.33	4.791	1.33	149.649	2.33	7.889	3.33	4.637
.50	5.548	1.50	33.039	2.50	7.007	3.50	4.362
.67	6.658	1.67	18.646	2.67	6.324	3.67	4.123
.83	8.477	1.83	13.522	2.83	5.778	3.83	3.911
1.00	12.149	2.00	10.799	3.00	5.330	4.00	3.724

```
-------------------------------------------------------------------------------------
004:0003-----------------------------------------------------------------------------
* PRE-DEVELOPMENT (EXISTING)
---------------------
| CALIB NASHYD        |   Area     (ha)=    29.30   Curve Number    (CN)=51.00
| 01:PRE    DT= 1.00 |   Ia       (mm)=    9.300   # of Linear Res.(N)= 3.00
---------------------    U.H. Tp(hrs)=     .803

     Unit Hyd Qpeak  (cms)=     1.394

     PEAK FLOW       (cms)=      .292 (i)
     TIME TO PEAK    (hrs)=     2.433
     RUNOFF VOLUME    (mm)=     8.746
     TOTAL RAINFALL   (mm)=    60.078
     RUNOFF COEFFICIENT   =      .146

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

-------------------------------------------------------------------------------------
004:0004-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
004:0002-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
004:0002-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
004:0002-----------------------------------------------------------------------------
  ** END OF RUN :   4

*******************************************************************************



--------------------
| START             |  Project  dir.: C:\09-062\SWMHYMO\PRE\CHI\

--------------------  Rainfall dir.: C:\09-062\SWMHYMO\PRE\CHI\

    TZERO =    .00 hrs on         0
    METOUT=    2 (output = METRIC)
    NRUN  = 005
    NSTORM=    1
           #  1=100CHI4.stm
```

```
-----------------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------------------
*#************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date         : 01-04-2013
*#  Modeller     : [JR]
*#  Company      : WMI & Associates Ltd.
*#  License #    :  2880720
*#************************************************************************
-----------------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------------------
--------------------
| READ STORM        |    Filename: 100-Year Chicago Storm Distribution (4-h
| Ptotal=  73.84 mm|    Comments: 100-Year Chicago Storm Distribution (4-h
--------------------
              TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .17   5.248 |  1.17  31.788 |  2.17  11.222 |  3.17   6.134
               .33   5.931 |  1.33 182.809 |  2.33   9.752 |  3.33   5.741
               .50   6.865 |  1.50  40.631 |  2.50   8.664 |  3.50   5.402
               .67   8.234 |  1.67  22.982 |  2.67   7.822 |  3.67   5.106
               .83  10.476 |  1.83  16.686 |  2.83   7.149 |  3.83   4.845
              1.00  14.996 |  2.00  13.336 |  3.00   6.596 |  4.00   4.613

-----------------------------------------------------------------------------------------
005:0003----------------------------------------------------------------------------------
* PRE-DEVELOPMENT (EXISTING)
----------------------
| CALIB NASHYD        |   Area    (ha)=   29.30   Curve Number    (CN)=51.00
| 01:PRE    DT= 1.00 |   Ia      (mm)=   9.300   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .803

     Unit Hyd Qpeak  (cms)=    1.394

     PEAK FLOW       (cms)=     .458 (i)
     TIME TO PEAK    (hrs)=    2.400
     RUNOFF VOLUME    (mm)=   13.498
     TOTAL RAINFALL   (mm)=   73.838
     RUNOFF COEFFICIENT   =     .183

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

-----------------------------------------------------------------------------------------
005:0004----------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------------------
      FINISH
```



```
-----------------------------------------------------------------------------------------
*****************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2013-01-04     at 19:32:56
=========================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date        : 01-04-2013
*#  Modeller    : [JR]
*#  Company     : WMI & Associates Ltd.
*#  License #   :  2880720
*#*****************************************************************************
*%
*%  POST-DEVELOPMENT CONDITION
*%
*% 2-YEAR 24hr SCS TYPE-II STORM DISTRIBUTION ORILLIA IDF DATA
START                   TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[1]
*%                       ["2SCS24.stm"] <--storm filename,
*%-------------------|-------------------------------------------------------------|
READ STORM              STORM_FILENAME=["STORM.001"]
*%-------------------|-------------------------------------------------------------|
* CATCHMENT 101
CALIB STANDHYD          ID=[1], NHYD=["101"], DT=[1](min), AREA=[11.05](ha),
                        XIMP=[0.195], TIMP=[0.35], DWF=[0](cms), LOSS=[2],
                        SCS curve number CN=[54],
                        Pervious   surfaces: IAper=[6.7](mm), SLPP=[5.0](%),
                                         LGP=[40](m), MNP=[0.25], SCP=[0](min),
                        Impervious surfaces: IAimp=[2.0](mm), SLPI=[2.0](%),
                                         LGI=[200](m), MNI=[0.013], SCI=[0](min),
                        RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-------------------|-------------------------------------------------------------|
* EXTERNAL AREA #1
CALIB NASHYD            ID=[2], NHYD=["EXT1"], DT=[1]min, AREA=[7.78](ha),
                        DWF=[0](cms),  CN/C=[56], IA=[7.2](mm),
                        N=[3], TP=[0.290]hrs,
                        RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-------------------|-------------------------------------------------------------|
* EXTERNAL AREA #2
CALIB STANDHYD          ID=[3], NHYD=["EXT2"], DT=[1](min), AREA=[6.14](ha),
                        XIMP=[0.14], TIMP=[0.25], DWF=[0](cms), LOSS=[2],
                        SCS curve number CN=[59],
                        Pervious   surfaces: IAper=[5](mm), SLPP=[8.0](%),
                                         LGP=[90](m), MNP=[0.25], SCP=[0](min),
                        Impervious surfaces: IAimp=[2.0](mm), SLPI=[3.0](%),
                                         LGI=[150](m), MNI=[0.013], SCI=[0](min),
                        RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-------------------|-------------------------------------------------------------|
SHIFT HYD               IDout=[4], NHYD=["S-EXT2"], IDin=[3], TLAG=[10](min)
*%-------------------|-------------------------------------------------------------|
ADD HYD                 IDsum=[5], NHYD=["S-EXT1+2"], IDs to add=[2+3]
*%-------------------|-------------------------------------------------------------|
ROUTE RESERVOIR         IDout=[6],   NHYD=["POND OUT"],  IDin=[1],
                        RDT=[1](min),
                              TABLE of ( OUTFLOW-STORAGE ) values
                                          (cms) - (ha-m)
                                         [ 0.0000 , 0.0000]
                                         [ 0.0080 , 0.0652]
```



```
                                         [ 0.2510 , 0.1704]
                                         [ 0.3230 , 0.2527]
                                         [ 1.6410 , 0.2973]
                                         [ 2.7340 , 0.3206]
                                         [   -1   ,   -1  ]  (max twenty pts)
                              IDovf=[   ], NHYDovf=[   ]
*%-------------------|-------------------------------------------------------------|
* EXTERNAL AREA #3
CALIB NASHYD            ID=[8], NHYD=["EXT3"], DT=[1]min, AREA=[4.36](ha),
                        DWF=[0](cms),  CN/C=[57], IA=[6.9](mm),
                        N=[3], TP=[0.553]hrs,
                        RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-------------------|-------------------------------------------------------------|
*% 5-YEAR 24hr SCS TYPE-II STORM DISTRIBUTION ORILLIA IDF DATA
START                   TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[2]
*%                       ["5SCS24.stm"] <--storm filename
*%-------------------|-------------------------------------------------------------|
*% 25-YEAR 24hr SCS TYPE-II STORM DISTRIBUTION ORILLIA IDF DATA
START                   TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[3]
*%                       ["25SCS24.stm"] <--storm filename
*%-------------------|-------------------------------------------------------------|
*% 100-YEAR 24hr SCS TYPE-II STORM DISTRIBUTION ORILLIA IDF DATA
START                   TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[4]
*%                       ["100SCS24.stm"] <--storm filename
*%-------------------|-------------------------------------------------------------|
*% TIMMINS REGIONAL STORM (12-HR)
START                   TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[5]
*%                       ["12REGTIM.089"] <--storm filename
*%-------------------|-------------------------------------------------------------|
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   # 2880720
      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: WMI & Associates Ltd.                         +++++++++
+++++++++                Barrie                 SERIAL#:2880720        +++++++++
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

*******************************************************************************
*********             ++++++ 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: 2013-01-06     TIME: 14:43:42     RUN COUNTER: 000336            *
*******************************************************************************
* Input   filename: C:\09-062\SWMHYMO\POST\SCS\POST2.dat                      *
* Output  filename: C:\09-062\SWMHYMO\POST\SCS\POST2.out                      *
* Summary filename: C:\09-062\SWMHYMO\POST\SCS\POST2.sum                      *
* User comments:                                                              *
* 1:__________________________________________________________________________*
* 2:__________________________________________________________________________*
* 3:__________________________________________________________________________*
*******************************************************************************

-----------------------------------------------------------------------------------
001:0001---------------------------------------------------------------------------
*#*****************************************************************************
*# Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*# Date        : 01-04-2013
```



```
*#  Modeller    : [JR]
*#  Company     : WMI & Associates Ltd.
*#  License #   :  2880720
*#*****************************************************************************
--------------------
| START             |  Project  dir.: C:\09-062\SWMHYMO\POST\SCS\
--------------------   Rainfall dir.: C:\09-062\SWMHYMO\POST\SCS\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   1
           #  1=2SCS24.stm
-----------------------------------------------------------------------------------
001:0002---------------------------------------------------------------------------
--------------------
| READ STORM        |   Filename: 2-Year SCS Type-II Storm Distribution (2
| Ptotal=  46.70 mm|   Comments: 2-Year SCS Type-II Storm Distribution (2
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.20	.467	6.20	.934	12.20	9.340	18.20	.701
.40	.467	6.40	.934	12.40	5.838	18.40	.700
.60	.467	6.60	.934	12.60	4.203	18.60	.934
.80	.467	6.80	.934	12.80	3.970	18.80	.701
1.00	.467	7.00	.934	13.00	2.802	19.00	.701
1.20	.467	7.20	.934	13.20	2.335	19.20	.934
1.40	.467	7.40	.934	13.40	2.335	19.40	.701
1.60	.467	7.60	.934	13.60	2.335	19.60	.934
1.80	.467	7.80	.934	13.80	2.335	19.80	.701
2.00	.467	8.00	.934	14.00	2.335	20.00	.934
2.20	.467	8.20	1.401	14.20	1.401	20.20	.701
2.40	.467	8.40	1.401	14.40	1.401	20.40	.701
2.60	.467	8.60	1.401	14.60	1.401	20.60	.467
2.80	.467	8.80	1.401	14.80	1.401	20.80	.701
3.00	.467	9.00	1.401	15.00	1.401	21.00	.700
3.20	.467	9.20	1.401	15.20	1.167	21.20	.467
3.40	.467	9.40	1.401	15.40	1.167	21.40	.701
3.60	.467	9.60	1.401	15.60	1.167	21.60	.467
3.80	.467	9.80	1.401	15.80	1.167	21.80	.701
4.00	.467	10.00	1.401	16.00	1.167	22.00	.467
4.20	.934	10.20	2.568	16.20	1.168	22.20	.467
4.40	.934	10.40	2.569	16.40	1.167	22.40	.701
4.60	.934	10.60	2.568	16.60	1.167	22.60	.467
4.80	.934	10.80	2.569	16.80	1.167	22.80	.700
5.00	.934	11.00	2.568	17.00	.700	23.00	.467
5.20	.934	11.20	3.503	17.20	.701	23.20	.467
5.40	.934	11.40	5.137	17.40	.934	23.40	.467
5.60	.934	11.60	12.375	17.60	.701	23.60	.701
5.80	.934	11.80	25.685	17.80	.934	23.80	.467
6.00	.934	12.00	52.538	18.00	.701	24.00	.467

```
--------------------------------------------------------------------------------
001:0003------------------------------------------------------------------------
* CATCHMENT 101
---------------------
| CALIB STANDHYD    |   Area     (ha)=   11.05
| 01:101    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   19.50
---------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=      3.87         7.18
     Dep. Storage      (mm)=      2.00         6.70
     Average Slope      (%)=      2.00         5.00
     Length             (m)=    200.00        40.00
     Mannings n            =      .013         .250

