Functional Servicing and Stormwater Management Report

Proposed Commercial/Industrial Development
Claremont North Business Park
5435, 5455 and 5475 Old Brock Road
Pickering, Ontario

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Project No. 160622415

January 17, 2019

Revision	Description	Author		Quality Check		Independent Review	

Sign-off Sheet

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Executive Summary

This report describes the overall site grading, servicing and SWM strategy to functionally service the proposed development in support of a Zoning By-Law Amendment application with the City of Pickering. It also demonstrates conformity to the relevant sections of the ORMCP.

Storm - Existing drainage patterns will be maintained and attenuated in accordance to ORMCP Conservation Polices. Current Old Brock Road major/minor flow conveyance to the wetland southeast of the site will be preserved. Onsite major/minor flows will be captured and controlled by a proposed dry pond to treat and control surface water runoff to rates and volumes prescribed by the Agencies for the Duffins Creek Watershed. The proposed stormwater management and drainage strategy will be resilient towards the future effects of Climate Change.

Sanitary – No municipal system exists adjacent to site to serve as an outlet. Site sanitary will drain via a private sewer network to a septic system at the southwest corner of the site sized for a peak load of 17,000 L/day. Carwash output will not contribute to the septic load as it will be stored and regularly hauled offsite.

Water – No municipal water system is currently available adjacent to site to service the development. A proposed private well located at the northern most point of the site will service the site for domestic and fire through a private water network. Domestic and fire loads are estimated to be 0.31 L/s (26,980 L/day) and 3000 (USGPM), respectively.

Grading – Site slope analysis demonstrates the site is exempt from the Landform Conservation Policy set out by the Oak Ridges Moraine Conservation Plan. Grades are set to maintain much of the existing general topography of the site in keeping with ORMCP Conservation Polices.

The existing 17m vertical drop from north to south along the site necessitates the use of steep driveways at entrances and parking lot interfaces to ensure reasonable gradients within parking areas. Exposed foundations and retaining walls are additionally implemented to maintain workable slopes within site and avoid foundation steps.

1.0 INTRODUCTION

This report commissioned by S. Larkin Developments Inc. (Larkin) has been prepared to demonstrate the functional capacity of the subject site to support the proposed development from a grading, private servicing and stormwater management (SWM) perspective for a zoning by-law amendment application for 5435, 5455 and 5475 Old Brock Road in the City of Pickering (the "site". The purpose of the proposed development is to permit additional industrial type builidngs, a retail gas outlet with an accessory restaurant use, associated car wash and to formalize existing employment uses on the site.

1.1 SITE LOCATION AND DESCRIPTION

The site, depicted in the aerial figure below, is located south of Uxbridge Pickering Townline between Brock Road and Old Brock Road in the Village of Claremont. The 4.37 hectare lot is mostly undeveloped and contains a residential dwelling, heavy equipment maintenance shop (five bays), barn and various supporting trailers/sheds. The surface makeup is mostly grass, shrubs and soil. Three (3) existing driveways provide access along the western periphery to Old Brock Road.

The subject development resides within the Oak Ridges Moraine, and a wetland is located within the southeast portion of the site. Approaches implemented to conform to the Oak Ridges Moraine Conservation Plan (ORMCP) polices are discussed in relevant sections. This FSR addresses sections 19,25,30,36,43, 45, 46 and 47 of the ORMCP and is in conjunction with various recommendations provided within two (2) other Stantec documents entitled *Preliminary Geotechnical/Hydrogeological Report*, dated January 17, 2019, and *Natural Heritage Evaluation Report and Oak Ridges Moraine Conformity Evaluation*, also dated January 17, 2019.

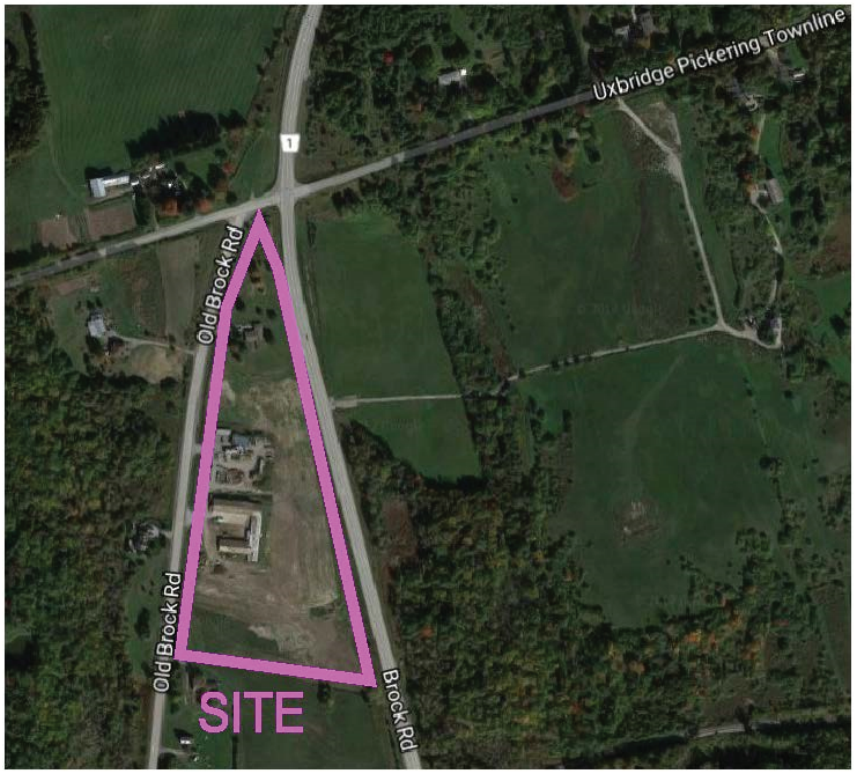


Figure 1.1 - Site Location

1.2 SITE PROPOSAL

The purpose of the proposed development is to build new infrastructure that will provide services to the community, including three (3) new industrial type buildings, a retail gas outlet with a restaurant and car wash, and associated parking areas for the overall site are proposed. The existing barn structure will be maintained and be incorporated into the proposed development. A third driveway access will be provided along Old Brock Road, and a new access driveway will connect the site to Brock Road. The existing wetland will be maintained. The Development Concept Plan and Pre-Consultation Meeting Minutes, dated January 15, 2016, are provided in **Appendix A.**

2.0 FUNCTIONAL SERVICING

The site shall be constructed and serviced in accordance to City of Pickering and Region of Durham design standards and ORMCP polices.

2.1 STORM DRAINAGE

Under existing conditions, the site sheet drains south towards the wetland situated at the southeast corner of the site. Additionally, Old Brock Road major flows which enter the site through the southwestern boundary drain easterly across the site and into an existing wetland feature.

Existing drainage patterns will be maintained and attenuated in accordance to ORMCP policies. An overland flow channel south of the proposed dry pond is provided to ensure portions of Old Brock Road major/minor storm conveyance to the wetland is maintained as observed under pre-development conditions.

Onsite minor system flows will be captured via catch basins and directed towards the proposed dry pond located west of the existing wetland. Major flows are directed to the pond via overland relief, which has been accommodated by the proposed grading plan. The storm system throughout the proposed site has been designed to convey 100-year peak flows to prevent localized major storm runoff from spilling onto Brock Road (uncontrolled) and to ensure all onsite major system drainage will be directed toward the proposed stormwater management dry pond.

Stormwater management is discussed in further detail in **Section 3.0**

The Conceptual Grading Plan (C-101) and Servicing Plan (C-102) are provided in **Appendix B.**

2.2 SANITARY

Currently no municipal sanitary system exists along roads adjacent to the site and the existing buildings are serviced by onsite septic beds. The proposed development will be supported by a larger septic bed situated at the southwest corner of the site, and all existing onsite septic beds will be decommissioned as part of the future development.

The proposed septic system has been preliminarily sized by FlowSpec Engineering (septic subconsultant) for the peak site sanitary load of 17,000 L/day as per OBC Table 8.2.1.3.B. It is our understanding the carwash output will not contribute to the septic load, as it is anticipated to contain higher concentrations of inorganic Total Suspended Solids (TSS), which has the potential to adversely affect the proposed septic bed. As such, car wash wastewater will be stored, recycled and ultimately hauled offsite, as required.

A private sanitary network will deliver site sanitary flows to the septic bed. Individual services to buildings will be sized at detailed design in coordination with building mechanical engineers.

A supporting engineering design memorandum outlining the conceptual onsite sewage disposal system is provided in **Appendix C**. The Conceptual Servicing Plan (C-102) is provided in **Appendix B**.

2.3 WATER

Currently no municipal watermain system exists along roads adjacent to the site and the existing buildings are serviced by onsite supply wells. The proposed development will be supported by a larger well situated in the northernmost portion of the site, and all existing wells will be decommissioned.

Water storage tanks adjacent to the well shall be sized to have capacity for domestic as well as firefighting purposes at the detailed design stage. Buildings and standpipes distributed throughout the site will be serviced for domestic and fire by a private water network. Individual services to buildings will be sized at detailed design in coordination with building mechanical engineers.

The peak site domestic load is estimated to be 0.31 L/s (26,980 L/day) in accordance to the Region of Durham Design Specifications for watermains. Fire Underwriters Survey (FUS) calculation yields a required firefighting flow estimate of 3000 (USGPM) for the development. Although the proposed buildings may be equipped with sprinkler systems, as the existing barn is not equipped with a sprinkler system, no sprinkler protection credit was used to calculate fire flow demand for the site, particularly since the barn is adjacent to the gas station. A more in-depth assessment of necessary firefighting flow estimates can be conducted at the detailed design stage.

Water calculation sheets are provided in **Appendix D**. The Conceptual Servicing Plan (C-102) is provided in **Appendix B**.

2.4 GRADING

The site is located within an area of Landform Conservation in the ORMCP. Specifically, MNR technical paper #4 "Landform Conservation on The Oak Ridges Moraine" defines classification. As demonstrated in the Site Slope Analysis in **Appendix A**, 17% of the existing site slopes are steeper than 10%. This falls under the minimum requirement of 20%. This renders the site exempt from the Landform Conservation Policy (section 30) set out by the ORMCP.

The existing site falls southerly at a vertical relief of close to 17 meters over a distance of 450 meters. It is our understanding the last earthworks activity was in the late 1970's when fill from north end of the site was placed at the south end where the current embankment at the southwest corner of the site resides (refer to *Preliminary Geotechnical/Hydrogeological Report*).

Site grading is done in a fashion to avoid major earth moving and alterations to existing general topography, and majority of site elevations are close to existing in keeping with ORMCP Conservation Polices. Preliminary earthworks analysis suggests that there will be approximately 25,760 m^3 of cut and 15,900 m^3 of fill operation is involved, yielding a net export volume of 9,860 m^3, to achieve the proposed grading presented herein. This analysis assumes existing fill onsite is suitable for reuse. A more accurate earthworks analysis will be carried out at detailed design, which will account for whether existing fill is suitable for reuse or not and if any surplus materials may be utilized locally, as per ORMCP section 36. As outlined in the *Preliminary Geotechnical/Hydrogeological Report*, onsite soils toward the south/central portion of the property are loosely compacted and anticipated to contain some organic materials.

The steep site topography has created challenges in matching boundary grades; as such, 8% to 10% driveways have been utilized to ensure gradients within site parking areas remain within reasonable limits. The occasional exposed foundation and retaining walls have also been conceptually applied to maintain workable slopes within site and to avoid foundation steps.

The Conceptual Grading Plan (C-101) is provided in **Appendix B**.

2.5 EROSION CONTROL

Prior to the initiation of any construction within the site, a comprehensive Erosion and Sediment Control (ESC) Plan acceptable to the City of Pickering, Region of Durham, and ORMCP policies will be implemented. Appropriate drawings will be prepared at the detailed design stage and submitted to the Agencies for review and approval.

The ESC plans will include all necessary siltation control facilities and will be designed in accordance with the current Agency guidelines.

Below is a list of recommended erosion and sediment control measures that should be further investigated at the detailed design stage for suitability during construction of the Subject Site:

- Temporary sediment control fences, and tree protection fences (if required) installed prior to grading;
- Temporary swales throughout site along with rock check dams;
- Seed temporary topsoil stockpiles to prevent wind erosion (if required);
- All proposed open space areas will be restored/stabilized as per the landscape restoration planting plan(s), to be prepared at the detailed design stage, upon completion of grading; and
- All temporary erosion and sediment control measures should be routinely inspected and repaired during construction. Temporary controls will not be removed until the areas they serve are restored and stable.

An Erosion and Sediment Control Plan should be prepared at the detailed design stage, in accordance with the *Erosion & Sediment Control Guidelines for Urban Construction* (TRCA, 2006).

3.0 STORMWATER MANAGMENT

3.1 BACKGROUND AND DESIGN CRITERIA

This FSR has been prepared in accordance with or using information from the following reports and documents:

- "*Natural Heritage Evaluation Report and Oak Ridges Moraine Conformity Evaluation*", prepared by Stantec Consulting Ltd., dated January 17, 2019;
- "*Preliminary Geotechnical/Hydrogeological Report*", prepared by Stantec Consulting Ltd., dated January 17, 2019;
- "*Oak Ridges Moraine Conservation Plan", prepared by the Government of Ontario, dated 2017;*
- "*The Living City Policies", prepared by the Toronto and Region Conservation Authority, dated November 28, 2014.*
- "*Addendum: Duffins Creek Hydrology Update – Stormwater Management Criteria for Non-Seaton Development Lands*", prepared by Aquafor Beech for the TRCA, dated May 23, 2013;
- "*2012 Duffins Creek Hydrology Update – Final Report",* prepared by Aquafor Beech for the City of Pickering, dated February 11, 2013;
- "*Stormwater Management Criteria",* prepared by the Toronto and Region Conservation Authority, dated August 2012;
- "*Stormwater Management Planning and Design Manual*" (SWMPDM), prepared by the Ministry of the Environment, dated March, 2003;
- "*Low Impact Development Stormwater Management Planning and Design Guide*" (LID Manual), prepared by the Credit Valley Conservation and Toronto and Region Conservation, dated 2010; and
- "*Stormwater Management Design Guidelines",* prepared by the City of Pickering, undated.

In addition to the above noted documents, considerations from Transport Canada with the future potential of a Pickering Airport have also been considered in this conceptual SWM design.

Based on the above noted documents, the required SWM controls for the Site currently include the following:

- Generally maintain existing flow patterns;
- Prevent increases in stream channel erosion by providing erosion control to consist of the 25 mm 4 hour Chicago storm released over a period of 24 hour to 48 hour period. In addition, at a minimum, retain 5 mm onsite;
- Prevent increases in flood risk by providing water quantity by controlling post-development flows to pre-development levels for the greater storage requirement of 1) 2-year through 100-year storm events using both 1 hour and 12 hour AES storms with the City of Pickering's rainfall Intensity-Duration-Frequency (IDF) data (City of Pickering); or the unit release rates presented within Table 8.1 of the "Addendum: Duffins Creek Hydrology Update" (TRCA)
- Protect water quality by providing enhanced water quality (80% total suspended solids removal) through a treatment train approach that may include:
    - Lot level controls such as devices and designs that direct roof discharge to ponding areas;
    - Conveyance controls such as grassed swales; and,
    - End-of-pipe controls.
- Maintain a 'water balance' by ensuring post-development runoff volumes will mirror pre-development conditions;
- Due to the site's proximity to a potential future Pickering Airport, the site may not utilize a wet SWM pond due to safety concerns associated with water dwelling birds; and,
- Maintain groundwater quantity and flow by providing onsite retention to match existing stormwater infiltration volumes without the use of rapid infiltration basins or columns.

3.2 EXISTING CONDITIONS

3.2.1 Drainage

Under existing conditions the site sheet drains south towards the wetland situated at the southeast corner of the site (refer to **Figure 3.1**). Within the site area, there are three existing buildings with a total approximate footprint area of 0.16 ha, the remainder of the site is undeveloped. Under existing conditions, the weighted runoff coefficient is approximately 0.27.

External to the site are three main external drainage areas:

1. Northwest External Drainage Area – 1.55 ha consisting of open land to the north of Uxbridge Pickering Townline, the Old Brock Road/Brock Road/Uxbridge Pickering Townline intersection, and the western side of Brock Road that drains to a roadside ditch;

2. West External Drainage Area – 0.63 ha consisting of the eastern side of Old Brock Road draining to a roadside ditch and through the site; and,

3. South External Drainage Area – 0.76 ha consisting of the lands to the south of the site that sheet drain toward the existing onsite wetland.

Under existing conditions, the total drainage area to the onsite wetland is approximately 7.52 ha with a weighted runoff coefficient of 0.34. The existing release rate at the onsite wetland outlet (1,050 mm diameter CSP culvert underneath Brock Road) was modeled in Visual OTTHYMO (VO2). Pre-development peak-flow rates should not increase under the post-developed conditions. A summary of flows at the site outlet underneath Brock Road is presented in **Table 3.1**.

Table 3.1 – Site Outlet Release Rates

Storm	Release Rate (m^3/s)
25mm 4hour	0.350
2 Year 1 Hour AES Storm	0.581
2 Year 12 Hour AES Storm	0.367
100 Year 1 Hour AES Storm	1.783
100 Year 12 Hour AES Storm	0.805

The maximum headwater elevation at the existing 1,050 mm diameter CSP culvert underneath Old Brock Road will be approximately 272.25 m during the 1-hour 100-year AES Storm. The resulting 100-year headwater ponding area that would result (neglecting any reservoir storage routing) is illustrated on Conceptual Grading Plan (C-101). For calculations, refer to the summary provided in **Appendix E**.

Under proposed conditions, the two roadside ditches along Old Brock Road and Brock Road will not be re-graded as these are within public right-of-way areas; existing drainage patterns will be maintained in accordance to ORMCP polices. The development area has been graded to ensure that Brock Road and Old Brock Road major/minor storm conveyance to the onsite wetland is maintained. No changes are proposed to the external drainage areas, patterns or conveyance systems.

Using VO2, the release rates for the external drainage areas leading to a roadside ditch were calculated for both the 1-hour and 12-hour 100-year AES storm events. For both drainage areas, the 1-hour 100-year AES storm had a higher peak runoff rate. This simulated runoff rate compared to the capacity of the roadside ditches, are presented in **Table 3.2**. VO2 modeling and a summary of results are included in **Appendix E**.

Table 3.2 - Existing Capacity of Roadside Ditches

Roadside Ditch	Capacity (m^3/s)	Required (m^3/s)
West – Upstream	1.26	0.154
West – Downstream	0.52	
East – Upstream	4.97	0.506
East – Downstream	26.38	

As noted, the roadside ditches can convey the external drainage around the site. As such, no modifications to the roadside ditches will be necessary to address any existing drainage deficiencies. For an illustration of the existing drainage pattern, refer to **Figure 3.1**.

3.2.2 Soils Conditions

Based on the *Preliminary Geotechnical/Hydrogeological Report*, the existing soils consist of top soil with a base of silty clay fill. The geomean hydraulic conductivity of the soils is 4.3 x 10^{-7} m/s. Per Table 2 "Approximate Relationship of Soil Types to Permeability and Percolation Time" within the 1997 Ontario Building Code, the soils have an approximate infiltration rate of less than 12 mm/hr.

3.3 PROPOSED STORMWATER MANAGEMENT PLAN

Under proposed conditions, the site has a development area of 3.20 ha consisting of a 2.89 ha commercial development, 0.27 ha SWM pond and 0.04 ha of uncontrolled drainage. The remainder of the site, 1.85 ha in area, consisting of steeper slopes and the onsite wetland, will remain undeveloped at this time. A breakdown of the development area is presented in **Table 3.3**. For details regarding the drainage areas, refer to **Figure 3.2**.

Table 3.3 – Proposed Development Area

Zone	Area (ha)	Runoff Coefficient
Commercial	2.89	0.80
SWM Pond	0.27	0.60
Uncontrolled	0.04	0.90
Total Development	3.20	0.78

Due to grading constraints, a small 0.04 ha area of the site consisting of a site entrance and drive isle cannot be controlled by the SWM pond; however, the onsite stormwater management pond will provide the required 'over control' to ensure that post-development controls satisfy pre-development rates at the site outlet underneath Brock Road.

The SWM strategy outlined herein is resilient against the potential future effects of Climate Change, for the following reasons:

- The Site is not immediately adjacent to a regulated watercourse and is positioned at the very upstream limit of the drainage catchment divide. As such, there will be no

increased risk of surface flooding from potential future increasing flows along the riverine system since the nearest regulated watercourse is located much further downstream from the property;

- Onsite minor system drainage has been sized using present day municipal design standards. If there is a preference to adopt a higher-level drainage design standard to account for the potential future effects of Climate Change, then this can be further discussed at the detailed design stage. However, it should be noted that the proposed minor system will not collect basement foundation drains (only subdrains along slab-on-grade construction and storm sewer). As such, the onsite minor system drainage is at very low risk to the potential future effects of Climate Change;

- The Site is comprised of moderately sloping terrain (north to south), which provides excess overland (major system) drainage conveyance capacity across the property and toward the site outlet.

3.3.1 Stormwater Quality

Quality control for the Site will be provided via a treatment train approach consisting of an Oil/Grit Separator (OGS), dry SWM pond, and vegetated swale, which will cumulatively exceed the MOECC water quality treatment requirements for Level 1 (80% TSS Removal Efficiency). The use of an OGS, dry pond and vegetated swale in combination meets the City of Pickering's requirements that dry ponds shall not be used as a stand-alone treatment system. In addition, an Oil-Water Separator will be installed to pre-treat runoff from surface areas in the immediate vicinity of the proposed gas station location.

The SWM pond volume required to provide Basic (60% long term suspended solids removal) was calculated using the MOECC's SWMPDM's Table 3.2. Table 3.2 calculated the required water quality treatment volume of 605 m^3; the SWM pond exceeds the required volume providing 645 m^3 of extended detention storage. For details, refer to calculations in **Appendix E**. At the detailed design stage, the use of vegetated filter strip, grass swales with stormwater retention zones, infiltration trenches, rooftop discharge to ponding areas, and sand filters as part of an extended treatment train approach will be further explored.

3.3.2 Stormwater Quantity

Stormwater quantity control for the Site will be provided by a dry SWM pond located at the southern edge of the site adjacent to the wetland. The SWM pond will treat/control flows to pre-development conditions at the site outlet underneath Brock Road. The SWM pond has been designed in general accordance with Table 4.8 in the MOECC's SWMPDM. The pond was designed as follows:

- An 825 mm diameter inlet pipe with an invert of 274.10 m;

- A pond forebay bottom of 274.10 m and main cell bottom of 274.60 m

- A top of 275.60 m;
- 3:1 side slopes;
- A maintenance access location to the north of the forebay at a road stub;
- A sediment drying area at the east side of the pond block;
- Erosion control and active storage volume are controlled by a Hickenbottom outlet leading to two orifices plate within an outlet control manhole;
- The control manhole outlets to a pre-cast headwall complete with a level spreader designed to promote sheet flow toward the onsite wetland; and
- Emergency overflow provided by a broad crested weir with freeboard between the maximum flow depth and the top of the SWM pond berm.

Using VO2, the release rates for each storm event and each catchment were calculated. The 25 mm 4 Hour Chicago storm was used to calculate the required erosion and sediment control volume and release rate. Per VO2, the site requires 613 m^3 of storage with a maximum release rate of 0.014 m^3/s (an average release rate of 0.070 m^3/s); resulting in a drawdown time of ~24.3 hours (greater than the minimum 24 hour drawdown time required). This meets the requirement of preventing increases in stream channel erosion. The extended detention water level has an elevation of 274.96 m. A summary of the existing and proposed, 2-year and 100-year storm event runoff rates for the full site area of 4.58 ha (includes the undeveloped lands) is presented in, and **Table 3.4**.

Table 3.4 – Site Release Rates

Storm	Existing Release Rate (m^3/s)	Proposed Release Rate (m^3/s)	Difference Runoff (m^3/s)
25mm 4hour	0.195	0.068	-0.127
2 Year 1 Hour AES Storm	0.321	0.109	-0.212
2 Year 12 Hour AES Storm	0.222	0.104	-0.118
5 Year 1 Hour AES Storm	0.901	0.224	-0.677
5 Year 12 Hour AES Storm	0.458	0.202	-0.256
10 Year 1 Hour AES Storm	0.645	0.320	-0.325
10 Year 12 Hour AES Storm	0.341	0.259	-0.082
25 Year 1 Hour AES Storm	0.809	0.436	-0.373
25 Year 12 Hour AES Storm	0.400	0.323	-0.077
50 Year 1 Hour AES Storm	0.930	0.522	-0.408
50 Year 12 Hour AES Storm	0.444	0.369	-0.075
100 Year 1 Hour AES Storm	1.048	0.609	-0.439
100 Year 12 Hour AES Storm	0.487	0.414	-0.073

As noted in the above table, the proposed site release rate has remained the same as, or decreased from, the existing site conditions. This meets the requirement of preventing increases in downstream flood risk within the watershed.

To achieve the above noted release rates, the dry SWM pond was sized to match existing storm release rates; this was done for all storm events. Based on the VO2 modeling presented in **Table 3.5**, the pond volume shall be greater than 1,282 m^3 (determined in the 100-year, 1 hour AES storm). Within the site, a total pond volume of 1,799 m^3 between an elevation of 247.60 m and 275.65 m, has been provided; this exceeds the required active storage volume.

Table 3.5 – Dry Pond Release Rates and Volume

Storm	Release Rate (m^3/s)	Pond Volume (m^3)	Water Level (m)
25mm 4hour	0.014	613	274.96
2 Year 1 Hour AES Storm	0.015	659	274.99
2 Year 12 Hour AES Storm	0.059	760	275.05
100 Year 1 Hour AES Storm	0.338	1,282	275.34
100 Year 12 Hour AES Storm	0.275	1,171	275.28

The 100-year water elevation is 275.34 m which allows for 0.31 m of freeboard to the top of pond (275.65 m). For VO2 input/output calculations, refer to the detailed calculations in **Appendix E.**

Conceptual details of the pond access road, sediment drying area, fencing, signage, lining requirements and details of the outlet structure will be provided at detailed design.

Under proposed conditions, the total drainage area to the onsite wetland is 7.52 ha with a weighted runoff coefficient of 0.55; this is the same overall contributing drainage area as observed under the existing (present day) conditions. The proposed release rate from the wetland was modeled in VO2 and was compared to the existing release rates. The results are presented in **Table 3.6.**

Table 3.6 – Proposed Release Rates at Wetland

Storm	Existing Release Rate (m^3/s)	Proposed Release Rate (m^3/s)	Difference Runoff (m^3/s)
25mm 4hour	0.350	0.235	-0.115
2 Year 1 Hour AES Storm	0.581	0.369	-0.212
2 Year 12 Hour AES Storm	0.367	0.238	-0.129
100 Year 1 Hour AES Storm	1.783	1.314	-0.469
100 Year 12 Hour AES Storm	0.805	0.731	-0.074

For all storm events, the release rate from the wetland has not increased. As such, the development meets the requirement of preventing increasing in flood risks within the watershed.

3.3.3 TRCA Design Criteria

The site is located in Catchment Number 51 of the TRCA's "Addendum: Duffins Creek Hydrology Update – Stormwater Management Criteria for Non-Seaton Development Lands". Table 8.1 prescribes unit flow release rates based on site and impervious site areas, which are identified as 'TRCA Revised' in the table below. The original TRCA unit-release rate criteria are also provided for reference (TRCA SWM Criteria, 2012). Once scaled to the site, the release rates were found to be much lower than the computed existing release rates for the site (refer to **Table 3.7** below).

Table 3.7 – TRCA Release Rates

Return Period	Release Rate ($m^3/s/ha$)			TRCA Release as % of Existing	
	Stantec Existing	TRCA Original	TRCA Revised	TRCA Original	TRCA Revised
2 Year	0.048	0.009	0.008	19%	16%
100 Year	0.106	0.032	0.029	30%	27%

As noted in the above table, the TRCA's Revised release rates range from 16% to 27% of the existing conditions release rates. It should be noted that the existing site is comprised of ~97% pervious cover. As such, the TRCA criteria were not used in support of the conceptual site design as they were deemed to be too conservative and given the conceptual site design already accommodates a post-development to pre-development peak flow reduction for all the storm events simulated. In the event that the TRCA insists that background unit-rates be abided by, then the onsite dry pond will need to incorporate an additional 1,500 m^3 (an increase of 121% from the proposed design concept) of active detention storage at the detailed design stage, which would require the development concept to be modified in/around the dry pond at that time.

