

**FUNCTIONAL SERVICING &
PRELIMINARY STORMWATER
MANAGEMENT REPORT**

**LONG POINT ROAD
SUBDIVISION**

**TOWN OF THE BLUE MOUNTAINS
COUNTY OF GREY**

PREPARED FOR:

TERRA BROOK HOMES

PREPARED BY:

**C.F. CROZIER & ASSOCIATES INC.
40 HURON STREET, SUITE 301
COLLINGWOOD, ONTARIO
L9Y 4R3**

JANUARY 2022

CFCA FILE NO. 1988-5783

The material in this report reflects best judgment in light of the information available at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. C.F. Crozier & Associates Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.



Revision Number	Date	Comments
Rev.1	Sept 24, 2018	Issued for First Submission
Rev.2	Feb. 19, 2021	Issued for First Submission - Draft Plan Version #8
Rev.3	Aug. 20, 2021	Issued for Second Submission – Draft Plan Version #8
Rev.4	Jan. 24, 2022	Issued for Third Submission – Draft Plan Version #8

TABLE OF CONTENTS

1.0	INTRODUCTION	1
2.0	SITE DESCRIPTION	1
3.0	WATER SERVICING.....	2
3.1	EXISTING INFRASTRUCTURE.....	2
3.2	PROPOSED WATER SERVICING STRATEGY.....	2
3.3	DESIGN WATER DEMAND.....	2
3.4	FIRE FLOW DEMAND	2
4.0	SANITARY SERVICING	3
4.1	EXISTING INFRASTRUCTURE.....	3
4.2	SANITARY DEMAND.....	3
4.3	PROPOSED SANITARY SERVICING STRATEGY	4
5.0	DRAINAGE & STORMWATER MANAGEMENT.....	4
5.1	EXISTING DRAINAGE.....	5
5.2	PROPOSED DRAINAGE.....	5
5.3	STORMWATER QUANTITY CONTROL.....	5
5.3.1	Groundwater Buoyancy	6
5.4	STORMWATER QUALITY CONTROL	7
6.0	UTILITIES.....	8
7.0	SEDIMENT AND EROSION CONTROLS DURING CONSTRUCTION	8
8.0	CONCLUSIONS & RECOMMENDATIONS	9

LIST OF TABLES

- Table 1:** Estimated Design Water Demand
- Table 2:** Estimated Fire Demand Flows
- Table 3:** Estimated Sanitary Design Flows (22 Units)
- Table 4:** Visual OTTHYMO Method and Storage Volume Results
- Table 5:** SWM Quality Control Characteristics

LIST OF APPENDICES

- Appendix A:** Subsurface Characterization Program (Wilson Associates)
- Appendix B:** As-Constructed Drawings
- Appendix C:** Domestic Water and Sanitary Flow Calculations
- Appendix D:** Quality Control Measures & Stormwater Flow Calculations
- Appendix E:** Groundwater Buoyancy Calculations

LIST OF FIGURES

- Figure 1:** Location of Proposed Development
- Figure 2:** Proposed Draft Plan
- Figure 3:** General Site Servicing Plan
- Figure 4:** Grading and Storm Sewer
- Figure 5:** Details and Cross-Sections

1.0 INTRODUCTION

C.F. Crozier & Associates Inc. (Crozier) was retained by Terra Brook Homes to prepare a Functional Servicing & Preliminary Stormwater Management Report in support of a Zoning By-Law Amendment and Draft Plan of Subdivision Application consisting of 22 single detached lots. The proposed development is comprised of two properties, legally described as Plan 529 PT Lot 85 RP;16R2186 Parts 4 & 8, and Plan 529 PT Lot 85 RP;16R2186 Parts 5 & 9 in the Town of The Blue Mountains, County of Grey. The location of the proposed development and the proposed Draft Plan are included as **Figure 1** and **Figure 2**, respectively.

The proposed development, consisting of 22 lots, will be serviced with municipal sanitary, storm, and watermain infrastructure located within the municipal right-of-way (ROW). Preliminary servicing details have been reflected on the General Site Servicing Plan included in this report as **Figure 3**. Grading and storm servicing details have been reflected on the Grading and Storm Sewer Plan included in this report as **Figure 4**. Cross-sections to support the functional servicing design are included in **Figure 5**.

This report has been prepared to document details associated with the functional servicing and stormwater management design for the proposed development. Contained in this report is a description of the existing site (Section 2.0); the water servicing strategy (Section 3.0); the sanitary servicing strategy (Section 4.0); the drainage & stormwater management strategy (Section 5.0); proposed utilities (Section 6.0); sediment and erosion control plan (Section 7.0); and a concluding discussion (Section 8.0).

2.0 SITE DESCRIPTION

The Subject Property is approximately 2.2 ha and located in a residential area in the Town of The Blue Mountains, north of Highway 26 and adjacent to Long Point Road.

The Subject Property is bounded by:

- Residential properties to the north
- A residential property to the south
- A municipal drainage easement to the west
- Long Point Road to the east

The site consists of a single cul-de-sac and access will be provided from Long Point Road. A TIS was not required for this site due to the smaller unit count and the ongoing MTO EA assessing traffic impacts along the MTO corridor in this area. These lands were included in that assessment and impacts from this site were agreed to be negligible given the draft approved future growth in the area (2018).

Currently the site is undeveloped and fully treed. The site is relatively flat, with the grades generally descending from southeast to northwest. The site drains into a municipal drain west of the property, which conveys flows approximately 1 km north of the site where it discharges to Georgian Bay.

The site is currently zoned Residential/Recreational Area per the Town of The Blue Mountains Official Plan, which specifies a maximum single detached density of 10 units/ha. Therefore, 22 units on 2.2 ha is in conformance with this zoning requirement.

A subsurface characterization program prepared by Wilson Associates (July 5, 2018) was completed for the site to identify the seasonal high-water table as well as determine the underlying soil profile. Within the investigation, three (3) boreholes were advanced across the site. The boreholes revealed that the site is underlain by a thin layer of fine sand with some silt deposit and sand with some gravel

and clay glacial till. In addition, monitoring wells were installed within each of the boreholes. The monitoring wells revealed that groundwater levels range between 0.58 m and 0.81 m below grade in the summer and 0.03 m and 0.43 m below grade in the spring (Wilson Associates, May 2019). The results of the subsurface investigation have been provided in **Appendix A**.

3.0 WATER SERVICING

The following subsections provide an analysis of the water servicing and fire protection strategy proposed for the Long Point Road Development.