     Max.eff.Inten.(mm/hr)=      52.54        10.31
                over (min)        4.00        17.00
     Storage Coeff.   (min)=      4.07 (ii)   17.37 (ii)
     Unit Hyd. Tpeak  (min)=      4.00        17.00
     Unit Hyd. peak   (cms)=       .28          .07
                                                         *TOTALS*
     PEAK FLOW        (cms)=       .30          .13        .382 (iii)
     TIME TO PEAK     (hrs)=     12.00        12.20      12.000
     RUNOFF VOLUME     (mm)=     44.70         7.89      15.071
     TOTAL RAINFALL    (mm)=     46.70        46.70      46.701
     RUNOFF COEFFICIENT    =       .96          .17        .323

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =   54.0     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------------------------------------------------------------------------
* EXTERNAL AREA #1
---------------------
| CALIB NASHYD       |   Area     (ha)=     7.78   Curve Number    (CN)=56.00
| 02:EXT1   DT= 1.00 |   Ia       (mm)=    7.200   # of Linear Res.(N)= 3.00
---------------------   U.H. Tp(hrs)=      .290

     Unit Hyd Qpeak   (cms)=     1.025

     PEAK FLOW        (cms)=      .090 (i)
     TIME TO PEAK     (hrs)=    12.217
     RUNOFF VOLUME     (mm)=     6.527
     TOTAL RAINFALL    (mm)=    46.701
     RUNOFF COEFFICIENT    =      .140

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

--------------------------------------------------------------------------------
001:0005------------------------------------------------------------------------
* EXTERNAL AREA #2
```



```
---------------------
| CALIB STANDHYD     |   Area     (ha)=    6.14
| 03:EXT2    DT= 1.00 |   Total Imp(%)=   25.00   Dir. Conn.(%)=   14.00
---------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=      1.53         4.61
     Dep. Storage      (mm)=      2.00         5.00
     Average Slope      (%)=      3.00         8.00
     Length             (m)=    150.00        90.00
     Mannings n            =      .013         .250

     Max.eff.Inten.(mm/hr)=      52.54         9.57
                over (min)        3.00        22.00
     Storage Coeff.   (min)=      3.03 (ii)   22.40 (ii)
     Unit Hyd. Tpeak  (min)=      3.00        22.00
     Unit Hyd. peak   (cms)=       .37          .05
                                                         *TOTALS*
     PEAK FLOW        (cms)=       .12          .08        .165 (iii)
     TIME TO PEAK     (hrs)=     12.00        12.28      12.000
     RUNOFF VOLUME     (mm)=     44.70         9.13      14.113
     TOTAL RAINFALL    (mm)=     46.70        46.70      46.701
     RUNOFF COEFFICIENT    =       .96          .20        .302

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =   59.0     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.

--------------------------------------------------------------------------------
001:0006------------------------------------------------------------------------
---------------------
| SHIFT HYD(S-EXT2    ) |
| IN= 3---> OUT= 4      |
| SHIFT=  10.0 min      |        AREA     QPEAK      TPEAK      R.V.
-----------------------          (ha)     (cms)      (hrs)      (mm)
         ID= 3:EXT2              6.14      .165     12.000    14.113
   SHIFT ID= 4:S-EXT2            6.14      .165     12.150    14.113

--------------------------------------------------------------------------------
001:0007------------------------------------------------------------------------
---------------------
| ADD HYD (S-EXT1+2  ) | ID: NHYD          AREA    QPEAK    TPEAK   R.V.    DWF
-----------------------                    (ha)    (cms)    (hrs)   (mm)   (cms)
                    ID1 02:EXT1            7.78     .090    12.22   6.53    .000

                   +ID2 03:EXT2            6.14     .165    12.00  14.11    .000

                    ===========================================================
                    SUM 05:S-EXT1+2       13.92     .220    12.02   9.87    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

```
001:0008--------------------------------------------------------------------------------
| ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
|  IN>01:(101    )   |
| OUT<06:(POND O)    |     ========= OUTLFOW STORAGE TABLE =========
```

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
.000	.0000E+00	.323	.2527E+00
.008	.6520E-01	1.641	.2973E+00
.251	.1704E+00	2.734	.3206E+00

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >01: (101)	11.05	.382	12.000	15.071
OUTFLOW<06: (POND O)	11.05	.063	12.867	15.070

```
            PEAK   FLOW   REDUCTION [Qout/Qin](%)=    16.379
            TIME SHIFT OF PEAK FLOW         (min)=    52.00
            MAXIMUM  STORAGE   USED        (ha.m.)=.8882E-01

001:0009--------------------------------------------------------------------------------
* EXTERNAL AREA #3
| CALIB NASHYD        |   Area      (ha)=     4.36   Curve Number    (CN)=57.00
| 08:EXT3    DT= 1.00 |   Ia        (mm)=    6.900   # of Linear Res.(N)= 3.00
                          U.H. Tp(hrs)=      .553

     Unit Hyd Qpeak  (cms)=      .301

     PEAK FLOW       (cms)=      .034 (i)
     TIME TO PEAK    (hrs)=    12.517
     RUNOFF VOLUME    (mm)=     6.845
     TOTAL RAINFALL   (mm)=    46.701
     RUNOFF COEFFICIENT   =      .147

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

001:0010--------------------------------------------------------------------------------
  ** END OF RUN :    1

*********************************************************************************

| START               |  Project  dir.: C:\09-062\SWMHYMO\POST\SCS\
```



```
--------------------  Rainfall dir.: C:\09-062\SWMHYMO\POST\SCS\

    TZERO =    .00 hrs on         0
    METOUT=    2 (output = METRIC)
    NRUN  = 002
    NSTORM=    1
           #  1=5SCS24.stm
002:0002--------------------------------------------------------------------------------
*#******************************************************************************
*#   Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#   Date        : 01-04-2013
*#   Modeller    : [JR]
*#   Company     : WMI & Associates Ltd.
*#   License #   :  2880720
*#******************************************************************************
002:0002--------------------------------------------------------------------------------
| READ STORM          |     Filename: 5-Year SCS Type-II Storm Distribution (2
| Ptotal=  60.60 mm|        Comments: 5-Year SCS Type-II Storm Distribution (2
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.20	.606	6.20	1.212	12.20	12.120	18.20	.909
.40	.606	6.40	1.212	12.40	7.575	18.40	.909
.60	.606	6.60	1.212	12.60	5.454	18.60	1.212
.80	.606	6.80	1.212	12.80	5.151	18.80	.909
1.00	.606	7.00	1.212	13.00	3.636	19.00	.909
1.20	.606	7.20	1.212	13.20	3.030	19.20	1.212
1.40	.606	7.40	1.212	13.40	3.030	19.40	.909
1.60	.606	7.60	1.212	13.60	3.030	19.60	1.212
1.80	.606	7.80	1.212	13.80	3.030	19.80	.909
2.00	.606	8.00	1.212	14.00	3.030	20.00	1.212
2.20	.606	8.20	1.818	14.20	1.818	20.20	.909
2.40	.606	8.40	1.818	14.40	1.818	20.40	.909
2.60	.606	8.60	1.818	14.60	1.818	20.60	.606
2.80	.606	8.80	1.818	14.80	1.818	20.80	.909
3.00	.606	9.00	1.818	15.00	1.818	21.00	.909
3.20	.606	9.20	1.818	15.20	1.515	21.20	.606
3.40	.606	9.40	1.818	15.40	1.515	21.40	.909
3.60	.606	9.60	1.818	15.60	1.515	21.60	.606
3.80	.606	9.80	1.818	15.80	1.515	21.80	.909
4.00	.606	10.00	1.818	16.00	1.515	22.00	.606
4.20	1.212	10.20	3.333	16.20	1.515	22.20	.606
4.40	1.212	10.40	3.333	16.40	1.515	22.40	.909
4.60	1.212	10.60	3.333	16.60	1.515	22.60	.606
4.80	1.212	10.80	3.333	16.80	1.515	22.80	.909
5.00	1.212	11.00	3.333	17.00	.909	23.00	.606
5.20	1.212	11.20	4.545	17.20	.909	23.20	.606
5.40	1.212	11.40	6.666	17.40	1.212	23.40	.606
5.60	1.212	11.60	16.059	17.60	.909	23.60	.909
5.80	1.212	11.80	33.330	17.80	1.212	23.80	.606

```
        6.00    1.212 |  12.00  68.175 |  18.00     .909 |  24.00     .606

-------------------------------------------------------------------------------------
002:0003-----------------------------------------------------------------------------
* CATCHMENT 101
----------------------
| CALIB STANDHYD     |   Area     (ha)=   11.05
| 01:101     DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   19.50
----------------------
                          IMPERVIOUS     PERVIOUS (i)
     Surface Area     (ha)=      3.87          7.18
     Dep. Storage     (mm)=      2.00          6.70
     Average Slope     (%)=      2.00          5.00
     Length            (m)=    200.00         40.00
     Mannings n           =      .013          .250

     Max.eff.Inten.(mm/hr)=     68.17         19.60
                over (min)      4.00         14.00
     Storage Coeff.  (min)=      3.67 (ii)    13.96 (ii)
     Unit Hyd. Tpeak (min)=      4.00         14.00
     Unit Hyd. peak  (cms)=       .30           .08
                                                         *TOTALS*
     PEAK FLOW       (cms)=       .39           .25          .577 (iii)
     TIME TO PEAK    (hrs)=     12.00         12.15        12.017
     RUNOFF VOLUME    (mm)=     58.60         13.25        22.093
     TOTAL RAINFALL   (mm)=     60.60         60.60        60.601
     RUNOFF COEFFICIENT   =       .97           .22          .365

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =   54.0     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.

-------------------------------------------------------------------------------------
002:0004-----------------------------------------------------------------------------
* EXTERNAL AREA #1
----------------------
| CALIB NASHYD       |   Area     (ha)=     7.78   Curve Number    (CN)=56.00
| 02:EXT1    DT= 1.00 |   Ia        (mm)=    7.200   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=      .290

     Unit Hyd Qpeak  (cms)=     1.025

     PEAK FLOW       (cms)=      .159 (i)
     TIME TO PEAK    (hrs)=    12.217
     RUNOFF VOLUME    (mm)=    11.272
     TOTAL RAINFALL   (mm)=    60.601
     RUNOFF COEFFICIENT   =      .186

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

-------------------------------------------------------------------------------------
```



```
002:0005-----------------------------------------------------------------------------
* EXTERNAL AREA #2
----------------------
| CALIB STANDHYD     |   Area     (ha)=    6.14
| 03:EXT2    DT= 1.00 |   Total Imp(%)=   25.00   Dir. Conn.(%)=   14.00
----------------------
                          IMPERVIOUS     PERVIOUS (i)
     Surface Area     (ha)=      1.53          4.61
     Dep. Storage     (mm)=      2.00          5.00
     Average Slope     (%)=      3.00          8.00
     Length            (m)=    150.00         90.00
     Mannings n           =      .013          .250

     Max.eff.Inten.(mm/hr)=     68.17         17.89
                over (min)      3.00         18.00
     Storage Coeff.  (min)=      2.73 (ii)    17.81 (ii)
     Unit Hyd. Tpeak (min)=      3.00         18.00
     Unit Hyd. peak  (cms)=       .40           .06
                                                         *TOTALS*
     PEAK FLOW       (cms)=       .16           .15          .254 (iii)
     TIME TO PEAK    (hrs)=     12.00         12.22        12.000
     RUNOFF VOLUME    (mm)=     58.60         15.04        21.146
     TOTAL RAINFALL   (mm)=     60.60         60.60        60.601
     RUNOFF COEFFICIENT   =       .97           .25          .349

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =   59.0     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.