3.3.4 Water Balance & Erosion Control

In order to address the TRCA's water balance criteria (TRCA SWM Criteria, 2010) and the ORMCP Subsection 24(8)iii, an annual water balance was calculated using the Thornthwaite and Mather (1955) method for both the pre-development and (unmitigated) post-development conditions. The calculations applied Environment Canada's climate normal from Pearson Airport from 1981

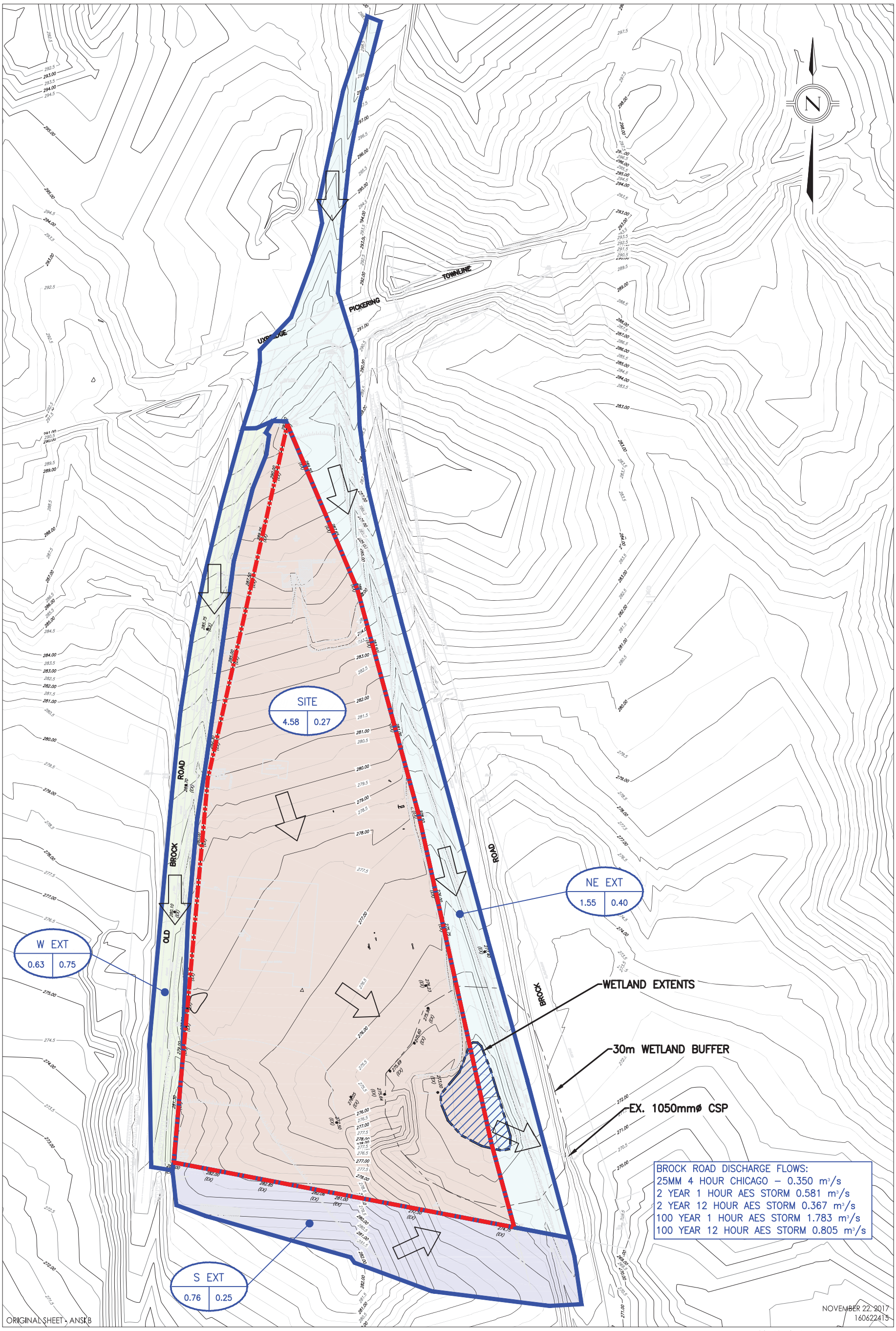
to 2010. As the site's impervious area will increase as a result of the proposed development, the unmitigated site runoff volume will increase; with a corresponding decrease in infiltration and evapotranspiration.

The annual reduction in site infiltration as a result of an unmitigated development is approximately 2,132 m^3/year across the 4.37 ha site. The total pre-development infiltration volume is approximately equivalent to 10.7% of the total annual precipitation. The moderately sloped existing conditions topography and low permeability soils appear to be cause of the lower existing conditions infiltration fraction. Refer to **Appendix E** for water balance calculations.

As outlined in the City of Toronto's Wet Weather Flow Management Guidelines (Figure 1a), 10.7% of the total annual precipitation would equate to capturing and infiltrating events up to and including a ~ 1mm to 2 mm discrete rainfall event across the 4.37 ha site. However, despite this minimum requirement to satisfy water balance, the TRCA's current minimum erosion control criteria includes the onsite retention of 5 mm, which will exceed the post-development to pre-development water balance target noted above.

Various infiltration practices will be explored at the detailed design stage to satisfy the governing erosion control requirement and ORMCP water conservation. Practices may include but will not necessarily be limited to the use of vegetated filter strips, surface infiltration measures, subsurface infiltration measures, onsite water reuse measures, grass swales with stormwater retention zones. Rapid infiltration basins and columns will not be considered.

Further information related to the characterization of existing underlying groundwater conditions can be found in the separately prepared document entitled, *Preliminary Geotechnical/Hydrogeological Report* (Stantec, January 2019). Further information related to the characterization of existing and proposed surface water systems can be referenced in Subsection 3.2 and Subsection 3.3 herein, respectively.



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Markham, Ontario L3R 0B8
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1:2000 0 20 40 60 80 100

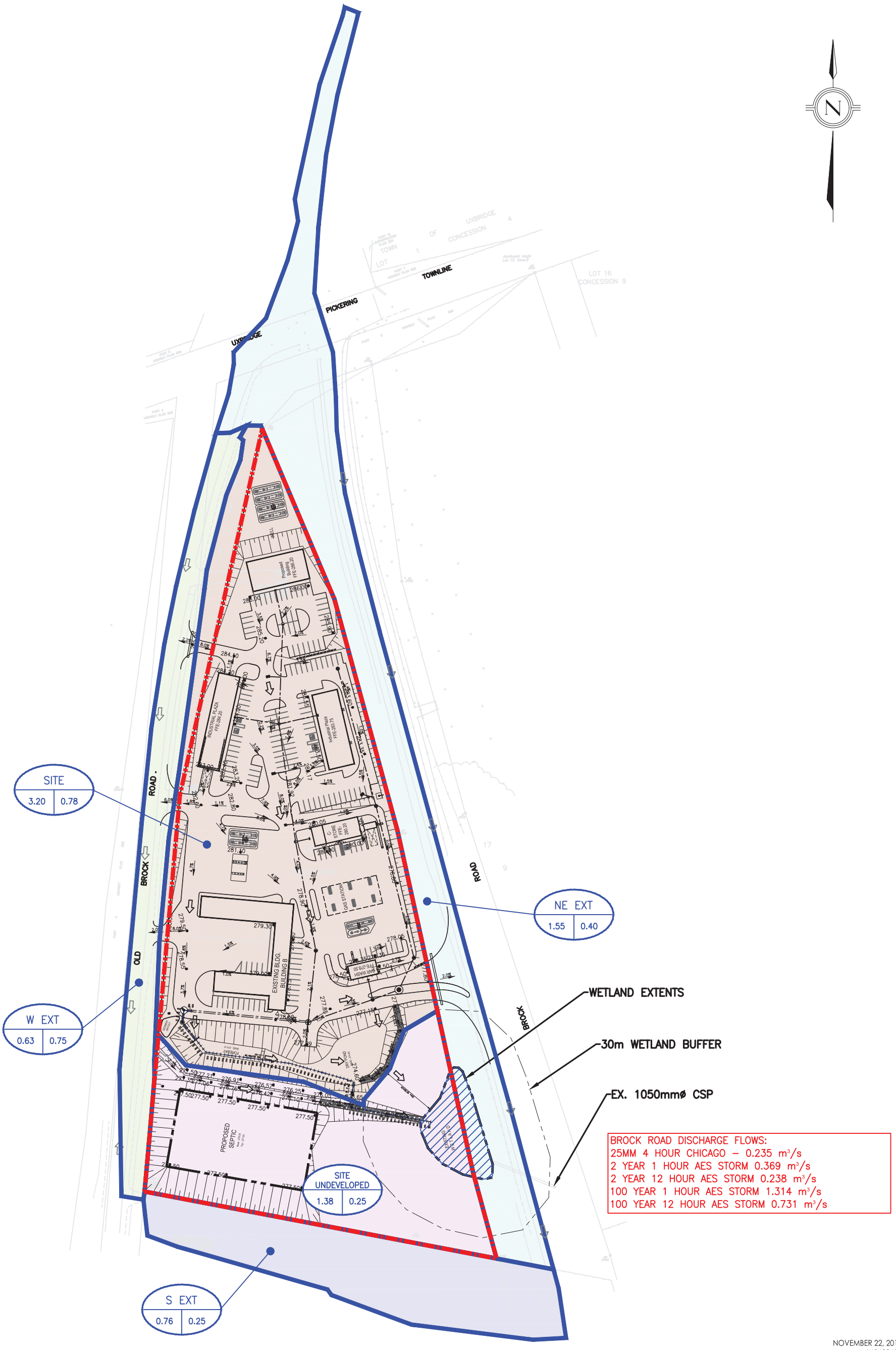
SITE
0.69 | 0.25
CATCHMENT ID
RUNOFF COEFFICIENT
CATCHMENT AREA

MAJOR OVERLAND FLOW
EXISTING CATCHMENT AREA
SITE PROPERTY LINE

Client/Project
S. LARKING DEVELOPMENTS
CLAREMONT NORTH
BUSINESS PARK

Figure No.
3.1

Title
EXISTING DRAINAGE AREA PLAN



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ORIGINAL SHEET - ANSI B

NOVEMBER 22, 2017
160622415

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SITE
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CATCHMENT ID
RUNOFF COEFFICIENT
CATCHMENT AREA

MAJOR OVERLAND FLOW
PROPOSED CATCHMENT AREA
SITE PROPERTY LINE

Client/Project
S. LARKING DEVELOPMENTS
CLAREMONT NORTH
BUSINESS PARK

Figure No.
3.2

Title
PROPOSED DRAINAGE AREA PLAN

4.0 CLOSURE

This report describes the overall site grading, servicing and SWM strategy to functionally service the proposed development in support of a Zoning By-Law Amendment application with the City of Pickering. It also demonstrates planning, design and construction practices that ensure that no buildings or other site alterations impede hydrological functions etc. as per Section 20 (Supporting Connectivity) of the ORMCP. This report also demonstrates that the site can be developed in conformance with Section 24 (Watershed Plans) of the ORMCP as relevant background, agency-imposed Watershed Planning criteria for Duffins Creek have been fully considered as part of the conceptual SWM design outlined herein.

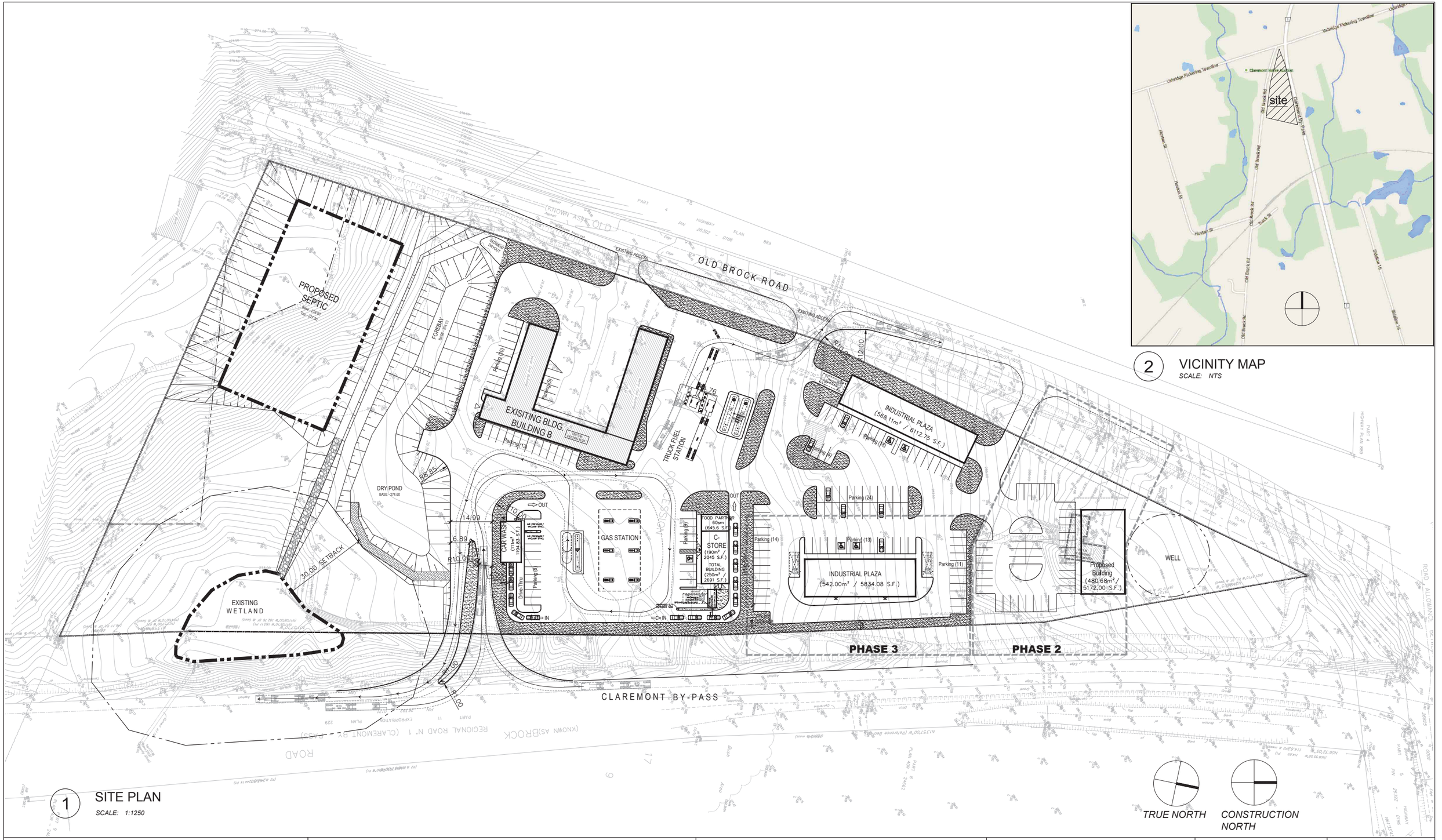
An analysis of the existing site topography demonstrates the site is exempt from the Landform Conservation Policy set out by the ORMCP. Grades under the post-development condition will be set to maintain much of the existing general topography of the site in keeping with ORMCP policies.

No municipal sanitary system exists adjacent to site to serve as an outlet. Site sanitary will drain via a private sewer network to a septic system that is contemplated near the southwest corner of the site. Carwash output will not contribute to the septic load as it will be stored and regularly hauled offsite. Since the site will not discharge treated sanitary effluent to surface water, no assimilative capacity of the downstream watercourse is necessary.

No municipal water system is currently available adjacent to site to service the development. A proposed private well located at the northern most point of the site will service the site for domestic and fire through a private water network. A separate, *Preliminary Geotechnical/Hydrogeological Report* (Stantec, January 2019), has been prepared which outlines the underlying groundwater conditions on the subject property and provides a recommendation for a future onsite water supply well. Water conservation measures can be explored further at the detailed design stage to potentially reduce groundwater consumption, as desired.

As outlined herein, existing drainage patterns will be maintained and attenuated in accordance to ORMCP polices. Current Old Brock Road major/minor flow conveyance to the wetland southeast of the site will be preserved. Onsite major/minor flows will be captured and controlled in a proposed dry pond. An onsite oil-grit separator in combination with a dry pond and vegetated swale outlet will exceed the minimum requirements for onsite water quality treatment. A proposed dry pond will capture and detain surface water runoff to pre-development levels. A variety of infiltration measures will be explored at the detailed design stage to ensure the onsite retention of a 5 mm storm will be achieved to satisfy and exceed imposed erosion control and water balance criteria, respectively.

Appendix A BACKGROUND INFORMATION



2 VICINITY MAP

SCALE: NTS

1 SITE PLAN

SCALE: 1:1250

TRUE NORTH

CONSTRUCTION NORTH

CARIÇARI LEE ARCHITECTS

113 Miranda Avenue
Toronto, ON M6B 3W8
t/ 416 962 9670
f/ 416 962 9671
e/ info@caricarilee.com

PROJECT NAME :

Claremont North Business Park
Old Brock Road & Brock Road, Claremont, ON

DRAWING TITLE :

PROPOSED SITE PLAN

DATE	No.	ISSUE
2017 NOV 28	1	ISSUED FOR COORDINATION

NOTES:

CONTRACTOR TO VERIFY ALL DIMENSIONS ON THE SITE AND REPORT ANY DISCREPANCY TO THE ARCHITECT BEFORE PROCEEDING WITH THE WORK.

ALL DRAWINGS ARE THE PROPERITY OF THE ARCHITECT AND MUST BE RETURNED AT THE COMPLETION OF WORK.

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNTIL COUNTERSIGNED.

SCALE :	AS SHOWN
PROJECT NO. :	15003
DATE :	MAR. 2017
DRAWN :	AP
CHECKED :	JC

REVISION NO. :

DWG. NO. :

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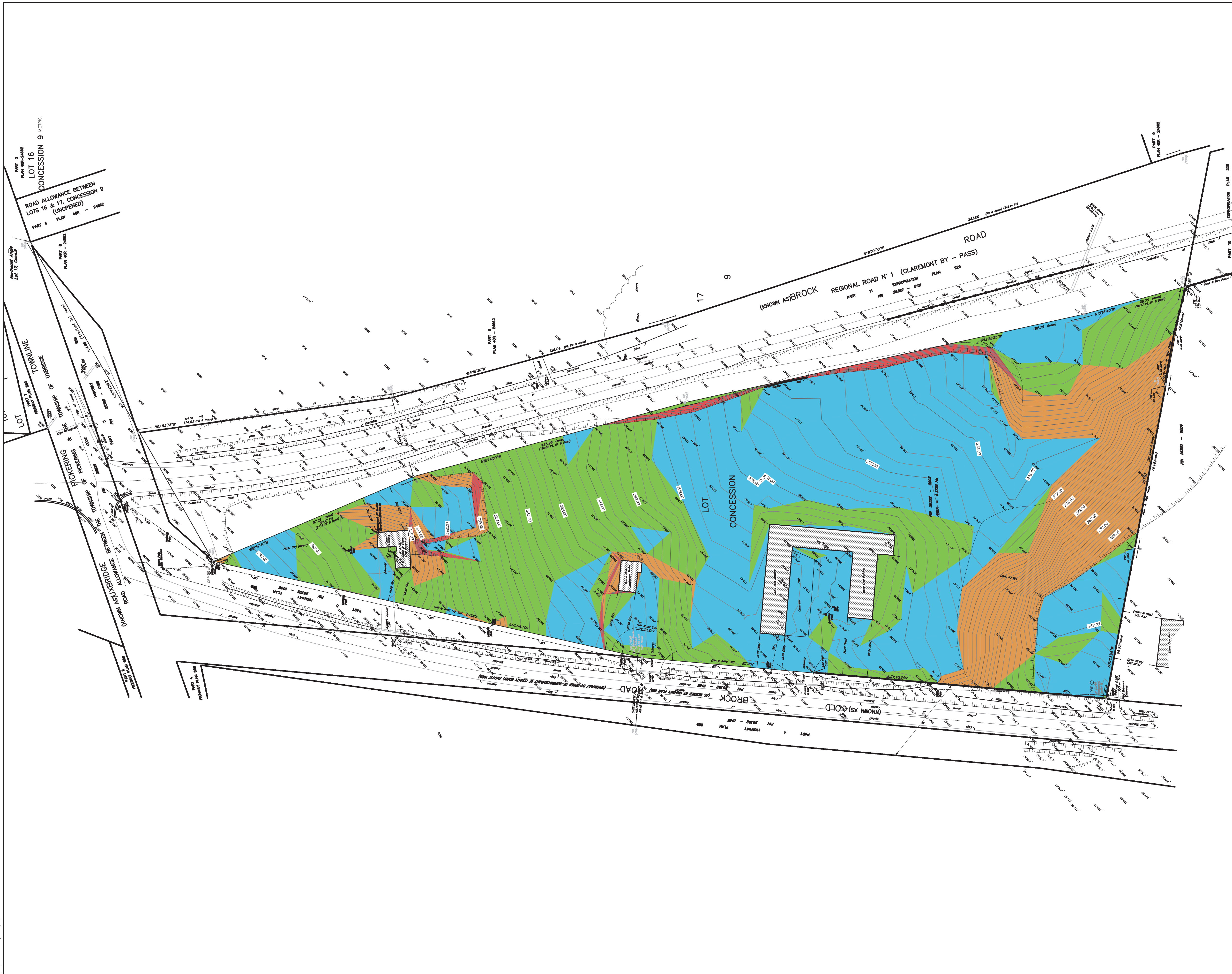

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Consultants

Legend

Slopes Table

Minimum Slope	Maximum Slope	Area	Color	% AREA
0.00%	5.00%	25352.60		53.58
5.00%	10.00%	13726.75		29.01
10.00%	25.00%	7515.27		15.88
25.00%		722.55		1.53

Notes

ELEVATION DATUM

Elevations are geodetic and are referred to the City of Pickering elevation datum
Benchmark : 9–006 Elevation : 288.406 m

Brass Cap set in east face on brick bungalow on west side of Regional Road N° 1 ±93 m south of Pickering–Uxbridge Townline Road. Plate 0.50 m south of northeast corner and 0.40 m above grade.

Point at which elevations taken shown thus · 288.72

NOTE

ELEVATIONS AND SITE CONDITION ARE BASED ON INITIAL SIGNING DATE OF SURVEY BEING, NOVEMBER 26, 2009 BY R.G. McKIBBON LTD., O.L.S. NO ATTEMPT HAS BEEN MADE TO VERIFY SAME IN MARCH, 2016.

NOTE

R.G. McKIBBON LTD. SURVEY DATED NOVEMBER 9, 2009 (FILE: L–09–05) PARTIALLY UPDATED MARCH 30, 2016 BY LLOYD AND PURCELL LTD. TO REFLECT CONVERSION OF PLAN INTO UTM NAD83 CSRS (2010.0 EPOCH) AND CURRENT POSITION OF POST AND WIRE FENCE ALONG A PORTION OF THE SOUTH LIMIT AND WEST LIMIT.

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name:	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project

S. Larkin Developments Inc.
Claremont North Business Park

Pickering, ON

Title

Site Slope Analysis
Landform Conservation Policy Assessment

Project No.	Scale	
160622415	1:750	
Drawing No.	Sheet	Revision
	of	

Minutes/Meeting Summary

Pre-consultation Meeting
January 15, 2016
11:00 am - 12:00 pm
Engineering & Public Works Meeting Room

Subject: 5435, 5455 & 5475 Old Brock Road
Part 1 of Part of Lot 17, Concession 9, City of Pickering

Applicant: Rosemarie L. Humphries
Humphries Planning Group Inc.

Attendees: Karl Kiproff – Region of Durham, Health Department
Rosemarie Humphries – Humphries Planning Group
Shaun Larkin – S. Larkin Developments Inc.
Steven Strong – Toronto and Region Conservation Authority (TRCA)

Nilesh Surti – Manager, Development Review & Urban Design
Déan Jacobs, Principal Planner - Policy
Paal Helgesen – Development Engineer
Irina Marouchko – Water Resources Engineer
Kyle Bentley – Chief Building Official
Adam Fowler – Fire Inspector
Rob Watson – Fire Inspector

Item	**Details & Discussion & Conclusion** (summary of discussion)	**Action Items /Status**
Proposal	To permit a retail gas outlet with an accessory restaurant use and an associated automatic car wash, and to formalize the existing employment uses on the site.	
Type of Applications	Zoning By-law Amendment (Major) **Note**: A separate pre-consultation meeting will be held for any subsequent application for Site Plan Approval.	
Discussion	**Humphries Planning & S. Larkin** The site currently contains buildings being used for machinery sales/repair, landscape storage/sales and indoor/outdoor storage, as well as a single detached dwelling and a trailer. The current proposal is to apply for a zoning by-law amendment to permit a retail gas outlet with an accessory restaurant use and an associated automatic car wash, and to formalize the existing employment uses on the site. The proposal also includes a truck fill. Over time, the intention is to introduce commercial uses on the site also.	

Item	Details & Discussion & Conclusion (summary of discussion)	Action Items /Status
	It was clarified that although the property in question has three municipal addresses, it is legally one property. The property was leveled in 1974/1975 and does not reflect any landform conservation characteristics. **Steven Strong, Toronto and Region Conservation Authority (TRCA)** The subject site is located within the TRCA Regulated Area of the Duffins Creek Watershed. The site is regulated with respect to its location within a wetland/wetland area of interference. As such, any proposed works on the subject site will be subject to the criteria of O.Reg. 166/06 and requires TRCA permit and planning approval. As part of a Zoning By-law Amendment application, TRCA will require the following: • Planning Rationale Report, demonstrating how the proposed land uses meets the intent of the Oak Ridges Moraine Conservation Plan, the Regional Official Pan, and the Pickering Official Plan ○ Regarding the identified Category 2 Landform Conservation area identified in the Pickering Official Plan, a short discussion regarding the location and nature of the historical disturbance of the landform and grading on the site needs to be contained in the Planning Rationale Report (If the site has been substantially graded in the past, the extent should be discussed to assist in the determination of conformity to the ORMCP Landform Conservation policies). • Topographic Plan of Survey • Proposed Site Plan • Natural Heritage Evaluation • Hydrogeological Study/ Water Balance Study Standard Planning Review Fee: $7,350.00 – please confirm the fee at the time of submission. **Paal Helgesen – City of Pickering, Engineering & Public Works (Development Review)** The following reports will be required: • Functional Servicing and Stormwater Report (FSSR) • A brief regarding construction management, and erosion and sediment controls to be contained within the FSSR	

Item	Details & Discussion & Conclusion (summary of discussion)	Action Items /Status
	• A Geotechnical Report • Traffic Impact Study (in accordance with the Region's Traffic Impact Study Guidelines). The City's Traffic Engineer shall review the proposed Terms of Reference for the Traffic Impact Study. Reports are to be signed and stamped by a professional engineer. **Irina Marouchko – City of Pickering, Engineering & Public Works (Water Resources)** A Stormwater Management study and Functional Grading Plan is required. The stormwater management criteria for the site are as follows: • Quality control – level 1 • Quantity control – as outlined in the Duffins Creek Hydrologic Update, 2012 (accessible on-line) • Erosion Control - minimum of 5 millimeters (rainfall) on-site infiltration or retained The Stormwater Management Study and Grading Plan are to be signed and stamped by a professional engineer. Suggested that the owner investigates the use of stormwater for the proposed car wash use. **Rob Watson & Adam Fowler, Pickering Fire Services** • Detailed comments to be provided at Site Plan stage • No on-site holding tank is required for firefighting purposes • The proposed restaurant use will require a fire route – details contingent upon ultimate site and building configuration **Karl Kiproff, Region of Durham – Health Department** **Sewage Services** • One-site sewage disposal system required • If the sewage flow exceeds 10 000 liters a day, approval of the system is required from the Ministry of Environment and Climate Change • Indicate location of existing sewage system, proposed area of new system, and reserve area in accordance with Regional Health requirements on Site Plan	

Item	Details & Discussion & Conclusion (summary of discussion)	Action Items /Status
	• Noted that it is uncommon to have a car wash facility on private services – waste water must be disposed through on-site sewage system **Water Services** • Private water supply system required • Please indicate location of existing wells and proposed new wells on Site Plan (**note**: any abandoned wells need to be properly decommissioned) • The private water supply is classed as a "Small Drinking Water System" under the Health Protection and Promotion Act, which will require regular inspections and reporting on the condition of the system and water quality **Food Safety** • Inspections regarding food and personal hygiene will be carried out by the Health Inspector of the Region on a regular basis. Detailed provisions regarding permits from the Region's Health Department will form part of the Building Permit stage. **Heather Finlay - Region of Durham, Planning & Economic Development Department** **(advised by email on January 14, 2016)** Regional Official Plan Conformity: This property is designated "Hamlet" in Schedule 'B' – Map 'B3' of the Regional Official Plan. Hamlets are intended to provide opportunities for minor residential infill and small-scale industrial, commercial and institutional uses, subject to meeting the criteria of the Oak Ridges Moraine Conservation Plan, the Regional Official Plan and the City of Pickering Official Plan. As such, it appears that this proposal is generally in conformity with the Regional Official Plan. **Studies** • Archaeological Assessment – This property is within the Region's comprehensive archaeological potential model. Therefore, a Stage 1 Archaeological Assessment is to be completed by a Qualified Person (QP) at application submission. This study, and any further studies required by the QP must be completed and submitted to the Ministry of Culture, Tourism and Sport (MTCS) for their clearance letter(s). A copy of this documentation is to be sent to the Region for our records and clearance of the condition.	

Item	Details & Discussion & Conclusion (summary of discussion)	Action Items /Status
	• Site Screening Questionnaire (SSQ) – This form is part of a formal zoning application, and is to be completed by a QP to ensure that there is no potential for site contamination on or adjacent to the property. If there is any potential for contamination, a Record of Site Condition compliant Phase One Environmental Site Assessment (ESA), and any further studies (including a Record of Site Condition) may be required. Please note that all site contamination reports have a stale date of 18 months as per Ontario. Reg. 153/04. • Hydrogeological Study – the Region will require a Hydrogeological Study, and may require the Peer Review of this study coordinated through our office, and the cost of this is solely borne by the applicant, in consultation with the TRCA. **Fees** • Zoning By-law Amendment Review Fee - $1,000.00 **Copies** • five copies of the application and any information included in the zoning amendment submission • two copies- Archaeological Assessment • two copies - Site Screening questionnaire/Phase 1 ESA **Peter Castellan - Region of Durham, Public Works Department** **(advised by email on January 13, 2016)** This section of Brock Road is classified as a ROD Type A arterial road with a minimum right-of-way of 36.0 m. It appears there is sufficient right-of-way in this area to meet this criteria. The ultimate site plan configuration indicates two accesses to Old Brock Road and one access to Brock Road. Access to Brock Road will be dependent on the submission of a Traffic Impact Study. Please refer to the Region's Traffic Impact Study (TIS) Guidelines which can be found at durham.ca. The TIS shall also include a sight line analysis at the proposed Brock Road access. Subject to review of the TIS, if access is deemed permissible by the Region, we would require the construction of auxiliary lanes to facilitate the ingress and egress of traffic on Brock Road.	

