Functional Servicing and Stormwater Management Report (FSR/SWM)

613 Helena Street Residential Development Town of Fort Erie

ARCADIS

IBI GROUP

Prepared for SS Fort Erie Inc.
by Arcadis IBI Group
ARCADIS IBI GROUP Project #131951
November 22, 2022

Document Control Page

CLIENT:	SS Fort Erie Inc.	
PROJECT NAME:	613 Helena Street Residential Development, Town of Fort Erie	
REPORT TITLE:	Functional Servicing and Stormwater Management Report	
IBI REFERENCE:	Arcadis IBI Group Project #131951	
VERSION:	2	
DIGITAL MASTER:	J\HM\131951_613_Helen\7.0_Production\7.03_Design\04_Civil\ FSR\131951_613Helena_FSSR_FINAL_V2_Nov 2022.docx	
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CIRCULATION LIST:	SS Fort Erie Inc.	
HISTORY:		
IDENTIFICATION	**DATE**	**DESCRIPTION OF ISSUED AND/OR REVISION**
First Submission	Feb. 2022	Issued for Client Review
Second Submission	**Nov 2022**	**Issued for Client Review**

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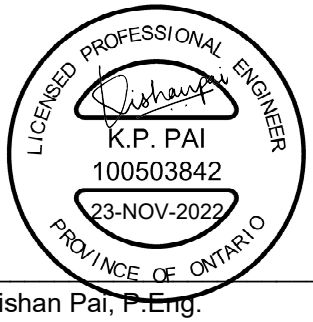

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1 Introduction

IBI Group Professional Services (Canada) Inc. (Arcadis IBI Group) was retained by "SS Fort Erie Inc." (the "Owner") to prepare a site-specific Functional Servicing and Stormwater Management Report (FSSR), for a proposed residential development at 613 Helena Street (the "Subject Lands"), in accordance with the Town of Fort Erie (the Town") and the Regional Municipality of Niagara (the "Region") development guidelines.

The total development area is approximately 8.2 ha and located near the intersection of Washington Road, and Albany Street.

Refer to **Plate 1** for an aerial view of the site and **Plate 2 and 3** for landscape views along Helena Street.

PLATE 1: Site Aerial Photo (Source: maps.google.ca)

PLATE 2: Helena Street looking southwest at subject lands (Source: maps.google.ca)

PLATE 3: Helena Street looking northwest at the subject lands (Source: maps.google.ca)

This report will document the functional grading, servicing and stormwater management controls for the subject lands in order to demonstrate the feasibility of the proposed development in accordance with local and municipal regulatory agencies development criteria from a site civil engineering perspective.

2 Existing Conditions

The subject lands are 8.20 ha mainly greenfield with five (5) existing buildings and bounded by greenfield lands to the north and south, Helena Street to the east and Kraft Road to the west.

The subject lands are presently located outside the current Fort Erie urban boundary, but within the potential boundary expansion area of the Town of Fort Erie, Niagara Region.

2.1 Roads

Currently, the subject lands are only accessible from Helena Street, which is a township rural street with two (2) lanes of traffic and a right-of-way width of 20m.

2.2 Topography and Drainage

The subject land is generally flat with approximately 2.37 ha of site flows overland westerly to the adjacent wetland. The storm runoff from the remaining 1.88 ha is draining overland and through existing ditches to the west roadside ditch on Helena Street. See **Figure 3** in **Appendix A**, which shows the existing catchment boundary and drainage flow directions of the subject land.

The existing roadside ditches on both sides of Helena Street flow south and outlet at the intersection of Washington Road and Albany Street.

2.3 Sanitary Infrastructure

The proposed development is within the service area of the Dominion Road Sewage Pumping Station (SPS). Based on the research information, the Dominion Road pumping station has been recently upgraded according to the Region's comments, dated January 18, 2019. In this memorandum, Region of Niagara staff have confirmed that the proposed sanitary flow from the fully developed site can readily be accommodated by the receiving infrastructure. Their preliminary review of the downstream sanitary sewer system indicates that capacity is available within the system to convey the flows from the proposed development.

Based on the as-constructed drawings provided by the Region, a 200 mm diameter sanitary sewer exists at the intersection of the Helena and Albany Street. The existing sanitary manhole (#22) is located approx. 465 m south of the subject lands.

2.4 Water Supply and Distribution

P0resently There is no existing watermain servicing the subject site. Based on the as-constructed drawing provided by the Town, the nearest existing municipal watermain is a 150/200 mm diameter pipe located approximately 450 m south of the development at the intersection of Helena Street and Albany Street.

There is also a fire hydrant located at 100m north of the subject site on Helena Street that has a fire flow around 50 L/s according to the Niagara Region 2016 Water and Wastewater Master Servicing Plan.

2.5 Utilities

The nearest residential development is located just south of Albany Street where utilities such as: hydro, gas, telephone, and cable services are present and can be extended to service the proposed development. Use of these utilities will be verified and confirmed at the detail design phase.

3 Proposed Conditions

The proposed residential development will consist of 17 townhome blocks, municipal roadways, landscaped areas, and a designated SWM pond block.

Refer to **Figure 2** in **Appendix A** for a preliminary site plan of the development.

3.1 Roads

The proposed development will have two (2) vehicular accesses from Helena Street. The internal roadway will consist of a standard 20.0m R.O.W. which will be designed as a two-lane standard local roadway per the Town of Fort Erie's Typical Urban Road Cross-Section, Standard Drawing No. PW-501 FE.

3.2 Grading

The grading strategy for the proposed development will respect the existing grades along the property lines and the existing drainage divide. In general, the proposed site grading of the site will match the existing perimeter grades where possible. Split lots and walk-out grading of the medium density blocks will be used to minimize the cut/fill requirements. The proposed lot grading will direct runoff unto the municipal ROW, rear lot swales, and ultimately into the proposed storm sewers, with some rear yard areas conveyed to the wet land. The proposed grading will respect the existing drainage split, with most of the area directed west towards the SWM Pond and wet land, and the remaining area conveyed to the ditch on Helena Street.

Refer to **Figure 8** in **Appendix A** where a preliminary grading plan shows the proposed grading approach.

As a general guideline for the proposed site grading, the following Town standards will be observed:

- Lot surfaces shall be constructed to a minimum grading of two precent (2.0%);
- Minimum – maximum road grading (including sidewalks) of 0.5% - 8%;
- Maximum grade of 3:1 for slope; and,
- Minimum – maximum driveway grade of 2% to 6%.

The proposed site grading is constrained by the existing grades along the site perimeter and Helena Street, we will however ensure smooth transitions between proposed and existing ground. Any drainage alternation will not have negative effect on the neighbouring properties. The majority of the overland flows from the residential development will be conveyed towards the Kraft drain Wetland Complex.

Grading of the site and building accesses will ensure barrier free walkways to main entrances. Pedestrians will have access throughout the development via sidewalks to the various building entrances.

3.3 Sanitary Infrastructure

The total design flow from the proposed development is 6.70 L/s as per the design guidelines of the Town of Fort Erie's **Subdivision Control Guidelines 2021**.

The proposed sanitary sewer network consists of 200mm diameter pipe which collects and conveys sewage towards the south of the site along Helena Street with cover ranging from 1.5m – 4.50m. The sewers have slope ranging from of 0.35%-0.50% with 1.0% for the initial sewer leg. The sanitary sewer along Helena Street was designed with 0.35% slope to maintain frost cover and minimum velocity.

A sanitary outlet for the subject lands will connect to the existing sewer along Helena Street. The preferred sanitary outlet is via a 200mm diameter gravity trunk sewer to the existing sanitary manhole #22 located at south of the subject site along Helena Street.

The sewer layout and inverts have been conceptually designed and are shown in the **Figure 5** in **Appendix A**.

A minimum of 1.5m of depth on local sanitary sewers have been provided to allow gravity connections to slab on grade residential dwellings and due to grading constraints on Helena Street. Providing the standard depth of 2.40m on Helena Street is difficult without raising the existing road grade.

During detailed design, local sanitary sewers within the subdivision will be sized based on the design flow (detailed below) and in accordance to Regional design standards.

In accordance with the Town's Subdivision Control Guidelines, residential sewage flows shall be calculated on the basis of the following for residential areas:

- Residential Average Daily Domestic Flow – 320 litres/person/day (lpcd)
- Infiltration Allowance for new subdivision – 0.15 litres/sec/hectare; and,
- Peaking factor – minimum 2.0 and maximum 4.0
- Velocity – minimum 0.6 m/s and maximum 3.0 m/s

All sanitary sewer shall be sized to handle the theoretical daily peak flow per the town's requirement, the sanitary sewage flows have been estimated using the following formula:

$$Q = \frac{PqM}{86.4} + IA$$

The subject lands are zoned for specific residential use, the following population density has been used and as shown in the following **Table 3.1.**

Table 3.1 Population Densities – Known Lot Configuration

TYPE OF HOUSING	PERSONS/HECTARE
Townhouses, Semi-Detached, Duplex	80

Refer to the **Sanitary Design Sheet**, in **Appendix B**.

3.4 Stormwater Management

3.4.1 Design Criteria

This report provides a brief stormwater management (SWM) review of the pre-development conditions, post-development conditions, and addresses opportunities to reduce peak flows to meet Town and Niagara Peninsula Conservation Authority (NPCA) criteria.

Refer to **Appendix A** for drainage area plans and **Appendix E** for calculations.

The Town of Fort Erie and Niagara Peninsula Conservation Authority have the following requirements for stormwater management:

- Mitigate downstream erosion impacts: Attenuate post-development peak flows for the 2-year, 5-year and 100-year design storm to pre-development rates.
- Provide stormwater quality control to an Enhanced Protection Level (80% TSS removal).

3.4.2 Existing Drainage Condition

The subject site is approximately 4.25 hectares and mostly consists of agricultural and vacant lands. Existing residential buildings cover only ~15% of the total area. Approximately 2.37 ha of the site drains west via overland flows to the adjacent wetland. The remaining 1.88 ha drains through existing ditches to the west roadside ditch on Helena Street. This roadside ditch outlets to an existing 1050mm diameter storm sewer at the interstation of Helena Street and Washington Road. **Table 3.2** summarizes the existing drainage condition of the site. Error! Reference source not found. summarizes the existing drainage condition of the site.

Table 3.2 – Existing Drainage Area and Runoff Coefficients

Drainage Area ID	Description	Outlet	Total Area (ha)	Runoff Coefficient	Impervious %
A1 Pre	Agricultural Land, existing buildings	Western Wetland	2.37	0.25	0
A2 Pre		Roadside ditch on Helena St.	0.84	0.27	9
A3 Pre			0.46	0.34	19
A4 Pre			0.58	0.31	16
Site - Total			4.25	0.28	12
EXT-1	Grassed Land	Roadside ditch on Helena St.	0.24	0.25	0

Refer to **Figure 3** following this report for the pre-development drainage area plan.

A Hydro-Geotechnical Investigation was undertaken by HLV2K Engineering Limited (HLV2K) dated September 08, 2021. Four boreholes (BH5, BH6, BH7 and BH11) were converted to groundwater monitoring wells and were used to obtain hydrologic and groundwater quality information. Groundwater elevations were found to range from 179.30 m to 180.58 m. The native soil (silty clay) in the area is dense with low hydraulic conductivity and the infiltration is expected to be low. The geotechnical investigation report is included in **Appendix F**.

3.4.3 Stormwater Management Strategy

The proposed storm sewer system will capture runoff up to the 5-year return period and discharge it to tow outlets, the proposed SWM dry pond to the west or the western roadside ditch along Helena Street to the east. For storms greater than the 5-year return period and up to the 100-year return period, runoff will be conveyed within the road right-of-way.

Similar to the existing conditions, the proposed site development will drain via two (2) storm outlets. Storm sewer and overland flow from Area A1-Post will discharge to a SWM dry pond (Area A4-Post) at the northwest corner of the site and will ultimately drain to the adjacent wetland. The proposed SWM dry pond will be designed to provide stormwater quantity and quality control for Area A1-Post. A Jellyfish OGS will provide the required 80% removal with the dry pond providing additional treatment as part of the treatment-train approach. The SWM pond outlet will discharge to a flow spreader to dissipate flows and prevent erosion and sedimentation of the wetland.

For the eastern part of the development, storm sewers from Areas A5-Post and A6-Post will discharge to the western roadside ditch on Helena Street. Superpipes are proposed to capture and store up to the 100-year return period runoff to attenuate peak flows to the ditch to pre-development rates. An oil-grit separator (OGS) will provide some treatment (60% TSS removal). The remaining 20% TSS removal will be provided by the existing ditch along Helena Street frontage as part of a treatment train approach.

Figure 4 in **Appendix A** shows the proposed stormwater catchment areas and flow directions.

As per Town of Fort Erie and NPCA requirements, a hydrologic model was prepared using VISUAL OTTHYMO to simulate the existing and proposed drainage conditions for the site. The 2-, 5- and 100-year storm events were generated based on Town of Fort Erie's IDF parameters. Parameters for the hydrologic model were based on land use, land cover and site grades. A Curve Number (CN) of 74 for Hydrologic Soil Group C was used for the site based on the above hydro-geotechnical investigation.

The hydrologic model schematic and modeling parameter summary tables are included in **Appendix E**.

3.4.4 Proposed Drainage Conditions

Based on the current site plan, the proposed development will consist of townhouses, roadways, landscaped areas, and a SWM pond. As per the proposed grading/servicing plans for the site, the development will be comprised of a total of eight (8) internal drainage areas and one (1) external drainage area.

Table 3.3 provides a summary of the runoff coefficients for each proposed drainage areas. Runoff coefficient calculations applied a runoff coefficient of 0.9 for impervious areas and a runoff coefficient of 0.25 for pervious areas, as per the Town's standards. Refer to **Figure 4** for the post-development drainage area plan.

Table 3.3 – Drainage Area and Runoff Coefficients

Drainage Area ID	Description	Total Area (ha)	Runoff Coefficient	Impervious %
A1 Post	Residential to SWM Pond - Controlled	2.27	0.67	66
A2 Post	Residential Roof + Landscape to South Wetland - Uncontrolled	0.30	0.58	54
A3 Post	Residential Roof + Landscape to North Wetland - Uncontrolled	0.42	0.53	47

Drainage Area ID	Description	Total Area (ha)	Runoff Coefficient	Impervious %
A4 Post	SWM Pond Block	0.45	0.25	0
A5 Post	Residential area to Roadside Ditch - Controlled	0.24	0.71	73
A6 Post	Residential area to Roadside Ditch - Controlled	0.35	0.65	64
A7 Post	Easement-Uncontrolled	0.07	0.31	16
A8 Post	Residential Roof South to Roadside Ditch - Controlled	0.16	0.61	58
Site - Total		**4.25**	**0.60**	**57**
EXT-1	Grassed Land to Roadside Ditch	0.24	0.25	0

3.4.4.1 Proposed Minor Storm Drainage System

The proposed minor system will capture runoff up to the 5-year return period. The storm sewers for Area A1-Post are sized between 300mm to 525mm diameter with a slope of 0.5% and a minimum cover of 1.5 m. RYCBs will be proposed to capture rear yards flows from the interior lots of catchment area A1- Post. The super-pipe (CBMH2 to CBMH10) for Area A5-Post will be 750mm diameter with a slope of 0.3% and a minimum cover of 1.0 m to the spring line at CBMH10, which will require frost protection. The super-pipe (MH9 to CBMH10) for Area A6-Post will be 750mm diameter with a slope of 0.5% and a minimum cover of 0.78 m to the spring line at CBMH10, which will require frost protection. An OGS will be provided immediately downstream of the orifice control prior to the Helena Street roadside ditch.

3.4.4.2 Proposed Major Storm Drainage System

The site will be graded to contain the proposed major system runoff from most of the development on site. The major runoff from drainage area A1-Post (100-year storm event) will be ultimately directed overland along the road to the proposed SWM pond (A4-Post) and controlled on site. Major runoff from drainage areas A5-Post and A6-Post will be captured by Super CB's in Street A (North and South) and directed to the superpipes noted above. Major runoff from A7-Post (easement) will drain overland to the roadside ditch on Helena Steet. Runoff generated from the site perimeter areas of the site (A2-Post and A3-Post) will drain uncontrolled towards the adjacent wetlands.

3.4.5 Stormwater Quantity Control

As per Town of Fort Erie's storm design criteria, the total post-development flows from the site should not exceed pre-development peak flows for corresponding storm events. Since the proposed development will increase the overall imperviousness of the site, quantity controls are required to achieve the target flow rates. Stormwater management quantity controls for the site are provided using super-pipes with an orifice control upstream of the roadside ditch (Outlet 2) on Helena Street as well as the outflow control associated with the SWM pond (Outlet 1) located at the northwest corner of the site.

VISUAL OTTHYMO was used to model the hydrology under existing and proposed conditions for the 24-hr Chicago 2-year, 5-year and 100-year storm events with rainfall intensity values derived from the Township of Fort Erie Subdivision Control Guidelines (2016).

Model results determined the SWM pond storage volume required to attenuate post-development peak flows from A1-Post to A4-Post to pre-development rates. The proposed dry pond will provide an active storage volume of 2206 m^3 (total pond volume of 2726 m^3 with 0.3m freeboard), of which 1616 m^3 will be required to control the 100-year storm event. A 75 mm circular orifice opening and 100mm x 100mm rectangular weir will be installed at the pond outlet structure to control the 2 to 100-year peak discharge. Error! Reference source not found. summarizes the peak discharge from the site and storage volume requirements vs. storage volume provided by the SWM pond.

Table 3.4 – Outlet 1- SWM Pond - Controlled Release Rates to Wetland

Return Event	Allowable Release Rate to Wetland (m^3/s)	Total Proposed Discharge Rate (m^3/s)	Uncontrolled Discharge Rate to Wetland (m^3/s)	Controlled Discharge from Pond (m^3/s)	Active Storage Required (m^3)	Active Storage Provided (m^3)
2-yr	0.074	0.074	0.063	0.011	554	2206
5-yr	0.129	0.100	0.083	0.017	842	
100-yr	0.310	0.193	0.158	0.035	1616	

Refer to **Appendix E** for detailed hydrologic modelling input and output printouts and stage-storage-discharge relationships of SWM pond and super-pipe.

As summarized in Error! Reference source not found. below, proposed runoff from drainage area A5-Post and A6-Post will be controlled by an 85m long 750mm superpipe located in the easement and 51m long 750mm superpipe located in Street A (south) with a 200mm orifice control at CBMH 10 prior to discharging to the existing roadside ditch. Super-pipes and MHs will provide a total of 73 m^3 storage volume to control 2-year to 100-year peak flows. Required super-pipe storage volumes are generated in the hydrologic model and detailed results are provided in **Appendix E**.

Table 3.5 - A6 Post – Super Pipe - Controlled Release Rates to Roadside Ditch

Return Event	Allowable Release Rate to Ditch (m^3/s)	Total Proposed Discharge Rate (m^3/s)	Uncontrolled Discharge Rate to Ditch (m^3/s)	Controlled Discharge after Orifice (m^3/s)	Pipe Storage Required (m^3)	Pipe Storage Provided (m^3)
2-yr	0.081	0.079	0.027	0.052	22	73.6
5-yr	0.134	0.097	0.039	0.060	32	
100-yr	0.336	0.175	0.082	0.110	73	

Table 3.6 - Total Release Discharge Rates – Proposed vs. Existing

Return Event	Existing Conditions-Total (m^3/s)	Proposed Conditions-Total (m^3/s)	Change in Total (m^3/s)
2yr	0.155	0.153	-0.002
5yr	0.263	0.197	-0.066
100yr	0.646	0.368	-0.278

As shown in Error! Reference source not found. above, the proposed total release rates from the site for 2-, 5- and 100-yr storm decreases compared to existing conditions. Therefore, the total post-development release rates that consist of the controlled flow rates from the SWM pond and superpipes and the

uncontrolled flow rates from A2-Post, A3-Post and A7-Post do not exceed the total pre-development release rates for corresponding storm events.

The analysis indicates the following:

- For the 2-year to 100-year events, the total proposed conditions peak discharges from the site will be controlled to existing conditions levels as illustrated **Error! Reference source not found.**. This satisfies the stormwater management quantity control requirement set by the Town of Fort Erie and NPCA.
- Sufficient storage volume is provided by the SWM pond as well as within the super pipes to contain stormwater as illustrated within tables above.

3.4.6 Stormwater Quality Control

Stormwater quality controls are required to meet Enhanced (Level 1) Protection with 80% total TSS removal, as defined by the Ministry of the Environment, Conservation and Parks (MECP) 2003 Stormwater Management Planning and Design (SWMPD) Manual. Quality controls will be provided by a treatment-train approach designed to treat flows prior to discharging from the site.

For residential area A1-Post the treatment-train will consist of a Jellyfish OGS (or approved equivalent) followed by the SWM dry pond prior to discharging to the adjacent wetlands. For residential area A5-Post and A6-Post, the treatment-train will consist of an oil-grit separator (OGS) unit installed downstream of the orifice control as well as treatment from the downstream roadside ditch along the Helena Street frontage.

The OGS unit has been sized to provide 60% TSS removal, as certified by the ETV. The treatment-train approach parameters at each storm outlet are summarized in **Table 3.7** below.

Table 3.7 – Quality Control Treatment Train Parameter Summary

Outlet ID	Treatment Train	Drainage Area (Ha)	Paved Impervious	Overall TSS Removal
1	SWM Dry Pond+ Jellyfish Filter	2.27	26%	91%
2	OGS + Ditch / Swale	0.59	22%	92%

Uncontrolled areas A2-Post, A3-Post, A7-Post and A8-Post are comprised of landscaped areas and hence runoff is considered to be clean. Combined with the proposed treatment-train at each outlet, the proposed stormwater management control will provide an overall TSS removal of at least 90% for the subject site. Therefore, the treatment train approach meets the requirement for an “Enhanced” level (80% TSS removal) of water quality control. Refer to **Appendix** E for detailed OGS sizing report. Detailed quality control calculations are also provided in **Appendix E**.

3.4.7 Water Balance

The native soil in the area is dense with low hydraulic conductivity and the infiltration is expected to be low. However, a water balance analysis was completed for the site to estimate the change in water recharge for the pre and post development condition. The results are presented in a separate water balance analysis report by HLV2K Engineering Limited (HLV2K) dated November 10, 2021. The water balance analysis report is included in **Appendix F** for reference.

3.5 Water Supply and Distribution

The proposed development is to be serviced by the pressure zone 241m water distribution system, in the Town of Fort Erie.

As suggested by the Town, the proposed development will receive water supply from a connection to the existing municipal 200 mm watermain located at the intersection of Helena Street and Albany Street.

Approximately 116 residential units are to be developed within the subject land with the ground elevations ranging from 182 to 186 m.

The estimated water consumption for the proposed residential development is anticipated to be approximately 2 L/s, 3 L/s and 5 L/s for the average day, maximum day and peak hour condition, respectively. **Appendix D** shows the water demand estimations and the design guidelines of the Town of Fort Erie's Subdivision Control Guidelines 2021.

As per Town's Subdivision Control Guidelines 2021, the required fire flow was determined in accordance with the calculations from the FUS. The following assumptions have been made for the fire flow estimations:

- Consist of wood frame construction.
- A fire wall (2-hour rating) each will be installed for every three units within the buildings for each Townhouse block.
- A 25% reduction for the Occupancy and Contents Adjustment Factor.
- The floor area for each unit is approximately 163 m2 (1750 ft^2).
- Based on the above assumptions, the required fire flow using the FUS method (see **Appendix D** for details) is approximately 133L/s for the subject development.

For watermain sizing, a 200mm watermain is proposed within the subject land. Two (2) watermain sizing options for the proposed section along Helena Street, from Albany Street and subject site connection, have been considered and evaluated to provide water servicing to the subject site:

Option 1

A 200 mm watermain along Helen Street: As shown in Appendix D, the required system head (HGL) 240m is at the proposed watermain connection located at Albany Street and Helena Street. It is slightly below the existing system HGL 241 m (at the water tower location). With the additional head losses along the existing watermains in the distribution system. Option 1 appeared not feasible to provide sufficient flow to the subject lands under maximum day plus fire flow conditions.

Option 2

A 250 mm watermain along Helena Street. The required system head (HGL) 210m is at the proposed watermain connection located at Albany Street and Helena Street. The required system head is significantly reduced, in comparison with Option 1. Option 2 is a preferable option.

In addition, water turnover rates for the proposed watermain Option 2 have been analyzed as shown in **Appendix D**. The turnover rates (under average day demand) are less than 2 hours along the watermains within the subject lands and less than 5 hours for the proposed watermains including a 250mm watermain along Helena Street, which meets the typical water turnover requirement of 24 hours.

As shown in **Appendix D**, the water turnover rates along the proposed 200 mm watermain within the subject lands meet the typical water turnover rate requirements. A larger 200mm watermain significantly reduces the head losses for the watermains within the subject lands under the fire flow conditions. Therefore, a 200 mm watermain within the subject lands is recommended.

Refer to **Figure 6** in **Appendix A** for details of the proposed water servicing. Please note that a 200 mm watermain along Helena Street is currently shown in **Figure 6**. Further detailed analysis will be conducted by the Town's consultant to assess the available system capacity and/or confirm the size requirement for the proposed watermain along Helena Street.

The Town may consider performing hydrant fire flow tests along the existing watermains in the vicinity of the subject lands to confirm the available system pressures near the proposed watermain connection.

Periodic watermain flushing shall be performed to ensure that adequate water turnover be maintained under the initial development conditions.

3.6 Utilities

The various utility services (i.e., Hydro, Gas, Cable and Telephone) will facilitate the proposed development by extending their respective existing infrastructure from the intersection of Helena Street and Albany Street.

We anticipate that each of these utilities will as required, identify their specific requirements through the standard application circulation, review and design process.

4 Erosion & Sediment Control

During construction, erosion and sediment control measures will be required in accordance with the Town of Fort Erie, Niagara Region and Niagara Peninsula Conservation Authority. Details of these controls will be provided during the detailed engineering design and will include as a minimum the following:

- Silt fences erected around the site perimeter before any grading or topsoil stripping begins on the site to protect adjacent areas from migration of sediment in runoff.
- Installation of a "mud mat" at the construction entrance(s) to the site to minimize the amount of sediment transported off site by construction vehicles.
- Stabilization of all disturbed areas to minimize the opportunity for erosion.
- Stabilization of slopes greater than 5:1 using suitable methods (e.g. erosion control mats, tackifier and seed, etc.) as soon as practical.

5 Summary

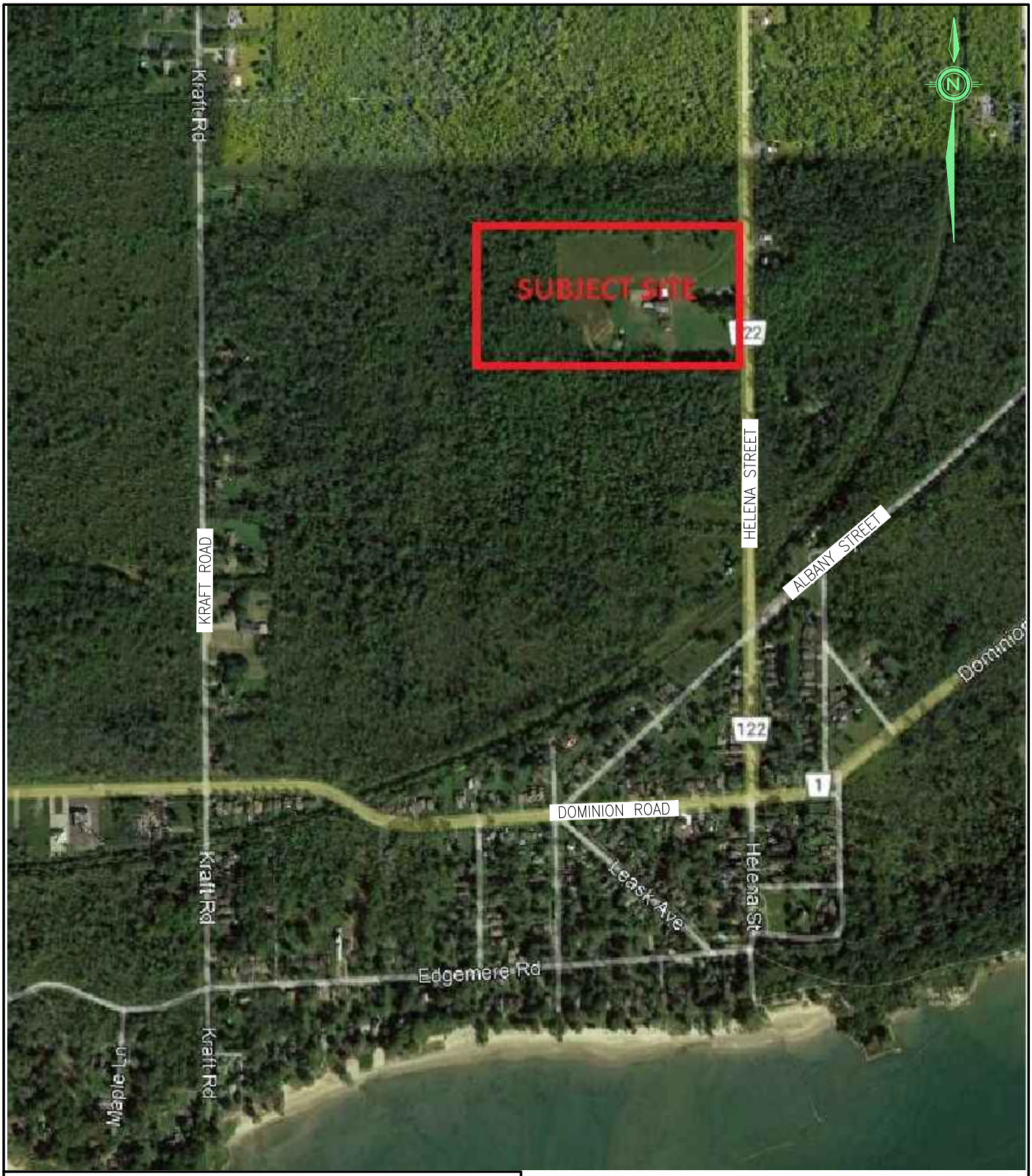
This report demonstrates that the proposed Helena Street Residential Development is feasible from a civil engineering perspective in accordance with the Town of Fort Erie Subdivision Control Guideline.

The following summarizes key aspects of the design:

- The proposed site grading will achieve compliant site gradients and match into the existing grades at its limits.
- The proposed development will outlet sanitary sewage into municipal infrastructure by extending the sewer and connecting to the existing Dominion Road Sewage Pumping Station.
- Stormwater management design for the proposed development incorporates quality and quantity control at an enhanced protection level utilizing a wetland facility. The proposed development will attenuate the proposed conditions under 5-year and 100-year storm events to pre-development levels.
- The proposed Helena Street Residential Development will connect to the proposed 250 mm watermain along Helena Street (south of subject site). The size of this watermain will be confirmed by the Town.

We trust the foregoing in conjunction with the functional engineering drawings are satisfactory to demonstrate the development's feasibility from a municipal engineering perspective to support the rezoning application for the development. Should there be any questions or if further information required, please do not hesitate to contact Arcadis IBI Group.

Appendix A
Figures



LOCATION PLAN
HELENA STREET RESIDENTIAL DEVELOPMENT
613 HELENA STREET , FORT ERIE
REGIONAL MUNICIPALITY OF NIAGARA

CLIENT:	SS FORT ERIE INC.
DATE: NOVEMBER 2022	PROJECT No.: 131951
SCALE: N.T.S.	FIGURE No.: 1

Niagara Region

FORT ERIE ONTARIO Our Focus: Your Future

ARCADIS IBI GROUP
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\\conrest.ibigroup.com\J\HM\131951_613_Helen\7.0_Production\7.03_Design\04_Civil\FSR\SHEETS\LOCATION PLAN.dwg (Location Plan)

BLOCK 20
ROAD WIDENING

LIMIT OF PSW

DRIPLINE AS STAKED BY BEACON AND REGION OF NIAGARA MARCH 24, 2020

15.0m BUFFER TO WETLAND/DRIPLINE

15.00 BUFFER

EX. POND
TO BE REMOVED

BLOCK 18
STORMWATER
MANAGEMENT
0.53ha (1.31ac)

OVERLAND
FLOW ROUTE

EASEMENT

STREET 'A'

20.00
5.75
8.50
5.75

HELENA STREET

EX. BUILDING
(TO BE REMOVED)

EX. GARAGE
(TO BE REMOVED)

POST AND WIRE FENCE

ASPHALT

CONCRETE
(TO BE REMOVED)

BLOCK 19
ENVIRONMENTAL LANDS
3.82ha (9.39ac)

BLOCK 10

EX. POND
(TO BE REMOVED)

BUSLANE

TOP OF BANK

SITE PLAN
HELENA STREET RESIDENTIAL DEVELOPMENT
613 HELENA STREET , FORT ERIE
REGIONAL MUNICIPALITY OF NIAGARA

CLIENT:	SS FORT ERIE INC.		
DATE:	NOVEMBER 2022	PROJECT No.:	131951
SCALE:	1:500	FIGURE No.:	2

Niagara Region

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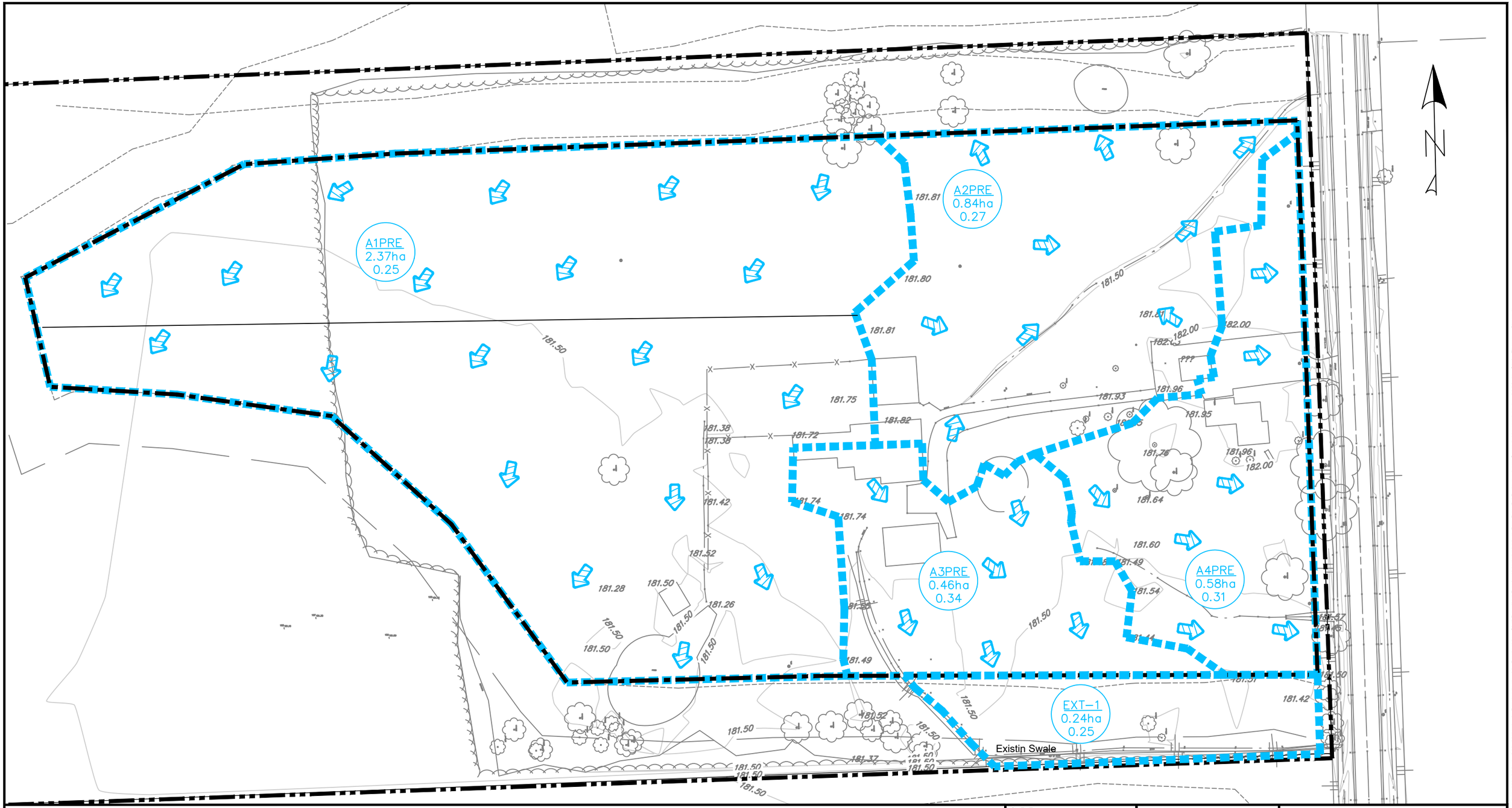
LEGEND

SITE BOUNDARY



LEGEND:

- DRAINAGE AREA BOUNDARY
- PROPERTY LINE
- SITE BOUNDARY
- EXISTING CONTOURS
- EXISTING ELEVATION (237.20)
- OVERLAND FLOW

A3PRE / 5.36ha / 0.70 — DRAINAGE AREA ID* / AREA (ha) / RUNOFF COEFFICIENT

CLIENT	SS FORT ERIE INC.
PROJECT NAME	HELENA ST. RESIDENTIAL DEVELOPMENT 613 HELENA ST., FORT ERIE, REGIONAL MUNICIPALITY OF NIAGARA
SCALE:	1:750
DATE:	2022-10-13
PROJECT ENG:	WH
DRAWN BY:	NL
CHECKED BY:	WH
APPROVED BY:	WH
PROJECT NO:	131951
FIGURE NAME	PRE-DEVELOPMENT DRAINAGE AREAS
FIGURE NO.	1
REVISION	2

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SCALE CHECK 10mm 1 in

File Location: H:\131951_613_Helen\7 0_Production\7 03_Design\04_Civil\Detailed Design\Model\131951-Pre-Dev.DAP.dwg Last Saved: November 17, 2022, by Chris Zhang Plotted: Wednesday, November 23, 2022 9:56:56 AM by Chris Zhang

PROPOSED DRAINAGE CATCHMENTS

HELENA STREET RESIDENTIAL DEVELOPMENT

613 HELENA STREET , FORT ERIE
REGIONAL MUNICIPALITY OF NIAGARA

CLIENT:	SS FORT ERIE INC.		
DATE:	NOVEMBER 2022	PROJECT No.:	131951
SCALE:	1:500	FIGURE No.:	4

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LEGEND

- EX. CONTOURS
- PROPOSED STORM SEWER
- DRAINAGE AREA BOUNDARY
- OVERLAND FLOWING TO THE STREET
- OVERLAND FLOWING TO THE BACK OF LOT
- OVERLAND FLOWING TO THE POND
- A1Post — DRAINAGE AREA ID
- 2.27ha — AREA (HECTARES)
- C=0.6 — % IMPERVIOUS
- SITE BOUNDARY
- PROP. HEAD WALL

PROP. MH02A
TOP = 184.13
SW. INV. 181.77 (200ø)
E. INV. 181.74 (200ø)

PROP. MH05A
TOP = 182.25
W. INV. 180.61 (200ø)
S. INV. 180.55 (200ø)

PROP. MH03A
TOP = 184.83
W. INV. 181.36 (200ø)
E. INV. 181.36 (200ø)

PROP. MH04A
TOP = 185.66
W. INV. 180.94 (200ø)
E. INV. 180.94 (200ø)

PROP. MH09
TOP = 182.15
W. INV. 180.35 (200ø)
S. INV. 180.29 (200ø)
N. INV. 180.29 (200ø)

PROP. MH01A
TOP = 184.05
N. INV. 181.95 (200ø)
SE. INV. 182.05 (200ø)

PROP. MH06A
TOP = 184.00
NW. INV. 181.46 (200ø)
SE. INV. 181.43 (200ø)

PROP. MH07A
TOP = 183.97
NW. INV. 181.35 (200ø)
E. INV. 181.32 (200ø)

PROP. MH08A
TOP = 185.13
W. INV. 180.68 (200ø)
E. INV. 180.68 (200ø)

PROP. MH10
TOP = 182.12
N. INV. 180.19 (200ø)
S. INV. 180.19 (200ø)

PROP. MH11A
TOP = 181.93
N. INV. 179.84 (200ø)
S. INV. 179.84 (200ø)

PROP. MH12A
TOP = 181.78
N. INV. 179.49 (200ø)
S. INV. 179.49 (200ø)

PROP. MH13A
TOP = 181.42
N. INV. 179.14 (200ø)
S. INV. 179.14 (200ø)

EX. SAN. MH22
EX. TOP=181.18
EX. INV. 178.80

BLOCK 18
STORMWATER
MANAGEMENT
0.53ha (1.31ac)

BLOCK 10

STREET 'A'

OVERLAND
FLOW ROUTE

HELENA STREET

ALBANY STREET

WASHINGTON RD.

EASEMENT

200ø SAN @ 0.5%

200ø SAN @ 1.0%

200ø SAN @ 0.35%

EX. 200ø SAN

0.56 ha | 80 | 22 | 45
0.50 ha | 80 | 18 | 40
0.24 ha | 80 | 6 | 19
0.46 ha | 80 | 16 | 37
0.46 ha | 80 | 17 | 37
0.90 ha | 80 | 35 | 72
0.23 ha | 80 | 6 | 18
0.42 ha | 80 | 15 | 34
0.1 ha | 0 | 0 | 0
0.02 ha | 0 | 0 | 0
0.12 ha | 0 | 0 | 0
0.13 ha | 0 | 0 | 0
0.15 ha | 0 | 0 | 0

15.00 BUFFER

15.0m BUFFER TO WETLAND/DRIPLINE

DRIPLINE AS STAKED BY BEACON AND REGION OF NIAGARA MARCH 24, 2020

BUSHLINE

TOP OF BANK

LIMIT OF PSW

POST AND WIRE FENCE

EX. BUILDING (TO BE REMOVED)

REFER TO THIS DRAWING

LEGEND

- PROP. SANITARY SEWER
- PROP. SAN MANHOLE
- PROP. SANITARY DRAINAGE AREA
- EX. SANITARY SEWER
- EX. SAN MANHOLE
- SITE BOUNDARY
- AREA / UNITS: 0.90 ha | 80 | 31 | 72 — P/Ha — POPULATION

PRELIMINARY FUNCTIONAL SANITARY SERVICING
HELENA STREET RESIDENTIAL DEVELOPMENT
613 HELENA STREET , FORT ERIE
REGIONAL MUNICIPALITY OF NIAGARA

CLIENT:	SS FORT ERIE INC.		
DATE:	NOVEMBER 2022	PROJECT No.:	131951
SCALE:	1:500	FIGURE No.:	5

Niagara Region

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PRELIMINARY FUNCTIONAL WATER DISTRIBUTION

HELENA STREET RESIDENTIAL DEVELOPMENT

613 HELENA STREET , FORT ERIE

REGIONAL MUNICIPALITY OF NIAGARA

CLIENT:	SS FORT ERIE INC.		
DATE:	NOVEMBER 2022	PROJECT No.:	131951
SCALE:	1:500	FIGURE No.:	6

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LEGEND

200mmØ WATERMAIN	EXISTING 150mmØ WATERMAIN
EXISTING 200mmØ WATERMAIN	ABANDONED 100mmØ WATERMAIN
PROPOSED FIRE HYDRANT	SITE BOUNDARY

BLOCK 20
ROAD WIDENING

UNCONTROLLED

0.60
0.07ha.

0.60
0.39ha.

PROP. MH5
TOP = 184.05
S. INV. 182.00 (450ø)
E. INV. 182.03 (450ø)

PROP. MH4
TOP = 184.83
W. INV. 182.45 (450ø)
E. INV. 182.53 (375ø)

PROP. MH01
TOP = 185.66
W. INV. 182.95 (375ø)
E. INV. 181.92 (300ø)

PROP. MH02
TOP = 182.80
W. INV. 181.65 (300ø)
S. INV. 181.35 (750ø)

PROP. 600ø
CSP CULVERT

BLOCK 18
STORMWATER
MANAGEMENT
0.53ha (1.31ac)
DRY SWM POND
HEAD WALL

INV. 181.55

525ø STM
@ 0.5%

75mm CONTROL ORIFICE

JELLYFISH UNIT
TOP183.43

525ø STM
@ 0.5%

OVERLAND
FLOW ROUTE

TO WETLAND
(±181.26)

HW 01
W. INV. 181.55 (525ø)

PROP. JELLYFISH UNIT
TOP = 183.43
W. INV. 181.62 (525ø)
E. INV. 181.64 (525ø)

0.60
0.08ha.

PROP. MH6
TOP = 183.99
N. INV. 181.93 (450ø)
W. INV. 181.86 (525ø)
S. INV. 181.93 (450ø)

BLOCK 19
ENVIRONMENTAL LANDS
3.82ha (9.39ac)

STREET 'A'

450ø STM @ 0.5%

375ø STM @ 0.5%

300ø STM @ 0.5%
(INSULATED)

0.60
0.42ha.

0.60
0.38ha.

0.60
0.22ha.

0.60
0.28ha.

0.60
0.82ha.

0.60
0.37ha.

0.60
0.21ha.

PROP. MH7
TOP = 184.00
N. INV. 182.28 (450ø)
S. INV. 182.31 (450ø)

PROP. MH8
TOP = 183.97
N. INV. 182.40 (450ø)
E. INV. 182.48 (375ø)

0.60
0.48ha.

UNCONTROLLED

PROP. MH9
TOP = 185.13
E. INV. 181.34 (750ø)
W. INV. 183.11 (375ø)

EX. POND
(TO BE REMOVED)

EX. BUILDING
(TO BE REMOVED)

EX. GARAGE
(TO BE REMOVED)

CONCRETE
TO BE REMOVED

RLCB1

RLCB2

SWALE

DITCH

BUSHLINE

LIMIT OF PSW

15.0m BUFFER TO WETLAND/DRIPLINE

DRIPLINE AS STAKED BY BEACON AND REGION OF NIAGARA MARCH 24, 2020

15.00 BUFFER

EASEMENT

HELENA STREET

750ø STM @ 0.30%

UNCONTROLLED

0.60
0.08ha.