3.1 EXISTING INFRASTRUCTURE

Per As-Constructed Drawings (FM5 – FM7, Ainley 2006) an existing 150 mm diameter watermain is located within the Long Point Road right-of-way. Town staff, through previously issued comments, confirmed that this watermain is owned and operated by the Town of The Blue Mountains. As-Constructed drawings have been provided in **Appendix B**.

3.2 PROPOSED WATER SERVICING STRATEGY

The development will be serviced via connection to the existing watermain on Long Point Road. This watermain is owned and operated by the Town of The Blue Mountains. A tee connection will be provided from the existing main with a loop in the cul-de-sac to prevent a dead end.

3.3 DESIGN WATER DEMAND

The Town of The Blue Mountains Design Criteria (The Blue Mountains Engineering Standards, April 2009) were referenced to calculate water demand flows for the proposed development. A per capita water demand of 450 L/C/day was used with an occupancy density of 2.3 persons/unit. The maximum peak day factor of 2.0 and peak hour factor of 4.50 were applied to the average daily demand flow of 0.26 L/sec to obtain max daily demand and peak hour demand flows. A summary of the results is presented in **Table 1** below and detailed calculations have been provided in **Appendix C**.

Table 1: Estimated Design Water Demand

Standard	Average Daily Demand (L/sec)	Maximum Daily Demand (L/sec)	Peak Hourly Demand (L/sec)
Town of The Blue Mountains	0.26	0.53	1.19

3.4 FIRE FLOW DEMAND

The Fire Underwriters Survey (FUS) and Ontario Building Code (OBC) methods were used to estimate the fire flow requirements for the proposed development. All buildings are assumed to fall into building Class C with an estimated gross floor area (GFA) of 410 m². **Table 2** summarizes the fire flow and duration requirements under both OBC and FUS approaches.

Table 2: Estimated Fire Demand Flows

Method	Demand Flow (L/sec)	Duration (h)
OBC	45	1.25
FUS	100	1.5

The subdivision currently meets the OBC fire flow requirements but does not meet the fire flow requirements calculated using the FUS. Please refer to the external flow analysis completed By JLR located for reference in **Appendix B**. If the Town requires that available fire flows meet the FUS requirements we will work with the developer/builder to revise the unit layout and/or provide fire protection measures on the interior and exterior of the units to lower the fire flow demands to the available flow in the existing system. This will be investigated further at detailed design. **Appendix C** contains the FUS and OBC calculations.

4.0 SANITARY SERVICING

The following subsections provide an analysis of the sanitary servicing strategy for the proposed Long Point Road Development.

4.1 EXISTING INFRASTRUCTURE

Per As-Constructed Drawing (N^o81042/43-SW5, July 1984), a sanitary manhole labelled "MH#69" is located approximately 140 m west of the Highway 26 and Osler Bluff Road intersection. This manhole connects to a gravity sanitary sewer system that conveys flow to the Craigeith sewage pumping station. Flow from this point is conveyed to the existing wastewater treatment plant located north of the proposed development on Long Point Road via two parallel sanitary high pressure forcemains. The As-Constructed Drawing has been provided in **Appendix B**.

4.2 SANITARY DEMAND

Sanitary design flow calculations were completed in accordance with the Town of The Blue Mountains Design Criteria (The Blue Mountains Engineering Standards, April 2009). A per capita sewage flow of 450 L/C/day was used with an occupancy density of 2.3 persons/unit. Infiltration flow of 0.23 L/sec/ha and a peaking factor 4.3 were applied to the sewage flow rate to obtain the total estimated design sewage flow for the Subject Property. A summary of the design flows is presented in **Table 3** below and detailed calculations have been provided in **Appendix C**.

Table 3: Estimated Sanitary Design Flows (22 Units)

Standard	Average Flow (L/sec)	Peaking Factor	Peak Flow (L/sec)	Infiltration Flow (L/sec)	Total Estimated Design Flow (L/sec)
Town of The Blue Mountains	0.26	4.3	1.12	0.51	1.64

The proposed sanitary system will be sized to convey a peak sanitary flow of 1.64 L/sec for the development.

4.3 PROPOSED SANITARY SERVICING STRATEGY

Connection to the existing high-pressure forcemains located on Long Point Road was eliminated as a potential servicing strategy for this development, as the cost to construct a sanitary pump station for this small of a development was deemed infeasible. As a result, the development will be serviced through a low pressure forcemain that will connect to the existing gravity sanitary sewer located on Highway 26.

According to the January 27, 2020 Highway 26 Flow Monitoring Study by Tatham Engineering, there is currently residual capacity within the existing 300 mm diameter sanitary gravity sewer on Highway 26 based on monitored flow studies. It is understood that based on theoretical flow values (considering the full buildout of all developments draining to the ex. 300 mm sewer) the sewer will reach capacity. Alternative arrangements such as upsizing the sewer or preparing an ECA application based on monitored rather than theoretical flows will be investigated further at detailed design to ensure the subject development does not contribute to the sewer reaching capacity.

At this time, it is anticipated that the low pressure forcemain can be installed via directional drilling. Utilizing this methodology would minimize roadway restorations requirements along Long Point Road and Highway 26. Consultation with the Town during detailed design would be required to determine a corridor for the forcemain within the existing municipal right-of-way. A conceptual cross-section illustrating the location of the forcemain along Long Point Road can be seen on **Figure 3**. The Town has indicated that a future gravity sanitary sewer will be constructed on Long Point Road, which the subject development will be expected to tie into. During detailed design we will account for the future connection and decommissioning/removal of the low pressure forcemain downstream of the development entrance. The ECA application will be amended as necessary for the future sanitary connection to Long Point Road.

It is acknowledged through received comments that an alternative alignment within the municipal drain easement through a change of use easement would not be supported by the Town.

5.0 DRAINAGE & STORMWATER MANAGEMENT

Management of stormwater and site drainage for the proposed development will proceed in conformance with the standards provided by the Town of The Blue Mountains (TOBM), Grey Sauble Conservation Authority (GSCA), and Ministry of the Environment, Conservation and Parks (MECP).

A stormwater management strategy and accompanying recommendations regarding the proposed development have been included below.