Item	Details & Discussion & Conclusion (summary of discussion)	Action Items /Status
	A stormwater management report would also be required for this site. **Kyle Bentley - City of Pickering, Building Services** • Detailed comments are to be provided at Site Plan and Building Permit stages • Details regarding the existing wells may be required at the Building Permit stage **Nilesh Surti & Déan Jacobs, City Development** **Preliminary comments on Concept Site Plan** Clarification is required as to whether the existing uses will continue to operate, in which case they need to be shown and included in the rezoning application and shown on the concept site plan (including vehicular access, parking, etc.), or that they will seize to exist and are to be demolished. **Pickering Official Plan (POP) schedules and policy sections** • Schedule 1 (Land Use Structure) designates the site "Oak Ridges Moraine Rural Hamlet", and Schedule IV-10 Settlement 10: Claremont – North Section designates the site "Hamlet Employment". Permissible uses within the "Hamlet Employment" designation include, among other things, "automotive uses" – see Table 17 in the POP. • Section 15.38 of the POP states that within the urban area or within a rural hamlet, City Council may approve a site specific zoning by-law with appropriate provisions and restrictions, to permit a retail gasoline outlet in any land use designation except Open Space - Natural Areas, subject to certain criteria. • Schedule III (Resource Management) designates the majority of site "Minimum Area of Influence" with "Minimum Vegetation Protection Zone" in part along the eastern boundary, because of the proximity to "Significant Woodlands (east, north and south of site) and "Wetlands" (west of site). (See requirements in section 15.41) • Schedule VI (ORM Landform Conservation Areas): the lands fall within a Category 2 Landform Conservation Area (see requirements in section 15.40). **The Restricted Area Zoning By-law 3037** • Zones the site "Oak Ridges Moraine Agricultural (ORM-A)" Zone. This zone category does not permit a retail gasoline outlet. A rezoning application is therefore required.	

Item	Details & Discussion & Conclusion (summary of discussion)	Action Items /Status

	Studies
	• Planning Rationale (Justification report)
	  ○ Need to address conformity with the ORMCP and the policies in the Pickering and Regional Official Plans
	  ○ Need to contain Sustainable Development Brief (See City's Sustainable Development Guidelines (2007)
	  ○ Need to contain key findings & recommendations from background studies to inform the rationale
	  ○ In terms of section 15.40 (Landform Conservation), the Planning Rationale Report needs to contain a short brief regarding the location and nature of the historical disturbance of the landform and grading on the site – also see Steven Strong's comments on this matter
	• Natural Heritage Evaluation – see section 15.41 in the POP
	• Hydrological Evaluation
	• Site Suitability Study (See section 15.7 in the POP) – this can form part of the Functional Servicing and Stormwater Report
	• Archaeological Assessment
	• Traffic Impact Study (analysis to include Old Brock Road) **Note**: Region to circulate T.O.R. to City
	• Site Screening and Phase 1 ESA
	Application Fee
	• Major Zoning By-law Amendment: $ 12,500.00 (subject to increase after April 2016)
	Other
	• One Digital (to scale) colour drawing of Concept Site Plan in high resolution (minimum dpi of 100)
	• Survey of property
	• 20 copies of application form and CD containing all reports and studies
	To be noted is that community engagement is anticipated to be a key component of the planning process. Staff will consult with Regional and Local Ward Councillors regarding the need for a community open house.	

Item	Details & Discussion & Conclusion (summary of discussion)	Action Items /Status
Staff Recommendations	• For more information on the City's Sustainable Development Guidelines Report, visit the website link below: http://www.pickering.ca/en/living/resources/mainreportfinalmay07developmentguidelines.pdf • the Sustainable Development Guidelines for Plans of Subdivision and Zoning Amendment applications are provided below: http://www.pickering.ca/en/living/resources/appendixb-guideline2.pdf	
Technical Reports Required	• Please see attached Technical Report Checklist	
Fees Requirement	For the proposed development, the following fees are required (**fees are subject to change pending application submission date**) **City of Pickering** (2015 fee By-law) • Zoning By-law Amendment Application (major) **$12,500.00** **Region of Durham** • Zoning By-law Amendment Application Review Fee **$1,000.00** **TRCA** • Zoning By-law Amendment (standard) **$7,350.00** **Region of Durham Health Department** Zoning By-law Amendment Commenting Fee **$245.00**	

Meeting Adjourned: 12 noon

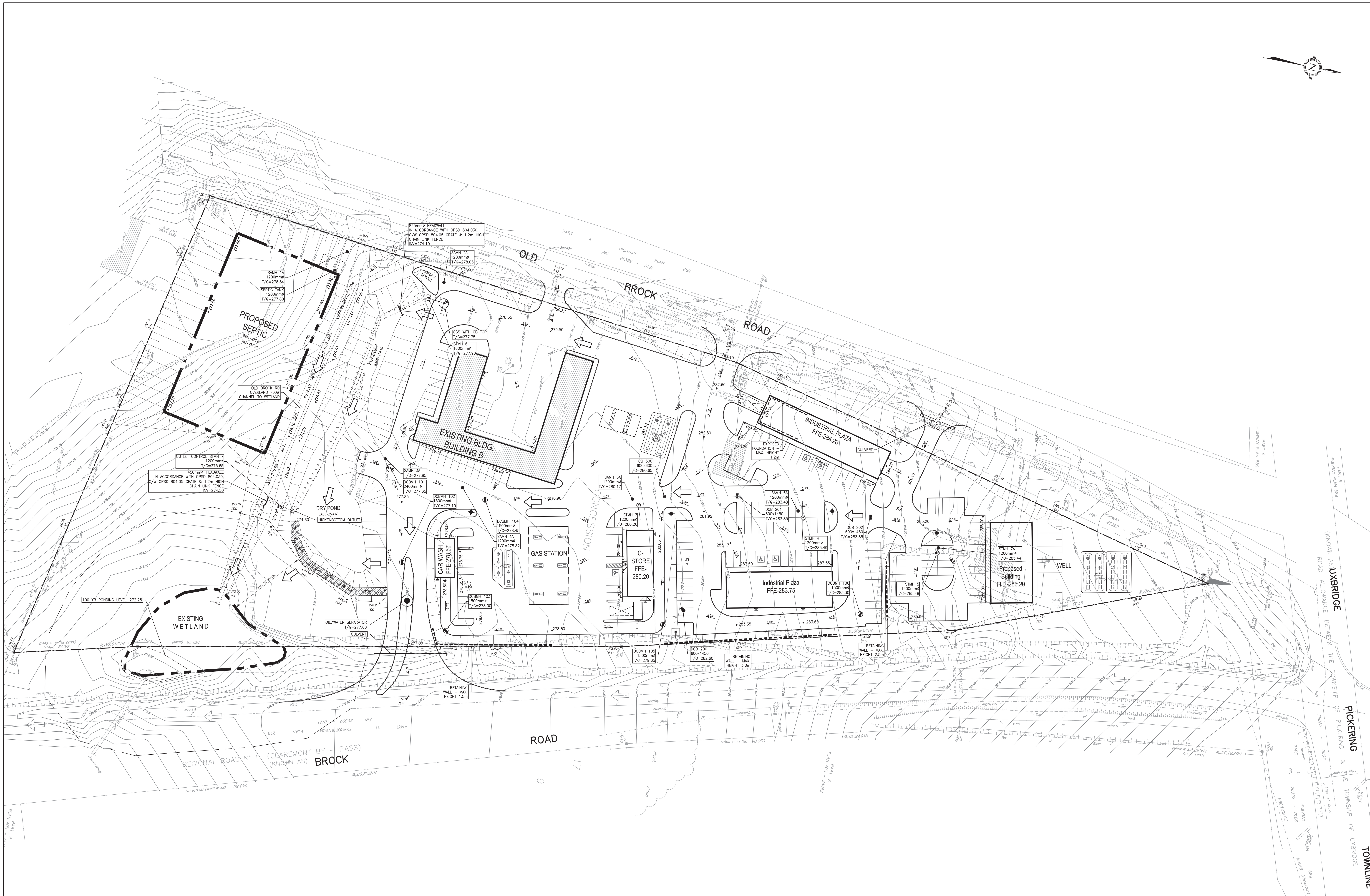
J:\Documents\Development\D-1000 Development & Planning - General\D-1000-001 Pre-Consultation\2016\5435 Old Brock Road (S Larkin)\Pre-Consultation Minutes - Meeting Summary.docx

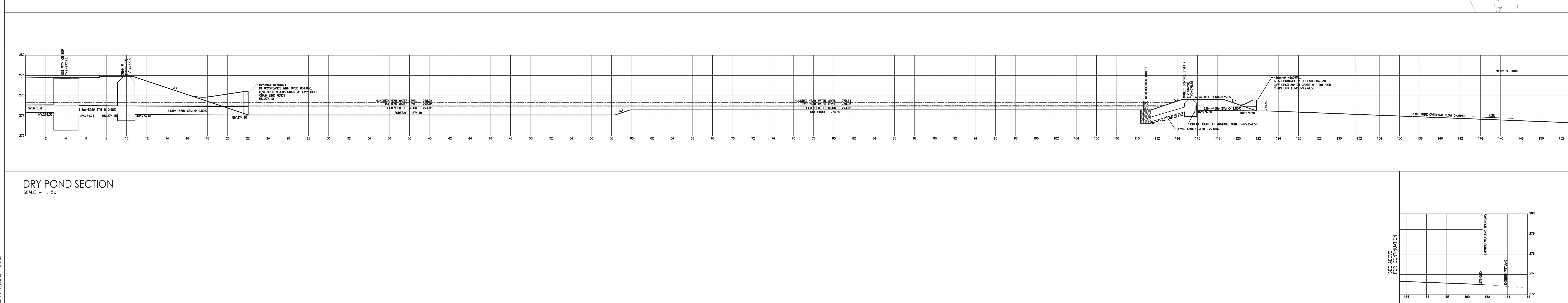
Attachment

Copy: Peter Castellan – Region of Durham, Works Department
Heather Finley, Project Planner – Region of Durham
Karl Kiproff – Region of Durham Health Department
Steven Strong - TRCA
Rosemarie Humphries – Humphries Planning Group
Shaun Larkin – S. Larkin Developments Inc.

Nilesh Surti – Manager, Development Review & Urban Design
Kyle Bentley – Chief Building Official
Paal Helgesen – Development Engineer
Irina Marouchko – Water Resources Engineer
Déan Jacobs, Principal Planner - Policy
Adam Fowler – Fire Inspector
Rob Watson – Fire Inspector

Appendix B CONCEPTUAL ENGINEERING PLANS





DRY POND SECTION

SCALE - 1:150

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Markham, Ontario L3R 0B8
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Legend

•285.00	PROPOSED ELEVATION
275.50 (EX)	EXISTING ELEVATIONS
	OVERLAND FLOW
	EXISTING OVERLAND FLOW
	SANITARY MANHOLE
	STORM MANHOLE
	CATCH BASIN
	DOUBLE CATCH BASIN
	CATCH BASIN MANHOLE
	SIAMESE CONNECTION
	VALVE AND VALVE BOX
	HYDRANT AND VALVE
	CONCRETE CURB
	PROPERTY BOUNDARY

Notes

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD
ZONING BY-LAW AMENDMENT APPLICATION	PF	TG	17.11.27

File Name:

Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project

S. LARKIN DEVELOPMENTS INC.

CLAREMONT NORTH BUSINESS PARK
Old Brock Road and Brock Road
Claremont, Ontario

Title

CONCEPTUAL GRADING PLAN

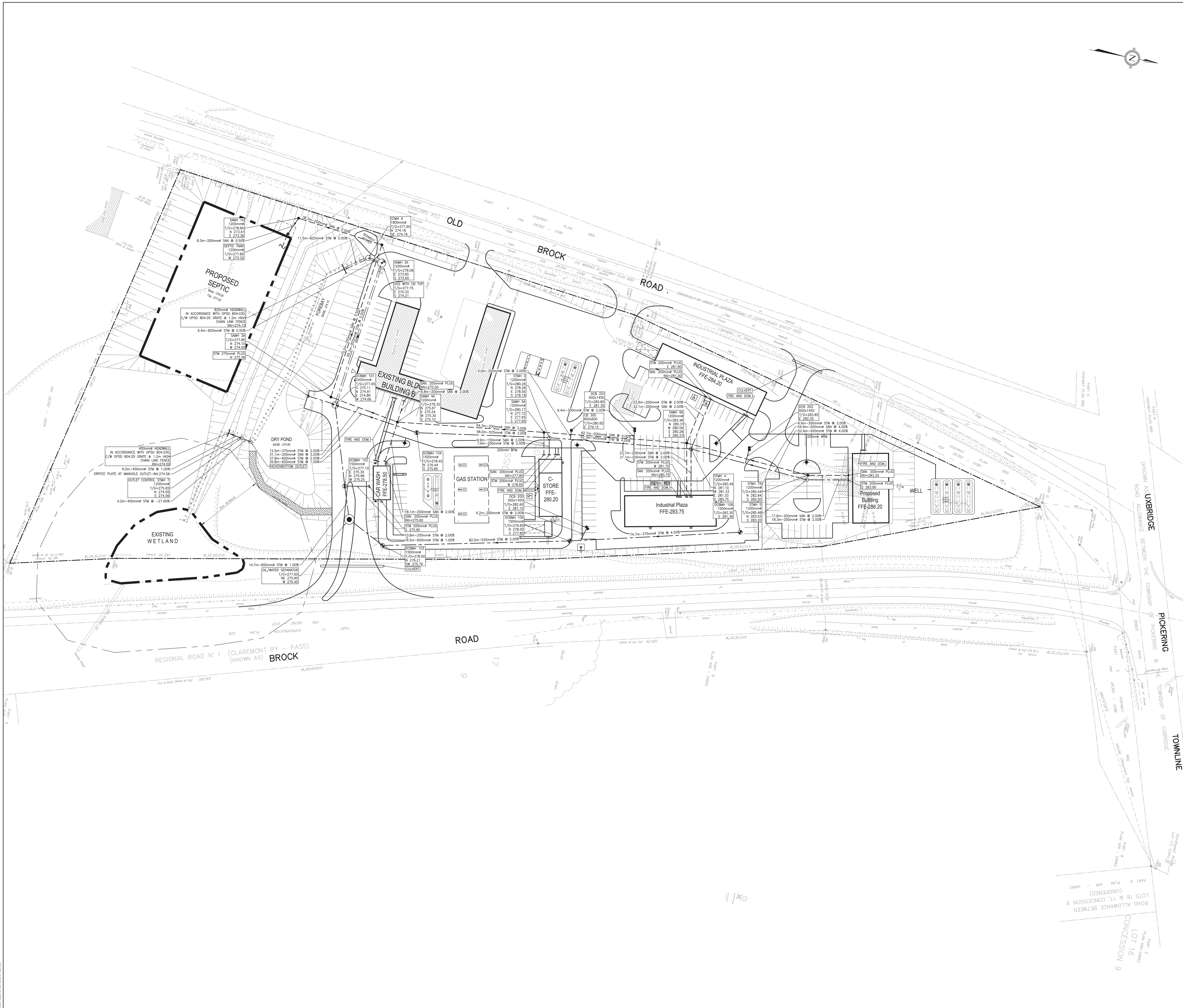
Project No. 160622415

Scale 1:500

Drawing No. C-101

Sheet of

Revision 0



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Legend

- SANITARY MANHOLE
- STORM MANHOLE
- CATCH BASIN
- DOUBLE CATCH BASIN
- CATCH BASIN MANHOLE
- SIAMESE CONNECTION
- VALVE AND VALVE BOX
- HYDRANT AND VALVE
- WATERMAIN
- STORM SEWER
- SANITARY SEWER
- PROPERTY BOUNDARY

Notes

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD
ZONING BY-LAW AMENDMENT APPLICATION	PF	TG	17.11.27

File Name: Dwn. Chkd. Dsgn. YY.MM.DD

Permit-Seal

Client/Project

S. LARKIN DEVELOPMENTS INC.

CLAREMONT NORTH BUSINESS PARK
Old Brock Road and Brock Road
Claremont, Ontario

Title

CONCEPTUAL
SERVICING PLAN

Project No. 160622415

Scale 1:500

Drawing No. **C-102**

Sheet of

Revision 0

Appendix C SANITARY

November 23, 2017

Mr. Tim Gallagher
Stantec
300W-675 Cochrane Drive
Markham, ON L3R 0B8

File No.: 00026-1
Document No.: 00026-1.02

Dear Mr. Gallagher:

Subject: Proposed Claremont North Business Park
Old Brock Road and Brock Road, Claremont
City of Pickering

This report presents a wastewater servicing assessment for the proposed Claremont North Business Park commercial development on Old Brock Road and Brock Road in Claremont, and is intended to supplement a wider functional servicing assessment for the development by Stantec.

The development is to be comprised of the following: i) a restaurant, ii) a gas station, convenience store, and carwash, and iii) several industrial buildings. Wastewater servicing of the development is to be provided by a new private onsite Class 4 (i.e., leaching bed) wastewater treatment system ("WTS").

The property has an area of about 4.4 ha, and is bounded by Brock Road to the east and Old Brock Road to the west, as shown on the appended development concept prepared by Caricari Lee Architects. The ground-surface topography descends moderately to the south-southeast from the northerly corner of the property, with evidence of previous intermittent filling, to a swale and wetland depression which together traverse the southerly portion of the property. South of these features, the grade ascends sharply to a mildly-sloped area at the southwesterly corner of the property.

Currently contained on the property are a single-family residence, as well as additional buildings used for machinery repair, landscaping storage, and general storage. As part of the proposed development, the residence is to be demolished and the largest of the additional buildings is to be retained.

The purpose of this report is to provide preliminary design criteria and specifications for the WTS, as well as to outline additional information required to prepare a final design. To this end, the following information is contained herein:

- brief characterization of subsurface conditions as they pertain to wastewater servicing, based on exploration by FlowSpec Engineering ("FlowSpec") and hydrogeological assessment by Stantec;
- preliminary assessment of percolation time;
- preliminary calculation of daily wastewater flow;
- estimation of wastewater chemistry;
- discussion of effluent criteria;
- description of preliminary design specifications for the WTS; and
- recommendations for additional information required to prepare a final design and support the Site Plan Approval process.

Subsurface Characterization

FlowSpec performed a subsurface exploration of the property in June 2016, which consisted of the excavation of test pits on the northerly upland portion of the property and within the above-referenced swale near the wetland depression.

The soil stratigraphy at the northerly upland test pits was generally comprised of fill and/or topsoil, overlying silt and sand till, and underlain by clayey sandy silt till. The soil encountered within the swale was comprised of fill and organic topsoil, overlying saturated silt.

Stantec performed a hydrogeological investigation and assessment of the property in 2016 and 2017 and provided its preliminary report (Project No. 160622415; report dated September 15, 2017) to FlowSpec for use in preparing this report. The investigation involved the advancement and installation of several monitoring wells around the perimeter of the property, which were screened both in the shallow unconfined groundwater regime ("shallow groundwater") and deeper water-supply aquifer. Groundwater levels in the monitoring wells were recorded via data-logger and manual measurement.

The Stantec investigation revealed that shallow groundwater flows in a south-southeasterly direction toward the above-referenced wetland depression, and follows a similar pattern to that of the ground-surface topography. The FlowSpec exploration and Stantec investigation together revealed that the high groundwater table is generally less than 1 m below the ground-surface.

The WTS leaching bed is currently proposed to be located at the southwesterly corner of the property. It is therefore recommended that the direction of shallow groundwater flow be specifically delineated in this location, in order to determine if the effluent plume is expected to: i) migrate offsite to the south-southeast, or ii) migrate to the east and northeast following ground-surface topography toward the wetland depression. It is also recommended that additional test pits be excavated to specifically characterize subsurface conditions in this location at the final design stage.

Percolation Time

Notwithstanding the recommendation made in the previous section for additional subsurface characterization, for the purpose of a preliminary percolation time assessment, the till soils encountered in the upland test pits are presumed to extend across other upland areas of the property and into the proposed leaching bed location.

On this basis, samples of the till soils collected during the FlowSpec exploration underwent laboratory-derived particle-size analysis by Stantec. A preliminary percolation time was then assessed by classifying the soils (based on the Unified Soil Classification System), correlating the classification with a percolation time (based on Ontario Building Code ("OBC") Supplementary Standard SB-6, "Percolation Time and Soil Descriptions"), and compensating appropriately for characteristics observed during the subsurface exploration (i.e., density, consistency, and structure).

The assessment is summarized in the following table:

Soil Description	Unified Soil Classification	Percolation Time (min/cm)
Silt and Sand Till, some clay and gravel (upper till)	ML	50
Clayey Sandy Silt Till, some gravel (lower till)	ML-CL	>50

A preliminary percolation time at or above 50 min/cm was assessed and is to be refined upon completion of the additional subsurface characterization at the final design stage, as recommended in the previous section.

Wastewater Flow

A preliminary theoretical peak daily wastewater flow for the proposed development was calculated using maximum projected building occupancy data and the following information supplied to FlowSpec by Stantec:

1. The restaurant is to include the following features: i) 24-hour operation, ii) short-order menu, and iii) a drive-through.
2. A reclamation system is proposed for the carwash to reduce the volume of wastewater. This type of wastewater is not suitable for discharge to a leaching bed, due to its inherent soap and sediment content, such that the carwash is to be serviced by a holding tank. *Since wastewater from the carwash is not to be directed to the WTS, its wastewater flow was not included in the calculation.*
3. The industrial buildings are to be "dry" in operation (i.e., no process wastewater) and are to contain no showers.

The calculation is presented in the following table and is based on flow-rates prescribed in OBC Table 8.2.1.3.B. and experience:

Occupancy Classification	Occupancy Data	Peak Daily Wastewater Flow (L/day)
Restaurant (24-hour): 16 seats	16 seats x 250 L/day/seat	4,000
Gas Station / Convenience Store: 12 fuel-outlets and 2 water-closets	12 fuel outlets x 560 L/day/fuel-outlet + 2 water-closets x 950 L/day/water-closet	8,620
Dry Industrial (with no showers): 32 employees	32 employees x 75 L/day/employee	2,400
	Total	**15,020**

A preliminary theoretical peak daily wastewater flow of 17,000 L/day was assessed, in order to provide a factor of safety for potential alteration as the design progresses.

Given the theoretical peak daily wastewater flow exceeds 10,000 L/day, approval of the design and construction of the WTS falls under the jurisdiction of Section 53 of the Ontario Water Resources Act, as administered by the Ontario Ministry of the Environment and Climate Change ("MOECC").

Wastewater Chemistry

The proposed development is expected to generate wastewater with concentrations of grease, biochemical oxygen demand (i.e., organics), solids, and nitrogen which are higher than typical domestic (i.e., household) wastewater. The increased concentrations are attributed to food preparation in the restaurant (higher organics and solids), high urine content from washrooms in commercial buildings (higher nitrogen), and an absence of showers and laundry which would typically dilute concentrations of these constituents in domestic wastewater.

Constituent concentrations estimated for each type of wastewater, as well as a preliminary combined chemistry are presented in the following table:

Constituent	Concentration (mg/L)		
	Restaurant	Washrooms	Combined
Five-Day Biochemical Oxygen Demand ("BOD_5")	2,200	200	1,200
Total Nitrogen	120	120	120

Effluent Concentration Limits and Objectives

Approval of the design and construction of the WTS falls under the mandate of the MOECC (as described above), which requires consideration for potential nutrient (i.e., nitrogen and phosphorous) impact of the WTS on groundwater (that is or may be used as water-supply) and surface water (generally within approximately 300 m).

The specific direction of shallow groundwater flow in the proposed leaching bed location (i.e., southwest corner of the property) will determine if the effluent plume is expected to: i) migrate offsite to the south-southeast as shallow groundwater, ii) or migrate and outflow to the onsite wetland depression.

Under the former scenario, the MOECC typically stipulates a strict nitrogen concentration limit in groundwater where an effluent plume reaches a property line (i.e., nitrate+nitrite-nitrogen ("nitrate") concentration of 2.5 mg/L). The limit may only be achieved via dilution of the effluent plume in groundwater from precipitation and/or wastewater treatment prior to discharge. Given the leaching bed is to be situated adjacent to the potential downgradient property boundary, reduction of organics, solids, and nitrogen via wastewater treatment would be required to comply with the MOECC property line nitrate concentration limit.

Under the latter scenario, the MOECC and Toronto Region Conservation Authority ("TRCA") may stipulate a strict nitrogen concentration limit at the point where shallow groundwater outflows to the wetland depression, given the depression is hydraulically connected to a designated wetland across Brock Road. Similar to the former scenario described above, reduction of organics, solids, and nitrogen via wastewater treatment may be required to comply with MOECC and TRCA discharge guidelines.

Moreover, under the latter scenario, phosphorous and pathogen reduction is typically required in scenarios where effluent discharges to surface water. Given effluent is to discharge to the subsurface prior to outflow in this case, phosphorous is expected to be removed via adsorption to soil particles and pathogens are expected to be removed via effluent migration through unsaturated soil prior to reaching shallow groundwater. Therefore, additional treatment for phosphorous and pathogen removal is not anticipated.

Specific effluent criteria is to be derived upon delineation of shallow groundwater flow direction in the proposed leaching bed location. For the purpose of this report, however, a preliminary effluent nitrate concentration limit of 3.0 mg/L was assessed. In order to achieve this limit, a proprietary wastewater treatment unit is required, which is also capable of reducing five-day carbonaceous BOD_5 ("$CBOD_5$") and total suspended solids ("TSS") to an effluent concentration objective of 10 mg/L.

Reduction of $CBOD_5$ and TSS to an effluent concentration of 10 mg/L allows for discharge to a Type A dispersal leaching bed, which provides a permissible reduction in bed area of about 30% when compared to the bed area required when effluent is discharged from a conventional septic tank.

Design Specifications

On the basis of the preliminary design criteria described above, the WTS is to be comprised of the following key components: i) proprietary treatment unit, and ii) Type A dispersal leaching bed.

Although specific effluent concentration limits and objectives have yet to be finalized, for preliminary design purposes, the proprietary treatment unit is to be designed to achieve an effluent nitrate concentration limit of 3.0 mg/L and an effluent $CBOD_5$ and TSS concentration objective of 10 mg/L.

A Type A dispersal leaching bed is comprised of a layer of continuous stone containing a series of gravity distribution pipes, overlying a layer of imported sand fill which extends into a tapered mantle beyond the stone layer. In this case the stone layer would be contained in the mildly sloped southwest corner of the property, and the mantle(s) would extend down the slopes to the north and east.

The minimum leaching bed area required by OBC Sentence 8.7.7.1.(5). is calculated below:

$A = Q \times T \div 400$

where:
A = minimum leaching bed area required (m^2)
Q = peak daily wastewater flow (L/day)
T = percolation time (min/cm)

$A = 17{,}000 \text{ L/day} \times 50 \text{ min/cm} \div 400$
$= 2{,}125 \text{ m}^2$

The minimum leaching bed area required by OBC Sentence 8.7.7.1.(5). is based on a maximum percolation time of 50 min/cm, even in scenarios where the percolation time exceeds 50 min/cm. It is the opinion of FlowSpec that a technical limitation exists with this formula, such that it is inappropriate for use in situations where the percolation time is greater than 50 min/cm (as may be the case here, to be confirmed upon excavation of additional test pits in the proposed bed location).

Therefore, the leaching bed area used for these preliminary design specifications was calculated using a maximum hydraulic loading rate of 6 L/day/m^2 (considered reasonable for the underlying till soils), as follows:

$A = Q \div L_R$

where:
A = minimum leaching bed area required (m^2)
Q = peak daily wastewater flow (L/day)
L_R = maximum hydraulic loading rate (L/day/m^2)

$A = 17{,}000 \text{ L/day} \div 6 \text{ L/day/m}^2$
$= 2{,}834 \text{ m}^2$

A leaching bed area of 3,000 m^2 has been accommodated in the development concept, and is to be refined upon excavation of additional test pits in the proposed bed location at the final design stage. A preliminary bed envelope is illustrated on the appended development concept.

Should you have any questions regarding the above, please do not hesitate to contact the undersigned.

Yours truly,
FlowSpec Engineering Ltd.