PROP. MH10
TOP = 182.62
W. INV. 181.09 (750ø)
N. INV. 181.09 (750ø)
S. INV. 181.06 (450ø)

PROP. 600ø
CSP CULVERT

450ø STM @ 0.50%

OGS-EF06

450ø STM @ 0.50%

HW 02
INV. 181.05

SWALE @ 0.50%

DITCH OUTLET
W. INV. 180.96

BLOCK 10

750ø STM @ 0.5%
(INSULATED)

20mmø
ORIFICE
CONTROL

CBMH10
TOP
182.62

MH9
TOP
185.13

MH5
TOP
184.05

MH4
TOP
184.83

MH1
TOP
185.66

CBMH2
TOP
182.80

MH10
TOP
183.97

MH8
TOP
183.97

N

LEGEND

- EX. CONTOURS
- PROPOSED STORM SEWER
- STORM DRAINAGE AREA
- OVERLAND FLOWING TO THE STREET
- OVERLAND FLOWING TO THE BACK OF LOT
- OVERLAND FLOWING TO THE POND
- 0.60 / 0.35ha — RUNOFF COEFFICIENT / AREA
- SITE BOUNDARY
- PROP. HEAD WALL

PRELIMINARY FUNCTIONAL STORMWATER MANAGEMENT
HELENA STREET RESIDENTIAL DEVELOPMENT
613 HELENA STREET , FORT ERIE
REGIONAL MUNICIPALITY OF NIAGARA

CLIENT:	SS FORT ERIE INC.		
DATE:	NOVEMBER 2022	PROJECT No.:	131951
SCALE:	1:500	FIGURE No.:	7

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BLOCK 20
ROAD WIDENING

MATCH 3:1 SLOPE
TO EXISTING GRADE

BLOCK 18
STORMWATER
MANAGEMENT
0.53ha (1.31ac)

POND BOTTOM (181.55m)

4.0m ACCESS ROAD

FREE-BOARD (183.70m)

JELLYFISH UNIT
TOP:183.43

OVERLAND
FLOW ROUTE

STREET 'A'

HELENA STREET

EASEMENT

PROP. 600Ø
CSP CULVERT

MATCH TO
EX. GRADE

BLOCK 19
ENVIRONMENTAL LANDS
3.82ha (9.39ac)

BLOCK 10

MATCH 3:1 SLOPE
TO EXISTING GRADE

15.00 BUFFER

DRIPLINE AS STAKED BY BEACON AND REGION OF NIAGARA MARCH 24, 2020

LIMIT OF PSW

EX. BUILDING
(TO BE REMOVED)

EX. GARAGE
(TO BE REMOVED)

CONCRETE
(TO BE REMOVED)

DITCH

SWALE

PRELIMINARY GRADING PLAN
HELENA STREET RESIDENTIAL DEVELOPMENT

613 HELENA STREET , FORT ERIE
REGIONAL MUNICIPALITY OF NIAGARA

CLIENT:	SS FORT ERIE INC.		
DATE:	NOVEMBER 2022	PROJECT No.:	131951
SCALE:	1:500	FIGURE No.:	8

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LEGEND

- EX. CONTOURS
- EX. ELEVATION
- PROP. ELEVATION
- SLOPE ARROW
- TRANSITION SLOPE
- SEWER FLOW DIRECTION
- PROP. STM MANHOLE
- PROP. CB MANHOLE
- PROP. HEAD WALL
- PROP. CATCHBASIN
- PROP. SAN MANHOLE
- SITE BOUNDARY
- BUFFER LINE
- OVERLAND FLOWING TO THE STREET
- OVERLAND FLOWING TO THE BACK OF LOT
- OVERLAND FLOWING TO THE POND

Appendix B
Sanitary Calculations

B1 – Sanitary Design Sheet

Minimum Dia. = 200 mm

Mannings "n"= 0.013

Minimum Velocity = 0.60 m/s

Minimum Grade = 0.60 %

Avg. Domestic Flow = 320 l/c/d

Infiltration = 0.15 l/s/ha

Max. Peaking Factor= 4.5

Min. Peaking Factor= 2.0

Maximum Velocity = 3.65 m/s

SANITARY SEWER DESIGN SHEET

Project - Helena Street Residential Development, SS Fort Erie Inc.

Town of Fort Erie

Niagara Regional

Project: Helena Street Residential Development

Project No: 131951

Date: NOV. 22, 2022

Designed by: J.M.

NOMINAL PIPE SIZE USED

\\caneast.ibigroup.com\J\HM\131951_613_Helen\7.0_Production\7.03_Design\04_Civil\FSR\Sewer Design Sheets\SAN\[131951_Helena_SAN_FSR-20221122.xls]Design

STREET	FROM MH	TO MH	RESIDENTIAL						MEDIUM DENSITY					FLOW CALCULATIONS						PIPE DATA				
			AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENISTY (P/ha)	DENSITY (P/unit)	POP	ACC. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	ACC. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACC. POP.	PEAKING FACTOR	RES. FLOW (l/s)	COMM. FLOW (l/s)	TOTAL FLOW (l/s)	DIA. (mm)	SLOPE (%)	Q FULL (l/s)	V FULL (m/s)	V ACT (m/s)
Street A	MH01A	MH02A	0.24	0.24	6	80		19	19	0	0	0	0	0	0.04	19	4.38	0.31	0.0	0.35	200	1.00	32.8	1.04	0.33
Street A	MH02A	MH03A	0.5	0.74	18	80		40	59	0	0	0	0	0	0.1	59	4.30	0.9	0.0	1.05	200	0.50	23.2	0.74	0.37
Street A	MH03A	MH04A	0.56	1.30	22	80		45	104	0	0	0	0	0	0.2	104	4.24	1.6	0.0	1.83	200	0.50	23.2	0.74	0.43
Street A to Helena Street	MH04A	MH05A	0.46	1.76	16	80		37	141	0	0	0	0	0	0.3	141	4.20	2.2	0.0	2.45	200	0.50	23.2	0.74	0.47
Street A	MH01A	MH06A	0.46	0.46	17	80		37	37	0	0	0	0	0	0.1	37	4.34	0.6	0.0	0.66	200	1.00	32.8	1.04	0.39
Street A	MH06A	MH07A	0.23	0.69	6	80		18	55	0	0	0	0	0	0.1	55	4.31	0.9	0.0	0.98	200	0.50	23.2	0.74	0.37
Street A	MH07A	MH08A	0.9	1.59	35	80		72	127	0	0	0	0	0	0.2	127	4.21	2.0	0.0	2.22	200	0.50	23.2	0.74	0.45
Street A to Helena Street	MH08A	MH09A	0.42	2.01	15	80		34	161	0	0	0	0	0	0.3	161	4.18	2.5	0.0	2.79	200	0.50	23.2	0.74	0.49
Helena Street	MH05A	MH09A	0.1	1.86	0			0	141	0	0	0	0	0	0.3	141	4.20	2.2	0.0	2.47	200	0.35	19.4	0.62	0.42
Helena Street	MH09A	MH10A	0.02	3.89	0			0	302	0	0	0	0	0	0.6	406	4.02	6.0	0.0	6.62	200	0.35	19.4	0.62	0.56
Helena Street	MH10A	MH11A	0.15	4.04	0			0	302	0	0	0	0	0	0.6	406	4.02	6.0	0.0	6.64	200	0.35	19.4	0.62	0.56
Helena Street	MH11A	MH12A	0.12	4.16	0			0	302	0	0	0	0	0	0.6	406	4.02	6.0	0.0	6.66	200	0.35	19.4	0.62	0.56
Helena Street	MH12A	MH13A	0.12	4.28	0			0	302	0	0	0	0	0	0.6	406	4.02	6.0	0.0	6.68	200	0.35	19.4	0.62	0.56
Helena Street	MH13A	EX. MH22	0.13	4.41	0			0	302	0	0	0	0	0	0.7	406	4.02	6.0	0.0	6.70	200	0.35	19.4	0.62	0.56

Appendix C
Storm Calculations

C1 – Storm Design Sheet

5 yr Storm Sewer Design Sheet

Town of Fort Erie
Niagara Region

Rainfall Intensity = $\frac{A}{(Tc+B)^c}$

	5-YEAR	100-YEAR
A=	747.93	1083.55
B=	6.8	6.618
c=	0.768	0.735

Starting Tc = 10 min

- UNDERGROUND STORAGE PIPE

Project: Helena Street Residential Development, SS Fort Erie Inc.
Project No: 131951
Date: Nov. 22, 2022
Designed by: J.M.

File Location: \\caneast.ibigroup.com\J\HM\131951_613_Helen\7.0_Production\7.03_Design\04_Civil\FSR\Sewer Design Sheets\STM\[131951_Helena_STM_FSR-20221123.xls]5yr

STREET	FROM MH	TO MH	5-YR AREA (ha)	5-YR RUNOFF COEFFICIENT "R"	5-YR "AR"	5-YR ACCUM. "AR"	5-YR RAINFALL INTENSITY (mm/hr)	5-YR ACCUM. FLOW (m^3/s)	Controlled flow (m^3/s)	Total Flow (m^3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	TIME OF TRAVEL (min)	ACC. TIME OF CONC. (min)
Street A	*STMH 01*	*STMH 02*	*0.22*	*0.60*	*0.13*	*0.13*	*85.67*	*0.031*	*0.000*	*0.031*	*45.0*	*0.50*	*300*	*0.068*	*0.967*	*0.775*	*10.775*
Easement	*STMH 02*	*STMH 10*	*0*	*0.60*	*0.00*	*0.13*	*82.75*	*0.030*	*0.000*	*0.030*	*85.0*	*0.30*	*750*	*0.609*	*1.380*	*1.026*	*11.802*
Street A	*STMH 09*	*STMH 10*	*0.37*	*0.60*	*0.22*	*0.22*	*85.67*	*0.053*	*0.000*	*0.053*	*66.9*	*0.50*	*750*	*0.787*	*1.782*	*0.626*	*10.626*
Street A to Helena Street	*STMH 10-I*	*DITCH2*	*0*	*0.60*	*0.00*	*0.00*	*85.67*	*0.000*	*0.121*	*0.121*	*10.4*	*0.50*	*450*	*0.201*	*1.268*	*0.137*	*10.137*
Street A	*STMH 01S*	*STMH 04*	*0.38*	*0.60*	*0.23*	*0.23*	*85.67*	*0.054*	*0.000*	*0.054*	*83.8*	*0.50*	*375*	*0.124*	*1.123*	*1.244*	*11.244*
Street A	*STMH 04*	*STMH 05*	*0.42*	*0.60*	*0.25*	*0.48*	*81.09*	*0.108*	*0.000*	*0.108*	*83.8*	*0.50*	*450*	*0.201*	*1.268*	*1.102*	*12.346*
Street A	*STMH 05*	*STMH 06*	*0.07*	*0.60*	*0.04*	*0.52*	*77.49*	*0.112*	*0.000*	*0.112*	*14.2*	*0.50*	*450*	*0.201*	*1.268*	*0.187*	*12.533*
Street A	*STMH 09S*	*STMH 08*	*0.82*	*0.60*	*0.49*	*0.49*	*85.67*	*0.117*	*0.000*	*0.117*	*107.9*	*0.50*	*375*	*0.124*	*1.123*	*1.602*	*11.602*
Street A	*STMH 08*	*STMH 07*	*0.21*	*0.60*	*0.13*	*0.62*	*79.88*	*0.137*	*0.000*	*0.137*	*17.7*	*0.50*	*450*	*0.201*	*1.268*	*0.233*	*11.835*
Street A	*STMH 07*	*STMH 06*	*0.28*	*0.60*	*0.17*	*0.79*	*79.11*	*0.173*	*0.000*	*0.173*	*70.1*	*0.50*	*450*	*0.201*	*1.268*	*0.922*	*12.756*
SPILLWAY	*STMH 06*	*OGS*	*0*	*0.60*	*0.00*	*1.31*	*76.23*	*0.277*	*0.000*	*0.277*	*43.4*	*0.50*	*525*	*0.304*	*1.405*	*0.515*	*13.271*
POND	*OGS*	*HW 01*	*0*	*0.60*	*0.00*	*1.31*	*74.73*	*0.272*	*0.000*	*0.272*	*7.1*	*0.50*	*525*	*0.304*	*1.405*	*0.084*	*13.356*

Appendix D
Water Demand Calculations

D1 – Estimated Water Demand

Estimated Water Demand

Project: Helena Residential Development , Town of Fort Eric

Date: February 2022

File: 131951_Helen St Water Demand.xls

Town's Subdivision Control Guidelines 2021

Landuse		Persons/unit (PPU)
Residential		4
Average Day Consumption (L/d/Capita)		320
Maximum Day Consumption (L/d/Capita)		570
Peak Hour Consumption (L/d/Capita)		860

			Estimated Water Demand (L/s)		
			Ave Day	Max Day	Peak Hour
Landuse	**No of units**	**Population**			
Residential	116	464	2	3	5

Fire Flow Estimation using FUS Method

Based on Part II of Water Supply for Public Fire Protection 1999 (Page 17 to 20 Guide for determination of required fire flow)

Project: Helena Residential Development , Town of Fort Eric
Date: February 2022
File: 131951_Helen St Fire Flow estimation.xls

Item A to D, P20) Fire flow rate based on type of construction (Rounded off to nearest 1000 L/min)
Item 1, P17 F1=220C1A^.5 Fire Flow Formula
F1= Required fire Flow (L/min)
A= **488** m^2

		Area (ft2)	Area ($m^{2)}$
Floor area (8 units)		14,000	1,301
Fire Wall, every 2 units		3,500	325
Fire Wall, every 3 units		5,250	**488**

C1 = 1.5 Type of construction (Page 17)

C1=1.5	for wood frame construction (structure essentially all combustible)
C1=1.0	for ordinary construction (brick or other masonry walls, combustibles floor and interior)
C1=0.8	for non-combustible construction (unprotected metal structural components, masonry or metal walls)
C1=0.6	for fire-resistive construction (fully protected frame, floors, roof)

a) fire-resistive construction with vertical opening inadequately protected:
two largest floors plus 50% of each of any floors immediately above up to eight

F1= **7000** L/min

b) fire-resistive construction with vertical opening and exterior communications adequately protected (one hour rating):
one largest floors plus 25% of each of the two immediately adjoining floors

Item E, P20) Determine the increase or decrease for type of occupancies (Do not round off the answer)
Item 2, P18)
F2= F1 * C2 Adjusted Fire Flow rate (L/s)
C2= -25% C2=-25% Non-Combustible, P18
F2= **5250** L/min C2=-15% Limited Combustible, P18
No percentage increase or decrease for occupancy in commercial building

Item F, P20) Determine the decrease for automatic sprinkler system protection and standard design
Item 3, P18) (Do not round off the answer)

F3 =	F2 *C3	C3=0	No sprinkler system
C3=	0%	C3=-50%	Complete automatic sprinkler System (total credits of 50% as shown below), P18
F3=	**0** L/min	C3=-30%	Adequately designed system conforming to NFPA 13 and other NFPA Sprinkler standards

Item G, P20) Determine the increase for structure exposure distance, P18 (Do not round off the answer)
Item 4, p18)
F4 = F2 *C4 Exposure to the other buildings,
C4= 60% C4 = 0% if >45 m
F4= **3150** L/min C4 = 25 % (if 0 to 3 m)
C4 = 20 % (if 3 to 10 m)
C4 = 15 % (if 10 to 20 m)
C4 = 10 % (if 20 to 30 m)
C4 = 5 % (if 30 to 45 m)

Side	Exposure Distance (m)	Percentage Charge (%)
North	20	15
South	20	15
East	3	20
West	Fire wall	10
	Total	60

Item H, P20) Adjust the Fire Flow Value (Rounded off to nearest 1000 L/min)
F5= F2+F3+F4
F5= 8400 L/min
F5= 8000 L/min
F5= **133** L/s

Watermain Head Losses Estimation and System Head Requirement

Project: Helena Residential Development , Town of Fort Eric

Date: February 2022

File: 131951_head loss.xls

Watermain Head Losses Estimation

Pipeline Section	From	To	Length	Diameter	Area	Pipe Flow	Velocity	"C"	Head Loss
			L	D	A	Q	V	Factor	Hf[1]
			(m)	(m)	(m2)	(m3/s)	(m/s)	-	(m)
Option 1 - 200 mm along Helen St									
Along Helen Street	Albany Street Connection	Subject Site Connection	450	0.20	0.03	0.136	4.3	130	37.4
Internal Watermain Section[2]	Subject Site Connection	Far End Hydrant near Block 5	130	0.20	0.03	0.068	2.2	130	3.0
Total Head losses (from Albany St to far end hydrant near Block 5 within Subject Site)									40.4
Option 2 - 250 mm along Helen St									
Along Helen Street	Albany Street Connection	Subject Site Connection	450	0.25	0.05	0.136	2.8	130	12.6
Internal Watermain Section[2]	Subject Site Connection	Far End Hydrant near Block 5	130	0.20	0.03	0.068	2.2	130	3.0
Total Head losses (from Albany St to far end hydrant near Block 5 within Subject Site)									15.6

Note: [1] Hf=10.7*(Q/C)^1.85*(1/D^4.87)*L; [2] Only one branch of the internal watermain (and half of the fire flow) was used to estimate the head losses.

Water Turnover Rate Estimation

Average Day Demand	
L/s	2
M^3/d	148

Volume (m3)	Water Turnover Rate (hrs)
22	3.6
8	1.3
30	4.9

System Head Requirement

Given:	
Target HGL 241 m or Existing Tower Top Water Level (m)	241
Elevation within Site (m)	186
Required pressure under Fire Flow condition (140kPa or 14m)	14

Required HGL at Helen St and Albany St (m)	
Option 1 - Required HGL at Helen St and Albany St	**240**
Option 2 - Required HGL at Helen St and Albany St	**210**

Appendix E

Stormwater Management

E1 – VO Model Inputs
E2 – VO Model Results
E3 – Storage Discharge Relationship Sheet - Pond
E4 – Storage Discharge Relationship Sheet – Super Pipes
E5 – EFO ETV Verification Statement

IBI

Prepared By: Chris Zhang

Post-Development Composite Runoff Coefficient Calculation

Town of Fort Erie - 613 Helena Street Residential Development
File No. 131951
Date: November 2022

Town of Fort Erie Standard Runoff Coefficients

Pervious Areas	0.25
Impervious Areas	0.90

Drainage Area ID	Pervious Area (ha)	Impervious Area (ha)	Total Area (ha)	Composite Runoff Coefficient	Imperviousness (%)	Time of Concentration (min.)
A1 Pre	2.37	0.00	2.37	0.25	0	10
A2 Pre	0.82	0.02	0.84	0.27	9	10
A3 Pre	0.40	0.06	0.46	0.34	19	10
A4 Pre	0.52	0.06	0.58	0.31	16	10
Total	**4.05**	**0.20**	**4.25**	**0.28**	12	**10**
Ext-1	0.22	0.00	0.22	0.25	0	10

IBI

Prepared By: Chris Zhang

Post-Development Composite Runoff Coefficient Calculation

Town of Fort Erie - 613 Helena Street Residential Development

File No. 131951

Date: November 2022

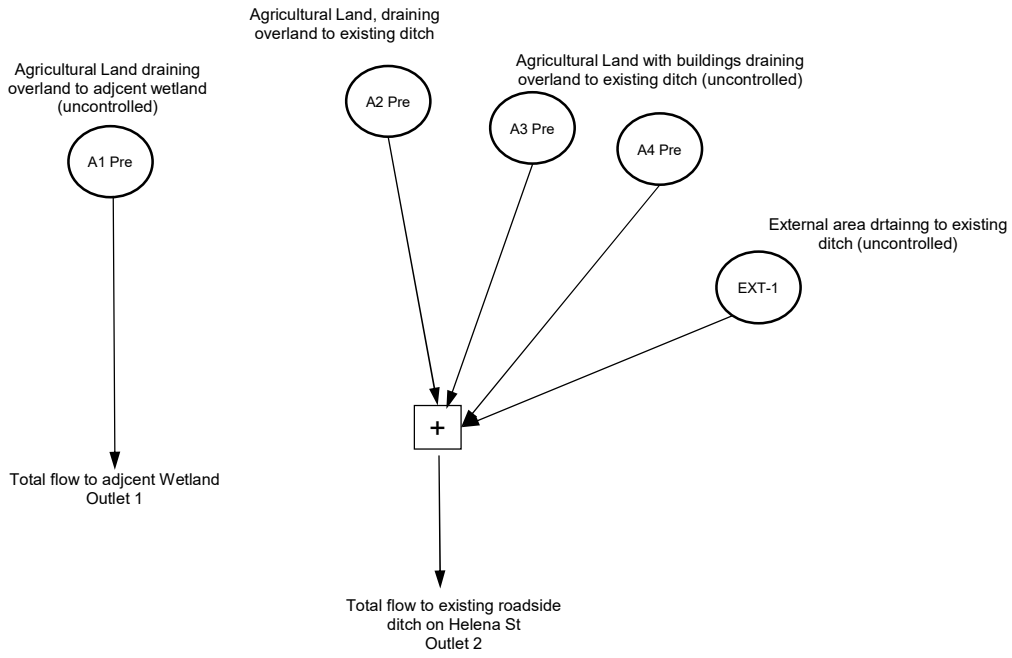
Town of Fort Erie Standard Runoff Coefficients

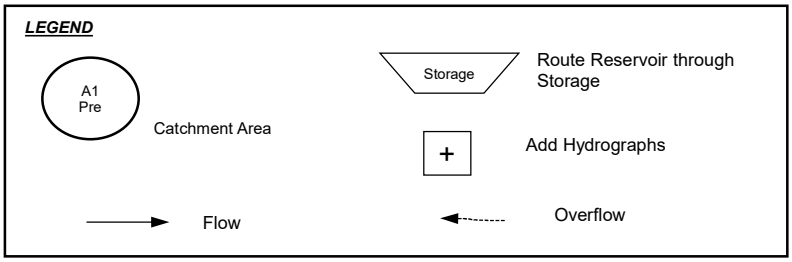
Pervious Areas	0.25
Impervious Areas	0.90

Drainage Area ID	Pervious Area (ha)	Impervious Area (ha)	Total Area (ha)	Composite Runoff Coefficient	Imperviousness (%)	Time of Concentration (min.)
A1 Post	0.82	1.45	2.27	0.67	66	10
A2 Post	0.15	0.15	0.30	0.58	54	10
A3 Post	0.24	0.18	0.42	0.53	47	10
A4 Post	0.45	0.00	0.45	0.25	0	10
A5 Post	0.07	0.17	0.24	0.71	73	10
A6 Post	0.14	0.21	0.35	0.65	64	10
A7 Post	0.06	0.01	0.07	0.31	16	10
A8 Post	0.07	0.09	0.16	0.61	58	10
Total	**1.99**	**2.26**	**4.25**	**0.60**	57	**10**
Ext-1	0.24	0.00	0.24	0.25	0	10

IBI	EXISTING CONDITIONS MODEL SCHEMATIC
	Town of Fort Erie - 613 Helena Street Residential Development
	File No. 131951
	Date: November 2022

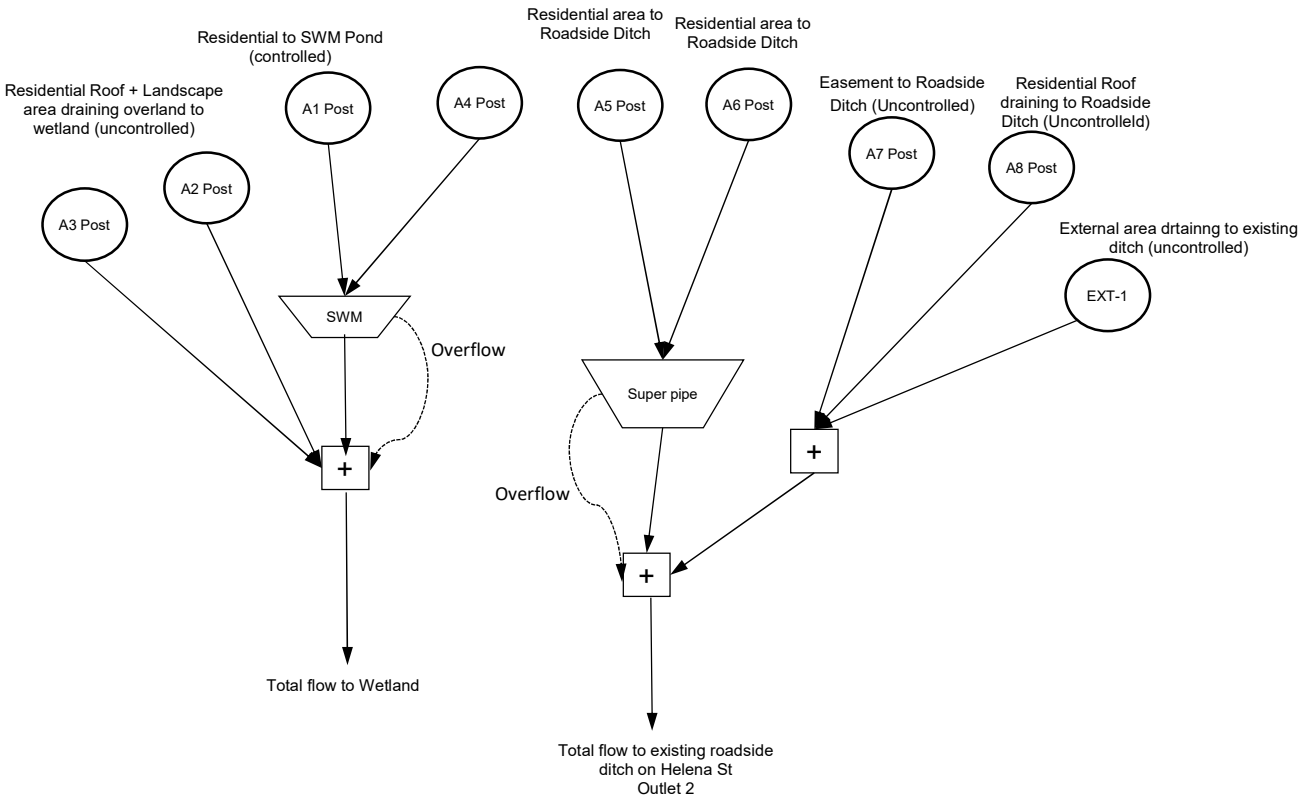
EXISTING CONDITIONS MODEL SCHEMATIC

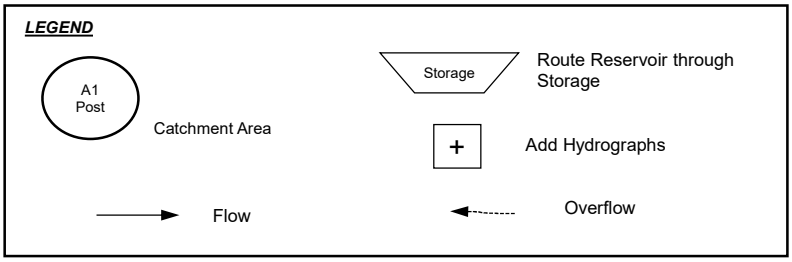




IBI	PROPOSED CONDITIONS MODEL SCHEMATIC
	Town of Fort Erie - 613 Helena Street Residential Development
	File No. 131951
	Date: November 2022

PROPOSED CONDITIONS MODEL SCHEMATIC





IBI

Prepared by: Chris Zhang

Active Storage (Stage - Storage - Discharge)
SWM Pond

Town of Fort Erie - 613 Helena Street Residential Development
File No. 131951
Date: Nov, 2022

Description	"c"	Dia./ Height	Dia. / Width	Control Elevation	Invert Elevation	
Bottom Draw + Circular Orifice	0.63	0.075	0.075	181.59	181.55	Circular orifice
Rectangular Orifice	0.63	0.100	0.100	182.60	182.55	Rectangular orifice

Description	Depth (m)	Elevation (m)	Pond Area (m2)	Incremental Volume (m3)	Cumulative Storage Volume (m3)	Circular Orifice (cms)	Rectangular Orifice (cms)	Emergency Spillway (cms)	Total Outflow (cms)	Total Outflow (L/s)	VO Model Inputs Discharge (m3/s)	VO Model Inputs Storage (m-ha)
Bottom of Pond	0.00	181.55	505.91	0.00	0.00	0.000	0.000		0.000	0.0	0.0000	0.0000
	0.25	181.80	608.37	139.29	139.29	0.006	0.000		0.006	5.7	0.0057	0.0139
	0.50	182.05	719.11	165.94	305.22	0.008	0.000		0.008	8.4	0.0084	0.0305
	0.75	182.30	837.98	194.64	499.86	0.010	0.000		0.010	10.4	0.0104	0.0500
	1.00	182.55	964.41	225.30	725.16	0.012	0.000		0.012	12.1	0.0121	0.0725
	1.25	182.80	1098.19	257.83	982.98	0.014	0.010		0.023	23.4	0.0234	0.0983
	1.50	183.05	1238.78	292.12	1275.10	0.015	0.015		0.030	29.6	0.0296	0.1275
	1.75	183.30	1385.72	328.06	1603.16	0.016	0.018		0.034	34.5	0.0345	0.1603
	2.00	183.55	1538.98	365.59	1968.75	0.017	0.021		0.039	38.6	0.0386	0.1969
0.3m Freeboard	2.15	183.70	1633.96	237.97	2206.72	0.018	0.023		0.041	40.9	0.0409	0.2207
Top of Pond	2.45	184.00	1830.72	519.70	2726.42	0.019	0.026		0.045	45.1	0.0451	0.2726

IBI	**Pipe Storage + MH Storage** **Volume Calculation**
	613 Helena St File No. 131951 Date: Nov, 2022

UNDERGROUND STORAGE VOLUME CALCULATIONS FOR SITE

Storm Sewer Storage				
Storm Sewers	Diameter	Area	Length	Volume
	(mm)	(m^2)	(m)	(m^3)
CBMH2 to CBMH10	750	0.44	85.5	37.8
MH9 to CBMH10	750	0.44	51.0	22.5
Total				**60.3**

Structure Storage					
Structure	Diameter	Area	T/G (HWL)	Outlet Invert	Volume
	(mm)	(m^2)	(m)	(m)	(m^3)
CBMH10	1800	2.5	182.62	181.05	4.0
CBMH2	1500	1.8	182.80	181.35	2.6
MH9	1500	1.8	185.13	181.34	6.7
Total					**13.3**

Total Volume (Pipes + Structures): 73.6 m^3

Project No.:	131951			Diameter	X-Sect Area	Invert	Horizontal(y/n)	Cd	
Project:	613 Helena St	IBI	Orifice 1	200	0.0314	181.08	n	0.61	Orifice Plate
Description:	CBMH10 Outlet Stage-Storage-Discharge		Orifice 2						

	Water Surface EL (m)	Pipe Storage (m^3)	Surface Storage (m^3)	Total Storage (m^3)	Orifice 1 (m^3/s)	Orifice 2 (m^3/s)	Total Discharge (m^3/s)	
1	**181.090**	0.0	0	0.0	0.000	0.00	0.000	invert of CBMH10
2	**181.190**	5.0	0	5.0	0.028	0.00	0.028	750 mm Super pipe
3	**181.290**	10.0	0	10.0	0.039	0.00	0.039	
4	**181.390**	12.0	0	12.0	0.047	0.00	0.047	
5	**181.490**	20.4	0	20.4	0.054	0.00	0.054	
6	**181.590**	29.9	0	29.9	0.061	0.00	0.061	
7	**181.690**	39.3	0	39.3	0.066	0.00	0.066	
8	**181.790**	47.9	0	47.9	0.072	0.00	0.072	
9	**181.890**	53.6	0	53.6	0.076	0.00	0.076	
10	**181.990**	57.7	0	57.7	0.081	0.00	0.081	
11	**182.090**	60.3	0	60.3	0.085	0.00	0.085	
12	**182.190**	60.3	0	60.3	0.089	0.00	0.089	
13	**182.290**	60.3	0	60.3	0.093	0.00	0.093	
14	**182.390**	60.3	0	60.3	0.097	0.00	0.097	
15	**182.490**	60.3	0	60.3	0.101	0.00	0.101	
16	**182.590**	60.3	0	60.3	0.104	0.00	0.104	
17	**182.690**	64.3	0	64.3	0.108	0.00	0.108	MH Top - Outlet Control Manhole = 183.62
18	**182.790**	64.3	0	64.3	0.111	0.00	0.111	
19	**182.810**	73.6	0	73.6	0.112	0.00	0.112	MH Top - MH9 = 182.80

IBI

Prepared by: Chris Zhang

Visual Otthymo Model Input Parameters (NASHYD)

613 Helena St
File No. 131951
Date: Feb, 2022

Pre-Development Drainage Area (OTTHYMO)

Parameter	Unit	Description	A1 Pre	A2 Pre	A4 Post	EXT-1
Area	ha	Watershed Area	2.37	0.84	0.48	0.24
TP	hr	Unit Hydrograph Time to Peak	0.17	0.11	0.10	
DT	min	Time Step Increment	5			
DWF	cms	Dry Weather Flow (Base Flow)	0			
CN	-	SCS Modified Curve Number[1]	74			
IA	mm	Initial Abstraction	1.5			
N	-	Number of Linear Reservior	2			
Rain	mm/hr	Optional Rainfall Intensities	0-Without Rainfall			

Note: 1 - Based on AMC II

Time of Concentration Calculation

Area Number	Area (ha)	Cpre	CN	L (m)	Elevation Change (m)	Sw (%)	Tp (hr)
A1 Pre	2.37	0.25	74	227	0.6	0.2	0.17
A2 Pre	0.84	0.27	74	95	0.3	0.3	0.11
A4 Post	0.48	0.25	74	30	1.5	5.0	0.10
EXT-1	0.24	0.25	74	40	0.6	1.5	0.17

IBI *Prepared by: Chris Zhang*		**Visual Otthymo Model Input Parameters (STANDHYD)** 613 Helena St File No. 131951 Date: Feb, 2022

Parameter	Description	Post A1	Post A2	Post A3	Post A5	Post A6	Post A7	Post A8	Pre A3	Pre A4
AREA		2.27	0.30	0.39	0.24	0.35	0.07	0.16	0.46	0.58
XIMP	Impervious Area (Direct Connection)	66%	54%	47%	73%	64%	16%	58%	19%	13%
TIMP	Total Impervious Area	66%	54%	47%	73%	64%	16%	58%	19%	13%
LGI	Overland Flow Length (Impervious)	123.0	44.7	51.0	40.0	48.3	21.6	32.7	55.4	62.18
SLPI	Average Slope (Impervious)	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
DT	Time Step Increment	5	5	5	5	5	5	5	5	5
DWF	Dry Weather Flow (Base Flow)	0	0	0	0	0	0	0	0	0
LOSS	Rainfall Loss Method	Loss = 2 (SCS Curve Method), Silty clay, CN = 74, IA = 1.5mm								
SLPP	Average Slope (Pervious)	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
LGP	Overland Flow Length (Pervious)	40	40	40	40	40	40	40	40	40
MNP	Manning's Roughness Coefficient (Pervious)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
DPSI	Depression Storage (Impervious)	1.5 mm	1.5 mm	1.5 mm	1.5 mm	1.5 mm	1.5 mm	1.5 mm	1.5 mm	1.5 mm
MNI	Manning's Roughness Coefficient	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	1.013

```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2007)
       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    TM
       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 *****

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Summary filename: C:\Users\Chris.Zhang\AppData\Local\Civica\VH5\c48cc875-0d46-4cf3-b9ff-15292ba03324\b6130ec

DATE: 11-22-2022 TIME: 05:41:35

USER:

COMMENTS: _____

****
** SIMULATION : Forr Erie-Chicago-24h-100-yr **
****

| CHICAGO STORM |
| Ptotal=123.65 mm |

IDF curve parameters: A=1083.550
B= 6.618
C= 0.735
used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	1.41	6.00	4.25	12.00	3.79	18.00	1.94
0.17	1.43	6.17	4.58	12.17	3.68	18.17	1.91
0.33	1.45	6.33	4.98	12.33	3.58	18.33	1.89
0.50	1.48	6.50	5.48	12.50	3.48	18.50	1.87
0.67	1.50	6.67	6.10	12.67	3.39	18.67	1.85
0.83	1.53	6.83	6.92	12.83	3.30	18.83	1.83
1.00	1.56	7.00	8.05	13.00	3.22	19.00	1.81
1.17	1.59	7.17	9.73	13.17	3.14	19.17	1.79
1.33	1.62	7.33	12.55	13.33	3.07	19.33	1.77
1.50	1.65	7.50	18.40	13.50	3.00	19.50	1.75
1.67	1.68	7.67	39.99	13.67	2.94	19.67	1.73
1.83	1.72	7.83	137.32	13.83	2.88	19.83	1.71
2.00	1.75	8.00	51.10	14.00	2.82	20.00	1.69
2.17	1.79	8.17	28.93	14.17	2.76	20.17	1.68
2.33	1.83	8.33	20.61	14.33	2.71	20.33	1.66
2.50	1.88	8.50	16.22	14.50	2.66	20.50	1.64
2.67	1.92	8.67	13.50	14.67	2.61	20.67	1.63
2.83	1.97	8.83	11.63	14.83	2.56	20.83	1.61
3.00	2.02	9.00	10.27	15.00	2.52	21.00	1.60
3.17	2.08	9.17	9.22	15.17	2.47	21.17	1.58
3.33	2.13	9.33	8.39	15.33	2.43	21.33	1.57
3.50	2.20	9.50	7.72	15.50	2.39	21.50	1.55
3.67	2.26	9.67	7.16	15.67	2.35	21.67	1.54
3.83	2.33	9.83	6.69	15.83	2.32	21.83	1.53
4.00	2.41	10.00	6.28	16.00	2.28	22.00	1.51
4.17	2.49	10.17	5.93	16.17	2.25	22.17	1.50
4.33	2.58	10.33	5.62	16.33	2.21	22.33	1.49
4.50	2.68	10.50	5.34	16.50	2.18	22.50	1.47
4.67	2.79	10.67	5.10	16.67	2.15	22.67	1.46
4.83	2.90	10.83	4.88	16.83	2.12	22.83	1.45
5.00	3.03	11.00	4.68	17.00	2.09	23.00	1.44
5.17	3.18	11.17	4.50	17.17	2.06	23.17	1.43
5.33	3.34	11.33	4.33	17.33	2.04	23.33	1.41

5.50	3.52	11.50	4.18	17.50	2.01	23.50	1.40
5.67	3.73	11.67	4.04	17.67	1.99	23.67	1.39
5.83	3.97	11.83	3.91	17.83	1.96	23.83	1.38

CALIB					
NASHYD (0001)	Area	(ha)=	2.37	Curve Number	(CN)= 74.0
ID= 1 DT= 5.0 min	Ia	(mm)=	1.50	# of Linear Res.	(N)= 3.00
	U.H. Tp(hrs)=		0.17		

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41

5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39
5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

Unit Hyd Qpeak (cms)= 0.532

PEAK FLOW (cms)= 0.310 (i)
TIME TO PEAK (hrs)= 8.083
RUNOFF VOLUME (mm)= 70.331
TOTAL RAINFALL (mm)= 123.651
RUNOFF COEFFICIENT = 0.569

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

Junction Command(0006)

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2(0001)	2.37	0.31	8.08	70.33
OUTFLOW: ID= 2(0006)	2.37	0.31	8.08	70.33

CALIB NASHYD (0002) ID= 1 DT= 5.0 min	Area (ha)= 0.84	Curve Number (CN)= 74.0
	Ia (mm)= 1.50	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.11	

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55

3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41
5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39
5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

Unit Hyd Qpeak (cms)= 0.292

PEAK FLOW (cms)= 0.136 (i)
TIME TO PEAK (hrs)= 8.000
RUNOFF VOLUME (mm)= 69.284
TOTAL RAINFALL (mm)= 123.651
RUNOFF COEFFICIENT = 0.560

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

CALIB					
NASHYD (0011)	Area (ha)=	0.24	Curve Number (CN)=	74.0
ID= 1 DT= 5.0 min	Ia (mm)=	1.50	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=	0.17		

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64

2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41
5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39
5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

Unit Hyd Qpeak (cms)= 0.054

PEAK FLOW (cms)= 0.031 (i)
TIME TO PEAK (hrs)= 8.083
RUNOFF VOLUME (mm)= 70.329
TOTAL RAINFALL (mm)= 123.651
RUNOFF COEFFICIENT = 0.569

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

CALIB	
STANDHYD (0003)	Area (ha)= 0.46
ID= 1 DT= 5.0 min	Total Imp(%)= 19.00 Dir. Conn.(%)= 19.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.09	0.37
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	55.38	40.00
Mannings n	=	0.013	0.250

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81

1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41
5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39
5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

Max.Eff.Inten.(mm/hr)=	137.32	74.65	
over (min)	5.00	10.00	
Storage Coeff. (min)=	1.28 (ii)	9.22 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.33	0.12	
			TOTALS
PEAK FLOW (cms)=	0.03	0.05	0.079 (iii)
TIME TO PEAK (hrs)=	8.00	8.08	8.00
RUNOFF VOLUME (mm)=	122.15	70.58	80.37
TOTAL RAINFALL (mm)=	123.65	123.65	123.65
RUNOFF COEFFICIENT =	0.99	0.57	0.65

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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 (0004)	Area (ha)= 0.58
ID= 1 DT= 5.0 min	Total Imp(%)= 16.00 Dir. Conn.(%)= 16.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.09	0.49
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	62.18	40.00
Mannings n	=	0.013	0.250

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41
5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40

```
               5.667    3.52 |11.667    4.18 |17.667    2.01 | 23.67    1.40
               5.750    3.73 |11.750    4.04 |17.750    1.99 | 23.75    1.39
               5.833    3.73 |11.833    4.04 |17.833    1.99 | 23.83    1.39
               5.917    3.97 |11.917    3.91 |17.917    1.96 | 23.92    1.38
               6.000    3.97 |12.000    3.91 |18.000    1.96 | 24.00    1.38

     Max.Eff.Inten.(mm/hr)=     137.32        74.65
               over (min)         5.00        10.00
     Storage Coeff.  (min)=       1.37 (ii)    9.31 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.33         0.12
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.04         0.07          0.095 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.08           8.00
     RUNOFF VOLUME    (mm)=     122.15        70.58          78.82
     TOTAL RAINFALL   (mm)=     123.65       123.65         123.65
     RUNOFF COEFFICIENT   =       0.99         0.57           0.64

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
              YOU SHOULD CONSIDER SPLITTING THE AREA.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  74.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0010)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0011):     0.24   0.031     8.08    70.33
     + ID2= 2 (  0002):     0.84   0.136     8.00    69.28
       ================================================
       ID = 3 (  0010):     1.08   0.162     8.00    69.52

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

--------------------
| ADD HYD  (  0010)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0010):     1.08   0.162     8.00    69.52
     + ID2= 2 (  0003):     0.46   0.079     8.00    80.37
       ================================================
       ID = 1 (  0010):     1.54   0.241     8.00    72.76

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

--------------------
| ADD HYD  (  0010)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0010):     1.54   0.241     8.00    72.76
     + ID2= 2 (  0004):     0.58   0.095     8.00    78.82
       ================================================
       ID = 3 (  0010):     2.12   0.336     8.00    74.42

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
================================================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2007)
       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    TM
       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 *****
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Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\Chris.Zhang\AppData\Local\Civica\VH5\c48cc875-0d46-4cf3-b9ff-15292ba03324\a530ebe
Summary filename: C:\Users\Chris.Zhang\AppData\Local\Civica\VH5\c48cc875-0d46-4cf3-b9ff-15292ba03324\a530ebe

DATE: 11-22-2022 TIME: 05:41:35

USER:

COMMENTS: _____

****
** SIMULATION : Fort Erie- Chicago-24h-2yr **
****

| CHICAGO STORM |
| Ptotal= 45.98 mm |

IDF curve parameters: A= 628.050
B= 6.652
C= 0.796
used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.41	6.00	1.36	12.00	1.20	18.00	0.57
0.17	0.41	6.17	1.48	12.17	1.16	18.17	0.57
0.33	0.42	6.33	1.62	12.33	1.12	18.33	0.56
0.50	0.43	6.50	1.80	12.50	1.09	18.50	0.55
0.67	0.44	6.67	2.03	12.67	1.06	18.67	0.55
0.83	0.44	6.83	2.33	12.83	1.03	18.83	0.54
1.00	0.45	7.00	2.76	13.00	1.00	19.00	0.53
1.17	0.46	7.17	3.42	13.17	0.98	19.17	0.53
1.33	0.47	7.33	4.55	13.33	0.95	19.33	0.52
1.50	0.48	7.50	7.02	13.50	0.93	19.50	0.51
1.67	0.49	7.67	16.99	13.67	0.91	19.67	0.51
1.83	0.50	7.83	66.94	13.83	0.89	19.83	0.50
2.00	0.52	8.00	22.29	14.00	0.87	20.00	0.50
2.17	0.53	8.17	11.71	14.17	0.85	20.17	0.49
2.33	0.54	8.33	7.97	14.33	0.83	20.33	0.49
2.50	0.56	8.50	6.08	14.50	0.81	20.50	0.48
2.67	0.57	8.67	4.94	14.67	0.80	20.67	0.48
2.83	0.59	8.83	4.17	14.83	0.78	20.83	0.47
3.00	0.60	9.00	3.63	15.00	0.76	21.00	0.47
3.17	0.62	9.17	3.22	15.17	0.75	21.17	0.46
3.33	0.64	9.33	2.90	15.33	0.74	21.33	0.46
3.50	0.66	9.50	2.64	15.50	0.72	21.50	0.45
3.67	0.68	9.67	2.42	15.67	0.71	21.67	0.45
3.83	0.70	9.83	2.25	15.83	0.70	21.83	0.44
4.00	0.73	10.00	2.10	16.00	0.69	22.00	0.44
4.17	0.76	10.17	1.96	16.17	0.68	22.17	0.43
4.33	0.79	10.33	1.85	16.33	0.66	22.33	0.43
4.50	0.82	10.50	1.75	16.50	0.65	22.50	0.43
4.67	0.85	10.67	1.66	16.67	0.64	22.67	0.42
4.83	0.89	10.83	1.58	16.83	0.63	22.83	0.42
5.00	0.94	11.00	1.51	17.00	0.62	23.00	0.41
5.17	0.99	11.17	1.45	17.17	0.62	23.17	0.41
5.33	1.04	11.33	1.39	17.33	0.61	23.33	0.41
5.50	1.11	11.50	1.34	17.50	0.60	23.50	0.40
5.67	1.18	11.67	1.29	17.67	0.59	23.67	0.40
5.83	1.26	11.83	1.24	17.83	0.58	23.83	0.40

| CALIB |
| NASHYD (0001) |
|ID= 1 DT= 5.0 min |

Area (ha)= 2.37 Curve Number (CN)= 74.0
Ia (mm)= 1.50 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.17

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
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57

0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57
0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54
1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53
1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51
1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49
2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48
2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46
3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Unit Hyd Qpeak (cms)= 0.532

PEAK FLOW (cms)= 0.074 (i)
TIME TO PEAK (hrs)= 8.083
RUNOFF VOLUME (mm)= 14.741
TOTAL RAINFALL (mm)= 45.978
RUNOFF COEFFICIENT = 0.321

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

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  | Junction Command(0006) |
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	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2(0001)	2.37	0.07	8.08	14.74
OUTFLOW: ID= 2(0006)	2.37	0.07	8.08	14.74

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| CALIB              |
| NASHYD   (  0002)|   Area    (ha)=   0.84   Curve Number   (CN)= 74.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   1.50   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.11

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

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57
0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57
0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54
1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53
1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51
1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49
2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48
2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46
3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41

5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Unit Hyd Qpeak (cms)= 0.292

PEAK FLOW (cms)= 0.033 (i)
TIME TO PEAK (hrs)= 8.000
RUNOFF VOLUME (mm)= 14.522
TOTAL RAINFALL (mm)= 45.978
RUNOFF COEFFICIENT = 0.316

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

CALIB NASHYD (0011)	Area (ha)= 0.24	Curve Number (CN)= 74.0
ID= 1 DT= 5.0 min	Ia (mm)= 1.50	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.17	

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
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57
0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57
0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54
1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53
1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51
1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49
2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48
2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46
3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44

4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Unit Hyd Qpeak (cms)= 0.054

PEAK FLOW (cms)= 0.008 (i)
TIME TO PEAK (hrs)= 8.083
RUNOFF VOLUME (mm)= 14.740
TOTAL RAINFALL (mm)= 45.978
RUNOFF COEFFICIENT = 0.321

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

CALIB	
STANDHYD (0003)	Area (ha)= 0.46
ID= 1 DT= 5.0 min	Total Imp(%)= 19.00 Dir. Conn.(%)= 19.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.09	0.37
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	55.38	40.00
Mannings n	=	0.013	0.250

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
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57
0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57
0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54
1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53
1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51
1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49
2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48

2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46
3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Max.Eff.Inten.(mm/hr)=	66.94	13.27		
over (min)	5.00	20.00		
Storage Coeff. (min)=	1.71 (ii)	17.54 (ii)		
Unit Hyd. Tpeak (min)=	5.00	20.00		
Unit Hyd. peak (cms)=	0.32	0.06		
			TOTALS	
PEAK FLOW (cms)=	0.02	0.01	0.020 (iii)	
TIME TO PEAK (hrs)=	8.00	8.25	8.00	
RUNOFF VOLUME (mm)=	44.48	14.79	20.41	
TOTAL RAINFALL (mm)=	45.98	45.98	45.98	
RUNOFF COEFFICIENT =	0.97	0.32	0.44	