-------------------------------------------------------------------------------------
002:0006-----------------------------------------------------------------------------
------------------------
| SHIFT HYD(S-EXT2    )|
| IN= 3---> OUT= 4     |
| SHIFT=  10.0 min     |       AREA      QPEAK      TPEAK       R.V.
------------------------       (ha)      (cms)      (hrs)       (mm)
        ID= 3:EXT2              6.14       .254     12.000     21.146
  SHIFT ID= 4:S-EXT2            6.14       .254     12.150     21.146

-------------------------------------------------------------------------------------
002:0007-----------------------------------------------------------------------------
------------------------
| ADD HYD (S-EXT1+2  ) | ID: NHYD          AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                    (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 02:EXT1            7.78      .159    12.22   11.27     .000

                    +ID2 03:EXT2            6.14      .254    12.00   21.15     .000
                     ==========================================================
                     SUM 05:S-EXT1+2       13.92      .358    12.02   15.63     .000
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

002:0008

```
| ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
|  IN>01:(101    )   |
| OUT<06:(POND O)    |
```

OUTFLOW STORAGE TABLE

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
.000	.0000E+00	.323	.2527E+00
.008	.6520E-01	1.641	.2973E+00
.251	.1704E+00	2.734	.3206E+00

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >01: (101)	11.05	.577	12.017	22.093
OUTFLOW<06: (POND O)	11.05	.131	12.583	22.092

```
PEAK   FLOW   REDUCTION [Qout/Qin](%)=   22.643
TIME SHIFT OF PEAK FLOW        (min)=    34.00
MAXIMUM  STORAGE   USED       (ha.m.)=.1183E+00
```

002:0009

* EXTERNAL AREA #3

```
| CALIB NASHYD       |   Area     (ha)=    4.36   Curve Number    (CN)=57.00
| 08:EXT3   DT= 1.00 |   Ia       (mm)=   6.900   # of Linear Res.(N)= 3.00
                         U.H. Tp(hrs)=     .553

    Unit Hyd Qpeak  (cms)=      .301

    PEAK FLOW        (cms)=      .060 (i)
    TIME TO PEAK     (hrs)=    12.500
    RUNOFF VOLUME     (mm)=    11.755
    TOTAL RAINFALL    (mm)=    60.601
    RUNOFF COEFFICIENT   =       .194

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

002:0010

002:0002

** END OF RUN :   2

****


```
| START              |  Project  dir.: C:\09-062\SWMHYMO\POST\SCS\
                        Rainfall dir.: C:\09-062\SWMHYMO\POST\SCS\

    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 003
    NSTORM=    1
           #  1=25SCS24.stm
```

003:0002

```
*#***************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date         : 01-04-2013
*#  Modeller     : [JR]
*#  Company      : WMI & Associates Ltd.
*#  License #    :  2880720
*#***************************************************************************
```

003:0002

```
| READ STORM          |   Filename: 25-Year SCS Type-II Storm Distribution (
| Ptotal=  81.40 mm|      Comments: 25-Year SCS Type-II Storm Distribution (
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.20	.814	6.20	1.628	12.20	16.280	18.20	1.221
.40	.814	6.40	1.628	12.40	10.175	18.40	1.221
.60	.814	6.60	1.628	12.60	7.326	18.60	1.628
.80	.814	6.80	1.628	12.80	6.919	18.80	1.221
1.00	.814	7.00	1.628	13.00	4.884	19.00	1.221
1.20	.814	7.20	1.628	13.20	4.070	19.20	1.628
1.40	.814	7.40	1.628	13.40	4.070	19.40	1.221
1.60	.814	7.60	1.628	13.60	4.070	19.60	1.628
1.80	.814	7.80	1.628	13.80	4.070	19.80	1.221
2.00	.814	8.00	1.628	14.00	4.070	20.00	1.628
2.20	.814	8.20	2.442	14.20	2.442	20.20	1.221
2.40	.814	8.40	2.442	14.40	2.442	20.40	1.221
2.60	.814	8.60	2.442	14.60	2.442	20.60	.814
2.80	.814	8.80	2.442	14.80	2.442	20.80	1.221
3.00	.814	9.00	2.442	15.00	2.442	21.00	1.221
3.20	.814	9.20	2.442	15.20	2.035	21.20	.814
3.40	.814	9.40	2.442	15.40	2.035	21.40	1.221
3.60	.814	9.60	2.442	15.60	2.035	21.60	.814
3.80	.814	9.80	2.442	15.80	2.035	21.80	1.221
4.00	.814	10.00	2.442	16.00	2.035	22.00	.814
4.20	1.628	10.20	4.477	16.20	2.035	22.20	.814
4.40	1.628	10.40	4.477	16.40	2.035	22.40	1.221
4.60	1.628	10.60	4.477	16.60	2.035	22.60	.814
4.80	1.628	10.80	4.477	16.80	2.035	22.80	1.221
5.00	1.628	11.00	4.477	17.00	1.221	23.00	.814

```
      5.20    1.628 |  11.20    6.105 |  17.20    1.221 |  23.20     .814
      5.40    1.628 |  11.40    8.954 |  17.40    1.628 |  23.40     .814
      5.60    1.628 |  11.60   21.571 |  17.60    1.221 |  23.60    1.221
      5.80    1.628 |  11.80   44.770 |  17.80    1.628 |  23.80     .814
      6.00    1.628 |  12.00   91.575 |  18.00    1.221 |  24.00     .814

-------------------------------------------------------------------------------------
003:0003-----------------------------------------------------------------------------
* CATCHMENT 101
---------------------
| CALIB STANDHYD     |   Area    (ha)=   11.05
| 01:101    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   19.50
---------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      3.87        7.18
     Dep. Storage     (mm)=      2.00        6.70
     Average Slope     (%)=      2.00        5.00
     Length            (m)=    200.00       40.00
     Mannings n           =      .013        .250

     Max.eff.Inten.(mm/hr)=     91.58       38.15
                over (min)      3.00       11.00
     Storage Coeff.  (min)=      3.26 (ii)  11.14 (ii)
     Unit Hyd. Tpeak (min)=      3.00       11.00
     Unit Hyd. peak  (cms)=       .36         .10
                                                         *TOTALS*
     PEAK FLOW        (cms)=       .54         .50          .953 (iii)
     TIME TO PEAK     (hrs)=     12.00       12.10        12.000
     RUNOFF VOLUME     (mm)=     79.39       23.03        34.025
     TOTAL RAINFALL    (mm)=     81.40       81.40        81.400
     RUNOFF COEFFICIENT   =       .98         .28          .418

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  54.0    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.

-------------------------------------------------------------------------------------
003:0004-----------------------------------------------------------------------------
* EXTERNAL AREA #1
---------------------
| CALIB NASHYD       |   Area    (ha)=    7.78   Curve Number   (CN)=56.00
| 02:EXT1   DT= 1.00 |   Ia      (mm)=   7.200   # of Linear Res.(N)= 3.00
---------------------    U.H. Tp(hrs)=    .290

     Unit Hyd Qpeak  (cms)=    1.025

     PEAK FLOW       (cms)=     .289 (i)
     TIME TO PEAK    (hrs)=   12.200
     RUNOFF VOLUME    (mm)=   20.110
     TOTAL RAINFALL   (mm)=   81.400
     RUNOFF COEFFICIENT  =     .247
```



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

-------------------------------------------------------------------------------------
003:0005-----------------------------------------------------------------------------
* EXTERNAL AREA #2
---------------------
| CALIB STANDHYD     |   Area    (ha)=    6.14
| 03:EXT2   DT= 1.00 |   Total Imp(%)=   25.00   Dir. Conn.(%)=   14.00
---------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      1.53        4.61
     Dep. Storage     (mm)=      2.00        5.00
     Average Slope     (%)=      3.00        8.00
     Length            (m)=    150.00       90.00
     Mannings n           =      .013        .250

     Max.eff.Inten.(mm/hr)=     91.58       35.51
                over (min)      2.00       14.00
     Storage Coeff.  (min)=      2.43 (ii)  13.89 (ii)
     Unit Hyd. Tpeak (min)=      2.00       14.00
     Unit Hyd. peak  (cms)=       .49         .08
                                                         *TOTALS*
     PEAK FLOW        (cms)=       .22         .29          .435 (iii)
     TIME TO PEAK     (hrs)=     12.00       12.13        12.000
     RUNOFF VOLUME     (mm)=     79.39       25.69        33.215
     TOTAL RAINFALL    (mm)=     81.40       81.40        81.400
     RUNOFF COEFFICIENT   =       .98         .32          .408

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  59.0    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.

-------------------------------------------------------------------------------------
003:0006-----------------------------------------------------------------------------
---------------------
| SHIFT HYD(S-EXT2   )|
| IN= 3---> OUT= 4    |
| SHIFT=  10.0 min    |        AREA      QPEAK      TPEAK       R.V.
----------------------         (ha)      (cms)      (hrs)       (mm)
        ID= 3:EXT2             6.14       .435     12.000     33.215
  SHIFT ID= 4:S-EXT2           6.14       .435     12.150     33.215

-------------------------------------------------------------------------------------
003:0007-----------------------------------------------------------------------------
---------------------
| ADD HYD (S-EXT1+2  ) | ID: NHYD          AREA     QPEAK   TPEAK    R.V.     DWF
----------------------                     (ha)     (cms)   (hrs)    (mm)    (cms)
                         ID1 02:EXT1       7.78      .289   12.20   20.11     .000

                        +ID2 03:EXT2       6.14      .435   12.00   33.21     .000
```

```
              ==========================================================
              SUM 05:S-EXT1+2       13.92      .627    12.02  25.89    .000


   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 003:0008------------------------------------------------------------------------
 ---------------------
 | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
 |  IN>01:(101    )   |
 | OUT<06:(POND O)    |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)     (ha.m.)   |   (cms)     (ha.m.)
                             .000  .0000E+00    |     .323  .2527E+00
                             .008  .6520E-01    |    1.641  .2973E+00
                             .251  .1704E+00    |    2.734  .3206E+00

      ROUTING RESULTS              AREA      QPEAK      TPEAK        R.V.
      --------------------         (ha)      (cms)      (hrs)        (mm)
      INFLOW >01: (101    )        11.05      .953     12.000      34.025
      OUTFLOW<06: (POND O)         11.05      .251     12.450      34.023

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   26.372
                    TIME SHIFT OF PEAK FLOW         (min)=    27.00
                    MAXIMUM  STORAGE   USED        (ha.m.)=.1708E+00

 --------------------------------------------------------------------------------
 003:0009------------------------------------------------------------------------
 * EXTERNAL AREA #3
 ----------------------
 | CALIB NASHYD         |   Area    (ha)=     4.36   Curve Number    (CN)=57.00
 | 08:EXT3    DT= 1.00  |   Ia      (mm)=    6.900   # of Linear Res.(N)= 3.00
 ----------------------     U.H. Tp(hrs)=     .553

      Unit Hyd Qpeak  (cms)=      .301

      PEAK FLOW       (cms)=      .108 (i)
      TIME TO PEAK    (hrs)=    12.500
      RUNOFF VOLUME    (mm)=    20.856
      TOTAL RAINFALL   (mm)=    81.400
      RUNOFF COEFFICIENT   =      .256