David Morlock, P.Eng.
Consulting Engineer

Appendix D WATER

Project Name - Claremont North Business Park
Project Number - 160622415
Date - Nov-17

Stantec

DOMESTIC WATER CALCULATION SHEET

Criteria Used:	**Durham Region Standards**						
Function	Population	Units	Flow	Units	Min Hr Factor	Peak Hr Factor	Max Day Factor
Single Family Residential	3.5	Per House	4500	L/min	-	-	-
Townhouse	3.5	Per House	4500	L/min	-	-	-
1 Bdrm Apt	1.6	Per Unit	4500	L/min	-	-	-
2 Bdrm Apt	2.7	Per Unit	4500	L/min	-	-	-
3 Bdrm Apt	2.7	Per Unit	4500	L/min	-	-	-
Commercial	-	1000m^2 of GFA	5,000	L/Day	-	-	-
Office	-	1000m^2 of GFA	5,000	L/Day	-	-	-

Residential Component

Location	Unit Type	Number of Units	Population	Average Day (L/d)	Min Hour (L/hr)	Peak Hour (L/hr)	Max Day (L/d)
			Total Residential	0	0	0	0

Non-Residential Component

Location	Function	GFA Area (Ha)	Population	Average Day (L/d)	Min Hour (L/hr)	Peak Hour (L/hr)	Max Day (L/d)
Claremont North Business Park	Commercial	0.32	-	16000	-	-	16000
			Total Commercial	16000	0	0	16000
Number obtained from carwash supplier =>			Total Carwash	10980	0	0	10980
			Total Site	26980	0	0	26980

Total Peak Flow (L/s)	0.31

Project Name - Claremont North Business Park
Project Number - 160622415
Date - Nov-17

Stantec

FUS CALCULATION SHEET

1. Fire flow estimate		3. Sprinkler Protection Factor	
C=	0.6	Factor (%)=	0%
		F (L/min)=	5796
Largest Floor Area (m^2)=	1234	**4. Exposure Factor**	
Above Floor Area (m^2)=	0	Distance to Closest Structure	
Below Floor Area (m^2)=	0	Side 1 (m)=	15
A (m^2)=	1234	Side 2 (m)=	20
		Side 3 (m)=	20
F (L/min)=	4637	Side 4 (m)=	20
2. Occupancy Factor		Factor (%)=	60%
Factor (%)=	25%	**F (L/min)=**	**10000**
F (L/min)=	5796	**F (USGPM)=**	**3000**

Appendix E STORMWATER MANAGEMENT

Project: Claremont Business Park - ESSO
Project Number: 160622415
Project Location: Claremont, ON

Drainage Areas

Existing Development Area

Zone	Area (ha)	Runoff Coefficient
Building	0.16	0.90
Open Space	4.42	0.25
Total	4.58	0.27

Existing Drainage Areas

Zone	Area (ha)	Runoff Coefficient
Northeast External	1.55	0.40
West External	0.63	0.75
South External	0.76	0.25
Site	4.58	0.27
Total	7.52	0.34

Proposed Site Area

Zone	Area (ha)	Runoff Coefficient
Commercial	2.89	0.80
SWM Pond	0.27	0.60
Uncontrolled	0.04	0.90
Undeveloped	1.38	0.25
Total Site	4.58	0.62

Proposed Development Area

Zone	Area (ha)	Runoff Coefficient
Commercial	2.89	0.80
SWM Pond	0.27	0.60
Uncontrolled	0.04	0.90
Total Development	3.20	0.78

Proposed Drainage Areas

Zone	Area (ha)	Runoff Coefficient
Northeast External	1.55	0.40
West External	0.63	0.75
South External	0.76	0.25
Site	4.58	0.62
Total	7.52	0.55

Project: Claremont Business Park - ESSO
Project Number: 160622415
Project Location: Claremont, ON

Stormwater Release Rates

Existing

Existing Site Area Release Rates

Area (ha) = 4.58

Storm	Release Rate (m^3/s)	Total Rainfall (mm)	Runoff Volume (mm)
25mm 4hour	0.195	25.0	15.4
2 Year 1 Hour AES Storm	0.321	23.8	14.6
2 Year 12 Hour AES Storm	0.222	41.1	31.1
5 Year 1 Hour AES Storm	0.901	32.6	24.8
5 Year 12 Hour AES Storm	0.458	53.2	44.7
10 Year 1 Hour AES Storm	0.645	38.5	28.6
10 Year 12 Hour AES Storm	0.341	61.3	50.5
25 Year 1 Hour AES Storm	0.809	45.9	35.7
25 Year 12 Hour AES Storm	0.400	71.4	60.3
50 Year 1 Hour AES Storm	0.930	41.0	51.4
50 Year 12 Hour AES Storm	0.444	67.7	79.0
100 Year 1 Hour AES Storm	1.048	56.8	46.2
100 Year 12 Hour AES Storm	0.487	86.5	75.0

Existing Drainage Area Release Rates

Area (ha) = 7.52

Storm	Release Rate (m^3/s)
25mm 4hour	0.350
2 Year 1 Hour AES Storm	0.581
2 Year 12 Hour AES Storm	0.367
100 Year 1 Hour AES Storm	1.783
100 Year 12 Hour AES Storm	0.805

Existing External Drainage Areas

Storm	Drainage Area	Release Rate (m^3/s)
100 Year 1 Hour AES Storm	Northeast - 1.55 ha	0.154
100 Year 12 Hour AES Storm		0.077
100 Year 1 Hour AES Storm	West - 0.63 ha	0.506
100 Year 12 Hour AES Storm		0.169

Existing Roadside Ditch Capacity

Roadside Ditch	Capacity (m^3/s)	Required (m^3/s)
West - Upstream	1.26	0.154
West - Downstream	0.52	
East - Upstream	4.97	0.506
East - Downstream	26.38	

Proposed

Proposed Development Area Release Rates

Area (ha) = 3.20

Storm	Release Rate (m^3/s)	Total Rainfall (mm)	Runoff Volume (mm) [1]
25mm 4hour	0.014	25.0	22.81
2 Year 1 Hour AES Storm	0.015	23.8	21.60
2 Year 12 Hour AES Storm	0.060	41.1	38.80
100 Year 1 Hour AES Storm	0.342	56.8	54.51
100 Year 12 Hour AES Storm	0.279	86.5	84.12

Proposed SWM Pond Release Rates

Storm	Release Rate (m^3/s)	Pond Volume (m^3)	Water Level (m)
25mm 4hour	0.014	613	274.96
2 Year 1 Hour AES Storm	0.015	659	274.99
2 Year 12 Hour AES Storm	0.059	760	275.05
100 Year 1 Hour AES Storm	0.338	1,282	275.34
100 Year 12 Hour AES Storm	0.275	1,171	275.28

24.3 hours ← Expected drawdown time. Assumed average release rate is half of the maximum.

Proposed Site Release Rates

Area (ha) = 4.58

Storm	Release Rate (m^3/s)	Total Rainfall (mm)	Runoff Volume (mm) [1]
25mm 4hour	0.068	25.0	20.5
2 Year 1 Hour AES Storm	0.109	23.8	19.4
2 Year 12 Hour AES Storm	0.104	41.1	36.4
5 Year 1 Hour AES Storm	0.224	32.6	28.0
5 Year 12 Hour AES Storm	0.202	53.2	48.3
10 Year 1 Hour AES Storm	0.320	38.5	33.8
10 Year 12 Hour AES Storm	0.259	61.3	56.3
25 Year 1 Hour AES Storm	0.436	45.9	41.1
25 Year 12 Hour AES Storm	0.323	71.4	66.3
50 Year 1 Hour AES Storm	0.522	41.0	46.6
50 Year 12 Hour AES Storm	0.369	67.7	73.9
100 Year 1 Hour AES Storm	0.609	56.8	51.9
100 Year 12 Hour AES Storm	0.414	86.5	81.3

[1] Unmitigated runoff volume - no runoff reduction techniques applied.

Proposed Drainage Area Release Rates

Area (ha) = 7.52

Storm	Release Rate (m^3/s)
25mm 4hour	0.235
2 Year 1 Hour AES Storm	0.369
2 Year 12 Hour AES Storm	0.238
100 Year 1 Hour AES Storm	1.314
100 Year 12 Hour AES Storm	0.731

TRCA

TRCA Unit Flow Relationship per Table 8.1
Addendum: Duffins Creek Hydrology Update
Stormwater Management Criteria for Non-Seaton Development Lands
Published by Aquafor Beech for the TRCA, dated May 23, 2013

TABLE 8.1:
Stormwater Management Target Criteria: Future Development Lands (Non-Seaton Lands)

Catchment No.	Tributary Name	Model Catchment ID		Existing Pre-development	Future Development Area		2012 Unit Flow Stormwater Management ‡			
							Storm Event	Unit Flow Release Rate Target		Storage Requirements	
		Rural	Urban	(rural) Area (ha)	Area (ha)	% Impervious		(L/s/ha)	(L/s/imp-ha)	(m3/ha)	(m3/imp-ha)
51	Michell Creek near Claremont	5101	5104	716	18.7	39	2-year	2.42	6.21	153	392
							5-year	3.94	10.11	213	547
							10-year	5.03	12.90	253	649
							25-year	6.58	16.88	306	786
							50-year	7.81	20.02	346	887
							100-year	9.11	23.37	387	993

Development Drainage Area (ha) = 3.20
Development Drainage Impervious Percent[1] = 82
Development Drainage Impervious Area (ha) = 2.61

[1]Percent impervious (I) converted from C values based on Simple Method, C = 0.05 + 0.009(I); (Schueler, 1987)

Return Period	Release Rate (L/s/ha)		Release Rate ($m^3/s/ha$)	
	Based on Area	Based on Imp. Area	Based on Area	Based on Imp. Area
2 Year	7.7	16.2	0.008	0.016
100 Year	29.2	61.0	0.029	0.061

TRCA Proposed Release Rates

Storm	Release Rate (m^3/s)
2 Year 12 Hour AES Storm	0.060
100 Year 12 Hour AES Storm	0.279

Existing Conditions Unit Release Rates vs TRCA Unit Release Rates

Return Period	Release Rate ($m^3/s/ha$)		TRCA Relase as a Percentage of Existing
	Existing	TRCA	
2 Year	0.048	0.008	16%
100 Year	0.106	0.029	27%

Brock Road Culvert

Upstream Invert =	271.2	m
Downstream Invert =	270.87	m
Length =	34.75	m
Slope =	0.0095	m/m
Diameter =	1.05	m
Tailwater Elevation =	271.92	m (obvert of culvert)
Headwater Elevation =	272.25	m

Headwater elevation calculated in CulvertMaster. Flow of 1.783 m^3/s based on 100 Year 1 Hour AES Storm (existing conditions)

Project: Claremont Business Park - ESSO
Project Number: 160622415
Project Location: Claremont, ON

Stormwater Release Rates Summary

Site Area Release Rates

Area (ha) = 4.58

Storm	Existing Release Rate (m^3/s)	Proposed Release Rate (m^3/s)	Difference Runoff (m^3/s)
25mm 4hour	0.195	0.068	-0.127
2 Year 1 Hour AES Storm	0.321	0.109	-0.212
2 Year 12 Hour AES Storm	0.222	0.104	-0.118
5 Year 1 Hour AES Storm	0.901	0.224	-0.677
5 Year 12 Hour AES Storm	0.458	0.202	-0.256
10 Year 1 Hour AES Storm	0.645	0.320	-0.325
10 Year 12 Hour AES Storm	0.341	0.259	-0.082
25 Year 1 Hour AES Storm	0.809	0.436	-0.373
25 Year 12 Hour AES Storm	0.400	0.323	-0.077
50 Year 1 Hour AES Storm	0.930	0.522	-0.408
50 Year 12 Hour AES Storm	0.444	0.369	-0.075
100 Year 1 Hour AES Storm	1.048	0.609	-0.439
100 Year 12 Hour AES Storm	0.487	0.414	-0.073

Drainage Area Release Rates

Area (ha) = 7.52

Storm	Existing Release Rate (m^3/s)	Proposed Release Rate (m^3/s)	Difference Runoff (m^3/s)
25mm 4hour	0.350	0.235	-0.115
2 Year 1 Hour AES Storm	0.581	0.369	-0.212
2 Year 12 Hour AES Storm	0.367	0.238	-0.129
100 Year 1 Hour AES Storm	1.783	1.314	-0.469
100 Year 12 Hour AES Storm	0.805	0.731	-0.074

Stormwater Runoff Volume Summary

Development Area Runoff Volumes

Area (ha) = 3.20

Storm	Existing Runoff Volume (mm) [1]	Proposed Runoff Volume (mm)	Change in Runoff Volume (mm) [2]
25mm 4hour	15.4	22.8	7.4
2 Year 1 Hour AES Storm	14.6	21.6	7.0
2 Year 12 Hour AES Storm	31.1	38.8	7.8
100 Year 1 Hour AES Storm	46.2	54.5	8.3
100 Year 12 Hour AES Storm	75.0	84.1	9.2

[1] From the existing conditions site area model

[2] Unmitigated runoff volume - no runoff reduction techniques applied.

Project: Claremont Business Park - ESSO
Project Number: 160622415
Project Location: Claremont, ON

SWM Pond Sizing

Elevation (m)	Area (m^2)	Incremental Volume (m^3)	Total Volume (m^3)	Total Volume Above NWL (m^3)	
274.10	240	0	0		
274.20	265	25	25		
274.30	274	27	52		
274.40	315	29	82		
274.50	340	33	114	0	<-- Forebay volume
274.60	1,336	84	198	84	
274.70	1,404	137	335	221	
274.80	1,481	144	479	365	
274.90	1,558	152	631	517	
275.00	1,635	160	791	677	<-- Ext. Det. Water Level 274.96 m
275.10	1,712	167	958	844	<-- 2 Year Water Level 275.05 m
275.20	1,790	175	1,134	1,019	
275.30	1,869	183	1,316	1,202	<-- 100 Year Water Level 275.34 m
275.40	1,948	191	1,507	1,393	
275.50	2,028	199	1,706	1,592	
275.60	2,110	207	1,913	1,799	<-- Top of Pond 275.65 m

Project: Claremont Business Park - ESSO
Project Number: 160622415
Project Location: Claremont, ON

Stormwater Quality

Dry SWM Pond

Table 3.2 Water Quality Storage Requirements based on receiving Waters
MOE, 2003

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Basic 60% long-term S.S. removal	Dry Pond	90	150	200	240

Development Drainage Area (ha) =	3.20
Development Drainage Impervious Percent[1] =	82%
Development Drainage Impervious Area (ha) =	2.61
Required Storage Volume (m^3/ha) =	232
Required Storage Volume (m^3) =	605
Provided Storage Volume (m^3) =	613

As the provided extended detention storage volume exceeds the required storage volume, the pond will provide 60% long-term suspended solids removal.

WATER BALANCE CALCULATIONS

TABLE 1
EXISTING CONDITIONS MONTHLY WATER BALANCE
CLAREMONT NORTH BUSINESS PARK DEVELOPMENT

Model Type: Thornthwaite and Mather (1955)
Client: S. Larkin Developments Inc.
Location 5435, 5455 and 5475 Old Brock Road, Pickering, ON
Total Site Area (ha) 4.37

Sub-Area Descriptions (topography, soils, cover)	
Sub-Area A	Rolling to Hilly - Silty Clay - Moderately Rooted Crops

Land Description Factors (Seeend of table for sub-area descriptions)	Sub-Area A													Total
Topography	0.15													
Soils	0.15													
Cover	0.10													
Sum (Infiltration Factor)†	0.40													
Soil Moisture Capacity (mm)	200													
Site area (ha)	4.37													4.37
Imperviousness Coefficient	0.05													
Impervious Area (ha)	0.22													0.22
Percentage of Total Site Area	5.0%													5%
Remaining Pervious Area (ha)	4.15													4.15
Total Pervious Site Area (ha)	4.15													4.15
Percentage of Total Site Area	95.0%													95%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Climate Data ‡													
Average Daily Temperature (°C)	-5.8	-5.6	-0.4	6.7	13	18.6	21.2	20.2	15.7	8.9	3.1	-2.9	**7.7**
Precipitation (mm)	62.1	50.5	53.2	74.1	79.6	82.8	79	76.2	81.8	68	80	65.7	**853**

Potential Evapotranspiration Analysis for Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat Index	0.0	0.0	0.0	1.6	4.2	7.3	8.9	8.3	5.7	2.4	0.5	0.0	**39**
Unadjusted Potential Evapotranspiration (mm)	0.0	0.0	0.0	29.3	61.0	90.8	104.9	99.5	75.2	40.1	12.5	0.0	**513**
Potential Evapotranspiration Adjusting Factor for Latitude*	0.77	0.87	0.99	1.12	1.23	1.29	1.26	1.16	1.04	0.92	0.81	0.75	
Adjusted Potential Evapotranspiration (PET)(mm)	0	0	0	33	75	117	132	116	78	37	10	0	**598**
Precipitation - PET (mm)	62	51	53	41	5	-34	-53	-40	3	31	70	66	**255**

Evapotranspiration Analysis													
Sub-Area A	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-34	-87	-127	-123	-92	-22	0	
Storage (S)	200	200	200	200	200	169	109	58	61	93	163	200	
Change in Storage	0	0	0	0	0	-31	-60	-51	3	31	70	37	
Actual Evapotranspiration (mm)	0	0	0	33	75	114	139	127	78	37	10	0	**613**
Recharge/Runoff Analysis													
Water Surplus (mm)	62	51	53	41	5	0	0	0	0	0	0	28	**240**
Potential Infiltration (I)	25	20	21	17	2	0	0	0	0	0	0	11	96
Potential Direct Surface Water Runoff (R)	37	30	32	25	3	0	0	0	0	0	0	17	144
Potential Infiltration (mm)	0	0	0	94	2	0	0	0	0	0	0	0	96
Pervious Evapotranspiration (m^3)	0	0	0	1361	3115	4735	5755	5295	3257	1530	417	0	25,466
Pervious Runoff (m^3)	1548	1259	1326	1031	115	0	0	0	0	0	0	703	**5,981**
Pervious Infiltration (m^3)	0	0	0	3911	77	0	0	0	0	0	0	0	**3,987**
Potential Impervious Evaporation (mm)	6	5	5	7	8	8	8	8	8	7	8	7	85
Potential Impervious Runoff (mm)	56	45	48	67	72	75	71	69	74	61	72	59	768
Impervious Runoff (m^3)	122	100	105	146	157	163	156	150	161	134	158	129	**1,681**

Notes on last page.

Pre-Development Infiltration	3,987	(m^3/yr)	91	mm/yr	0.1	L/s	
Pre-Development Runoff	7,663	(m^3/yr)	175	mm/yr	0.2	L/s	**CHECK ROW - HIDE DO NOT PRINT**
Pre-Development Evapotranspiration	25,653	(m^3/yr)	587	mm/yr	0.8	L/s	**CHECK ROW - HIDE DO NOT PRINT**
Total	37,303	(m^3/yr)	853	mm/yr	1.2	L/s	**CHECK ROW - HIDE DO NOT PRINT**
Original Precipitation	37,303	(m^3/yr)	853	mm/yr	1.2	L/s	**CHECK ROW - HIDE DO NOT PRINT**
Error	0.000	(m^3/yr)	0.000	mm/yr	0.000	L/s	**CHECK ROW - HIDE DO NOT PRINT**

Notes:

† Infiltration factors after Ontario Ministry of the Environment, 2003. Stormwater Management Planning and Design Manual. March 2003.; and Ontario Ministry of Environment and Energy (MOEE). 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

* PET adjustment factors after Thornthwaite, C.W., and J.R. Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration and the water balance. Drexel Institute of Technology, Laboratory of Climatology, Publications in Climatology, Volume X, No. 3. Centerton, New Jersey.

‡ Climate Data after Environment Canada, 2017. Canadian Climate Normals 1981-2010, Toronto Buttonville A, Climate ID 615HMAK. [Online] http://climate.weather.gc.ca/climate_normals/index_e.html Accessed September 26 2017

Assumptions:

[1] The monthly average precipitation collected at the Toronto Buttonville A climate station is considered reflective of the precipitation trends that have historically occurred at the Site. This station is 23.5 km SE of the Site at an elevation of 198.1 mAMSL

[2] Surplus water is not available for runoff and recharge during months where water losses from actual evapotranspiration exceed precipitation inputs.

[3] Runoff, infiltration and evapotranspiration do not occur in months where the average daily temperature is below 0°C, which is the case for the months of December through March at the Site.

[4] Precipitation during freezing months (i.e., December to March) is assumed to accumulate as snow and result in additional precipitation in the first month thereafter where the average temperature is greater than 0°C (i.e., April).

[5] Soil moisture capacity is at a maximum in April.

TABLE 2
POST-DEVELOPMENT MONTHLY WATER BALANCE
CLAREMONT NORTH BUSINESS PARK DEVELOPMENT

Model Type: Thornthwaite and Mather (1955)
Client: S. Larkin Developments Inc.
Location 5435, 5455 and 5475 Old Brock Road, Pickering, ON
Total Site Area (ha) 4.37

Sub-Area Descriptions (topography, soils, cover)	
Sub-Area B	Rolling to Hilly - Silty Clay - Urban Lawn

Land Description Factors (Seeend of table for sub-area descriptions)	Sub-Area B													Total
Topography	0.15													
Soils	0.15													
Cover	0.05													
Sum (Infiltration Factor)†	0.35													
Soil Moisture Capacity (mm)	150													
Site area (ha)	4.37													4.37
Imperviousness Coefficient	0.54													
Impervious Area (ha)	2.34													2.34
Percentage of Total Site Area	53.5%													54%
Remaining Pervious Area (ha)	2.03													2.03
Total Pervious Site Area (ha)	2.03													2.03
Percentage of Total Site Area	46.5%													46%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Climate Data ‡													
Average Daily Temperature (°C)	-5.8	-5.6	-0.4	6.7	13	18.6	21.2	20.2	15.7	8.9	3.1	-2.9	**7.7**
Precipitation (mm)	62.1	50.5	53.2	74.1	79.6	82.8	79	76.2	81.8	68	80	65.7	**853**

Potential Evapotranspiration Analysis for Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat Index	0.0	0.0	0.0	1.6	4.2	7.3	8.9	8.3	5.7	2.4	0.5	0.0	**39**
Unadjusted Potential Evapotranspiration (mm)	0.0	0.0	0.0	29.3	61.0	90.8	104.9	99.5	75.2	40.1	12.5	0.0	**513**
Potential Evapotranspiration Adjusting Factor for Latitude*	0.77	0.87	0.99	1.12	1.23	1.29	1.26	1.16	1.04	0.92	0.81	0.75	
Adjusted Potential Evapotranspiration (PET)(mm)	0	0	0	33	75	117	132	116	78	37	10	0	**598**
Precipitation - PET (mm)	62	51	53	41	5	-34	-53	-40	3	31	70	66	**255**

Evapotranspiration Analysis													
Sub-Area B	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-34	-87	-127	-123	-92	-22	0	
Storage (S)	150	150	150	150	150	120	67	29	32	63	133	150	
Change in Storage	0	0	0	0	0	-30	-53	-38	3	31	70	17	
Actual Evapotranspiration (mm)	0	0	0	33	75	113	132	114	78	37	10	0	**592**
Recharge/Runoff Analysis													
Water Surplus (mm)	62	51	53	41	5	0	0	0	0	0	0	49	**261**
Potential Infiltration (I)	22	18	19	14	2	0	0	0	0	0	0	17	91
Potential Direct Surface Water Runoff (R)	40	33	35	27	3	0	0	0	0	0	0	32	169
Potential Infiltration (mm)	0	0	0	90	2	0	0	0	0	0	0	0	91
Pervious Evapotranspiration (m^3)	0	0	0	666	1525	2300	2677	2326	1594	749	204	0	12,040
Pervious Runoff (m^3)	821	667	703	546	61	0	0	0	0	0	0	648	**3,446**
Pervious Infiltration (m^3)	0	0	0	1823	33	0	0	0	0	0	0	0	**1,855**
Potential Impervious Evaporation (mm)	6	5	5	7	8	8	8	8	8	7	8	7	85
Potential Impervious Runoff (mm)	56	45	48	67	72	75	71	69	74	61	72	59	768
Impervious Runoff (m^3)	1308	1064	1120	1561	1676	1744	1664	1605	1723	1432	1685	1384	**17,965**

Notes on last page.

Existing Infiltration	3,987	(m^3/yr)	91	mm/yr	0.1	L/s	
Post-Development Infiltration	1,855	(m^3/yr)	42	mm/yr	0.1	L/s	
Infiltration Deficit	2,132	(m^3/yr)	49	mm/yr	0.1	L/s	
Post-Development Runoff	21,411	(m^3/yr)	490	mm/yr	0.7	L/s	**CHECK ROW - HIDE DO NOT PRINT**
Post-Development Evapotranspiration	14,037	(m^3/yr)	321	mm/yr	0.4	L/s	**CHECK ROW - HIDE DO NOT PRINT**
Total	37,303	(m^3/yr)	853	mm/yr	1.2	L/s	**CHECK ROW - HIDE DO NOT PRINT**
Original Precipitation	37,303	(m^3/yr)	853	mm/yr	1.2	L/s	**CHECK ROW - HIDE DO NOT PRINT**
Error	0.000	(m^3/yr)	0.000	mm/yr	0.000	L/s	**CHECK ROW - HIDE DO NOT PRINT**

Notes:

† Infiltration factors after Ontario Ministry of the Environment, 2003. Stormwater Management Planning and Design Manual. March 2003.; and Ontario Ministry of Environment and Energy (MOEE). 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

* PET adjustment factors after Thornthwaite, C.W., and J.R. Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration and the water balance. Drexel Institute of Technology, Laboratory of Climatology, Publications in Climatology, Volume X, No. 3. Centerton, New Jersey.

‡ Climate Data after Environment Canada, 2017. Canadian Climate Normals 1981-2010, Toronto Buttonville A, Climate ID 615HMAK. [Online] http://climate.weather.gc.ca/climate_normals/index_e.html Accessed September 26 2017

Assumptions:

[1] The monthly average precipitation collected at the Toronto Buttonville A climate station is considered reflective of the precipitation trends that have historically occurred at the Site. This station is 23.5 km SE of the Site at an elevation of 198.1 mAMSL

[2] Surplus water is not available for runoff and recharge during months where water losses from actual evapotranspiration exceed precipitation inputs.

[3] Runoff, infiltration and evapotranspiration do not occur in months where the average daily temperature is below 0°C, which is the case for the months of December through March at the Site.

[4] Precipitation during freezing months (i.e., December to March) is assumed to accumulate as snow and result in additional precipitation in the first month thereafter where the average temperature is greater than 0°C (i.e., April).

[5] Soil moisture capacity is at a maximum in April.

Within the hydrologic cycle, the flow of water into and out of system can be described through a simplified water balance equation as follows:

$$P = ET + S + R + I \quad \textbf{Equation 1}$$

Where:

- P = precipitation
- ET = evapotranspiration
- S = change in groundwater storage
- R = runoff
- I = infiltration (groundwater recharge)

Equation 1 may be further simplified by ignoring the change in groundwater storage (S), which trends over time to zero. The various components of the hydrologic cycle may be estimated through calculations, or based on measurements made in the field. Precipitation (P) is typically a measured value. Evapotranspiration (ET) is calculated based on measured air temperatures. Infiltration (I) and Runoff (R) are calculated based on P and ET, where the difference between P and ET is the water surplus (WS) available for Infiltration (I) and Recharge (R) as follows:

$$WS = P - ET \quad \textbf{Equation 2}$$

Where WS is used to calculate I after applying an infiltration factor (IF),

$$I = WS \times IF \quad \textbf{Equation 3}$$

And R is estimated by subtracting I from WS,

$$R = WS - I \quad \textbf{Equation 4}$$

For this assessment, ET was calculated using the soil moisture balance model by Thornthwaite and Mather (1955). In the Thornthwaite and Mather model monthly potential evapotranspiration (PET) is calculated based on the measured average monthly daily temperature (T_a) and a heat index (H_i) value assuming 12 hours of daylight in a day and 30 days in a month, as follows:

$$PET = 16 \times \left(\frac{10T_a}{H_i}\right)^{\alpha} \quad \textbf{Equation 5}$$

Where T_a is taken as 0 degrees Celsius for months with negative temperatures, and H_i, the heat index is estimated as,

$$H_i = \sum_{i=1}^{12} \left(\frac{10T_a}{5}\right)^{1.514} \quad \textbf{Equation 6}$$

For α

$$\alpha = 0.49 + (0.0179 \times H_i) - \left(0.0000771 \times {H_i}^2\right) + \left(0.000000675 \times {H_i}^3\right) \quad \textbf{Equation 7}$$

PET values are then multiplied by an adjustment factor, after Thornthwaite and Mather (1957), which represents the average number of daylight hours per month at the latitude of the subject property to give the Adjusted Potential Evapotranspiration (PET_{adj}).

Actual Evapotranspiration (AET) is derived as,

$$AET = PET_{adj} - \Delta S \qquad \textbf{Equation 8}$$

Where ΔS is the change in storage for the month, calculated as,

$$\Delta S = S_{mc} \times e^{\left(\frac{APWL}{S_{mc}}\right)} \qquad \textbf{Equation 9}$$

Where:

S_{mc} = soil moisture capacity

APWL = accumulated potential water loss, calculated for $\Delta P < 0$ as $APWL = -\sum_{i=0}^{12} PET_i$, and for $\Delta P > 0$ by rearranging equation 8; with ΔP= net precipitation = P - PET_{adj}

WS is derived by subtracting AET from the monthly precipitation,

$$WS = P - AET \qquad \textbf{Equation 10}$$

And the infiltration and runoff calculated per Equation 3 and 4 above. The infiltration factor shown in Equation 3 is estimated based on the topography, soil type and land cover after MOE (2003) and the Ministry of the Environment and Energy (MOEE) (1995). Climate data is obtained from the nearest station with reliable daily precipitation and temperature records.

References:

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

Ministry of Environment and Energy. 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

Thornthwaite, C.W. and Mather, J.W. 1955. The water balance. Philadelphia, PA: Drexel Institute of Technology, Climatological Laboratory Publication No.8.

Thornthwaite, C.W., and Mather J.W., 1957. Instructions and Tables for Computing Potential Evapotranspiration and the water balance. Drexel Institute of Technology, Laboratory of Climatology, Publications in Climatology, Volume X, No. 3. Centerton, New Jersey.