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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 (0004)	Area (ha)=	0.58	
ID= 1 DT= 5.0 min	Total Imp(%)=	16.00	Dir. Conn.(%)= 16.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.09	0.49
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	62.18	40.00
Mannings n	=	0.013	0.250

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
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57
0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57

0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54
1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53
1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51
1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49
2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48
2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46
3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Max.Eff.Inten.(mm/hr)=	66.94	13.27		
over (min)	5.00	20.00		
Storage Coeff. (min)=	1.83 (ii)	17.66 (ii)		
Unit Hyd. Tpeak (min)=	5.00	20.00		
Unit Hyd. peak (cms)=	0.32	0.06		
			TOTALS	
PEAK FLOW (cms)=	0.02	0.01	0.022 (iii)	
TIME TO PEAK (hrs)=	8.00	8.25	8.00	
RUNOFF VOLUME (mm)=	44.48	14.79	19.52	
TOTAL RAINFALL (mm)=	45.98	45.98	45.98	
RUNOFF COEFFICIENT =	0.97	0.32	0.42	

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

***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0010)|		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3			(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0011):			0.24	0.008	8.08	14.74
+ ID2= 2 (0002):			0.84	0.033	8.00	14.52
ID = 3 (0010):			1.08	0.039	8.00	14.57

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0010)|		AREA	QPEAK	TPEAK	R.V.
3 + 2 = 1			(ha)	(cms)	(hrs)	(mm)
ID1= 3 (0010):			1.08	0.039	8.00	14.57
+ ID2= 2 (0003):			0.46	0.020	8.00	20.41
ID = 1 (0010):			1.54	0.059	8.00	16.31

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 (0010):			1.54	0.059	8.00	16.31
+ ID2= 2 (0004):			0.58	0.022	8.00	19.52
ID = 3 (0010):			2.12	0.081	8.00	17.19

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2007)
       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    TM
       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 6.2\VO2\voin.dat
Output filename: C:\Users\Chris.Zhang\AppData\Local\Civica\VH5\c48cc875-0d46-4cf3-b9ff-15292ba03324\0d24aef
Summary filename: C:\Users\Chris.Zhang\AppData\Local\Civica\VH5\c48cc875-0d46-4cf3-b9ff-15292ba03324\0d24aef

DATE: 11-22-2022 TIME: 05:41:35

USER:

COMMENTS: _____

****
** SIMULATION : Fort Erie-Chicago-24h-5yr **
****

CHICAGO STORM	Ptotal= 67.12 mm

IDF curve parameters: A= 747.930
B= 6.800
C= 0.768
used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.67	6.00	2.15	12.00	1.90	18.00	0.94
0.17	0.68	6.17	2.32	12.17	1.84	18.17	0.93
0.33	0.69	6.33	2.54	12.33	1.79	18.33	0.91
0.50	0.71	6.50	2.80	12.50	1.74	18.50	0.90
0.67	0.72	6.67	3.14	12.67	1.69	18.67	0.89
0.83	0.73	6.83	3.59	12.83	1.64	18.83	0.88
1.00	0.75	7.00	4.22	13.00	1.60	19.00	0.87
1.17	0.76	7.17	5.16	13.17	1.56	19.17	0.86
1.33	0.78	7.33	6.77	13.33	1.52	19.33	0.85
1.50	0.79	7.50	10.20	13.50	1.49	19.50	0.84
1.67	0.81	7.67	23.44	13.67	1.45	19.67	0.83
1.83	0.83	7.83	85.67	13.83	1.42	19.83	0.82
2.00	0.85	8.00	30.36	14.00	1.39	20.00	0.82
2.17	0.87	8.17	16.55	14.17	1.36	20.17	0.81
2.33	0.89	8.33	11.51	14.33	1.33	20.33	0.80
2.50	0.91	8.50	8.91	14.50	1.31	20.50	0.79
2.67	0.93	8.67	7.32	14.67	1.28	20.67	0.78
2.83	0.96	8.83	6.24	14.83	1.26	20.83	0.77
3.00	0.98	9.00	5.47	15.00	1.24	21.00	0.77
3.17	1.01	9.17	4.88	15.17	1.21	21.17	0.76
3.33	1.04	9.33	4.41	15.33	1.19	21.33	0.75
3.50	1.07	9.50	4.04	15.50	1.17	21.50	0.74
3.67	1.10	9.67	3.73	15.67	1.15	21.67	0.74
3.83	1.14	9.83	3.46	15.83	1.13	21.83	0.73
4.00	1.18	10.00	3.24	16.00	1.11	22.00	0.72
4.17	1.22	10.17	3.05	16.17	1.10	22.17	0.72
4.33	1.27	10.33	2.88	16.33	1.08	22.33	0.71
4.50	1.32	10.50	2.73	16.50	1.06	22.50	0.70
4.67	1.37	10.67	2.60	16.67	1.05	22.67	0.70
4.83	1.44	10.83	2.48	16.83	1.03	22.83	0.69
5.00	1.50	11.00	2.37	17.00	1.02	23.00	0.69
5.17	1.58	11.17	2.28	17.17	1.00	23.17	0.68
5.33	1.66	11.33	2.19	17.33	0.99	23.33	0.67
5.50	1.76	11.50	2.11	17.50	0.98	23.50	0.67
5.67	1.87	11.67	2.03	17.67	0.96	23.67	0.66
5.83	2.00	11.83	1.97	17.83	0.95	23.83	0.66

CALIB NASHYD (0001) | ID= 1 DT= 5.0 min	Area (ha)= 2.37 Curve Number (CN)= 74.0 Ia (mm)= 1.50 # of Linear Res.(N)= 3.00 U.H. Tp(hrs)= 0.17

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
0.083	0.67	6.083	2.15	12.083	1.90	18.08	0.94
0.167	0.67	6.167	2.15	12.167	1.90	18.17	0.94
0.250	0.68	6.250	2.32	12.250	1.84	18.25	0.93
0.333	0.68	6.333	2.32	12.333	1.84	18.33	0.93
0.417	0.69	6.417	2.54	12.417	1.79	18.42	0.91
0.500	0.69	6.500	2.54	12.500	1.79	18.50	0.91
0.583	0.71	6.583	2.80	12.583	1.74	18.58	0.90
0.667	0.71	6.667	2.80	12.667	1.74	18.67	0.90
0.750	0.72	6.750	3.14	12.750	1.69	18.75	0.89
0.833	0.72	6.833	3.14	12.833	1.69	18.83	0.89
0.917	0.73	6.917	3.59	12.917	1.64	18.92	0.88
1.000	0.73	7.000	3.59	13.000	1.64	19.00	0.88
1.083	0.75	7.083	4.22	13.083	1.60	19.08	0.87
1.167	0.75	7.167	4.22	13.167	1.60	19.17	0.87
1.250	0.76	7.250	5.16	13.250	1.56	19.25	0.86
1.333	0.76	7.333	5.16	13.333	1.56	19.33	0.86
1.417	0.78	7.417	6.77	13.417	1.52	19.42	0.85
1.500	0.78	7.500	6.77	13.500	1.52	19.50	0.85
1.583	0.79	7.583	10.20	13.583	1.49	19.58	0.84
1.667	0.79	7.667	10.20	13.667	1.49	19.67	0.84

1.750	0.81	7.750	23.44	13.750	1.45	19.75	0.83
1.833	0.81	7.833	23.44	13.833	1.45	19.83	0.83
1.917	0.83	7.917	85.67	13.917	1.42	19.92	0.82
2.000	0.83	8.000	85.67	14.000	1.42	20.00	0.82
2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Unit Hyd Qpeak (cms)= 0.532

PEAK FLOW (cms)= 0.129 (i)
TIME TO PEAK (hrs)= 8.083
RUNOFF VOLUME (mm)= 27.708
TOTAL RAINFALL (mm)= 67.124
RUNOFF COEFFICIENT = 0.413

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

Junction Command(0006)

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2(0001)	2.37	0.13	8.08	27.71
OUTFLOW: ID= 2(0006)	2.37	0.13	8.08	27.71

CALIB NASHYD (0002) ID= 1 DT= 5.0 min	Area (ha)= 0.84	Curve Number (CN)= 74.0
	Ia (mm)= 1.50	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.11	

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
0.083	0.67	6.083	2.15	12.083	1.90	18.08	0.94
0.167	0.67	6.167	2.15	12.167	1.90	18.17	0.94
0.250	0.68	6.250	2.32	12.250	1.84	18.25	0.93
0.333	0.68	6.333	2.32	12.333	1.84	18.33	0.93
0.417	0.69	6.417	2.54	12.417	1.79	18.42	0.91
0.500	0.69	6.500	2.54	12.500	1.79	18.50	0.91
0.583	0.71	6.583	2.80	12.583	1.74	18.58	0.90
0.667	0.71	6.667	2.80	12.667	1.74	18.67	0.90
0.750	0.72	6.750	3.14	12.750	1.69	18.75	0.89
0.833	0.72	6.833	3.14	12.833	1.69	18.83	0.89
0.917	0.73	6.917	3.59	12.917	1.64	18.92	0.88
1.000	0.73	7.000	3.59	13.000	1.64	19.00	0.88
1.083	0.75	7.083	4.22	13.083	1.60	19.08	0.87
1.167	0.75	7.167	4.22	13.167	1.60	19.17	0.87
1.250	0.76	7.250	5.16	13.250	1.56	19.25	0.86
1.333	0.76	7.333	5.16	13.333	1.56	19.33	0.86
1.417	0.78	7.417	6.77	13.417	1.52	19.42	0.85
1.500	0.78	7.500	6.77	13.500	1.52	19.50	0.85
1.583	0.79	7.583	10.20	13.583	1.49	19.58	0.84
1.667	0.79	7.667	10.20	13.667	1.49	19.67	0.84
1.750	0.81	7.750	23.44	13.750	1.45	19.75	0.83
1.833	0.81	7.833	23.44	13.833	1.45	19.83	0.83
1.917	0.83	7.917	85.67	13.917	1.42	19.92	0.82
2.000	0.83	8.000	85.67	14.000	1.42	20.00	0.82
2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Unit Hyd Qpeak (cms)= 0.292

PEAK FLOW (cms)= 0.057 (i)
TIME TO PEAK (hrs)= 8.000
RUNOFF VOLUME (mm)= 27.296
TOTAL RAINFALL (mm)= 67.124
RUNOFF COEFFICIENT = 0.407

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

CALIB NASHYD (0011)	Area (ha)= 0.24	Curve Number (CN)= 74.0
ID= 1 DT= 5.0 min	Ia (mm)= 1.50	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.17	

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
0.083	0.67	6.083	2.15	12.083	1.90	18.08	0.94
0.167	0.67	6.167	2.15	12.167	1.90	18.17	0.94
0.250	0.68	6.250	2.32	12.250	1.84	18.25	0.93
0.333	0.68	6.333	2.32	12.333	1.84	18.33	0.93
0.417	0.69	6.417	2.54	12.417	1.79	18.42	0.91
0.500	0.69	6.500	2.54	12.500	1.79	18.50	0.91
0.583	0.71	6.583	2.80	12.583	1.74	18.58	0.90
0.667	0.71	6.667	2.80	12.667	1.74	18.67	0.90
0.750	0.72	6.750	3.14	12.750	1.69	18.75	0.89
0.833	0.72	6.833	3.14	12.833	1.69	18.83	0.89
0.917	0.73	6.917	3.59	12.917	1.64	18.92	0.88
1.000	0.73	7.000	3.59	13.000	1.64	19.00	0.88
1.083	0.75	7.083	4.22	13.083	1.60	19.08	0.87
1.167	0.75	7.167	4.22	13.167	1.60	19.17	0.87
1.250	0.76	7.250	5.16	13.250	1.56	19.25	0.86
1.333	0.76	7.333	5.16	13.333	1.56	19.33	0.86
1.417	0.78	7.417	6.77	13.417	1.52	19.42	0.85
1.500	0.78	7.500	6.77	13.500	1.52	19.50	0.85
1.583	0.79	7.583	10.20	13.583	1.49	19.58	0.84
1.667	0.79	7.667	10.20	13.667	1.49	19.67	0.84
1.750	0.81	7.750	23.44	13.750	1.45	19.75	0.83
1.833	0.81	7.833	23.44	13.833	1.45	19.83	0.83
1.917	0.83	7.917	85.67	13.917	1.42	19.92	0.82
2.000	0.83	8.000	85.67	14.000	1.42	20.00	0.82
2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66

5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Unit Hyd Qpeak (cms)= 0.054

PEAK FLOW (cms)= 0.013 (i)
TIME TO PEAK (hrs)= 8.083
RUNOFF VOLUME (mm)= 27.707
TOTAL RAINFALL (mm)= 67.124
RUNOFF COEFFICIENT = 0.413

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

CALIB STANDHYD (0003)	Area (ha)= 0.46
ID= 1 DT= 5.0 min	Total Imp(%)= 19.00 Dir. Conn.(%)= 19.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.09	0.37
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	55.38	40.00
Mannings n	=	0.013	0.250

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
0.083	0.67	6.083	2.15	12.083	1.90	18.08	0.94
0.167	0.67	6.167	2.15	12.167	1.90	18.17	0.94
0.250	0.68	6.250	2.32	12.250	1.84	18.25	0.93
0.333	0.68	6.333	2.32	12.333	1.84	18.33	0.93
0.417	0.69	6.417	2.54	12.417	1.79	18.42	0.91
0.500	0.69	6.500	2.54	12.500	1.79	18.50	0.91
0.583	0.71	6.583	2.80	12.583	1.74	18.58	0.90
0.667	0.71	6.667	2.80	12.667	1.74	18.67	0.90
0.750	0.72	6.750	3.14	12.750	1.69	18.75	0.89
0.833	0.72	6.833	3.14	12.833	1.69	18.83	0.89
0.917	0.73	6.917	3.59	12.917	1.64	18.92	0.88
1.000	0.73	7.000	3.59	13.000	1.64	19.00	0.88
1.083	0.75	7.083	4.22	13.083	1.60	19.08	0.87
1.167	0.75	7.167	4.22	13.167	1.60	19.17	0.87
1.250	0.76	7.250	5.16	13.250	1.56	19.25	0.86
1.333	0.76	7.333	5.16	13.333	1.56	19.33	0.86
1.417	0.78	7.417	6.77	13.417	1.52	19.42	0.85
1.500	0.78	7.500	6.77	13.500	1.52	19.50	0.85
1.583	0.79	7.583	10.20	13.583	1.49	19.58	0.84
1.667	0.79	7.667	10.20	13.667	1.49	19.67	0.84
1.750	0.81	7.750	23.44	13.750	1.45	19.75	0.83
1.833	0.81	7.833	23.44	13.833	1.45	19.83	0.83
1.917	0.83	7.917	85.67	13.917	1.42	19.92	0.82
2.000	0.83	8.000	85.67	14.000	1.42	20.00	0.82
2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72

4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Max.Eff.Inten.(mm/hr)=	85.67	25.57	
over (min)	5.00	15.00	
Storage Coeff. (min)=	1.55 (ii)	13.73 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	0.33	0.08	
			TOTALS
PEAK FLOW (cms)=	0.02	0.02	0.031 (iii)
TIME TO PEAK (hrs)=	8.00	8.17	8.00
RUNOFF VOLUME (mm)=	65.62	27.81	34.98
TOTAL RAINFALL (mm)=	67.12	67.12	67.12
RUNOFF COEFFICIENT =	0.98	0.41	0.52

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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 (0004)	Area (ha)=	0.58	
ID= 1 DT= 5.0 min	Total Imp(%)=	16.00	Dir. Conn.(%)= 16.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.09	0.49
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	62.18	40.00
Mannings n	=	0.013	0.250

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
0.083	0.67	6.083	2.15	12.083	1.90	18.08	0.94
0.167	0.67	6.167	2.15	12.167	1.90	18.17	0.94
0.250	0.68	6.250	2.32	12.250	1.84	18.25	0.93
0.333	0.68	6.333	2.32	12.333	1.84	18.33	0.93
0.417	0.69	6.417	2.54	12.417	1.79	18.42	0.91
0.500	0.69	6.500	2.54	12.500	1.79	18.50	0.91
0.583	0.71	6.583	2.80	12.583	1.74	18.58	0.90
0.667	0.71	6.667	2.80	12.667	1.74	18.67	0.90
0.750	0.72	6.750	3.14	12.750	1.69	18.75	0.89
0.833	0.72	6.833	3.14	12.833	1.69	18.83	0.89
0.917	0.73	6.917	3.59	12.917	1.64	18.92	0.88
1.000	0.73	7.000	3.59	13.000	1.64	19.00	0.88
1.083	0.75	7.083	4.22	13.083	1.60	19.08	0.87
1.167	0.75	7.167	4.22	13.167	1.60	19.17	0.87
1.250	0.76	7.250	5.16	13.250	1.56	19.25	0.86
1.333	0.76	7.333	5.16	13.333	1.56	19.33	0.86
1.417	0.78	7.417	6.77	13.417	1.52	19.42	0.85
1.500	0.78	7.500	6.77	13.500	1.52	19.50	0.85
1.583	0.79	7.583	10.20	13.583	1.49	19.58	0.84
1.667	0.79	7.667	10.20	13.667	1.49	19.67	0.84
1.750	0.81	7.750	23.44	13.750	1.45	19.75	0.83

1.833	0.81	7.833	23.44	13.833	1.45	19.83	0.83
1.917	0.83	7.917	85.67	13.917	1.42	19.92	0.82
2.000	0.83	8.000	85.67	14.000	1.42	20.00	0.82
2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Max.Eff.Inten.(mm/hr)=	85.67	25.57		
over (min)	5.00	15.00		
Storage Coeff. (min)=	1.66 (ii)	13.84 (ii)		
Unit Hyd. Tpeak (min)=	5.00	15.00		
Unit Hyd. peak (cms)=	0.32	0.08		
			TOTALS	
PEAK FLOW (cms)=	0.02	0.02	0.036 (iii)	
TIME TO PEAK (hrs)=	8.00	8.17	8.00	
RUNOFF VOLUME (mm)=	65.62	27.81	33.85	
TOTAL RAINFALL (mm)=	67.12	67.12	67.12	
RUNOFF COEFFICIENT =	0.98	0.41	0.50	

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0010) 1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0011):	0.24	0.013	8.08	27.71
+ ID2= 2 (0002):	0.84	0.057	8.00	27.30
ID = 3 (0010):	1.08	0.067	8.00	27.39

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0010)					
3 + 2 = 1		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
	ID1= 3 (0010):	1.08	0.067	8.00	27.39
+	ID2= 2 (0003):	0.46	0.031	8.00	34.98
	ID = 1 (0010):	1.54	0.099	8.00	29.65

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 (0010):	1.54	0.099	8.00	29.65
+	ID2= 2 (0004):	0.58	0.036	8.00	33.85
	ID = 3 (0010):	2.12	0.134	8.00	30.80

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

FINISH

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

       V    V   I    SSSSS  U   U    A    L             (v 6.2.2007)
       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    TM
       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 6.2\VO2\voin.dat
  Output  filename: C:\Users\Chris.Zhang\AppData\Local\Civica\VH5\c48cc875-0d46-4cf3-b9ff-15292ba03324\28d5043
  Summary filename: C:\Users\Chris.Zhang\AppData\Local\Civica\VH5\c48cc875-0d46-4cf3-b9ff-15292ba03324\28d5043


DATE: 11-23-2022                          TIME: 09:36:28

USER:


COMMENTS: _____________________________________________________________

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  ************************************************
  ** SIMULATION : Forr Erie-Chicago-24h-100-yr  **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1083.550
| Ptotal=123.65 mm |                          B=   6.618
--------------------                          C=   0.735
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  = 24.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    1.41 |  6.00    4.25 | 12.00    3.79 | 18.00    1.94
                0.17    1.43 |  6.17    4.58 | 12.17    3.68 | 18.17    1.91
                0.33    1.45 |  6.33    4.98 | 12.33    3.58 | 18.33    1.89
                0.50    1.48 |  6.50    5.48 | 12.50    3.48 | 18.50    1.87
                0.67    1.50 |  6.67    6.10 | 12.67    3.39 | 18.67    1.85
                0.83    1.53 |  6.83    6.92 | 12.83    3.30 | 18.83    1.83
                1.00    1.56 |  7.00    8.05 | 13.00    3.22 | 19.00    1.81
                1.17    1.59 |  7.17    9.73 | 13.17    3.14 | 19.17    1.79
                1.33    1.62 |  7.33   12.55 | 13.33    3.07 | 19.33    1.77
                1.50    1.65 |  7.50   18.40 | 13.50    3.00 | 19.50    1.75
                1.67    1.68 |  7.67   39.99 | 13.67    2.94 | 19.67    1.73
                1.83    1.72 |  7.83  137.32 | 13.83    2.88 | 19.83    1.71
                2.00    1.75 |  8.00   51.10 | 14.00    2.82 | 20.00    1.69
                2.17    1.79 |  8.17   28.93 | 14.17    2.76 | 20.17    1.68
                2.33    1.83 |  8.33   20.61 | 14.33    2.71 | 20.33    1.66
                2.50    1.88 |  8.50   16.22 | 14.50    2.66 | 20.50    1.64
                2.67    1.92 |  8.67   13.50 | 14.67    2.61 | 20.67    1.63
                2.83    1.97 |  8.83   11.63 | 14.83    2.56 | 20.83    1.61
                3.00    2.02 |  9.00   10.27 | 15.00    2.52 | 21.00    1.60
                3.17    2.08 |  9.17    9.22 | 15.17    2.47 | 21.17    1.58
                3.33    2.13 |  9.33    8.39 | 15.33    2.43 | 21.33    1.57
                3.50    2.20 |  9.50    7.72 | 15.50    2.39 | 21.50    1.55
                3.67    2.26 |  9.67    7.16 | 15.67    2.35 | 21.67    1.54
                3.83    2.33 |  9.83    6.69 | 15.83    2.32 | 21.83    1.53
                4.00    2.41 | 10.00    6.28 | 16.00    2.28 | 22.00    1.51
                4.17    2.49 | 10.17    5.93 | 16.17    2.25 | 22.17    1.50
                4.33    2.58 | 10.33    5.62 | 16.33    2.21 | 22.33    1.49
                4.50    2.68 | 10.50    5.34 | 16.50    2.18 | 22.50    1.47
                4.67    2.79 | 10.67    5.10 | 16.67    2.15 | 22.67    1.46
                4.83    2.90 | 10.83    4.88 | 16.83    2.12 | 22.83    1.45
                5.00    3.03 | 11.00    4.68 | 17.00    2.09 | 23.00    1.44
                5.17    3.18 | 11.17    4.50 | 17.17    2.06 | 23.17    1.43
                5.33    3.34 | 11.33    4.33 | 17.33    2.04 | 23.33    1.41
```

5.50	3.52	11.50	4.18	17.50	2.01	23.50	1.40
5.67	3.73	11.67	4.04	17.67	1.99	23.67	1.39
5.83	3.97	11.83	3.91	17.83	1.96	23.83	1.38

CALIB					
NASHYD (0013)	Area (ha)=	0.48	Curve Number (CN)=	74.0	
ID= 1 DT= 5.0 min	Ia (mm)=	2.50	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.17			

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41

5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39
5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

Unit Hyd Qpeak (cms)= 0.108

PEAK FLOW (cms)= 0.062 (i)
TIME TO PEAK (hrs)= 8.083
RUNOFF VOLUME (mm)= 69.512
TOTAL RAINFALL (mm)= 123.651
RUNOFF COEFFICIENT = 0.562

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

CALIB
STANDHYD (0005)
ID= 1 DT= 5.0 min

Area (ha)= 2.27
Total Imp(%)= 66.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.50	0.77
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	123.02	40.00
Mannings n	=	0.013	0.250

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53

4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41
5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39
5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

Max.Eff.Inten.(mm/hr)=	137.32	********	
over (min)	5.00	10.00	
Storage Coeff. (min)=	2.07 (ii)	6.84 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.31	0.14	
			TOTALS
PEAK FLOW (cms)=	0.57	0.16	0.718 (iii)
TIME TO PEAK (hrs)=	8.00	8.08	8.00
RUNOFF VOLUME (mm)=	122.15	89.36	111.00
TOTAL RAINFALL (mm)=	123.65	123.65	123.65
RUNOFF COEFFICIENT =	0.99	0.72	0.90

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0009)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
ID1= 1 (0013):		0.48	0.062	8.08	69.51
+ ID2= 2 (0005):		2.27	0.718	8.00	111.00
ID = 3 (0009):		2.75	0.771	8.00	103.76

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR(0004)
IN= 2---> OUT= 1
DT= 5.0 min

OVERFLOW IS OFF

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.0296	0.1275
0.0057	0.0139	0.0345	0.1603
0.0084	0.0305	0.0386	0.1969
0.0104	0.0500	0.0409	0.2207
0.0121	0.0725	0.0451	0.2726
0.0234	0.0983	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0009)	2.750	0.771	8.00	103.76
OUTFLOW: ID= 1 (0004)	2.750	0.035	11.00	103.53

PEAK FLOW REDUCTION [Qout/Qin](%)= 4.50
TIME SHIFT OF PEAK FLOW (min)=180.00
MAXIMUM STORAGE USED (ha.m.)= 0.1616

CALIB
STANDHYD (0010)
ID= 1 DT= 5.0 min

Area (ha)= 0.30
Total Imp(%)= 54.00 Dir. Conn.(%)= 52.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.16	0.14
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	44.72	40.00
Mannings n	=	0.013	0.250

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41
5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39

5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

			TOTALS
Max.Eff.Inten.(mm/hr)=	137.32	79.75	
over (min)	5.00	10.00	
Storage Coeff. (min)=	1.13 (ii)	8.85 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.34	0.12	
PEAK FLOW (cms)=	0.06	0.02	0.078 (iii)
TIME TO PEAK (hrs)=	8.00	8.08	8.00
RUNOFF VOLUME (mm)=	122.15	71.90	98.01
TOTAL RAINFALL (mm)=	123.65	123.65	123.65
RUNOFF COEFFICIENT =	0.99	0.58	0.79

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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 (0011)	Area (ha)=	0.42
ID= 1 DT= 5.0 min	Total Imp(%)=	47.00 Dir. Conn.(%)= 42.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.20	0.22
Dep. Storage (mm)=	1.50	1.50
Average Slope (%)=	2.00	2.00
Length (m)=	52.92	40.00
Mannings n =	0.013	0.250

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57

3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41
5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39
5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

Max.Eff.Inten.(mm/hr)=	137.32	85.81	
over (min)	5.00	10.00	
Storage Coeff. (min)=	1.25 (ii)	8.75 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.33	0.12	
			TOTALS
PEAK FLOW (cms)=	0.07	0.04	0.100 (iii)
TIME TO PEAK (hrs)=	8.00	8.08	8.00
RUNOFF VOLUME (mm)=	122.15	73.36	93.84
TOTAL RAINFALL (mm)=	123.65	123.65	123.65
RUNOFF COEFFICIENT =	0.99	0.59	0.76

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0016) | 1 + 2 = 3		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0010):		0.30	0.078	8.00	98.01
+ ID2= 2 (0011):		0.42	0.100	8.00	93.84
ID = 3 (0016):		0.72	0.178	8.00	95.58

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0016) | 3 + 2 = 1		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0016):		0.72	0.178	8.00	95.58
+ ID2= 2 (0004):		2.75	0.035	11.00	103.53
ID = 1 (0016):		3.47	0.193	8.00	101.88

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB NASHYD (0033) | ID= 1 DT= 5.0 min				
	Area (ha)=	0.24	Curve Number (CN)=	74.0
	Ia (mm)=	1.50	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=	0.17		

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41
5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39
5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

Unit Hyd Qpeak (cms)= 0.054

PEAK FLOW (cms)= 0.031 (i)
TIME TO PEAK (hrs)= 8.083
RUNOFF VOLUME (mm)= 70.329
TOTAL RAINFALL (mm)= 123.651
RUNOFF COEFFICIENT = 0.569

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

CALIB	
STANDHYD (0018)	Area (ha)= 0.07
ID= 1 DT= 5.0 min	Total Imp(%)= 16.00 Dir. Conn.(%)= 16.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.01	0.06
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	21.60	40.00
Mannings n	=	0.013	0.250

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44

5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41
5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39
5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

Max.Eff.Inten.(mm/hr)=	137.32	74.65	
over (min)	5.00	10.00	
Storage Coeff. (min)=	0.73 (ii)	8.66 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.34	0.12	
			TOTALS
PEAK FLOW (cms)=	0.00	0.01	0.012 (iii)
TIME TO PEAK (hrs)=	8.00	8.08	8.00
RUNOFF VOLUME (mm)=	122.15	70.58	78.75
TOTAL RAINFALL (mm)=	123.65	123.65	123.65
RUNOFF COEFFICIENT =	0.99	0.57	0.64

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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 (0032)| Area (ha)= 0.16
ID= 1 DT= 5.0 min | Total Imp(%)= 58.00 Dir. Conn.(%)= 58.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.09	0.07
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	32.66	40.00
Mannings n	=	0.013	0.250

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64

2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41
5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39
5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

Max.Eff.Inten.(mm/hr)=	137.32	74.65		
over (min)	5.00	10.00		
Storage Coeff. (min)=	0.93 (ii)	8.87 (ii)		
Unit Hyd. Tpeak (min)=	5.00	10.00		
Unit Hyd. peak (cms)=	0.34	0.12		
			TOTALS	
PEAK FLOW (cms)=	0.04	0.01	0.044 (iii)	
TIME TO PEAK (hrs)=	8.00	8.08	8.00	
RUNOFF VOLUME (mm)=	122.15	70.58	100.45	
TOTAL RAINFALL (mm)=	123.65	123.65	123.65	
RUNOFF COEFFICIENT =	0.99	0.57	0.81	

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0023)					
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	
ID1= 1 (0018):	0.07	0.012	8.00	78.75	
+ ID2= 2 (0032):	0.16	0.044	8.00	100.45	
ID = 3 (0023):	0.23	0.056	8.00	93.84	

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0023)					
3 + 2 = 1	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	
ID1= 3 (0023):	0.23	0.056	8.00	93.84	
+ ID2= 2 (0033):	0.24	0.031	8.08	70.33	
ID = 1 (0023):	0.47	0.082	8.00	81.84	

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB		
STANDHYD (0019)	Area (ha)= 0.24	
ID= 1 DT= 5.0 min	Total Imp(%)= 73.00	Dir. Conn.(%)= 73.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.18	0.06
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	40.00	40.00
Mannings n	=	0.013	0.250

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61
3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43

5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41
5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39
5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

Max.Eff.Inten.(mm/hr)=	137.32	********		
over (min)	5.00	10.00		
Storage Coeff. (min)=	1.05 (ii)	5.23 (ii)		
Unit Hyd. Tpeak (min)=	5.00	10.00		
Unit Hyd. peak (cms)=	0.34	0.16		
			TOTALS	
PEAK FLOW (cms)=	0.07	0.01	0.077 (iii)	
TIME TO PEAK (hrs)=	8.00	8.08	8.00	
RUNOFF VOLUME (mm)=	122.15	70.58	108.22	
TOTAL RAINFALL (mm)=	123.65	123.65	123.65	
RUNOFF COEFFICIENT =	0.99	0.57	0.88	

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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 (0022)	Area (ha)=	0.35	
ID= 1 DT= 5.0 min	Total Imp(%)=	64.00	Dir. Conn.(%)= 64.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.22	0.13
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	48.30	40.00
Mannings n	=	0.013	0.250

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
0.083	1.41	6.083	4.25	12.083	3.79	18.08	1.94
0.167	1.41	6.167	4.25	12.167	3.79	18.17	1.94
0.250	1.43	6.250	4.58	12.250	3.68	18.25	1.91
0.333	1.43	6.333	4.58	12.333	3.68	18.33	1.91
0.417	1.45	6.417	4.98	12.417	3.58	18.42	1.89
0.500	1.45	6.500	4.98	12.500	3.58	18.50	1.89
0.583	1.48	6.583	5.48	12.583	3.48	18.58	1.87
0.667	1.48	6.667	5.48	12.667	3.48	18.67	1.87
0.750	1.50	6.750	6.10	12.750	3.39	18.75	1.85
0.833	1.50	6.833	6.10	12.833	3.39	18.83	1.85
0.917	1.53	6.917	6.92	12.917	3.30	18.92	1.83
1.000	1.53	7.000	6.92	13.000	3.30	19.00	1.83
1.083	1.56	7.083	8.05	13.083	3.22	19.08	1.81
1.167	1.56	7.167	8.05	13.167	3.22	19.17	1.81
1.250	1.59	7.250	9.73	13.250	3.14	19.25	1.79
1.333	1.59	7.333	9.73	13.333	3.14	19.33	1.79
1.417	1.62	7.417	12.55	13.417	3.07	19.42	1.77
1.500	1.62	7.500	12.55	13.500	3.07	19.50	1.77
1.583	1.65	7.583	18.40	13.583	3.00	19.58	1.75
1.667	1.65	7.667	18.40	13.667	3.00	19.67	1.75
1.750	1.68	7.750	39.99	13.750	2.94	19.75	1.73
1.833	1.68	7.833	40.00	13.833	2.94	19.83	1.73
1.917	1.72	7.917	137.32	13.917	2.88	19.92	1.71
2.000	1.72	8.000	137.31	14.000	2.88	20.00	1.71
2.083	1.75	8.083	51.10	14.083	2.82	20.08	1.69
2.167	1.75	8.167	51.10	14.167	2.82	20.17	1.69
2.250	1.79	8.250	28.93	14.250	2.76	20.25	1.68
2.333	1.79	8.333	28.93	14.333	2.76	20.33	1.68
2.417	1.83	8.417	20.61	14.417	2.71	20.42	1.66
2.500	1.83	8.500	20.61	14.500	2.71	20.50	1.66
2.583	1.88	8.583	16.22	14.583	2.66	20.58	1.64
2.667	1.88	8.667	16.22	14.667	2.66	20.67	1.64
2.750	1.92	8.750	13.50	14.750	2.61	20.75	1.63
2.833	1.92	8.833	13.50	14.833	2.61	20.83	1.63
2.917	1.97	8.917	11.63	14.917	2.56	20.92	1.61
3.000	1.97	9.000	11.63	15.000	2.56	21.00	1.61

3.083	2.02	9.083	10.27	15.083	2.52	21.08	1.60
3.167	2.02	9.167	10.27	15.167	2.52	21.17	1.60
3.250	2.08	9.250	9.22	15.250	2.47	21.25	1.58
3.333	2.08	9.333	9.22	15.333	2.47	21.33	1.58
3.417	2.13	9.417	8.39	15.417	2.43	21.42	1.57
3.500	2.13	9.500	8.39	15.500	2.43	21.50	1.57
3.583	2.20	9.583	7.72	15.583	2.39	21.58	1.55
3.667	2.20	9.667	7.72	15.667	2.39	21.67	1.55
3.750	2.26	9.750	7.16	15.750	2.35	21.75	1.54
3.833	2.26	9.833	7.16	15.833	2.35	21.83	1.54
3.917	2.33	9.917	6.69	15.917	2.32	21.92	1.53
4.000	2.33	10.000	6.69	16.000	2.32	22.00	1.53
4.083	2.41	10.083	6.28	16.083	2.28	22.08	1.51
4.167	2.41	10.167	6.28	16.167	2.28	22.17	1.51
4.250	2.49	10.250	5.93	16.250	2.25	22.25	1.50
4.333	2.49	10.333	5.93	16.333	2.25	22.33	1.50
4.417	2.58	10.417	5.62	16.417	2.21	22.42	1.49
4.500	2.58	10.500	5.62	16.500	2.21	22.50	1.49
4.583	2.68	10.583	5.34	16.583	2.18	22.58	1.47
4.667	2.68	10.667	5.34	16.667	2.18	22.67	1.47
4.750	2.79	10.750	5.10	16.750	2.15	22.75	1.46
4.833	2.79	10.833	5.10	16.833	2.15	22.83	1.46
4.917	2.90	10.917	4.88	16.917	2.12	22.92	1.45
5.000	2.90	11.000	4.88	17.000	2.12	23.00	1.45
5.083	3.03	11.083	4.68	17.083	2.09	23.08	1.44
5.167	3.03	11.167	4.68	17.167	2.09	23.17	1.44
5.250	3.18	11.250	4.50	17.250	2.06	23.25	1.43
5.333	3.18	11.333	4.50	17.333	2.06	23.33	1.43
5.417	3.34	11.417	4.33	17.417	2.04	23.42	1.41
5.500	3.34	11.500	4.33	17.500	2.04	23.50	1.41
5.583	3.52	11.583	4.18	17.583	2.01	23.58	1.40
5.667	3.52	11.667	4.18	17.667	2.01	23.67	1.40
5.750	3.73	11.750	4.04	17.750	1.99	23.75	1.39
5.833	3.73	11.833	4.04	17.833	1.99	23.83	1.39
5.917	3.97	11.917	3.91	17.917	1.96	23.92	1.38
6.000	3.97	12.000	3.91	18.000	1.96	24.00	1.38

Max.Eff.Inten.(mm/hr)=	137.32	********		
over (min)	5.00	10.00		
Storage Coeff. (min)=	1.18 (ii)	6.12 (ii)		
Unit Hyd. Tpeak (min)=	5.00	10.00		
Unit Hyd. peak (cms)=	0.33	0.15		
			TOTALS	
PEAK FLOW (cms)=	0.09	0.02	0.104 (iii)	
TIME TO PEAK (hrs)=	8.00	8.08	8.00	
RUNOFF VOLUME (mm)=	122.15	70.58	103.58	
TOTAL RAINFALL (mm)=	123.65	123.65	123.65	
RUNOFF COEFFICIENT =	0.99	0.57	0.84	

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0031)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0019):	0.24	0.077	8.00	108.22
	+ ID2= 2 (0022):	0.35	0.104	8.00	103.58
	ID = 3 (0031):	0.59	0.181	8.00	105.46

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR(0020)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0715	0.0048
	0.0282	0.0005	0.0764	0.0054
	0.0389	0.0010	0.0810	0.0058
	0.0473	0.0012	0.0853	0.0060
	0.0544	0.0020	0.1077	0.0064
	0.0606	0.0030	0.1116	0.0074
	0.0663	0.0039	0.0000	0.0000

	AREA	QPEAK	TPEAK	R.V.

```
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0031)      0.590      0.181      8.00     105.46
   OUTFLOW: ID= 1 (  0020)      0.590      0.110      8.08     105.46

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 60.94
                  TIME SHIFT OF PEAK FLOW         (min)=  5.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0073

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

--------------------
| ADD HYD  (  0024)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0020):     0.59   0.110     8.08   105.46
     + ID2= 2 (  0023):     0.47   0.082     8.00    81.84
       ================================================
       ID = 3 (  0024):     1.06   0.175     8.08    94.99

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
================================================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2007)
       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    TM
       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 6.2\VO2\voin.dat
  Output  filename: C:\Users\Chris.Zhang\AppData\Local\Civica\VH5\c48cc875-0d46-4cf3-b9ff-15292ba03324\b858647
  Summary filename: C:\Users\Chris.Zhang\AppData\Local\Civica\VH5\c48cc875-0d46-4cf3-b9ff-15292ba03324\b858647


DATE: 11-23-2022                          TIME: 09:36:28

USER:


COMMENTS: _____________________________________________________________


--------------------------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : Fort Erie- Chicago-24h-2yr    **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 628.050
| Ptotal= 45.98 mm |                          B=   6.652
--------------------                          C=   0.796
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  = 24.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    0.41 |  6.00    1.36 | 12.00    1.20 | 18.00    0.57
                0.17    0.41 |  6.17    1.48 | 12.17    1.16 | 18.17    0.57
                0.33    0.42 |  6.33    1.62 | 12.33    1.12 | 18.33    0.56
                0.50    0.43 |  6.50    1.80 | 12.50    1.09 | 18.50    0.55
                0.67    0.44 |  6.67    2.03 | 12.67    1.06 | 18.67    0.55
                0.83    0.44 |  6.83    2.33 | 12.83    1.03 | 18.83    0.54
                1.00    0.45 |  7.00    2.76 | 13.00    1.00 | 19.00    0.53
                1.17    0.46 |  7.17    3.42 | 13.17    0.98 | 19.17    0.53
                1.33    0.47 |  7.33    4.55 | 13.33    0.95 | 19.33    0.52
                1.50    0.48 |  7.50    7.02 | 13.50    0.93 | 19.50    0.51
                1.67    0.49 |  7.67   16.99 | 13.67    0.91 | 19.67    0.51
                1.83    0.50 |  7.83   66.94 | 13.83    0.89 | 19.83    0.50
```

2.00	0.52	8.00	22.29	14.00	0.87	20.00	0.50
2.17	0.53	8.17	11.71	14.17	0.85	20.17	0.49
2.33	0.54	8.33	7.97	14.33	0.83	20.33	0.49
2.50	0.56	8.50	6.08	14.50	0.81	20.50	0.48
2.67	0.57	8.67	4.94	14.67	0.80	20.67	0.48
2.83	0.59	8.83	4.17	14.83	0.78	20.83	0.47
3.00	0.60	9.00	3.63	15.00	0.76	21.00	0.47
3.17	0.62	9.17	3.22	15.17	0.75	21.17	0.46
3.33	0.64	9.33	2.90	15.33	0.74	21.33	0.46
3.50	0.66	9.50	2.64	15.50	0.72	21.50	0.45
3.67	0.68	9.67	2.42	15.67	0.71	21.67	0.45
3.83	0.70	9.83	2.25	15.83	0.70	21.83	0.44
4.00	0.73	10.00	2.10	16.00	0.69	22.00	0.44
4.17	0.76	10.17	1.96	16.17	0.68	22.17	0.43
4.33	0.79	10.33	1.85	16.33	0.66	22.33	0.43
4.50	0.82	10.50	1.75	16.50	0.65	22.50	0.43
4.67	0.85	10.67	1.66	16.67	0.64	22.67	0.42
4.83	0.89	10.83	1.58	16.83	0.63	22.83	0.42
5.00	0.94	11.00	1.51	17.00	0.62	23.00	0.41
5.17	0.99	11.17	1.45	17.17	0.62	23.17	0.41
5.33	1.04	11.33	1.39	17.33	0.61	23.33	0.41
5.50	1.11	11.50	1.34	17.50	0.60	23.50	0.40
5.67	1.18	11.67	1.29	17.67	0.59	23.67	0.40
5.83	1.26	11.83	1.24	17.83	0.58	23.83	0.40

CALIB NASHYD (0013) ID= 1 DT= 5.0 min	Area (ha)= 0.48 Ia (mm)= 2.50 U.H. Tp(hrs)= 0.17	Curve Number (CN)= 74.0 # of Linear Res.(N)= 3.00	

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
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57
0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57
0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54
1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53
1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51
1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49
2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48
2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46
3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45

3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Unit Hyd Qpeak (cms)= 0.108

PEAK FLOW (cms)= 0.014 (i)
TIME TO PEAK (hrs)= 8.083
RUNOFF VOLUME (mm)= 14.191
TOTAL RAINFALL (mm)= 45.978
RUNOFF COEFFICIENT = 0.309

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

CALIB	
STANDHYD (0005)	Area (ha)= 2.27
ID= 1 DT= 5.0 min	Total Imp(%)= 66.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.50	0.77
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	123.02	40.00
Mannings n	=	0.013	0.250

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
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57
0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57
0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54
1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53
1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51
1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49

2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48
2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46
3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Max.Eff.Inten.(mm/hr)=	66.94	23.99		
over (min)	5.00	20.00		
Storage Coeff. (min)=	2.76 (ii)	15.25 (ii)		
Unit Hyd. Tpeak (min)=	5.00	20.00		
Unit Hyd. peak (cms)=	0.28	0.07		
			TOTALS	
PEAK FLOW (cms)=	0.27	0.03	0.287 (iii)	
TIME TO PEAK (hrs)=	8.00	8.25	8.00	
RUNOFF VOLUME (mm)=	44.48	22.15	36.88	
TOTAL RAINFALL (mm)=	45.98	45.98	45.98	
RUNOFF COEFFICIENT =	0.97	0.48	0.80	

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0009) | 1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0013):	0.48	0.014	8.08	14.19
+ ID2= 2 (0005):	2.27	0.287	8.00	36.88
ID = 3 (0009):	2.75	0.299	8.00	32.92

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR(0004) | IN= 2---> OUT= 1 | DT= 5.0 min	OVERFLOW IS OFF			
	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)

0.0000	0.0000	|	0.0296	0.1275
0.0057	0.0139	|	0.0345	0.1603
0.0084	0.0305	|	0.0386	0.1969
0.0104	0.0500	|	0.0409	0.2207
0.0121	0.0725	|	0.0451	0.2726
0.0234	0.0983	|	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0009)	2.750	0.299	8.00	32.92
OUTFLOW: ID= 1 (0004)	2.750	0.011	10.83	32.70

PEAK FLOW REDUCTION [Qout/Qin](%)= 3.62
TIME SHIFT OF PEAK FLOW (min)=170.00
MAXIMUM STORAGE USED (ha.m.)= 0.0554

CALIB STANDHYD (0010) ID= 1 DT= 5.0 min	Area (ha)= 0.30 Total Imp(%)= 54.00 Dir. Conn.(%)= 52.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.16	0.14
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	44.72	40.00
Mannings n	=	0.013	0.250

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
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57
0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57
0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54
1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53
1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51
1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49
2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48
2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46
3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44

4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Max.Eff.Inten.(mm/hr)=	66.94	16.09		
over (min)	5.00	20.00		
Storage Coeff. (min)=	1.50 (ii)	16.16 (ii)		
Unit Hyd. Tpeak (min)=	5.00	20.00		
Unit Hyd. peak (cms)=	0.33	0.06		
			TOTALS	
PEAK FLOW (cms)=	0.03	0.00	0.031 (iii)	
TIME TO PEAK (hrs)=	8.00	8.25	8.00	
RUNOFF VOLUME (mm)=	44.48	15.25	30.41	
TOTAL RAINFALL (mm)=	45.98	45.98	45.98	
RUNOFF COEFFICIENT =	0.97	0.33	0.66	

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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 (0011)	Area (ha)=	0.42	
ID= 1 DT= 5.0 min	Total Imp(%)=	47.00	Dir. Conn.(%)= 42.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.20	0.22
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	52.92	40.00
Mannings n	=	0.013	0.250

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
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57
0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57
0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54
1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53
1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51

1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49
2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48
2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46
3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Max.Eff.Inten.(mm/hr)=	66.94	17.54		
over (min)	5.00	20.00		
Storage Coeff. (min)=	1.66 (ii)	15.82 (ii)		
Unit Hyd. Tpeak (min)=	5.00	20.00		
Unit Hyd. peak (cms)=	0.32	0.07		
			TOTALS	
PEAK FLOW (cms)=	0.03	0.01	0.036 (iii)	
TIME TO PEAK (hrs)=	8.00	8.25	8.00	
RUNOFF VOLUME (mm)=	44.48	15.77	27.81	
TOTAL RAINFALL (mm)=	45.98	45.98	45.98	
RUNOFF COEFFICIENT =	0.97	0.34	0.60	

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0016)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0010):	0.30	0.031	8.00	30.41
+ ID2= 2 (0011):	0.42	0.036	8.00	27.81
ID = 3 (0016):	0.72	0.066	8.00	28.89

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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--------------------
| ADD HYD  (  0016)|
|   3 +  2 =  1    |          AREA     QPEAK     TPEAK      R.V.
--------------------          (ha)     (cms)     (hrs)      (mm)
       ID1= 3 (  0016):      0.72    0.066      8.00     28.89
     + ID2= 2 (  0004):      2.75    0.011     10.83     32.70
       ================================================
       ID = 1 (  0016):      3.47    0.074      8.00     31.91

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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| CALIB            |
| NASHYD   (  0033)|   Area    (ha)=   0.24   Curve Number   (CN)= 74.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   1.50   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.17

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

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57
0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57
0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54
1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53
1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51
1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49
2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48
2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46
3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42

5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Unit Hyd Qpeak (cms)= 0.054

PEAK FLOW (cms)= 0.008 (i)
TIME TO PEAK (hrs)= 8.083
RUNOFF VOLUME (mm)= 14.740
TOTAL RAINFALL (mm)= 45.978
RUNOFF COEFFICIENT = 0.321

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

CALIB	
STANDHYD (0018)	Area (ha)= 0.07
ID= 1 DT= 5.0 min	Total Imp(%)= 16.00 Dir. Conn.(%)= 16.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.01	0.06
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	21.60	40.00
Mannings n	=	0.013	0.250

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
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57
0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57
0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54
1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53
1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51
1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49
2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48
2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46

3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Max.Eff.Inten.(mm/hr)=	66.94	13.27	
over (min)	5.00	20.00	
Storage Coeff. (min)=	0.97 (ii)	16.80 (ii)	
Unit Hyd. Tpeak (min)=	5.00	20.00	
Unit Hyd. peak (cms)=	0.34	0.06	
			TOTALS
PEAK FLOW (cms)=	0.00	0.00	0.003 (iii)
TIME TO PEAK (hrs)=	8.00	8.25	8.00
RUNOFF VOLUME (mm)=	44.48	14.79	16.12
TOTAL RAINFALL (mm)=	45.98	45.98	45.98
RUNOFF COEFFICIENT =	0.97	0.32	0.35

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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 (0032)	Area (ha)= 0.16
ID= 1 DT= 5.0 min	Total Imp(%)= 58.00 Dir. Conn.(%)= 58.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.09	0.07
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	32.66	40.00
Mannings n	=	0.013	0.250

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
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57
0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57
0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54

1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53
1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51
1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49
2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48
2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46
3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Max.Eff.Inten.(mm/hr)=	66.94	13.27	
over (min)	5.00	20.00	
Storage Coeff. (min)=	1.24 (ii)	17.08 (ii)	
Unit Hyd. Tpeak (min)=	5.00	20.00	
Unit Hyd. peak (cms)=	0.33	0.06	
			TOTALS
PEAK FLOW (cms)=	0.02	0.00	0.018 (iii)
TIME TO PEAK (hrs)=	8.00	8.25	8.00
RUNOFF VOLUME (mm)=	44.48	14.79	31.97
TOTAL RAINFALL (mm)=	45.98	45.98	45.98
RUNOFF COEFFICIENT =	0.97	0.32	0.70

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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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--------------------
| ADD HYD  (  0023)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0018):     0.07   0.003     8.00    16.12
     + ID2= 2 (  0032):     0.16   0.018     8.00    31.97
       ================================================
       ID = 3 (  0023):     0.23   0.021     8.00    27.15

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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| ADD HYD  (  0023)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0023):     0.23   0.021     8.00    27.15
     + ID2= 2 (  0033):     0.24   0.008     8.08    14.74
       ================================================
       ID = 1 (  0023):     0.47   0.027     8.00    20.81

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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--------------------
| CALIB            |
| STANDHYD (  0019)|   Area    (ha)=   0.24
|ID= 1 DT= 5.0 min |   Total Imp(%)=  73.00   Dir. Conn.(%)=  73.00
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                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.18         0.06
     Dep. Storage     (mm)=       1.50         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      40.00        40.00
     Mannings n           =      0.013        0.250

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


                        ---- TRANSFORMED HYETOGRAPH ----
  TIME     RAIN |  TIME     RAIN |'  TIME     RAIN |  TIME     RAIN
   hrs    mm/hr |   hrs    mm/hr |'   hrs    mm/hr |   hrs    mm/hr
 0.083     0.41 | 6.083     1.36 |12.083     1.20 | 18.08     0.57
 0.167     0.41 | 6.167     1.36 |12.167     1.20 | 18.17     0.57
 0.250     0.41 | 6.250     1.48 |12.250     1.16 | 18.25     0.57
 0.333     0.41 | 6.333     1.48 |12.333     1.16 | 18.33     0.57
 0.417     0.42 | 6.417     1.62 |12.417     1.12 | 18.42     0.56
 0.500     0.42 | 6.500     1.62 |12.500     1.12 | 18.50     0.56
 0.583     0.43 | 6.583     1.80 |12.583     1.09 | 18.58     0.55
 0.667     0.43 | 6.667     1.80 |12.667     1.09 | 18.67     0.55
 0.750     0.44 | 6.750     2.03 |12.750     1.06 | 18.75     0.55
 0.833     0.44 | 6.833     2.03 |12.833     1.06 | 18.83     0.55
 0.917     0.44 | 6.917     2.33 |12.917     1.03 | 18.92     0.54
 1.000     0.44 | 7.000     2.33 |13.000     1.03 | 19.00     0.54
 1.083     0.45 | 7.083     2.76 |13.083     1.00 | 19.08     0.53
 1.167     0.45 | 7.167     2.76 |13.167     1.00 | 19.17     0.53
 1.250     0.46 | 7.250     3.42 |13.250     0.98 | 19.25     0.53
 1.333     0.46 | 7.333     3.42 |13.333     0.98 | 19.33     0.53
 1.417     0.47 | 7.417     4.55 |13.417     0.95 | 19.42     0.52
 1.500     0.47 | 7.500     4.55 |13.500     0.95 | 19.50     0.52
 1.583     0.48 | 7.583     7.02 |13.583     0.93 | 19.58     0.51
 1.667     0.48 | 7.667     7.02 |13.667     0.93 | 19.67     0.51
 1.750     0.49 | 7.750    16.99 |13.750     0.91 | 19.75     0.51
 1.833     0.49 | 7.833    16.99 |13.833     0.91 | 19.83     0.51
 1.917     0.50 | 7.917    66.94 |13.917     0.89 | 19.92     0.50
 2.000     0.50 | 8.000    66.94 |14.000     0.89 | 20.00     0.50
 2.083     0.52 | 8.083    22.29 |14.083     0.87 | 20.08     0.50
 2.167     0.52 | 8.167    22.29 |14.167     0.87 | 20.17     0.50
 2.250     0.53 | 8.250    11.71 |14.250     0.85 | 20.25     0.49
 2.333     0.53 | 8.333    11.71 |14.333     0.85 | 20.33     0.49
 2.417     0.54 | 8.417     7.97 |14.417     0.83 | 20.42     0.49
 2.500     0.54 | 8.500     7.97 |14.500     0.83 | 20.50     0.49
 2.583     0.56 | 8.583     6.08 |14.583     0.81 | 20.58     0.48
 2.667     0.56 | 8.667     6.08 |14.667     0.81 | 20.67     0.48
 2.750     0.57 | 8.750     4.94 |14.750     0.80 | 20.75     0.48
 2.833     0.57 | 8.833     4.94 |14.833     0.80 | 20.83     0.48
 2.917     0.59 | 8.917     4.17 |14.917     0.78 | 20.92     0.47
 3.000     0.59 | 9.000     4.17 |15.000     0.78 | 21.00     0.47
 3.083     0.60 | 9.083     3.63 |15.083     0.76 | 21.08     0.47
 3.167     0.60 | 9.167     3.63 |15.167     0.76 | 21.17     0.47
 3.250     0.62 | 9.250     3.22 |15.250     0.75 | 21.25     0.46
 3.333     0.62 | 9.333     3.22 |15.333     0.75 | 21.33     0.46
 3.417     0.64 | 9.417     2.90 |15.417     0.74 | 21.42     0.46
 3.500     0.64 | 9.500     2.90 |15.500     0.74 | 21.50     0.46
 3.583     0.66 | 9.583     2.64 |15.583     0.72 | 21.58     0.45
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3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Max.Eff.Inten.(mm/hr)=	66.94	13.27		
over (min)	5.00	20.00		
Storage Coeff. (min)=	1.41 (ii)	17.24 (ii)		
Unit Hyd. Tpeak (min)=	5.00	20.00		
Unit Hyd. peak (cms)=	0.33	0.06		
			TOTALS	
PEAK FLOW (cms)=	0.03	0.00	0.033 (iii)	
TIME TO PEAK (hrs)=	8.00	8.25	8.00	
RUNOFF VOLUME (mm)=	44.48	14.79	36.44	
TOTAL RAINFALL (mm)=	45.98	45.98	45.98	
RUNOFF COEFFICIENT =	0.97	0.32	0.79	

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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 (0022)	Area (ha)=	0.35	
ID= 1 DT= 5.0 min	Total Imp(%)=	64.00	Dir. Conn.(%)= 64.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.22	0.13
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	48.30	40.00
Mannings n	=	0.013	0.250

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
0.083	0.41	6.083	1.36	12.083	1.20	18.08	0.57
0.167	0.41	6.167	1.36	12.167	1.20	18.17	0.57
0.250	0.41	6.250	1.48	12.250	1.16	18.25	0.57
0.333	0.41	6.333	1.48	12.333	1.16	18.33	0.57
0.417	0.42	6.417	1.62	12.417	1.12	18.42	0.56
0.500	0.42	6.500	1.62	12.500	1.12	18.50	0.56
0.583	0.43	6.583	1.80	12.583	1.09	18.58	0.55
0.667	0.43	6.667	1.80	12.667	1.09	18.67	0.55
0.750	0.44	6.750	2.03	12.750	1.06	18.75	0.55
0.833	0.44	6.833	2.03	12.833	1.06	18.83	0.55
0.917	0.44	6.917	2.33	12.917	1.03	18.92	0.54
1.000	0.44	7.000	2.33	13.000	1.03	19.00	0.54
1.083	0.45	7.083	2.76	13.083	1.00	19.08	0.53
1.167	0.45	7.167	2.76	13.167	1.00	19.17	0.53
1.250	0.46	7.250	3.42	13.250	0.98	19.25	0.53

1.333	0.46	7.333	3.42	13.333	0.98	19.33	0.53
1.417	0.47	7.417	4.55	13.417	0.95	19.42	0.52
1.500	0.47	7.500	4.55	13.500	0.95	19.50	0.52
1.583	0.48	7.583	7.02	13.583	0.93	19.58	0.51
1.667	0.48	7.667	7.02	13.667	0.93	19.67	0.51
1.750	0.49	7.750	16.99	13.750	0.91	19.75	0.51
1.833	0.49	7.833	16.99	13.833	0.91	19.83	0.51
1.917	0.50	7.917	66.94	13.917	0.89	19.92	0.50
2.000	0.50	8.000	66.94	14.000	0.89	20.00	0.50
2.083	0.52	8.083	22.29	14.083	0.87	20.08	0.50
2.167	0.52	8.167	22.29	14.167	0.87	20.17	0.50
2.250	0.53	8.250	11.71	14.250	0.85	20.25	0.49
2.333	0.53	8.333	11.71	14.333	0.85	20.33	0.49
2.417	0.54	8.417	7.97	14.417	0.83	20.42	0.49
2.500	0.54	8.500	7.97	14.500	0.83	20.50	0.49
2.583	0.56	8.583	6.08	14.583	0.81	20.58	0.48
2.667	0.56	8.667	6.08	14.667	0.81	20.67	0.48
2.750	0.57	8.750	4.94	14.750	0.80	20.75	0.48
2.833	0.57	8.833	4.94	14.833	0.80	20.83	0.48
2.917	0.59	8.917	4.17	14.917	0.78	20.92	0.47
3.000	0.59	9.000	4.17	15.000	0.78	21.00	0.47
3.083	0.60	9.083	3.63	15.083	0.76	21.08	0.47
3.167	0.60	9.167	3.63	15.167	0.76	21.17	0.47
3.250	0.62	9.250	3.22	15.250	0.75	21.25	0.46
3.333	0.62	9.333	3.22	15.333	0.75	21.33	0.46
3.417	0.64	9.417	2.90	15.417	0.74	21.42	0.46
3.500	0.64	9.500	2.90	15.500	0.74	21.50	0.46
3.583	0.66	9.583	2.64	15.583	0.72	21.58	0.45
3.667	0.66	9.667	2.64	15.667	0.72	21.67	0.45
3.750	0.68	9.750	2.42	15.750	0.71	21.75	0.45
3.833	0.68	9.833	2.42	15.833	0.71	21.83	0.45
3.917	0.70	9.917	2.25	15.917	0.70	21.92	0.44
4.000	0.70	10.000	2.25	16.000	0.70	22.00	0.44
4.083	0.73	10.083	2.10	16.083	0.69	22.08	0.44
4.167	0.73	10.167	2.10	16.167	0.69	22.17	0.44
4.250	0.76	10.250	1.96	16.250	0.68	22.25	0.43
4.333	0.76	10.333	1.96	16.333	0.68	22.33	0.43
4.417	0.79	10.417	1.85	16.417	0.66	22.42	0.43
4.500	0.79	10.500	1.85	16.500	0.66	22.50	0.43
4.583	0.82	10.583	1.75	16.583	0.65	22.58	0.43
4.667	0.82	10.667	1.75	16.667	0.65	22.67	0.43
4.750	0.85	10.750	1.66	16.750	0.64	22.75	0.42
4.833	0.85	10.833	1.66	16.833	0.64	22.83	0.42
4.917	0.89	10.917	1.58	16.917	0.63	22.92	0.42
5.000	0.89	11.000	1.58	17.000	0.63	23.00	0.42
5.083	0.94	11.083	1.51	17.083	0.62	23.08	0.41
5.167	0.94	11.167	1.51	17.167	0.62	23.17	0.41
5.250	0.99	11.250	1.45	17.250	0.62	23.25	0.41
5.333	0.99	11.333	1.45	17.333	0.62	23.33	0.41
5.417	1.04	11.417	1.39	17.417	0.61	23.42	0.41
5.500	1.04	11.500	1.39	17.500	0.61	23.50	0.41
5.583	1.11	11.583	1.34	17.583	0.60	23.58	0.40
5.667	1.11	11.667	1.34	17.667	0.60	23.67	0.40
5.750	1.18	11.750	1.29	17.750	0.59	23.75	0.40
5.833	1.18	11.833	1.29	17.833	0.59	23.83	0.40
5.917	1.26	11.917	1.24	17.917	0.58	23.92	0.40
6.000	1.26	12.000	1.24	18.000	0.58	24.00	0.40

Max.Eff.Inten.(mm/hr)=	66.94	13.27		
over (min)	5.00	20.00		
Storage Coeff. (min)=	1.57 (ii)	17.40 (ii)		
Unit Hyd. Tpeak (min)=	5.00	20.00		
Unit Hyd. peak (cms)=	0.33	0.06		
			TOTALS	
PEAK FLOW (cms)=	0.04	0.00	0.043 (iii)	
TIME TO PEAK (hrs)=	8.00	8.25	8.00	
RUNOFF VOLUME (mm)=	44.48	14.79	33.76	
TOTAL RAINFALL (mm)=	45.98	45.98	45.98	
RUNOFF COEFFICIENT =	0.97	0.32	0.73	

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0031)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)

```
        ID1= 1 (  0019):     0.24   0.033     8.00    36.44
      + ID2= 2 (  0022):     0.35   0.043     8.00    33.76
        ================================================
        ID = 3 (  0031):     0.59   0.076     8.00    34.85

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0020)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0715      0.0048
                          0.0282     0.0005   |   0.0764      0.0054
                          0.0389     0.0010   |   0.0810      0.0058
                          0.0473     0.0012   |   0.0853      0.0060
                          0.0544     0.0020   |   0.1077      0.0064
                          0.0606     0.0030   |   0.1116      0.0074
                          0.0663     0.0039   |   0.0000      0.0000

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0031)      0.590      0.076      8.00      34.85
   OUTFLOW: ID= 1 (  0020)      0.590      0.052      8.08      34.85

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 68.89
                  TIME SHIFT OF PEAK FLOW         (min)=  5.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0022

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

--------------------
| ADD HYD  (  0024)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0020):     0.59   0.052     8.08    34.85
      + ID2= 2 (  0023):     0.47   0.027     8.00    20.81
        ================================================
        ID = 3 (  0024):     1.06   0.079     8.00    28.63

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

 FINISH
================================================================================================================================

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

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2007)
       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    TM
       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 6.2\VO2\voin.dat
  Output  filename: C:\Users\Chris.Zhang\AppData\Local\Civica\VH5\c48cc875-0d46-4cf3-b9ff-15292ba03324\6c757e4
  Summary filename: C:\Users\Chris.Zhang\AppData\Local\Civica\VH5\c48cc875-0d46-4cf3-b9ff-15292ba03324\6c757e4


DATE: 11-23-2022                          TIME: 09:36:28

USER:


COMMENTS: _____________________________________________________________

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  ********************************************
  ** SIMULATION : Fort Erie-Chicago-24h-5yr     **
  ********************************************
```

CHICAGO STORM	Ptotal= 67.12 mm

IDF curve parameters: A= 747.930
B= 6.800
C= 0.768
used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.67	6.00	2.15	12.00	1.90	18.00	0.94
0.17	0.68	6.17	2.32	12.17	1.84	18.17	0.93
0.33	0.69	6.33	2.54	12.33	1.79	18.33	0.91
0.50	0.71	6.50	2.80	12.50	1.74	18.50	0.90
0.67	0.72	6.67	3.14	12.67	1.69	18.67	0.89
0.83	0.73	6.83	3.59	12.83	1.64	18.83	0.88
1.00	0.75	7.00	4.22	13.00	1.60	19.00	0.87
1.17	0.76	7.17	5.16	13.17	1.56	19.17	0.86
1.33	0.78	7.33	6.77	13.33	1.52	19.33	0.85
1.50	0.79	7.50	10.20	13.50	1.49	19.50	0.84
1.67	0.81	7.67	23.44	13.67	1.45	19.67	0.83
1.83	0.83	7.83	85.67	13.83	1.42	19.83	0.82
2.00	0.85	8.00	30.36	14.00	1.39	20.00	0.82
2.17	0.87	8.17	16.55	14.17	1.36	20.17	0.81
2.33	0.89	8.33	11.51	14.33	1.33	20.33	0.80
2.50	0.91	8.50	8.91	14.50	1.31	20.50	0.79
2.67	0.93	8.67	7.32	14.67	1.28	20.67	0.78
2.83	0.96	8.83	6.24	14.83	1.26	20.83	0.77
3.00	0.98	9.00	5.47	15.00	1.24	21.00	0.77
3.17	1.01	9.17	4.88	15.17	1.21	21.17	0.76
3.33	1.04	9.33	4.41	15.33	1.19	21.33	0.75
3.50	1.07	9.50	4.04	15.50	1.17	21.50	0.74
3.67	1.10	9.67	3.73	15.67	1.15	21.67	0.74
3.83	1.14	9.83	3.46	15.83	1.13	21.83	0.73
4.00	1.18	10.00	3.24	16.00	1.11	22.00	0.72
4.17	1.22	10.17	3.05	16.17	1.10	22.17	0.72
4.33	1.27	10.33	2.88	16.33	1.08	22.33	0.71
4.50	1.32	10.50	2.73	16.50	1.06	22.50	0.70
4.67	1.37	10.67	2.60	16.67	1.05	22.67	0.70
4.83	1.44	10.83	2.48	16.83	1.03	22.83	0.69
5.00	1.50	11.00	2.37	17.00	1.02	23.00	0.69
5.17	1.58	11.17	2.28	17.17	1.00	23.17	0.68
5.33	1.66	11.33	2.19	17.33	0.99	23.33	0.67
5.50	1.76	11.50	2.11	17.50	0.98	23.50	0.67
5.67	1.87	11.67	2.03	17.67	0.96	23.67	0.66
5.83	2.00	11.83	1.97	17.83	0.95	23.83	0.66

CALIB NASHYD (0013) | ID= 1 DT= 5.0 min	Area (ha)= 0.48	Curve Number (CN)= 74.0
	Ia (mm)= 2.50	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.17	

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
0.083	0.67	6.083	2.15	12.083	1.90	18.08	0.94
0.167	0.67	6.167	2.15	12.167	1.90	18.17	0.94
0.250	0.68	6.250	2.32	12.250	1.84	18.25	0.93
0.333	0.68	6.333	2.32	12.333	1.84	18.33	0.93
0.417	0.69	6.417	2.54	12.417	1.79	18.42	0.91
0.500	0.69	6.500	2.54	12.500	1.79	18.50	0.91
0.583	0.71	6.583	2.80	12.583	1.74	18.58	0.90
0.667	0.71	6.667	2.80	12.667	1.74	18.67	0.90
0.750	0.72	6.750	3.14	12.750	1.69	18.75	0.89
0.833	0.72	6.833	3.14	12.833	1.69	18.83	0.89
0.917	0.73	6.917	3.59	12.917	1.64	18.92	0.88
1.000	0.73	7.000	3.59	13.000	1.64	19.00	0.88
1.083	0.75	7.083	4.22	13.083	1.60	19.08	0.87
1.167	0.75	7.167	4.22	13.167	1.60	19.17	0.87
1.250	0.76	7.250	5.16	13.250	1.56	19.25	0.86
1.333	0.76	7.333	5.16	13.333	1.56	19.33	0.86
1.417	0.78	7.417	6.77	13.417	1.52	19.42	0.85
1.500	0.78	7.500	6.77	13.500	1.52	19.50	0.85
1.583	0.79	7.583	10.20	13.583	1.49	19.58	0.84
1.667	0.79	7.667	10.20	13.667	1.49	19.67	0.84

1.750	0.81	7.750	23.44	13.750	1.45	19.75	0.83
1.833	0.81	7.833	23.44	13.833	1.45	19.83	0.83
1.917	0.83	7.917	85.67	13.917	1.42	19.92	0.82
2.000	0.83	8.000	85.67	14.000	1.42	20.00	0.82
2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Unit Hyd Qpeak (cms)= 0.108

PEAK FLOW (cms)= 0.025 (i)
TIME TO PEAK (hrs)= 8.083
RUNOFF VOLUME (mm)= 27.044
TOTAL RAINFALL (mm)= 67.124
RUNOFF COEFFICIENT = 0.403

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

CALIB	
STANDHYD (0005)	Area (ha)= 2.27
ID= 1 DT= 5.0 min	Total Imp(%)= 66.00 Dir. Conn.(%)= 66.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.50	0.77
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	123.02	40.00
Mannings n	=	0.013	0.250

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
0.083	0.67	6.083	2.15	12.083	1.90	18.08	0.94
0.167	0.67	6.167	2.15	12.167	1.90	18.17	0.94

0.250	0.68	6.250	2.32	12.250	1.84	18.25	0.93
0.333	0.68	6.333	2.32	12.333	1.84	18.33	0.93
0.417	0.69	6.417	2.54	12.417	1.79	18.42	0.91
0.500	0.69	6.500	2.54	12.500	1.79	18.50	0.91
0.583	0.71	6.583	2.80	12.583	1.74	18.58	0.90
0.667	0.71	6.667	2.80	12.667	1.74	18.67	0.90
0.750	0.72	6.750	3.14	12.750	1.69	18.75	0.89
0.833	0.72	6.833	3.14	12.833	1.69	18.83	0.89
0.917	0.73	6.917	3.59	12.917	1.64	18.92	0.88
1.000	0.73	7.000	3.59	13.000	1.64	19.00	0.88
1.083	0.75	7.083	4.22	13.083	1.60	19.08	0.87
1.167	0.75	7.167	4.22	13.167	1.60	19.17	0.87
1.250	0.76	7.250	5.16	13.250	1.56	19.25	0.86
1.333	0.76	7.333	5.16	13.333	1.56	19.33	0.86
1.417	0.78	7.417	6.77	13.417	1.52	19.42	0.85
1.500	0.78	7.500	6.77	13.500	1.52	19.50	0.85
1.583	0.79	7.583	10.20	13.583	1.49	19.58	0.84
1.667	0.79	7.667	10.20	13.667	1.49	19.67	0.84
1.750	0.81	7.750	23.44	13.750	1.45	19.75	0.83
1.833	0.81	7.833	23.44	13.833	1.45	19.83	0.83
1.917	0.83	7.917	85.67	13.917	1.42	19.92	0.82
2.000	0.83	8.000	85.67	14.000	1.42	20.00	0.82
2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Max.Eff.Inten.(mm/hr)=	85.67	48.02		
over (min)	5.00	15.00		
Storage Coeff. (min)=	2.50 (ii)	11.96 (ii)		
Unit Hyd. Tpeak (min)=	5.00	15.00		
Unit Hyd. peak (cms)=	0.29	0.09		
			TOTALS	
PEAK FLOW (cms)=	0.35	0.06	0.388 (iii)	
TIME TO PEAK (hrs)=	8.00	8.17	8.00	
RUNOFF VOLUME (mm)=	65.62	38.99	56.57	
TOTAL RAINFALL (mm)=	67.12	67.12	67.12	
RUNOFF COEFFICIENT =	0.98	0.58	0.84	

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

```
       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    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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--------------------
| ADD HYD  (  0009)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0013):     0.48   0.025     8.08    27.04
     + ID2= 2 (  0005):     2.27   0.388     8.00    56.57
       ================================================
       ID = 3 (  0009):     2.75   0.409     8.00    51.41

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0004)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
-------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |   0.0296      0.1275
                         0.0057     0.0139   |   0.0345      0.1603
                         0.0084     0.0305   |   0.0386      0.1969
                         0.0104     0.0500   |   0.0409      0.2207
                         0.0121     0.0725   |   0.0451      0.2726
                         0.0234     0.0983   |   0.0000      0.0000

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0009)      2.750     0.409      8.00       51.41
   OUTFLOW: ID= 1 (  0004)      2.750     0.017     10.92       51.19

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.21
                  TIME SHIFT OF PEAK FLOW         (min)=175.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0842

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--------------------
| CALIB            |
| STANDHYD (  0010)|   Area    (ha)=   0.30
|ID= 1 DT= 5.0 min |   Total Imp(%)=  54.00   Dir. Conn.(%)=  52.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.16         0.14
     Dep. Storage     (mm)=       1.50         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      44.72        40.00
     Mannings n           =      0.013        0.250

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


                         ---- TRANSFORMED HYETOGRAPH ----
   TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
    hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
  0.083    0.67 | 6.083    2.15 |12.083    1.90 | 18.08    0.94
  0.167    0.67 | 6.167    2.15 |12.167    1.90 | 18.17    0.94
  0.250    0.68 | 6.250    2.32 |12.250    1.84 | 18.25    0.93
  0.333    0.68 | 6.333    2.32 |12.333    1.84 | 18.33    0.93
  0.417    0.69 | 6.417    2.54 |12.417    1.79 | 18.42    0.91
  0.500    0.69 | 6.500    2.54 |12.500    1.79 | 18.50    0.91
  0.583    0.71 | 6.583    2.80 |12.583    1.74 | 18.58    0.90
  0.667    0.71 | 6.667    2.80 |12.667    1.74 | 18.67    0.90
  0.750    0.72 | 6.750    3.14 |12.750    1.69 | 18.75    0.89
  0.833    0.72 | 6.833    3.14 |12.833    1.69 | 18.83    0.89
  0.917    0.73 | 6.917    3.59 |12.917    1.64 | 18.92    0.88
  1.000    0.73 | 7.000    3.59 |13.000    1.64 | 19.00    0.88
  1.083    0.75 | 7.083    4.22 |13.083    1.60 | 19.08    0.87
  1.167    0.75 | 7.167    4.22 |13.167    1.60 | 19.17    0.87
  1.250    0.76 | 7.250    5.16 |13.250    1.56 | 19.25    0.86
  1.333    0.76 | 7.333    5.16 |13.333    1.56 | 19.33    0.86
  1.417    0.78 | 7.417    6.77 |13.417    1.52 | 19.42    0.85
  1.500    0.78 | 7.500    6.77 |13.500    1.52 | 19.50    0.85
  1.583    0.79 | 7.583   10.20 |13.583    1.49 | 19.58    0.84
  1.667    0.79 | 7.667   10.20 |13.667    1.49 | 19.67    0.84
  1.750    0.81 | 7.750   23.44 |13.750    1.45 | 19.75    0.83
  1.833    0.81 | 7.833   23.44 |13.833    1.45 | 19.83    0.83
  1.917    0.83 | 7.917   85.67 |13.917    1.42 | 19.92    0.82
  2.000    0.83 | 8.000   85.67 |14.000    1.42 | 20.00    0.82
```

2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Max.Eff.Inten.(mm/hr)=	85.67	27.51		
over (min)	5.00	15.00		
Storage Coeff. (min)=	1.36 (ii)	13.19 (ii)		
Unit Hyd. Tpeak (min)=	5.00	15.00		
Unit Hyd. peak (cms)=	0.33	0.08		
			TOTALS	
PEAK FLOW (cms)=	0.04	0.01	0.041 (iii)	
TIME TO PEAK (hrs)=	8.00	8.17	8.00	
RUNOFF VOLUME (mm)=	65.62	28.53	47.79	
TOTAL RAINFALL (mm)=	67.12	67.12	67.12	
RUNOFF COEFFICIENT =	0.98	0.43	0.71	

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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 (0011)	Area (ha)=	0.42
ID= 1 DT= 5.0 min	Total Imp(%)=	47.00 Dir. Conn.(%)= 42.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.20	0.22
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	52.92	40.00
Mannings n	=	0.013	0.250

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
0.083	0.67	6.083	2.15	12.083	1.90	18.08	0.94
0.167	0.67	6.167	2.15	12.167	1.90	18.17	0.94
0.250	0.68	6.250	2.32	12.250	1.84	18.25	0.93
0.333	0.68	6.333	2.32	12.333	1.84	18.33	0.93
0.417	0.69	6.417	2.54	12.417	1.79	18.42	0.91
0.500	0.69	6.500	2.54	12.500	1.79	18.50	0.91
0.583	0.71	6.583	2.80	12.583	1.74	18.58	0.90
0.667	0.71	6.667	2.80	12.667	1.74	18.67	0.90
0.750	0.72	6.750	3.14	12.750	1.69	18.75	0.89
0.833	0.72	6.833	3.14	12.833	1.69	18.83	0.89
0.917	0.73	6.917	3.59	12.917	1.64	18.92	0.88
1.000	0.73	7.000	3.59	13.000	1.64	19.00	0.88
1.083	0.75	7.083	4.22	13.083	1.60	19.08	0.87
1.167	0.75	7.167	4.22	13.167	1.60	19.17	0.87
1.250	0.76	7.250	5.16	13.250	1.56	19.25	0.86
1.333	0.76	7.333	5.16	13.333	1.56	19.33	0.86
1.417	0.78	7.417	6.77	13.417	1.52	19.42	0.85
1.500	0.78	7.500	6.77	13.500	1.52	19.50	0.85
1.583	0.79	7.583	10.20	13.583	1.49	19.58	0.84
1.667	0.79	7.667	10.20	13.667	1.49	19.67	0.84
1.750	0.81	7.750	23.44	13.750	1.45	19.75	0.83
1.833	0.81	7.833	23.44	13.833	1.45	19.83	0.83
1.917	0.83	7.917	85.67	13.917	1.42	19.92	0.82
2.000	0.83	8.000	85.67	14.000	1.42	20.00	0.82
2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Max.Eff.Inten.(mm/hr)=	85.67	29.85	
over (min)	5.00	15.00	
Storage Coeff. (min)=	1.51 (ii)	12.95 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	0.33	0.08	
			TOTALS
PEAK FLOW (cms)=	0.04	0.01	0.049 (iii)

```
     TIME TO PEAK    (hrs)=       8.00         8.17          8.00
     RUNOFF VOLUME    (mm)=      65.62        29.35         44.57
     TOTAL RAINFALL   (mm)=      67.12        67.12         67.12
     RUNOFF COEFFICIENT   =       0.98         0.44          0.66

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  74.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0016)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0010):     0.30   0.041     8.00    47.79
     + ID2= 2 (  0011):     0.42   0.049     8.00    44.57
       ================================================
       ID = 3 (  0016):     0.72   0.091     8.00    45.91

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

--------------------
| ADD HYD  (  0016)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0016):     0.72   0.091     8.00    45.91
     + ID2= 2 (  0004):     2.75   0.017    10.92    51.19
       ================================================
       ID = 1 (  0016):     3.47   0.100     8.00    50.09

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0033)|   Area    (ha)=   0.24   Curve Number   (CN)= 74.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   1.50   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.17

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


                        ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    0.67 | 6.083    2.15 |12.083    1.90 | 18.08    0.94
               0.167    0.67 | 6.167    2.15 |12.167    1.90 | 18.17    0.94
               0.250    0.68 | 6.250    2.32 |12.250    1.84 | 18.25    0.93
               0.333    0.68 | 6.333    2.32 |12.333    1.84 | 18.33    0.93
               0.417    0.69 | 6.417    2.54 |12.417    1.79 | 18.42    0.91
               0.500    0.69 | 6.500    2.54 |12.500    1.79 | 18.50    0.91
               0.583    0.71 | 6.583    2.80 |12.583    1.74 | 18.58    0.90
               0.667    0.71 | 6.667    2.80 |12.667    1.74 | 18.67    0.90
               0.750    0.72 | 6.750    3.14 |12.750    1.69 | 18.75    0.89
               0.833    0.72 | 6.833    3.14 |12.833    1.69 | 18.83    0.89
               0.917    0.73 | 6.917    3.59 |12.917    1.64 | 18.92    0.88
               1.000    0.73 | 7.000    3.59 |13.000    1.64 | 19.00    0.88
               1.083    0.75 | 7.083    4.22 |13.083    1.60 | 19.08    0.87
               1.167    0.75 | 7.167    4.22 |13.167    1.60 | 19.17    0.87
               1.250    0.76 | 7.250    5.16 |13.250    1.56 | 19.25    0.86
               1.333    0.76 | 7.333    5.16 |13.333    1.56 | 19.33    0.86
               1.417    0.78 | 7.417    6.77 |13.417    1.52 | 19.42    0.85
               1.500    0.78 | 7.500    6.77 |13.500    1.52 | 19.50    0.85
               1.583    0.79 | 7.583   10.20 |13.583    1.49 | 19.58    0.84
               1.667    0.79 | 7.667   10.20 |13.667    1.49 | 19.67    0.84
               1.750    0.81 | 7.750   23.44 |13.750    1.45 | 19.75    0.83
               1.833    0.81 | 7.833   23.44 |13.833    1.45 | 19.83    0.83
               1.917    0.83 | 7.917   85.67 |13.917    1.42 | 19.92    0.82
               2.000    0.83 | 8.000   85.67 |14.000    1.42 | 20.00    0.82
               2.083    0.85 | 8.083   30.36 |14.083    1.39 | 20.08    0.82
               2.167    0.85 | 8.167   30.36 |14.167    1.39 | 20.17    0.82
               2.250    0.87 | 8.250   16.55 |14.250    1.36 | 20.25    0.81
               2.333    0.87 | 8.333   16.55 |14.333    1.36 | 20.33    0.81
               2.417    0.89 | 8.417   11.51 |14.417    1.33 | 20.42    0.80
               2.500    0.89 | 8.500   11.51 |14.500    1.33 | 20.50    0.80
               2.583    0.91 | 8.583    8.91 |14.583    1.31 | 20.58    0.79
               2.667    0.91 | 8.667    8.91 |14.667    1.31 | 20.67    0.79
               2.750    0.93 | 8.750    7.32 |14.750    1.28 | 20.75    0.78
               2.833    0.93 | 8.833    7.32 |14.833    1.28 | 20.83    0.78
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2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Unit Hyd Qpeak (cms)= 0.054

PEAK FLOW (cms)= 0.013 (i)
TIME TO PEAK (hrs)= 8.083
RUNOFF VOLUME (mm)= 27.707
TOTAL RAINFALL (mm)= 67.124
RUNOFF COEFFICIENT = 0.413

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

CALIB STANDHYD (0018)	Area (ha)= 0.07
ID= 1 DT= 5.0 min	Total Imp(%)= 16.00 Dir. Conn.(%)= 16.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.01	0.06
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	21.60	40.00
Mannings n	=	0.013	0.250

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
0.083	0.67	6.083	2.15	12.083	1.90	18.08	0.94
0.167	0.67	6.167	2.15	12.167	1.90	18.17	0.94
0.250	0.68	6.250	2.32	12.250	1.84	18.25	0.93
0.333	0.68	6.333	2.32	12.333	1.84	18.33	0.93
0.417	0.69	6.417	2.54	12.417	1.79	18.42	0.91
0.500	0.69	6.500	2.54	12.500	1.79	18.50	0.91
0.583	0.71	6.583	2.80	12.583	1.74	18.58	0.90
0.667	0.71	6.667	2.80	12.667	1.74	18.67	0.90
0.750	0.72	6.750	3.14	12.750	1.69	18.75	0.89
0.833	0.72	6.833	3.14	12.833	1.69	18.83	0.89
0.917	0.73	6.917	3.59	12.917	1.64	18.92	0.88
1.000	0.73	7.000	3.59	13.000	1.64	19.00	0.88
1.083	0.75	7.083	4.22	13.083	1.60	19.08	0.87
1.167	0.75	7.167	4.22	13.167	1.60	19.17	0.87
1.250	0.76	7.250	5.16	13.250	1.56	19.25	0.86
1.333	0.76	7.333	5.16	13.333	1.56	19.33	0.86

1.417	0.78	7.417	6.77	13.417	1.52	19.42	0.85
1.500	0.78	7.500	6.77	13.500	1.52	19.50	0.85
1.583	0.79	7.583	10.20	13.583	1.49	19.58	0.84
1.667	0.79	7.667	10.20	13.667	1.49	19.67	0.84
1.750	0.81	7.750	23.44	13.750	1.45	19.75	0.83
1.833	0.81	7.833	23.44	13.833	1.45	19.83	0.83
1.917	0.83	7.917	85.67	13.917	1.42	19.92	0.82
2.000	0.83	8.000	85.67	14.000	1.42	20.00	0.82
2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Max.Eff.Inten.(mm/hr)=	85.67	25.57		
over (min)	5.00	15.00		
Storage Coeff. (min)=	0.88 (ii)	13.06 (ii)		
Unit Hyd. Tpeak (min)=	5.00	15.00		
Unit Hyd. peak (cms)=	0.34	0.08		
			TOTALS	
PEAK FLOW (cms)=	0.00	0.00	0.004 (iii)	
TIME TO PEAK (hrs)=	8.00	8.17	8.00	
RUNOFF VOLUME (mm)=	65.62	27.81	33.01	
TOTAL RAINFALL (mm)=	67.12	67.12	67.12	
RUNOFF COEFFICIENT =	0.98	0.41	0.49	

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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 (0032)	Area (ha)= 0.16
ID= 1 DT= 5.0 min	Total Imp(%)= 58.00 Dir. Conn.(%)= 58.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.09	0.07
Dep. Storage	(mm)=	1.50	1.50
Average Slope	(%)=	2.00	2.00
Length	(m)=	32.66	40.00
Mannings n	=	0.013	0.250

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
0.083	0.67	6.083	2.15	12.083	1.90	18.08	0.94
0.167	0.67	6.167	2.15	12.167	1.90	18.17	0.94
0.250	0.68	6.250	2.32	12.250	1.84	18.25	0.93
0.333	0.68	6.333	2.32	12.333	1.84	18.33	0.93
0.417	0.69	6.417	2.54	12.417	1.79	18.42	0.91
0.500	0.69	6.500	2.54	12.500	1.79	18.50	0.91
0.583	0.71	6.583	2.80	12.583	1.74	18.58	0.90
0.667	0.71	6.667	2.80	12.667	1.74	18.67	0.90
0.750	0.72	6.750	3.14	12.750	1.69	18.75	0.89
0.833	0.72	6.833	3.14	12.833	1.69	18.83	0.89
0.917	0.73	6.917	3.59	12.917	1.64	18.92	0.88
1.000	0.73	7.000	3.59	13.000	1.64	19.00	0.88
1.083	0.75	7.083	4.22	13.083	1.60	19.08	0.87
1.167	0.75	7.167	4.22	13.167	1.60	19.17	0.87
1.250	0.76	7.250	5.16	13.250	1.56	19.25	0.86
1.333	0.76	7.333	5.16	13.333	1.56	19.33	0.86
1.417	0.78	7.417	6.77	13.417	1.52	19.42	0.85
1.500	0.78	7.500	6.77	13.500	1.52	19.50	0.85
1.583	0.79	7.583	10.20	13.583	1.49	19.58	0.84
1.667	0.79	7.667	10.20	13.667	1.49	19.67	0.84
1.750	0.81	7.750	23.44	13.750	1.45	19.75	0.83
1.833	0.81	7.833	23.44	13.833	1.45	19.83	0.83
1.917	0.83	7.917	85.67	13.917	1.42	19.92	0.82
2.000	0.83	8.000	85.67	14.000	1.42	20.00	0.82
2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66

```
              5.917    2.00 |11.917    1.97 |17.917    0.95 | 23.92    0.66
              6.000    2.00 |12.000    1.97 |18.000    0.95 | 24.00    0.66

     Max.Eff.Inten.(mm/hr)=      85.67        25.57
               over (min)         5.00        15.00
     Storage Coeff.  (min)=       1.13 (ii)   13.31 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.34         0.08
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.02         0.00          0.024 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.17           8.00
     RUNOFF VOLUME    (mm)=      65.62        27.81          49.69
     TOTAL RAINFALL   (mm)=      67.12        67.12          67.12
     RUNOFF COEFFICIENT   =       0.98         0.41           0.74

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  74.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0023)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0018):     0.07   0.004     8.00    33.01
      + ID2= 2 (  0032):     0.16   0.024     8.00    49.69
        ================================================
        ID = 3 (  0023):     0.23   0.028     8.00    44.61

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

--------------------
| ADD HYD  (  0023)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0023):     0.23   0.028     8.00    44.61
      + ID2= 2 (  0033):     0.24   0.013     8.08    27.71
        ================================================
        ID = 1 (  0023):     0.47   0.039     8.00    35.98

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0019)|   Area    (ha)=   0.24
|ID= 1 DT= 5.0 min |   Total Imp(%)=  73.00   Dir. Conn.(%)=  73.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.18         0.06
     Dep. Storage     (mm)=       1.50         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      40.00        40.00
     Mannings n             =     0.013        0.250

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


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    0.67 | 6.083    2.15 |12.083    1.90 | 18.08    0.94
               0.167    0.67 | 6.167    2.15 |12.167    1.90 | 18.17    0.94
               0.250    0.68 | 6.250    2.32 |12.250    1.84 | 18.25    0.93
               0.333    0.68 | 6.333    2.32 |12.333    1.84 | 18.33    0.93
               0.417    0.69 | 6.417    2.54 |12.417    1.79 | 18.42    0.91
               0.500    0.69 | 6.500    2.54 |12.500    1.79 | 18.50    0.91
               0.583    0.71 | 6.583    2.80 |12.583    1.74 | 18.58    0.90
               0.667    0.71 | 6.667    2.80 |12.667    1.74 | 18.67    0.90
               0.750    0.72 | 6.750    3.14 |12.750    1.69 | 18.75    0.89
               0.833    0.72 | 6.833    3.14 |12.833    1.69 | 18.83    0.89
               0.917    0.73 | 6.917    3.59 |12.917    1.64 | 18.92    0.88
               1.000    0.73 | 7.000    3.59 |13.000    1.64 | 19.00    0.88
               1.083    0.75 | 7.083    4.22 |13.083    1.60 | 19.08    0.87
               1.167    0.75 | 7.167    4.22 |13.167    1.60 | 19.17    0.87
               1.250    0.76 | 7.250    5.16 |13.250    1.56 | 19.25    0.86
               1.333    0.76 | 7.333    5.16 |13.333    1.56 | 19.33    0.86
               1.417    0.78 | 7.417    6.77 |13.417    1.52 | 19.42    0.85
               1.500    0.78 | 7.500    6.77 |13.500    1.52 | 19.50    0.85
```

1.583	0.79	7.583	10.20	13.583	1.49	19.58	0.84
1.667	0.79	7.667	10.20	13.667	1.49	19.67	0.84
1.750	0.81	7.750	23.44	13.750	1.45	19.75	0.83
1.833	0.81	7.833	23.44	13.833	1.45	19.83	0.83
1.917	0.83	7.917	85.67	13.917	1.42	19.92	0.82
2.000	0.83	8.000	85.67	14.000	1.42	20.00	0.82
2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Max.Eff.Inten.(mm/hr)=	85.67	25.57		
over (min)	5.00	15.00		
Storage Coeff. (min)=	1.27 (ii)	13.45 (ii)		
Unit Hyd. Tpeak (min)=	5.00	15.00		
Unit Hyd. peak (cms)=	0.33	0.08		
			TOTALS	
PEAK FLOW (cms)=	0.04	0.00	0.044 (iii)	
TIME TO PEAK (hrs)=	8.00	8.17	8.00	
RUNOFF VOLUME (mm)=	65.62	27.81	55.38	
TOTAL RAINFALL (mm)=	67.12	67.12	67.12	
RUNOFF COEFFICIENT =	0.98	0.41	0.83	

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 74.0 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 (0022)	Area (ha)= 0.35
ID= 1 DT= 5.0 min	Total Imp(%)= 64.00 Dir. Conn.(%)= 64.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.22	0.13
Dep. Storage	(mm)=	1.50	1.50