- Water Quantity Control
 - Control of the post-development peak flows to pre-development levels for all storms up to and including the 100-year event
- Water Quality Control
 - "Enhanced Protection" per MECP
- Development Standard
 - Urban cross section within 20 m right-of-way
 - Lot grading at 2% optimum
 - Minor/major drainage system to convey frequent rainfall/runoff events

5.1 EXISTING DRAINAGE

The soil type identified on the site is Granby well sorted sandy washout (Soil Map of Simcoe County, North Sheet, Soil Survey Report No. 29), which is classified as Hydrologic Soil Group C (Design Chart H2-6A, MTO Drainage Manual, 1985). This soil type has been generally confirmed in the Geotechnical Report by Wilson Associates, which identified onsite soils as predominantly glaciolacustrine sand overlying sandy silt till.

Drainage from the site is predominately sheet flow from the southeast to the northwest and discharges into a Municipal Drain, as identified under the Drainage Act, located at the west limits of the site. The Municipal Drain conveys flows north to a culvert that crosses Brophy's Lane. North of Brophy's Lane, stormwater traverses the Town of The Blue Mountains wastewater treatment facility lands where it discharges into a small pond northwest of the treatment facility's main entrance. Town staff have advised that this pond is an aesthetic feature with no stormwater quality or quantity features. The pond discharges to a drainage channel flowing north down the Long Point Road west ditch to Georgian Bay.

The configuration of the municipal drain will not be altered, and peak and erosive flows will not be increased in post-development. Erosive flows in the immediate receiving portion of the Municipal Drain are negligible, as the Drain is lined with rip-rap material that is meant to prevent erosion. In the downstream portion of the drain (Long Point Rd ditch) the flows in the ditch are the same as the pre-development drainage condition so there should be no additional erosive flows. A geomorphologist can be used to support this theory by investigating the existing conditions of the Municipal Drain.

5.2 PROPOSED DRAINAGE

The proposed development consists of an urban cross section roadway complete with curb and gutter with an internal storm sewer system. Front yards, side yards and rooftops will be graded to direct runoff towards the ROW where they will be collected by catchbasins and conveyed through the proposed storm sewer system, up to and including the 100-year storm event. An overland flow route will be located within the Open Space Block 25 in the event the storm sewer is blocked/surcharges. Rear yards will slope to the back of the lots where swales will convey flows west to the municipal drain. The proposed drainage configuration for the site is presented in **Figure 4** and the dimensions of the swales are presented in **Figure 5**.

Approximately 1.40 ha (Drainage Area 1A, 1B and 1C) of flows will drain west via a storm sewer system and overland flow route, discharging into an enhanced grass swale for treatment and conveyance to the existing Municipal Drain located along the west limits of the site and ultimately discharging to Georgian Bay. Approximately 0.79 ha of flows from rear yards and the Open Space Block 25 (Drainage Area 1D) will be collected in drainage swales and directed toward the Municipal Drain without quantity control. This drainage is considered clean, as it consists of rooftop and vegetative runoff only.

The internal roadway grading/geometrics will conform with the Town of The Blue Mountains Design Standards (The Blue Mountains Engineering Standards, April 2009).

5.3 STORMWATER QUANTITY CONTROL

Quantity control for the development will be provided by an oversized storm sewer pipe (concrete box culvert) within the proposed Town's ROW. Outflow from this storm sewer storage will be controlled by an orifice plate located at the downstream end of the box culvert. Additional methods for quantity control will be explored at the detailed design stage to reduce the size of the oversized storm sewer pipe.

To model this development the stormwater management hydrologic computer program Visual OTTHYMO (VO) was used to model the post-development controlled and uncontrolled drainage areas. The 4-hour Chicago, 24-hour SCS Type II and 25mm quality rainfall distributions were applied to the hydrologic model and were used throughout the analysis. Refer to **Appendix D** for full hydrologic calculations and models. The pre- and post-development flows for the site during the 4-hour Chicago and the 24-hour SCS storm events are seen in **Table 4**. The post-development flows represent the peak flow rates at the outlet and include both the controlled flows from the oversized storm system and the uncontrolled flows from rear yards and the Open Space Block.

With the use of an orifice plate and the provided storage from the proposed oversized storm sewer system, including catchbasins, double catchbasins, and surface storage within the cul-de-sac, the post-development peak flows from the site will not exceed the pre-development flows to the municipal drain. The results of the analysis are presented in **Table 4**. Detailed calculations have been provided in **Appendix D**.

Table 4: Visual OTTHYMO Method and Storage Volume Results

Storm	Pre-Development (m ³ /sec)	Post-Development (m ³ /sec)			Storage (m ³) (793 m ³ Available)
	Total	Uncontrolled (1D)	Controlled (1A, 1B & 1C)	Total	
2-year CHI	0.011	0.010	0.001	0.011	269
5-year CHI	0.025	0.022	0.001	0.023	397
10-year CHI	0.037	0.032	0.002	0.034	484
25-year CHI	0.06	0.05	0.01	0.06	580
50-year CHI	0.07	0.06	0.01	0.07	647
100-year CHI	0.08	0.07	0.01	0.08	697
2-year SCS	0.030	0.028	0.001	0.029	406
5-year SCS	0.06	0.05	0.01	0.06	551
10-year SCS	0.08	0.07	0.01	0.08	629
25-year SCS	0.11	0.09	0.02	0.11	699
50-year SCS	0.14	0.11	0.03	0.14	745
100-year SCS	0.16	0.12	0.03	0.15	787

Based on the information shown in **Table 4**, the proposed oversized storm sewer will provide the require storage volumes to control peak flows from the site. Final design and sizing will be completed as part of detailed design.

5.3.1 Groundwater Buoyancy

The proposed culvert dimensions are 1000 mm X 4800 mm. It includes 250 mm thick walls with an associated mass per 2.5 m unit length. Hanson Building Products did not provide a mass per 2.5 m unit length for their 1000 mm X 4800 mm box, so a mass was taken from a similarly sized M CON culvert (1500mm X 3000 mm). The depth of road materials and backfill was set to 1.2 m, which stands as the minimum backfill coverage outlined by the MECP. Beyond this depth, the differential between the force due to gravity and buoyancy only increases.

A few other conservative assumptions were made to enable the calculation of net forces on the culvert. One is that the ultimate bearing capacity of the soil underlying the culvert is sufficient to support all forces. Another assumption is that the only forces acting on the culvert are due to gravity and buoyancy. The force of gravity is acting on the culvert and the soil that lies on top of it and the force of buoyancy is due to the displacement volume of fluid as a result of the culvert and soil submerged within it.

The density of soil or overburden on top of the culvert was estimated to be 1500 kg/m³. This estimate is highly conservative given that a typical road structure can include soil densities of 2200 kg/m³ and beyond for materials such as compacted granulars and asphalt.