Metadata including Station Name, Province, Latitude, Longitude, Elevation, Climate ID, WMO ID, TC ID

STATION_NAME	PROVINCE	LATITUDE	LONGITUDE	ELEVATION	CLIMATE_ID	WMO_ID	TC_ID
TORONTO BUTTONVILLE A	ON	43°51'44.000" N	79°22'12.000" W	198.1 m	615HMAK	71639	YKZ

Legend
A = WMO "3 and 5 rule" (i.e. no more than 3 consecutive and no more than 5 total missing for either temperature or precipitation)
B = At least 25 years
C = At least 20 years
D = At least 15 years

1981 to 2010 Canadian Climate Normals station data

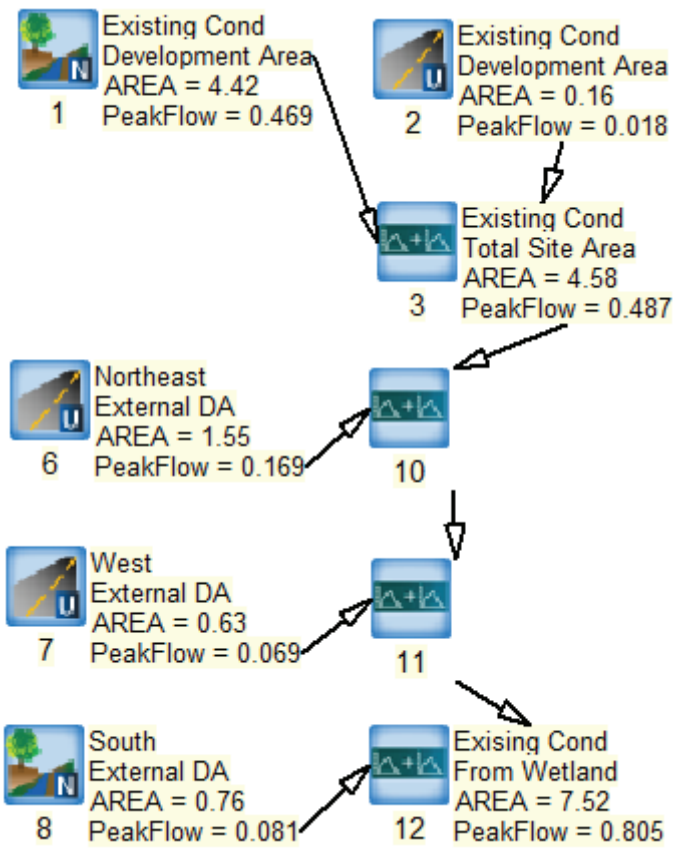
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Temperature														
Daily Average (°C)		-5.8	-5.6	-0.4	6.7	13	18.6	21.2	20.2	15.7	8.9	3.1	-2.9	7.7 C
Standard Deviation		3.1	2.3	2	1.7	1.8	1.3	1.4	1.4	1.4	1.5	1.6	2.7	1.1 C
Daily Maximum (°C)		-1.5	-0.9	4.5	12.1	19.1	24.6	27.1	26	21.5	14.1	7.2	0.9	12.9 C
Daily Minimum (°C)		-10.1	-10.2	-5.3	1.2	6.8	12.6	15.2	14.3	9.9	3.6	-1.1	-6.8	2.5 C
Extreme Maximum (°C)		14.9	14.9	26	31.7	34.6	36.6	37.2	37.8	34.4	31	22.1	18	
Date (yyyy/dd)	2005/13	2000/27	1998/30	1990/26	2006/29	1995/19	1988/07	2001/08	2002/09	2007/08	1999/09	2001/06		
Extreme Minimum (°C)		-35.2	-25.7	-25.6	-10.6	-2.1	1.9	6.9	4.2	-2	-7.4	-15	-26	
Date (yyyy/dd)	1994/16	1987/15	2003/03	2003/06	1996/02	1986/03	1988/03	1986/29	1989/27	1988/31	1987/21	2004/20		
Precipitation														
Rainfall (mm)		26	22.9	33.6	66.7	79.5	82.8	78.8	76.2	81.8	66.7	68.3	34.2	717.4 C
Snowfall (cm)		38.9	29.9	19.3	7.5	0.1	0	0	0	0	0.6	12.1	34.2	142.6 C
Precipitation (mm)		62.1	50.5	53.2	74.1	79.6	82.8	79	76.2	81.8	68	80	65.7	852.9 C
Average Snow Depth (cm)		9	9	4	0	0	0	0	0	0	0	1	4	2 C
Median Snow Depth (cm)		8	9	3	0	0	0	0	0	0	0	0	3	2 C
Snow Depth at Month-end (cm)		12	6	1	0	0	0	0	0	0	0	0	5	2 C
Extreme Daily Rainfall (mm)		40.4	36.3	38	45.1	64.6	41.6	42.8	71.2	80.3	43	43.7	30.6	
Date (yyyy/dd)	1995/15	1990/22	1991/27	2009/03	2000/12	2000/13	2009/23	1986/15	1986/10	1995/05	1993/27	2006/01		
Extreme Daily Snowfall (cm)		37.4	23.8	22	19.2	1.8	0	0	0	0	6.4	18.5	33.5	
Date (yyyy/dd)	1999/03	2001/08	1999/06	2009/06	2005/02	1986/01	1986/01	1986/01	1986/01	1997/27	1987/25	2000/12		
Extreme Daily Precipitation (mm)		40.4	36.3	38	45.1	64.6	41.6	42.8	71.2	80.3	43	43.7	42.6	
Date (yyyy/dd)	1995/15	1990/22	1991/27	2009/03	2000/12	2000/13	2009/23	1986/15	1986/10	1995/05	1993/27	1990/03		
Extreme Snow Depth (cm)	57	45	44	16	0	0	0	0	0	0	1	70	43	
Date (yyyy/dd)	1999/16	2001/09	2008/09	1994/07	1986/23	1986/01	1986/01	1986/01	1986/01	2008/29	1986/23	1992/12		
Days with Maximum Temperature														
<= 0 °C		17.8	15.3	7.3	0.58	0	0	0	0	0	0	2	12.8	55.9 C
> 0 °C		13.2	13	23.7	29.4	31	30	31	31	30	31	28	18.2	309.4 C
> 10 °C	0.78	0.54	6.3	18.7	29.9	30	31	31	29.9	24	8.2	1.2		211.4 C
> 20 °C	0	0	0.7	3	12.3	24.6	30.3	29.5	18.7	4.1	0.16	0		123.3 C
> 30 °C	0	0	0	0.13	0.79	4	7	4.3	0.84	0.04	0	0		17 C
> 35 °C	0	0	0	0	0	0.2	0.6	0.32	0	0	0	0		1.1 C
Days with Minimum Temperature														
> 0 °C	2.4	1	5.1	17.5	29.5	30	31	31	29.6	24	12.2	3.3		216.7 C
<= 2 °C	30.3	28.2	28.5	18.2	4.5	0.04	0	0	1	11.9	22.9	30		175.5 C
<= 0 °C	28.6	27.2	25.9	12.5	1.5	0	0	0	0.4	7	17.8	27.7		148.5 C
< -2 °C	26	25.3	21.2	6.6	0.04	0	0	0	0	2.4	11.8	23		116.3 C
< -10 °C	14.8	14.2	6.4	0.08	0	0	0	0	0	0	1.1	8.5		45 C
< -20 °C	3.4	1.8	0.26	0	0	0	0	0	0	0	0	0.64		6.1 C
< - 30 °C	0.09	0	0	0	0	0	0	0	0	0	0	0		0.09 C
Days with Rainfall														
>= 0.2 mm	5.8	3.8	6.7	10.8	12	11.8	11.2	9.9	10.8	13	11.3	6.6		113.7 C
>= 5 mm	1.8	1.5	2.3	4.8	4.9	5.3	5	4.4	4.7	4.4	3.8	2.5		45.4 C
>= 10 mm	0.71	0.79	1.1	1.9	2.7	3.1	2.8	2.6	2.8	2	2.4	1.1		24 C
>= 25 mm	0.08	0.17	0.09	0.29	0.63	0.48	0.68	0.52	0.64	0.24	0.32	0.12		4.3 C
Days With Snowfall														
>= 0.2 cm	13.4	10.8	7	2.9	0.13	0	0	0	0	0.48	4.7	10.8		50.2 C
>= 5 cm	2.5	2	0.96	0.42	0	0	0	0	0	0.04	0.68	1.8		8.3 C
>= 10 cm	0.79	0.5	0.43	0.17	0	0	0	0	0	0	0.24	0.64		2.8 C
>= 25 cm	0.04	0	0	0	0	0	0	0	0	0	0	0.12		0.16 C
Days with Precipitation														
>= 0.2 mm	16.7	12.9	12	12.3	12	11.8	11.2	9.9	10.8	13.2	14.5	15.3		152.7 C
>= 5 mm	4.3	3.3	3.4	5.3	4.9	5.3	5	4.4	4.7	4.5	4.6	4		53.5 C
>= 10 mm	1.5	1.2	1.6	2.2	2.7	3.1	2.8	2.6	2.8	2.1	2.7	1.9		27.2 C
>= 25 mm	0.13	0.17	0.09	0.33	0.63	0.48	0.68	0.52	0.64	0.24	0.4	0.28		4.6 C
Days with Snow Depth														
>= 1 cm	21.3	22.7	11	1	0	0	0	0	0	0.04	2.8	15.8		74.6 C
>= 5 cm	16.2	17.7	6.8	0.43	0	0	0	0	0	0	1.1	8.4		50.6 C
>= 10 cm	11	11.3	3.9	0.17	0	0	0	0	0	0	0.58	4.7		31.6 C
>= 20 cm	4.6	3.9	1.1	0	0	0	0	0	0	0	0.04	1.8		11.4 C

Wind														
Speed (km/h)		14	13.9	13.8	13.9	12.3	11.4	10.7	10	10.6	11.6	12.9	13.4	12.4 C
Most Frequent Direction	SW	W	NW	NW	NW	NW	NW	N	N	W	W	W	NW	C
Maximum Hourly Speed (km/h)		65	65	67	56	57	50	65	56	52	56	80	54	80
Date (yyyy/dd)	1989/08	1987/08	1991/28	1995/04	2010/08	1988/05	1999/24	1992/10	1989/23	1996/30	1991/30	1991/15	1991/30	
Direction of Maximum Hourly Speed	W	N	W	NW	NW	NW	NW	NW	NW	W	SW	W	SW	
Maximum Gust Speed (km/h)		111	100	111	89	87	111	135	102	83	104	111	93	135
Date (yyyy/dd)	1992/14	1997/27	2002/09	2001/12	1990/17	1986/16	1995/15	1987/16	2000/20	1999/13	1991/30	1991/14	1995/15	
Direction of Maximum Gust	N	W	SW	S	W	NW	NW	W	NW	NW	SW	W	NW	
Days with Winds >= 52 km/h		0.8	0.9	0.9	0.6	0.4	0.4	0.2	0.3	0.2	0.4	0.9	0.6	6.7 C
Days with Winds >= 63 km/h		0.2	0.2	0.3	0.1	0	0.2	0.1	0.1	0	0.2	0.4	0.1	1.9 C
Degree Days														
Above 24 °C		0	0	0	0	0.3	4.1	11.9	6.4	0.8	0	0	0	23.5 C
Above 18 °C		0	0	0	1.3	13.2	56.2	104.4	82.5	21.8	1.1	0	0	280.5 C
Above 15 °C		0	0	0.3	4.4	33.6	119.3	191.7	161.9	60.5	5.8	0	0	577.5 C
Above 10 °C		0.1	0	2.7	22.8	112	259	346.2	315.6	175.3	38.6	3.5	0.2	1275.9 C
Above 5 °C		2	0.6	17.6	86.9	248.3	408.8	501.2	470.6	320.9	130.8	30	3.4	2220.9 C
Above 0 °C		17	11.2	68.3	209.2	402.7	558.8	656.2	625.6	470.9	275.5	111.9	27.9	3435.2 C
Below 0 °C		196.6	168.4	76.6	4.6	0	0	0	0	0	0.2	19.4	118.6	584.2 C
Below 5 °C		336.5	299	180.9	32.2	0.5	0	0	0	0	10.4	87.5	249	1196.2 C
Below 10 °C		489.6	439.7	321	118.2	19.3	0.2	0	0	4.4	73.2	211	400.8	2077.5 C
Below 15 °C		644.5	581	473.6	249.8	95.8	10.6	0.4	1.3	39.6	195.5	357.6	555.6	3205.3 C
Below 18 °C		737.5	665.7	566.3	336.7	168.5	37.4	6.2	15	90.9	283.7	447.5	648.6	4004 C
Humidex														
Extreme Humidex		16	14.4	29.2	35.7	41	44.6	50.9	47.4	43.6	37.8	24.9	20.6	
Date (yyyy/dd)	2005/13	2000/27	1998/30	1990/25	2006/29	1994/15	1995/14	2006/01	1991/16	2007/08	1990/03	1998/07		
Days with Humidex >= 30		0	0	0	0.4	3.5	10.1	17.1	14.5	5.4	0.6	0	0	51.6 C
Days with Humidex >= 35		0	0	0	0.1	0.7	4.3	7.6	5.8	1.2	0.1	0	0	19.8 C
Days with Humidex >= 40		0	0	0	0	0.1	0.7	2.2	1.3	0.1	0	0	0	4.4 C
Wind Chill														
Extreme Wind Chill		-42.6	-37.4	-35.6	-18.6	-4.4	0	0	0	-4.2	-8.8	-23.9	-36.6	
Date (yyyy/dd)	1994/16	1995/05	2003/03	1995/05	2004/04	1986/01	1986/01	1986/01	1989/27	1988/31	1987/21	1989/22		
Days with Wind Chill < -20		9.3	7.9	2.4	0	0	0	0	0	0	0	0.1	4	23.7 C
Days with Wind Chill < -30		1.8	0.5	0.2	0	0	0	0	0	0	0	0	0.3	2.8 C
Days with Wind Chill < -40		0.1	0	0	0	0	0	0	0	0	0	0	0	0.1 C
Humidity														
Average Vapour Pressure (kPa)		0-Jan	0.3	0.5	0.7	1	1.5	1.7	1.7	1.4	0.9	0.6	0.4	0.9 C
Average Relative Humidity - 0600LST (%)		79.6	77.6	77.2	76.1	77.9	79.3	82.5	87.4	89.6	87.6	85.1	82.1	81.8 C
Average Relative Humidity - 1500LST (%)		6960%	6400%	5780%	5290%	5230%	5390%	5340%	55.9	59.2	62.4	68.9	71.1	60.1 C
Pressure														
Average Station Pressure (kPa)		9920%	9930%	9930%	9910%	9910%	9910%	9910%	99.3	99.3	99.3	99.3	99.3	99.2 C
Average Sea Level Pressure (kPa)		10-Apr	10-Apr	10-Apr	10-Apr	10-Apr	10-Apr	10-Apr	101.6	101.7	101.7	101.7	101.7	101.6 C
Visibility (hours with)														
< 1 km		16.2	12	11.1	6.2	7.2	5.8	2.4	1.8	5.4	7.4	12.4	13.6	101.5 D
1 to 9 km		150.6	116.7	96.7	80.6	61.7	71.3	72.3	77.4	79.4	80.4	103.8	126.9	1117.7 D
> 9 km		577.2	550.2	636.2	633.2	675.1	642.9	669.4	664.9	635.3	656.2	603.7	603.5	7547.6 D
Cloud Amount (hours with)														
0 to 2 tenths		132.4	152.6	216	186.2	209.8	192.6	199.7	240.7	236.5	176.9	117.1	120.2	2180.6 D
3 to 7 tenths		101.6	109.8	128.2	129.5	162.3	197.6	231.5	213.8	167	150.8	124.4	101.3	1817.7 D
8 to 10 tenths		510	416.5	399.8	404.3	371.9	329.8	312.9	289.6	316.5	416.3	478.5	522.5	4768.5 D

1981 to 2010 Canadian Climate Normals station data (Frost-Free)							
	Frost-Free:	Code					
Average Date of Last Spring Frost	42860	C					
Average Date of First Fall Frost	43018	C					
Average Length of Frost-Free Period	157 Days	C					
Probability of last temperature in spring of 0 °C or lower on or after indicated dates	0.1	0.25	0.33	0.5	0.66	0.75	0.9
Date	42873	42866	42864	42860	42857	42854	42850
Probability of first temperature in fall of 0 °C or lower on or after indicated dates	0.1	0.25	0.33	0.5	0.66	0.75	0.9
Date	43003	43009	43011	43018	43023	43029	43035
Probability of frost-free period equal to or less than indicated period (Days)	0.1	0.25	0.33	0.5	0.66	0.75	0.9
Days	139	146	148	157	160	166	181

VO2 MODEL INPUT/OUTPUT

Existing Conditions - VO2 Output



Simulation 1 – 25 mm 4 Hour AES
Simulation 2 – 2 Year – 1 Hour AES
Simulation 4 – 2 Year – 12 Hour AES
Simulation 5 – 100 Year – 1 Hour AES
Simulation 7 – 100 Year – 12 Hour AES

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

       OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO
      O   O    T      T    H   H   Y Y   MM MM  O   O
      O   O    T      T    H   H    Y    M   M  O   O
       OOO     T      T    H   H    Y    M   M   OOO

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


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 2.3.3\voin.dat
  Output  filename: V:\01606\Active\160622415\Analysis\SWM\Hydrology\VO2\2017-11-
20_VO2\Vo2.out
  Summary filename: V:\01606\Active\160622415\Analysis\SWM\Hydrology\VO2\2017-11-
20_VO2\Vo2.sum


DATE: 11/23/2017                          TIME: 11:02:47 AM

USER:


COMMENTS: _____________________________________________________________

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  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************


--------------------
|     READ STORM     |    Filename: V:\01606\Active\160622415\Ana
|                    |              lysis\SWM\Hydrology\VO2\Storms\25MM4HR.STM
| Ptotal= 25.02 mm   |    Comments: Twenty five mm Four Hour Chicago Storm
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    2.17 |  1.17    6.20 |  2.17    5.62 |  3.17    2.95
                 .33    2.38 |  1.33   12.18 |  2.33    4.80 |  3.33    2.76
                 .50    2.66 |  1.50   41.67 |  2.50    4.21 |  3.50    2.62
                 .67    3.03 |  1.67   15.28 |  2.67    3.78 |  3.67    2.47
                 .83    3.58 |  1.83    9.22 |  2.83    3.45 |  3.83    2.35
                1.00    4.47 |  2.00    6.88 |  3.00    3.18 |  4.00    2.23