Average Slope	(%)=	2.00	2.00
Length	(m)=	48.30	40.00
Mannings n	=	0.013	0.250

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
0.083	0.67	6.083	2.15	12.083	1.90	18.08	0.94
0.167	0.67	6.167	2.15	12.167	1.90	18.17	0.94
0.250	0.68	6.250	2.32	12.250	1.84	18.25	0.93
0.333	0.68	6.333	2.32	12.333	1.84	18.33	0.93
0.417	0.69	6.417	2.54	12.417	1.79	18.42	0.91
0.500	0.69	6.500	2.54	12.500	1.79	18.50	0.91
0.583	0.71	6.583	2.80	12.583	1.74	18.58	0.90
0.667	0.71	6.667	2.80	12.667	1.74	18.67	0.90
0.750	0.72	6.750	3.14	12.750	1.69	18.75	0.89
0.833	0.72	6.833	3.14	12.833	1.69	18.83	0.89
0.917	0.73	6.917	3.59	12.917	1.64	18.92	0.88
1.000	0.73	7.000	3.59	13.000	1.64	19.00	0.88
1.083	0.75	7.083	4.22	13.083	1.60	19.08	0.87
1.167	0.75	7.167	4.22	13.167	1.60	19.17	0.87
1.250	0.76	7.250	5.16	13.250	1.56	19.25	0.86
1.333	0.76	7.333	5.16	13.333	1.56	19.33	0.86
1.417	0.78	7.417	6.77	13.417	1.52	19.42	0.85
1.500	0.78	7.500	6.77	13.500	1.52	19.50	0.85
1.583	0.79	7.583	10.20	13.583	1.49	19.58	0.84
1.667	0.79	7.667	10.20	13.667	1.49	19.67	0.84
1.750	0.81	7.750	23.44	13.750	1.45	19.75	0.83
1.833	0.81	7.833	23.44	13.833	1.45	19.83	0.83
1.917	0.83	7.917	85.67	13.917	1.42	19.92	0.82
2.000	0.83	8.000	85.67	14.000	1.42	20.00	0.82
2.083	0.85	8.083	30.36	14.083	1.39	20.08	0.82
2.167	0.85	8.167	30.36	14.167	1.39	20.17	0.82
2.250	0.87	8.250	16.55	14.250	1.36	20.25	0.81
2.333	0.87	8.333	16.55	14.333	1.36	20.33	0.81
2.417	0.89	8.417	11.51	14.417	1.33	20.42	0.80
2.500	0.89	8.500	11.51	14.500	1.33	20.50	0.80
2.583	0.91	8.583	8.91	14.583	1.31	20.58	0.79
2.667	0.91	8.667	8.91	14.667	1.31	20.67	0.79
2.750	0.93	8.750	7.32	14.750	1.28	20.75	0.78
2.833	0.93	8.833	7.32	14.833	1.28	20.83	0.78
2.917	0.96	8.917	6.24	14.917	1.26	20.92	0.77
3.000	0.96	9.000	6.24	15.000	1.26	21.00	0.77
3.083	0.98	9.083	5.47	15.083	1.24	21.08	0.77
3.167	0.98	9.167	5.47	15.167	1.24	21.17	0.77
3.250	1.01	9.250	4.88	15.250	1.21	21.25	0.76
3.333	1.01	9.333	4.88	15.333	1.21	21.33	0.76
3.417	1.04	9.417	4.41	15.417	1.19	21.42	0.75
3.500	1.04	9.500	4.41	15.500	1.19	21.50	0.75
3.583	1.07	9.583	4.04	15.583	1.17	21.58	0.74
3.667	1.07	9.667	4.04	15.667	1.17	21.67	0.74
3.750	1.10	9.750	3.73	15.750	1.15	21.75	0.74
3.833	1.10	9.833	3.73	15.833	1.15	21.83	0.74
3.917	1.14	9.917	3.46	15.917	1.13	21.92	0.73
4.000	1.14	10.000	3.46	16.000	1.13	22.00	0.73
4.083	1.18	10.083	3.24	16.083	1.11	22.08	0.72
4.167	1.18	10.167	3.24	16.167	1.11	22.17	0.72
4.250	1.22	10.250	3.05	16.250	1.10	22.25	0.72
4.333	1.22	10.333	3.05	16.333	1.10	22.33	0.72
4.417	1.27	10.417	2.88	16.417	1.08	22.42	0.71
4.500	1.27	10.500	2.88	16.500	1.08	22.50	0.71
4.583	1.32	10.583	2.73	16.583	1.06	22.58	0.70
4.667	1.32	10.667	2.73	16.667	1.06	22.67	0.70
4.750	1.37	10.750	2.60	16.750	1.05	22.75	0.70
4.833	1.37	10.833	2.60	16.833	1.05	22.83	0.70
4.917	1.44	10.917	2.48	16.917	1.03	22.92	0.69
5.000	1.44	11.000	2.48	17.000	1.03	23.00	0.69
5.083	1.50	11.083	2.37	17.083	1.02	23.08	0.69
5.167	1.50	11.167	2.37	17.167	1.02	23.17	0.69
5.250	1.58	11.250	2.28	17.250	1.00	23.25	0.68
5.333	1.58	11.333	2.28	17.333	1.00	23.33	0.68
5.417	1.66	11.417	2.19	17.417	0.99	23.42	0.67
5.500	1.66	11.500	2.19	17.500	0.99	23.50	0.67
5.583	1.76	11.583	2.11	17.583	0.98	23.58	0.67
5.667	1.76	11.667	2.11	17.667	0.98	23.67	0.67
5.750	1.87	11.750	2.03	17.750	0.96	23.75	0.66
5.833	1.87	11.833	2.03	17.833	0.96	23.83	0.66
5.917	2.00	11.917	1.97	17.917	0.95	23.92	0.66
6.000	2.00	12.000	1.97	18.000	0.95	24.00	0.66