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

 --------------------------------------------------------------------------------
 003:0010------------------------------------------------------------------------
 --------------------------------------------------------------------------------
 003:0002------------------------------------------------------------------------
 --------------------------------------------------------------------------------
 003:0002------------------------------------------------------------------------
   ** END OF RUN :   3
```



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



 --------------------
 | START              |   Project  dir.: C:\09-062\SWMHYMO\POST\SCS\
 --------------------     Rainfall dir.: C:\09-062\SWMHYMO\POST\SCS\
    TZERO =    .00 hrs on         0
    METOUT=    2 (output = METRIC)
    NRUN  = 004
    NSTORM=    1
           #  1=100SCS24.stm
 --------------------------------------------------------------------------------
 004:0002------------------------------------------------------------------------
 *#******************************************************************************
 *#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
 *#  Date        : 01-04-2013
 *#  Modeller    : [JR]
 *#  Company     : WMI & Associates Ltd.
 *#  License #   :  2880720
 *#******************************************************************************
 --------------------------------------------------------------------------------
 004:0002------------------------------------------------------------------------
 --------------------
 | READ STORM         |    Filename: 100-Year SCS Type-II Storm Distribution
 | Ptotal=  98.70 mm|      Comments: 100-Year SCS Type-II Storm Distribution
 --------------------
                 TIME     RAIN |   TIME     RAIN |   TIME     RAIN |   TIME     RAIN
                  hrs    mm/hr |    hrs    mm/hr |    hrs    mm/hr |    hrs    mm/hr
                  .20     .987 |   6.20    1.974 |  12.20   19.740 |  18.20    1.481
                  .40     .987 |   6.40    1.974 |  12.40   12.338 |  18.40    1.480
                  .60     .987 |   6.60    1.974 |  12.60    8.883 |  18.60    1.974
                  .80     .987 |   6.80    1.974 |  12.80    8.390 |  18.80    1.481
                 1.00     .987 |   7.00    1.974 |  13.00    5.922 |  19.00    1.481
                 1.20     .987 |   7.20    1.974 |  13.20    4.935 |  19.20    1.974
                 1.40     .987 |   7.40    1.974 |  13.40    4.935 |  19.40    1.481
                 1.60     .987 |   7.60    1.974 |  13.60    4.935 |  19.60    1.974
                 1.80     .987 |   7.80    1.974 |  13.80    4.935 |  19.80    1.481
                 2.00     .987 |   8.00    1.974 |  14.00    4.935 |  20.00    1.974
                 2.20     .987 |   8.20    2.961 |  14.20    2.961 |  20.20    1.481
                 2.40     .987 |   8.40    2.961 |  14.40    2.961 |  20.40    1.481
                 2.60     .987 |   8.60    2.961 |  14.60    2.961 |  20.60     .987
                 2.80     .987 |   8.80    2.961 |  14.80    2.961 |  20.80    1.481
                 3.00     .987 |   9.00    2.961 |  15.00    2.961 |  21.00    1.480
                 3.20     .987 |   9.20    2.961 |  15.20    2.467 |  21.20     .987
                 3.40     .987 |   9.40    2.961 |  15.40    2.467 |  21.40    1.481
                 3.60     .987 |   9.60    2.961 |  15.60    2.467 |  21.60     .987
                 3.80     .987 |   9.80    2.961 |  15.80    2.467 |  21.80    1.481
```

```
     4.00     .987 |  10.00    2.961 |  16.00    2.467 |  22.00     .987
     4.20    1.974 |  10.20    5.428 |  16.20    2.468 |  22.20     .987
     4.40    1.974 |  10.40    5.429 |  16.40    2.467 |  22.40    1.481
     4.60    1.974 |  10.60    5.428 |  16.60    2.467 |  22.60     .987
     4.80    1.974 |  10.80    5.429 |  16.80    2.467 |  22.80    1.480
     5.00    1.974 |  11.00    5.428 |  17.00    1.480 |  23.00     .987
     5.20    1.974 |  11.20    7.403 |  17.20    1.481 |  23.20     .987
     5.40    1.974 |  11.40   10.857 |  17.40    1.974 |  23.40     .987
     5.60    1.974 |  11.60   26.155 |  17.60    1.481 |  23.60    1.481
     5.80    1.974 |  11.80   54.285 |  17.80    1.974 |  23.80     .987
     6.00    1.974 |  12.00  111.038 |  18.00    1.481 |  24.00     .987

------------------------------------------------------------------------------------
004:0003---------------------------------------------------------------------------
* CATCHMENT 101
----------------------
| CALIB STANDHYD      |   Area     (ha)=    11.05
| 01:101     DT= 1.00 |   Total Imp(%)=    35.00    Dir. Conn.(%)=    19.50
----------------------
                              IMPERVIOUS     PERVIOUS (i)
     Surface Area      (ha)=       3.87          7.18
     Dep. Storage      (mm)=       2.00          6.70
     Average Slope      (%)=       2.00          5.00
     Length             (m)=     200.00         40.00
     Mannings n            =       .013          .250

     Max.eff.Inten.(mm/hr)=     111.04         54.60
                over (min)       3.00         10.00
     Storage Coeff.   (min)=      3.02 (ii)     9.85 (ii)
     Unit Hyd. Tpeak  (min)=      3.00         10.00
     Unit Hyd. peak   (cms)=       .37           .11
                                                          *TOTALS*
     PEAK FLOW         (cms)=       .65           .75         1.310 (iii)
     TIME TO PEAK      (hrs)=     12.00         12.08        12.000
     RUNOFF VOLUME      (mm)=     96.70         32.47        44.999
     TOTAL RAINFALL     (mm)=     98.70         98.70        98.701
     RUNOFF COEFFICIENT    =       .98           .33          .456

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =   54.0     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.

------------------------------------------------------------------------------------
004:0004---------------------------------------------------------------------------
* EXTERNAL AREA #1
----------------------
| CALIB NASHYD        |   Area     (ha)=     7.78   Curve Number   (CN)=56.00
| 02:EXT1    DT= 1.00 |   Ia       (mm)=    7.200   # of Linear Res.(N)= 3.00
----------------------    U.H. Tp(hrs)=      .290

     Unit Hyd Qpeak  (cms)=    1.025
```



```
     PEAK FLOW       (cms)=      .417 (i)
     TIME TO PEAK    (hrs)=    12.200
     RUNOFF VOLUME    (mm)=    28.764
     TOTAL RAINFALL   (mm)=    98.701
     RUNOFF COEFFICIENT   =      .291

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

------------------------------------------------------------------------------------
004:0005---------------------------------------------------------------------------
* EXTERNAL AREA #2
----------------------
| CALIB STANDHYD      |   Area     (ha)=     6.14
| 03:EXT2    DT= 1.00 |   Total Imp(%)=    25.00    Dir. Conn.(%)=    14.00
----------------------
                              IMPERVIOUS     PERVIOUS (i)
     Surface Area      (ha)=       1.53          4.61
     Dep. Storage      (mm)=       2.00          5.00
     Average Slope      (%)=       3.00          8.00
     Length             (m)=     150.00         90.00
     Mannings n            =       .013          .250

     Max.eff.Inten.(mm/hr)=     111.04         54.33
                over (min)       2.00         12.00
     Storage Coeff.   (min)=      2.25 (ii)    11.92 (ii)
     Unit Hyd. Tpeak  (min)=      2.00         12.00
     Unit Hyd. peak   (cms)=       .52           .09
                                                          *TOTALS*
     PEAK FLOW         (cms)=       .26           .45          .629 (iii)
     TIME TO PEAK      (hrs)=     12.00         12.10        12.000
     RUNOFF VOLUME      (mm)=     96.70         35.84        44.367
     TOTAL RAINFALL     (mm)=     98.70         98.70        98.701
     RUNOFF COEFFICIENT    =       .98           .36          .450

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =   59.0     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.

------------------------------------------------------------------------------------
004:0006---------------------------------------------------------------------------
----------------------
| SHIFT HYD(S-EXT2     )|
| IN= 3---> OUT= 4      |
| SHIFT=  10.0 min      |        AREA      QPEAK      TPEAK       R.V.
-------------------------        (ha)      (cms)      (hrs)       (mm)
        ID= 3:EXT2               6.14       .629     12.000     44.367
  SHIFT ID= 4:S-EXT2             6.14       .629     12.150     44.367

------------------------------------------------------------------------------------
004:0007---------------------------------------------------------------------------
```

```
------------------------
| ADD HYD (S-EXT1+2  ) | ID: NHYD        AREA    QPEAK   TPEAK   R.V.    DWF
------------------------                 (ha)    (cms)   (hrs)   (mm)   (cms)
                        ID1 02:EXT1      7.78     .417   12.20  28.76   .000

                       +ID2 03:EXT2      6.14     .629   12.00  44.37   .000

                        ===================================================
                        SUM 05:S-EXT1+2 13.92     .915   12.02  35.65   .000

  NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
004:0008------------------------------------------------------------------------
---------------------
| ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<06:(POND O)   |     =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000   .0000E+00   |    .323   .2527E+00
                            .008   .6520E-01   |   1.641   .2973E+00
                            .251   .1704E+00   |   2.734   .3206E+00

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )       11.05     1.310    12.000     44.999
     OUTFLOW<06: (POND O)        11.05      .299    12.467     44.997

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   22.865
                  TIME SHIFT OF PEAK FLOW         (min)=    28.00
                  MAXIMUM  STORAGE   USED        (ha.m.)=.2258E+00

--------------------------------------------------------------------------------
004:0009------------------------------------------------------------------------
* EXTERNAL AREA #3
----------------------
| CALIB NASHYD       |   Area      (ha)=    4.36   Curve Number    (CN)=57.00
| 08:EXT3   DT= 1.00 |   Ia        (mm)=   6.900   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=      .553

     Unit Hyd Qpeak  (cms)=     .301

     PEAK FLOW       (cms)=     .156 (i)
     TIME TO PEAK    (hrs)=   12.483
     RUNOFF VOLUME    (mm)=   29.735
     TOTAL RAINFALL   (mm)=   98.701
     RUNOFF COEFFICIENT   =     .301

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

--------------------------------------------------------------------------------
```



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004:0010------------------------------------------------------------------------
--------------------------------------------------------------------------------
004:0002------------------------------------------------------------------------
--------------------------------------------------------------------------------
004:0002------------------------------------------------------------------------
--------------------------------------------------------------------------------
004:0002------------------------------------------------------------------------
 ** END OF RUN :    4

*******************************************************************************



---------------------
| START             |   Project  dir.: C:\09-062\SWMHYMO\POST\SCS\
---------------------   Rainfall dir.: C:\09-062\SWMHYMO\POST\SCS\

    TZERO =    .00 hrs on       0
    METOUT=    2 (output = METRIC)
    NRUN  = 005
    NSTORM=    1
           #  1=12REGTIM.O89
--------------------------------------------------------------------------------
005:0002------------------------------------------------------------------------
*#******************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date        : 01-04-2013
*#  Modeller    : [JR]
*#  Company     : WMI & Associates Ltd.
*#  License #   :  2880720
*#******************************************************************************
--------------------------------------------------------------------------------
005:0002------------------------------------------------------------------------
---------------------
| READ STORM        |    Filename: TIMMINS REGIONAL STORM (12-hour)
| Ptotal= 193.00 mm|    Comments: TIMMINS REGIONAL STORM (12-hour)
---------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              1.00  15.000 |   4.00   3.000 |   7.00  43.000 |  10.00  13.000
              2.00  20.000 |   5.00   5.000 |   8.00  20.000 |  11.00  13.000
              3.00  10.000 |   6.00  20.000 |   9.00  23.000 |  12.00   8.000

--------------------------------------------------------------------------------
005:0003------------------------------------------------------------------------
* CATCHMENT 101
----------------------
| CALIB STANDHYD     |   Area      (ha)=   11.05
| 01:101    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   19.50
----------------------
```

```
                          IMPERVIOUS    PERVIOUS (i)
 Surface Area      (ha)=      3.87         7.18
 Dep. Storage      (mm)=      2.00         6.70
 Average Slope      (%)=      2.00         5.00
 Length             (m)=    200.00        40.00
 Mannings n            =      .013         .250

 Max.eff.Inten.(mm/hr)=      43.00        32.61
            over (min)        4.00        13.00
 Storage Coeff.  (min)=       4.41 (ii)   12.80 (ii)
 Unit Hyd. Tpeak (min)=       4.00        13.00
 Unit Hyd. peak  (cms)=        .26          .09
                                                     *TOTALS*
 PEAK FLOW        (cms)=       .26          .62         .874 (iii)
 TIME TO PEAK     (hrs)=      7.00         7.02        7.000
 RUNOFF VOLUME     (mm)=    190.99        97.12      115.434
 TOTAL RAINFALL    (mm)=    193.00       193.00      193.000
 RUNOFF COEFFICIENT    =       .99          .50         .598

   (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
       CN* =  54.0    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.

-------------------------------------------------------------------------------------
005:0004-----------------------------------------------------------------------------
* EXTERNAL AREA #1
----------------------
| CALIB NASHYD        |   Area     (ha)=     7.78   Curve Number    (CN)=56.00
| 02:EXT1   DT= 1.00  |   Ia       (mm)=    7.200   # of Linear Res.(N)= 3.00
----------------------    U.H. Tp(hrs)=     .290

   Unit Hyd Qpeak   (cms)=    1.025

   PEAK FLOW        (cms)=     .488 (i)
   TIME TO PEAK     (hrs)=    7.067
   RUNOFF VOLUME     (mm)=   89.580
   TOTAL RAINFALL    (mm)=  193.000
   RUNOFF COEFFICIENT    =     .464

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

-------------------------------------------------------------------------------------
005:0005-----------------------------------------------------------------------------
* EXTERNAL AREA #2
----------------------
| CALIB STANDHYD      |   Area     (ha)=    6.14
| 03:EXT2   DT= 1.00  |   Total Imp(%)=   25.00   Dir. Conn.(%)=   14.00
----------------------
                            IMPERVIOUS    PERVIOUS (i)
   Surface Area      (ha)=      1.53         4.61
   Dep. Storage      (mm)=      2.00         5.00
```



```
 Average Slope      (%)=      3.00         8.00
 Length             (m)=    150.00        90.00
 Mannings n            =      .013         .250

 Max.eff.Inten.(mm/hr)=      43.00        32.04
            over (min)        3.00        15.00
 Storage Coeff.  (min)=       3.28 (ii)   15.23 (ii)
 Unit Hyd. Tpeak (min)=       3.00        15.00
 Unit Hyd. peak  (cms)=        .35          .07
                                                     *TOTALS*
 PEAK FLOW        (cms)=       .10          .38         .486 (iii)
 TIME TO PEAK     (hrs)=      6.98         7.03        7.000
 RUNOFF VOLUME     (mm)=    191.00       103.86      116.073
 TOTAL RAINFALL    (mm)=    193.00       193.00      193.000
 RUNOFF COEFFICIENT    =       .99          .54         .601

   (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
       CN* =  59.0    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.