--------------------------------------------------------------------------------

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| CALIB              |
| STANDHYD  (0006)   |   Area     (ha)=   1.55
|ID= 1 DT= 5.0 min   |   Total Imp(%)=  40.00   Dir. Conn.(%)=  40.00
```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.62	.93
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	101.70	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	2.17	1.083	6.20	2.083	5.62	3.08	2.95
.167	2.17	1.167	6.20	2.167	5.62	3.17	2.95
.250	2.38	1.250	12.18	2.250	4.80	3.25	2.76
.333	2.38	1.333	12.18	2.333	4.80	3.33	2.76
.417	2.66	1.417	41.67	2.417	4.21	3.42	2.62
.500	2.66	1.500	41.67	2.500	4.21	3.50	2.62
.583	3.03	1.583	15.28	2.583	3.78	3.58	2.47
.667	3.03	1.667	15.28	2.667	3.78	3.67	2.47
.750	3.58	1.750	9.22	2.750	3.45	3.75	2.35
.833	3.58	1.833	9.22	2.833	3.45	3.83	2.35
.917	4.47	1.917	6.88	2.917	3.18	3.92	2.23
1.000	4.47	2.000	6.88	3.000	3.18	4.00	2.23

				TOTALS
Max.Eff.Inten.	(mm/hr)=	41.67	27.87	
over	(min)	5.00	20.00	
Storage Coeff.	(min)=	3.66 (ii)	15.43 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	20.00	
Unit Hyd. peak	(cms)=	.25	.07	
PEAK FLOW	(cms)=	.07	.05	.091 (iii)
TIME TO PEAK	(hrs)=	1.50	1.75	1.50
RUNOFF VOLUME	(mm)=	24.02	19.28	21.17
TOTAL RAINFALL	(mm)=	25.02	25.02	25.02
RUNOFF COEFFICIENT	=	.96	.77	.85

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
STANDHYD (0002)	Area	(ha)=	.16		
ID= 1 DT= 5.0 min	Total Imp	(%)=	90.00	Dir. Conn.(%)=	90.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.14	.02
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	32.70	40.00
Mannings n	=	.013	.250

				TOTALS
Max.Eff.Inten.	(mm/hr)=	41.67	104.52	
over	(min)	5.00	10.00	
Storage Coeff.	(min)=	1.85 (ii)	6.01 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	.32	.15	
PEAK FLOW	(cms)=	.02	.00	.018 (iii)
TIME TO PEAK	(hrs)=	1.50	1.58	1.50
RUNOFF VOLUME	(mm)=	24.02	19.28	23.54
TOTAL RAINFALL	(mm)=	25.02	25.02	25.02
RUNOFF COEFFICIENT	=	.96	.77	.94

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0001)	Area	(ha)=	4.42	Curve Number (CN)=	98.0
ID= 1 DT=10.0 min	Ia	(mm)=	5.00	# of Linear Res.(N)=	3.00
	U.H. Tp	(hrs)=	.20		

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	2.17	1.167	6.20	2.167	5.62	3.17	2.95
.333	2.38	1.333	12.18	2.333	4.80	3.33	2.76
.500	2.66	1.500	41.67	2.500	4.21	3.50	2.62
.667	3.03	1.667	15.28	2.667	3.78	3.67	2.47
.833	3.58	1.833	9.22	2.833	3.45	3.83	2.35
1.000	4.47	2.000	6.88	3.000	3.18	4.00	.00

Unit Hyd Qpeak	(cms)=	.844
PEAK FLOW	(cms)=	.188 (i)
TIME TO PEAK	(hrs)=	1.667
RUNOFF VOLUME	(mm)=	15.146
TOTAL RAINFALL	(mm)=	24.652
RUNOFF COEFFICIENT	=	.614

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

CALIB					
STANDHYD (0007)	Area	(ha)=	.63		
ID= 1 DT= 5.0 min	Total Imp	(%)=	75.00	Dir. Conn.(%)=	75.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.47	.16
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	64.80	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	2.17	1.083	6.20	2.083	5.62	3.08	2.95

.167	2.17	1.167	6.20	2.167	5.62	3.17	2.95
.250	2.38	1.250	12.18	2.250	4.80	3.25	2.76
.333	2.38	1.333	12.18	2.333	4.80	3.33	2.76
.417	2.66	1.417	41.67	2.417	4.21	3.42	2.62
.500	2.66	1.500	41.67	2.500	4.21	3.50	2.62
.583	3.03	1.583	15.28	2.583	3.78	3.58	2.47
.667	3.03	1.667	15.28	2.667	3.78	3.67	2.47
.750	3.58	1.750	9.22	2.750	3.45	3.75	2.35
.833	3.58	1.833	9.22	2.833	3.45	3.83	2.35
.917	4.47	1.917	6.88	2.917	3.18	3.92	2.23
1.000	4.47	2.000	6.88	3.000	3.18	4.00	2.23

Max.Eff.Inten.(mm/hr)=	41.67	27.87	
over (min)	5.00	15.00	
Storage Coeff. (min)=	2.79 (ii)	14.56 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	.28	.08	
			TOTALS
PEAK FLOW (cms)=	.05	.01	.059 (iii)
TIME TO PEAK (hrs)=	1.50	1.67	1.50
RUNOFF VOLUME (mm)=	24.02	19.28	22.82
TOTAL RAINFALL (mm)=	25.02	25.02	25.02
RUNOFF COEFFICIENT =	.96	.77	.91

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0008)	Area (ha)= .76	Curve Number (CN)= 98.0	
ID= 1 DT=10.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .20		

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	2.17	1.167	6.20	2.167	5.62	3.17	2.95
.333	2.38	1.333	12.18	2.333	4.80	3.33	2.76
.500	2.66	1.500	41.67	2.500	4.21	3.50	2.62
.667	3.03	1.667	15.28	2.667	3.78	3.67	2.47
.833	3.58	1.833	9.22	2.833	3.45	3.83	2.35
1.000	4.47	2.000	6.88	3.000	3.18	4.00	.00

Unit Hyd Qpeak (cms)=	.145
PEAK FLOW (cms)=	.032 (i)
TIME TO PEAK (hrs)=	1.667
RUNOFF VOLUME (mm)=	15.145
TOTAL RAINFALL (mm)=	24.652
RUNOFF COEFFICIENT =	.614

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

ADD HYD (0003)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0002):	.16	.018	1.50	23.54
+ ID2= 2 (0001):	4.42	.188	1.67	15.15
ID = 3 (0003):	4.58	.195	1.67	15.44

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0010)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0006):	1.55	.091	1.50	21.17
+ ID2= 2 (0003):	4.58	.195	1.67	15.44
ID = 3 (0010):	6.13	.266	1.67	16.89

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0011)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0010):	6.13	.266	1.67	16.89
+ ID2= 2 (0007):	.63	.059	1.50	22.82
ID = 3 (0011):	6.76	.324	1.50	17.44

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0012)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0011):	6.76	.324	1.50	17.44
+ ID2= 2 (0008):	.76	.032	1.67	15.15
ID = 3 (0012):	7.52	.350	1.50	17.21

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

****
** SIMULATION NUMBER: 2 **
****

READ STORM	Filename: V:\01606\Active\160622415\Analysis\SWM\Hydrology\VO2\Storms\2Y1.STM
Ptotal= 23.80 mm	Comments: 2yr/1hr

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.00	.42	42.84	.75	22.85	1.08	2.86
.17	2.86	.50	79.97	.83	14.28		
.25	8.57	.58	42.84	.92	8.57		

.33	22.85	.67	34.27	1.00	2.86

CALIB					
STANDHYD (0006)	Area (ha)=	1.55			
ID= 1 DT= 5.0 min	Total Imp(%)=	40.00	Dir. Conn.(%)=	40.00	

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	.62	.93	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	101.70	40.00	
Mannings n	=	.013	.250	
Max.Eff.Inten.	(mm/hr)=	79.97	53.38	
over	(min)	5.00	15.00	
Storage Coeff.	(min)=	2.82 (ii)	11.89 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	15.00	
Unit Hyd. peak	(cms)=	.28	.09	
				TOTALS
PEAK FLOW	(cms)=	.13	.08	.154 (iii)
TIME TO PEAK	(hrs)=	.50	.75	.50
RUNOFF VOLUME	(mm)=	22.80	18.10	19.97
TOTAL RAINFALL	(mm)=	23.80	23.80	23.80
RUNOFF COEFFICIENT	=	.96	.76	.84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
STANDHYD (0002)	Area (ha)=	.16			
ID= 1 DT= 5.0 min	Total Imp(%)=	90.00	Dir. Conn.(%)=	90.00	

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	.14	.02	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	32.70	40.00	
Mannings n	=	.013	.250	
Max.Eff.Inten.	(mm/hr)=	79.97	160.15	
over	(min)	5.00	5.00	
Storage Coeff.	(min)=	1.43 (ii)	4.63 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	5.00	
Unit Hyd. peak	(cms)=	.33	.22	
				TOTALS
PEAK FLOW	(cms)=	.03	.00	.034 (iii)
TIME TO PEAK	(hrs)=	.50	.50	.50
RUNOFF VOLUME	(mm)=	22.80	18.10	22.31
TOTAL RAINFALL	(mm)=	23.80	23.80	23.80
RUNOFF COEFFICIENT	=	.96	.76	.94

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0001)	Area (ha)=	4.42	Curve Number (CN)=	98.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.20			

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	1.43	.500	61.41	.833	18.56	1.17	1.43
.333	15.71	.667	38.55	1.000	5.71		

Unit Hyd Qpeak	(cms)=	.844
PEAK FLOW	(cms)=	.306 (i)
TIME TO PEAK	(hrs)=	.667
RUNOFF VOLUME	(mm)=	14.355
TOTAL RAINFALL	(mm)=	23.802
RUNOFF COEFFICIENT	=	.603

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

CALIB					
STANDHYD (0007)	Area (ha)=	.63			
ID= 1 DT= 5.0 min	Total Imp(%)=	75.00	Dir. Conn.(%)=	75.00	

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	.47	.16	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	64.80	40.00	
Mannings n	=	.013	.250	
Max.Eff.Inten.	(mm/hr)=	79.97	53.38	
over	(min)	5.00	10.00	
Storage Coeff.	(min)=	2.15 (ii)	7.13 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	.31	.14	
				TOTALS
PEAK FLOW	(cms)=	.10	.02	.111 (iii)
TIME TO PEAK	(hrs)=	.50	.58	.50
RUNOFF VOLUME	(mm)=	22.80	18.10	21.62
TOTAL RAINFALL	(mm)=	23.80	23.80	23.80
RUNOFF COEFFICIENT	=	.96	.76	.91

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	.417	42.84	.750	22.85	1.08	2.86
.167	2.86	.500	79.97	.833	14.28		
.250	8.57	.583	42.84	.917	8.57		
.333	22.85	.667	34.27	1.000	2.86		

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB	
NASHYD (0008)	Area (ha)= .76 Curve Number (CN)= 98.0
ID= 1 DT=10.0 min	Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .20

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	1.43	.500	61.41	.833	18.56	1.17	1.43
.333	15.71	.667	38.55	1.000	5.71		

Unit Hyd Qpeak (cms)= .145

PEAK FLOW (cms)= .053 (i)
TIME TO PEAK (hrs)= .667
RUNOFF VOLUME (mm)= 14.354
TOTAL RAINFALL (mm)= 23.802
RUNOFF COEFFICIENT = .603

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

ADD HYD (0003)					
1 + 2 = 3		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	ID1= 1 (0002):	.16	.034	.50	22.31
	+ ID2= 2 (0001):	4.42	.306	.67	14.36
	ID = 3 (0003):	4.58	.321	.67	14.63

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0010)					
1 + 2 = 3		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	ID1= 1 (0006):	1.55	.154	.50	19.97
	+ ID2= 2 (0003):	4.58	.321	.67	14.63
	ID = 3 (0010):	6.13	.465	.67	15.98

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0011)					
1 + 2 = 3		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	ID1= 1 (0010):	6.13	.465	.67	15.98
	+ ID2= 2 (0007):	.63	.111	.50	21.62
	ID = 3 (0011):	6.76	.528	.67	16.51

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0012)					
1 + 2 = 3		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	ID1= 1 (0011):	6.76	.528	.67	16.51
	+ ID2= 2 (0008):	.76	.053	.67	14.35
	ID = 3 (0012):	7.52	.581	.67	16.29

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

****
** SIMULATION NUMBER: 4 **
****

READ STORM	Filename: V:\01606\Active\160622415\Analysis\SWM\Hydrology\VO2\Storms\2Y12.STM
Ptotal= 41.10 mm	Comments: 2yr/12hr

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.00	3.50	6.99	6.75	2.88	10.00	.41
.50	.41	3.75	6.99	7.00	2.88	10.25	.41
.75	.41	4.00	6.99	7.25	2.88	10.50	.41
1.00	.41	4.25	6.99	7.50	1.64	10.75	.41
1.25	.41	4.50	18.91	7.75	1.64	11.00	.41
1.50	.41	4.75	18.91	8.00	1.64	11.25	.41
1.75	.41	5.00	18.91	8.25	1.64	11.50	.41
2.00	.41	5.25	18.91	8.50	.82	11.75	.41
2.25	.41	5.50	5.34	8.75	.82	12.00	.41
2.50	2.47	5.75	5.34	9.00	.82	12.25	.41
2.75	2.47	6.00	5.34	9.25	.82		
3.00	2.47	6.25	5.34	9.50	.41		
3.25	2.47	6.50	2.88	9.75	.41		

CALIB		
STANDHYD (0006)	Area (ha)= 1.55	
ID= 1 DT= 5.0 min	Total Imp(%)= 40.00	Dir. Conn.(%)= 40.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.62	.93
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	101.70	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	3.167	2.47	6.250	5.34	9.33	.41
.167	.00	3.250	2.47	6.333	2.88	9.42	.41
.250	.00	3.333	6.99	6.417	2.88	9.50	.41
.333	.41	3.417	6.99	6.500	2.88	9.58	.41
.417	.41	3.500	6.99	6.583	2.88	9.67	.41
.500	.41	3.583	6.99	6.667	2.88	9.75	.41
.583	.41	3.667	6.99	6.750	2.88	9.83	.41
.667	.41	3.750	6.99	6.833	2.88	9.92	.41
.750	.41	3.833	6.99	6.917	2.88	10.00	.41
.833	.41	3.917	6.99	7.000	2.88	10.08	.41
.917	.41	4.000	6.99	7.083	2.88	10.17	.41
1.000	.41	4.083	6.99	7.167	2.88	10.25	.41
1.083	.41	4.167	6.99	7.250	2.88	10.33	.41
1.167	.41	4.250	6.99	7.333	1.64	10.42	.41
1.250	.41	4.333	18.91	7.417	1.64	10.50	.41
1.333	.41	4.417	18.91	7.500	1.64	10.58	.41
1.417	.41	4.500	18.91	7.583	1.64	10.67	.41
1.500	.41	4.583	18.91	7.667	1.64	10.75	.41
1.583	.41	4.667	18.91	7.750	1.64	10.83	.41
1.667	.41	4.750	18.91	7.833	1.64	10.92	.41
1.750	.41	4.833	18.91	7.917	1.64	11.00	.41
1.833	.41	4.917	18.91	8.000	1.64	11.08	.41
1.917	.41	5.000	18.91	8.083	1.64	11.17	.41
2.000	.41	5.083	18.91	8.167	1.64	11.25	.41
2.083	.41	5.167	18.91	8.250	1.64	11.33	.41
2.167	.41	5.250	18.91	8.333	.82	11.42	.41
2.250	.41	5.333	5.34	8.417	.82	11.50	.41
2.333	2.47	5.417	5.34	8.500	.82	11.58	.41
2.417	2.47	5.500	5.34	8.583	.82	11.67	.41
2.500	2.47	5.583	5.34	8.667	.82	11.75	.41
2.583	2.47	5.667	5.34	8.750	.82	11.83	.41
2.667	2.47	5.750	5.34	8.833	.82	11.92	.41
2.750	2.47	5.833	5.34	8.917	.82	12.00	.41
2.833	2.47	5.917	5.34	9.000	.82	12.08	.41
2.917	2.47	6.000	5.34	9.083	.82	12.17	.41
3.000	2.47	6.083	5.34	9.167	.82	12.25	.41
3.083	2.47	6.167	5.34	9.250	.82		

Max.Eff.Inten.(mm/hr)=	18.91	18.36	
over (min)	5.00	20.00	
Storage Coeff. (min)=	5.02 (ii)	18.93 (ii)	
Unit Hyd. Tpeak (min)=	5.00	20.00	
Unit Hyd. peak (cms)=	.21	.06	
			TOTALS
PEAK FLOW (cms)=	.03	.04	.077 (iii)
TIME TO PEAK (hrs)=	5.25	5.25	5.25
RUNOFF VOLUME (mm)=	40.10	35.02	37.04
TOTAL RAINFALL (mm)=	41.10	41.10	41.10
RUNOFF COEFFICIENT =	.98	.85	.90

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB	
STANDHYD (0002)	Area (ha)= .16
ID= 1 DT= 5.0 min	Total Imp(%)= 90.00 Dir. Conn.(%)= 90.00

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	.14	.02	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	32.70	40.00	
Mannings n	=	.013	.250	
Max.Eff.Inten.(mm/hr)=		18.91	18.36	
over (min)		5.00	20.00	
Storage Coeff. (min)=		2.54 (ii)	16.45 (ii)	
Unit Hyd. Tpeak (min)=		5.00	20.00	
Unit Hyd. peak (cms)=		.29	.06	
				TOTALS
PEAK FLOW (cms)=		.01	.00	.008 (iii)
TIME TO PEAK (hrs)=		4.75	5.25	5.25
RUNOFF VOLUME (mm)=		40.10	35.02	39.57
TOTAL RAINFALL (mm)=		41.10	41.10	41.10
RUNOFF COEFFICIENT =		.98	.85	.96

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB	
NASHYD (0001)	Area (ha)= 4.42 Curve Number (CN)= 98.0
ID= 1 DT=10.0 min	Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .20

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.00	3.333	4.73	6.500	2.88	9.67	.41
.333	.21	3.500	6.99	6.667	2.88	9.83	.41
.500	.41	3.667	6.99	6.833	2.88	10.00	.41
.667	.41	3.833	6.99	7.000	2.88	10.17	.41
.833	.41	4.000	6.99	7.167	2.88	10.33	.41
1.000	.41	4.167	6.99	7.333	2.26	10.50	.41
1.167	.41	4.333	12.95	7.500	1.64	10.67	.41
1.333	.41	4.500	18.91	7.667	1.64	10.83	.41
1.500	.41	4.667	18.91	7.833	1.64	11.00	.41
1.667	.41	4.833	18.91	8.000	1.64	11.17	.41
1.833	.41	5.000	18.91	8.167	1.64	11.33	.41
2.000	.41	5.167	18.91	8.333	1.23	11.50	.41
2.167	.41	5.333	12.13	8.500	.82	11.67	.41
2.333	1.44	5.500	5.34	8.667	.82	11.83	.41
2.500	2.47	5.667	5.34	8.833	.82	12.00	.41
2.667	2.47	5.833	5.34	9.000	.82	12.17	.41
2.833	2.47	6.000	5.34	9.167	.82	12.33	.20
3.000	2.47	6.167	5.34	9.333	.62		
3.167	2.47	6.333	4.11	9.500	.41		

Unit Hyd Qpeak (cms)=	.844	
PEAK FLOW (cms)=	.214 (i)	

TIME TO PEAK (hrs)= 5.167
RUNOFF VOLUME (mm)= 30.747
TOTAL RAINFALL (mm)= 41.100
RUNOFF COEFFICIENT = .748

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

CALIB			
STANDHYD (0007)	Area (ha)= .63		
ID= 1 DT= 5.0 min	Total Imp(%)= 75.00	Dir. Conn.(%)= 75.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.47	.16
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	64.80	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	3.167	2.47	6.250	5.34	9.33	.41
.167	.00	3.250	2.47	6.333	2.88	9.42	.41
.250	.00	3.333	6.99	6.417	2.88	9.50	.41
.333	.41	3.417	6.99	6.500	2.88	9.58	.41
.417	.41	3.500	6.99	6.583	2.88	9.67	.41
.500	.41	3.583	6.99	6.667	2.88	9.75	.41
.583	.41	3.667	6.99	6.750	2.88	9.83	.41
.667	.41	3.750	6.99	6.833	2.88	9.92	.41
.750	.41	3.833	6.99	6.917	2.88	10.00	.41
.833	.41	3.917	6.99	7.000	2.88	10.08	.41
.917	.41	4.000	6.99	7.083	2.88	10.17	.41
1.000	.41	4.083	6.99	7.167	2.88	10.25	.41
1.083	.41	4.167	6.99	7.250	2.88	10.33	.41
1.167	.41	4.250	6.99	7.333	1.64	10.42	.41
1.250	.41	4.333	18.91	7.417	1.64	10.50	.41
1.333	.41	4.417	18.91	7.500	1.64	10.58	.41
1.417	.41	4.500	18.91	7.583	1.64	10.67	.41
1.500	.41	4.583	18.91	7.667	1.64	10.75	.41
1.583	.41	4.667	18.91	7.750	1.64	10.83	.41
1.667	.41	4.750	18.91	7.833	1.64	10.92	.41
1.750	.41	4.833	18.91	7.917	1.64	11.00	.41
1.833	.41	4.917	18.91	8.000	1.64	11.08	.41
1.917	.41	5.000	18.91	8.083	1.64	11.17	.41
2.000	.41	5.083	18.91	8.167	1.64	11.25	.41
2.083	.41	5.167	18.91	8.250	1.64	11.33	.41
2.167	.41	5.250	18.91	8.333	.82	11.42	.41
2.250	.41	5.333	5.34	8.417	.82	11.50	.41
2.333	2.47	5.417	5.34	8.500	.82	11.58	.41
2.417	2.47	5.500	5.34	8.583	.82	11.67	.41
2.500	2.47	5.583	5.34	8.667	.82	11.75	.41
2.583	2.47	5.667	5.34	8.750	.82	11.83	.41
2.667	2.47	5.750	5.34	8.833	.82	11.92	.41
2.750	2.47	5.833	5.34	8.917	.82	12.00	.41
2.833	2.47	5.917	5.34	9.000	.82	12.08	.41
2.917	2.47	6.000	5.34	9.083	.82	12.17	.41
3.000	2.47	6.083	5.34	9.167	.82	12.25	.41
3.083	2.47	6.167	5.34	9.250	.82		

Max.Eff.Inten.(mm/hr)=	18.91	18.36	
over (min)	5.00	20.00	
Storage Coeff. (min)=	3.83 (ii)	17.74 (ii)	
Unit Hyd. Tpeak (min)=	5.00	20.00	
Unit Hyd. peak (cms)=	.25	.06	
			TOTALS
PEAK FLOW (cms)=	.02	.01	.032 (iii)
TIME TO PEAK (hrs)=	5.08	5.25	5.25
RUNOFF VOLUME (mm)=	40.10	35.02	38.81
TOTAL RAINFALL (mm)=	41.10	41.10	41.10
RUNOFF COEFFICIENT =	.98	.85	.94

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0008)	Area (ha)= .76	Curve Number (CN)= 98.0	
ID= 1 DT=10.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .20		

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.00	3.333	4.73	6.500	2.88	9.67	.41
.333	.21	3.500	6.99	6.667	2.88	9.83	.41
.500	.41	3.667	6.99	6.833	2.88	10.00	.41
.667	.41	3.833	6.99	7.000	2.88	10.17	.41
.833	.41	4.000	6.99	7.167	2.88	10.33	.41
1.000	.41	4.167	6.99	7.333	2.26	10.50	.41
1.167	.41	4.333	12.95	7.500	1.64	10.67	.41
1.333	.41	4.500	18.91	7.667	1.64	10.83	.41
1.500	.41	4.667	18.91	7.833	1.64	11.00	.41
1.667	.41	4.833	18.91	8.000	1.64	11.17	.41
1.833	.41	5.000	18.91	8.167	1.64	11.33	.41
2.000	.41	5.167	18.91	8.333	1.23	11.50	.41
2.167	.41	5.333	12.13	8.500	.82	11.67	.41
2.333	1.44	5.500	5.34	8.667	.82	11.83	.41
2.500	2.47	5.667	5.34	8.833	.82	12.00	.41
2.667	2.47	5.833	5.34	9.000	.82	12.17	.41
2.833	2.47	6.000	5.34	9.167	.82	12.33	.20
3.000	2.47	6.167	5.34	9.333	.62		
3.167	2.47	6.333	4.11	9.500	.41		

Unit Hyd Qpeak (cms)= .145

PEAK FLOW (cms)= .037 (i)
TIME TO PEAK (hrs)= 5.167
RUNOFF VOLUME (mm)= 30.747
TOTAL RAINFALL (mm)= 41.100
RUNOFF COEFFICIENT = .748

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

ADD HYD (0003)					
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0002):	.16	.008	5.25	39.57
+ ID2= 2 (0001):	4.42	.214	5.17	30.75
ID = 3 (0003):	4.58	.222	5.17	31.05

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0010)					
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0006):	1.55	.077	5.25	37.04
+ ID2= 2 (0003):	4.58	.222	5.17	31.05
ID = 3 (0010):	6.13	.298	5.17	32.57

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0011)					
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0010):	6.13	.298	5.17	32.57
+ ID2= 2 (0007):	.63	.032	5.25	38.81
ID = 3 (0011):	6.76	.330	5.17	33.15

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0012)					
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0011):	6.76	.330	5.17	33.15
+ ID2= 2 (0008):	.76	.037	5.17	30.75
ID = 3 (0012):	7.52	.367	5.17	32.91

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

****
**** SIMULATION NUMBER: 5 ****
****

READ STORM	Filename: V:\01606\Active\160622415\Analysis\SWM\Hydrology\VO2\Storms\100Y1.STM
Ptotal= 56.80 mm	Comments: 100yr/1hr

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.00	.42	102.24	.75	54.53	1.08	6.82
.17	6.82	.50	190.85	.83	34.08		
.25	20.45	.58	102.24	.92	20.45		
.33	54.53	.67	81.79	1.00	6.82		

CALIB STANDHYD (0006)	Area (ha)= 1.55
ID= 1 DT= 5.0 min	Total Imp(%)= 40.00 Dir. Conn.(%)= 40.00

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	.62	.93	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	101.70	40.00	
Mannings n	=	.013	.250	
Max.Eff.Inten.	(mm/hr)=	190.85	141.78	
over	(min)	5.00	10.00	
Storage Coeff.	(min)=	1.99 (ii)	8.13 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	.31	.13	
				TOTALS
PEAK FLOW	(cms)=	.32	.28	.506 (iii)
TIME TO PEAK	(hrs)=	.50	.58	.50
RUNOFF VOLUME	(mm)=	55.80	50.56	52.66
TOTAL RAINFALL	(mm)=	56.80	56.80	56.80
RUNOFF COEFFICIENT	=	.98	.89	.93

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB STANDHYD (0002)	Area (ha)= .16
ID= 1 DT= 5.0 min	Total Imp(%)= 90.00 Dir. Conn.(%)= 90.00

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	.14	.02	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	32.70	40.00	
Mannings n	=	.013	.250	
Max.Eff.Inten.	(mm/hr)=	190.85	425.34	
over	(min)	5.00	5.00	
Storage Coeff.	(min)=	1.01 (ii)	3.27 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	5.00	
Unit Hyd. peak	(cms)=	.34	.27	
				TOTALS
PEAK FLOW	(cms)=	.08	.01	.083 (iii)
TIME TO PEAK	(hrs)=	.50	.50	.50
RUNOFF VOLUME	(mm)=	55.80	50.56	55.26
TOTAL RAINFALL	(mm)=	56.80	56.80	56.80
RUNOFF COEFFICIENT	=	.98	.89	.97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)

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

CALIB					
NASHYD (0001)	Area (ha)=	4.42	Curve Number (CN)=	98.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.20			

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	3.41	.500	146.55	.833	44.30	1.17	3.41
.333	37.49	.667	92.02	1.000	13.63		

Unit Hyd Qpeak (cms)= .844

PEAK FLOW (cms)= 1.012 (i)
TIME TO PEAK (hrs)= .667
RUNOFF VOLUME (mm)= 45.866
TOTAL RAINFALL (mm)= 56.802
RUNOFF COEFFICIENT = .807

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

CALIB					
STANDHYD (0007)	Area (ha)=	.63			
ID= 1 DT= 5.0 min	Total Imp(%)=	75.00	Dir. Conn.(%)=	75.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.47	.16
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	64.80	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	.417	102.24	.750	54.53	1.08	6.82
.167	6.82	.500	190.85	.833	34.08		
.250	20.45	.583	102.24	.917	20.45		
.333	54.53	.667	81.79	1.000	6.82		

Max.Eff.Inten.(mm/hr)=	190.85	141.78		
over (min)	5.00	10.00		
Storage Coeff. (min)=	1.52 (ii)	5.03 (ii)		
Unit Hyd. Tpeak (min)=	5.00	10.00		
Unit Hyd. peak (cms)=	.33	.16		
			TOTALS	
PEAK FLOW (cms)=	.25	.06	.286 (iii)	
TIME TO PEAK (hrs)=	.50	.58	.50	
RUNOFF VOLUME (mm)=	55.80	50.56	54.49	
TOTAL RAINFALL (mm)=	56.80	56.80	56.80	
RUNOFF COEFFICIENT =	.98	.89	.96	

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0008)	Area (ha)=	.76	Curve Number (CN)=	98.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.20			

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	3.41	.500	146.55	.833	44.30	1.17	3.41
.333	37.49	.667	92.02	1.000	13.63		

Unit Hyd Qpeak (cms)= .145

PEAK FLOW (cms)= .174 (i)
TIME TO PEAK (hrs)= .667
RUNOFF VOLUME (mm)= 45.865
TOTAL RAINFALL (mm)= 56.802
RUNOFF COEFFICIENT = .807

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

ADD HYD (0003)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0002):	.16	.083	.50	55.26
	+ ID2= 2 (0001):	4.42	1.012	.67	45.87
	ID = 3 (0003):	4.58	1.048	.67	46.19

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0010)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0006):	1.55	.506	.50	52.66
	+ ID2= 2 (0003):	4.58	1.048	.67	46.19
	ID = 3 (0010):	6.13	1.454	.67	47.83

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0011)

1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0010):	6.13	1.454	.67	47.83
+ ID2= 2 (0007):	.63	.286	.50	54.49
ID = 3 (0011):	6.76	1.609	.67	48.45

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0012)

1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0011):	6.76	1.609	.67	48.45
+ ID2= 2 (0008):	.76	.174	.67	45.87
ID = 3 (0012):	7.52	1.783	.67	48.19

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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

READ STORM | Ptotal= 86.48 mm

Filename: V:\01606\Active\160622415\Analysis\SWM\Hydrology\VO2\Storms\100Y12.STM

Comments: 100yr/12hr

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.00	3.50	14.71	6.75	6.06	10.00	.86
.50	.86	3.75	14.71	7.00	6.06	10.25	.86
.75	.86	4.00	14.71	7.25	6.06	10.50	.86
1.00	.86	4.25	14.71	7.50	3.46	10.75	.86
1.25	.86	4.50	39.79	7.75	3.46	11.00	.86
1.50	.86	4.75	39.79	8.00	3.46	11.25	.86
1.75	.86	5.00	39.79	8.25	3.46	11.50	.86
2.00	.86	5.25	39.79	8.50	1.73	11.75	.86
2.25	.86	5.50	11.24	8.75	1.73	12.00	.86
2.50	5.19	5.75	11.24	9.00	1.73	12.25	.86
2.75	5.19	6.00	11.24	9.25	1.73		
3.00	5.19	6.25	11.24	9.50	.86		
3.25	5.19	6.50	6.06	9.75	.86		

CALIB | STANDHYD (0006) | ID= 1 DT= 5.0 min

Area (ha)= 1.55
Total Imp(%)= 40.00 Dir. Conn.(%)= 40.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.62	.93
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	101.70	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	3.167	5.19	6.250	11.24	9.33	.86
.167	.00	3.250	5.19	6.333	6.06	9.42	.86
.250	.00	3.333	14.71	6.417	6.06	9.50	.86
.333	.86	3.417	14.71	6.500	6.06	9.58	.86
.417	.86	3.500	14.71	6.583	6.06	9.67	.86
.500	.86	3.583	14.71	6.667	6.06	9.75	.86
.583	.86	3.667	14.71	6.750	6.06	9.83	.86
.667	.86	3.750	14.71	6.833	6.06	9.92	.86
.750	.86	3.833	14.71	6.917	6.06	10.00	.86
.833	.86	3.917	14.71	7.000	6.06	10.08	.86
.917	.86	4.000	14.71	7.083	6.06	10.17	.86
1.000	.86	4.083	14.71	7.167	6.06	10.25	.86
1.083	.86	4.167	14.71	7.250	6.06	10.33	.86
1.167	.86	4.250	14.71	7.333	3.46	10.42	.86
1.250	.86	4.333	39.79	7.417	3.46	10.50	.86
1.333	.86	4.417	39.79	7.500	3.46	10.58	.86
1.417	.86	4.500	39.79	7.583	3.46	10.67	.86
1.500	.86	4.583	39.79	7.667	3.46	10.75	.86
1.583	.86	4.667	39.79	7.750	3.46	10.83	.86
1.667	.86	4.750	39.79	7.833	3.46	10.92	.86
1.750	.86	4.833	39.79	7.917	3.46	11.00	.86
1.833	.86	4.917	39.79	8.000	3.46	11.08	.86
1.917	.86	5.000	39.79	8.083	3.46	11.17	.86
2.000	.86	5.083	39.79	8.167	3.46	11.25	.86
2.083	.86	5.167	39.79	8.250	3.46	11.33	.86
2.167	.86	5.250	39.79	8.333	1.73	11.42	.86
2.250	.86	5.333	11.24	8.417	1.73	11.50	.86
2.333	5.19	5.417	11.24	8.500	1.73	11.58	.86
2.417	5.19	5.500	11.24	8.583	1.73	11.67	.86
2.500	5.19	5.583	11.24	8.667	1.73	11.75	.86
2.583	5.19	5.667	11.24	8.750	1.73	11.83	.86
2.667	5.19	5.750	11.24	8.833	1.73	11.92	.86
2.750	5.19	5.833	11.24	8.917	1.73	12.00	.86
2.833	5.19	5.917	11.24	9.000	1.73	12.08	.86
2.917	5.19	6.000	11.24	9.083	1.73	12.17	.86
3.000	5.19	6.083	11.24	9.167	1.73	12.25	.86
3.083	5.19	6.167	11.24	9.250	1.73		

				TOTALS
Max.Eff.Inten.	(mm/hr)=	39.79	39.49	
over	(min)	5.00	15.00	
Storage Coeff.	(min)=	3.73 (ii)	13.97 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	15.00	
Unit Hyd. peak	(cms)=	.25	.08	
PEAK FLOW	(cms)=	.07	.10	.169 (iii)
TIME TO PEAK	(hrs)=	5.08	5.25	5.25
RUNOFF VOLUME	(mm)=	85.48	80.09	82.24
TOTAL RAINFALL	(mm)=	86.48	86.48	86.48
RUNOFF COEFFICIENT	=	.99	.93	.95

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)

(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.

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

CALIB

| STANDHYD (0002) | Area (ha)= .16
|ID= 1 DT= 5.0 min | Total Imp(%)= 90.00 Dir. Conn.(%)= 90.00

	IMPERVIOUS	PERVIOUS (i)	
Surface Area (ha)=	.14	.02	
Dep. Storage (mm)=	1.00	1.50	
Average Slope (%)=	1.00	2.00	
Length (m)=	32.70	40.00	
Mannings n =	.013	.250	
Max.Eff.Inten.(mm/hr)=	39.79	118.53	
over (min)	5.00	10.00	
Storage Coeff. (min)=	1.89 (ii)	6.13 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	.32	.15	
			TOTALS
PEAK FLOW (cms)=	.02	.00	.018 (iii)
TIME TO PEAK (hrs)=	4.67	5.25	5.25
RUNOFF VOLUME (mm)=	85.48	80.09	84.93
TOTAL RAINFALL (mm)=	86.48	86.48	86.48
RUNOFF COEFFICIENT =	.99	.93	.98

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB
NASHYD (0001)	Area (ha)= 4.42 Curve Number (CN)= 98.0
ID= 1 DT=10.0 min	Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .20

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.00	3.333	9.95	6.500	6.06	9.67	.86
.333	.43	3.500	14.71	6.667	6.06	9.83	.86
.500	.86	3.667	14.71	6.833	6.06	10.00	.86
.667	.86	3.833	14.71	7.000	6.06	10.17	.86
.833	.86	4.000	14.71	7.167	6.06	10.33	.86
1.000	.86	4.167	14.71	7.333	4.76	10.50	.86
1.167	.86	4.333	27.25	7.500	3.46	10.67	.86
1.333	.86	4.500	39.79	7.667	3.46	10.83	.86
1.500	.86	4.667	39.79	7.833	3.46	11.00	.86
1.667	.86	4.833	39.79	8.000	3.46	11.17	.86
1.833	.86	5.000	39.79	8.167	3.46	11.33	.86
2.000	.86	5.167	39.79	8.333	2.60	11.50	.86
2.167	.86	5.333	25.52	8.500	1.73	11.67	.86
2.333	3.02	5.500	11.24	8.667	1.73	11.83	.86
2.500	5.19	5.667	11.24	8.833	1.73	12.00	.86
2.667	5.19	5.833	11.24	9.000	1.73	12.17	.86
2.833	5.19	6.000	11.24	9.167	1.73	12.33	.43
3.000	5.19	6.167	11.24	9.333	1.30		
3.167	5.19	6.333	8.65	9.500	.86		

Unit Hyd Qpeak (cms)= .844

PEAK FLOW (cms)= .469 (i)
TIME TO PEAK (hrs)= 5.167
RUNOFF VOLUME (mm)= 74.616
TOTAL RAINFALL (mm)= 86.480
RUNOFF COEFFICIENT = .863

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

CALIB
STANDHYD (0007)	Area (ha)= .63
ID= 1 DT= 5.0 min	Total Imp(%)= 75.00 Dir. Conn.(%)= 75.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	.47	.16
Dep. Storage (mm)=	1.00	1.50
Average Slope (%)=	1.00	2.00
Length (m)=	64.80	40.00
Mannings n =	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	3.167	5.19	6.250	11.24	9.33	.86
.167	.00	3.250	5.19	6.333	6.06	9.42	.86
.250	.00	3.333	14.71	6.417	6.06	9.50	.86
.333	.86	3.417	14.71	6.500	6.06	9.58	.86
.417	.86	3.500	14.71	6.583	6.06	9.67	.86
.500	.86	3.583	14.71	6.667	6.06	9.75	.86
.583	.86	3.667	14.71	6.750	6.06	9.83	.86
.667	.86	3.750	14.71	6.833	6.06	9.92	.86
.750	.86	3.833	14.71	6.917	6.06	10.00	.86
.833	.86	3.917	14.71	7.000	6.06	10.08	.86
.917	.86	4.000	14.71	7.083	6.06	10.17	.86
1.000	.86	4.083	14.71	7.167	6.06	10.25	.86
1.083	.86	4.167	14.71	7.250	6.06	10.33	.86
1.167	.86	4.250	14.71	7.333	3.46	10.42	.86
1.250	.86	4.333	39.79	7.417	3.46	10.50	.86
1.333	.86	4.417	39.79	7.500	3.46	10.58	.86
1.417	.86	4.500	39.79	7.583	3.46	10.67	.86
1.500	.86	4.583	39.79	7.667	3.46	10.75	.86
1.583	.86	4.667	39.79	7.750	3.46	10.83	.86
1.667	.86	4.750	39.79	7.833	3.46	10.92	.86
1.750	.86	4.833	39.79	7.917	3.46	11.00	.86
1.833	.86	4.917	39.79	8.000	3.46	11.08	.86
1.917	.86	5.000	39.79	8.083	3.46	11.17	.86
2.000	.86	5.083	39.79	8.167	3.46	11.25	.86
2.083	.86	5.167	39.79	8.250	3.46	11.33	.86
2.167	.86	5.250	39.79	8.333	1.73	11.42	.86
2.250	.86	5.333	11.24	8.417	1.73	11.50	.86
2.333	5.19	5.417	11.24	8.500	1.73	11.58	.86
2.417	5.19	5.500	11.24	8.583	1.73	11.67	.86
2.500	5.19	5.583	11.24	8.667	1.73	11.75	.86
2.583	5.19	5.667	11.24	8.750	1.73	11.83	.86
2.667	5.19	5.750	11.24	8.833	1.73	11.92	.86
2.750	5.19	5.833	11.24	8.917	1.73	12.00	.86
2.833	5.19	5.917	11.24	9.000	1.73	12.08	.86
2.917	5.19	6.000	11.24	9.083	1.73	12.17	.86
3.000	5.19	6.083	11.24	9.167	1.73	12.25	.86
3.083	5.19	6.167	11.24	9.250	1.73		

Max.Eff.Inten.(mm/hr)=	39.79	39.49	
over (min)	5.00	15.00	
Storage Coeff. (min)=	2.85 (ii)	13.08 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	.28	.08	
			TOTALS
PEAK FLOW (cms)=	.05	.02	.069 (iii)
TIME TO PEAK (hrs)=	4.92	5.25	5.25
RUNOFF VOLUME (mm)=	85.48	80.09	84.12
TOTAL RAINFALL (mm)=	86.48	86.48	86.48
RUNOFF COEFFICIENT =	.99	.93	.97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0008)	Area (ha)= .76	Curve Number (CN)= 98.0	
ID= 1 DT=10.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .20		

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.00	3.333	9.95	6.500	6.06	9.67	.86
.333	.43	3.500	14.71	6.667	6.06	9.83	.86
.500	.86	3.667	14.71	6.833	6.06	10.00	.86
.667	.86	3.833	14.71	7.000	6.06	10.17	.86
.833	.86	4.000	14.71	7.167	6.06	10.33	.86
1.000	.86	4.167	14.71	7.333	4.76	10.50	.86
1.167	.86	4.333	27.25	7.500	3.46	10.67	.86
1.333	.86	4.500	39.79	7.667	3.46	10.83	.86
1.500	.86	4.667	39.79	7.833	3.46	11.00	.86
1.667	.86	4.833	39.79	8.000	3.46	11.17	.86
1.833	.86	5.000	39.79	8.167	3.46	11.33	.86
2.000	.86	5.167	39.79	8.333	2.60	11.50	.86
2.167	.86	5.333	25.52	8.500	1.73	11.67	.86
2.333	3.02	5.500	11.24	8.667	1.73	11.83	.86
2.500	5.19	5.667	11.24	8.833	1.73	12.00	.86
2.667	5.19	5.833	11.24	9.000	1.73	12.17	.86
2.833	5.19	6.000	11.24	9.167	1.73	12.33	.43
3.000	5.19	6.167	11.24	9.333	1.30		
3.167	5.19	6.333	8.65	9.500	.86		

Unit Hyd Qpeak (cms)=	.145
PEAK FLOW (cms)=	.081 (i)
TIME TO PEAK (hrs)=	5.167
RUNOFF VOLUME (mm)=	74.615
TOTAL RAINFALL (mm)=	86.480
RUNOFF COEFFICIENT =	.863

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

ADD HYD (0003)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0002):	.16	.018	5.25	84.93
+ ID2= 2 (0001):	4.42	.469	5.17	74.62
ID = 3 (0003):	4.58	.487	5.17	74.97

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0010)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0006):	1.55	.169	5.25	82.24
+ ID2= 2 (0003):	4.58	.487	5.17	74.97
ID = 3 (0010):	6.13	.655	5.17	76.81

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0011)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0010):	6.13	.655	5.17	76.81
+ ID2= 2 (0007):	.63	.069	5.25	84.12
ID = 3 (0011):	6.76	.724	5.17	77.49

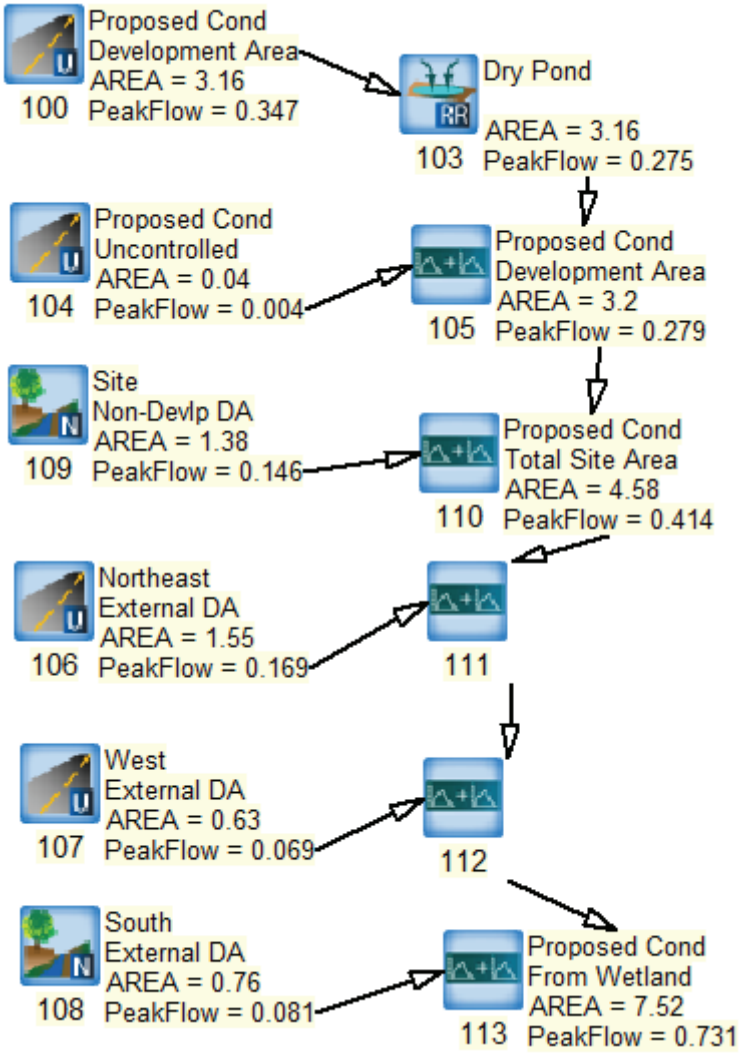
NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0012)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0011):	6.76	.724	5.17	77.49
+ ID2= 2 (0008):	.76	.081	5.17	74.62
ID = 3 (0012):	7.52	.805	5.17	77.20

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

FINISH

Proposed Conditions - VO2 Output



Simulation 1 – 25 mm 4 Hour AES
Simulation 2 – 2 Year – 1 Hour AES
Simulation 4 – 2 Year – 12 Hour AES
Simulation 5 – 100 Year – 1 Hour AES
Simulation 7 – 100 Year – 12 Hour AES

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

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

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO

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


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 2.3.3\voin.dat
  Output  filename: V:\01606\Active\160622415\Analysis\SWM\Hydrology\VO2\2017-11-
20_VO2\Vo2.out
  Summary filename: V:\01606\Active\160622415\Analysis\SWM\Hydrology\VO2\2017-11-
20_VO2\Vo2.sum


DATE: 11/23/2017                          TIME: 11:01:37 AM

USER:


COMMENTS: _____________________________________________________________


--------------------------------------------------------------------------------
--------------------------
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************


--------------------
|     READ STORM     |    Filename: V:\01606\Active\160622415\Ana
|                    |              lysis\SWM\Hydrology\VO2\Storms\25MM4HR.STM
| Ptotal= 25.02 mm   |    Comments: Twenty five mm Four Hour Chicago Storm
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    2.17 |  1.17    6.20 |  2.17    5.62 |  3.17    2.95
                 .33    2.38 |  1.33   12.18 |  2.33    4.80 |  3.33    2.76
                 .50    2.66 |  1.50   41.67 |  2.50    4.21 |  3.50    2.62
                 .67    3.03 |  1.67   15.28 |  2.67    3.78 |  3.67    2.47
                 .83    3.58 |  1.83    9.22 |  2.83    3.45 |  3.83    2.35
                1.00    4.47 |  2.00    6.88 |  3.00    3.18 |  4.00    2.23

--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD    (0108) |   Area     (ha)=    .76   Curve Number    (CN)= 98.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
```

```
--------------------   U.H. Tp(hrs)=    .20

     Unit Hyd Qpeak  (cms)=    .145

     PEAK FLOW       (cms)=    .032 (i)
     TIME TO PEAK    (hrs)=   1.667
     RUNOFF VOLUME    (mm)=  15.492
     TOTAL RAINFALL   (mm)=  25.023
     RUNOFF COEFFICIENT   =    .619

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

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0107) |   Area    (ha)=    .63
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .47          .16
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      64.80        40.00
     Mannings n           =       .013         .250

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

                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .083    2.17 | 1.083    6.20 | 2.083    5.62 | 3.08    2.95
               .167    2.17 | 1.167    6.20 | 2.167    5.62 | 3.17    2.95
               .250    2.38 | 1.250   12.18 | 2.250    4.80 | 3.25    2.76
               .333    2.38 | 1.333   12.18 | 2.333    4.80 | 3.33    2.76
               .417    2.66 | 1.417   41.67 | 2.417    4.21 | 3.42    2.62
               .500    2.66 | 1.500   41.67 | 2.500    4.21 | 3.50    2.62
               .583    3.03 | 1.583   15.28 | 2.583    3.78 | 3.58    2.47
               .667    3.03 | 1.667   15.28 | 2.667    3.78 | 3.67    2.47
               .750    3.58 | 1.750    9.22 | 2.750    3.45 | 3.75    2.35
               .833    3.58 | 1.833    9.22 | 2.833    3.45 | 3.83    2.35
               .917    4.47 | 1.917    6.88 | 2.917    3.18 | 3.92    2.23
              1.000    4.47 | 2.000    6.88 | 3.000    3.18 | 4.00    2.23

     Max.Eff.Inten.(mm/hr)=      41.67        27.87
               over (min)        5.00        15.00
     Storage Coeff.  (min)=      2.79 (ii)   14.56 (ii)
     Unit Hyd. Tpeak (min)=      5.00        15.00
     Unit Hyd. peak  (cms)=       .28          .08
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .05          .01          .059 (iii)
     TIME TO PEAK    (hrs)=      1.50         1.67          1.50
     RUNOFF VOLUME    (mm)=     24.02        19.28         22.82
     TOTAL RAINFALL   (mm)=     25.02        25.02         25.02
     RUNOFF COEFFICIENT   =       .96          .77           .91

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0106) |   Area    (ha)=   1.55
|ID= 1 DT= 5.0 min |   Total Imp(%)=  40.00   Dir. Conn.(%)=  40.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .62          .93
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     101.70        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      41.67        27.87
               over (min)        5.00        20.00
     Storage Coeff.  (min)=      3.66 (ii)   15.43 (ii)
     Unit Hyd. Tpeak (min)=      5.00        20.00
     Unit Hyd. peak  (cms)=       .25          .07
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .07          .05          .091 (iii)
     TIME TO PEAK    (hrs)=      1.50         1.75          1.50
     RUNOFF VOLUME    (mm)=     24.02        19.28         21.17
     TOTAL RAINFALL   (mm)=     25.02        25.02         25.02
     RUNOFF COEFFICIENT   =       .96          .77           .85

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0109) |   Area    (ha)=   1.38   Curve Number   (CN)= 98.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .20

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

                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .167    2.17 | 1.167    6.20 | 2.167    5.62 | 3.17    2.95
               .333    2.38 | 1.333   12.18 | 2.333    4.80 | 3.33    2.76
               .500    2.66 | 1.500   41.67 | 2.500    4.21 | 3.50    2.62
               .667    3.03 | 1.667   15.28 | 2.667    3.78 | 3.67    2.47
               .833    3.58 | 1.833    9.22 | 2.833    3.45 | 3.83    2.35
              1.000    4.47 | 2.000    6.88 | 3.000    3.18 | 4.00     .00

     Unit Hyd Qpeak  (cms)=    .264

     PEAK FLOW       (cms)=    .059 (i)
     TIME TO PEAK    (hrs)=   1.667
     RUNOFF VOLUME    (mm)=  15.146
     TOTAL RAINFALL   (mm)=  24.652
     RUNOFF COEFFICIENT   =    .614

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

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--------------------
| CALIB            |
```