Max.Eff.Inten.(mm/hr)=	85.67	25.57

```
                over (min)        5.00         15.00
     Storage Coeff.  (min)=       1.43 (ii)    13.60 (ii)
     Unit Hyd. Tpeak (min)=       5.00         15.00
     Unit Hyd. peak  (cms)=       0.33          0.08
                                                      *TOTALS*
     PEAK FLOW       (cms)=       0.05          0.01          0.057 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.17           8.00
     RUNOFF VOLUME    (mm)=      65.62         27.81          51.99
     TOTAL RAINFALL   (mm)=      67.12         67.12          67.12
     RUNOFF COEFFICIENT   =       0.98          0.41           0.77

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

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  74.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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

--------------------
| ADD HYD  (  0031)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0019):     0.24   0.044     8.00    55.38
     + ID2= 2 (  0022):     0.35   0.057     8.00    51.99
       ================================================
       ID = 3 (  0031):     0.59   0.100     8.00    53.37

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0020)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |   0.0715      0.0048
                         0.0282     0.0005   |   0.0764      0.0054
                         0.0389     0.0010   |   0.0810      0.0058
                         0.0473     0.0012   |   0.0853      0.0060
                         0.0544     0.0020   |   0.1077      0.0064
                         0.0606     0.0030   |   0.1116      0.0074
                         0.0663     0.0039   |   0.0000      0.0000

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0031)     0.590      0.100      8.00      53.37
   OUTFLOW: ID= 1 (  0020)     0.590      0.060      8.08      53.37

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 60.25
                  TIME SHIFT OF PEAK FLOW         (min)=  5.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0032

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

--------------------
| ADD HYD  (  0024)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0020):     0.59   0.060     8.08    53.37
     + ID2= 2 (  0023):     0.47   0.039     8.00    35.98
       ================================================
       ID = 3 (  0024):     1.06   0.097     8.00    45.66

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

Prepared by: Chris Zhang

Water Quality Calculations

Town of Fort Erie - 613 Helena Street Residential Development
File No. 131951
Date: November 2022

Storm Outlet 1 - SWM Pond

Surface	Method	Effective TSS Removal	Area (ha)	% Area of Site	Overall TSS Removal
Landscape	Inherent	100%	0.82	36%	36%
Rooftop	Inherent	100%	0.85	38%	38%
Impervious Area	Dry Pond / Jellyfish Unit	65%	0.60	26%	17%
Impervious Area	Untreated	0%	0.00	0%	0%
Total			2.27	100%	91%

Storm Outlet 2 - Roadside Ditch

Surface	Method	Effective TSS Removal	Area (ha)	% Area of Site	Overall TSS Removal
Landscape	Inherent	100%	0.21	36%	36%
Rooftop	Inherent	100%	0.25	43%	43%
Impervious Area	Swales / Oil-Grit Separator	65%	0.13	22%	14%
Impervious Area	Untreated	0%	0.00	0%	0%
Total			0.59	100%	92%

Treatment Train Approach:

$$R = A + B - [(A \times B) / 100] \qquad \text{(Equation 4-1)}$$

Where:

R = Total TSS Removal Rate

A = TSS Removal Rate of the First or Upstream BMP

B = TSS Removal Rate of the Second or Downstream BMP

*As per 'New Jersey Stormwater Best Management Practices Manual' Equation 4-1 (February 2004)

Treatment Train TSS Removal:
Dry Pond (Rate 1) = 30 %
Jellyfish Unit (Rate 2) = 50 %

Storm Outlet 1 - SWM Pond

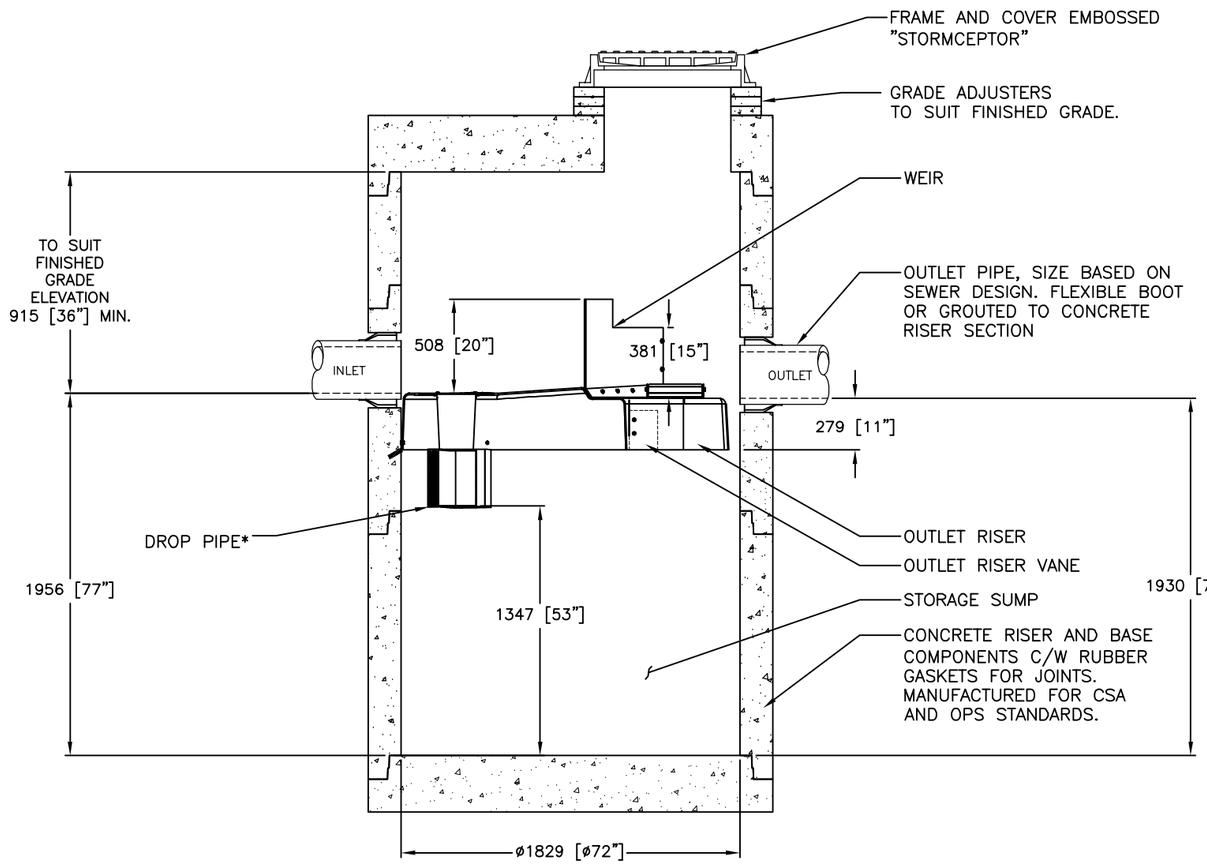
Removal at Infiltration:
R_{inf} = Rate 1 + Rate 2 - [(Rate 1 x Rate 2)/100]
R_{inf} = 65.0 %

Treatment Train TSS Removal:
Grassed Swales (Rate 1) = 30 %
Oil Grit Separator (Rate 2) = 50 %

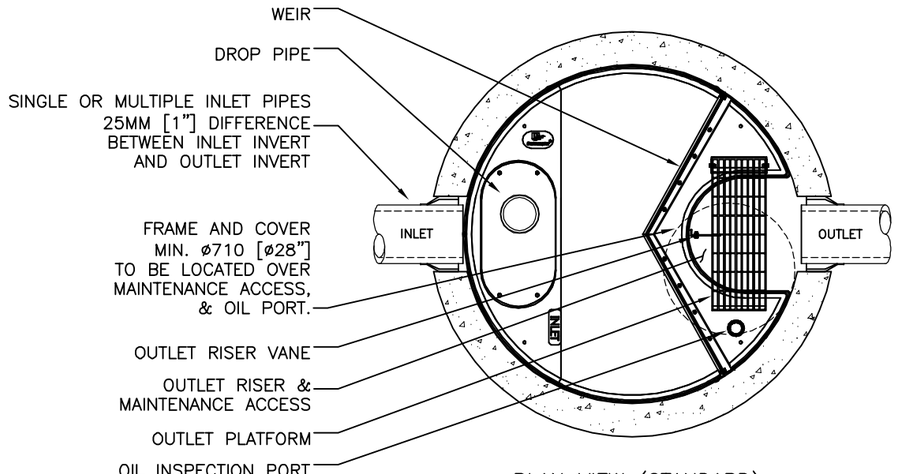
Storm Outlet 2 - Roadside Ditch

Removal at Infiltration:
R_{inf} = Rate 1 + Rate 2 - [(Rate 1 x Rate 2)/100]
R_{inf} = 65.0 %

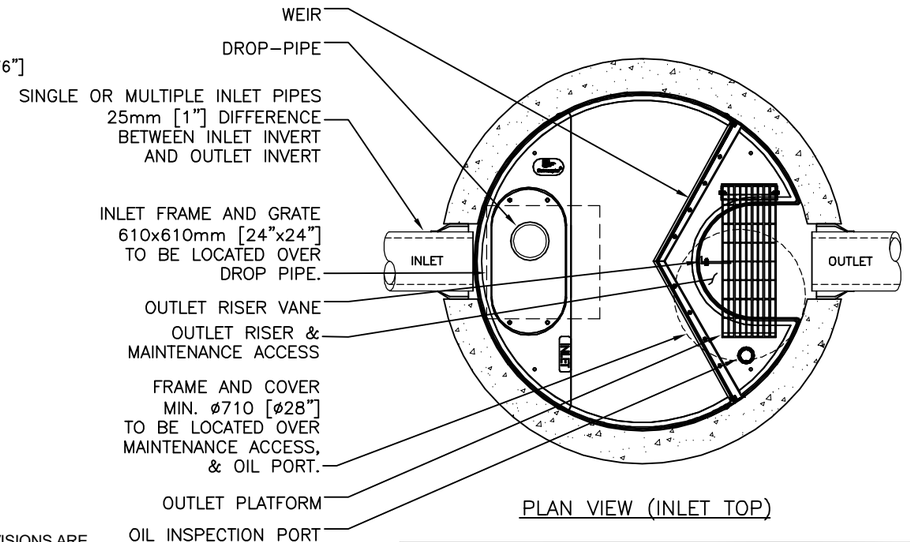
DRAWING NOT TO BE USED FOR CONSTRUCTION



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF6 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO6 (OIL CAPTURE CONFIGURATION).

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EF6				
STRUCTURE ID					*
WATER QUALITY FLOW RATE (L/s)					*
PEAK FLOW RATE (L/s)					*
RETURN PERIOD OF PEAK FLOW (yrs)					*
DRAINAGE AREA (HA)					*
DRAINAGE AREA IMPERVIOUSNESS (%)					*
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

MARK	DATE	REVISION DESCRIPTION	BY
1	6/8/18	OUTLET PLATFORM	JSK
0	05/26/17	INITIAL RELEASE	JSK

Stormceptor® EF

SCALE = NTS

imbrium®
407 FAIRVIEW DRIVE, WHITBY ON L1N 3A9
TF 800-565-4801 CA 416-850-8800 INTL +1-416-850-8800

DATE:	5/26/2017
DESIGNED: JSK	DRAWN: JSK
CHECKED: BSF	APPROVED: SP
PROJECT No.: EF6	SEQUENCE No.: *
SHEET:	1 OF 1

Stormceptor®

FORTERRA

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/23/2022

Province:	Ontario
City:	Fort Erie
Nearest Rainfall Station:	ST CATHARINES AP
Climate Station Id:	6137287
Years of Rainfall Data:	33

Site Name:	613 Helena-OGS -to Roadside Ditch

Drainage Area (ha):	0.59
Runoff Coefficient 'c':	0.67

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	60.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	12.29
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	613 Helena
Project Number:	131951
Designer Name:	Chris Zhang
Designer Company:	IBI
Designer Email:	chris.zhang@ibigroup.com
Designer Phone:	905-966-2053
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	57
EFO6	63
EFO8	67
EFO10	68
EFO12	69

Recommended Stormceptor EFO Model: EFO6

Estimated Net Annual Sediment (TSS) Load Reduction (%): 63

Water Quality Runoff Volume Capture (%): > 90

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THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

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Stormceptor® EF Sizing Report

Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	9.2	9.2	0.55	33.0	13.0	70	6.5	6.5
1	20.5	29.7	1.10	66.0	25.0	70	14.4	20.9
2	16.5	46.2	2.20	132.0	50.0	69	11.4	32.3
3	11.3	57.5	3.30	198.0	75.0	66	7.4	39.7
4	9.1	66.7	4.40	264.0	100.0	62	5.7	45.4
5	5.5	72.2	5.49	330.0	125.0	61	3.3	48.7
6	4.5	76.7	6.59	396.0	150.0	58	2.6	51.4
7	4.2	80.9	7.69	462.0	175.0	57	2.4	53.8
8	3.5	84.4	8.79	527.0	201.0	54	1.9	55.7
9	2.0	86.5	9.89	593.0	226.0	53	1.1	56.7
10	1.5	88.0	10.99	659.0	251.0	53	0.8	57.5
11	1.8	89.8	12.09	725.0	276.0	52	1.0	58.5
12	1.1	90.9	13.19	791.0	301.0	51	0.6	59.0
13	1.1	92.0	14.29	857.0	326.0	50	0.6	59.6
14	1.4	93.4	15.39	923.0	351.0	50	0.7	60.3
15	0.8	94.2	16.48	989.0	376.0	49	0.4	60.7
16	0.6	94.8	17.58	1055.0	401.0	48	0.3	61.0
17	0.5	95.3	18.68	1121.0	426.0	47	0.2	61.2
18	0.3	95.6	19.78	1187.0	451.0	47	0.2	61.3
19	0.2	95.9	20.88	1253.0	476.0	46	0.1	61.5
20	0.2	96.1	21.98	1319.0	501.0	45	0.1	61.6
21	0.5	96.6	23.08	1385.0	526.0	44	0.2	61.8
22	0.4	97.0	24.18	1451.0	552.0	44	0.2	62.0
23	0.3	97.3	25.28	1517.0	577.0	43	0.1	62.1
24	0.0	97.3	26.37	1582.0	602.0	42	0.0	62.1
25	0.2	97.4	27.47	1648.0	627.0	42	0.1	62.1
30	1.6	99.1	32.97	1978.0	752.0	41	0.7	62.8
35	0.6	99.7	38.46	2308.0	877.0	41	0.3	63.1
40	0.0	99.7	43.96	2637.0	1003.0	40	0.0	63.1
45	0.3	100.0	49.45	2967.0	1128.0	38	0.1	63.2
Estimated Net Annual Sediment (TSS) Load Reduction =								**63 %**

Climate Station ID: 6137287 *Years of Rainfall Data*: 33

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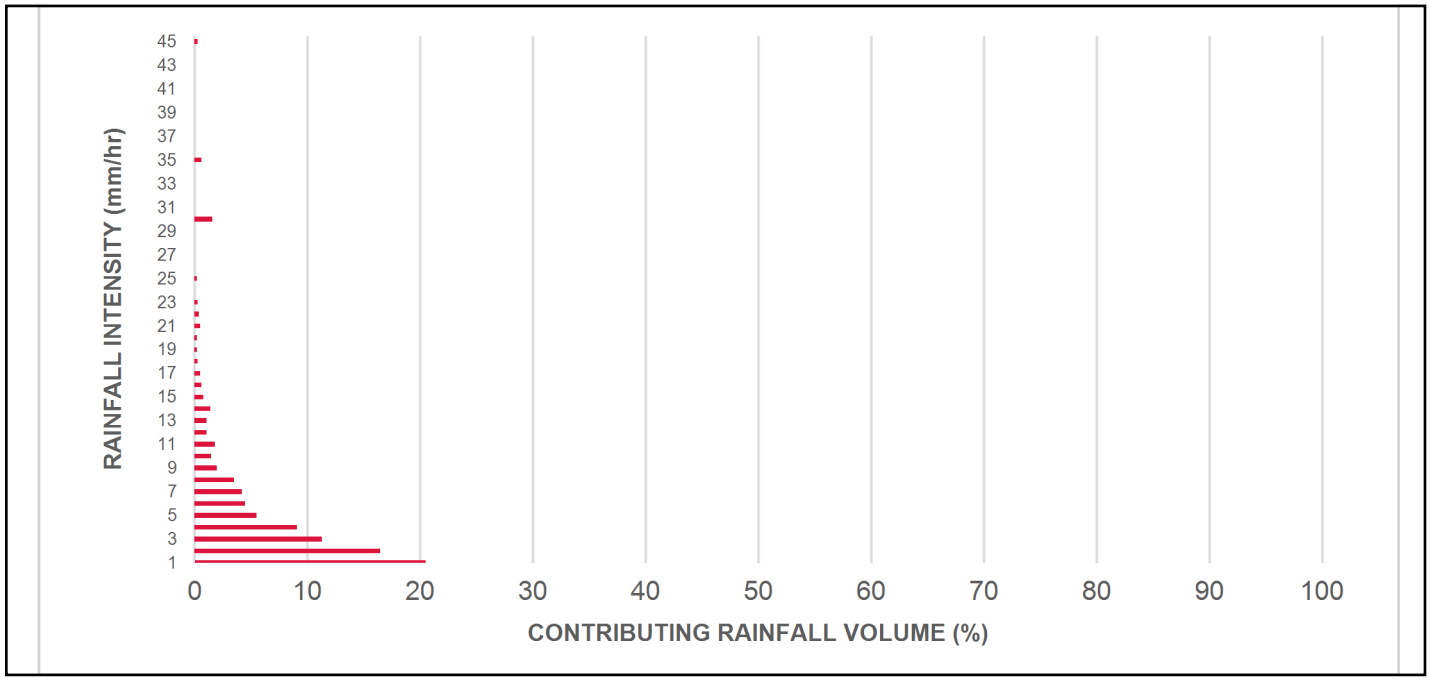
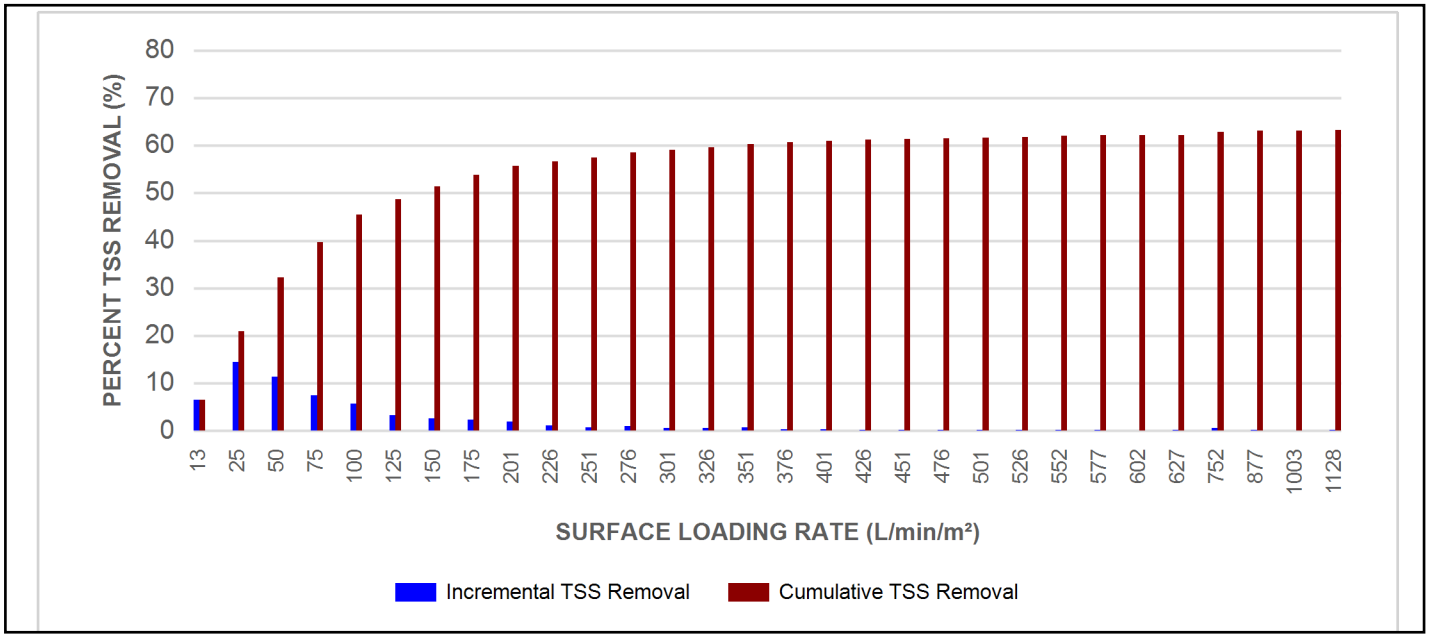
RAINFALL DATA FROM ST CATHARINES AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

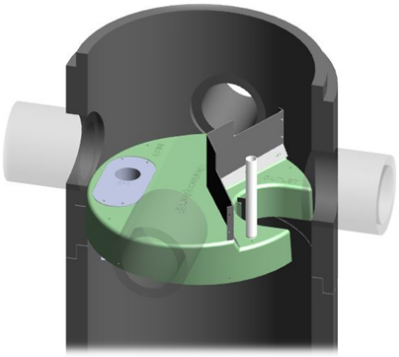
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

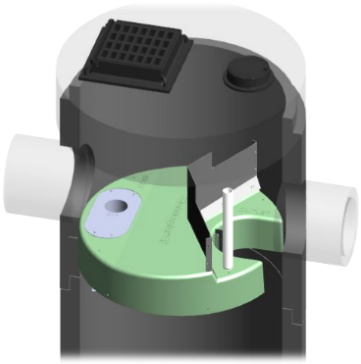
DESIGN FLEXIBILITY

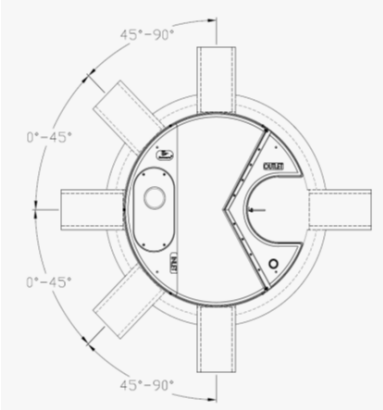
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EFO

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24		

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall

remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to

assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Jellyfish® Filter

Jellyfish® Filter Overview

imbrium®

About Imbrium® Systems

Imbrium® Systems is dedicated to protecting Canada's waterways. Based on our knowledge and experience in the Canadian stormwater industry, we have the ability to provide the most effective stormwater treatment technologies that capture and retain harmful pollutants from urban runoff before it enters our streams, rivers, lakes, and oceans.

Imbrium's engineered treatment solutions have been third-party tested and verified in accordance with the ISO 14034 Environmental Technology Verification (ETV) protocol to ensure performance in real-world conditions as designed. Our team of highly skilled engineers and partners provide the highest level of service from design to installation and long-term maintenance.

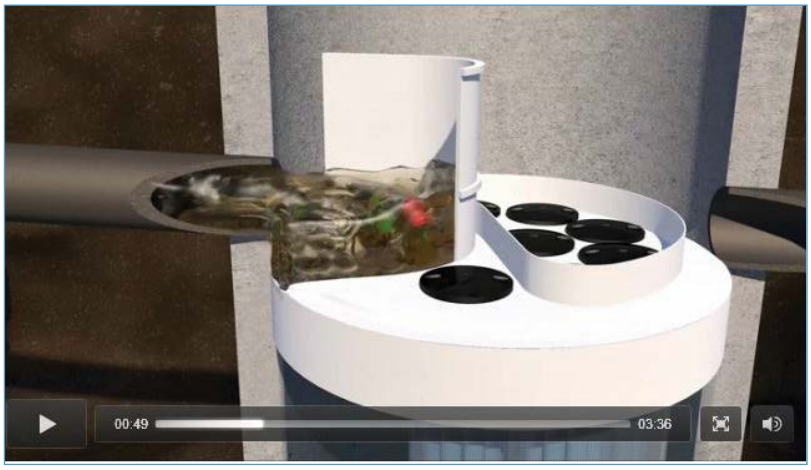
By working with Imbrium and our partners, you can expect superior treatment technology, unparalleled customer service, compliance with local stormwater regulations, and cleaner water. To find your local representative, please visit **www.imbriumsystems.com/localrep**.

Learn About the Jellyfish® Filter

Go online and watch our animation to learn how the Jellyfish Filter works. The animation also highlights important features of the Jellyfish Filter including...

- Applications
- Performance test results
- Inspection and maintenance
- Regulatory approvals

To view the Jellyfish Filter animation, visit:
www.imbriumsystems.com/jellyfish



Filtration as a Stormwater Management Strategy

Stormwater regulations are increasingly calling for more robust treatment levels. In addition to the removal of suspended solids, many regulations now require best management practices to remove significant amounts of nutrients, metals, and other common pollutants found in stormwater runoff. Meeting these regulations often requires the use of a filtration solution.

Low Impact Development (LID) and Green Infrastructure (GI) are complimented by filtration solutions. Benefits of LID and GI systems include retaining runoff and aesthetic appeal. Keeping LID and GI sites free from trash, fine sediment, oils, and debris while functioning as designed can be time consuming and costly.

As a result, the practice of combining LID and GI with filtration is becoming more common. Providing a single point of maintenance promotes proper system functionality and increases the aesthetic appeal by removing unsightly trash and debris.

A Jellyfish Filter Curb Inlet pretreats runoff entering a bioretention system.

The Jellyfish® Filter - Setting New Standards in Stormwater Treatment

The Jellyfish Filter is a stormwater quality treatment technology featuring high surface area and high flow rate membrane filtration at low driving head. By incorporating pretreatment with light-weight membrane filtration, the Jellyfish Filter removes floatables, trash, oil, debris, TSS, fine silt-sized particles, and a high percentage of particulate-bound pollutants; including phosphorus and nitrogen, metals and hydrocarbons.

The Jellyfish Filter uses high surface area membrane cartridges that are lightweight, durable, rinsable, and reusable. The patented up-flow hydraulic design and passive backwash feature combined with the cartridge technology ensures long-lasting performance.

The Jellyfish Filter.

Jellyfish® Filter Features and Benefits

Features	Benefits
High surface area membrane filtration	Low flux rate promotes cake filtration and slows membrane occlusion
High design treatment flow rate per cartridge (up to5 L/s)	Compact system with a small footprint, lower construction cost
Low driving head (typically 457 mm or less)	Design flexibility, lower construction cost
Lightweight cartridges with passive backwash	Easy maintenance and low life-cycle cost

Jellyfish® Filter Applications

- Urban development
- Highways, airports, seaports, and military installations
- Commercial and residential development, infill and redevelopment, and stormwater quality retrofit applications
- Pretreatment for Low Impact Development (LID), Green Infrastructure (GI), infiltration, and rainwater harvesting and reuse systems
- Industrial sites

A Jellyfish Filter pretreats a bioretention/bioswale system at a commercial site in Ontario, Canada.

A catch basin Jellyfish Filter is installed in a commercial development in Virginia USA.

A Jellyfish Filter provides treatment at an industrial park in Quebec, Canada.

Jellyfish® Filter Field Performance Test Results

Pollutant of Concern	% Removal
Total Trash	99%
Total Suspended Solids (TSS)	89%
Total Phosphorus (TP)	77%
Total Nitrogen (TN)	51%
Total Copper (TCu)	>80%
Total Zinc (TZn)	>50%

Sources:
TARP Field Study – 2012 JF 4-2-1 Configuration
MRDC Floatables Testing – 2008 JF6-6-1 Configuration
TAPE Field Study – 2020 JF6-6-1 Configuration

The pleated tentacles of the Jellyfish Filter provide a large surface area for pollutant removal.

Jellyfish® Filter Certifications and Verifications

The Jellyfish Filter is approved through numerous state, provincial, and federal agencies and verification programs, including:

- **Canada ISO 14034 Environmental Management – Environmental Technology Verification (ETV)**
- Ontario Ministry of the Environment – New Environmental Technology Evaluation (NETE) – Certification
- New Jersey Corporation for Advanced Technology (NJCAT) – Field Performance Verification per TARP Tier II Protocol
- Washington State Department of Ecology (TAPE –CULD)
- Maryland Department of the Environment (MD DOE)
- Texas Commission on Environmental Quality (TCEQ)
- Virginia Department of Environmental Quality (VA DEQ)
- New York Department of Environmental Conservation (DEC)

Jellyfish® Filter Configurations

The Jellyfish Filter is available in a variety of configurations. Typically, 457 mm (18 inches) of driving head is designed into the system. For low drop sites, the designed driving head can be less.

Lightweight Jellyfish Filter Configurations

Custom configurations include tanks made from fiberglass for site specific applications.

A Jellyfish Filter was constructed from fiberglass to reduce the weight of the system, allowing for a suspended installation above an underground parking structure. The reduced weight eliminated the need for structural changes, and suspending the Jellyfish resulted in no loss of parking space, maximizing real-estate value.

Other custom configurations include:

- On-line capability (internal bypass)
- Peak Diversion Vault Configurations

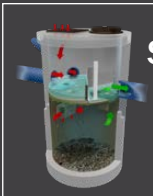
Jellyfish® Filter Maintenance

Inspection and maintenance activities for the Jellyfish Filter typically include:

- Visual inspection of deck, cartridge lids, and maintenance access wall.
- Vacuum extraction of oil, floatable trash/debris, and sediment from the manhole sump.
- External rinsing and re-installing of filter cartridges.
- Replacement of filter cartridge tentacles as needed. Cartridge replacement intervals vary by site; typical replacement is anticipated every 2-5 years.

The Jellyfish Filter cartridge is light and easy to clean.

Watch the Jellyfish Filter inspection and maintenance video at **www.imbriumsystems.com/jellyfish**

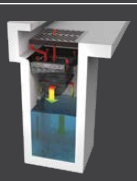


STORMCEPTOR EF SYSTEM

The enhanced flow "EF" Stormceptor® effectively targets sediment (TSS), free oils, gross pollutants and other pollutants that attach to particles, such as nutrients and metals, Stormceptor delivers protection 24/7.

FILTERRA BIORETENTION

The Filterra® Bioretention System is an engineered biofiltration device with components that make it similar to bioretention in pollutant removal and application, but has been optimized for high volume/flow treatment in a compact system.



LITTATRAP CATCH BASIN

The LittaTrap™ is a simple and effective solution to remove sediment and trash from stormwater systems at its source. The LittaTrap sits inside the storm drain and captures and retains sediment and trash before it enters stormwater infrastructure, effectively pretreating downstream structures and aiding in pollutant removal.

LEARN MORE

- Access project profiles, photos, videos, and more online at **www.imbriumsystems.com/jellyfish.**

REQUEST DESIGN ASSISTANCE

- Call us at (888) 279-8826 or 301-279-8827 to talk to one of our engineers for technical support or design assistance.

START A PROJECT

- Submit your system requirements on our product Design Worksheet at **www.imbriumsystems.com/pdw.**

FIND A LOCAL REPRESENTATIVE

- Visit **www.imbrumsystems.com/localrep** for contact information for your local Imbrium representative.

imbrium®

+1 416-960-9900

www.imbriumsystems.com

Imbrium® Systems is an engineered stormwater treatment company that designs and manufactures stormwater treatment solutions that protect water resources from harmful pollutants. By developing technologies to address the long-term impact of urban runoff, Imbrium ensures our clients' projects are compliant with government water quality regulations. For information, visit www.imbriumsystems.com or call +1 416-960-9900.

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STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

Specifies requirements for construction and performance of an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS

ASTM C 891: Specification for Installation of Underground Precast Concrete Utility Structures
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 4101: Specification for Copolymer steps construction

Ontario Provincial Standards
OPSS 1350: Material Specification for Concrete - Materials and Production
OPSD 401.01: Maintenance Hole Frame and Closed Cover
OPSD 405.010: Safety Steps
OPSD 701.030 1200 mm Diameter Precast Concrete Maintenance Hole Components
OPSD 701.050 1800 mm Diameter Precast Concrete Maintenance Hole Components
OPSD 701.060: 2400 mm Diameter Precast Concrete Maintenance Hole Components
OPSD 701.070: 3000 mm Diameter Precast Concrete Maintenance Hole Components
OPSD 701.080: 3600 mm Diameter Precast Concrete Maintenance Hole Components

CAN/CSA-A257.4-14
Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

CAN/CSA-A257.4-14
Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Plant Prequalification Program - Prequalification Requirements for Precast Concrete Drainage Products

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete and call out or note the fiberglass (FRP) internals/components.

1.4 PRODUCT SUBSTITUTIONS

No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the engineer of record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The device shall be a cylindrical or rectangular, all concrete structure (including risers), constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications; whichever is more stringent. The device shall be watertight.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. The deck shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges (maximum manned weight = 450 pounds (204 kg)); (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of reusable cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be a minimum of eleven 2.75-inch (70-mm) or greater diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle, or similar mechanism to secure the cartridge into the deck. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid, or on the individual cartridge itself, and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum design flux rate shall be 0.21 gpm/ft^2 (0.142 lps/m^2).

Each membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry

installation weight as follows (if length of filter cartridge is between those listed below, the surface area and weight shall be proportionate to the next length shorter and next length longer as shown below):

Filter Cartridge Length (in / mm)	Minimum Filtration Membrane Surface Area (ft2 / m2)	Maximum Filter Cartridge Dry Weight (lbs / kg)
15	106 / 9.8	10.5 / 4.8
27	190 / 17.7	15.0 / 6.8
40	282 / 26.2	20.5 / 9.3
54	381 / 35.4	25.5 / 11.6

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck, or other mechanism, that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir, or other mechanism, shall collect a pool of filtered water during inflow events that backwashes the high flow rate cartridges when the inflow event subsides. All filter cartridges and membranes shall be reusable and allow for the use of filtration membrane rinsing procedures to restore flow capacity and sediment capacity; extending cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the deck. Access shall have a minimum vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables and coarse sediment. The baffle shall be flexible and continuous in cylindrical configurations, and shall be a straight concrete or aluminum wall in rectangular configurations.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer. Depths less than 24 inches may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer, and shall be watertight.

2.2.2 All precast concrete components shall be manufactured by a plant certified through the Ontario Plant Prequalification Program for the appropriate concrete products. In addition, the product must be approved through the OPS New Products Committee and listed as such with the Road Authority.

2.2.3 Precast bases shall be manufactured to the OPSD 701 series of specifications in accordance with its internal diameter.

2.3 GASKETS. Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape, or Conseal CS-101 are not acceptable gasket materials.

2.4 JOINTS. All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.5 FRAME AND COVER. Frame and covers must be manufactured in accordance with OPSD 401.01 and shall be clearly embossed with manufacturer's product name.

2.6 DOORS AND HATCHES. If provided shall meet designated loading requirements at a minimum for incidental traffic.

2.7 CONCRETE. All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478 as well as CSA and OPSD specifications. They shall also be listed within the approved products to manufacture with the Ontario Plant Prequalification Certificate.

2.8 FIBERGLASS. The fiberglass portion of the stormwater quality filter treatment device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS. Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION. All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter treatment device shall have been field tested in accordance with either TARP Tier II Protocol (TARP, 2003) and New Jersey Tier II Stormwater Test Requirements – Amendments to TARP Tier II Protocol (NJDEP, 2009) or Washington State Technology Assessment Protocol – Ecology (TAPE), 2011 or later version. The field test shall have been verified in accordance with ISO 14034:2016 Environmental Management – Environmental Technology Verification (ETV). See Section 3.2 of this specification for field test performance requirements.

3.1.2 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.3 Pollutants - The stormwater quality filter treatment device shall be ISO 14034 verified to remove oil/grease, coarse and fine particulates (SSC), TSS, particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.4 Bypass - The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows. Internal bypass systems shall be equipped with a floatables baffle, and must avoid passage through the sump and/or cartridge filtration zone.

3.1.5 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum design treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft^2 (0.142 lps/m^2).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter treatment device shall have been field tested in accordance with either TARP Tier II Protocol (TARP, 2003) and New Jersey Tier II Stormwater Test Requirements – Amendments to TARP Tier II Protocol (NJDEP, 2009) or Washington State Technology Assessment Protocol – Ecology (TAPE), 2011 or later version. The field test shall have been verified in accordance with ISO 14034:2016 Environmental Management – Environmental Technology Verification (ETV). The field test shall have monitored a minimum of twenty (20) TARP or TAPE qualifying storm events.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have ISO 14034 verified load based TSS removal efficiency of at least 85% and a ISO 14034 verified load based SSC removal efficiency of at least 98%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median

removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrients:

3.2.5.1 Total Phosphorus (TP) Removal - The stormwater quality filter treatment device shall have ISO 14034 ETV verified load based median TP removal efficiency of at least 49%.

3.2.5.2 Total Nitrogen (TN) Removal - The stormwater quality filter treatment device shall have ISO 14034 ETV verified load based median TN removal efficiency of at least 39%.

3.2.6 Metals:

3.2.6.1 Total Zinc (Zn) Removal - The stormwater quality filter treatment device shall have ISO 14034 ETV verified load based median Zn removal efficiency of at least 69%.

3.2.6.2 Total Copper (Cu) Removal - The stormwater quality filter treatment device shall have ISO 14034 ETV verified load based median Cu removal efficiency of at least 91%.

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

3.3.1 Durability of membranes are subject to good handling practices during inspection and maintenance (removal, rinsing, and reinsertion) events, and site specific conditions that may have heavier or lighter loading onto the cartridges, and pollutant variability that may impact the membrane structural integrity. Membrane maintenance and replacement shall be in accordance with manufacturer's recommendations.

3.3.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade (outside the structure).

3.3.3 Manual rinsing of the reusable filter cartridges shall promote restoration of the flow capacity and sediment capacity of the filter cartridges, extending cartridge service life.

3.3.4 The filter device shall have a minimum 12 inches (305 mm) of sediment storage depth, and a minimum of 12 inches between the top of the sediment storage and bottom of the filter cartridge tentacles, unless otherwise specified by the design

engineer. Variances may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

3.3.5 Sediment removal from the filter treatment device shall be able to be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.6 Maintenance access shall have a minimum clear height that provides suitable vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

3.3.7 Filter cartridges shall be able to be maintained without the requirement of additional lifting equipment.

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a watertight precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes, whichever is more stringent. Selected sections of a general specification that are applicable are summarized below.

4.1.1.1 The watertight precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- concrete riser section(s) and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1.2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary to restore original condition and watertight seals. Once the stormwater quality treatment device has been constructed, any/all lift holes must be plugged watertight with mortar or non-shrink grout.

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the

structure is watertight, and such that any pipe intrusion into the device does not impact the device functionality.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.2 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

4.3 FILTER CARTRIDGE INSTALLATION Filter cartridges shall be installed in the cartridge deck only after the construction site is fully stabilized and in accordance with the manufacturer's guidelines and recommendations. Contractor to contact the manufacturer to schedule cartridge delivery and review procedures/requirements to be completed to the device prior to installation of the cartridges and activation of the system.

PART 5 – QUALITY ASSURANCE

5.1 FILTER CARTRIDGE INSTALLATION Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed complete after site is stabilized and unit is ready to accept cartridges. Unit is ready to accept cartridges after is has been cleaned out and any standing water, debris, and other materials have been removed. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction, and in accordance with the manufacturer's recommendations and guidance. For systems with cartridges installed prior to full site stabilization and prior to system activation, the contractor can plug inlet and outlet pipes to prevent stormwater and other influent from entering the device. Plugs must be removed during the activation process.

5.2 INSPECTION AND MAINTENANCE

5.2.1 The manufacturer shall provide an Owner's Manual upon request.

5.2.2 After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines and the local regulatory agency/body.

5.3 REPLACEMENT FILTER CARTRIDGES When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

END OF SECTION

Appendix F
References

HYDROGEOLOGICAL INVESTIGATION
PROPOSED DEVELOPMENT

613 Helena Street, Fort Erie, Ontario

Prepared for:

SS WELLAND INC.

4080 Confederation Parkway, Unit 701
Mississauga, ON L5B 0G1

Prepared by:

HLV2K ENGINEERING LIMITED
A Consulting Engineers Company

2179 Dunwin Drive, Unit 4
Mississauga, Ontario L5L 1X2

Project No. 2100394AG

February 17, 2022

HLV2K ENGINEERING LIMITED
A Consulting Engineers Company

February 17, 2022 Reference No.: 2100394AG

SS Welland Inc.
4080 Confederation Parkway, Unit 701
Mississauga, ON L5B 0G1
L5B 0G1

Attention: Mr. Hunain Siddiqui
Email: hunain@emrahomes.ca

RE: Hydrogeological Consulting Services for Proposed Development
613 Helena Street, Fort Erie, Ontario

Dear Mr. Siddiqui,

HLV2K Engineering Limited (HLV2K) is pleased to provide the Hydrogeological Investigation Report for the above-mentioned project. The report presents HLV2K's understanding of the hydrogeological setting of the study area based on exploratory drilling, data collection, analyses, and review.

We trust that this information meets your present requirements. If we can be of additional assistance in this regard, please contact this office.

For and on behalf of HLV2K Engineering Limited,

k. Mohamadi

Kourosh Mohammadi, Ph.D., P.Eng.

President and Principal Hydrogeological Engineer

TABLE OF CONTENT

TABLES

FIGURES

APPENDICES

LIST OF ACRONYMS AND DEFINITIONS

BH	Borehole
EASR	Environmental Activity and Sector Registry
GPM	Gallon per Minute
K	Hydraulic Conductivity
mbgs	Metres Below Ground Surface
MECP	Ontario Ministry of the Environment, Conservation and Parks
O.Reg.903	Ontario's Wells Regulation
PAHs	Polycyclic Aromatic Hydrocarbons
PHCs	Petroleum Hydrocarbons
PTTW	Permit To Take Water
PWQOs	Provincial Water Quality Objectives
VOCs	Volatile Organic Compounds
WWIS	Water Well Information System
WWR	Water Well Record

1 INTRODUCTION

1.1 General

HLV2K Engineering Limited (HLV2K) was retained by SS Welland Inc. (the Client) to complete a hydrogeological investigation to evaluate the site conditions at proposed development area located at 613 Helena Street in Fort Erie, Ontario (the Site). The Site location is shown on **Figure 1**.

The Site is a rectangular shaped property, approximately 8.15 (ha), lies in a typical rural setting in an area of mixed residential, agricultural and vacant land use. Approximately 60% of the subject property is used for agricultural purposes.

The Site is currently occupied by a two-storey residential dwelling and associated garage, a two-storey barn and two storage buildings (The site buildings covered approximately 15% of the total Site area). The western portion of the Site is occupied by a forested area. Prior to the development of these structures, the Site was in agricultural use.

It is our understanding that the project involves the development of a residential subdivision on the property

1.2 Purpose

The purpose of the hydrogeological investigation was to characterize the existing hydrogeological conditions at and in the vicinity of the Site, assess the need for, and options for, groundwater control in association with the proposed construction, evaluate potential impacts to the local groundwater regime resulting from the proposed construction, and identify appropriate mitigative measures, as warranted.

This hydrogeological study may be utilized in support for an application for a Permit to Take Water (PTTW) for dewatering purposes during construction or registering in Environmental Activity and Sector Registry (EASR), if necessary. The purpose of completing the PTTW / EASR application is to conduct the work in compliance with Ontario Regulation 387/04 (as amended) and the Ontario Water Resources Act (OWRA). The water taking EASR is for construction projects that require more than 50,000 liters per day (L/day) of water and less than 400,000 L/day under normal conditions. A PTTW is required for any surface water or groundwater taking during construction in excess of 400 cubic metres per day (m^3/day).

2 METHOD OF INVESTIGATION

2.1 General

This hydrogeological investigation was based on review of previously completed geotechnical and environmental reports and published information for the study area, including previously published regional physiographic and geologic mapping and watershed planning reports. Many of these documents are referred to throughout various sections of this report and the relevant details can be found in the References section following the text of the report.

In particular, the work completed in association with this hydrogeological study consisted of the following tasks:

- Reviewing and interpreting available reports and published data;
- Developing Health & Safety and Sampling and Analysis Plans for work at the Site;
- Assessing the current Site conditions, areas of interest and to confirm the previous borehole locations;
- Developing the groundwater monitoring wells installed by geotechnical group on the Site by removing at least three well volumes of groundwater or two times to dry;
- Reviewing water well records available from the Ministry of the Environment, Conservation, and Parks (MECP);
- Reviewing measured groundwater levels in each of the monitoring wells located at the Site;
- Evaluating proposed construction dewatering requirements;
- Estimation of the underfloor and perimeter drainage flow for permanent dewatering; and,
- Prepare a final report on the findings of this investigation.

2.2 Boreholes and Monitoring Wells

As part of geotechnical investigation for this Site (HLV2K, 2021), eleven boreholes (BH1 to BH11), were drilled to depths varying from 4.6m to 6.9m on September 08 and 09, 2021. The boreholes were advanced by utilizing continuous flight hollow stem augers. Upon completion of drilling, each borehole was backfilled in accordance with current regulations.

Four boreholes (BH5, BH6, BH7 and BH11) were converted to groundwater monitoring well and were used to obtain hydrologic and groundwater quality information. Monitoring wells were constructed in accordance with Ontario Regulation 903. The sand pack was extended above the screened interval to allow for settling of the sand/expansion of overlaying bentonite seal. A 50mm diameter Schedule 40 polyvinyl chloride (PVC) pipe including a screen section of 3 m length with a factory machined slot width of 0.25 mm, completed with a PVC riser pipe was used.

All the pipe and screen sections were wrapped in plastic that was removed just prior to installation to minimize the potential for contamination. The base of the monitoring wells was covered with a PVC cap to prevent the influx of sediment. Clean silica sand supplied in bags, was placed in the annular space between the pipe and the sides of the borehole to obtain relatively sediment free groundwater. A bentonite seal was added to the annular space above the sand pack to reduce the infiltration of surface water into the borehole annulus.

The wells were extended to grade with solid PVC riser pipe. The sand pack was extended above the screened interval to allow for settling of the sand/expansion of overlaying bentonite seal. The wells were completed with slip on cap. Wells construction details and borehole logs from this investigation and previously drilled by others are presented in **Appendix A**.

The locations of the boreholes were established in the field by HLV2K based on the plan provided by the client. The borehole elevations and locations were surveyed and established by the HLV2K staff. The approximate borehole locations are shown in **Figure 2**.

It should be noted that the ground surface elevations noted on the appended borehole logs are approximate and were used for the purpose of relating borehole soil stratigraphy and should not be used or relied on for other purposes. Two existing and one newly installed

Table 1: Information on Groundwater Monitoring Wells

MW ID	Estimated Ground Surface Elevation (m)	Borehole Bottom		Well Screen Interval Depth (mbgs)		Well Screen Interval Elevation (m)	
		Depth (mbgs)	Elevation (m)	from	to	from	To
BH5	181.4	5.2	176.2	2.0	5.0	179.4	176.4
BH6	181.3	5.2	176.1	2.0	5.0	179.3	176.3
BH7	181.7	4.6	177.1	1.4	4.4	180.3	177.3
BH11	181.9	6.1	175.8	2.9	5.9	179.0	176.0

2.3 Groundwater Monitoring and Sampling

One (1) groundwater sample was collected from monitoring well (BH6) on September 28, 2021. This groundwater sample was collected and analyzed for general chemical parameters and compared with Provincial Water Quality Objectives (PWQOs).

Prior to sampling, all wells were developed. The development of the monitoring wells was conducted by purging and surging the well water to stress the formation around the well screen so that mobile particulates were removed. The purpose of the well development is to improve the hydraulic connection between the well and the geologic materials in the vicinity of the well, and to subsequently obtain a groundwater sample representative of the in-situ conditions. The groundwater level was measured in the monitoring wells and wells were developed by purging to dry, twice.

The collected sample was submitted to ALS Environmental Laboratories in Mississauga, a member of the Canadian Association for Laboratory Accreditation (CALA), for chemical analysis. Copies of the laboratory certificates of analysis are provided in **Appendix B**.

2.4 In-Situ Hydraulic Conductivity Testing

Rising head hydraulic conductivity tests (slug tests) were conducted on four (4) monitoring wells, BH5, BH6, BH7 and BH11 on October 21, 2021 to assess the subsurface hydraulic conductivity conditions.

A summary of the hydraulic conductivity test methodology is as follows:

- The static groundwater level in each monitoring well was initially measured and recorded;
- For the rising head test, a known volume of water was removed from each tested well using an inertial pump and low density tubing; and,
- The water level in each well was then measured and recorded at regular time intervals

The water level data from the monitoring wells were analysed using AQTESOLV Professional V4.5 and the Bouwer-Rice equation to estimate the hydraulic conductivity (K) of the soil adjacent to the screened portion of the well.

3 SITE CONDITIONS

3.1 Physical Setting

The Site is located on north side of Concession Road 5 and west side of Osborne Street. The surrounding areas are mostly vacant with natural cover and few residential and commercial properties. According to the Oak Ridges Moraine (ORM) Atlas which is available online at (http://www.mah.gov.on.ca/page334.aspx) and the Niagara Escarpment Plan (NEP) Maps available online at (http://www.escarpment.org/landplanning), the Site is not located within an area where either the Oak Ridges Moraine Conservation Plan or the Niagara Escarpment Plan would be applicable.

3.2 Climatic Conditions

Average monthly climate data from an Environment Canada climate station located at the Fort Erie (Station ID 6132470), approximately 2.2 km southwest of the Site, for the period between 1981 and 2010 is provided in **Table 2**, below (Environment Canada, 2021). The data indicates that the climate in the study area is typical continental with cold winters and warm summers and precipitation records showing local seasonal variation. As shown in **Table 2**, below, the mean annual precipitation is 1051.3 mm/year, with annual mean rainfall of 876.3 mm/year (83% of total precipitation). Average monthly precipitation ranged from 66.6 mm in February to 105.4 mm in September. The mean annual daily temperature is 8.6 degrees Celsius (°C), ranging from -4.1 °C in January to 21.2 °C in July.

Table 2: Climate Data Summary (1981 – 2010) – Fort Erie Station (ID 6132470)

MONTH	Daily Average Temperature (°C)	Average Rainfall (mm)	Average Snow (cm)	Average Precipitation (mm)
January	-4.1	34.2	44.7	78.9
February	-3.3	32.8	33.8	66.6
March	0.4	44.7	26.3	71.0
April	6.6	74.4	4.4	78.8
May	12.7	92.3	0.9	93.2
June	18.1	81.7	0.0	81.7
July	21.2	84.7	0.0	84.7
August	20.6	88.5	0.0	88.5
September	16.7	105.4	0.0	105.4
October	10.4	95.3	1.4	96.7
November	4.9	89.9	12.9	102.8
December	-0.8	52.5	50.7	103.2
Year	**8.6**	**876.4**	**175.1**	**1051.5**

NOTE: Data was obtained from Environment Canada website (Environment Canada 2021).

3.3 Physiography and Drainage

A review of the topographic map provided online by Natural Resources Canada (Toporama) depicts the Site as located within an area that is generally low relief at an approximate elevation of 122 m. The Site is located within Lake Erie drainage area part of Niagara Peninsula watershed. The Site located approximately 1.1 km north of Lake Erie.

Lake Erie drainage area contains several small creek watersheds and tile drained areas which flow generally south and discharge into Lake Erie. The Site is located within Krafts Drain area. The Kraft Drain is approximately 900 m west of the Site.

According to the physiographic regions of Ontario identified by Chapman and Putnam (2007), the Site is located in Haldimand Clay Plain physiographic region. The Haldimand Clay Plain consists of fine-grained silts and clays deposited at the bottom of a deep glacial lake basin. It is characterized by heavy clay soils which are relatively impermeable, resulting in a high level of runoff and little groundwater recharge.

3.4 Geological Mapping

Most of the Niagara Peninsula is covered by unconsolidated sediment. The unconsolidated sediments mainly resulted from glacial advances and retreats that occurred during the last glaciation period in southern Ontario (NPSA, 2013). A regional description of the Quaternary geology for the area of the Site can be found on the Ontario Geological Survey Digital Map - Surficial geology of southern Ontario (OGS, 2010) and Freenstra (1984). A section of this map showing the surficial geology in the vicinity of the Site is presented on **Figure 3**.

As shown on **Figure 3**, the surficial deposits in the immediate vicinity of the Site are mapped as deeper water glaciolacustrine unit consists of clay and silt overlying the Wentworth Till.

The sedimentary bedrock consists mainly of interbedded limestone and dolostone carbonate materials, and shale. Bedrock units of the Devonian Period (newest) to the Ordovician Period (oldest) are present. Dolomite bedrock was encountered in boreholes BH1, BH4, BH7, and BH11 at approximate depth of 4.5 m to 6.8 m.

3.5 Subsurface Soil Conditions

The subsurface soil conditions encountered during boreholes advanced at the Site are shown on the borehole logs in **Appendix A**. A summary of the soil conditions is provided below. Reference should be made to the geotechnical report (HLV2K, 2021) for a detailed description of the soil conditions at the Site.

In general, below the fill/disturbed native materials (silty clay, trace sand, trace gravel), the site is underlain by native soils (silty clay till to clayey silt till, trace gravel). The native materials encountered at all the borehole locations were quite consistent and were generally firm to very stiff silty clay till over silty clay to maximum explored depth ranging from 0.6 to 6.8 mbgs. In all borehole soft clayey materials found ranging 3.1 to 4.9 mbgs.

4 GROUNDWATER CONDITIONS

4.1 Regional Groundwater Recharge

Recharge is the process by which groundwater is replenished and involves the vertical infiltration of water through the subsoil deposits and geologic materials to the saturated zone. The major sources of recharge in the study area are a result of precipitation and freshet. The amount of groundwater recharge in a particular area depends on surficial geology, topography, and the extent of land development in that area. Generally, regional groundwater recharge is irregularly distributed temporally and spatially as interpreted from specific climatic conditions, local geology, and land development status.

The Site is mostly vacant and is currently occupied by a two-storey residential dwelling and associated garage, a two-storey barn and two storage buildings (The site buildings covered approximately 15% of the total Site area). The western portion of the Site is occupied by a forested area. Therefore, the groundwater recharge occurs under natural condition. The native soil in the area is dense with low hydraulic conductivity and the infiltration is expected to be low. However, a water balance analysis will be completed for the site to estimate the change in water recharge pre and post development. The results will be presented in a separate report.

4.2 Groundwater Level Fluctuations

The groundwater level data collected from the monitoring wells are provided in **Table 3**, below. The screen elevations of these monitoring wells are shown in **Table 1** above.

The groundwater level monitoring rounds were completed in September and October 2021 as part of this investigation. As shown in **Table 3** below, the groundwater levels in monitoring wells were measured at approximate depth of 0.41 to 2.59 m below the existing ground surface (mbgs). The corresponding elevations for groundwater were from 179.31 m to 180.84 m.

It should be noted that groundwater conditions vary depending on factors such as temperature, season, precipitation, construction activity and other situations, which may be different from those encountered at the time of the monitoring. The possibility of groundwater level fluctuations at the Site should be considered when designing and developing the construction plans for the project.

Regional groundwater flow in the area typically reflects the local topography and generally occurs from topographic highs to topographic lows. The dominant groundwater flow direction at the Site is north to south towards Lake Erie.

Table 3: Summary of Groundwater Level Observations in Monitoring Wells

MW ID	Ground Surface Elevation (m)	Groundwater Level Observations			
		28-SEP-21		21-OCT-21	
		Depth (mbgs)	Elevation (m)	Depth (mbgs)	Elevation (m)
BH5	181.4	0.82	180.58	0.76	180.64
BH6	181.3	0.90	180.35	0.41	180.84
BH7	181.7	1.43	180.31	1.36	180.38
BH11	181.9	2.59	179.31	1.09	180.81

4.3 Inferred Hydrostratigraphy

The subsurface investigations revealed that beneath the surficial materials, the subsurface conditions encountered in the boreholes consisted of fill materials overlaying native soil, and dolomite bedrock. The bedrock was relatively shallow at approximate depth of 4.5 to 6.8 mbgs. Groundwater was encountered in the silty clay layer. Conditions encountered in the monitoring wells in the silty clay layer indicated that the groundwater in this layer can be considered confined.

4.4 Results of In-Situ Hydraulic Conductivity Tests

Table 4 below summarizes the results of the hydraulic conductivity testing in the monitoring wells and the hydrostratigraphic units in which these monitoring wells were screened. The hydraulic conductivity and analysis data sheets are presented in **Appendix C**.

Table 4: Summary of In-Situ Hydraulic Conductivity Test Results

MW ID	Hydraulic Conductivity (cm/s)	Hydraulic Conductivity (m/day)	Stratigraphic Unit
BH5	1.2×10^{-6}	1.0×10^{-3}	Silty clay
BH6	7.3×10^{-7}	6.3×10^{-4}	Silty clay
BH7	2.2×10^{-6}	1.9×10^{-3}	Silty clay
BH11	2.5×10^{-7}	2.1×10^{-4}	Silty clay

4.5 Groundwater Use in the Study Area

As part of this hydrogeological study, HLV2K did a search of the MECP Water Well Information System (WWIS) database to identify active wells near the Site. The database search was for the area located within 500 m from the Site. The database search identified records for 8 wells.

Figure 4 presents the locations of the identified wells as well as the associated water use categories within 500 m around the Site. A detailed table showing water well record (WRR) information for these wells is provided in **Appendix D**. The classification of these wells is as follows:

- 3 wells stated as observation wells
- 5 wells stated as water supply.

The search revealed the presence of 5 domestic water wells or other water supply wells potentially in use in the area of the Site. These wells were completed between 1946 and 2000.

4.6 Groundwater Quality for Temporary Dewatering

During construction, the groundwater pumped in conjunction with excavation dewatering (where required) may be discharged into the water bodies within the Site. In this case, the discharge water quality will have to conform to the discharge limits identified in the Ontario Water Quality Objective Limits (PWQOs).