-------------------------------------------------------------------------------------
005:0006-----------------------------------------------------------------------------
----------------------
| SHIFT HYD(S-EXT2    )|
| IN= 3---> OUT= 4     |
| SHIFT=  10.0 min     |       AREA     QPEAK      TPEAK      R.V.
------------------------       (ha)     (cms)      (hrs)      (mm)
       ID= 3:EXT2              6.14      .486      7.000   116.073
  SHIFT ID= 4:S-EXT2           6.14      .486      7.150   116.073

-------------------------------------------------------------------------------------
005:0007-----------------------------------------------------------------------------
------------------------
| ADD HYD (S-EXT1+2  ) | ID: NHYD          AREA      QPEAK    TPEAK   R.V.    DWF
------------------------                   (ha)      (cms)    (hrs)   (mm)   (cms)
                     ID1 02:EXT1           7.78       .488     7.07  89.58    .000

                    +ID2 03:EXT2           6.14       .486     7.00 116.07    .000

                     ==================================================================
                     SUM 05:S-EXT1+2      13.92       .968     7.00 101.27    .000


   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
005:0008-----------------------------------------------------------------------------
----------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(101   )    |
| OUT<06:(POND O)    |    =========  OUTLFOW STORAGE TABLE  ========
```

```
---------------------  OUTFLOW   STORAGE   |  OUTFLOW    STORAGE
                        (cms)    (ha.m.)   |   (cms)     (ha.m.)
                         .000  .0000E+00   |     .323  .2527E+00
                         .008  .6520E-01   |    1.641  .2973E+00
                         .251  .1704E+00   |    2.734  .3206E+00

     ROUTING RESULTS              AREA     QPEAK      TPEAK        R.V.
     --------------------         (ha)     (cms)      (hrs)        (mm)
     INFLOW >01: (101    )       11.05      .874      7.000     115.434
     OUTFLOW<06: (POND O)        11.05      .837      7.050     115.431

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   95.807
                   TIME SHIFT OF PEAK FLOW         (min)=     3.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2701E+00

-------------------------------------------------------------------------------------
005:0009-----------------------------------------------------------------------------
* EXTERNAL AREA #3
----------------------
| CALIB NASHYD       |   Area     (ha)=     4.36   Curve Number    (CN)=57.00
| 08:EXT3    DT= 1.00 |  Ia       (mm)=    6.900   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=      .553

     Unit Hyd Qpeak  (cms)=      .301

     PEAK FLOW       (cms)=      .239 (i)
     TIME TO PEAK    (hrs)=     7.267
     RUNOFF VOLUME    (mm)=    91.692
     TOTAL RAINFALL   (mm)=   193.000
     RUNOFF COEFFICIENT   =      .475

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

-------------------------------------------------------------------------------------
005:0010-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
005:0002-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
005:0002-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
005:0002-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
005:0002-----------------------------------------------------------------------------
      FINISH
-------------------------------------------------------------------------------------
*************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2013-01-06     at 14:43:42
=====================================================================================
```

```
2     Metric units
*#****************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date         : 01-06-2013
*#  Modeller     : [JR]
*#  Company      : WMI & Associates Ltd.
*#  License #    :  2880720
*#****************************************************************************
*%
*%  POST-DEVELOPMENT CONDITION (4HR CHICAGO STORM)
*%
*% 25mm CHICAGO STORM DISTRIBUTION ORILLIA IDF DATA (4 HOUR)
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[1]
*%                    ["25mm4hr.stm"] <--storm filename,
*%-----------------|----------------------------------------------------------|
READ STORM           STORM_FILENAME=["STORM.001"]
*%-----------------|----------------------------------------------------------|
* CATCHMENT 101
CALIB STANDHYD       ID=[1], NHYD=["101"], DT=[1](min), AREA=[11.05](ha),
                     XIMP=[0.195], TIMP=[0.35], DWF=[0](cms), LOSS=[2],
                     SCS curve number CN=[54],
                     Pervious   surfaces: IAper=[6.7](mm), SLPP=[5.0](%),
                                          LGP=[40](m), MNP=[0.25], SCP=[0](min),
                     Impervious surfaces: IAimp=[2.0](mm), SLPI=[2.0](%),
                                          LGI=[200](m), MNI=[0.013], SCI=[0](min),
                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|----------------------------------------------------------|
* EXTERNAL AREA #1
CALIB NASHYD         ID=[2], NHYD=["EXT1"], DT=[1]min, AREA=[7.78](ha),
                     DWF=[0](cms),  CN/C=[56], IA=[7.2](mm),
                     N=[3], TP=[0.290]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|----------------------------------------------------------|
* EXTERNAL AREA #2
CALIB STANDHYD       ID=[3], NHYD=["EXT2"], DT=[1](min), AREA=[6.14](ha),
                     XIMP=[0.14], TIMP=[0.25], DWF=[0](cms), LOSS=[2],
                     SCS curve number CN=[59],
                     Pervious   surfaces: IAper=[5](mm), SLPP=[8.0](%),
                                          LGP=[90](m), MNP=[0.25], SCP=[0](min),
                     Impervious surfaces: IAimp=[2.0](mm), SLPI=[3.0](%),
                                          LGI=[150](m), MNI=[0.013], SCI=[0](min),
                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|----------------------------------------------------------|
SHIFT HYD            IDout=[4], NHYD=["S-EXT2"], IDin=[3], TLAG=[10](min)
*%-----------------|----------------------------------------------------------|
ADD HYD              IDsum=[5], NHYD=["S-EXT1+2"], IDs to add=[2+3]
*%-----------------|----------------------------------------------------------|
ROUTE RESERVOIR      IDout=[6],   NHYD=["POND OUT"],  IDin=[1],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                       (cms) - (ha-m)
                                     [ 0.0000 , 0.0000]
                                     [ 0.0080 , 0.0652]
```



```
                                     [ 0.2510 , 0.1704]
                                     [ 0.3230 , 0.2527]
                                     [ 1.6410 , 0.2973]
                                     [ 2.7340 , 0.3206]
                                     [   -1   ,  -1  ]  (max twenty pts)
                           IDovf=[   ], NHYDovf=[   ]
*%-----------------|----------------------------------------------------------|
* EXTERNAL AREA #3
CALIB NASHYD         ID=[8], NHYD=["EXT3"], DT=[1]min, AREA=[4.36](ha),
                     DWF=[0](cms),  CN/C=[57], IA=[6.9](mm),
                     N=[3], TP=[0.553]hrs,
                     RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|----------------------------------------------------------|
*% 2-YEAR CHICAGO STORM DISTRIBUTION ORILLIA IDF DATA (4 HOUR)
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[2]
*%                    ["2CHI4.stm"] <--storm filename
*%-----------------|----------------------------------------------------------|
*% 5-YEAR CHICAGO STORM DISTRIBUTION ORILLIA IDF DATA (4 HOUR)
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[3]
*%                    ["5CHI4.stm"] <--storm filename
*%-----------------|----------------------------------------------------------|
*% 25-YEAR CHICAGO STORM DISTRIBUTION ORILLIA IDF DATA (4 HOUR)
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[4]
*%                    ["25CHI4.stm"] <--storm filename
*%-----------------|----------------------------------------------------------|
*% 100-YEAR CHICAGO STORM DISTRIBUTION ORILLIA IDF DATA (4 HOUR)
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[5]
*%                    ["100CHI4.stm"] <--storm filename
*%-----------------|----------------------------------------------------------|
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  # 2880720
        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: WMI & Associates Ltd.                     +++++++++
 +++++++++                Barrie            SERIAL#:2880720         +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 *************************************************************************
 *********           ++++++ 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: 2013-01-06     TIME: 15:05:01     RUN COUNTER: 000337          *
 *************************************************************************
 * Input   filename: C:\09-062\SWMHYMO\POST\CHI\POST2.dat                      *
 * Output  filename: C:\09-062\SWMHYMO\POST\CHI\POST2.out                      *
 * Summary filename: C:\09-062\SWMHYMO\POST\CHI\POST2.sum                      *
 * User comments:                                                              *
 * 1:_________________________________________________________________________*
 * 2:_________________________________________________________________________*
 * 3:_________________________________________________________________________*
 *************************************************************************

-------------------------------------------------------------------------------
001:0001-----------------------------------------------------------------------
*#************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date        : 01-06-2013
```



```
*#  Modeller    : [JR]
*#  Company     : WMI & Associates Ltd.
*#  License #   :  2880720
*#************************************************************************
 --------------------
 | START            |  Project  dir.: C:\09-062\SWMHYMO\POST\CHI\
 --------------------  Rainfall dir.: C:\09-062\SWMHYMO\POST\CHI\

    TZERO =    .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   1
           #  1=25mm4hr.stm
-------------------------------------------------------------------------------
001:0002-----------------------------------------------------------------------
 --------------------
 | READ STORM       |    Filename: 25mm Chicago Storm Distribution (4-hour)
 | Ptotal=  25.00 mm|    Comments: 25mm Chicago Storm Distribution (4-hour)
 --------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   1.740 |   1.17  10.720 |   2.17   3.750 |   3.17   2.040
               .33   1.970 |   1.33  62.850 |   2.33   3.250 |   3.33   1.910
               .50   2.290 |   1.50  13.740 |   2.50   2.890 |   3.50   1.790
               .67   2.740 |   1.67   7.730 |   2.67   2.610 |   3.67   1.700
               .83   3.500 |   1.83   5.590 |   2.83   2.380 |   3.83   1.610
              1.00   5.020 |   2.00   4.460 |   3.00   2.190 |   4.00   1.530

-------------------------------------------------------------------------------
001:0003-----------------------------------------------------------------------
 * CATCHMENT 101
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=   11.05
 | 01:101    DT= 1.00  |   Total Imp(%)=   35.00   Dir. Conn.(%)=   19.50
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=       3.87         7.18
     Dep. Storage      (mm)=       2.00         6.70
     Average Slope      (%)=       2.00         5.00
     Length             (m)=     200.00        40.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=       62.85         2.52
                over (min)         4.00        27.00
     Storage Coeff.  (min)=        3.79 (ii)   27.18 (ii)
     Unit Hyd. Tpeak (min)=        4.00        27.00
     Unit Hyd. peak  (cms)=         .29          .04
                                                        *TOTALS*
     PEAK FLOW       (cms)=         .34          .03       .342 (iii)
     TIME TO PEAK    (hrs)=        1.33         1.83      1.333
     RUNOFF VOLUME    (mm)=       23.00         1.97      6.075
     TOTAL RAINFALL   (mm)=       25.00        25.00     25.000
```

```
     RUNOFF COEFFICIENT    =         .92          .08          .243

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  54.0    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-------------------------------------------------------------------------------
* EXTERNAL AREA #1
-----------------------
| CALIB NASHYD        |   Area    (ha)=     7.78   Curve Number   (CN)=56.00
| 02:EXT1    DT= 1.00 |   Ia      (mm)=    7.200   # of Linear Res.(N)= 3.00
-----------------------   U.H. Tp(hrs)=     .290

     Unit Hyd Qpeak  (cms)=    1.025

     PEAK FLOW       (cms)=     .021 (i)
     TIME TO PEAK    (hrs)=    1.733
     RUNOFF VOLUME    (mm)=    1.458
     TOTAL RAINFALL   (mm)=   25.000
     RUNOFF COEFFICIENT  =      .058

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

---------------------------------------------------------------------------------------
001:0005-------------------------------------------------------------------------------
* EXTERNAL AREA #2
-----------------------
| CALIB STANDHYD      |   Area    (ha)=    6.14
| 03:EXT2    DT= 1.00 |   Total Imp(%)=   25.00   Dir. Conn.(%)=   14.00
-----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.53         4.61
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       3.00         8.00
     Length            (m)=     150.00        90.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=      62.85         2.53
                over (min)       3.00        36.00
     Storage Coeff.  (min)=       2.82 (ii)   35.81 (ii)
     Unit Hyd. Tpeak (min)=       3.00        36.00
     Unit Hyd. peak  (cms)=        .39          .03
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .14          .02         .146 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.98        1.333
     RUNOFF VOLUME    (mm)=      23.00         2.44        5.319
     TOTAL RAINFALL   (mm)=      25.00        25.00       25.000
     RUNOFF COEFFICIENT   =        .92          .10         .213

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
```



```
           CN* =  59.0    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.