| STANDHYD (0104) | Area (ha)= .04
|ID= 1 DT= 5.0 min | Total Imp(%)= 90.00 Dir. Conn.(%)= 90.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	.04	.00
Dep. Storage (mm)=	1.00	1.50
Average Slope (%)=	1.00	2.00
Length (m)=	16.30	40.00
Mannings n =	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	2.17	1.083	6.20	2.083	5.62	3.08	2.95
.167	2.17	1.167	6.20	2.167	5.62	3.17	2.95
.250	2.38	1.250	12.18	2.250	4.80	3.25	2.76
.333	2.38	1.333	12.18	2.333	4.80	3.33	2.76
.417	2.66	1.417	41.67	2.417	4.21	3.42	2.62
.500	2.66	1.500	41.67	2.500	4.21	3.50	2.62
.583	3.03	1.583	15.28	2.583	3.78	3.58	2.47
.667	3.03	1.667	15.28	2.667	3.78	3.67	2.47
.750	3.58	1.750	9.22	2.750	3.45	3.75	2.35
.833	3.58	1.833	9.22	2.833	3.45	3.83	2.35
.917	4.47	1.917	6.88	2.917	3.18	3.92	2.23
1.000	4.47	2.000	6.88	3.000	3.18	4.00	2.23

			TOTALS
Max.Eff.Inten.(mm/hr)=	41.67	104.52	
over (min)	5.00	10.00	
Storage Coeff. (min)=	1.22 (ii)	5.38 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	.33	.16	
PEAK FLOW (cms)=	.00	.00	.004 (iii)
TIME TO PEAK (hrs)=	1.50	1.58	1.50
RUNOFF VOLUME (mm)=	24.02	19.28	23.52
TOTAL RAINFALL (mm)=	25.02	25.02	25.02
RUNOFF COEFFICIENT =	.96	.77	.94

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB
STANDHYD (0100)	Area (ha)= 3.16
ID= 1 DT= 5.0 min	Total Imp(%)= 82.00 Dir. Conn.(%)= 82.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	2.59	.57
Dep. Storage (mm)=	1.00	1.50
Average Slope (%)=	1.00	2.00
Length (m)=	145.10	40.00
Mannings n =	.013	.250

Max.Eff.Inten.(mm/hr)=	41.67	27.87
over (min)	5.00	20.00
Storage Coeff. (min)=	4.53 (ii)	16.30 (ii)
Unit Hyd. Tpeak (min)=	5.00	20.00
Unit Hyd. peak (cms)=	.23	.06

			TOTALS
PEAK FLOW (cms)=	.28	.03	.289 (iii)
TIME TO PEAK (hrs)=	1.50	1.75	1.50
RUNOFF VOLUME (mm)=	24.02	19.28	23.17
TOTAL RAINFALL (mm)=	25.02	25.02	25.02
RUNOFF COEFFICIENT =	.96	.77	.93

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR (0103)
IN= 2---> OUT= 1
DT= 5.0 min

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
.0000	.0000	.3500	.1300
.0150	.0677	.0000	.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0100)	3.160	.289	1.50	23.17
OUTFLOW: ID= 1 (0103)	3.160	.014	4.08	22.80

PEAK FLOW REDUCTION [Qout/Qin](%)= 4.69
TIME SHIFT OF PEAK FLOW (min)=155.00
MAXIMUM STORAGE USED (ha.m.)= .0613

ADD HYD (0105)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0104):	.04	.004	1.50	23.52
+ ID2= 2 (0103):	3.16	.014	4.08	22.80
ID = 3 (0105):	3.20	.014	4.00	22.81

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0110)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0109):	1.38	.059	1.67	15.15
+ ID2= 2 (0105):	3.20	.014	4.00	22.81
ID = 3 (0110):	4.58	.068	1.67	20.50

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0111)

```
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0106):     1.55     .091     1.50    21.17
        + ID2= 2 (0110):     4.58     .068     1.67    20.50
          ================================================
          ID = 3 (0111):     6.13     .149     1.50    20.67

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

```
--------------------
| ADD HYD   (0112) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0107):      .63     .059     1.50    22.82
        + ID2= 2 (0111):     6.13     .149     1.50    20.67
          ================================================
          ID = 3 (0112):     6.76     .208     1.50    20.87

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

```
--------------------
| ADD HYD   (0113) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0108):      .76     .032     1.67    15.49
        + ID2= 2 (0112):     6.76     .208     1.50    20.87
          ================================================
          ID = 3 (0113):     7.52     .235     1.50    20.33

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

```
  ****************************
  ** SIMULATION NUMBER:   2 **
  ****************************


--------------------
|    READ STORM    |    Filename: V:\01606\Active\160622415\Ana
|                  |              lysis\SWM\Hydrology\VO2\Storms\2Y1.STM
| Ptotal= 23.80 mm |    Comments: 2yr/1hr
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08     .00 |   .42   42.84 |   .75   22.85 |  1.08    2.86
                 .17    2.86 |   .50   79.97 |   .83   14.28 |
                 .25    8.57 |   .58   42.84 |   .92    8.57 |
                 .33   22.85 |   .67   34.27 |  1.00    2.86 |
```

```
--------------------
| CALIB            |
| NASHYD    (0108) |   Area    (ha)=    .76   Curve Number   (CN)= 98.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .20

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


                         ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .167    1.43 |  .500   61.41 |  .833   18.56 |  1.17    1.43
                .333   15.71 |  .667   38.55 | 1.000    5.71 |

     Unit Hyd Qpeak  (cms)=    .145

     PEAK FLOW       (cms)=    .053 (i)
     TIME TO PEAK    (hrs)=    .667
     RUNOFF VOLUME    (mm)=  14.354
     TOTAL RAINFALL   (mm)=  23.802
     RUNOFF COEFFICIENT   =    .603