The analytical results for the groundwater samples from BH6 were compared to the PWQO limits. BH6 is screened in silty clay and silty clay till at approximate depth of 5.1 mbgs.

The laboratory certificates of analysis are provided in **Appendix B**. These results showed that all parameter concentrations were below the PWQO limits with the exception of copper. In addition, the detection limit of phosphorus concentration was higher than the PWQO limit.

5 GROUNDWATER DEWATERING ESTIMATES

5.1 Introduction

It is our understanding that the project is considered for approximately 8.15 ha of residential development. According to the drawings provided by the Client (**Appendix E**), all houses will have one level of basement. The finish floor of underground basement is expected to be at an approximate depth of 3 mbgs or the geodetic elevation of 179 m.

It is anticipated that the base of the footings will be about 1 m below the finished basement floor at approximate elevation 178 m±.

The highest stabilized groundwater level measured in the monitoring wells installed at the Site in was at about 180.4 m measured in BH6. Therefore, dewatering is anticipated to be necessary during construction.

Assuming that the groundwater level should be reduced as necessary to 1 m below the base of the excavations, the approximate groundwater elevation during the construction should be 177 m or less. For the purpose of calculations to estimate the potential dewatering rate, the excavation was considered as an open excavation.

Hydraulic conductivity is varied from 2.5 x 10-7 to 2.2 x 10^{-6} cm/s. the highest hydraulic conductivity of 2.2 x 10^{-6} cm/s was used in dewatering estimation.

Uniform aquifer thicknesses were assumed for the layer. According to the drawing provided to HLV2K by the Client (**Appendix E**) the area of the buildings is approximately 13,000 m^2 assuming approximately 50% of the lot size to be building area and basement is extended to the edge of the building.

For the purpose of the dewatering estimation, it was assumed that the excavation is carried out in stages and at each stage the excavation is a rectangular with 200 m length and 50 m wide for the largest plot.

5.2 Estimating Short-Term Dewatering Rate during Construction

The anticipated daily dewatering rates were estimated using the equations provided in the reference book "Construction Dewatering and Groundwater Control: New Methods and Applications - Third Edition. New York, New York: John Wiley & Sons (Powers et. al., 2007)", for a rectangular system of closely spaced wells to dewater an excavation. Steady flow to the excavation was assumed for the purpose of the analysis.

The estimated groundwater inflow rate (Q_R) to an excavation was calculated as follows:

$$Q_R = \frac{2\pi K\left(H^2 - h^2\right)}{\ln\left(\frac{R}{r_e}\right)}$$

Where,

K – Hydraulic conductivity = 1.9 x 10^{-3} [m/d];

H – Distance from static water level to bottom of aquifer = 5.4 [m];

h – Distance from lowered water level to bottom of the aquifer = 2.0 [m];

R - Radius of the cone of depression (zone of influence) [m], estimated approximately using the following empirical relationship developed by Sichart

$R = r_e + 3000(H - h)K^{0.5}$, (K in m/s); and

$r_e=((w \times \ell)/\pi)^{0.5}$

w – excavation width and ℓ – excavation length

To lower the water table 1 m below the bottom of the excavation, it is estimated that the total dewatering rate to be approximately 2.5 m^3/day. The total flow at any time will depend on the length of excavation that needs dewatering and the expected rate of progress. The zone of influence (R) is estimated to be maximum 1.5 m from the edge of the excavation.

Allowing for changes in soil properties, specifically hydraulic conductivity and transmissivity, it is expected that there will be variations and changes in the amount of groundwater that can be pumped from any part of the site. Allowing a 100% contingency for the variability in hydraulic conductivity that could be experienced, the expected pumping rate needed for the site is about 5 m^3/day. This rate is below the MECP threshold of 50 m^3/day for registration under the Environmental Activity and Sector Registry (EASR). Considering the possibility of heavy rain during the excavation, the maximum dewatering rate is proposed to be **49 m^3/day**.

It should also be noted that the construction works will most likely be carried out in stages and dewatering of the entire site for the full term of the contract will not be necessary to achieve the required drawdown.

5.3 Estimating Long-Term Drainage Requirement

The perimeter and underfloor drainage systems were proposed by geotechnical investigation to cut-off the groundwater seepage into the excavations and lower the groundwater below the subgrade level. The rate for the long-term drainage system for each house is expected to be 1.5 m^3/day considering the largest plot and assuming 50% of the plot size area to be the basement area. The seeped water from surface should also be considered in the long-term drainage system. According to the Ontario Ministry of Transportation IDF Curve (available online: http://www.mto.gov.on.ca/IDF_Curves), the storm event with 2-year return period of Site is 58.8 mm/day. Assuming 50% infiltration rate for this storm event and 50% of the lot to be permeable surface, the expected infiltrated water is 12.5 m^3/day.

Allowing for variations in grain size in the aquifer, specifically hydraulic conductivity and transmissivity, seepage through shoring wall or from surface, and presence of sand seems, it is expected that there will be variations in the amount of groundwater that can be drained by foundation and/or underfloor drainage systems. Therefore, it is prudent to consider a contingency factor in designing the drainage capacity. It is recommended that the drainage capacity including sumps, pumps and related utilities for foundation and underfloor drains be designed for minimum 18.9 L/min (approximately 5 GPM) for each house.

The analytical results for samples collected at the monitoring location indicated that groundwater from properly filtered drains and/or with filtration/settlement of the discharge as appropriate, would meet the Region's storm and/or sanitary discharge limits. The pumped water can also discharge into the backyard or landscape area of the house.

6 PREDICTED EFFECTS

Based on the hydrogeological information and data analysis in this report, the potential impacts to surface water and groundwater resources in the vicinity of the Site due to excavation dewatering for construction of the proposed tower at the Site are described below.

6.1 Groundwater Use

As indicated in Section 4.5, the search of the MECP water well records indicated the presence of 5 water supply wells within approximately 500 m of the Site. These wells were completed between 1946 and 2000. A water well survey is recommended before commencing the excavation to ensure the existence of these wells.

6.2 Surface Water Resources

No surface watercourse was identified in the vicinity and within the zone of influence of the dewatering. Kraft Drain is approximately 900 m west of the Site and no impact is anticipated on that.

It should be noted that the flow and water level in any surface water body is naturally fluctuated with the season and precipitation regime. Therefore, these natural fluctuations should be separated from the impact of dewatering, if any.

6.3 Discharge to Municipal Sewer System

It is our understanding that discharge to sewer municipality has not been considered during the construction and pumped water can be managed on Site. Based on the results provided in the certificate of analysis, all parameters were below the PWQos limits with the exception of dissolved copper. Since no surface body is in the vicinity of the Site, as long as the pumped water is managed within the Site, no adverse impact is expected.

7 DEWATERING MONITORING AND MITIGATION PLAN

7.1 Groundwater Monitoring

The dewatering requirements may be variable depending on the size of the excavation (length, width and depth), aquifer properties and construction methods. Suitable dewatering method(s) and volume of discharge need to be identified by the contractor using technical evaluation reports and proposed dewatering plan(s). Prior to construction, and where required, discharge permits should be in place for discharging water into local sanitary and/or storm sewers. If discharge to surface water is expected, the water quality should meet the limits of PWQOs. Due to the low hydraulic conductivity and anticipated low water quantity, the impact of groundwater on the outside of the Site is expected to be minimum.

The location(s) of the point of discharge with respect to the dewatering systems need to be confirmed by the contractor and where required, Erosion and Sedimentation Control (ESC) measures such as filter bags, straw bales, and silt fences should be implemented.

Discharge locations should be monitored on a daily basis. Discharge volume should be measured using a digital totalizing flow meter (in-line flow meter).

If any impacts attributable to the dewatering are noted, then mitigation measures should be initiated. In the event of excessive sediment, these measures could potentially include use of additional filtration measures such as settlement tanks or filter bags.

Records of daily water quantity pumped, treatment method used, water quality parameters tested, and the method of discharge should be maintained and updated regularly by the construction contractor.

7.2 Water Well Survey

Based on the results provided in water well record search, 5 water supply have been identified within 500 m radius around the Site. A water well survey is recommended before the commencement of the construction to ensure the existence of these wells. Selected wells should be monitored during the construction and water level and quality of the water should be recorded and tested. If the impact of dewatering on these wells is observed, the mitigation measures should be initiated. These measures could potentially include the reduction of the dewatering rate or supplying water to the well owner.

8 SUMMARY AND CONCLUSION

Based on the results of the subsurface investigation, hydrogeological assessment, and analysis of hydraulic conductivity testing and groundwater level monitoring data, the following summary of conclusions and recommendations is provided:

- The estimated daily groundwater pumping rate for temporary dewatering is below than the 50 m^3/day PTTW or EASR threshold. The registration on MECP EASR is not required.

- It is recommended that the dewatering system be designed and evaluated by a qualified engineer and performed by a licensed dewatering contractor. The dewatering engineer/contractor should be reminded that during the dewatering activities, care must be taken to prevent the removal of fine soil particles with the pumped water or to use proper filtration prior to discharge to the Region and/or Town sewer system.

- Discharge from temporary dewatering during the construction of the proposed underground basement is expected to be managed on Site. If off-site discharge is required, the water quality should meet receiver municipality or PWQOs limits. Dissolved copper concentration was above the PWQOs limit.

- Long-term foundation and underfloor drainage system are recommended for the houses to reduce the hydrostatic pressure and remove seeped water. The anticipated flow rate including the infiltrated water from the surface is approximately 14 m^3/day or less for each house. It is prudent to consider a contingency factor in designing the drainage capacity. It is recommended that the drainage capacity including sumps, pumps and related utilities is designed for minimum 18.9 L/min (5 GPM).

- HLV2K recommends the decommissioning of existing groundwater monitoring wells after completion of the construction of the project. In conformance with Ontario's Wells Regulation (O.Reg.903) of the Ontario Water Resources Act, the installation and eventual decommissioning of groundwater wells must be carried out by a licensed well contractor. If a well will be damaged/destroyed during the construction activities, then the well should be properly decommissioned in advance of that work.

9 STATEMENT OF LIMITATIONS

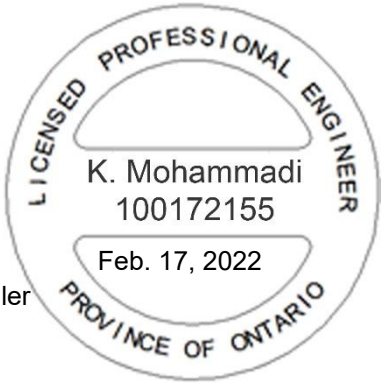
The contents of this report are subject to the attached '***Statement of Limitation***' sheet. The reader's attention is specifically drawn to these conditions as it is considered essential that they be followed for proper use and interpretation of this report. The Statement of Limitations is not intended to reduce the level of responsibility accepted by HLV2K, but rather to ensure that all parties who have been given reliance for this report are aware of the responsibilities each assumes in so doing.

This report was prepared by HLV2K exclusively for the account of SS WELLAND INC. (the CLIENT). Other than by the CLIENT, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of HLV2K. Any use, reliance on or decision made by any person other than CLIENT based on this report is the sole responsibility of such other person. The CLIENT and HLV2K make no representation or warranty to any other person with regard to this report and the work referred to in this report and the CLIENT and HLV2K accept no duty of care to any other person or any liability or responsibility whatsoever for any losses, expenses, damages, fines, penalties or other harm that may be suffered or incurred by any other person as a result of the use of, reliance on, any decision made or any action taken based on this report or the work referred to in this report.

10 CLOSURE

We trust that this information is satisfactory for your present requirements. Should you have any questions or require additional information, please do not hesitate to contact this office.

For and Behalf of HLV2K Engineering Limited



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HLV2K Engineering Limited

STATEMENT OF LIMITATIONS

Your report has been developed based on your unique project specific requirements as understood by HLV2K Engineering Limited (HLV2K) and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking HLV2K to assess how factors that changed subsequent to the date of the report affect the report's recommendations. HLV2K cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions, which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult HLV2K to be advised how time may have impacted on the project.

The findings derived from this investigation were based on information collected and/or provided by the Client. It may become apparent that soil and groundwater conditions differ between and beyond the testing locations examined during future investigations or other work that could not be detected or anticipated at the time of this study. As such, HLV2K cannot be held liable for environmental conditions that were not apparent from the available information. The conclusions presented represent the best judgment of the assessors based on limited investigations.

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature, external data source review, sampling, and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions, which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of HLV2K through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report is based on the assumption that he site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only HLV2K, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and HLV2K cannot be held responsible for such misinterpretation.

To avoid misuse of the information contained in your report it is recommended that you confer with HLV2K before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

HLV2K Engineering Limited

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain HLV2K to work with other project design professionals who are affected by the report. Have HLV2K explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment.

Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact HLV2K for information relating to geoenvironmental issues.

HLV2K is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with HLV2K to develop alternative approaches to problems that may be of genuine benefit both in time and in cost.

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from HLV2K to other parties but are included to identify where HLV2K's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from HLV2K closely and do not hesitate to ask any questions you may have.

Third party information reviewed and used to formulate this report is assumed to be complete and correct. HLV2K used this information in good faith and will not accept any responsibility for deficiencies, misinterpretation or incompleteness of the information contained in documents prepared by third parties.

Nothing in this report is intended to constitute or provide a legal opinion.

Should additional information become available, HLV2K requests that this information be brought to our attention so that we may re-assess the conclusions presented herein.

FIGURES

Legend

Approx. Site Boundary

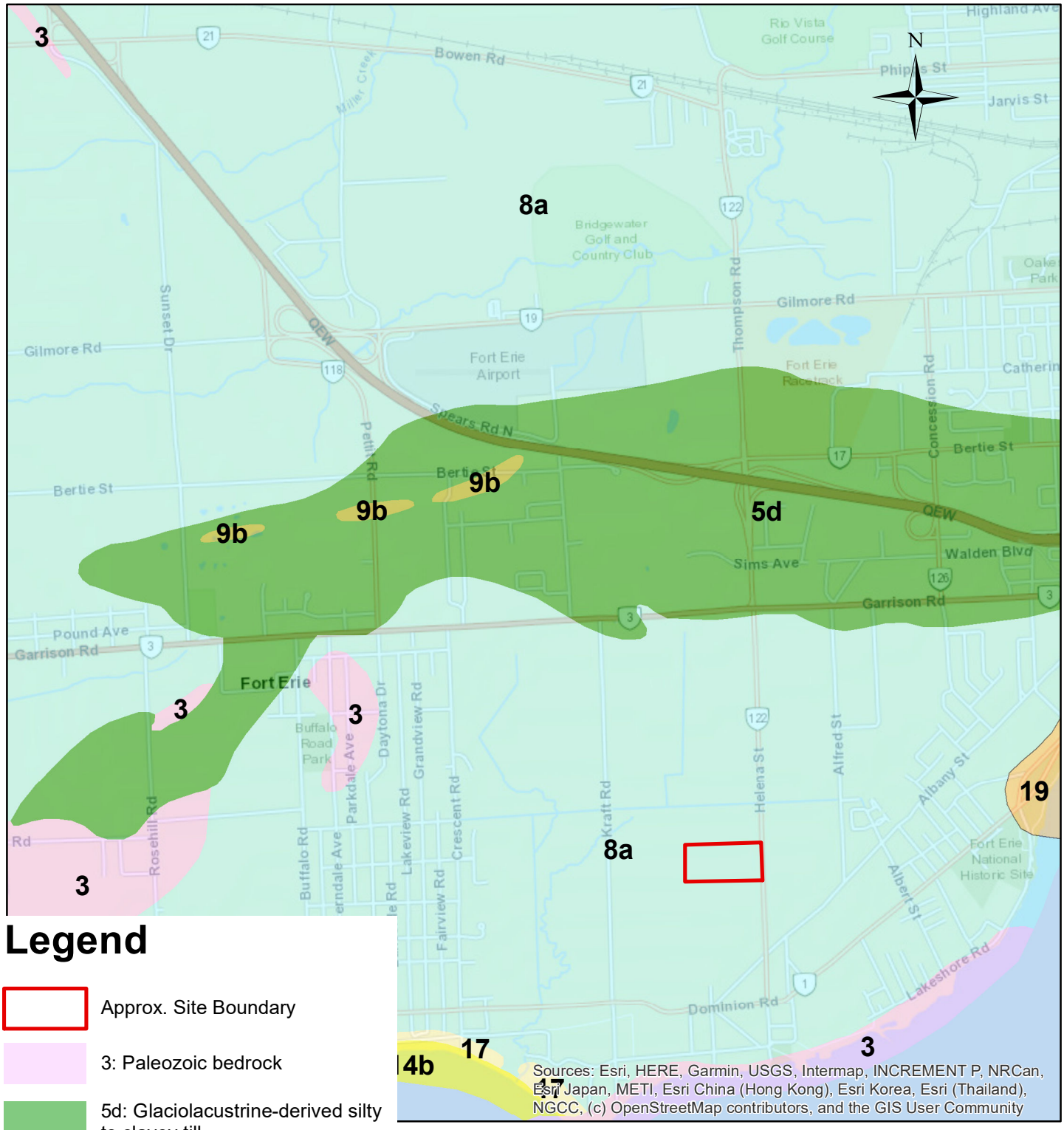
Drawn: MM	Title: SITE LOCATION PLAN
Approved: KM	Project: HYDROGEOLOGICAL INVESTIGATION Proposed Residential Development 613 Helena Street, Fort Erie, Ontario
Date: NOV. 2021	
Project No.: 2100394AG	
	Client: SS WELLAND INC.
HLV2K ENGINEERING LIMITED	0 125 250 500 Meters — **FIGURE 1**

Legend

- Approx. Site Boundary
- Borehole
- Monitoring Well

Drawn: MM	Title: BOREHOLE LOCATION PLAN
Approved: KM	Project: HYDROGEOLOGICAL INVESTIGATION Proposed Residential Development 613 Helena Street, Fort Erie, Ontario
Date: NOV. 2021	
Project No.: 2100394AG	
	Client: SS WELLAND INC.
HLV2K ENGINEERING LIMITED	0 20 40 80 Meters

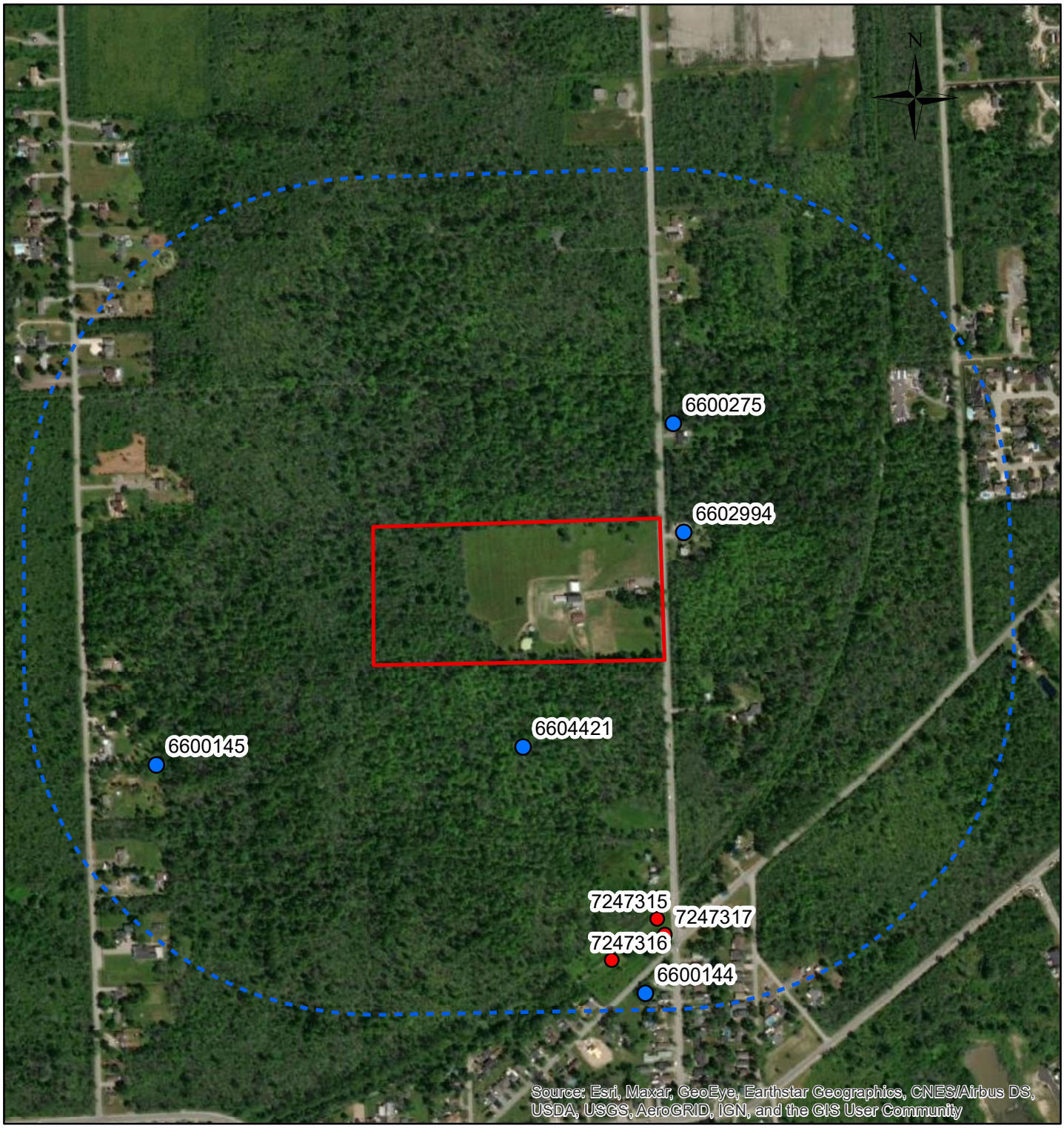
FIGURE 2



Legend

- Approx. Site Boundary
- 3: Paleozoic bedrock
- 5d: Glaciolacustrine-derived silty to clayey till
- 8a: Glaciolacustrine deep water deposits
- 9b: Littoral-foreshore deposits
- 14b: Littoral-foreshore deposits
- 17: Eolian deposits
- 19: Modern alluvial deposits

Drawn: MM	Title SURFICIAL GEOLOGY MAP	
Approved: KM	Project HYDROGEOLOGICAL INVESTIGATION Proposed Residential Development 613 Helena Street, Fort Erie, Ontario	
Date: NOV. 2021		
Project No.: 2100394AG		
	Client SS WELLAND INC.	
HLV2K ENGINEERING LIMITED	0 255 510 1,020 Meters	FIGURE 3



Legend

- Approx. Site Boundary
- 500mBuffer

Final Status

- Observation Wells
- Water Supply

Drawn: MM	Title: WATER WELL RECORDS
Approved: KM	Project: HYDROGEOLOGICAL INVESTIGATION Proposed Residential Development 613 Helena Street, Fort Erie, Ontario
Date: NOV. 2021	
Project No.: 2100394AG	
	Client: SS WELLAND INC.
HLV2K ENGINEERING LIMITED	0 65 130 260 Meters

FIGURE 4

APPENDIX A

Borehole Logs

LOG OF BOREHOLE BH1

PROJECT: Sabrina Homes

CLIENT: Sabrina Homes

PROJECT LOCATION: 613 Helena Street, Fort Erie, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan N 4751014.752 E 668156.609

DRILLING DATA

Method: Hollow Stem Augur

Diameter: 150mm

Date: Sep/08/2021

REF. NO.: 2100394AG

DRAWING NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
182.2						
0.0 / 182.0	**Asphalt:** 150mm				182	
0.2	**Fill:** sand and gravel, trace silt and clay, brown, moist, compact	1	SS	57		
181.4						
0.8	**Silty Clay Till:** trace gravel and sand, brown, very moist, firm to very stiff	2	SS	7	181	
		3	SS	16		1 7 45 47
		4	SS	27	180	
		5	SS	17	179	
177.6					178	
4.6	**Silty Clay:** trace sand, brown, moist, firm to very stiff	6	SS	6	177	

STRATA PLOT

GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L

WATER CONTENT (%) 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES $+^3$, $\times^3$: Numbers refer to Sensitivity ○ ε_f=3% Strain at Failure

LOG OF BOREHOLE BH1

PROJECT: Sabrina Homes

CLIENT: Sabrina Homes

PROJECT LOCATION: 613 Helena Street, Fort Erie, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan N 4751014.752 E 668156.609

DRILLING DATA

Method: Hollow Stem Augur

Diameter: 150mm

Date: Sep/08/2021

REF. NO.: 2100394AG

DRAWING NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE & Sensitivity, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Silty Clay: trace sand, brown, moist, firm to very stiff(Continued)						176				
			7	SS	8				○		
175.3											
~~176.0~~ 6.9	~~**Bedrock:** weathered, black~~ dolomite		8	SS	~~50/50mm~~				○		
	End of Borehole: borehole terminated at 6.9m										
	Upon completion: 1) Cave-in: open 2) Water: dry										

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH2

PROJECT: Sabrina Homes

CLIENT: Sabrina Homes

PROJECT LOCATION: 613 Helena Street, Fort Erie, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan N 4750966.835 E 668089.3891

DRILLING DATA

Method: Soild Stem Augur

Diameter: 150mm

Date: Sep/08/2021

REF. NO.: 2100394AG

DRAWING NO.: 3

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.6						
0.0 / 181.3	**Topsoil:**300mm					
0.3 / 181.0	**Disturbed Native/Fill:** silty clay, trace sand and gravel, trace rootlets, brown to black, very moist, loose	1	SS	4	181	
0.6	**Silty Clay Till:** trace sand, trace gravel, brown to black, very moist, stiff to very stiff	2	SS	16		
1		3	SS	20	180	
2		4	SS	15	179	
3		5	SS	8	178	
4						
177.0						
4.6	**Silty Clay:** trace sand, brown, very moist, soft	6	SS	3	177	1 7 52 40
5 / 176.4						
5.2	**End of Borehole:**borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry					

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS

Measurement: 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon_f=3\%}$ Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH3

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4750999.13 E 668085.3975

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/09/2021

REF. NO.: 2100394AG
DRAWING NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.7 / 0.0	**Gravel:** 100mm											
0.1 / 181.3	**Fill:** sandy silt with some gravel, organic inclusions, brown, very moist, loose		1	SS	6							
0.4	**Silty Clay Till:** trace sand and gravel, trace rootlets, brown, very moist, firm to stiff		2	SS	13		181					
			3	SS	18		180					
			4	SS	15		179					
			5	SS	10		178					
177.2 / 4.6	**Silty Clay:** trace sand, brown, very moist, soft		6	SS	4		177					
176.6 / 5.2	**End of Borehole:** borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH4

PROJECT: Sabrina Homes

CLIENT: Sabrina Homes

PROJECT LOCATION: 613 Helena Street, Fort Erie, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan N 4750990.884 E 668007.3711

DRILLING DATA

Method: Soild Stem Augur

Diameter: 150mm

Date: Sep/09/2021

REF. NO.: 2100394AG

DRAWING NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.4												
0.0 / 181.3	**Topsoil:** 150mm											
0.2 / 181.0	**Disturbed Native/Fill:** silty clay, trace gravel, trace rootlets, brown , very moist, loose		1	SS	5							
0.5	**Silty Clay Till:** trace gravel, brown, very moist, firm to very stiff		2	SS	18		181					
1			3	SS	20		180					
2			4	SS	14		179					
3			5	SS	10		178					
4			6	SS	50/130mm		177					
176.6 / 4.9 / 176.4	**Bedrock:** weathered dolomite											
5 5.0	**End of Borehole:** borehole terminated at 5.0m Upon completion: 1) Cave-in: open 2) Water: dry											

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε_f=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH5

PROJECT: Sabrina Homes

CLIENT: Sabrina Homes

PROJECT LOCATION: 613 Helena Street, Fort Erie, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan N 4750949.591 E 668062.0856

DRILLING DATA

Method: Soild Stem Augur

Diameter: 150mm

Date: Sep/08/2021

REF. NO.: 2100394AG

DRAWING NO.: 6

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
181.4					
0.0 / 181.3	**Topsoil:** 150mm				
0.2 / 180.9	**Disturbed Native/Fill:** silty clay, trace gravel, trace rootlets, brown, very moist, loose	1	SS	5	181
0.5	**Silty Clay Till:** trace gravel, brown, very moist, firm to very stiff	2	SS	14	180
1		3	SS	21	
2		4	SS	16	179
3		5	SS	10	178
4					177
176.8					
4.6	**Silty Clay:** trace sand and gravel, brown, very moist, firm	6	SS	6	
5 / 176.2					
5.2	**End of Borehole:** borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry 3) Monitoring well installed upon completion				

GROUND WATER CONDITIONS: W. L. 179.7 m, Oct 21, 2021

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
- ○ UNCONFINED
- ● QUICK TRIAXIAL
- + FIELD VANE & Sensitivity
- × LAB VANE

PLASTIC LIMIT (w_P) — NATURAL MOISTURE CONTENT (w) — LIQUID LIMIT (w_L)

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ε=3%: Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH6

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4750942.554 E 668149.6001

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/08/2021

REF. NO.: 2100394AG
DRAWING NO.: 7

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
181.2					
0.0 / 181.1	**Topsoil:** 150mm				
0.2 / 180.9	**Disturbed Native/Fill:** silty clay,trace gravel, trace rootlets, brown, moist, loose	1	SS	5	181
0.3	**Silty Clay Till:** trace sand and gravel, greyish brown, very moist, firm to very stiff	2	SS	22	
					180
		3	SS	26	
		4	SS	14	179
		5	SS	8	178
176.7					177
4.6	**Silty Clay:** trace sand and gravel, brown, very moist, soft	6	SS	4	
176.1					
5.2	**End of Borehole:** borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry 3) Monitoring well installed upon completion				

W. L. 179.9 m
Oct 21, 2021

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
$+^3$, $\times^3$: Numbers refer to Sensitivity
○ ε_f=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH7

PROJECT: Sabrina Homes

CLIENT: Sabrina Homes

PROJECT LOCATION: 613 Helena Street, Fort Erie, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan N 4751054.703 E 668018.9953

DRILLING DATA

Method: Soild Stem Augur

Diameter: 150mm

Date: Sep/08/2021

REF. NO.: 2100394AG

DRAWING NO.: 8

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"
181.7				
0.0 / 181.6	**Topsoil:** 150mm			
0.2 / 181.4	**Disturbed Native/Fill:** silty clay,trace gravel, trace rootlets, brown, very moist, loose	1	SS	7
0.3	**Silty Clay Till:** trace gravel, brown, very moist, firm to very stiff			
		2	SS	12
		3	SS	22
178.7		4	SS	16
3.1	**Silty Clay:** trace sand and gravel, brown, very moist, firm	5	SS	6
177.2				
4.5 / 177.1	**Bedrock:** weathered dolomite	6	SS	50/50mm
4.6	**End of Borehole:** borehole terminated at 4.6m Upon completion: 1) Cave-in: open 2) Water: dry 3) Monitoring well installed upon completion			

GROUND WATER CONDITIONS: W. L. 179.5 m Oct 21, 2021

ELEVATION: 181, 180, 179, 178

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%) — GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH8

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4751060.32 E 668093.7114

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/08/2021

REF. NO.: 2100394AG
DRAWING NO.: 9

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.8												
0.0 / 181.5	**Topsoil:**230mm											
0.2 / 181.3	**Disturbed Native/Fill:** silty clay,trace gravel, trace rootlets, brown, very moist, loose		1	SS	5							
0.5	**Silty Clay Till:** trace sand and gravel, brown, very moist, firm to very stiff		2	SS	15		181					
1			3	SS	21		180					
2			4	SS	18		179					
3 / 178.7												
3.1	**Silty Clay:** trace sand and gravel, brown, very moist, firm turning soft		5	SS	6		178					
4			6	SS	3		177					
5 / 176.6												
5.2	**End of Borehole:**borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH9

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4751026.281 E 668127.6148

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/09/2021

REF. NO.: 2100394AG
DRAWING NO.: 10

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.8												
0.0 / 181.6	**Topsoil:**230mm											
0.2 / 181.3	**Disturbed Native/Fill:** silty clay,trace gravel, trace rootlets, brown, very moist, loose		1	SS	6							
0.5	**Silty Clay Till:** trace sand and gravel, brown, very moist, firm to very stiff		2	SS	16		181					
1			3	SS	20		180					
2			4	SS	16		179					
3 / 178.7												
3.1	**Silty Clay:** trace sand, brown, very moist, firm turning soft		5	SS	8		178					
4			6	SS	3		177					
5 / 176.6												
5.2	**End of Borehole:**borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH10

PROJECT: Sabrina Homes

CLIENT: Sabrina Homes

PROJECT LOCATION: 613 Helena Street, Fort Erie, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan N 4750966.835 E 668089.3891

DRILLING DATA

Method: Soild Stem Augur

Diameter: 150mm

Date: Sep/09/2021

REF. NO.: 2100394AG

DRAWING NO.: 11

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
181.6					
0.0 / 181.4	**Topsoil:** 150mm				
0.2 / 181.1	**Disturbed Native/Fill:** silty clay, trace gravel, trace rootlets, brown, very moist, loose	1	SS	5	
0.5	**Silty Clay Till:** trace sand and gravel, brown, very moist, firm to very stiff	2	SS	13	181
		3	SS	20	180
178.5		4	SS	23	179
3.1	**Silty Clay:** trace sand, brown, very moist, firm	5	SS	8	178
176.4		6	SS	4	177
5.2	**End of Borehole:** borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry				

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
- ○ UNCONFINED
- ● QUICK TRIAXIAL
- + FIELD VANE & Sensitivity
- × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH11

PROJECT: Sabrina Homes

CLIENT: Sabrina Homes

PROJECT LOCATION: 613 Helena Street, Fort Erie, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan N 4751054.793 E 668166.184

DRILLING DATA

Method: Soild Stem Augur

Diameter: 150mm

Date: Sep/08/2021

REF. NO.: 2100394AG

DRAWING NO.: 12

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
181.9 / 0.0	**Topsoil:** 150mm				
181.8 / 0.2	**Disturbed Native/Fill:** silty clay, trace gravel, trace rootlets, brown, moist, loose	1	SS	5	
181.4 / 0.5	**Silty Clay Till:** trace sand and gravel, brown, very moist, firm to very stiff	2	SS	14	181
		3	SS	18	180
		4	SS	20	179
		5	SS	14	178
177.3 / 4.6	**Silty Clay:** trace sand, brown, very moist, firm	6	SS	4	177
175.9 / 6.0	**Bedrock:** weathered, dolomite	7	SS	50/50mm	176
175.8 / 6.1	**End of Borehole:** borehole terminated at 6.1m				

Upon completion:
1) Cave-in: open
2) Water: dry
3) Monitoring well installed upon completion

GROUND WATER CONDITIONS: W. L. 179.8 m Oct 21, 2021

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

APPENDIX B

Water Quality Certificates of Analysis

HLV2K Engineering Limited (Brampton)
ATTN: Kourosh Mohammadi
2179 Dunwin Drive
Unit 4
Mississauga ON L5L 1X2

Date Received: 28-SEP-21
Report Date: 07-OCT-21 11:14 (MT)
Version: FINAL

Client Phone: 437-370-0317

Certificate of Analysis

Lab Work Order #: L2644748

Project P.O. #: NOT SUBMITTED
Job Reference: 2100394AG
C of C Numbers:
Legal Site Desc:

Comments: ADDITIONAL 29-SEP-21 07:56

Amanda Overholster
Account Manager

ANALYTICAL REPORT

Summary of Guideline Exceedances

ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit
Guideline						
Ontario Provincial Water Quality Objectives (JULY, 1994) - Surface Water PWQO						
L2644748-1	BH6	Dissolved Metals	Copper (Cu)-Dissolved	0.00133	0.001	mg/L
			Phosphorus (P)-Dissolved	<0.050	0.01	mg/L

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Physical Tests - WATER

			Lab ID	L2644748-1
			Sample Date	28-SEP-21
			Sample ID	BH6
		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Colour, Apparent	CU	-	-	<2.0 PEHT
Conductivity	umhos/cm	-	-	968
pH	pH units	6.5-8.5	-	8.05
Total Dissolved Solids	mg/L	-	-	541 DLDS
Turbidity	NTU	-	-	<0.10

Guide Limit #1: Surface Water PWQO

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Anions and Nutrients - WATER

			Lab ID	L2644748-1
			Sample Date	28-SEP-21
			Sample ID	BH6
		Guide Limits		
Analyte	Unit	#1	#2	
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	486
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	486
Ammonia, Total (as N)	mg/L	-	-	0.041
Bromide (Br)	mg/L	-	-	<0.10
Chloride (Cl)	mg/L	-	-	4.17
Computed Conductivity	uS/cm	-	-	911
Conductivity % Difference	%	-	-	-6
Fluoride (F)	mg/L	-	-	0.699
Hardness (as CaCO3)	mg/L	-	-	514
Ion Balance	%	-	-	112
Langelier Index		-	-	1
Nitrate and Nitrite as N	mg/L	-	-	0.129
Nitrate (as N)	mg/L	-	-	0.129
Nitrite (as N)	mg/L	-	-	<0.010
Saturation pH	pH	-	-	7.09
Orthophosphate-Dissolved (as P)	mg/L	-	-	0.0099
TDS (Calculated)	mg/L	-	-	579
Sulfate (SO4)	mg/L	-	-	103
Anion Sum	me/L	-	-	10.4
Cation Sum	me/L	-	-	11.6
Cation - Anion Balance	%	-	-	6

Guide Limit #1: Surface Water PWQO

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Organic / Inorganic Carbon - WATER

		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Lab ID				L2644748-1
Sample Date				28-SEP-21
Sample ID				BH6
Dissolved Carbon Filtration Location		-	-	LAB
Dissolved Organic Carbon	mg/L	-	-	4.25

Guide Limit #1: Surface Water PWQO

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Inorganic Parameters - WATER

		Guide Limits		
Analyte	Unit	#1	#2	
Lab ID				L2644748-1
Sample Date				28-SEP-21
Sample ID				BH6
Silica	mg/L	-	-	12.8

Guide Limit #1: Surface Water PWQO

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Bacteriological Tests - WATER

			Lab ID	L2644748-1
			Sample Date	28-SEP-21
			Sample ID	BH6
		Guide Limits		
Analyte	Unit	#1	#2	
E. Coli	CFU/100mL	100	-	0
Total Coliforms	CFU/100mL	-	-	0

Guide Limit #1: Surface Water PWQO

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Dissolved Metals - WATER

			Lab ID	L2644748-1
			Sample Date	28-SEP-21
			Sample ID	BH6
Analyte	**Unit**	**Guide Limits #1**	**#2**	
Dissolved Metals Filtration Location		-	-	LAB
Aluminum (Al)-Dissolved	mg/L	0.015	-	<0.0050
Antimony (Sb)-Dissolved	mg/L	0.02	-	0.00040
Arsenic (As)-Dissolved	mg/L	0.005	-	0.00102
Barium (Ba)-Dissolved	mg/L	-	-	0.0871
Beryllium (Be)-Dissolved	mg/L	0.011	-	<0.00010
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.000050
Boron (B)-Dissolved	mg/L	0.2	-	0.133
Cadmium (Cd)-Dissolved	mg/L	0.0001	-	<0.000010
Calcium (Ca)-Dissolved	mg/L	-	-	54.1
Chromium (Cr)-Dissolved	mg/L	-	-	<0.00050
Cobalt (Co)-Dissolved	mg/L	0.0009	-	0.00027
Copper (Cu)-Dissolved	mg/L	0.001	-	0.00133
Iron (Fe)-Dissolved	mg/L	0.3	-	<0.010
Lead (Pb)-Dissolved	mg/L	0.001	-	<0.000050
Magnesium (Mg)-Dissolved	mg/L	-	-	92.0
Manganese (Mn)-Dissolved	mg/L	-	-	0.0298
Molybdenum (Mo)-Dissolved	mg/L	0.04	-	0.0105
Nickel (Ni)-Dissolved	mg/L	0.025	-	0.00148
Phosphorus (P)-Dissolved	mg/L	0.01	-	<0.050
Potassium (K)-Dissolved	mg/L	-	-	5.05
Selenium (Se)-Dissolved	mg/L	0.1	-	0.0110
Silicon (Si)-Dissolved	mg/L	-	-	6.00
Silver (Ag)-Dissolved	mg/L	0.0001	-	<0.000050
Sodium (Na)-Dissolved	mg/L	-	-	28.1
Strontium (Sr)-Dissolved	mg/L	-	-	6.75
Sulfur (S)-Dissolved	mg/L	-	-	35.0
Thallium (Tl)-Dissolved	mg/L	0.0003	-	0.000026
Tin (Sn)-Dissolved	mg/L	-	-	0.00097
Titanium (Ti)-Dissolved	mg/L	-	-	<0.00030

Guide Limit #1: Surface Water PWQO

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Dissolved Metals - WATER

			Lab ID	L2644748-1
			Sample Date	28-SEP-21
			Sample ID	BH6
		Guide Limits		
Analyte	Unit	#1	#2	
Tungsten (W)-Dissolved	mg/L	0.03	-	<0.00010
Uranium (U)-Dissolved	mg/L	0.005	-	0.00428
Vanadium (V)-Dissolved	mg/L	0.006	-	0.00183
Zinc (Zn)-Dissolved	mg/L	0.02	-	<0.0010
Zirconium (Zr)-Dissolved	mg/L	0.004	-	<0.00030

Guide Limit #1: Surface Water PWQO

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
PEHT	Parameter Exceeded Recommended Holding Time Prior to Analysis

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SPEC-PCT-WT	Water	Automated Speciated Alkalinity	APHA 2320B

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BR-IC-N-WT	Water	Bromide in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CL-IC-N-WT	Water	Chloride by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

COLOUR-APPARENT-WT	Water	Colour	APHA 2120

Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

DOC-WT	Water	Dissolved Organic Carbon	APHA 5310B

Sample is filtered through a 0.45um filter, then injected into a heated reaction chamber which is packed with an oxidative catalyst. The water is vaporized and the organic carbon is oxidized to carbon dioxide. The carbon dioxide is transported in a carrier gas and is measured by a non-dispersive infrared detector.

EC-MF-WT	Water	E. coli	SM 9222D

A 100 mL volume of sample is filtered through a membrane, the membrane is placed on mFC-BCIG agar and incubated at 44.5 –0 .2 °C for 24 – 2 h. Method ID: WT-TM-1200

EC-SCREEN-WT	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

EC-WT	Water	Conductivity	APHA 2510 B

Water samples can be measured directly by immersing the conductivity cell into the sample.

ETL-N2N3-WT	Water	Calculate from NO2 + NO3	APHA 4110 B
ETL-SILICA-CALC-WT	Water	Calculate from SI-TOT-WT	EPA 200.8
F-IC-N-WT	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

IONBALANCE-OP03-WT	Water	Detailed Ion Balance Calculation	APHA 1030E, 2330B, 2510A
MET-D-CCMS-WT	Water	Dissolved Metals in Water by CRC	APHA 3030B/6020A (mod)

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
		ICPMS	
		Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.	
		Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.	
		Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).	
NH3-F-WT	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
		This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.	
NO2-IC-WT	Water	Nitrite in Water by IC	EPA 300.1 (mod)
		Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	
NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)
		Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	
PH-WT	Water	pH	APHA 4500 H-Electrode
		Water samples are analyzed directly by a calibrated pH meter.	
		Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days	
PO4-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS
		This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.	
SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)
		Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	
SOLIDS-TDS-WT	Water	Total Dissolved Solids	APHA 2540C
		This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.	
TC-MF-WT	Water	Total Coliforms	SM 9222B
		A 100mL volume of sample is filtered through a membrane, the membrane is placed on mENDO LES agar and incubated at 35–0.5°C for 24–2h. Method ID: WT-TM-1200	
TURBIDITY-WT	Water	Turbidity	APHA 2130 B
		Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.	

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2644748 Report Date: 07-OCT-21

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2

Contact: Kourosh Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-SPEC-PCT-WT	**Water**							
Batch R5605452								
WG3628224-4 DUP		**WG3628224-3**						
Alkalinity, Total (as CaCO3)		97.6	94.8		mg/L	2.9	20	30-SEP-21
Alkalinity, Bicarbonate (as CaCO3)		97.6	94.8		mg/L	2.9	20	30-SEP-21
Alkalinity, Carbonate (as CaCO3)		<1.0	<1.0	RPD-NA	mg/L	N/A	20	30-SEP-21
Alkalinity, Hydroxide (as CaCO3)		<1.0	<1.0	RPD-NA	mg/L	N/A	20	30-SEP-21
WG3628224-2 LCS								
Alkalinity, Total (as CaCO3)			104.3		%		85-115	30-SEP-21
WG3628224-1 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	30-SEP-21
Alkalinity, Bicarbonate (as CaCO3)			<2.0		mg/L		2	30-SEP-21
Alkalinity, Carbonate (as CaCO3)			<2.0		mg/L		2	30-SEP-21
Alkalinity, Hydroxide (as CaCO3)			<2.0		mg/L		2	30-SEP-21
BR-IC-N-WT	**Water**							
Batch R5607207								
WG3629471-4 DUP		**WG3629471-3**						
Bromide (Br)		<0.10	<0.10	RPD-NA	mg/L	N/A	20	01-OCT-21
WG3629471-2 LCS								
Bromide (Br)			101.5		%		85-115	01-OCT-21
WG3629471-1 MB								
Bromide (Br)			<0.10		mg/L		0.1	01-OCT-21
WG3629471-5 MS		**WG3629471-3**						
Bromide (Br)			101.4		%		75-125	01-OCT-21
CL-IC-N-WT	**Water**							
Batch R5607207								
WG3629471-4 DUP		**WG3629471-3**						
Chloride (Cl)		7.62	7.62		mg/L	0.0	20	01-OCT-21
WG3629471-2 LCS								
Chloride (Cl)			100.6		%		90-110	01-OCT-21
WG3629471-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	01-OCT-21
WG3629471-5 MS		**WG3629471-3**						
Chloride (Cl)			97.6		%		75-125	01-OCT-21
COLOUR-APPARENT-WT	**Water**							
Batch R5605759								
WG3629030-3 DUP		**L2645896-6**						
Colour, Apparent		5.1	5.1		CU	1.0	20	30-SEP-21
WG3629030-2 LCS								

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Kourosh Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
COLOUR-APPARENT-WT	**Water**							
Batch R5605759								
WG3629030-2 LCS								
Colour, Apparent			100.0		%		85-115	30-SEP-21
WG3629030-1 MB								
Colour, Apparent			<2.0		CU		2	30-SEP-21
DOC-WT	**Water**							
Batch R5613019								
WG3630165-3 DUP		**L2645135-2**						
Dissolved Organic Carbon		12.6	14.2		mg/L	12	20	06-OCT-21
WG3630165-2 LCS								
Dissolved Organic Carbon			93.2		%		80-120	06-OCT-21
WG3630165-1 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	06-OCT-21
WG3630165-4 MS		**L2645135-2**						
Dissolved Organic Carbon			N/A	MS-B	%		-	06-OCT-21
EC-MF-WT	**Water**							
Batch R5605334								
WG3627624-3 DUP		**L2644972-2**						
E. Coli		3	3		CFU/100mL	0.0	65	29-SEP-21
WG3627624-1 MB								
E. Coli			0		CFU/100mL		1	29-SEP-21
EC-WT	**Water**							
Batch R5605452								
WG3628224-4 DUP		**WG3628224-3**						
Conductivity		319	318		umhos/cm	0.3	10	30-SEP-21
WG3628224-2 LCS								
Conductivity			96.0		%		90-110	30-SEP-21
WG3628224-1 MB								
Conductivity			<1.0		umhos/cm		1	30-SEP-21
F-IC-N-WT	**Water**							
Batch R5607207								
WG3629471-4 DUP		**WG3629471-3**						
Fluoride (F)		0.056	0.056		mg/L	0.2	20	01-OCT-21
WG3629471-2 LCS								
Fluoride (F)			102.0		%		90-110	01-OCT-21
WG3629471-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	01-OCT-21
WG3629471-5 MS		**WG3629471-3**						

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Kourosh Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F-IC-N-WT	**Water**							
Batch R5607207								
WG3629471-5 MS		**WG3629471-3**						
Fluoride (F)			98.6		%		75-125	01-OCT-21
MET-D-CCMS-WT	**Water**							
Batch R5607058								
WG3629897-4 DUP		**WG3629897-3**						
Aluminum (Al)-Dissolved		<0.050	<0.050	RPD-NA	mg/L	N/A	20	01-OCT-21
Antimony (Sb)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	01-OCT-21
Arsenic (As)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	01-OCT-21
Barium (Ba)-Dissolved		0.115	0.120		mg/L	4.2	20	01-OCT-21
Beryllium (Be)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	01-OCT-21
Bismuth (Bi)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	01-OCT-21
Boron (B)-Dissolved		<0.10	<0.10	RPD-NA	mg/L	N/A	20	01-OCT-21
Cadmium (Cd)-Dissolved		0.000480	0.000474		mg/L	1.3	20	01-OCT-21
Calcium (Ca)-Dissolved		135	128		mg/L	5.6	20	01-OCT-21
Chromium (Cr)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	01-OCT-21
Cobalt (Co)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	01-OCT-21
Copper (Cu)-Dissolved		<0.0020	<0.0020	RPD-NA	mg/L	N/A	20	01-OCT-21
Iron (Fe)-Dissolved		<0.10	<0.10	RPD-NA	mg/L	N/A	20	01-OCT-21
Lead (Pb)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	01-OCT-21
Magnesium (Mg)-Dissolved		27.1	29.4		mg/L	8.0	20	01-OCT-21
Manganese (Mn)-Dissolved		0.0097	0.0104		mg/L	7.5	20	01-OCT-21
Molybdenum (Mo)-Dissolved		0.00135	0.00149		mg/L	9.8	20	01-OCT-21
Nickel (Ni)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	01-OCT-21
Phosphorus (P)-Dissolved		<0.50	<0.50	RPD-NA	mg/L	N/A	20	01-OCT-21
Potassium (K)-Dissolved		3.84	3.95		mg/L	2.7	20	01-OCT-21
Selenium (Se)-Dissolved		0.00164	0.00175		mg/L	6.5	20	01-OCT-21
Silicon (Si)-Dissolved		4.48	4.61		mg/L	2.9	20	01-OCT-21
Silver (Ag)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	01-OCT-21
Sodium (Na)-Dissolved		378	398		mg/L	5.2	20	01-OCT-21
Strontium (Sr)-Dissolved		0.646	0.622		mg/L	3.8	20	01-OCT-21
Sulfur (S)-Dissolved		15.5	16.2		mg/L	4.2	20	01-OCT-21
Thallium (Tl)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	01-OCT-21
Tin (Sn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	01-OCT-21

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Kourosh Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R5607058								
WG3629897-4 DUP		**WG3629897-3**						
Titanium (Ti)-Dissolved		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	01-OCT-21
Tungsten (W)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	01-OCT-21
Uranium (U)-Dissolved		0.00114	0.00112		mg/L	1.5	20	01-OCT-21
Vanadium (V)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	01-OCT-21
Zinc (Zn)-Dissolved		0.078	0.083		mg/L	6.4	20	01-OCT-21
Zirconium (Zr)-Dissolved		<0.0020	<0.0020	RPD-NA	mg/L	N/A	20	01-OCT-21
WG3629897-2 LCS								
Aluminum (Al)-Dissolved			94.7		%		80-120	01-OCT-21
Antimony (Sb)-Dissolved			91.5		%		80-120	01-OCT-21
Arsenic (As)-Dissolved			95.0		%		80-120	01-OCT-21
Barium (Ba)-Dissolved			98.4		%		80-120	01-OCT-21
Beryllium (Be)-Dissolved			95.6		%		80-120	01-OCT-21
Bismuth (Bi)-Dissolved			95.7		%		80-120	01-OCT-21
Boron (B)-Dissolved			91.3		%		80-120	01-OCT-21
Cadmium (Cd)-Dissolved			95.1		%		80-120	01-OCT-21
Calcium (Ca)-Dissolved			94.9		%		80-120	01-OCT-21
Chromium (Cr)-Dissolved			92.6		%		80-120	01-OCT-21
Cobalt (Co)-Dissolved			93.0		%		80-120	01-OCT-21
Copper (Cu)-Dissolved			92.3		%		80-120	01-OCT-21
Iron (Fe)-Dissolved			92.2		%		80-120	01-OCT-21
Lead (Pb)-Dissolved			93.8		%		80-120	01-OCT-21
Magnesium (Mg)-Dissolved			100.9		%		80-120	01-OCT-21
Manganese (Mn)-Dissolved			92.3		%		80-120	01-OCT-21
Molybdenum (Mo)-Dissolved			94.2		%		80-120	01-OCT-21
Nickel (Ni)-Dissolved			92.9		%		80-120	01-OCT-21
Phosphorus (P)-Dissolved			95.8		%		80-120	01-OCT-21
Potassium (K)-Dissolved			90.0		%		80-120	01-OCT-21
Selenium (Se)-Dissolved			95.4		%		80-120	01-OCT-21
Silicon (Si)-Dissolved			89.3		%		60-140	01-OCT-21
Silver (Ag)-Dissolved			90.5		%		80-120	01-OCT-21
Sodium (Na)-Dissolved			99.2		%		80-120	01-OCT-21
Strontium (Sr)-Dissolved			96.2		%		80-120	01-OCT-21
Sulfur (S)-Dissolved			95.2		%		80-120	01-OCT-21

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Kourosh Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R5607058								
WG3629897-2 LCS								
Thallium (Tl)-Dissolved			95.1		%		80-120	01-OCT-21
Tin (Sn)-Dissolved			90.7		%		80-120	01-OCT-21
Titanium (Ti)-Dissolved			90.4		%		80-120	01-OCT-21
Tungsten (W)-Dissolved			91.7		%		80-120	01-OCT-21
Uranium (U)-Dissolved			90.2		%		80-120	01-OCT-21
Vanadium (V)-Dissolved			94.6		%		80-120	01-OCT-21
Zinc (Zn)-Dissolved			94.7		%		80-120	01-OCT-21
Zirconium (Zr)-Dissolved			91.4		%		80-120	01-OCT-21
WG3629897-1 MB								
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	01-OCT-21
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	01-OCT-21
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	01-OCT-21
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	01-OCT-21
Beryllium (Be)-Dissolved			<0.00010		mg/L		0.0001	01-OCT-21
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	01-OCT-21
Boron (B)-Dissolved			<0.010		mg/L		0.01	01-OCT-21
Cadmium (Cd)-Dissolved			<0.000005C		mg/L		0.000005	01-OCT-21
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	01-OCT-21
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	01-OCT-21
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	01-OCT-21
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	01-OCT-21
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	01-OCT-21
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	01-OCT-21
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	01-OCT-21
Manganese (Mn)-Dissolved			<0.00050		mg/L		0.0005	01-OCT-21
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	01-OCT-21
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	01-OCT-21
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	01-OCT-21
Potassium (K)-Dissolved			<0.050		mg/L		0.05	01-OCT-21
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	01-OCT-21
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	01-OCT-21
Silver (Ag)-Dissolved			<0.000050		mg/L		0.00005	01-OCT-21
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	01-OCT-21
Strontium (Sr)-Dissolved			<0.0010		mg/L		0.001	01-OCT-21

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Kourosh Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R5607058								
WG3629897-1 MB								
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	01-OCT-21
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	01-OCT-21
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	01-OCT-21
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	01-OCT-21
Tungsten (W)-Dissolved			<0.00010		mg/L		0.0001	01-OCT-21
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	01-OCT-21
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	01-OCT-21
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	01-OCT-21
Zirconium (Zr)-Dissolved			<0.00020		mg/L		0.0002	01-OCT-21
WG3629897-5 MS		**WG3629897-6**						
Aluminum (Al)-Dissolved			88.8		%		70-130	01-OCT-21
Antimony (Sb)-Dissolved			89.8		%		70-130	01-OCT-21
Arsenic (As)-Dissolved			96.4		%		70-130	01-OCT-21
Barium (Ba)-Dissolved			N/A	MS-B	%		-	01-OCT-21
Beryllium (Be)-Dissolved			97.0		%		70-130	01-OCT-21
Bismuth (Bi)-Dissolved			90.7		%		70-130	01-OCT-21
Boron (B)-Dissolved			N/A	MS-B	%		-	01-OCT-21
Cadmium (Cd)-Dissolved			92.6		%		70-130	01-OCT-21
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	01-OCT-21
Chromium (Cr)-Dissolved			90.2		%		70-130	01-OCT-21
Cobalt (Co)-Dissolved			92.9		%		70-130	01-OCT-21
Copper (Cu)-Dissolved			76.0		%		70-130	01-OCT-21
Iron (Fe)-Dissolved			85.8		%		70-130	01-OCT-21
Lead (Pb)-Dissolved			89.0		%		70-130	01-OCT-21
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	01-OCT-21
Manganese (Mn)-Dissolved			78.7		%		70-130	01-OCT-21
Molybdenum (Mo)-Dissolved			85.2		%		70-130	01-OCT-21
Nickel (Ni)-Dissolved			90.1		%		70-130	01-OCT-21
Phosphorus (P)-Dissolved			101.9		%		70-130	01-OCT-21