It is worth noting that the location of the maximum buoyancy is on the west end of the development where the proposed centreline has the least relief to the groundwater surface. The groundwater surface used for all calculations were the highest observed levels recorded within the Hydrogeological Report prepared by Wilson Associates from April 2019.

In summary, the force differential was found to be about 206 kN, this means that no ballast or groundwater drainage system is required for the proposed culvert. See **Appendix E** for a full set of supporting calculations.

5.4 STORMWATER QUALITY CONTROL

A preliminary screening of the most practical stormwater water quality measures to implement on-site was undertaken. CB Shields will be installed for catchbasins within the storm system. An oil grit separator will be installed at the end of the storm sewer systems prior to discharging to the enhanced grass swale for further treatment and conveyance to the municipal drain along the west limits of the site and subsequently draining to the Georgian Bay. The OGS unit will be located downstream of the quantity control, as depicted in **Figure 4**.

CB Shields have a removal efficiency of 50%, CB Shields have been specified in the appropriate structures and a Stormceptor EFO4 has been specified at the end of the storm sewer system. The Stormceptor unit has been designed for 50% TSS removal to maximise the TSS removal from stormwater prior to discharging to the enhanced grass swale.

Refer to **Table 5** below for a detailed breakdown of the performance of the proposed quality control measures. Sizing calculations have been provided in **Appendix D**.

Table 5: SWM Quality Control Characteristics

Catchment	ID	Contributing Drainage Area (ha)	Type	Total Suspended Solids Removal (%)	Total Annual Runoff Volume Treated (%)
Internal Sewer	OGS #1	1.40	EFO4	50	>90
All Catchbasins and Double Catchbasins	CB Shield	1.40	600 Sump	50	>90

To determine the TSS removal from stormwater prior to entering the enhanced grass swale, the following equation for treatment practices in series was used.

$$R = A + B - \left[\frac{A \times B}{100} \right]$$

R = Combined Removal Efficiency

A = CB & DCB Shield Removal Efficiency – 50%

B = Oil Grit Separator Removal Efficiency – 50%

Based on the equation above the stormwater in the storm sewers will have an 75% TSS removal prior to entering the enhanced grass swale.

The enhanced grass swale will be approximately 48 m long with a longitudinal slope of 0.3%. Furthermore, the enhanced grass swale will be vegetated with plants to reduce velocities and encourage sediment settlement. Based on *New Jersey Stormwater Best Management Practices Manual (July 2014)* Enhanced grass swales exceeding 16 m have a 50% TSS removal efficiency.

To determine the overall removal efficiency for controlled catchments the treatment practices in series was used.

$$R = A + B - \left[\frac{A \times B}{100} \right]$$

R = Combined Removal Efficiency

A = TSS Removal Prior to Entering the Enhanced Grass Swale – 75%

B = Enhanced Grass Swale Removal Efficiency – 50%

Based on the equation above the proposed treatment will provide an 87.5% TSS removal for the controlled catchments.

Once the OGS unit is installed, and operating according to the manufacturer's specifications, and assumed by the Town, Town staff will be required to inspect and service the unit on a regular basis per the guidelines outlined in an Owner's Manual, to ensure long term efficiency.

6.0 UTILITIES

The site is proposed to be serviced with natural gas, telephone, cable TV, and hydro. We understand these utilities are available in the Long Point Road right-of-way adjacent the proposed development. Coordination with the utilities will be undertaken during the detailed design phases to confirm utility design capacity and connection locations.

7.0 SEDIMENT AND EROSION CONTROLS DURING CONSTRUCTION

Sediment and erosion controls will be installed prior to the commencement of any construction activities and will be maintained until the site is stabilized or as directed by the Site Engineer and/or the Town of The Blue Mountains. A Grading & Sediment Erosion Control Plan will be prepared as part of the detailed design package to identify the location of the recommended control features. Controls will be inspected after each significant rainfall event and maintained in proper working condition. A summary of proposed controls to be implemented is included below.

- Silt Fencing

Silt fence will be installed where required to intercept sheet flow. Heavy duty silt fence will be located around the downstream side of the work zone limits. It should be noted that additional silt fencing

may be added based on field decisions by the Site Engineer and Contractor prior to, during and following construction.

- Mud Mat

A mud mat will be installed at the entrance to the construction zone to prevent mud tracking from the site onto the surrounding lands and perimeter roadway network.

- Dust Suppression

During construction activities, the Contractor will ensure that measures for dust suppression are provided as required.

8.0 CONCLUSIONS & RECOMMENDATIONS

Based on the foregoing we conclude that the proposed Long Point Road Residential Development can be adequately serviced.

1. Access to the site will be provided by way of roadway connections to Long Point Road.
2. A preliminary site drainage plan has been completed to demonstrate that overland flow routes to the Municipal Drain can be achieved.
3. The development will be serviced via an internal low-pressure forcemain sanitary sewer system that will outlet to the existing Highway 26 gravity sanitary sewer and to a gravity sewer along Long Point Road in the future (post-occupancy).
4. Domestic water supply for the development will be provided via a connection to the existing Town of The Blue Mountain watermain within the Long Point Road right-of-way. System pressures, flows, and external improvements will be confirmed with the Town of The Blue Mountain as development approvals proceed.
5. A superpipe (concrete box culvert) and surface ponding internal to the site will provide stormwater quantity control. Stormwater quality control will be provided by a treatment train prior to discharging to the Municipal Drain.
6. Buoyancy forces from the high groundwater table are negligible on the proposed infrastructure.
7. Utilities are available to service the site.

Therefore, we recommend approval of the Planning Applications for the site from the perspective of engineering servicing requirements.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.



Travis Gibson, P.Eng., PMP
Project Manager

C.F. CROZIER & ASSOCIATES INC.



Brendan Hummelen, P.Eng.
Project Engineer

J:\1900\1988-Terrabrook Homes\5783-Longpoint Road\Reports\FSR\3rd Submission\2022.01.24_FSR&SWM Report.docx

APPENDIX A

Subsurface Characterization Program (Wilson Associates)

July 5, 2018

Ms. Brittany Robertson, P.Eng.
C.F. Crozier & Associates
40 Huron Street
Suite 301
Collingwood, ON
L9Y 4R3



Dear Ms. Robertson:

Re: Subsurface Characterization Program
Proposed Long Point Road Subdivision, Blue Mountains

It is proposed to develop a ± 22 -lot urban residential subdivision on a ± 2.2 ha parcel of land located within Part of Lots 20 and 21, Concession 1, Geographic Township of Collingwood, Town of Blue Mountains (Plan 529, Part Lot 85, RP16R2186, Parts 4, 5, 8 & 9). Figure 1 shows the layout of the site and surroundings.