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

```
--------------------
| CALIB            |
| STANDHYD  (0107) |   Area    (ha)=    .63
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .47          .16
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      64.80        40.00
     Mannings n           =       .013         .250

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


                         ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .083     .00 |  .417   42.84 |  .750   22.85 |  1.08    2.86
                .167    2.86 |  .500   79.97 |  .833   14.28 |
                .250    8.57 |  .583   42.84 |  .917    8.57 |
                .333   22.85 |  .667   34.27 | 1.000    2.86 |

     Max.Eff.Inten.(mm/hr)=      79.97        53.38
               over (min)        5.00        10.00
     Storage Coeff.  (min)=      2.15 (ii)    7.13 (ii)
     Unit Hyd. Tpeak (min)=      5.00        10.00
     Unit Hyd. peak  (cms)=       .31          .14
                                                        *TOTALS*
     PEAK FLOW       (cms)=       .10          .02          .111 (iii)
     TIME TO PEAK    (hrs)=       .50          .58           .50
     RUNOFF VOLUME    (mm)=     22.80        18.10         21.62
     TOTAL RAINFALL   (mm)=     23.80        23.80         23.80
     RUNOFF COEFFICIENT   =       .96          .76           .91

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  98.0    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.
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| CALIB            |
| STANDHYD  (0106) |   Area    (ha)=   1.55
|ID= 1 DT= 5.0 min |   Total Imp(%)=  40.00   Dir. Conn.(%)=  40.00
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		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	.62	.93	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	101.70	40.00	
Mannings n	=	.013	.250	
Max.Eff.Inten.	(mm/hr)=	79.97	53.38	
over	(min)	5.00	15.00	
Storage Coeff.	(min)=	2.82 (ii)	11.89 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	15.00	
Unit Hyd. peak	(cms)=	.28	.09	
				TOTALS
PEAK FLOW	(cms)=	.13	.08	.154 (iii)
TIME TO PEAK	(hrs)=	.50	.75	.50
RUNOFF VOLUME	(mm)=	22.80	18.10	19.97
TOTAL RAINFALL	(mm)=	23.80	23.80	23.80
RUNOFF COEFFICIENT	=	.96	.76	.84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0109)	Area (ha)=	1.38	Curve Number (CN)=	98.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.20			

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	1.43	.500	61.41	.833	18.56	1.17	1.43
.333	15.71	.667	38.55	1.000	5.71		

Unit Hyd Qpeak	(cms)=	.264	
PEAK FLOW	(cms)=	.095	(i)
TIME TO PEAK	(hrs)=	.667	
RUNOFF VOLUME	(mm)=	14.355	
TOTAL RAINFALL	(mm)=	23.802	
RUNOFF COEFFICIENT	=	.603	

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

CALIB					
STANDHYD (0104)	Area (ha)=	.04			
ID= 1 DT= 5.0 min	Total Imp(%)=	90.00	Dir. Conn.(%)=	90.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.04	.00
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	16.30	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	.417	42.84	.750	22.85	1.08	2.86
.167	2.86	.500	79.97	.833	14.28		
.250	8.57	.583	42.84	.917	8.57		
.333	22.85	.667	34.27	1.000	2.86		

Max.Eff.Inten.	(mm/hr)=	79.97	160.15	
over	(min)	5.00	5.00	
Storage Coeff.	(min)=	.94 (ii)	4.15 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	5.00	
Unit Hyd. peak	(cms)=	.34	.24	
				TOTALS
PEAK FLOW	(cms)=	.01	.00	.009 (iii)
TIME TO PEAK	(hrs)=	.50	.50	.50
RUNOFF VOLUME	(mm)=	22.80	18.10	22.32
TOTAL RAINFALL	(mm)=	23.80	23.80	23.80
RUNOFF COEFFICIENT	=	.96	.76	.94

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
STANDHYD (0100)	Area (ha)=	3.16			
ID= 1 DT= 5.0 min	Total Imp(%)=	82.00	Dir. Conn.(%)=	82.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	2.59	.57
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	145.10	40.00
Mannings n	=	.013	.250
Max.Eff.Inten.	(mm/hr)=	79.97	53.38
over	(min)	5.00	10.00
Storage Coeff.	(min)=	3.49 (ii)	7.70 (ii)
Unit Hyd. Tpeak	(min)=	5.00	10.00
Unit Hyd. peak	(cms)=	.26	.13
			TOTALS
PEAK FLOW	(cms)=	.50	.06 .538 (iii)
TIME TO PEAK	(hrs)=	.50	.58 .50
RUNOFF VOLUME	(mm)=	22.80	18.10 21.95
TOTAL RAINFALL	(mm)=	23.80	23.80 23.80
RUNOFF COEFFICIENT	=	.96	.76 .92

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR (0103)				
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	.0000	.0000	.3500	.1300
	.0150	.0677	.0000	.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0100)	3.160	.538	.50	21.95
OUTFLOW: ID= 1 (0103)	3.160	.015	1.17	21.59

PEAK FLOW REDUCTION [Qout/Qin](%)= 2.71
TIME SHIFT OF PEAK FLOW (min)= 40.00
MAXIMUM STORAGE USED (ha.m.)= .0659

ADD HYD (0105)		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
1 + 2 = 3	ID1= 1 (0104):	.04	.009	.50	22.32
	+ ID2= 2 (0103):	3.16	.015	1.17	21.59
	ID = 3 (0105):	3.20	.015	.92	21.60

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0110)		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
1 + 2 = 3	ID1= 1 (0109):	1.38	.095	.67	14.36
	+ ID2= 2 (0105):	3.20	.015	.92	21.60
	ID = 3 (0110):	4.58	.109	.67	19.51

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0111)		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
1 + 2 = 3	ID1= 1 (0106):	1.55	.154	.50	19.97
	+ ID2= 2 (0110):	4.58	.109	.67	19.51
	ID = 3 (0111):	6.13	.253	.67	19.62

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0112)		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
1 + 2 = 3	ID1= 1 (0107):	.63	.111	.50	21.62
	+ ID2= 2 (0111):	6.13	.253	.67	19.62
	ID = 3 (0112):	6.76	.327	.50	19.81

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0113)		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
1 + 2 = 3	ID1= 1 (0108):	.76	.053	.67	14.35
	+ ID2= 2 (0112):	6.76	.327	.50	19.81
	ID = 3 (0113):	7.52	.369	.67	19.26

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

****
** SIMULATION NUMBER: 4 **
****

READ STORM	Filename: V:\01606\Active\160622415\Analysis\SWM\Hydrology\VO2\Storms\2Y12.STM
Ptotal= 41.10 mm	Comments: 2yr/12hr

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.00	3.50	6.99	6.75	2.88	10.00	.41
.50	.41	3.75	6.99	7.00	2.88	10.25	.41
.75	.41	4.00	6.99	7.25	2.88	10.50	.41
1.00	.41	4.25	6.99	7.50	1.64	10.75	.41
1.25	.41	4.50	18.91	7.75	1.64	11.00	.41
1.50	.41	4.75	18.91	8.00	1.64	11.25	.41
1.75	.41	5.00	18.91	8.25	1.64	11.50	.41
2.00	.41	5.25	18.91	8.50	.82	11.75	.41
2.25	.41	5.50	5.34	8.75	.82	12.00	.41
2.50	2.47	5.75	5.34	9.00	.82	12.25	.41
2.75	2.47	6.00	5.34	9.25	.82		
3.00	2.47	6.25	5.34	9.50	.41		
3.25	2.47	6.50	2.88	9.75	.41		

CALIB		
NASHYD (0108)	Area (ha)=	.76
ID= 1 DT=10.0 min	Ia (mm)=	5.00
	U.H. Tp(hrs)=	.20
	Curve Number (CN)=	98.0
	# of Linear Res.(N)=	3.00

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.00	3.333	4.73	6.500	2.88	9.67	.41
.333	.21	3.500	6.99	6.667	2.88	9.83	.41
.500	.41	3.667	6.99	6.833	2.88	10.00	.41
.667	.41	3.833	6.99	7.000	2.88	10.17	.41
.833	.41	4.000	6.99	7.167	2.88	10.33	.41
1.000	.41	4.167	6.99	7.333	2.26	10.50	.41

1.167	.41	4.333	12.95	7.500	1.64	10.67	.41
1.333	.41	4.500	18.91	7.667	1.64	10.83	.41
1.500	.41	4.667	18.91	7.833	1.64	11.00	.41
1.667	.41	4.833	18.91	8.000	1.64	11.17	.41
1.833	.41	5.000	18.91	8.167	1.64	11.33	.41
2.000	.41	5.167	18.91	8.333	1.23	11.50	.41
2.167	.41	5.333	12.13	8.500	.82	11.67	.41
2.333	1.44	5.500	5.34	8.667	.82	11.83	.41
2.500	2.47	5.667	5.34	8.833	.82	12.00	.41
2.667	2.47	5.833	5.34	9.000	.82	12.17	.41
2.833	2.47	6.000	5.34	9.167	.82	12.33	.20
3.000	2.47	6.167	5.34	9.333	.62		
3.167	2.47	6.333	4.11	9.500	.41		

Unit Hyd Qpeak (cms)= .145

PEAK FLOW (cms)= .037 (i)
TIME TO PEAK (hrs)= 5.167
RUNOFF VOLUME (mm)= 30.747
TOTAL RAINFALL (mm)= 41.100
RUNOFF COEFFICIENT = .748

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

CALIB			
STANDHYD (0107)	Area (ha)= .63		
ID= 1 DT= 5.0 min	Total Imp(%)= 75.00	Dir. Conn.(%)= 75.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.47	.16
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	64.80	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	3.167	2.47	6.250	5.34	9.33	.41
.167	.00	3.250	2.47	6.333	2.88	9.42	.41
.250	.00	3.333	6.99	6.417	2.88	9.50	.41
.333	.41	3.417	6.99	6.500	2.88	9.58	.41
.417	.41	3.500	6.99	6.583	2.88	9.67	.41
.500	.41	3.583	6.99	6.667	2.88	9.75	.41
.583	.41	3.667	6.99	6.750	2.88	9.83	.41
.667	.41	3.750	6.99	6.833	2.88	9.92	.41
.750	.41	3.833	6.99	6.917	2.88	10.00	.41
.833	.41	3.917	6.99	7.000	2.88	10.08	.41
.917	.41	4.000	6.99	7.083	2.88	10.17	.41
1.000	.41	4.083	6.99	7.167	2.88	10.25	.41
1.083	.41	4.167	6.99	7.250	2.88	10.33	.41
1.167	.41	4.250	6.99	7.333	1.64	10.42	.41
1.250	.41	4.333	18.91	7.417	1.64	10.50	.41
1.333	.41	4.417	18.91	7.500	1.64	10.58	.41
1.417	.41	4.500	18.91	7.583	1.64	10.67	.41
1.500	.41	4.583	18.91	7.667	1.64	10.75	.41
1.583	.41	4.667	18.91	7.750	1.64	10.83	.41
1.667	.41	4.750	18.91	7.833	1.64	10.92	.41
1.750	.41	4.833	18.91	7.917	1.64	11.00	.41
1.833	.41	4.917	18.91	8.000	1.64	11.08	.41
1.917	.41	5.000	18.91	8.083	1.64	11.17	.41
2.000	.41	5.083	18.91	8.167	1.64	11.25	.41
2.083	.41	5.167	18.91	8.250	1.64	11.33	.41
2.167	.41	5.250	18.91	8.333	.82	11.42	.41
2.250	.41	5.333	5.34	8.417	.82	11.50	.41
2.333	2.47	5.417	5.34	8.500	.82	11.58	.41
2.417	2.47	5.500	5.34	8.583	.82	11.67	.41
2.500	2.47	5.583	5.34	8.667	.82	11.75	.41
2.583	2.47	5.667	5.34	8.750	.82	11.83	.41
2.667	2.47	5.750	5.34	8.833	.82	11.92	.41
2.750	2.47	5.833	5.34	8.917	.82	12.00	.41
2.833	2.47	5.917	5.34	9.000	.82	12.08	.41
2.917	2.47	6.000	5.34	9.083	.82	12.17	.41
3.000	2.47	6.083	5.34	9.167	.82	12.25	.41
3.083	2.47	6.167	5.34	9.250	.82		

Max.Eff.Inten.	(mm/hr)=	18.91	18.36	
over	(min)	5.00	20.00	
Storage Coeff.	(min)=	3.83 (ii)	17.74 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	20.00	
Unit Hyd. peak	(cms)=	.25	.06	
				TOTALS
PEAK FLOW	(cms)=	.02	.01	.032 (iii)
TIME TO PEAK	(hrs)=	5.08	5.25	5.25
RUNOFF VOLUME	(mm)=	40.10	35.02	38.81
TOTAL RAINFALL	(mm)=	41.10	41.10	41.10
RUNOFF COEFFICIENT	=	.98	.85	.94

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
STANDHYD (0106)	Area (ha)= 1.55		
ID= 1 DT= 5.0 min	Total Imp(%)= 40.00	Dir. Conn.(%)= 40.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.62	.93
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	101.70	40.00
Mannings n	=	.013	.250

Max.Eff.Inten.	(mm/hr)=	18.91	18.36	
over	(min)	5.00	20.00	
Storage Coeff.	(min)=	5.02 (ii)	18.93 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	20.00	
Unit Hyd. peak	(cms)=	.21	.06	
				TOTALS
PEAK FLOW	(cms)=	.03	.04	.077 (iii)
TIME TO PEAK	(hrs)=	5.25	5.25	5.25
RUNOFF VOLUME	(mm)=	40.10	35.02	37.04
TOTAL RAINFALL	(mm)=	41.10	41.10	41.10
RUNOFF COEFFICIENT	=	.98	.85	.90

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL

THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0109)	Area (ha)=	1.38	Curve Number (CN)=	98.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.20			

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.00	3.333	4.73	6.500	2.88	9.67	.41
.333	.21	3.500	6.99	6.667	2.88	9.83	.41
.500	.41	3.667	6.99	6.833	2.88	10.00	.41
.667	.41	3.833	6.99	7.000	2.88	10.17	.41
.833	.41	4.000	6.99	7.167	2.88	10.33	.41
1.000	.41	4.167	6.99	7.333	2.26	10.50	.41
1.167	.41	4.333	12.95	7.500	1.64	10.67	.41
1.333	.41	4.500	18.91	7.667	1.64	10.83	.41
1.500	.41	4.667	18.91	7.833	1.64	11.00	.41
1.667	.41	4.833	18.91	8.000	1.64	11.17	.41
1.833	.41	5.000	18.91	8.167	1.64	11.33	.41
2.000	.41	5.167	18.91	8.333	1.23	11.50	.41
2.167	.41	5.333	12.13	8.500	.82	11.67	.41
2.333	1.44	5.500	5.34	8.667	.82	11.83	.41
2.500	2.47	5.667	5.34	8.833	.82	12.00	.41
2.667	2.47	5.833	5.34	9.000	.82	12.17	.41
2.833	2.47	6.000	5.34	9.167	.82	12.33	.20
3.000	2.47	6.167	5.34	9.333	.62		
3.167	2.47	6.333	4.11	9.500	.41		

Unit Hyd Qpeak (cms)= .264

PEAK FLOW (cms)= .067 (i)
TIME TO PEAK (hrs)= 5.167
RUNOFF VOLUME (mm)= 30.747
TOTAL RAINFALL (mm)= 41.100
RUNOFF COEFFICIENT = .748

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

CALIB			
STANDHYD (0104)	Area (ha)=	.04	
ID= 1 DT= 5.0 min	Total Imp(%)=	90.00	Dir. Conn.(%)= 90.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.04	.00
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	16.30	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	3.167	2.47	6.250	5.34	9.33	.41
.167	.00	3.250	2.47	6.333	2.88	9.42	.41
.250	.00	3.333	6.99	6.417	2.88	9.50	.41
.333	.41	3.417	6.99	6.500	2.88	9.58	.41
.417	.41	3.500	6.99	6.583	2.88	9.67	.41
.500	.41	3.583	6.99	6.667	2.88	9.75	.41
.583	.41	3.667	6.99	6.750	2.88	9.83	.41
.667	.41	3.750	6.99	6.833	2.88	9.92	.41
.750	.41	3.833	6.99	6.917	2.88	10.00	.41
.833	.41	3.917	6.99	7.000	2.88	10.08	.41
.917	.41	4.000	6.99	7.083	2.88	10.17	.41
1.000	.41	4.083	6.99	7.167	2.88	10.25	.41
1.083	.41	4.167	6.99	7.250	2.88	10.33	.41
1.167	.41	4.250	6.99	7.333	1.64	10.42	.41
1.250	.41	4.333	18.91	7.417	1.64	10.50	.41
1.333	.41	4.417	18.91	7.500	1.64	10.58	.41
1.417	.41	4.500	18.91	7.583	1.64	10.67	.41
1.500	.41	4.583	18.91	7.667	1.64	10.75	.41
1.583	.41	4.667	18.91	7.750	1.64	10.83	.41
1.667	.41	4.750	18.91	7.833	1.64	10.92	.41
1.750	.41	4.833	18.91	7.917	1.64	11.00	.41
1.833	.41	4.917	18.91	8.000	1.64	11.08	.41
1.917	.41	5.000	18.91	8.083	1.64	11.17	.41
2.000	.41	5.083	18.91	8.167	1.64	11.25	.41
2.083	.41	5.167	18.91	8.250	1.64	11.33	.41
2.167	.41	5.250	18.91	8.333	.82	11.42	.41
2.250	.41	5.333	5.34	8.417	.82	11.50	.41
2.333	2.47	5.417	5.34	8.500	.82	11.58	.41
2.417	2.47	5.500	5.34	8.583	.82	11.67	.41
2.500	2.47	5.583	5.34	8.667	.82	11.75	.41
2.583	2.47	5.667	5.34	8.750	.82	11.83	.41
2.667	2.47	5.750	5.34	8.833	.82	11.92	.41
2.750	2.47	5.833	5.34	8.917	.82	12.00	.41
2.833	2.47	5.917	5.34	9.000	.82	12.08	.41
2.917	2.47	6.000	5.34	9.083	.82	12.17	.41
3.000	2.47	6.083	5.34	9.167	.82	12.25	.41
3.083	2.47	6.167	5.34	9.250	.82		

Max.Eff.Inten.(mm/hr)=	18.91	18.36		
over (min)	5.00	20.00		
Storage Coeff. (min)=	1.67 (ii)	15.58 (ii)		
Unit Hyd. Tpeak (min)=	5.00	20.00		
Unit Hyd. peak (cms)=	.32	.07		
			TOTALS	
PEAK FLOW (cms)=	.00	.00	.002 (iii)	
TIME TO PEAK (hrs)=	4.58	5.25	5.25	
RUNOFF VOLUME (mm)=	40.10	35.02	37.56	
TOTAL RAINFALL (mm)=	41.10	41.10	41.10	
RUNOFF COEFFICIENT =	.98	.85	.91	

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
STANDHYD (0100)	Area (ha)=	3.16	
ID= 1 DT= 5.0 min	Total Imp(%)=	82.00	Dir. Conn.(%)= 82.00

	IMPERVIOUS	PERVIOUS (i)

Surface Area	(ha)=	2.59	.57	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	145.10	40.00	
Mannings n	=	.013	.250	
Max.Eff.Inten.	(mm/hr)=	18.91	18.36	
over	(min)	5.00	25.00	
Storage Coeff.	(min)=	6.22 (ii)	20.12 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	25.00	
Unit Hyd. peak	(cms)=	.19	.05	
				TOTALS
PEAK FLOW	(cms)=	.14	.03	.163 (iii)
TIME TO PEAK	(hrs)=	5.25	5.25	5.25
RUNOFF VOLUME	(mm)=	40.10	35.02	39.18
TOTAL RAINFALL	(mm)=	41.10	41.10	41.10
RUNOFF COEFFICIENT	=	.98	.85	.95

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR (0103)				
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	.0000	.0000	.3500	.1300
	.0150	.0677	.0000	.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0100)	3.160	.163	5.25	39.18
OUTFLOW: ID= 1 (0103)	3.160	.059	5.67	38.82

PEAK FLOW REDUCTION [Qout/Qin](%)= 36.55
TIME SHIFT OF PEAK FLOW (min)= 25.00
MAXIMUM STORAGE USED (ha.m.)= .0760

ADD HYD (0105)	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0104):	.04	.002	5.25	37.56
+ ID2= 2 (0103):	3.16	.059	5.67	38.82
ID = 3 (0105):	3.20	.060	5.67	38.80

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0110)	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0109):	1.38	.067	5.17	30.75
+ ID2= 2 (0105):	3.20	.060	5.67	38.80
ID = 3 (0110):	4.58	.104	5.33	36.37

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0111)	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0106):	1.55	.077	5.25	37.04
+ ID2= 2 (0110):	4.58	.104	5.33	36.37
ID = 3 (0111):	6.13	.172	5.25	36.54

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0112)	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0107):	.63	.032	5.25	38.81
+ ID2= 2 (0111):	6.13	.172	5.25	36.54
ID = 3 (0112):	6.76	.204	5.25	36.75

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0113)	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0108):	.76	.037	5.17	30.75
+ ID2= 2 (0112):	6.76	.204	5.25	36.75
ID = 3 (0113):	7.52	.238	5.25	36.15

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

****
** SIMULATION NUMBER: 5 **
****

READ STORM	Filename: V:\01606\Active\160622415\Analysis\SWM\Hydrology\VO2\Storms\100Y1.STM
Ptotal= 56.80 mm	Comments: 100yr/1hr

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.00	.42	102.24	.75	54.53	1.08	6.82
.17	6.82	.50	190.85	.83	34.08		
.25	20.45	.58	102.24	.92	20.45		
.33	54.53	.67	81.79	1.00	6.82		

CALIB

| NASHYD (0108) | Area (ha)= .76 Curve Number (CN)= 98.0
|ID= 1 DT=10.0 min | Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
| | U.H. Tp(hrs)= .20

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	3.41	.500	146.55	.833	44.30	1.17	3.41
.333	37.49	.667	92.02	1.000	13.63		

Unit Hyd Qpeak (cms)= .145

PEAK FLOW (cms)= .174 (i)
TIME TO PEAK (hrs)= .667
RUNOFF VOLUME (mm)= 45.865
TOTAL RAINFALL (mm)= 56.802
RUNOFF COEFFICIENT = .807

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

CALIB	
STANDHYD (0107)	Area (ha)= .63
ID= 1 DT= 5.0 min	Total Imp(%)= 75.00 Dir. Conn.(%)= 75.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.47	.16
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	64.80	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	.417	102.24	.750	54.53	1.08	6.82
.167	6.82	.500	190.85	.833	34.08		
.250	20.45	.583	102.24	.917	20.45		
.333	54.53	.667	81.79	1.000	6.82		

				TOTALS
Max.Eff.Inten.	(mm/hr)=	190.85	141.78	
over	(min)	5.00	10.00	
Storage Coeff.	(min)=	1.52 (ii)	5.03 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	.33	.16	
PEAK FLOW	(cms)=	.25	.06	.286 (iii)
TIME TO PEAK	(hrs)=	.50	.58	.50
RUNOFF VOLUME	(mm)=	55.80	50.56	54.49
TOTAL RAINFALL	(mm)=	56.80	56.80	56.80
RUNOFF COEFFICIENT	=	.98	.89	.96

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB	
STANDHYD (0106)	Area (ha)= 1.55
ID= 1 DT= 5.0 min	Total Imp(%)= 40.00 Dir. Conn.(%)= 40.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.62	.93
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	101.70	40.00
Mannings n	=	.013	.250

				TOTALS
Max.Eff.Inten.	(mm/hr)=	190.85	141.78	
over	(min)	5.00	10.00	
Storage Coeff.	(min)=	1.99 (ii)	8.13 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	.31	.13	
PEAK FLOW	(cms)=	.32	.28	.506 (iii)
TIME TO PEAK	(hrs)=	.50	.58	.50
RUNOFF VOLUME	(mm)=	55.80	50.56	52.66
TOTAL RAINFALL	(mm)=	56.80	56.80	56.80
RUNOFF COEFFICIENT	=	.98	.89	.93

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB	
NASHYD (0109)	Area (ha)= 1.38 Curve Number (CN)= 98.0
ID= 1 DT=10.0 min	Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .20

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	3.41	.500	146.55	.833	44.30	1.17	3.41
.333	37.49	.667	92.02	1.000	13.63		

Unit Hyd Qpeak (cms)= .264

PEAK FLOW (cms)= .316 (i)
TIME TO PEAK (hrs)= .667
RUNOFF VOLUME (mm)= 45.865
TOTAL RAINFALL (mm)= 56.802
RUNOFF COEFFICIENT = .807

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

CALIB	
STANDHYD (0104)	Area (ha)= .04

|ID= 1 DT= 5.0 min | Total Imp(%)= 90.00 Dir. Conn.(%)= 90.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.04	.00
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	16.30	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	.417	102.24	.750	54.53	1.08	6.82
.167	6.82	.500	190.85	.833	34.08		
.250	20.45	.583	102.24	.917	20.45		
.333	54.53	.667	81.79	1.000	6.82		

				TOTALS
Max.Eff.Inten.	(mm/hr)=	190.85	425.34	
over	(min)	5.00	5.00	
Storage Coeff.	(min)=	.66 (ii)	2.93 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	5.00	
Unit Hyd. peak	(cms)=	.34	.28	
PEAK FLOW	(cms)=	.02	.00	.021 (iii)
TIME TO PEAK	(hrs)=	.50	.50	.50
RUNOFF VOLUME	(mm)=	55.80	50.56	55.26
TOTAL RAINFALL	(mm)=	56.80	56.80	56.80
RUNOFF COEFFICIENT	=	.98	.89	.97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB
STANDHYD (0100)
ID= 1 DT= 5.0 min

Area (ha)= 3.16
Total Imp(%)= 82.00 Dir. Conn.(%)= 82.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	2.59	.57
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	145.10	40.00
Mannings n	=	.013	.250

				TOTALS
Max.Eff.Inten.	(mm/hr)=	190.85	141.78	
over	(min)	5.00	10.00	
Storage Coeff.	(min)=	2.47 (ii)	5.44 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	.30	.16	
PEAK FLOW	(cms)=	1.28	.20	1.424 (iii)
TIME TO PEAK	(hrs)=	.50	.58	.50
RUNOFF VOLUME	(mm)=	55.80	50.56	54.86
TOTAL RAINFALL	(mm)=	56.80	56.80	56.80
RUNOFF COEFFICIENT	=	.98	.89	.97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR (0103)
IN= 2---> OUT= 1
DT= 5.0 min

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
.0000	.0000	.3500	.1300
.0150	.0677	.0000	.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0100)	3.160	1.424	.50	54.86
OUTFLOW: ID= 1 (0103)	3.160	.338	.83	54.50

PEAK FLOW REDUCTION [Qout/Qin](%)= 23.73
TIME SHIFT OF PEAK FLOW (min)= 20.00
MAXIMUM STORAGE USED (ha.m.)= .1282

ADD HYD (0105)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0104):	.04	.021	.50	55.26
+ ID2= 2 (0103):	3.16	.338	.83	54.50
ID = 3 (0105):	3.20	.342	.83	54.51

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0110)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0109):	1.38	.316	.67	45.87
+ ID2= 2 (0105):	3.20	.342	.83	54.51
ID = 3 (0110):	4.58	.609	.75	52.13

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0111)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0106):	1.55	.506	.50	52.66
+ ID2= 2 (0110):	4.58	.609	.75	52.13
ID = 3 (0111):	6.13	.985	.67	52.26

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0112)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0107):	.63	.286	.50	54.49
	+ ID2= 2 (0111):	6.13	.985	.67	52.26
	ID = 3 (0112):	6.76	1.140	.67	52.47

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0113)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0108):	.76	.174	.67	45.87
	+ ID2= 2 (0112):	6.76	1.140	.67	52.47
	ID = 3 (0113):	7.52	1.314	.67	51.94

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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

READ STORM	Filename: V:\01606\Active\160622415\Analysis\SWM\Hydrology\VO2\Storms\100Y12.STM
Ptotal= 86.48 mm	Comments: 100yr/12hr

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.00	3.50	14.71	6.75	6.06	10.00	.86
.50	.86	3.75	14.71	7.00	6.06	10.25	.86
.75	.86	4.00	14.71	7.25	6.06	10.50	.86
1.00	.86	4.25	14.71	7.50	3.46	10.75	.86
1.25	.86	4.50	39.79	7.75	3.46	11.00	.86
1.50	.86	4.75	39.79	8.00	3.46	11.25	.86
1.75	.86	5.00	39.79	8.25	3.46	11.50	.86
2.00	.86	5.25	39.79	8.50	1.73	11.75	.86
2.25	.86	5.50	11.24	8.75	1.73	12.00	.86
2.50	5.19	5.75	11.24	9.00	1.73	12.25	.86
2.75	5.19	6.00	11.24	9.25	1.73		
3.00	5.19	6.25	11.24	9.50	.86		
3.25	5.19	6.50	6.06	9.75	.86		

CALIB NASHYD (0108)	ID= 1 DT=10.0 min				
	Area	(ha)=	.76	Curve Number (CN)=	98.0
	Ia	(mm)=	5.00	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=		.20		

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.00	3.333	9.95	6.500	6.06	9.67	.86
.333	.43	3.500	14.71	6.667	6.06	9.83	.86
.500	.86	3.667	14.71	6.833	6.06	10.00	.86
.667	.86	3.833	14.71	7.000	6.06	10.17	.86
.833	.86	4.000	14.71	7.167	6.06	10.33	.86
1.000	.86	4.167	14.71	7.333	4.76	10.50	.86
1.167	.86	4.333	27.25	7.500	3.46	10.67	.86
1.333	.86	4.500	39.79	7.667	3.46	10.83	.86
1.500	.86	4.667	39.79	7.833	3.46	11.00	.86
1.667	.86	4.833	39.79	8.000	3.46	11.17	.86
1.833	.86	5.000	39.79	8.167	3.46	11.33	.86
2.000	.86	5.167	39.79	8.333	2.60	11.50	.86
2.167	.86	5.333	25.52	8.500	1.73	11.67	.86
2.333	3.02	5.500	11.24	8.667	1.73	11.83	.86
2.500	5.19	5.667	11.24	8.833	1.73	12.00	.86
2.667	5.19	5.833	11.24	9.000	1.73	12.17	.86
2.833	5.19	6.000	11.24	9.167	1.73	12.33	.43
3.000	5.19	6.167	11.24	9.333	1.30		
3.167	5.19	6.333	8.65	9.500	.86		

Unit Hyd Qpeak (cms)= .145

PEAK FLOW (cms)= .081 (i)
TIME TO PEAK (hrs)= 5.167
RUNOFF VOLUME (mm)= 74.615
TOTAL RAINFALL (mm)= 86.480
RUNOFF COEFFICIENT = .863

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

CALIB STANDHYD (0107)	ID= 1 DT= 5.0 min				
	Area	(ha)=	.63		
	Total Imp(%)=	75.00	Dir. Conn.(%)=	75.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	.47	.16
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	64.80	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	3.167	5.19	6.250	11.24	9.33	.86
.167	.00	3.250	5.19	6.333	6.06	9.42	.86
.250	.00	3.333	14.71	6.417	6.06	9.50	.86
.333	.86	3.417	14.71	6.500	6.06	9.58	.86
.417	.86	3.500	14.71	6.583	6.06	9.67	.86
.500	.86	3.583	14.71	6.667	6.06	9.75	.86
.583	.86	3.667	14.71	6.750	6.06	9.83	.86
.667	.86	3.750	14.71	6.833	6.06	9.92	.86
.750	.86	3.833	14.71	6.917	6.06	10.00	.86
.833	.86	3.917	14.71	7.000	6.06	10.08	.86
.917	.86	4.000	14.71	7.083	6.06	10.17	.86
1.000	.86	4.083	14.71	7.167	6.06	10.25	.86
1.083	.86	4.167	14.71	7.250	6.06	10.33	.86
1.167	.86	4.250	14.71	7.333	3.46	10.42	.86

1.250	.86	4.333	39.79	7.417	3.46	10.50	.86
1.333	.86	4.417	39.79	7.500	3.46	10.58	.86
1.417	.86	4.500	39.79	7.583	3.46	10.67	.86
1.500	.86	4.583	39.79	7.667	3.46	10.75	.86
1.583	.86	4.667	39.79	7.750	3.46	10.83	.86
1.667	.86	4.750	39.79	7.833	3.46	10.92	.86
1.750	.86	4.833	39.79	7.917	3.46	11.00	.86
1.833	.86	4.917	39.79	8.000	3.46	11.08	.86
1.917	.86	5.000	39.79	8.083	3.46	11.17	.86
2.000	.86	5.083	39.79	8.167	3.46	11.25	.86
2.083	.86	5.167	39.79	8.250	3.46	11.33	.86
2.167	.86	5.250	39.79	8.333	1.73	11.42	.86
2.250	.86	5.333	11.24	8.417	1.73	11.50	.86
2.333	5.19	5.417	11.24	8.500	1.73	11.58	.86
2.417	5.19	5.500	11.24	8.583	1.73	11.67	.86
2.500	5.19	5.583	11.24	8.667	1.73	11.75	.86
2.583	5.19	5.667	11.24	8.750	1.73	11.83	.86
2.667	5.19	5.750	11.24	8.833	1.73	11.92	.86
2.750	5.19	5.833	11.24	8.917	1.73	12.00	.86
2.833	5.19	5.917	11.24	9.000	1.73	12.08	.86
2.917	5.19	6.000	11.24	9.083	1.73	12.17	.86
3.000	5.19	6.083	11.24	9.167	1.73	12.25	.86
3.083	5.19	6.167	11.24	9.250	1.73		

Max.Eff.Inten.(mm/hr)=	39.79	39.49	
over (min)	5.00	15.00	
Storage Coeff. (min)=	2.85 (ii)	13.08 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	.28	.08	
			TOTALS
PEAK FLOW (cms)=	.05	.02	.069 (iii)
TIME TO PEAK (hrs)=	4.92	5.25	5.25
RUNOFF VOLUME (mm)=	85.48	80.09	84.12
TOTAL RAINFALL (mm)=	86.48	86.48	86.48
RUNOFF COEFFICIENT =	.99	.93	.97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
STANDHYD (0106)	Area (ha)= 1.55		
ID= 1 DT= 5.0 min	Total Imp(%)= 40.00	Dir. Conn.(%)= 40.00	
	IMPERVIOUS	PERVIOUS (i)	
Surface Area (ha)=	.62	.93	
Dep. Storage (mm)=	1.00	1.50	
Average Slope (%)=	1.00	2.00	
Length (m)=	101.70	40.00	
Mannings n =	.013	.250	
Max.Eff.Inten.(mm/hr)=	39.79	39.49	
over (min)	5.00	15.00	
Storage Coeff. (min)=	3.73 (ii)	13.97 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	.25	.08	
			TOTALS
PEAK FLOW (cms)=	.07	.10	.169 (iii)
TIME TO PEAK (hrs)=	5.08	5.25	5.25
RUNOFF VOLUME (mm)=	85.48	80.09	82.24
TOTAL RAINFALL (mm)=	86.48	86.48	86.48
RUNOFF COEFFICIENT =	.99	.93	.95

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0109)	Area (ha)= 1.38	Curve Number (CN)= 98.0	
ID= 1 DT=10.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .20		

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.00	3.333	9.95	6.500	6.06	9.67	.86
.333	.43	3.500	14.71	6.667	6.06	9.83	.86
.500	.86	3.667	14.71	6.833	6.06	10.00	.86
.667	.86	3.833	14.71	7.000	6.06	10.17	.86
.833	.86	4.000	14.71	7.167	6.06	10.33	.86
1.000	.86	4.167	14.71	7.333	4.76	10.50	.86
1.167	.86	4.333	27.25	7.500	3.46	10.67	.86
1.333	.86	4.500	39.79	7.667	3.46	10.83	.86
1.500	.86	4.667	39.79	7.833	3.46	11.00	.86
1.667	.86	4.833	39.79	8.000	3.46	11.17	.86
1.833	.86	5.000	39.79	8.167	3.46	11.33	.86
2.000	.86	5.167	39.79	8.333	2.60	11.50	.86
2.167	.86	5.333	25.52	8.500	1.73	11.67	.86
2.333	3.02	5.500	11.24	8.667	1.73	11.83	.86
2.500	5.19	5.667	11.24	8.833	1.73	12.00	.86
2.667	5.19	5.833	11.24	9.000	1.73	12.17	.86
2.833	5.19	6.000	11.24	9.167	1.73	12.33	.43
3.000	5.19	6.167	11.24	9.333	1.30		
3.167	5.19	6.333	8.65	9.500	.86		

Unit Hyd Qpeak (cms)= .264

PEAK FLOW (cms)=	.146 (i)
TIME TO PEAK (hrs)=	5.167
RUNOFF VOLUME (mm)=	74.616
TOTAL RAINFALL (mm)=	86.480
RUNOFF COEFFICIENT =	.863

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

CALIB			
STANDHYD (0104)	Area (ha)= .04		
ID= 1 DT= 5.0 min	Total Imp(%)= 90.00	Dir. Conn.(%)= 90.00	
	IMPERVIOUS	PERVIOUS (i)	
Surface Area (ha)=	.04	.00	
Dep. Storage (mm)=	1.00	1.50	
Average Slope (%)=	1.00	2.00	

Length	(m)=	16.30	40.00
Mannings n	=	.013	.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.00	3.167	5.19	6.250	11.24	9.33	.86
.167	.00	3.250	5.19	6.333	6.06	9.42	.86
.250	.00	3.333	14.71	6.417	6.06	9.50	.86
.333	.86	3.417	14.71	6.500	6.06	9.58	.86
.417	.86	3.500	14.71	6.583	6.06	9.67	.86
.500	.86	3.583	14.71	6.667	6.06	9.75	.86
.583	.86	3.667	14.71	6.750	6.06	9.83	.86
.667	.86	3.750	14.71	6.833	6.06	9.92	.86
.750	.86	3.833	14.71	6.917	6.06	10.00	.86
.833	.86	3.917	14.71	7.000	6.06	10.08	.86
.917	.86	4.000	14.71	7.083	6.06	10.17	.86
1.000	.86	4.083	14.71	7.167	6.06	10.25	.86
1.083	.86	4.167	14.71	7.250	6.06	10.33	.86
1.167	.86	4.250	14.71	7.333	3.46	10.42	.86
1.250	.86	4.333	39.79	7.417	3.46	10.50	.86
1.333	.86	4.417	39.79	7.500	3.46	10.58	.86
1.417	.86	4.500	39.79	7.583	3.46	10.67	.86
1.500	.86	4.583	39.79	7.667	3.46	10.75	.86
1.583	.86	4.667	39.79	7.750	3.46	10.83	.86
1.667	.86	4.750	39.79	7.833	3.46	10.92	.86
1.750	.86	4.833	39.79	7.917	3.46	11.00	.86
1.833	.86	4.917	39.79	8.000	3.46	11.08	.86
1.917	.86	5.000	39.79	8.083	3.46	11.17	.86
2.000	.86	5.083	39.79	8.167	3.46	11.25	.86
2.083	.86	5.167	39.79	8.250	3.46	11.33	.86
2.167	.86	5.250	39.79	8.333	1.73	11.42	.86
2.250	.86	5.333	11.24	8.417	1.73	11.50	.86
2.333	5.19	5.417	11.24	8.500	1.73	11.58	.86
2.417	5.19	5.500	11.24	8.583	1.73	11.67	.86
2.500	5.19	5.583	11.24	8.667	1.73	11.75	.86
2.583	5.19	5.667	11.24	8.750	1.73	11.83	.86
2.667	5.19	5.750	11.24	8.833	1.73	11.92	.86
2.750	5.19	5.833	11.24	8.917	1.73	12.00	.86
2.833	5.19	5.917	11.24	9.000	1.73	12.08	.86
2.917	5.19	6.000	11.24	9.083	1.73	12.17	.86
3.000	5.19	6.083	11.24	9.167	1.73	12.25	.86
3.083	5.19	6.167	11.24	9.250	1.73		

Max.Eff.Inten.	(mm/hr)=	39.79	118.53	
over	(min)	5.00	10.00	
Storage Coeff.	(min)=	1.24 (ii)	5.48 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	.33	.16	
				TOTALS
PEAK FLOW	(cms)=	.00	.00	.004 (iii)
TIME TO PEAK	(hrs)=	4.58	5.25	5.25
RUNOFF VOLUME	(mm)=	85.48	80.09	82.42
TOTAL RAINFALL	(mm)=	86.48	86.48	86.48
RUNOFF COEFFICIENT	=	.99	.93	.95

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB
STANDHYD (0100) | Area (ha)= 3.16
ID= 1 DT= 5.0 min | Total Imp(%)= 82.00 Dir. Conn.(%)= 82.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	2.59	.57
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	145.10	40.00
Mannings n	=	.013	.250
Max.Eff.Inten.	(mm/hr)=	39.79	39.49
over	(min)	5.00	15.00
Storage Coeff.	(min)=	4.62 (ii)	14.85 (ii)
Unit Hyd. Tpeak	(min)=	5.00	15.00
Unit Hyd. peak	(cms)=	.22	.08

				TOTALS
PEAK FLOW	(cms)=	.29	.06	.347 (iii)
TIME TO PEAK	(hrs)=	5.17	5.25	5.25
RUNOFF VOLUME	(mm)=	85.48	80.09	84.51
TOTAL RAINFALL	(mm)=	86.48	86.48	86.48
RUNOFF COEFFICIENT	=	.99	.93	.98

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 98.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR (0103)
IN= 2---> OUT= 1
DT= 5.0 min

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
.0000	.0000	.3500	.1300
.0150	.0677	.0000	.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0100)	3.160	.347	5.25	84.51
OUTFLOW: ID= 1 (0103)	3.160	.275	5.33	84.15

PEAK FLOW REDUCTION [Qout/Qin](%)= 79.26
TIME SHIFT OF PEAK FLOW (min)= 5.00
MAXIMUM STORAGE USED (ha.m.)= .1171

ADD HYD (0105)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0104):	.04	.004	5.25	82.42
+ ID2= 2 (0103):	3.16	.275	5.33	84.15
ID = 3 (0105):	3.20	.279	5.25	84.12

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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| ADD HYD   (0110) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0109):     1.38    .146     5.17    74.62
        + ID2= 2 (0105):     3.20    .279     5.25    84.12
          ================================================
          ID = 3 (0110):     4.58    .414     5.25    81.26

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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| ADD HYD   (0111) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0106):     1.55    .169     5.25    82.24
        + ID2= 2 (0110):     4.58    .414     5.25    81.26
          ================================================
          ID = 3 (0111):     6.13    .583     5.25    81.51

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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--------------------
| ADD HYD   (0112) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0107):      .63    .069     5.25    84.12
        + ID2= 2 (0111):     6.13    .583     5.25    81.51
          ================================================
          ID = 3 (0112):     6.76    .652     5.25    81.75

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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--------------------
| ADD HYD   (0113) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0108):      .76    .081     5.17    74.62
        + ID2= 2 (0112):     6.76    .652     5.25    81.75
          ================================================
          ID = 3 (0113):     7.52    .731     5.17    81.03

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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 FINISH
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