---------------------------------------------------------------------------------------
001:0006-------------------------------------------------------------------------------
-----------------------
| SHIFT HYD(S-EXT2    )|
| IN= 3---> OUT= 4     |
| SHIFT=  10.0 min     |      AREA     QPEAK      TPEAK      R.V.
------------------------      (ha)     (cms)      (hrs)      (mm)
        ID= 3:EXT2            6.14      .146      1.333     5.319
  SHIFT ID= 4:S-EXT2          6.14      .146      1.483     5.319

---------------------------------------------------------------------------------------
001:0007-------------------------------------------------------------------------------
-----------------------
| ADD HYD (S-EXT1+2  ) | ID: NHYD        AREA     QPEAK    TPEAK    R.V.    DWF
-----------------------                  (ha)     (cms)    (hrs)    (mm)   (cms)
                 ID1 02:EXT1              7.78      .021     1.73    1.46    .000

                +ID2 03:EXT2              6.14      .146     1.33    5.32    .000

                 ==================================================================
                 SUM 05:S-EXT1+2         13.92      .148     1.33    3.16    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------------------
001:0008-------------------------------------------------------------------------------
-----------------------
| ROUTE RESERVOIR     |     Requested routing time step =  1.0 min.
|  IN>01:(101    )    |
| OUT<06:(POND O)     |     =========  OUTLFOW STORAGE TABLE  =========
-----------------------     OUTFLOW     STORAGE   |  OUTFLOW    STORAGE
                             (cms)      (ha.m.)   |   (cms)     (ha.m.)
                              .000   .0000E+00    |    .323   .2527E+00
                              .008   .6520E-01    |   1.641   .2973E+00
                              .251   .1704E+00    |   2.734   .3206E+00

     ROUTING RESULTS              AREA     QPEAK      TPEAK       R.V.
     --------------------         (ha)     (cms)      (hrs)       (mm)
     INFLOW >01: (101    )       11.05      .342      1.333      6.075
     OUTFLOW<06: (POND O)        11.05      .007      4.283      6.075

                 PEAK   FLOW   REDUCTION [Qout/Qin](%)=    2.131
                 TIME SHIFT OF PEAK FLOW          (min)=   177.00
                 MAXIMUM  STORAGE   USED        (ha.m.)=.5940E-01

---------------------------------------------------------------------------------------
001:0009-------------------------------------------------------------------------------
```

```
* EXTERNAL AREA #3
----------------------
| CALIB NASHYD         |   Area     (ha)=     4.36   Curve Number   (CN)=57.00
| 08:EXT3    DT= 1.00 |   Ia       (mm)=    6.900   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=      .553

     Unit Hyd Qpeak  (cms)=      .301

     PEAK FLOW       (cms)=      .009 (i)
     TIME TO PEAK    (hrs)=     2.150
     RUNOFF VOLUME    (mm)=     1.562
     TOTAL RAINFALL   (mm)=    25.000
     RUNOFF COEFFICIENT   =      .062

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

-------------------------------------------------------------------------------------
001:0010-----------------------------------------------------------------------------
  ** END OF RUN :   1

********************************************************************************




---------------------
| START              |   Project  dir.: C:\09-062\SWMHYMO\POST\CHI\

---------------------   Rainfall dir.: C:\09-062\SWMHYMO\POST\CHI\

    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 002
    NSTORM=    1
           #  1=2CHI4.stm
-------------------------------------------------------------------------------------
002:0002-----------------------------------------------------------------------------
*#******************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]     Project Number: [09-062]
*#  Date          : 01-06-2013
*#  Modeller      : [JR]
*#  Company       : WMI & Associates Ltd.
*#  License #     :  2880720
*#******************************************************************************
-------------------------------------------------------------------------------------
002:0002-----------------------------------------------------------------------------
---------------------
| READ STORM          |    Filename: 2-Year Chicago Storm Distribution (4-hou
| Ptotal=  32.77 mm|    Comments: 2-Year Chicago Storm Distribution (4-hou
---------------------
              TIME     RAIN |  TIME     RAIN |  TIME     RAIN |  TIME     RAIN
               hrs    mm/hr |   hrs    mm/hr |   hrs    mm/hr |   hrs    mm/hr
```



```
          .17    2.285 |   1.17  14.057 |   2.17    4.915 |   3.17    2.674
          .33    2.585 |   1.33  82.380 |   2.33    4.266 |   3.33    2.501
          .50    2.995 |   1.50  18.005 |   2.50    3.787 |   3.50    2.353
          .67    3.598 |   1.67  10.127 |   2.67    3.416 |   3.67    2.223
          .83    4.586 |   1.83   7.331 |   2.83    3.120 |   3.83    2.109
         1.00    6.583 |   2.00   5.849 |   3.00    2.877 |   4.00    2.007

-------------------------------------------------------------------------------------
002:0003-----------------------------------------------------------------------------
* CATCHMENT 101
----------------------
| CALIB STANDHYD      |   Area     (ha)=   11.05
| 01:101     DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   19.50
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=       3.87         7.18
     Dep. Storage      (mm)=       2.00         6.70
     Average Slope      (%)=       2.00         5.00
     Length             (m)=     200.00        40.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=       82.38         5.90
                over (min)        3.00        20.00
     Storage Coeff.  (min)=       3.40 (ii)    20.03 (ii)
     Unit Hyd. Tpeak (min)=       3.00        20.00
     Unit Hyd. peak  (cms)=        .35          .06
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .46          .07             .473 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.65            1.333
     RUNOFF VOLUME    (mm)=      30.77         3.70            8.983
     TOTAL RAINFALL   (mm)=      32.77        32.77           32.772
     RUNOFF COEFFICIENT   =        .94          .11             .274

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  54.0     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.

-------------------------------------------------------------------------------------
002:0004-----------------------------------------------------------------------------
* EXTERNAL AREA #1
----------------------
| CALIB NASHYD         |   Area     (ha)=     7.78   Curve Number   (CN)=56.00
| 02:EXT1    DT= 1.00 |   Ia       (mm)=    7.200   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=      .290

     Unit Hyd Qpeak  (cms)=     1.025

     PEAK FLOW       (cms)=      .046 (i)
     TIME TO PEAK    (hrs)=     1.700
     RUNOFF VOLUME    (mm)=     2.904
     TOTAL RAINFALL   (mm)=    32.772
```

```
    RUNOFF COEFFICIENT   =     .089

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

---------------------------------------------------------------------------------------
002:0005-------------------------------------------------------------------------------
* EXTERNAL AREA #2
 ---------------------
| CALIB STANDHYD      |   Area    (ha)=    6.14
| 03:EXT2   DT= 1.00  |   Total Imp(%)=   25.00   Dir. Conn.(%)=   14.00
 ---------------------
                          IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=     1.53        4.61
    Dep. Storage     (mm)=     2.00        5.00
    Average Slope     (%)=     3.00        8.00
    Length            (m)=   150.00       90.00
    Mannings n          =      .013        .250

    Max.eff.Inten.(mm/hr)=    82.38        5.75
              over (min)      3.00       26.00
    Storage Coeff.  (min)=     2.53 (ii)   26.28 (ii)
    Unit Hyd. Tpeak (min)=     3.00       26.00
    Unit Hyd. peak  (cms)=      .42         .04
                                                      *TOTALS*
    PEAK FLOW        (cms)=     .19         .04         .197 (iii)
    TIME TO PEAK     (hrs)=    1.33        1.75        1.333
    RUNOFF VOLUME     (mm)=   30.77        4.43        8.115
    TOTAL RAINFALL    (mm)=   32.77       32.77       32.772
    RUNOFF COEFFICIENT   =     .94         .14         .248

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN* =   59.0    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.

---------------------------------------------------------------------------------------
002:0006-------------------------------------------------------------------------------
 ---------------------
| SHIFT HYD(S-EXT2    )|
| IN= 3---> OUT= 4     |
| SHIFT=  10.0 min     |      AREA      QPEAK      TPEAK      R.V.
 ----------------------       (ha)      (cms)      (hrs)      (mm)
         ID= 3:EXT2           6.14       .197      1.333      8.115
   SHIFT ID= 4:S-EXT2         6.14       .197      1.483      8.115

---------------------------------------------------------------------------------------
002:0007-------------------------------------------------------------------------------
 ---------------------
| ADD HYD (S-EXT1+2  ) | ID: NHYD       AREA    QPEAK   TPEAK    R.V.     DWF
 ---------------------                  (ha)    (cms)   (hrs)    (mm)    (cms)
                  ID1 02:EXT1           7.78     .046    1.70    2.90     .000
```



```
                  +ID2 03:EXT2           6.14     .197    1.33    8.12     .000
                  ==============================================================
                  SUM 05:S-EXT1+2       13.92     .204    1.33    5.20     .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------------------
002:0008-------------------------------------------------------------------------------
 ---------------------
| ROUTE RESERVOIR     |     Requested routing time step =  1.0 min.
|  IN>01:(101    )    |
| OUT<06:(POND O)     |     ========  OUTLFOW STORAGE TABLE  ========
 ---------------------      OUTFLOW    STORAGE   | OUTFLOW    STORAGE
                             (cms)     (ha.m.)   |  (cms)     (ha.m.)
                              .000   .0000E+00   |   .323   .2527E+00
                              .008   .6520E-01   |  1.641   .2973E+00
                              .251   .1704E+00   |  2.734   .3206E+00

    ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
    -------------------        (ha)     (cms)     (hrs)       (mm)
    INFLOW >01: (101    )     11.05      .473     1.333      8.983
    OUTFLOW<06: (POND O)      11.05      .033     3.367      8.982

              PEAK   FLOW   REDUCTION [Qout/Qin](%)=     6.874
              TIME SHIFT OF PEAK FLOW        (min)=    122.00
              MAXIMUM  STORAGE   USED       (ha.m.)=.7582E-01

---------------------------------------------------------------------------------------
002:0009-------------------------------------------------------------------------------
* EXTERNAL AREA #3
 ---------------------
| CALIB NASHYD        |   Area     (ha)=     4.36   Curve Number    (CN)=57.00
| 08:EXT3    DT= 1.00 |   Ia       (mm)=    6.900   # of Linear Res.(N)= 3.00
 ---------------------    U.H. Tp(hrs)=      .553

    Unit Hyd Qpeak   (cms)=      .301

    PEAK FLOW        (cms)=      .019 (i)
    TIME TO PEAK     (hrs)=     2.100
    RUNOFF VOLUME     (mm)=     3.078
    TOTAL RAINFALL    (mm)=    32.772
    RUNOFF COEFFICIENT   =       .094