It is understood that full municipal servicing will be available for the proposed subdivision.

As requested, a subsurface investigation was completed to identify the seasonal high watertable level, the soil profile and the bedrock surface level, and was conducted through the installation of three exploratory boreholes on June 7, 2018. An initial site reconnaissance was conducted May 18, 2018.

SITE SETTING AND GEOLOGICAL SETTING

The proposed subdivision is located on a ± 2.2 ha parcel of land located on the west side of Long Point Road, approximately 200m north of Highway 26. Frontage along Long Point Road is approximately 93m, and the depth of the site is approximately 237m. The site is currently mainly forested, and is undeveloped.

According to imagery provided by on-line Grey County Maps as well as topographical information provided by Ontario Base Mapping, the site exhibits a very shallow relief with an overall slope to the north. A northwards- flowing improved drainage course is mapped to be situated approximately in the middle of the site, as well as along the western edge of the site. Mapped wetlands are located to the west and the east of the site. Lands surrounding the site are undeveloped forest to the west, mainly forested rural residential lots to the north and south, and residential properties to the east along Long Point Road.

According to the Ontario Geological Survey Map P.919 "Quaternary Geology of the Collingwood-Nottawasaga Area", the upper soils in the vicinity of the site will consist of glaciolacustrine sand overlying sandy silt till and/or limestone bedrock.

The bedrock beneath the site consists of limestone of the Simcoe Group.

According to local historical water well records completed prior to the local supply of municipal water (i.e. late 1960's to early 1970's, copies attached), the overburden in the vicinity of the site is in the range of 3.7m to 8.5m deep. All historical well records in the vicinity of the site report obtaining groundwater from the limestone bedrock aquifer beneath the site. The overburden is locally of insufficient thickness to have provided a viable, secure source of groundwater for domestic use.

SUBSURFACE ASSESSMENT

Three boreholes were completed within accessible areas of the subject property on June 7, 2018. The boreholes were completed using a track-mounted power auger machine equipped with continuous flight hollow-stem augers and conventional soil sampling equipment. The boreholes were completed to the bedrock surface (4.6m at BH1 and BH3, 4.9m at BH2) and were instrumented as 5.1cm-diameter monitoring wells. Drilling conditions were observed through auger feedback on a continuous basis. Overburden formation samples were collected using conventional split-spoon technique and from auger cuttings, and were field-identified at regular depth intervals. Selected representative samples were retained for subsequent laboratory analysis.

Logs of the borehole installations are attached. Copies of the water well records for the monitoring well installations are also attached. The approximate locations of the boreholes are shown on attached Figure 1.

Two representative overburden formation samples were selected for laboratory analysis, these being from the surficial sands and the underlying sandy silt till. The following table provides a summary of the analyses:

Sample	Depth (m)	Grain-Size Distribution				Estimated Coefficient of Permeability (cm/sec)	Estimated T-time (minutes/cm)
		Clay%	Silt%	Sand%	Gravel%		
BH1 S1	0.3 - 0.8	0	12	88	0	2×10^{-3}	10
BH3 S2	1.5 - 2.0	13	37	34	16	7×10^{-6}	40

Note: The above coefficients of permeability and T-times are estimates based on field observation, grain-size analysis, experience with similar soils and guidelines published under the Ontario Building Code.

In summary, soil conditions are generally consistent with local Quaternary Geology mapping, with a thin fine sand with some silt deposit overlying a silt and sand with some gravel and clay glacial till. The bedrock surface was encountered at 4.6m to 4.9m below grade.

Copies of the grain-size curves are attached.

WATERTABLE

Monitoring wells were installed in the three boreholes for subsequent observation of the watertable surface. Water levels were observed in the monitoring wells on June 28, 2018.

The following tables summarize the water level observations, including the depth groundwater was first observed in the three boreholes during drilling.

Monitoring Well	Depth to First Groundwater in Open Borehole (m) June 7, 2018	Monitoring Well Observations June 28, 2018	
		Water Level (m below top of pipe)	Water Level (m below grade)
BH1	0.3	1.66	0.68
BH2	0.3	1.47	0.58
BH3	0.6	1.90	0.81

Consistent with the geological setting of the site, shallow groundwater conditions are present over the entire property. The observed early summer groundwater levels range between 0.58m and 0.81m below grade. Based on the setting and observations during the May 18, 2018 reconnaissance, it is anticipated that high spring water levels will be at or near current grade.

SUMMARY

1. The soil profile over the property consists of with a thin fine sand with some silt deposit overlying a silt and sand with some gravel and clay glacial till.
2. The bedrock surface is situated 4.6m to 4.9m below current grade.
3. Groundwater levels observed June 28, 2018 ranged between 0.58m and 0.81m below grade. Based on the setting and observations during an earlier spring reconnaissance, it is anticipated that high spring water levels will be at or near current grade.

Should you have any questions or require further detail, please do not hesitate to contact this office.

Yours sincerely,

IAN D. WILSON ASSOCIATES LIMITED



Geoffrey Rether, P.Geo.

Legend

- Parcels
- Large Scale Roads**
- Provincial Highway
- County Road
- Township Road
- Seasonal Road

APPROXIMATE LOCATIONS
OF EXPLORATORY
BOREHOLES

LONG POINT ROAD
SUBDIVISION

FIGURE 1

SCALE: AS SHOWN



Notes

This map is a user generated static output from an Internet mapping site and is for reference only.
Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

0.08 Kilometers



BOREHOLE VISUAL LOGS - Long Point Road Subdivision

BH3	Date:	June 7, 2018
	UTM Coordinates:	NAD 83, Zone 17, 556148E, 4930396N
	Collar Elevation:	±181m above sea level (per OBM)
	Depth:	4.9m

Visual Log:

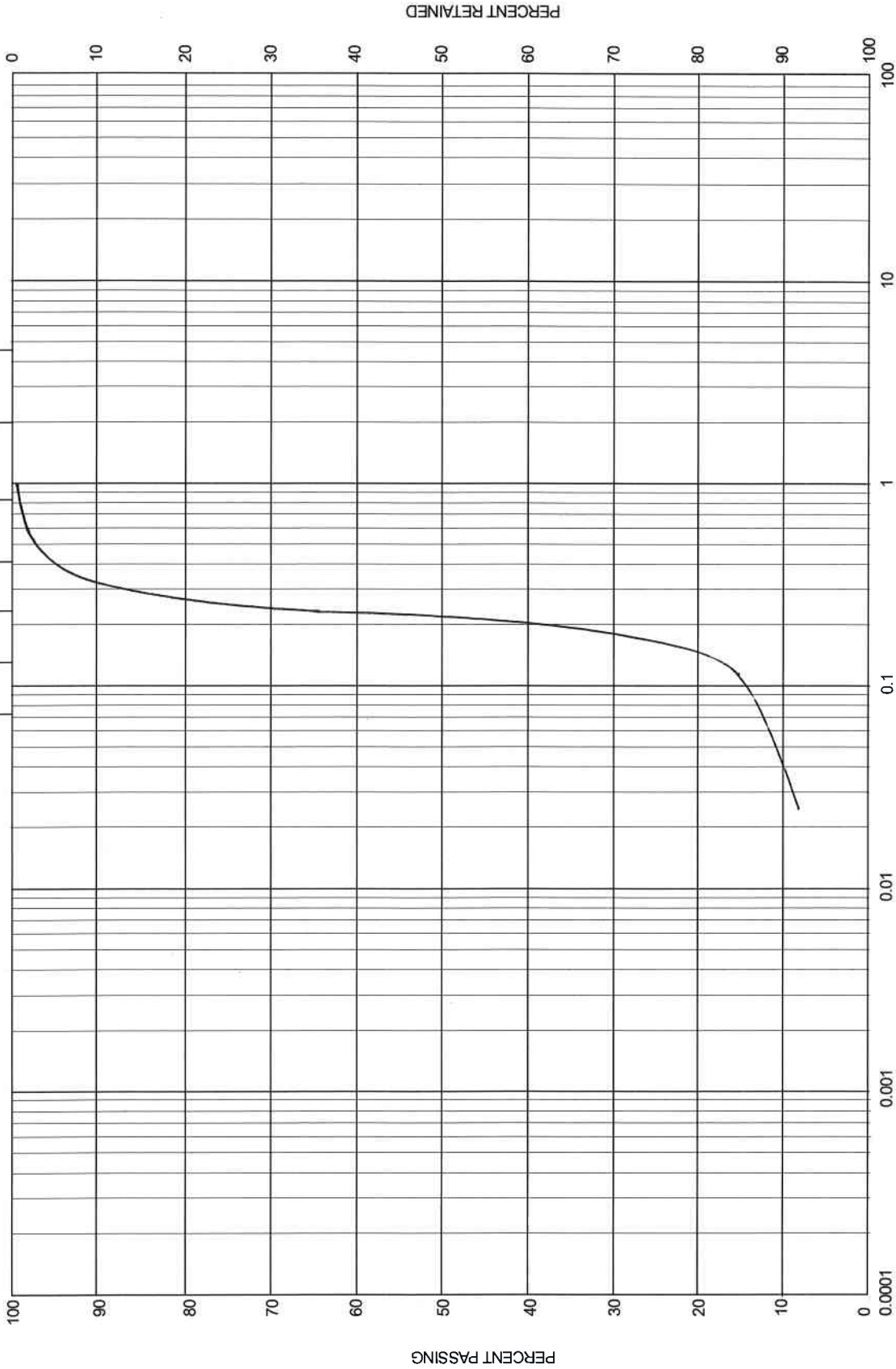
0m - 0.3m	black TOPSOIL
0.3m - 1.5m	grey to dark grey, soft, dry to wet (~0.6m) fine SAND with some silt
1.5m - 4.9m	grey, very compact, wet SILT and SAND till with some gravel and clay, sand seams near base
4.9m	rock refusal

- 5.1cm-diameter PVC monitoring well installed to base of borehole. 1.5m of #10 slot PVC screen at base. Imported sand 2.4m to 4.9m. Bentonite set grade to 2.4m.
- Water Level 0.81m below grade June 28, 2018.
- Sample 2 - 1.5m to 2.0m
Clay - 13%
Silt - 37%
Sand - 34%
Gravel - 16%

GRAIN SIZE DISTRIBUTION CHART

PROJECT / SAMPLE | Long Point Road Subdivision - BH1, S1 - 0.3m to 0.8m

← HYDROMETER ANALYSIS → SIEVE NUMBER (US STANDARD SIEVE SIZES)