Potassium (K)-Dissolved			N/A	MS-B	%		-	01-OCT-21
Selenium (Se)-Dissolved			93.2		%		70-130	01-OCT-21
Silicon (Si)-Dissolved			N/A	MS-B	%		-	01-OCT-21
Silver (Ag)-Dissolved			88.7		%		70-130	01-OCT-21
Sodium (Na)-Dissolved			N/A	MS-B	%		-	01-OCT-21

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Kourosh Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R5607058								
WG3629897-5 MS		**WG3629897-6**						
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	01-OCT-21
Sulfur (S)-Dissolved			N/A	MS-B	%		-	01-OCT-21
Thallium (Tl)-Dissolved			90.8		%		70-130	01-OCT-21
Tin (Sn)-Dissolved			91.7		%		70-130	01-OCT-21
Titanium (Ti)-Dissolved			93.5		%		70-130	01-OCT-21
Tungsten (W)-Dissolved			90.5		%		70-130	01-OCT-21
Uranium (U)-Dissolved			N/A	MS-B	%		-	01-OCT-21
Vanadium (V)-Dissolved			95.9		%		70-130	01-OCT-21
Zirconium (Zr)-Dissolved			92.3		%		70-130	01-OCT-21
NH3-F-WT	**Water**							
Batch R5608036								
WG3629516-3 DUP		**WG3629516-5**						
Ammonia, Total (as N)		40.4	40.0		mg/L	1.0	20	05-OCT-21
WG3629516-2 LCS								
Ammonia, Total (as N)			106.0		%		85-115	04-OCT-21
WG3629516-1 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	04-OCT-21
WG3629516-4 MS		**WG3629516-5**						
Ammonia, Total (as N)			N/A	MS-B	%		-	05-OCT-21
NO2-IC-WT	**Water**							
Batch R5607207								
WG3629471-4 DUP		**WG3629471-3**						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	20	01-OCT-21
WG3629471-2 LCS								
Nitrite (as N)			101.5		%		90-110	01-OCT-21
WG3629471-1 MB								
Nitrite (as N)			<0.010		mg/L		0.01	01-OCT-21
WG3629471-5 MS		**WG3629471-3**						
Nitrite (as N)			98.0		%		75-125	01-OCT-21
NO3-IC-WT	**Water**							
Batch R5607207								
WG3629471-4 DUP		**WG3629471-3**						
Nitrate (as N)		0.186	0.186		mg/L	0.0	20	01-OCT-21
WG3629471-2 LCS								
Nitrate (as N)			100.5		%		90-110	01-OCT-21
WG3629471-1 MB								

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Kourosh Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO3-IC-WT	**Water**							
Batch R5607207								
WG3629471-1 MB								
Nitrate (as N)			<0.020		mg/L		0.02	01-OCT-21
WG3629471-5 MS		**WG3629471-3**						
Nitrate (as N)			97.4		%		75-125	01-OCT-21
PH-WT	**Water**							
Batch R5605452								
WG3628224-4 DUP		**WG3628224-3**						
pH		7.75	7.67	J	pH units	0.08	0.2	30-SEP-21
WG3628224-2 LCS								
pH			7.01		pH units		6.9-7.1	30-SEP-21
PO4-DO-COL-WT	**Water**							
Batch R5605172								
WG3628180-3 DUP		**WG3628180-5**						
Orthophosphate-Dissolved (as P)		0.0073	0.0069		mg/L	6.0	20	30-SEP-21
WG3628180-2 LCS								
Orthophosphate-Dissolved (as P)			98.5		%		80-120	30-SEP-21
WG3628180-1 MB								
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	30-SEP-21
WG3628180-4 MS		**WG3628180-5**						
Orthophosphate-Dissolved (as P)			98.5		%		70-130	30-SEP-21
SO4-IC-N-WT	**Water**							
Batch R5607207								
WG3629471-4 DUP		**WG3629471-3**						
Sulfate (SO4)		13.0	13.0		mg/L	0.2	20	01-OCT-21
WG3629471-2 LCS								
Sulfate (SO4)			102.0		%		90-110	01-OCT-21
WG3629471-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	01-OCT-21
WG3629471-5 MS		**WG3629471-3**						
Sulfate (SO4)			98.9		%		75-125	01-OCT-21
SOLIDS-TDS-WT	**Water**							
Batch R5606921								
WG3629395-3 DUP		**L2645224-6**						
Total Dissolved Solids		2290	2250		mg/L	1.8	20	01-OCT-21
WG3629395-2 LCS								
Total Dissolved Solids			99.9		%		85-115	01-OCT-21
WG3629395-1 MB								

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Kourosh Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SOLIDS-TDS-WT	**Water**							
Batch R5606921								
WG3629395-1 MB								
Total Dissolved Solids			<10		mg/L		10	01-OCT-21
TC-MF-WT	**Water**							
Batch R5605352								
WG3627621-3 DUP		**L2644876-5**						
Total Coliforms		0	0		CFU/100mL	0.0	65	29-SEP-21
WG3627621-1 MB								
Total Coliforms			0		CFU/100mL		1	29-SEP-21
TURBIDITY-WT	**Water**							
Batch R5605915								
WG3628480-2 LCS								
Turbidity			102.0		%		85-115	30-SEP-21
WG3628480-1 MB								
Turbidity			<0.10		NTU		0.1	30-SEP-21

Quality Control Report

Workorder: L2644748 Report Date: 07-OCT-21

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Kourosh Mohammadi

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Workorder: L2644748 Report Date: 07-OCT-21

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Kourosh Mohammadi

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Organic / Inorganic Carbon							
Dissolved Organic Carbon							
	1	28-SEP-21 11:00	02-OCT-21 00:00	3	4	days	EHT

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2644748 were received on 28-SEP-21 14:28.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

L2644748-COFC

Chain of Custody (COC) / Analytical Request Form

COC Number: 20 - 898430

www

Canada Toll Free: 1 800 668 9878

Page of

Report To	Contact and company name below will appear on the final report
Company:	HLV2K Engineering Ltd
Contact:	Kourosh Mohammadi
Phone:	905-569-2765
Company address below will appear on the final report	
Street:	2179 Dunwin Dr Unit 4
City/Province:	Mississauga
Postal Code:	L5L 1X2

Invoice To		
	Same as Report To	☑ YES ☐ NO
	Copy of Invoice with Report	☑ YES ☐ NO
Company:		
Contact:		

Reports / Recipients	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Merge QC/QCI Reports with COA	☐ YES ☐ NO ☐ N/A
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	Kourosh.mohammadi@HLV2K.com
Email 2	
Email 3	

Invoice Recipients	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	21e0394AC
PO / AFE:	
LSD:	
ALS Lab Work Order # (ALS use only):	L2644748

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact: AO	Sampler:

Turnaround Time (TAT) Requested

- ☑ Routine [R] if received by 3pm M-F - no surcharges apply
- ☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
- ☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum
- ☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum
- ☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum
- ☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fees may apply to rush requests on weekends, statutory holidays and non-routine tests

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

For all tests with rush TATs requested, please contact your AM to confirm availability.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	BH6	28-9-21	11:00	GW	✓ Geochem			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

PWQOs (Provincial Water Quality Objectives)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☒ ICE ☒ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
7.5				7.5			

SHIPMENT RELEASE (client use)

Released by:	Date:	Time:

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by:	Date:	Time:
Karan	9/28/2021	14:28

FINAL SHIPMENT RECEPTION (ALS use only)

Received by:	Date:	Time:
W	09/28/21	17:0

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

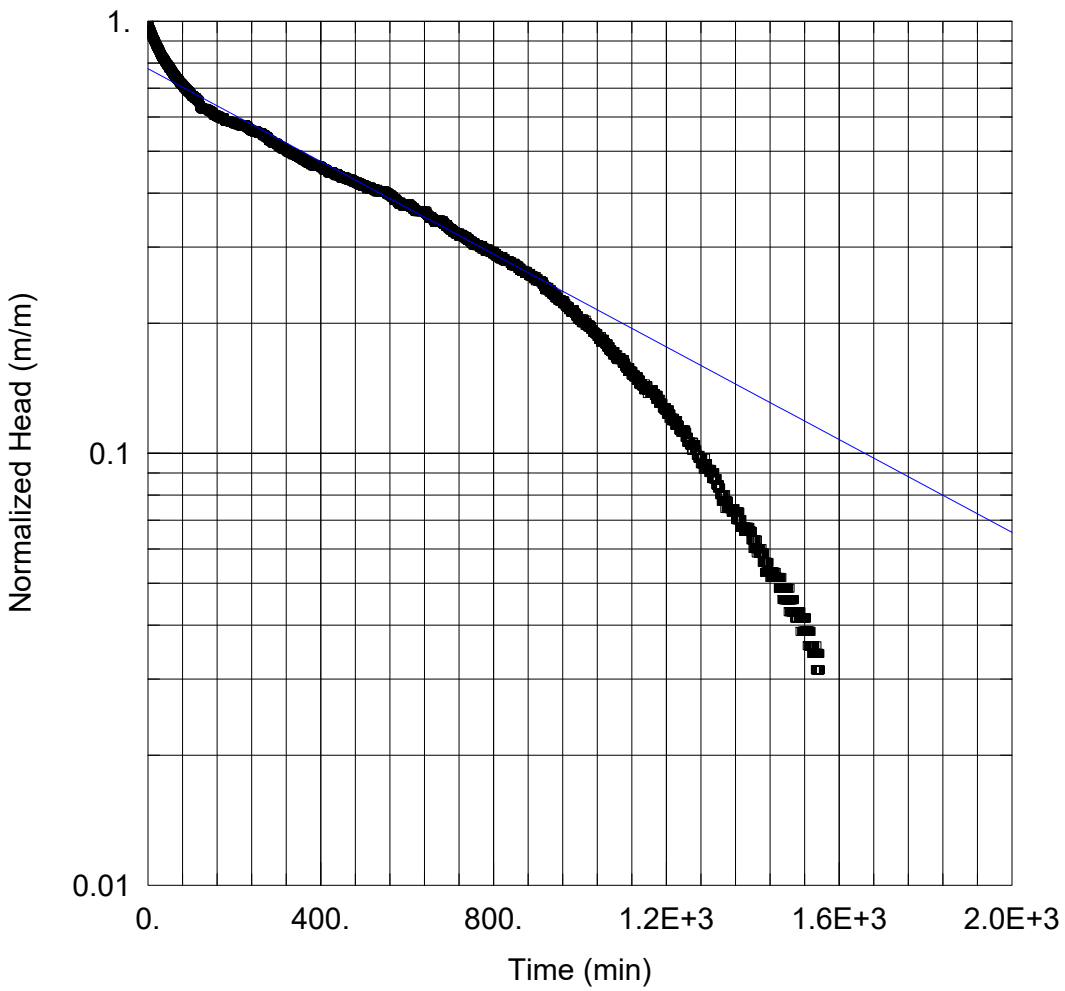
1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

APPENDIX C

In-Situ Hydraulic Conductivity Testing Results

In-Situ Hydraulic Conductivity Test (BH5)

Prepared By:	Prepared For:
HLV2K Engineering	SS Welland Inc.
Project:	**Location:**
2100394AG	Fort Erie, Ontario



SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 1.183E-6 cm/sec y0 = 0.5419 m

AQUIFER DATA

Saturated Thickness: 1.4 m Anisotropy Ratio (Kz/Kr): 1.

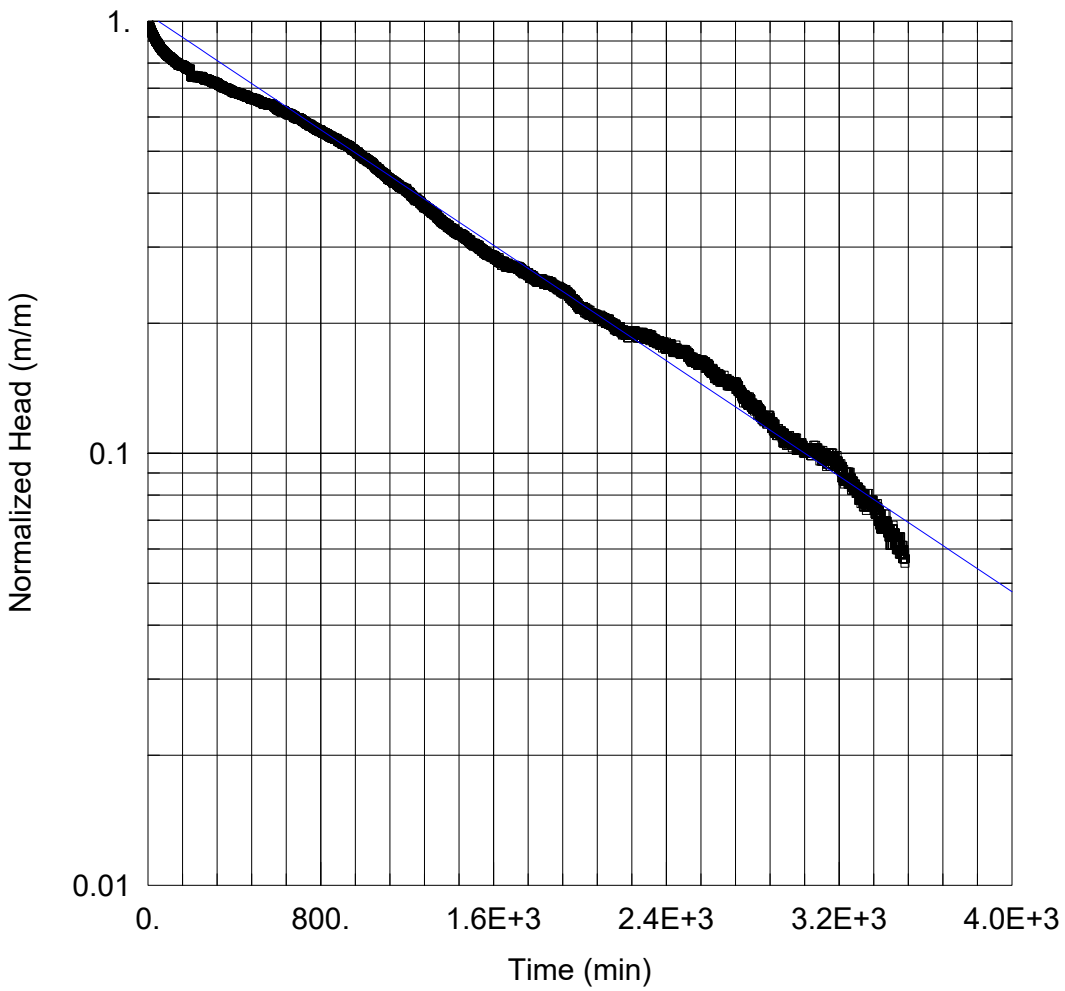
WELL DATA (BH5)

Initial Displacement: 0.698 m
Static Water Column Height: 4.24 m
Total Well Penetration Depth: 0.4 m
Screen Length: 0.4 m
Casing Radius: 0.025 m
Well Radius: 0.1 m

HLV2K ENGINEERING LIMITED

In-Situ Hydraulic Conductivity Test (BH6)

Prepared By:	Prepared For:
HLV2K Engineering	SS Welland Inc.
Project:	**Location:**
2100394AG	Fort Erie, Ontario



SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 7.339E-7 cm/sec y0 = 0.7463 m

AQUIFER DATA

Saturated Thickness: 1.5 m Anisotropy Ratio (Kz/Kr): 1.

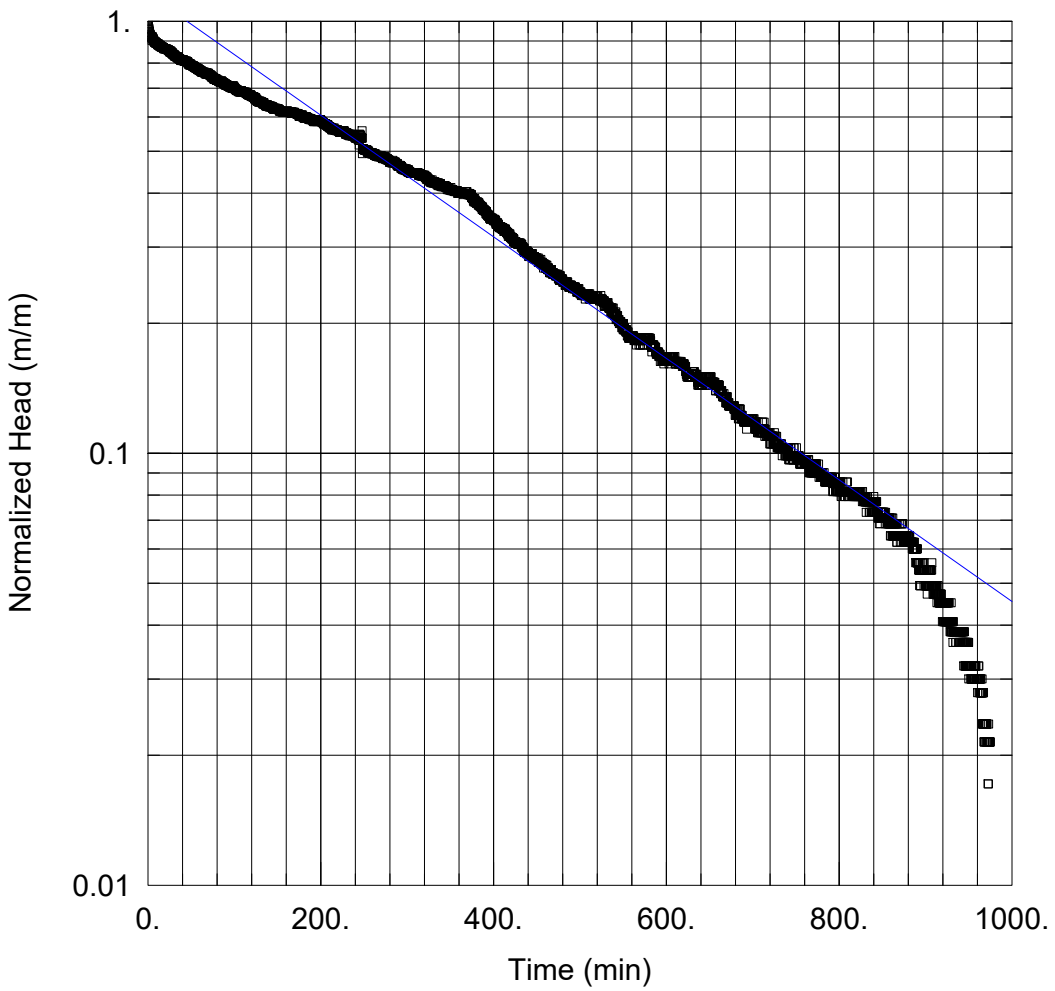
WELL DATA (BH6)

Initial Displacement: 0.719 m
Static Water Column Height: 4.54 m
Total Well Penetration Depth: 0.4 m
Screen Length: 0.4 m
Casing Radius: 0.025 m
Well Radius: 0.1 m

HLV2K ENGINEERING LIMITED

In-Situ Hydraulic Conductivity Test (BH7)

Prepared By:	Prepared For:
HLV2K Engineering	SS Welland Inc.
Project:	**Location:**
2100394AG	Fort Erie, Ontario



SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 2.185E-6 cm/sec y0 = 0.5395 m

AQUIFER DATA

Saturated Thickness: 1.46 m Anisotropy Ratio (Kz/Kr): 1.

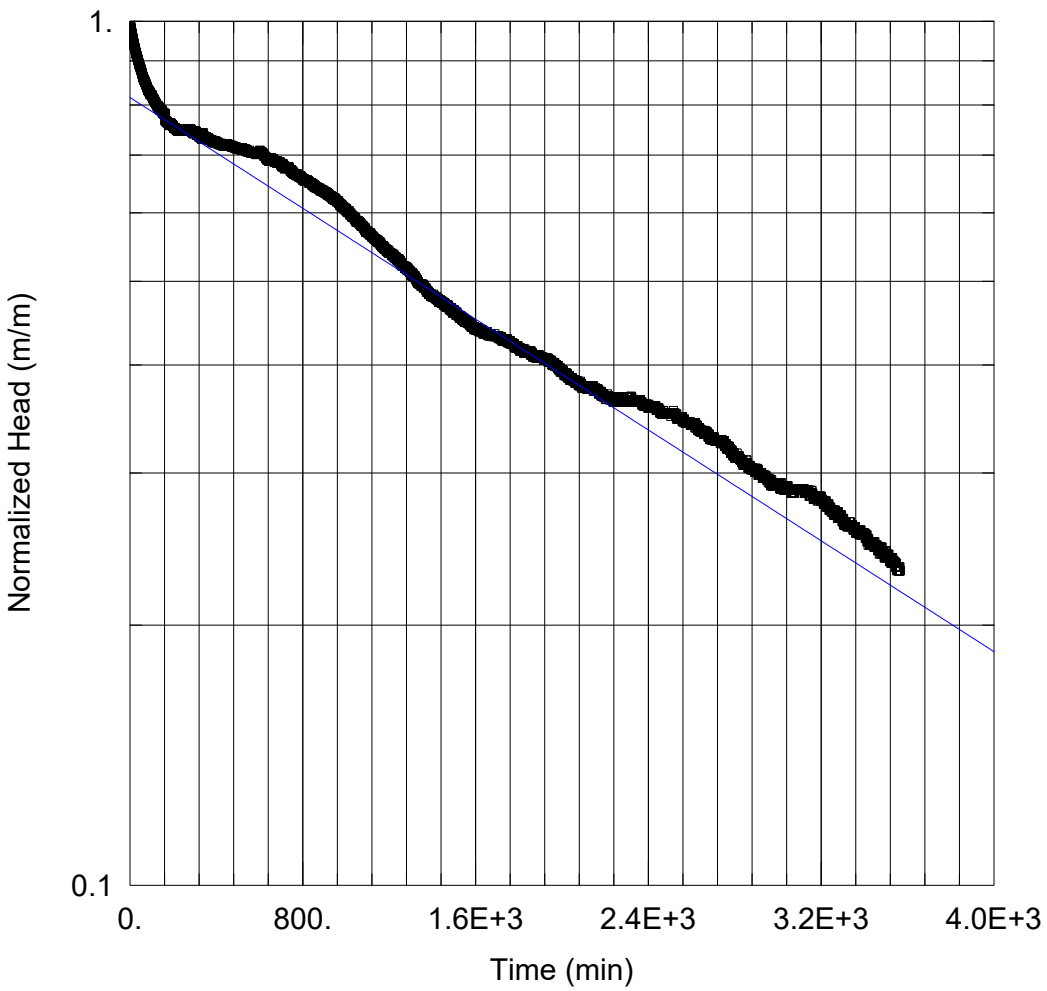
WELL DATA (BH7)

Initial Displacement: 0.466 m
Static Water Column Height: 3.04 m
Total Well Penetration Depth: 1.36 m
Screen Length: 1.36 m
Casing Radius: 0.025 m
Well Radius: 0.1 m

HLV2K ENGINEERING LIMITED

In-Situ Hydraulic Conductivity Test (BH11)

Prepared By:	Prepared For:
HLV2K Engineering	SS Welland Inc.
Project:	**Location:**
2100394AG	Fort Erie, Ontario



SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 2.455E-7 cm/sec y0 = 0.7092 m

AQUIFER DATA

Saturated Thickness: 1.5 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH11)

Initial Displacement: 0.869 m
Static Water Column Height: 4.91 m
Total Well Penetration Depth: 1.4 m
Screen Length: 1.4 m
Casing Radius: 0.025 m
Well Radius: 0.1 m

HLV2K ENGINEERING LIMITED

APPENDIX D

Information on Water Well Records

Water Well Record

WELL_ID	BOREHOLE ID	Easting	Northing	Well Depth (m)	Static Depth (m)	Bedrock Depth (m)	Date Completed	Final Status
6600144	10459878	668165	4750428	8.2	1.5	5.2	1967-06-28	Water Supply
6600145	10459879	667580	4750771	9.1		7.9	1946-07-10	Water Supply
6600275	10460009	668205	4751243	6.1	2.1	4.6	1961-07-10	Water Supply
6602994	10462616	668220	4751087	13.7	4.6	5.8	1974-08-17	Water Supply
6604421	10464018	667990	4750780	12.8	4.9	0.3	2000-03-20	Water Supply
7247315	1005653589	668182	4750534	4.6			2015-07-07	Observation Wells
7247316	1005653600	668117	4750475	4.3			2015-07-07	Observation Wells
7247317	1005653639	668193	4750512	4.3			2015-07-07	Observation Wells

Water Well Records

November 9, 2021

7:24:06 PM

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
FORT ERIE TOWN (BERT	17 668193 4750512 W	2015-07 7320	2 4	UT 0013		MT	0004 10	7247317 (Z214185) A187875	BRWN CLAY 0014 GREY ROCK
FORT ERIE TOWN (BERT	17 668117 4750475 W	2015-07 7320	2 4	UT 0013		MT	0004 10	7247316 (Z214186) A187874	BRWN CLAY 0014 GREY ROCK
FORT ERIE TOWN (BERT	17 668182 4750534 W	2015-07 7320	2 4	UT 0004		MT	0005 10	7247315 (Z214187) A187873	BRWN CLAY 0015 GREY ROCK
FORT ERIE TOWN (BERT CR	17 668220 4751087 W	1974-08 3661	6	FR 0044	15/30/5/2:0	DO		6602994 ()	BRWN CLAY 0019 GREY LMSN 0045
FORT ERIE TOWN (BERT CR	17 668661 4751703 W	1974-06 3640	6 6	UK 0024	5/15/5/1:0	DO		6602964 ()	BRWN LOAM 0001 BRWN CLAY 0010 GREY CLAY 0013 GREY LMSN 0025
FORT ERIE TOWN (BERT CR	17 668205 4751243 W	1961-07 5425	6 6	FR 0018	7/17/4/0:30	DO		6600275 ()	BRWN CLAY 0015 LMSN 0020
FORT ERIE TOWN (BERT CR	17 668165 4750428 W	1967-06 4720	6 6	FR 0027	5/15/20/1:0	DO		6600144 ()	BLUE CLAY 0017 LMSN 0027
FORT ERIE TOWN (BERT CR	17 668694 4751377 W	1957-07 5425	6 6	FR 0023	10/48/2/:	DO		6600032 ()	LOAM 0001 BRWN CLAY 0014 LMSN 0048
FORT ERIE TOWN (BERT LEF 02 001	17 667990 4750780 L	2000-03 4795	5 5	FR 0040	16/16/21/1:30	DO		6604421 (211395)	BLCK LOAM PCKD 0001 GREY SHLE LYRD 0016 GREY LMSN LYRD 0042
FORT ERIE TOWN (BERT LEF 02 002	17 667580 4750771 L	1946-07 4629	6	SU 0018	///:	DO		6600146 ()	LOAM 0024 LMSN 0030
FORT ERIE TOWN (BERT LEF 02 002	17 667580 4750771 L	1946-07 4629	6 6	FR 0010	///:	DO		6600145 ()	LOAM 0026 LMSN 0030
FORT ERIE TOWN (BERT LEF 03 001	17 668139 4751669 W	2015-06 7295	1.29			MO	0015 5	7244895 (Z204805) A179624	GREY GRVL GREY CLAY

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDYOAPSTONE		

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Well Use

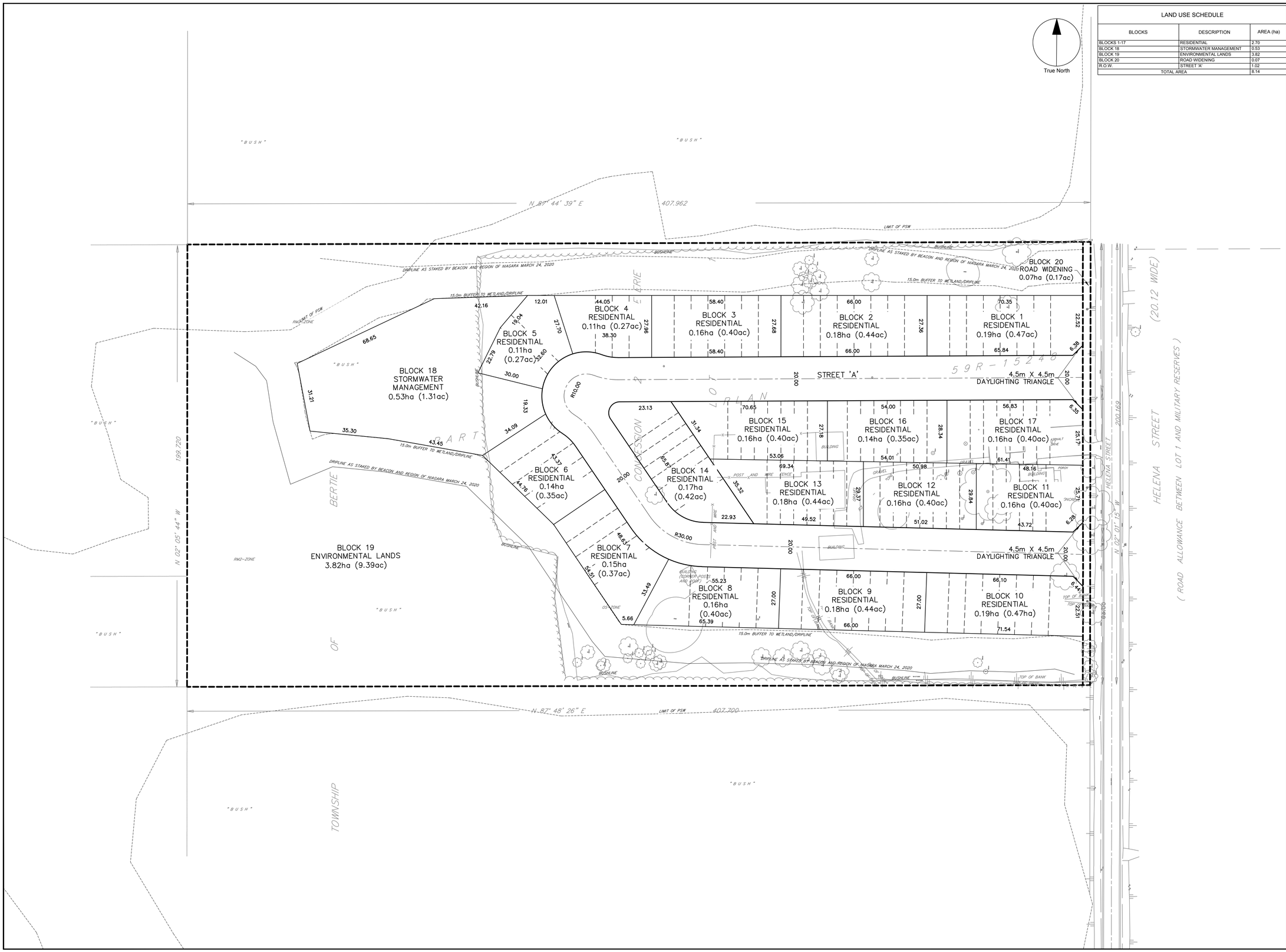
Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

APPENDIX E

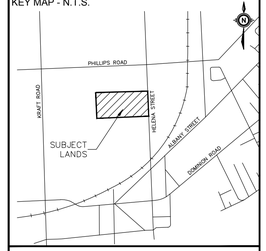
Drawing Provided by the Client



DRAFT PLAN OF SUBDIVISION 613 HELENA STREET

PART OF LOT 1, CONCESSION 2,
LAKE ERIE TOWNSHIP OF BERTIE
IN THE TOWN OF FORT ERIE
REGIONAL MUNICIPALITY OF NIAGARA

KEY MAP - N.T.S.



INFORMATION REQUIRED

UNDER SECTION 51 (17) OF THE PLANNING ACT, R.S.O. 1990. c.P.13 AS AMENDED
(a) - AS SHOWN
(b) - AS SHOWN
(c) - AS SHOWN
(d) - RESIDENTIAL
(e) - AS SHOWN
(f) - AS SHOWN
(g) - AS SHOWN
(h) - MUNICIPAL (PUBLIC)
(i) - SILTY CLAY
(j) - AS SHOWN
(k) - ALL SERVICES TO BE MADE AVAILABLE
(l) - AS SHOWN

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

SIGNED _____
PHILIP S. SUDA, O.L.S.
SUDA & MALESZYK SURVEYING INC.

DATE _____

OWNER'S CERTIFICATE

I HEREBY CONSENT TO THE FILING OF THIS PLAN BY IBI GROUP, IN DRAFT FORM.

SIGNED _____
MARIO BEVACQUA
1891187 ONTARIO INC.

DATE _____

#	DATE	BY	DESCRIPTION
1			

DRAWING ISSUE RECORD

APPROVALS

IBI GROUP
Suite 200 - 360 James Street North
Hamilton ON L8L 1H5 Canada
tel 905 546 1010 fax 905 546 1011
ibigroup.com

BENCHMARK

SCALE 10 5 0 10 20 30
1:750 (m)

PROJECT NO: 131951

DRAWN BY:	CHECKED BY:
T. NGUYEN	T. TUCKER
PROJECT MGR:	APPROVED BY:
T.TUCKER	

SHEET TITLE
DRAFT PLAN OF SUBDIVISION

SHEET NUMBER	ISSUE
DP 1.0	1

SCALE CHECK 10mm 1 in

File Location: J:\131951_613_Helen\7.0_Production\7.01_Sent-Received\Sent\Client\2021-04-08 - Draft Plan\131951DP 2021-04-08.dwg Last Saved: April 8, 2021, by Tracy Tucker Plotted: Thursday, April 8, 2021 10:39:00 AM by Tracy Tucker

WATER BALANCE ANALYSIS
PROPOSED RESIDENTIAL DEVELOPMENT

613 Helena Street, Fort Erie, Ontario

Prepared for:

SS WELLAND INC.

4080 Confederation Parkway, Unit 701
Mississauga, ON L5B 0G1

Prepared by:

HLV2K ENGINEERING LIMITED
A Consulting Engineers Company

2179 Dunwin Drive, Unit 4
Mississauga, Ontario L5L 1X2

Project No. 2100394AG

February 17, 2022

HLV2K ENGINEERING LIMITED
A Consulting Engineers Company

February 17, 2022 Reference No.: 2100394AG

SS Welland Inc.
4080 Confederation Parkway, Unit 701
Mississauga, ON L5B 0G1
L5B 0G1

Attention: Mr. Hunain Siddiqui
Email: hunain@emrahomes.ca

RE: Hydrogeological Consulting Services for Proposed Development
613 Helena Street, Fort Erie, Ontario

Dear Mr. Siddiqui,

HLV2K Engineering Limited (HLV2K) is pleased to provide the Water Balance Analysis Report for the above-mentioned project. We trust that this information meets your present requirements. If we can be of additional assistance in this regard, please contact this office.

For and on behalf of HLV2K Engineering Limited,

k. Mohamadi

Kourosh Mohammadi, Ph.D., P.Eng.

President and Principal Hydrogeological Engineer

TABLE OF CONTENT

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

HLV2K Engineering Limited (HLV2K) was retained by SS Welland Inc. (the Client) to complete a water balance assessment to evaluate the recharge rate for pre- and post-development conditions at the project site located at 613 Helena Street in Fort Erie, Ontario (the Site). The Site considered for development is approximately 8.15 hectares (ha) in area and is currently occupied by a two-storey residential dwelling and associated garage, a two-storey barn and two storage buildings (The site buildings covered approximately 15% of the total Site area). The western portion of the Site is occupied by a forested area. The Site location is shown on **Figure 1**. This report is intended to provide the water balance analysis for pre and post proposed development.

The proposed development would consist of seventeen blocks (17) blocks including 54 2-storey townhouses, 62 bungalow townhouses, storm pond, landscape, roads and walkways. Draft plan of subdivision shows the location of these blocks and features provided in **Appendix A**.

2 WATER BALANCE

When precipitation (P) occurs, it can either run off (R) through the surface water system, infiltrate (I) to the water table, or evapotranspire (ET) from the earth's surface and vegetation. The sum of R and I is defined as the water surplus (S). When long-term averages of P, R, I, and ET are used, there is no net change in groundwater storage (ST). On a yearly basis, however, there is a potential for small changes in ST.

The annual water budget can be stated as,

$$P = ET + R + I + ST$$

The monthly averages of P and temperature (T) were collected from Environment Canada data. Based on the physiographic setting and proximity to weather stations, the Fort Erie Station (Station ID 6132470) located approximately 2.2 km southwest of the Site chosen as the most representative precipitation and temperature data

Climate Normals are arithmetic calculations of observed climate values over a specified time period and are used to describe the climatic characteristics of a location. Real-time values, such as daily temperature, may be compared to the "climate normal" to compare departures from the "average". The Canadian Climate Normals are calculated based on World Meteorological Organization (WMO) Standards. The WMO considers 30 years sufficient to eliminate year-to-year variations. The most recently published 30-year period from Environment Canada is January 1981 to December 2010.

In addition, the WMO established that normals should be arithmetic means calculated for each month of the year from daily data. To qualify, temperature data, soil temperatures and evaporation must fit the following rule: "If more than 3 consecutive daily values are missing or more than 5 daily values in total in a given month are missing, the monthly mean should not be computed and the year-month mean should be considered missing." This is referred to as the "3/5" rule. For total precipitation, degree-days, and "days with" calculations, no missing days are allowed.

2.1 Thornthwaite Monthly Water-Balance Model

The Thornthwaite water balance (Thornthwaite, 1948; Mather, 1978; 1979) uses an accounting type procedure to analyze the allocation of water among various components of the hydrologic cycle. Inputs to the model are monthly temperature, precipitation and the site latitude. Outputs include monthly potential and actual evapotranspiration, soil moisture storage, soil moisture storage change, surplus, and runoff. For ease of calculation, an Excel spreadsheet was developed. This water balance was prepared according to the "Hydrogeological Assessment Submissions: Conservation Authority Guidelines to Support Development Application (2013).

2.2 Pre-Construction Water Balance

To predict water balance elements the 30-year average weather data was used. The detailed calculations are presented in below sections.

Precipitation (P)

Based on the 30-year average (1981-2010) for the Fort Erie meteorological station, the average precipitation is about 1051.5 mm/year. The monthly precipitation distribution is presented in **Table B.1** of **Appendix B**.

Storage (ST)

Long-term annual change in storage is 0, although there is some variation on a monthly basis. It should be noted that for the topography, soil conditions (silty sand till to sandy silt till) and vegetative cover (moderate to deep rooted crops), the maximum soil moisture storage was estimated at about 250 mm according to Table 3.1 of MECP Stormwater Management Planning and Design Manual (2003).

Evapotranspiration

Calculated potential evapotranspiration (PET) based on the Thornthwaite monthly water balance model is about 607 mm/year, or about 58% of the total precipitation. The actual evapotranspiration is calculated based on a potential evapotranspiration (PET) and soil-moisture-storage withdrawal (SMW). PET is estimated from monthly temperature and is defined as a water loss from a homogeneous, vegetation covered area that never lacks water (Thornthwaite, 1948; Mather, 1978). In Thornthwaite water balance, PET is calculated using Thornthwaite Method (Ponce, 1989). The method is based on an annual temperature efficiency index J, defined as the sum of 12 monthly values of heat index I. Each index I is a function of the mean monthly temperature T, in degrees Celsius, as follows:

$$I = \left(\frac{T}{5}\right)^{1.514}$$

Evapotranspiration is calculated by the following formula:

$$PET(0) = 1.6\left(\frac{10T}{J}\right)^{c}$$

in which PET(0) is the potential evapotranspiration at 0° latitude in centimeters per month; and c is an exponent to be evaluated as follows:

$$c = 0.000000675J^3 - 0.0000771J^2 + 0.01792J + 0.49239$$

At the latitude other than 0° potential evapotranspiration is calculated by

$$PET = K\,PET(0)$$

in which K is a constant for each month of the year, varying as a function of latitude. The latitude for Fort Erie station is 42° 53' and values of K are provided in **Table B.2** in **Appendix B**.

Water Surplus

The overall pre-construction water surplus for study area is estimated at 445 mm/year. Water surplus (S) has two components in Thornthwaite model: a runoff component, which is the overland flow component that occurs when soil moisture capacity is exceeded; and, an infiltration component. Using the MECP SWM manual (MECP, 2003) for guidance, it is estimated that about 50% of the water surplus (222.5 mm/year) infiltrates and the remaining 50% (222.5 mm/year) runs off either directly or as interflow. The details calculation is presented in **Table B.2** in **Appendix B**.

Annual Water Balance

The summary of annual water balance assessment for the pre-construction condition is provided in **Table B.3** in **Appendix B**.

2.3 Post-Construction Water Balance without LID

Based on the proposed Draft Plan provided by the Client (**Appendix A**), **Table 1** below shows a summary of post (proposed) construction land statistics.

Table 1: Post-Construction (Proposed) Land Statistics

Item	Area (m^2)
Total Area	81,500
Paved municipal roadways	10,500
Sidewalks	1,000
Townhouse driveways	2,700
Roofs	9,450
Soft landscaped lot lawns, Boulevards, Park, woodland, Open space, and (excluding SWM Pond)	56250
SWM Pond (30% of Block 18)	8,580

To predict water balance elements, the 30-year average weather data was used. Based on the provided development information, it is our understanding that about 30% of the post construction surface will be considered impervious. Additionally, the Conservation Authority guidelines suggest infiltration will be lowered by 10% (a factor of 0.1) because of site grading and compaction of the soil due to construction

work. However, the soil compaction issue might be resolved by increasing the topsoil depth to 300 mm. **Table B.4** in **Appendix B** presents the components of post construction water balance.

Precipitation (P)

Precipitation remains the same, the 30-year average (1981-2010) for the Fort Erie meteorological station (1051.5 mm/year) was used.

Storage (ST)

Long-term change in storage is 0. It should be noted that compared to pre-construction, there is a change in the distribution and magnitude of monthly soil moisture storage. It is assumed that development of the land will result in reduced grades that, with the same soil conditions (clayey silt to sandy silt till) and changed vegetative cover (shallow rooted lawns and gardens), will reduce the maximum soil moisture storage to 125 mm.

Evapotranspiration

In post construction, it was assumed that the increased impervious area would result in an additional 20% in potential evaporation from the areas covered with hard surfaces. The total water lost to evaporation increases, but the PET for pervious areas, calculated at 607 mm/year, remains about the same.

Water Surplus

The post-construction water surplus for the entire Site is calculated to be about 1,286 mm/year. Of this, about 707 mm/year will be converted to runoff on impervious areas and 579 mm/year will be available for infiltration or runoff on pervious areas in post-development condition. This exceeds the infiltration potential for the surficial soils, thus a component of the available infiltration water will also run off.

The results of the post construction water balance calculation suggest that there is enough water to maintain recharge, as there is a positive surplus (S) in the post construction scenario.

The major change between the pre- and post-construction water balance is that in the pre-construction setting, most of the water surplus is carried off the site as interflow and infiltration, whereas in the post construction setting, there is more interflow and overland flow. **Table B.5** in **Appendix B** shows that the volume of runoff will be increased from 25,551 m^3/year in pre-development to 32,287 m^3/year. The post-development infiltration volume is approximately 13,761 m^3/year which is almost 89% of the pre-development, if no mitigation measure is implemented and 30% of the site surface is converted to impervious surface.

2.4 Post-Construction Water Balance with LID

To assess the potential impacts of the proposed development on groundwater resources, the draft development plan was reviewed.

Table B.6 in **Appendix B** presents the overall post construction water balance with mitigation measures.

Post development infiltration and runoff rates will be affected by the presence of impervious surfaces (i.e. building/garage rooftops, asphalt driveways and road), which based on the proposed development plan will comprise approximately 30% of the development property. The results of the post-construction water balance assessment without LID measures (**Table B.5** in **Appendix B**) show that there will be enough water to infiltrate in the pervious areas to increase the infiltration rate and reduce the runoff in post-

construction development. Techniques to maximize the water availability in pervious areas such as designing grades to direct roof runoff towards lawns, side and rear yard swales, and other pervious areas throughout the development where possible can considerably increase the volume of infiltration in developed areas. Increasing the topsoil thickness by about two times the normal thickness is also considered as beneficial to enhance storage of water in the topsoil and increase the potential for infiltration. Other mitigation techniques that can be considered to mitigate increases in runoff and reductions in infiltration include such measures as subsurface infiltration trenches, permeable pavements, rain gardens, bioswales, galleries and pervious pipe systems. Surface methods should only be considered in areas where there is sufficient depth to water table to accommodate the systems within the unsaturated zone and sufficient soil hydraulic conductivity to function effectively. The MECP manual recommends that subsurface galleries or trenches should be about 1 m above the high water table.

The proposed LID measures for the Site would be the disconnected roof leaders to convey the rainwater from roofs to the permeable areas around the residential houses and increase the chance of infiltration.

It was considered that LID measures would be designed to infiltrate the 25 mm storm event or less which accounts for approximately 90% of precipitation. The estimated infiltration rate for the roof rainfall, then, calculated based on the followings:

- 20% of the rainfall on impervious surface (roofs) was assumed to be evaporated. It means there is 80% or 841 mm surplus.
- 90% of the rainfall event is 25 mm or less. Only 90% of the surplus was considered for infiltration (757.1 mm).
- The estimated infiltration rate on pervious areas is 45% in post-construction condition (MECP Guideline, 2003). The total infiltration rate from roof rains would be 341 mm or 32.4% of the precipitation.

Natural infiltration that occurs on pervious surfaces along with the proposed mitigative measures exceed the pre-development infiltration volume by approximately 1,524 m^3/year. The runoff volume also exceeds the pre-development runoff volume by approximately 3,728 m^3/year.

In this condition, the total infiltration volume will be 16,980 m^3/year and total runoff volume in the post-construction will be changed to 29,279 m^3/year. **Table 2** below summarizes the post-construction water balance for reducing the runoff and increasing infiltration using LID measures.

Table 2: Post -Construction Water Balance Summary

Parameter	Value
Average Annual Rainfall (mm)	1,051.5
Pre- Development Infiltration (m^3/year)	15,457
Post-Development Infiltration without Mitigation (m^3/year)	13,761
Post-Development Infiltration with Mitigation (m^3/year)	16,980
Pre- and Post-Development Infiltration Differential (%)	+10%

3 IMPACT ASSESSMENT

To assess the potential impacts of the proposed development on groundwater resources, the draft development plan was reviewed. From a hydrogeological perspective, the following changes will occur as a result of the proposed development.

- The subject site is characteristically homogeneous with respect to soil types at ground surface. There is a shallow overburden with approximate thickness of 5 to 6 m above bedrock.
- The development will create new hard surfaces over a portion of the site, increasing the impervious area. The amount of impervious areas is estimated to be about 30%.
- As a result of the increase in impervious area, the overall infiltration will decrease and the amount of overland flow runoff will increase, particularly during storm events. Runoff will be managed using conventional storm water management techniques or Low Impact Development (LID) that include storm water management (SWM) facilities.
- With the inevitable changes in impervious areas and potential changes to groundwater quality and quantity, best management practices (BMPs) that promote groundwater infiltration/recharge for the purpose of trying to establish post-development infiltration at pre-development levels makes a significant contribution to mitigate the effects of development. Some of the recommended practices includes:
  - Disconnected roof leaders to convey the rainwater from roofs to the permeable areas around the residential houses and increase the chance of infiltration. The discharge of residential roof drainage to unpaved parts of the lots and grass areas for natural infiltration can be an effective means of helping to balance pre to post development infiltration deficit. Using the roof-tops rainwater can also preserve the groundwater quality. The location of these facilities and the function/operation are addressed by others.
- Although, the increase in impervious area can potentially result in a slight lowering of shallow groundwater levels, maintaining infiltration at levels similar to existing conditions will result water levels within the current range of seasonal fluctuations. No change in the overall flow direction is expected. However, in localized areas some temporary lowering of the water table may be needed to facilitate construction below the water table, if required.
- The contribution of groundwater can be an important factor in the overall health of aquatic systems. Implementing mitigation measures to reduce the infiltration deficit will assist in maintaining the current level of groundwater contribution to the surface water features. As such, no negative impact is expected if LID measures are implemented to maintain the groundwater recharge similar to the existing conditions.

4 STATEMENT OF LIMITATIONS

The contents of this report are subject to the attached '***Statement of Limitation***' sheet. The reader's attention is specifically drawn to these conditions as it is considered essential that they be followed for proper use and interpretation of this report. The Statement of Limitations is not intended to reduce the level of responsibility accepted by Orbit, but rather to ensure that all parties who have been given reliance for this report are aware of the responsibilities each assumes in so doing.

This report was prepared by HLV2K exclusively for the account of SS Welland Inc. (the CLIENT). Other than by the CLIENT, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, or decision made by any person other than CLIENT based on this report is the sole responsibility of such other person. The CLIENT and Orbit make no representation or warranty to any other person with regard to this report and the work referred to in this report and the CLIENT and Orbit accept no duty of care to any other person or any liability or responsibility whatsoever for any losses, expenses, damages, fines, penalties or other harm that may be suffered or incurred by any other person as a result of the use of, reliance on, any decision made or any action taken based on this report or the work referred to in this report.

5 CLOSURE

We trust that this information is satisfactory for your present requirements. Should you have any questions or require additional information, please do not hesitate to contact this office.

For and Behalf of HLV2K Engineering Limited

k. Mohamadi

Kourosh Mohammadi, PhD., P.Eng.

Principal Hydrogeological Engineer and Groundwater Modeller

REFERENCES

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Mather, J. R., 1978. The Climatic Water Budget in Environmental Analysis. Lexington, Mass.: Lexington Books.

MECP (2003). Stormwater Management Planning and Design Manual, Ontario Ministry of Environment, 379p.

HLV2K Engineering Limited

STATEMENT OF LIMITATIONS

Your report has been developed based on your unique project specific requirements as understood by HLV2K Engineering Limited (HLV2K) and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking HLV2K to assess how factors that changed subsequent to the date of the report affect the report's recommendations. HLV2K cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions, which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult HLV2K to be advised how time may have impacted on the project.

The findings derived from this investigation were based on information collected and/or provided by the Client. It may become apparent that soil and groundwater conditions differ between and beyond the testing locations examined during future investigations or other work that could not be detected or anticipated at the time of this study. As such, HLV2K cannot be held liable for environmental conditions that were not apparent from the available information. The conclusions presented represent the best judgment of the assessors based on limited investigations.

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature, external data source review, sampling, and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions, which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of HLV2K through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report is based on the assumption that he site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only HLV2K, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and HLV2K cannot be held responsible for such misinterpretation.

To avoid misuse of the information contained in your report it is recommended that you confer with HLV2K before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

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Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain HLV2K to work with other project design professionals who are affected by the report. Have HLV2K explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment.

Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact HLV2K for information relating to geoenvironmental issues.

HLV2K is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with HLV2K to develop alternative approaches to problems that may be of genuine benefit both in time and in cost.

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from HLV2K to other parties but are included to identify where HLV2K's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from HLV2K closely and do not hesitate to ask any questions you may have.

Third party information reviewed and used to formulate this report is assumed to be complete and correct. HLV2K used this information in good faith and will not accept any responsibility for deficiencies, misinterpretation or incompleteness of the information contained in documents prepared by third parties.

Nothing in this report is intended to constitute or provide a legal opinion.

Should additional information become available, HLV2K requests that this information be brought to our attention so that we may re-assess the conclusions presented herein.

FIGURES

Legend

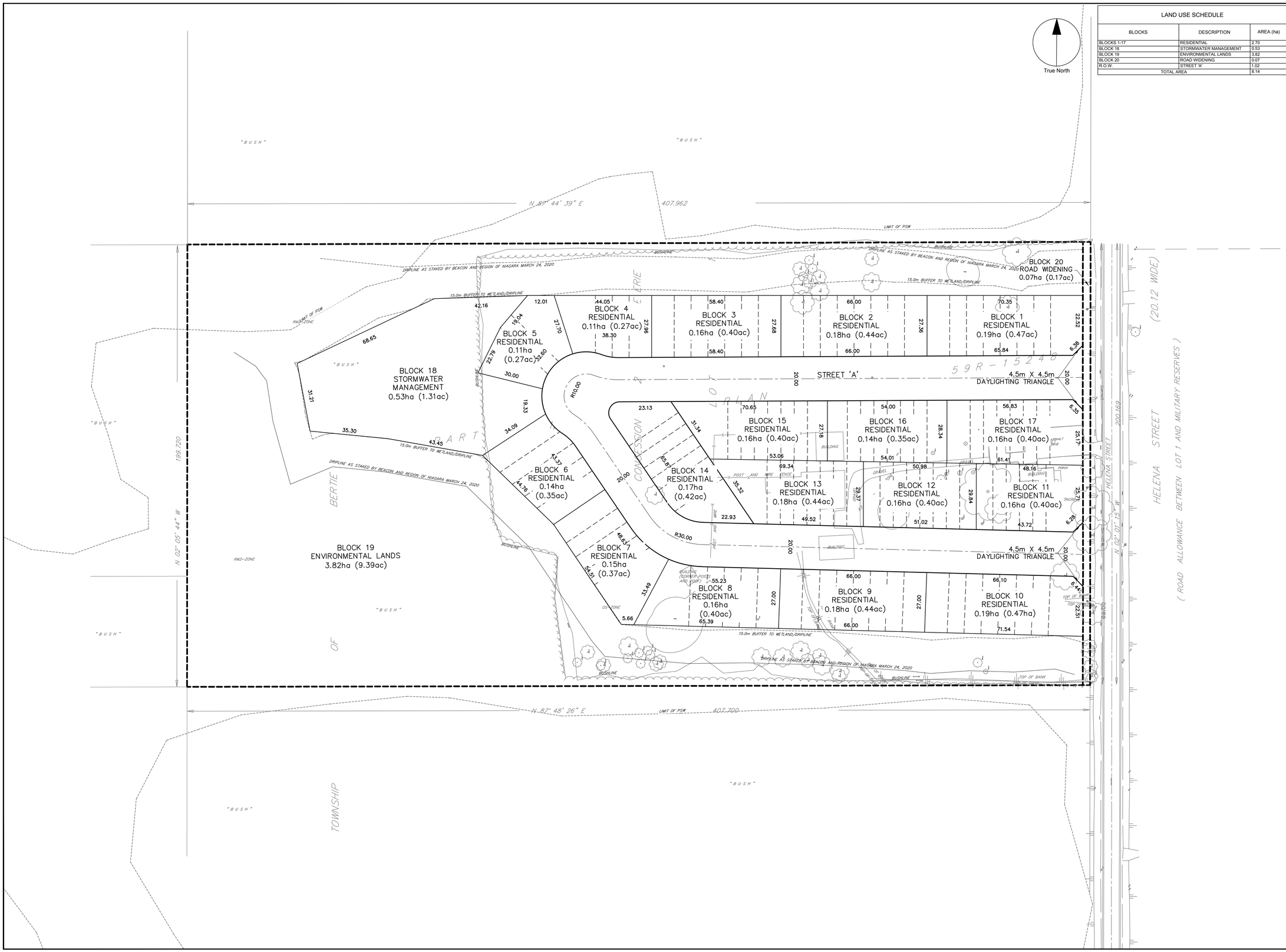
Approx. Site Boundary

Drawn: MM	Title: SITE LOCATION PLAN
Approved: KM	Project: WATER BALANCE STUDY Proposed Residential Development 613 Helena Street, Fort Erie, Ontario
Date: NOV. 2021	
Project No.: 2100394AG	
	Client: SS WELLAND INC.
HLV2K ENGINEERING LIMITED	0 125 250 500 Meters

FIGURE 1

APPENDIX A

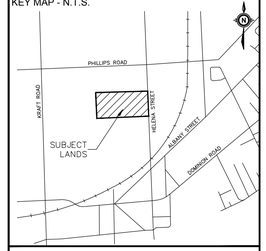
Drawing Provided by the Client



DRAFT PLAN OF SUBDIVISION 613 HELENA STREET

PART OF LOT 1, CONCESSION 2,
LAKE ERIE TOWNSHIP OF BERTIE
IN THE TOWN OF FORT ERIE
REGIONAL MUNICIPALITY OF NIAGARA

KEY MAP - N.T.S.



INFORMATION REQUIRED

UNDER SECTION 51 (17) OF THE PLANNING ACT, R.S.O. 1990. c.P.13 AS AMENDED
(a) - AS SHOWN
(b) - AS SHOWN
(c) - AS SHOWN
(d) - RESIDENTIAL
(e) - AS SHOWN
(f) - AS SHOWN
(g) - AS SHOWN
(h) - MUNICIPAL (PUBLIC)
(i) - SILTY CLAY
(j) - AS SHOWN
(k) - ALL SERVICES TO BE MADE AVAILABLE
(l) - AS SHOWN

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

SIGNED _____
PHILIP S. SUDA, O.L.S.
SUDA & MALESZYK SURVEYING INC.

DATE _____

OWNER'S CERTIFICATE

I HEREBY CONSENT TO THE FILING OF THIS PLAN BY IBI GROUP, IN DRAFT FORM.

SIGNED _____
MARIO BEVACQUA
1891187 ONTARIO INC.

DATE _____

#	DATE	BY	DESCRIPTION
1			

DRAWING ISSUE RECORD

APPROVALS

IBI GROUP
Suite 200 - 360 James Street North
Hamilton ON L8L 1H5 Canada
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BENCHMARK

SCALE 10 5 0 10 20 30
1:750 (m)

PROJECT NO: 131951

DRAWN BY:	CHECKED BY:
T. NGUYEN	T. TUCKER
PROJECT MGR:	APPROVED BY:
T.TUCKER	

SHEET TITLE
DRAFT PLAN OF SUBDIVISION

SHEET NUMBER	ISSUE
DP 1.0	1

SCALE CHECK 10mm 1 in

File Location: J:\131951_613_Helen\7.0_Production\7.01_Sent-Received\Sent\Client\2021-04-08 - Draft Plan\131951DP 2021-04-08.dwg Last Saved: April 8, 2021, by Tracy Tucker Plotted: Thursday, April 8, 2021 10:39:00 AM by Tracy Tucker

APPENDIX B

Water Balance Tables

TABLE B.1 - Climate Data

Fort Erie Station, Ontario

Latitude: 42°53' N Longitude: 79°58' W Elevation: 179.80 m

Temperature: Temperature:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average (°C)	-4.1	-3.3	0.4	6.6	12.7	18.1	21.2	20.6	16.7	10.4	4.9	-0.8	8.6
Rainfall (mm)	34.2	32.8	44.7	74.4	92.3	81.7	84.7	88.5	105.4	95.3	89.9	52.5	876.4
Snowfall (mm)	44.7	33.8	26.3	4.4	0.9	0.0	0.0	0.0	0.0	1.4	12.9	50.7	175.1
Precipitation (mm)	78.9	66.6	71.0	78.8	93.2	81.7	84.7	88.5	105.4	96.7	102.8	103.2	1051.5

TABLE B.2

Pre- and Post-Development Water Balance Components
Based on Thornthwaite's Soil Moisture Balance Approach

Potential Evapotranspiration Calculation	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Davily Average Temperature (^{o}C)	-4	-3	0	7	13	18	21	21	17	10	5	-1	9
Heat index: i = $(t/5)^{1.514}$	0.00	0.00	0.02	1.52	4.10	7.01	8.91	8.53	6.21	3.03	0.97	0.00	**40.3**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	27.94	58.53	87.36	104.44	101.11	79.76	46.70	19.95	0.00	**526**
Adjusting Factor K for U (Latitude 42^{o} 53' N)	0.77	0.88	0.99	1.11	1.22	1.28	1.26	1.17	1.05	0.92	0.81	0.75	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	31	72	112	131	118	83	43	16	0	**607**
PRE-DEVELOPMENT WATER BALANCE	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	79	67	71	79	93	82	85	89	105	97	103	103	1052
Potential Evapotranspiration (PET)	0	0	0	31	72	112	131	118	83	43	16	0	607
P - PET	79	67	71	48	22	-30	-47	-30	22	54	87	103	445
Change in Soil Moisture Storage	0	0	0	0	0	-30	-47	-30	22	54	31	0	**0**
Soil Moisture Storage (Assume January Soil Moisture Storage = 100% SMS)	250	250	250	250	250	220	173	143	165	219	250	250	
Actual Evapotranspiration (AET)	0	0	0	31	72	112	131	118	83	43	16	0	607
Soil Moisture Deficit (in mm)	0	0	0	0	0	30	77	107	85	31	0	0	
Surplus - available for infiltration or runoff	79	67	71	48	22	0	0	0	0	0	56	103	**445**
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	39.5	33.3	35.5	23.9	10.8	0.0	0.0	0.0	0.0	0.0	27.9	51.6	222
Potential Surface Water Runoff (independent of temperature)	39.5	33.3	35.5	23.9	10.8	0.0	0.0	0.0	0.0	0.0	27.9	51.6	222
POST- DEVELOPMENT WATER BALANCE ON IMPERVIOUS AREAS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	79	67	71	79	93	82	85	89	105	97	103	103	1052
Potential Evaporation (PE) from impervious areas (assume 20%)	15.8	13.3	14.2	15.8	18.6	16.3	16.9	17.7	21.1	19.3	20.6	20.6	210
P-PE (surplus available from impervious areas)	63	53	57	63	75	65	68	71	84	77	82	83	841
Water surplus change compared to pre-condition (for areas that change from vegetated open areas to impervious areas)	-16	-13	-14	15	53	65	68	71	84	77	27	-21	396

Soil Moisture Storage	250
PE from impervious areas %	20

*MOE SWM infiltration factor calculation	
topography - Flat aland, average slope <0.6 m/km	0.3
soils - relatively tight silty clay till materials	0.1
cover - predominantly cultivated land	0.1
Infiltration Factor	0.5

TABLE B.3 - Annual Pre-Construction Water Balance

	Pre-Construction		
	Unpaved Areas	Impervious Areas (building)	Totals
Area	69500	12000	81500
Pervious Area	69500	0	69500
Impervious Area	0	12000	12000
Infiltration Factors			
Topography Infiltration Factor	0.3	0	
Soil Infiltration Factor	0.1	0	
Land Cover Infiltration Factor	0.1	0	
MOE Infiltration Factor	0.5	0	
Actual Infiltration Factor	0.5	0	
Runoff Coefficient Pervious Surfaces	0.5	1	
Runoff from Impervious Surfaces*	0	0.8	
Inputs (per Unit Area)			
Precipitation (mm/yr)	1052	1052	1052
Run-On (mm/yr)	0	0	0
Other Inputs (mm/yr)	0	0	0
Total Inputs (mm/yr)	1052	1052	1052
Outputs (per Unit Area)			
Precipitation Surplus (mm/yr)	445	841	503
Net Surplus (mm/yr)	445	841	503
Evapotranspiration (mm/yr)	607	210	548
Infiltration (mm/yr)	222	0	190
Rooftop Infiltration (mm/yr)	0	0	0
Total Infiltration (mm/yr)	222	0	190
Runoff Pervious Areas	222	0	190
Runoff Impervious Areas	0	841	124
Total Runoff (mm/yr)	222	841	314
Total Outputs (mm/yr)	1052	1052	853
Difference (Inputs - Outputs)	0	0	
Inputs (Volumes)			
Precipitation (m3/yr)	73079	12618	85697
Run-On (m3/yr)	0	0	0
Other Inputs (m3/yr)	0	0	0
Total Inputs (m3/yr)	73079	12618.0	85697
Outputs (Volumes)			
Precipitation Surplus (m3/yr)	30913	10094	41008
Net Surplus (m3/yr)	30913	10094	41008
Evapotranspiration (m3/yr)	42166	2524	44689
Infiltration (m3/yr)	15457	0	15457
Rooftop Infiltration (m3/yr)	0	0	0
Total Infiltration (m3/yr)	15457	0	**15457**
Runoff Pervious Area (m3/yr)	15457	0	15457
Runoff Impervious Areas (m3/yr)	0	10094	10094
Total Runoff (m3/yr)	15457	10094	**25551**
Total Outputs (m3/yr)	73079	12618	85697
Difference (Inputs - Outputs)	0	0	0

* Evaporation from impervious areas was assumed to be 20% of precipitation

TABLE B.4 - WATER BALANCE COMPONENTS FOR CASE WHERE RUNOFF IS DIRECTED TO PERVIOUS AREAS

POTENTIAL EVAPOTRANSPIRATION CALCULATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Average Temperature (^{o} C)	-4.1	-3.3	0.4	6.6	12.7	18.1	21.2	20.6	16.7	10.4	4.9	-0.8	8.6
Heat index: i = $(t/5)^{1.514}$	0.00	0.00	0.02	1.52	4.10	7.01	8.91	8.53	6.21	3.03	0.97	0.00	**40.3**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	27.94	58.53	87.36	104.44	101.11	79.76	46.70	19.95	0.00	**526**
Adjusting Factor K for U (Latitude 42o 53' N)	0.77	0.88	0.99	1.11	1.22	1.28	1.26	1.17	1.05	0.92	0.81	0.75	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	31	72	112	131	118	83	43	16	0	**607**
POST-DEVELOPMENT WATER BALANCE	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Pervious areas will receive rainfall plus some runoff from impervious areas, so the following balance calculations use this total water supply to assess potential infiltration.													
Precipitation (P)	79	67	71	79	93	82	85	89	105	97	103	103	1052
Potential Evaporation (PE) from impervious areas (assume 20% of P)	16	13	14	16	19	16	17	18	21	19	21	21	210
P-PE (surplus available for runoff from impervious areas)	63	53	57	63	75	65	68	71	84	77	82	83	**841**
WAT (Total water supply to pervious areas = rain plus impervious area runoff)	142	120	128	142	168	147	152	159	190	174	185	186	**1893**
Potential Evapotranspiration from pervious areas (PET)	0	0	0	31	72	112	131	118	83	43	16	0	**607**
WAT - PET	142	120	128	111	96	35	21	41	106	131	169	186	**1286**
Change in Soil Moisture (mm)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Soil Moisture Storage (mm)*	125	125	125	125	125	125	125	125	125	125	125	125	
Actual Evapotranspiration (AET)	0	0	0	31	72	112	131	118	83	43	16	0	**607**
Total surplus - available for infiltration or runoff on pervious areas	142	120	128	111	96	35	21	41	106	131	169	186	**1286**
Estimate of I and R (based on MOE infiltration factor)*													
Potential Infiltration* (based on soil conditions; independent of temperature)	63.9	53.9	57.5	49.9	43.3	15.8	9.4	18.6	47.8	59.0	76.0	83.6	**579**
Potential Surface Water Runoff (independent of temperature)	78.1	65.9	70.3	60.9	52.9	19.3	11.5	22.7	58.5	72.1	92.9	102.2	**707**
Estimate of I and R (based on MOE Factors and CA Guideline assumption of a 10% reduction in infiltration reduction related to soil compaction)													
Potential Infiltration (based on soil conditions; independent of temperature)	57.5	48.6	51.8	44.9	38.9	14.2	8.5	16.7	43.1	53.1	68.4	75.2	**521**
Potential Surface Water Runoff (independent of temperature)	84.5	71.3	76.0	65.9	57.2	20.9	12.5	24.6	63.3	78.0	100.5	110.5	**765**

Max SMS	125
PE from impervious areas %	20

*MOE SWM infiltration factor calculation	
topography - flat to rolling	0.25
soils - tight sandy to clayey silt till	0.1
cover - predominantly impervious paved surface	0.1
Infiltration Factor	0.45

TABLE B.5 - Annual Post-Construction Water Balance without LID

	Unpaved Areas	Impervious Areas (Paved/Buildings)	Water (Pond)	Totals
Area	56250	23650	1600	81500
Pervious Area	56250	0	0	56250
Impervious Area	0	23650	1600	25250
Infiltration Factors				
Topography Infiltration Factor	0.25	0	0	
Soil Infiltration Factor	0.1	0	0	
Land Cover Infiltration Factor	0.1	0	0	
MOE Infiltration Factor	0.45	0	0	
Actual Infiltration Factor	0.55	0	0	
Runoff Coefficient Pervious Surfaces	0.45	1	1	
Runoff from Impervious Surfaces*	0	0.8	0.8	
Inputs (per Unit Area)				
Precipitation (mm/yr)	1052	1052	886	1052
Run-On (mm/yr)	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0
Total Inputs (mm/yr)	1052	1052	886	1052
Outputs (per Unit Area)				
Precipitation Surplus (mm/yr)	445	841	841	568
Net Surplus (mm/yr)	445	841	841	568
Evapotranspiration (mm/yr)	607	210	177	483
Infiltration (mm/yr)	245	0	0	169
Rooftop Infiltration (mm/yr)	0	0	0	0
Total Infiltration (mm/yr)	245	0	0	169
Runoff Pervious Areas	200	0	0	138
Runoff Impervious Areas	0	841	709	258
Total Runoff (mm/yr)	200	841	709	396
Total Outputs (mm/yr)	1052	1052	886	1048
Difference (Inputs - Outputs)	0	0	0	
Inputs (Volumes)				
Precipitation (m3/yr)	59147	24868	1418	85432
Run-On (m3/yr)	0	0	0	0
Other Inputs (m3/yr)	0	0	0	0
Total Inputs (m3/yr)	59147	24868	1418	85432
Outputs (Volumes)				
Precipitation Surplus (m3/yr)	25020	19894	1346	46260
Net Surplus (m3/yr)	25020	19894	1346	46260
Evapotranspiration (m3/yr)	34127	4974	284	39384
Infiltration (m3/yr)	13761	0	0	13761
Rooftop Infiltration (m3/yr)	0	0	0	0
Total Infiltration (m3/yr)	13761	0	0	**13761**
Runoff Pervious Area (m3/yr)	11259	0	0	11259
Runoff Impervious Areas (m3/yr)	0	19894	1134	21028
Total Runoff (m3/yr)	11259	19894	1134	**32287**
Total Outputs (m3/yr)	59147	24868	1418	85432
Difference (Inputs - Outputs)	0	0	0	0

* Evaporation from impervious areas was assumed to be 20% of precipitation

TABLE B.6 - Annual Post-Construction Water Balance with LID

	Unpaved Areas (Landscape/ Permeable Pavements)	Impervious Areas (Roads/Buildings)	Buildings with LID (Rooftop Rain)	Water	Totals
Area	56250	14200	9450	1600	81500
Pervious Area	56250	0	0	0	56250
Impervious Area	0	14200	9450	1600	25250
Infiltration Factors					
Topography Infiltration Factor	0.25	0	0	0	
Soil Infiltration Factor	0.1	0	0	0	
Land Cover Infiltration Factor	0.1	0	0	0	
MOE Infiltration Factor	0.45	0	0	0	
Actual Infiltration Factor	0.55	0	0	0	
Runoff Coeffcient Pervious Surfaces	0.45	1	1	1	
Runoff from Impervious Surfaces*	0	0.8	0.8	0.8	
Inputs (per Unit Area)					
Perecipitation (mm/yr)	1052	1052	1052	1052	1052
Run-On (mm/yr)	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0
Total Inputs (mm/yr)	1052	1052	1052	1052	1052
Outputs (per Unit Area)					
Precipitation Surplus (mm/yr)	445	841	841	841	568
Net Surplus (mm/yr)	445	841	841	841	568
Evapotranspiration (mm/yr)	607	210	210	210	484
Infiltration (mm/yr)	245	0	0	0	169
LID (mm/yr)	0	0	341	0	40
Total Infiltration (mm/yr)	245	0	341	0	208
Runoff Pervious Areas	200	0	0	0	138
Runoff Impervious Areas	0	841	501	841	221
Total Runoff (mm/yr)	200	841	501	841	359
Total Outputs (mm/yr)	1052	1052	1052	1052	1052
Difference (Inputs - Outputs)	0	0	0		
Inputs (Volumes)					
Precipitation (m3/yr)	59147	14931	9937	1682	85697
Run-On (m3/yr)	0	0	0	0	0
Other Inputs (m3/yr)	0	0	0	0	0
Total Inputs (m3/yr)	59147	14931	9937	1682	85697
Outputs (Volumes)					
Precipitation Surplus (m3/yr)	25020	11945	7949	1346	46260
Net Surplus (m3/yr)	25020	11945	7949	1346	46260
Evapotranspiration (m3/yr)	34127	2986	1987	336	39437
Infiltration (m3/yr)	13761	0	0	0	13761
Rooftop Infiltration/Other LID (m3/yr)	0	0	3219	0	3219
Total Infiltration (m3/yr)	13761	0	3219	0	**16980**
Runoff Pervious Area (m3/yr)	11259	0	0	0	11259
Runoff Impervious Areas (m3/yr)	0	11945	4730	1346	18021
Total Runoff (m3/yr)	11259	11945	4730	1346	**29279**
Total Outputs (m3/yr)	59147	14931	9936	1682	85696
Difference (Inputs - Outputs)	0	0	0	0	1

* Evaporation from impervious areas was assumed to be 20% of precipitation