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

---------------------------------------------------------------------------------------
002:0010-------------------------------------------------------------------------------
---------------------------------------------------------------------------------------
002:0002-------------------------------------------------------------------------------
 ** END OF RUN :   2
```

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

  --------------------
  | START            |  Project  dir.: C:\09-062\SWMHYMO\POST\CHI\
  --------------------  Rainfall dir.: C:\09-062\SWMHYMO\POST\CHI\
     TZERO =   .00 hrs on        0
     METOUT=   2 (output = METRIC)
     NRUN  = 003
     NSTORM=   1
            #  1=5CHI4.stm
 -------------------------------------------------------------------------------------
 003:0002-----------------------------------------------------------------------------
 *#******************************************************************************
 *#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
 *#  Date         : 01-06-2013
 *#  Modeller     : [JR]
 *#  Company      : WMI & Associates Ltd.
 *#  License #    :  2880720
 *#******************************************************************************
 -------------------------------------------------------------------------------------
 003:0002-----------------------------------------------------------------------------
  --------------------
  | READ STORM       |   Filename: 5-Year Chicago Storm Distribution (4-hou
  | Ptotal=  43.79 mm|   Comments: 5-Year Chicago Storm Distribution (4-hou
  --------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17   3.077 |  1.17  18.812 |  2.17   6.603 |  3.17   3.599
                 .33   3.479 |  1.33 109.412 |  2.33   5.734 |  3.33   3.367
                 .50   4.030 |  1.50  24.075 |  2.50   5.091 |  3.50   3.168
                 .67   4.838 |  1.67  13.572 |  2.67   4.594 |  3.67   2.993
                 .83   6.162 |  1.83   9.837 |  2.83   4.197 |  3.83   2.840
                1.00   8.836 |  2.00   7.853 |  3.00   3.872 |  4.00   2.703

 -------------------------------------------------------------------------------------
 003:0003-----------------------------------------------------------------------------
 * CATCHMENT 101
  ----------------------
  | CALIB STANDHYD     |   Area    (ha)=   11.05
  | 01:101     DT= 1.00 |  Total Imp(%)=   35.00   Dir. Conn.(%)=   19.50
  ----------------------
                                IMPERVIOUS     PERVIOUS (i)
      Surface Area     (ha)=       3.87          7.18
      Dep. Storage     (mm)=       2.00          6.70
      Average Slope     (%)=       2.00          5.00
      Length            (m)=     200.00         40.00
      Mannings n           =       .013          .250
```



```
      Max.eff.Inten.(mm/hr)=     109.41         13.15
                over (min)         3.00         15.00
      Storage Coeff.  (min)=       3.03 (ii)    15.11 (ii)
      Unit Hyd. Tpeak (min)=       3.00         15.00
      Unit Hyd. peak  (cms)=        .37           .08
                                                           *TOTALS*
      PEAK FLOW       (cms)=        .62           .16         .669 (iii)
      TIME TO PEAK    (hrs)=       1.33          1.55        1.333
      RUNOFF VOLUME    (mm)=      41.79          6.91       13.714
      TOTAL RAINFALL   (mm)=      43.79         43.79       43.791
      RUNOFF COEFFICIENT   =        .95           .16         .313

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  54.0     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.

 -------------------------------------------------------------------------------------
 003:0004-----------------------------------------------------------------------------
 * EXTERNAL AREA #1
  ----------------------
  | CALIB NASHYD       |   Area     (ha)=     7.78   Curve Number    (CN)=56.00
  | 02:EXT1    DT= 1.00 |  Ia       (mm)=    7.200   # of Linear Res.(N)= 3.00
  ----------------------   U.H. Tp(hrs)=     .290

      Unit Hyd Qpeak  (cms)=     1.025

      PEAK FLOW       (cms)=      .096 (i)
      TIME TO PEAK    (hrs)=     1.683
      RUNOFF VOLUME    (mm)=     5.669
      TOTAL RAINFALL   (mm)=    43.791
      RUNOFF COEFFICIENT   =      .129

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

 -------------------------------------------------------------------------------------
 003:0005-----------------------------------------------------------------------------
 * EXTERNAL AREA #2
  ----------------------
  | CALIB STANDHYD     |   Area    (ha)=    6.14
  | 03:EXT2    DT= 1.00 |  Total Imp(%)=   25.00   Dir. Conn.(%)=    14.00
  ----------------------
                                IMPERVIOUS     PERVIOUS (i)
      Surface Area     (ha)=       1.53          4.61
      Dep. Storage     (mm)=       2.00          5.00
      Average Slope     (%)=       3.00          8.00
      Length            (m)=     150.00         90.00
      Mannings n           =       .013          .250

      Max.eff.Inten.(mm/hr)=     109.41         12.97
                over (min)         2.00         19.00
```

```
       Storage Coeff.  (min)=        2.26 (ii)   19.41 (ii)
       Unit Hyd. Tpeak (min)=        2.00        19.00
       Unit Hyd. peak  (cms)=         .52          .06
                                                            *TOTALS*
       PEAK FLOW       (cms)=         .26          .10         .279 (iii)
       TIME TO PEAK    (hrs)=        1.33         1.63        1.333
       RUNOFF VOLUME    (mm)=       41.79         8.04       12.766
       TOTAL RAINFALL   (mm)=       43.79        43.79       43.791
       RUNOFF COEFFICIENT   =         .95          .18         .292

         (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
             CN* =  59.0    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.

-------------------------------------------------------------------------------------
003:0006-----------------------------------------------------------------------------
--------------------
| SHIFT HYD(S-EXT2    )|
| IN= 3---> OUT= 4     |
| SHIFT=  10.0 min     |          AREA      QPEAK      TPEAK      R.V.
-----------------------           (ha)      (cms)      (hrs)      (mm)
        ID= 3:EXT2                6.14       .279      1.333     12.766
  SHIFT ID= 4:S-EXT2              6.14       .279      1.483     12.766

-------------------------------------------------------------------------------------
003:0007-----------------------------------------------------------------------------
-----------------------
| ADD HYD (S-EXT1+2  ) | ID: NHYD          AREA      QPEAK   TPEAK   R.V.     DWF
-----------------------                    (ha)      (cms)   (hrs)   (mm)    (cms)
                         ID1 02:EXT1       7.78       .096    1.68    5.67    .000

                        +ID2 03:EXT2       6.14       .279    1.33   12.77    .000

                         ==========================================================
                         SUM 05:S-EXT1+2  13.92       .298    1.33    8.80    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
003:0008-----------------------------------------------------------------------------
--------------------
| ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
|  IN>01:(101     )  |
| OUT<06:(POND O)    |     =========  OUTLFOW STORAGE TABLE  =========
--------------------       OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)     (ha.m.)   |   (cms)     (ha.m.)
                             .000   .0000E+00   |     .323   .2527E+00
                             .008   .6520E-01   |    1.641   .2973E+00
                             .251   .1704E+00   |    2.734   .3206E+00
```



```
     ROUTING RESULTS              AREA      QPEAK      TPEAK        R.V.
     --------------------         (ha)      (cms)      (hrs)        (mm)
     INFLOW >01: (101    )       11.05       .669      1.333      13.714
     OUTFLOW<06: (POND O)        11.05       .080      2.483      13.714

                   PEAK    FLOW   REDUCTION [Qout/Qin](%)=    11.950
                   TIME SHIFT OF PEAK FLOW           (min)=    69.00
                   MAXIMUM  STORAGE   USED        (ha.m.)=.9634E-01

-------------------------------------------------------------------------------------
003:0009-----------------------------------------------------------------------------
* EXTERNAL AREA #3
----------------------
| CALIB NASHYD        |   Area     (ha)=     4.36   Curve Number    (CN)=57.00
| 08:EXT3    DT= 1.00 |   Ia       (mm)=    6.900   # of Linear Res.(N)= 3.00
----------------------    U.H. Tp(hrs)=     .553

     Unit Hyd Qpeak   (cms)=      .301

     PEAK FLOW        (cms)=      .038 (i)
     TIME TO PEAK     (hrs)=     2.067
     RUNOFF VOLUME     (mm)=     5.956
     TOTAL RAINFALL    (mm)=    43.791
     RUNOFF COEFFICIENT    =      .136

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

-------------------------------------------------------------------------------------
003:0010-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
003:0002-----------------------------------------------------------------------------
-------------------------------------------------------------------------------------
003:0002-----------------------------------------------------------------------------
  ** END OF RUN :   3

*****************************************************************************



--------------------
| START              |   Project  dir.: C:\09-062\SWMHYMO\POST\CHI\
--------------------     Rainfall dir.: C:\09-062\SWMHYMO\POST\CHI\

    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 004
    NSTORM=    1
           #  1=25CHI4.stm
-------------------------------------------------------------------------------------
004:0002-----------------------------------------------------------------------------
```

```
*#*************************************************************************
*#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
*#  Date        : 01-06-2013
*#  Modeller    : [JR]
*#  Company     : WMI & Associates Ltd.
*#  License #   :  2880720
*#*************************************************************************
---------------------------------------------------------------------------------
004:0002-------------------------------------------------------------------------
--------------------
| READ STORM        |      Filename: 25-Year Chicago Storm Distribution (4-ho
| Ptotal=  60.08 mm|       Comments: 25-Year Chicago Storm Distribution (4-ho
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   4.238 |   1.17  25.827 |   2.17   9.082 |   3.17   4.956
               .33   4.791 |   1.33 149.649 |   2.33   7.889 |   3.33   4.637
               .50   5.548 |   1.50  33.039 |   2.50   7.007 |   3.50   4.362
               .67   6.658 |   1.67  18.646 |   2.67   6.324 |   3.67   4.123
               .83   8.477 |   1.83  13.522 |   2.83   5.778 |   3.83   3.911
              1.00  12.149 |   2.00  10.799 |   3.00   5.330 |   4.00   3.724

---------------------------------------------------------------------------------
004:0003-------------------------------------------------------------------------
* CATCHMENT 101
----------------------
| CALIB STANDHYD      |    Area     (ha)=    11.05
| 01:101     DT= 1.00 |    Total Imp(%)=    35.00    Dir. Conn.(%)=    19.50
----------------------
                              IMPERVIOUS     PERVIOUS (i)
     Surface Area      (ha)=      3.87          7.18
     Dep. Storage      (mm)=      2.00          6.70
     Average Slope      (%)=      2.00          5.00
     Length             (m)=    200.00         40.00
     Mannings n           =       .013          .250

     Max.eff.Inten.(mm/hr)=     149.65         30.96
                over (min)        3.00         11.00
     Storage Coeff.   (min)=      2.68 (ii)    11.25 (ii)
     Unit Hyd. Tpeak  (min)=      3.00         11.00
     Unit Hyd. peak   (cms)=       .40           .10
                                                            *TOTALS*
     PEAK FLOW        (cms)=       .87           .37          1.040 (iii)
     TIME TO PEAK      (hrs)=     1.33          1.48          1.333
     RUNOFF VOLUME      (mm)=    58.08         13.03         21.814
     TOTAL RAINFALL     (mm)=    60.08         60.08         60.078
     RUNOFF COEFFICIENT   =        .97           .22           .363

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  54.0     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.
```



```
---------------------------------------------------------------------------------
004:0004-------------------------------------------------------------------------
* EXTERNAL AREA #1
----------------------
| CALIB NASHYD        |    Area     (ha)=    7.78   Curve Number    (CN)=56.00
| 02:EXT1    DT= 1.00 |    Ia       (mm)=   7.200   # of Linear Res.(N)= 3.00
----------------------     U.H. Tp(hrs)=     .290

     Unit Hyd Qpeak  (cms)=     1.025

     PEAK FLOW       (cms)=      .197 (i)
     TIME TO PEAK    (hrs)=     1.667
     RUNOFF VOLUME    (mm)=    11.076
     TOTAL RAINFALL   (mm)=    60.078
     RUNOFF COEFFICIENT   =      .184

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

---------------------------------------------------------------------------------
004:0005-------------------------------------------------------------------------
* EXTERNAL AREA #2
----------------------
| CALIB STANDHYD      |    Area     (ha)=     6.14
| 03:EXT2    DT= 1.00 |    Total Imp(%)=    25.00    Dir. Conn.(%)=    14.00
----------------------
                              IMPERVIOUS     PERVIOUS (i)
     Surface Area      (ha)=      1.53          4.61
     Dep. Storage      (mm)=      2.00          5.00
     Average Slope      (%)=      3.00          8.00
     Length             (m)=    150.00         90.00
     Mannings n           =       .013          .250

     Max.eff.Inten.(mm/hr)=     149.65         27.78
                over (min)        2.00         15.00
     Storage Coeff.   (min)=      1.99 (ii)    14.64 (ii)
     Unit Hyd. Tpeak  (min)=      2.00         15.00
     Unit Hyd. peak   (cms)=       .56           .08
                                                            *TOTALS*
     PEAK FLOW        (cms)=       .35           .22           .427 (iii)
     TIME TO PEAK      (hrs)=     1.33          1.55          1.333
     RUNOFF VOLUME      (mm)=    58.08         14.81         20.865
     TOTAL RAINFALL     (mm)=    60.08         60.08         60.078
     RUNOFF COEFFICIENT   =        .97           .25           .347

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  59.0     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.

---------------------------------------------------------------------------------
004:0006-------------------------------------------------------------------------
```

```
 ----------------------------
 | SHIFT HYD(S-EXT2    )|
 | IN= 3---> OUT= 4     |
 | SHIFT=  10.0 min     |     AREA     QPEAK      TPEAK       R.V.
 ------------------------      (ha)     (cms)      (hrs)       (mm)
        ID= 3:EXT2              6.14      .427      1.333     20.865
   SHIFT ID= 4:S-EXT2           6.14      .427      1.483     20.865

 ------------------------------------------------------------------------------
 004:0007----------------------------------------------------------------------
 ----------------------------
 | ADD HYD (S-EXT1+2  ) | ID: NHYD      AREA    QPEAK   TPEAK   R.V.    DWF
 ----------------------------            (ha)    (cms)   (hrs)   (mm)   (cms)
                       ID1 02:EXT1       7.78     .197    1.67  11.08    .000

                      +ID2 03:EXT2       6.14     .427    1.33  20.87    .000
                       ==============================================
                       SUM 05:S-EXT1+2  13.92     .473    1.33  15.39    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 004:0008----------------------------------------------------------------------
 ------------------------
 | ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
 |  IN>01:(101    )   |
 | OUT<06:(POND O)    |     =========  OUTFLOW STORAGE TABLE  =========
 ------------------------   OUTFLOW     STORAGE  |  OUTFLOW     STORAGE
                             (cms)     (ha.m.)   |   (cms)      (ha.m.)
                              .000   .0000E+00   |     .323   .2527E+00
                              .008   .6520E-01   |    1.641   .2973E+00
                              .251   .1704E+00   |    2.734   .3206E+00

     ROUTING RESULTS              AREA      QPEAK      TPEAK        R.V.
     -----------------------       (ha)      (cms)      (hrs)       (mm)
     INFLOW >01: (101    )        11.05      1.040      1.333     21.814
     OUTFLOW<06: (POND O)         11.05       .171      2.117     21.813

                 PEAK   FLOW   REDUCTION [Qout/Qin](%)=    16.426
                 TIME SHIFT OF PEAK FLOW          (min)=    47.00
                 MAXIMUM  STORAGE   USED        (ha.m.)=.1357E+00

 ------------------------------------------------------------------------------
 004:0009----------------------------------------------------------------------
 * EXTERNAL AREA #3
 ------------------------
 | CALIB NASHYD       |   Area     (ha)=    4.36   Curve Number   (CN)=57.00
 | 08:EXT3   DT= 1.00 |   Ia       (mm)=   6.900   # of Linear Res.(N)= 3.00
 ------------------------ U.H. Tp(hrs)=     .553

     Unit Hyd Qpeak  (cms)=      .301
```



```
      PEAK FLOW       (cms)=      .075 (i)
      TIME TO PEAK    (hrs)=     2.033
      RUNOFF VOLUME    (mm)=    11.552
      TOTAL RAINFALL   (mm)=    60.078
      RUNOFF COEFFICIENT    =      .192

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

 ------------------------------------------------------------------------------
 004:0010----------------------------------------------------------------------
 ------------------------------------------------------------------------------
 004:0002----------------------------------------------------------------------
 ------------------------------------------------------------------------------
 004:0002----------------------------------------------------------------------
 ------------------------------------------------------------------------------
 004:0002----------------------------------------------------------------------
   ** END OF RUN :   4

 *******************************************************************************

 ------------------------
 | START              |  Project  dir.: C:\09-062\SWMHYMO\POST\CHI\
 -----------------------  Rainfall dir.: C:\09-062\SWMHYMO\POST\CHI\

     TZERO =    .00 hrs on        0
     METOUT=    2 (output = METRIC)
     NRUN  = 005
     NSTORM=    1
            #  1=100CHI4.stm
 ------------------------------------------------------------------------------
 005:0002----------------------------------------------------------------------
 *#*****************************************************************************
 *#  Project Name: [221 FOX STREET SUBDIVISION]    Project Number: [09-062]
 *#  Date         : 01-06-2013
 *#  Modeller     : [JR]
 *#  Company      : WMI & Associates Ltd.
 *#  License #    :  2880720
 *#*****************************************************************************
 ------------------------------------------------------------------------------
 005:0002----------------------------------------------------------------------
 ------------------------
 | READ STORM         |    Filename: 100-Year Chicago Storm Distribution (4-h
 | Ptotal=  73.84 mm|      Comments: 100-Year Chicago Storm Distribution (4-h
 ------------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   5.248 |   1.17  31.788 |   2.17  11.222 |   3.17   6.134
```

```
 .33   5.931 |   1.33 182.809 |   2.33   9.752 |   3.33   5.741
 .50   6.865 |   1.50  40.631 |   2.50   8.664 |   3.50   5.402
 .67   8.234 |   1.67  22.982 |   2.67   7.822 |   3.67   5.106
 .83  10.476 |   1.83  16.686 |   2.83   7.149 |   3.83   4.845
1.00  14.996 |   2.00  13.336 |   3.00   6.596 |   4.00   4.613

------------------------------------------------------------------------------------
005:0003----------------------------------------------------------------------------
* CATCHMENT 101
----------------------
| CALIB STANDHYD     |   Area     (ha)=   11.05
| 01:101    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   19.50
----------------------

                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      3.87         7.18
     Dep. Storage     (mm)=      2.00         6.70
     Average Slope     (%)=      2.00         5.00
     Length            (m)=    200.00        40.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    182.81        52.79
                over (min)      2.00         9.00
     Storage Coeff.  (min)=      2.47 (ii)    9.39 (ii)
     Unit Hyd. Tpeak (min)=      2.00         9.00
     Unit Hyd. peak  (cms)=       .48          .12
                                                          *TOTALS*
     PEAK FLOW       (cms)=      1.07          .63          1.454 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.45          1.333
     RUNOFF VOLUME    (mm)=     71.84        19.26         29.511
     TOTAL RAINFALL   (mm)=     73.84        73.84         73.838
     RUNOFF COEFFICIENT   =       .97          .26           .400

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN* =   54.0    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.

------------------------------------------------------------------------------------
005:0004----------------------------------------------------------------------------
* EXTERNAL AREA #1
----------------------
| CALIB NASHYD       |   Area     (ha)=     7.78   Curve Number   (CN)=56.00
| 02:EXT1   DT= 1.00 |   Ia       (mm)=    7.200   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=      .290

     Unit Hyd Qpeak  (cms)=     1.025

     PEAK FLOW       (cms)=      .304 (i)
     TIME TO PEAK    (hrs)=     1.650
     RUNOFF VOLUME    (mm)=    16.681
     TOTAL RAINFALL   (mm)=    73.838
     RUNOFF COEFFICIENT   =      .226
```