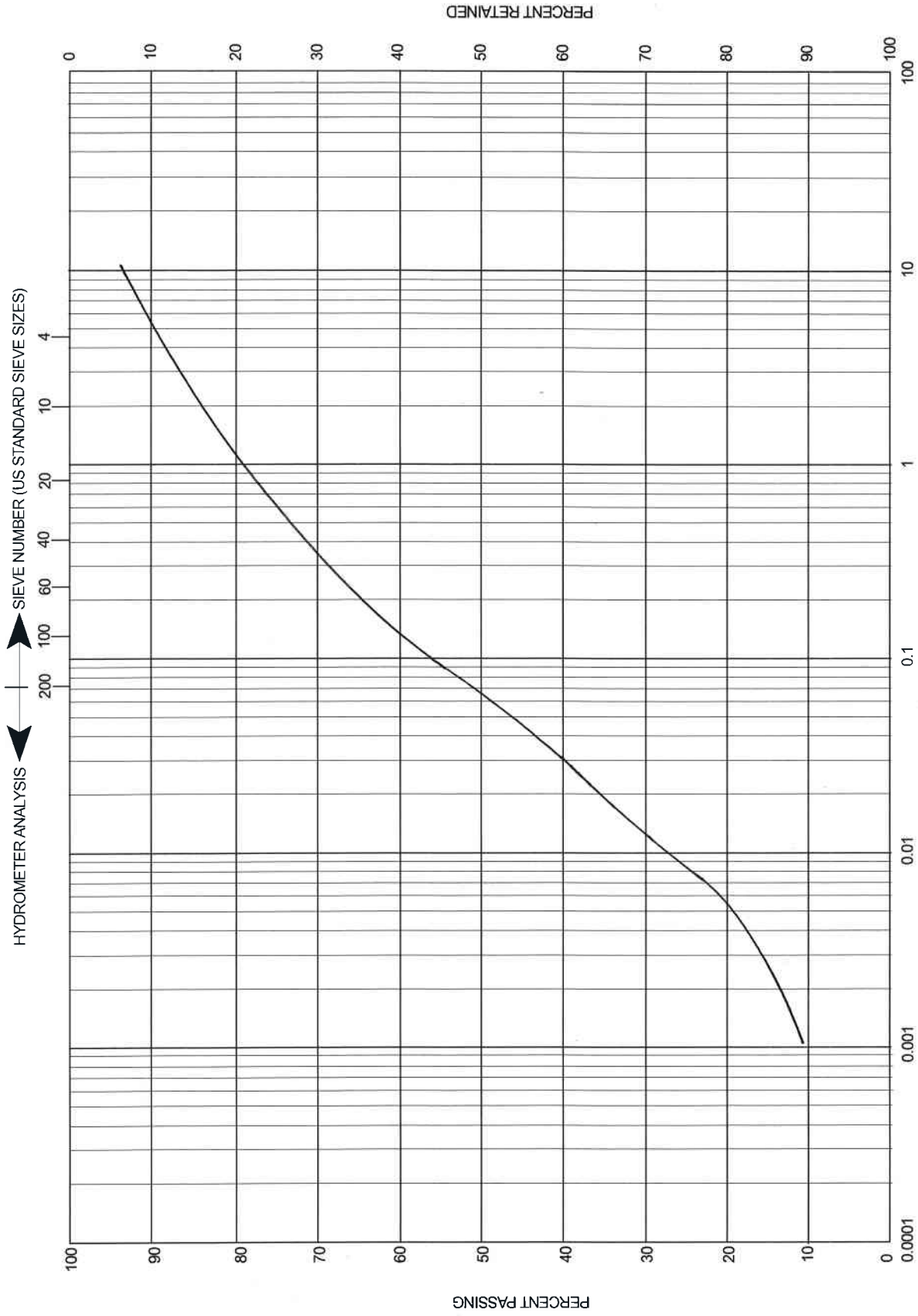


GRAIN SIZE IN MILLIMETRES

CLAY SIZE	SILT SIZE	SAND SIZE	GRAVEL SIZE	COBBLE SIZE

GRAIN SIZE DISTRIBUTION CHART

PROJECT / SAMPLE Long Point Road Subdivision - BH3, S2 - 1.5m to 2.0m



CLAY SIZE	SILT SIZE	SAND SIZE	GRAVEL SIZE	COBBLE SIZE

ON-SITE BOREHOLE
WELL RECORDS



Ontario

Ministry of the Environment and Climate Change

Well Tag No. (Place Sticker and/or Print Below)

A247422

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Measurements recorded in: Metric Imperial

Well Owner's Information

First Name: Tony Last Name / Organization: LESIAK E-mail Address: lesiak@orangeville.com Well Constructed by Well Owner

Mailing Address (Street Number/Name): 7 PINEHURST CR Municipality: LESLAKE Province: ON Postal Code: N7A 3H4 Telephone No. (inc. area code): 519 334 4192

Well Location

Address of Well Location (Street Number/Name): LONG POINT RD Township: Geo. Tshp. of Blue Huron Lot: 1 Concession: 1

County/District/Municipality: Grey County City/Town/Village: Rollingwood Province: Ontario Postal Code:

UTM Coordinates: Zone: 18 Easting: 1755162104 Northing: 497301427 Municipal Plan and Sublot Number: Plan 399 Pt. 12 S5AP Other: North 180 W 5 58' 9"

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft)
From	To			
<u>Brown</u>	<u>WET SAND</u>			<u>0</u> <u>5</u>
<u>Grey</u>	<u>SILT TILL</u>	<u>GRAVEL</u>	<u>DENSE</u>	<u>5</u> <u>15</u>
	<u>Lime Stone</u>		<u>HARD</u>	<u>15</u> <u>16</u>

Annular Space

Depth Set at (m/ft)	Type of Sealant Used (Material and Type)	Volume Placed (m ³ /ft ³)
From	To	
<u>16</u>	<u>8</u> <u>SILICA SAND</u>	
<u>8</u>	<u>1</u> <u>HYDRATED Bentonite</u>	
<u>1</u>	<u>0</u> <u>CONCRETE</u>	

Results of Well Yield Testing

After test of well yield, water was:
 Clear and sand free
 Other, specify _____

If pumping discontinued, give reason: _____

Time (min)	Draw Down		Recovery	
	Water Level (m/ft)	Time (min)	Water Level (m/ft)	Time (min)
Static Level				
1		1		
2		2		
3		3		
4		4		
5		5		
10		10		
15		15		
20		20		
25		25		
30		30		
40		40		
50		50		
60		60		

Pump intake set at (m/ft): _____

Pumping rate (l/min / GPM): _____

Duration of pumping: _____ hrs + _____ min

Final water level end of pumping (m/ft): _____

If flowing give rate (l/min / GPM): _____

Recommended pump depth (m/ft): _____

Recommended pump rate (l/min / GPM): _____

Well production (l/min / GPM): _____

Disinfected? Yes No

Method of Construction

Cable Tool Diamond Public Commercial Not used
 Rotary (Conventional) Jetting Domestic Municipal Dewatering
 Rotary (Reverse) Driving Livestock Test Hole Monitoring
 Boring Digging Irrigation Cooling & Air Conditioning
 Air percussion Industrial Other, specify _____
 Other, specify driller

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		Status of Well
			From	To	
<u>2"</u>	<u>PVC</u>	<u>3/16</u>	<u>11</u>	<u>13</u>	<input type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input checked="" type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify _____ <input type="checkbox"/> Other, specify _____
<u>4"</u>	<u>Steel CASING</u>	<u>1/8</u>	<u>1</u>	<u>13</u>	

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	
			From	To
<u>2"</u>	<u>PVC</u>	<u>010</u>	<u>16</u>	<u>11</u>

Water Details

Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested	Hole Diameter
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	Depth (m/ft) From To
<u>5</u>	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	<u>0</u> <u>16</u> <u>8</u>
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	

Well Contractor and Well Technician Information

Well Contractor's Licence No.: 4190 Municipality: _____ Address: _____

LONDON SOIL TEST LTD.
 712078 Southgate Sdrd. 71, RR #6
 Dundalk, ON N0C 1B0
 519-455-5777 info@londonsoil.com

Map of Well Location

Please provide a map below following instructions on the back.