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

------------------------------------------------------------------------------------
005:0005----------------------------------------------------------------------------
* EXTERNAL AREA #2
----------------------
| CALIB STANDHYD     |   Area     (ha)=    6.14
| 03:EXT2   DT= 1.00 |   Total Imp(%)=   25.00   Dir. Conn.(%)=   14.00
----------------------

                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      1.53         4.61
     Dep. Storage     (mm)=      2.00         5.00
     Average Slope     (%)=      3.00         8.00
     Length            (m)=    150.00        90.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    182.81        47.07
                over (min)      2.00        12.00
     Storage Coeff.  (min)=      1.84 (ii)   12.08 (ii)
     Unit Hyd. Tpeak (min)=      2.00        12.00
     Unit Hyd. peak  (cms)=       .59          .09
                                                          *TOTALS*
     PEAK FLOW       (cms)=       .43          .37           .599 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.50          1.333
     RUNOFF VOLUME    (mm)=     71.84        21.61         28.639
     TOTAL RAINFALL   (mm)=     73.84        73.84         73.838
     RUNOFF COEFFICIENT   =       .97          .29           .388

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN* =   59.0    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.

------------------------------------------------------------------------------------
005:0006----------------------------------------------------------------------------
---------------------
| SHIFT HYD(S-EXT2    )|
| IN= 3---> OUT= 4     |
| SHIFT=  10.0 min     |       AREA      QPEAK      TPEAK       R.V.
------------------------       (ha)      (cms)      (hrs)       (mm)
        ID= 3:EXT2             6.14       .599      1.333     28.639
  SHIFT ID= 4:S-EXT2           6.14       .599      1.483     28.639

------------------------------------------------------------------------------------
005:0007----------------------------------------------------------------------------
------------------------
| ADD HYD (S-EXT1+2  ) | ID: NHYD        AREA     QPEAK   TPEAK    R.V.    DWF
------------------------                 (ha)     (cms)   (hrs)    (mm)   (cms)
                     ID1 02:EXT1         7.78      .304    1.65   16.68    .000

                    +ID2 03:EXT2         6.14      .599    1.33   28.64    .000
```

```
          ============================================================
          SUM 05:S-EXT1+2       13.92      .718     1.50  21.96     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -----------------------------------------------------------------------------
 005:0008---------------------------------------------------------------------
 ---------------------
 | ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
 |  IN>01:(101    )  |
 | OUT<06:(POND O)   |     ========  OUTLFOW STORAGE TABLE  ========
 ---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000  .0000E+00     |    .323  .2527E+00
                            .008  .6520E-01     |   1.641  .2973E+00
                            .251  .1704E+00     |   2.734  .3206E+00

      ROUTING RESULTS               AREA     QPEAK     TPEAK      R.V.
      --------------------          (ha)     (cms)     (hrs)      (mm)
      INFLOW >01: (101    )        11.05     1.454     1.333    29.511
      OUTFLOW<06: (POND O)         11.05      .255     2.017    29.510

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   17.542
                   TIME SHIFT OF PEAK FLOW        (min)=    41.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1751E+00

 -----------------------------------------------------------------------------
 005:0009---------------------------------------------------------------------
 * EXTERNAL AREA #3
 ---------------------
 | CALIB NASHYD      |   Area     (ha)=     4.36   Curve Number    (CN)=57.00
 | 08:EXT3    DT= 1.00 | Ia       (mm)=    6.900   # of Linear Res.(N)= 3.00
 ---------------------   U.H. Tp(hrs)=      .553

      Unit Hyd Qpeak  (cms)=      .301

      PEAK FLOW       (cms)=      .115 (i)
      TIME TO PEAK    (hrs)=     2.017
      RUNOFF VOLUME    (mm)=    17.330
      TOTAL RAINFALL   (mm)=    73.838
      RUNOFF COEFFICIENT   =      .235

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

 -----------------------------------------------------------------------------
 005:0010---------------------------------------------------------------------
 -----------------------------------------------------------------------------
 005:0002---------------------------------------------------------------------
 -----------------------------------------------------------------------------
 005:0002---------------------------------------------------------------------
 -----------------------------------------------------------------------------
```



```
 005:0002---------------------------------------------------------------------
 -----------------------------------------------------------------------------
 005:0002---------------------------------------------------------------------
      FINISH
 -----------------------------------------------------------------------------
 *****************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2013-01-06     at 15:05:02
 =============================================================================
```

General Servicing and Lot Grading Concept Plans

Appendix D

Notes:

1. Unless noted otherwise, the measurements and distances shown on this drawing are shown in meters.
2. Do not scale drawings.
3. It is the contractor's responsibility to verify all dimensions, levels and datums on site and report any discrepancies or omissions to WMI & Associates Ltd. prior to construction.
4. This drawing is to be read and understood in conjunction with all other relevant documents applicable to this project.
5. This drawing is the exclusive property of WMI & Associates Ltd. and the reproduction of any part of this document without prior written consent is strictly prohibited.

Benchmark: 180.16m

Monument is located in the Town of Penetanguishene on the south side of Broad Street, being on the centreline production of the asphalt driveway to #19 Broad Street, and west of the centreline of Jury Drive. Monument is 4.8 metres south of the centreline Broad Street and 23.3 metres west of the centreline of Jury Drive.

No.	Issue / Revision	Date
1	First Submission	Feb. 1, 2013
2	Second Submission FSR	Oct. 31, 2013

221 FOX STREET SUBDIVISION

GENERAL SERVICING CONCEPT PLAN

Client:
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Toronto, Ontario

WMI & Associates Limited
119 Collier Street
Barrie, Ontario
L4M 1H5
Ph 705-797-2027
www.wmiengineering.ca

Drawn By	Checked By	Drawing No.
TG	DAI	GEN
Scale 1:1000	Project No. 09-062	

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Notes:

1. Unless noted otherwise, the measurements and distances shown on this drawing are shown in meters.
2. Do not scale drawings.
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No.	Issue / Revision	Date
1	First Submission	Feb. 1, 2013
2	Second Submission FSR	Oct. 31, 2013

221 FOX STREET SUBDIVISION

LOT GRADING CONCEPT PLAN

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Drawn By	Checked By	Drawing No.
TG	DAI	LGR
Scale 1:1000	Project No. 09-062	

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