Comments: see attached

Bus. telephone No. (inc. area code): _____ Name of Well Technician (Last Name, First Name): WATTS, Mike

Well Technician's Licence No.: NA 1 Signature of Technician and/or Contractor: [Signature] Date Submitted: 2014/05/07

Well owner's information package delivered: Yes No

Date Package Delivered: Y|Y|Y|Y|M|M|D|D

Date Work Completed: [Signature]

Ministry Use Only

Audit No.: 285305

Received: _____

20182110998



A047422
Z286305

Lo

Map data ©2018 Google

Google



Ontario

Ministry of the Environment and Climate Change

Well Tag No. (Place Sticker and/or Print Below)

A247423

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Measurements recorded in: Metric Imperial

Well Owner's Information

First Name: TONY Last Name / Organization: LESIAK E-mail Address: TLesiak@canadawater.com

Mailing Address (Street Number/Name): 7 KENHURST CR. Municipality: ETOBICOKE Province: ON Postal Code: M1R 3A7 Telephone No. (inc. area code): 416 233 4488

Well Location

Address of Well Location (Street Number/Name): Long Point RD Township: Co. Tshp of Collingwood Lot: R 10:21 Concession: 1

County/District/Municipality: GREY COUNTY City/Town/Village: Town of Blue Collingwood, Municipality: Ontario Postal Code: _____

UTM Coordinates Zone, Easting, Northing: NAD 83 175156014949301410 Municipal Plan and Sublot Number: Plan 599 PLOT 85RP Other: 1602186 P 458:9

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Brown	SAND		WET.	0	5
Grey	SILT TILL	GRAVEL	Dense.	5	15
Grey	Light Silt Bedrock		HARD.	15	

Annular Space			Results of Well Yield Testing			
Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m ³ /ft ³)	After test of well yield, water was:	Draw Down	Recovery
15	8	SILICA SAND		<input type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify	Time (min) / Water Level (m/ft)	Time (min) / Water Level (m/ft)
8	1	HYDRATED Bentonite		If pumping discontinued, give reason:	Static Level	
1	0	CONCRETE		Pump intake set at (m/ft)	1	1
				Pumping rate (l/min / GPM)	2	2
				Duration of pumping (hrs + min)	3	3
				Final water level end of pumping (m/ft)	4	4
				If flowing give rate (l/min / GPM)	5	5
				Recommended pump depth (m/ft)	10	10
				Recommended pump rate (l/min / GPM)	15	15
				Well production (l/min / GPM)	20	20
				Disinfected? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	25	25
					30	30
					40	40
					50	50
					60	60

Method of Construction: Other, specify: digger

Well Use: Public Commercial Not used Domestic Municipal Dewatering Livestock Test Hole Monitoring Irrigation Cooling & Air Conditioning Industrial Other, specify

Construction Record - Casing				Status of Well	
Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Well Thickness (cm/in)	Depth (m/ft) From	To	
2"	PVC	3/16	10	13	<input type="checkbox"/> Water Supply
4"	STEEL STRIP CASING	1/8	1	13	<input type="checkbox"/> Replacement Well
					<input type="checkbox"/> Test Hole
					<input type="checkbox"/> Recharge Well
					<input type="checkbox"/> Dewatering Well
					<input checked="" type="checkbox"/> Observation and/or Monitoring Hole
					<input type="checkbox"/> Alteration (Construction)
					<input type="checkbox"/> Abandoned, Insufficient Supply
					<input type="checkbox"/> Abandoned, Poor Water Quality
					<input type="checkbox"/> Abandoned, other, specify
					<input type="checkbox"/> Other, specify

Construction Record - Screen				
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To
2"	PVC	1010	15	10

Water Details		Hole Diameter	
Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify	Depth (m/ft) From	To
5		0	15
			8

Well Contractor and Well Technician Information

Business Name of Well Contractor: LONDON SOIL TEST LTD. 712078 Southgate Sdrd. 71, RR #6 Dundalk, ON N0C 1B0 519-455-5777 info@londonsoil.com

Well Contractor's Licence No.: 41190 Municipality: _____

Signature of Technician and/or Contractor: WATTS MIKE Date Submitted: _____

Well Technician's Licence No.: _____

Map of Well Location

Please provide a map below following instructions on the back.

Comments: see attached

Well owner's information package delivered: Yes No

Date Package Delivered: Y|Y|Y|Y M|M|D|D

Date Work Completed: Y|Y|Y|Y M|M|D|D

Ministry Use Only: Audit No. 2285303

20182110998

Long Point Rd

Long Point Rd

Long Point Rd

Long Point Rd

BH2

A247493
Z889303



Measurements recorded in: Metric Imperial

ADU7 401

Page 1 of 1

Well Owner's Information

First Name: Tony Last Name / Organization: LESIAK E-mail Address: tlesiak@canadawater.com

Mailing Address (Street Number/Name): 7 PINEHURST CR. Municipality: ETOBICOKE Province: ON Postal Code: M1A 3A4 Telephone No. (inc. area code): 416 733 4492

Well Constructed by Well Owner

Well Location

Address of Well Location (Street Number/Name): Home Point RD. Township: Geo. Twp of Collingwood Lot: 17 20121 Concession: 1

County/District/Municipality: GREY COUNTY City/Town/Village: Town of Blue Mountains Province: Ontario Postal Code: _____

UTM Coordinates: Zone: 17 Easting: 956110184930396 Northing: 46095974608530 Municipal Plan and Sublot Number: Plan 579 4608 8530 P.P. 1687186 Pts 4, 3, 8, 9

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From To
Brown	SAND		WT.	0 5
CRP?	SILT CLAY	GRAVEL	HARD	5 16
	BED ROCK			16 -

Annular Space

Depth Set at (m/ft) From To	Type of Sealant Used (Material and Type)	Volume Placed (m ³ /ft ³)
16 8	SILICA SAND	
8 1	HYDROKIT Bentonite	
1 0	CONCRETE	

Results of Well Yield Testing

After test of well yield, water was:
 Clear and sand free
 Other, specify _____

If pumping discontinued, give reason: _____

Time (min)	Draw Down		Recovery	
	Water Level (m/ft)	Time (min)	Water Level (m/ft)	Time (min)
Static Level	5			
1		1		
2		2		
3		3		
4		4		
5		5		
10		10		
15		15		
20		20		
25		25		
30		30		
40		40		
50		50		
60		60		

Pump intake set at (m/ft): _____

Pumping rate (l/min / GPM): _____

Duration of pumping: _____ hrs + _____ min

Final water level end of pumping (m/ft): _____

If flowing give rate (l/min / GPM): _____

Recommended pump depth (m/ft): _____

Recommended pump rate (l/min / GPM): _____

Well production (l/min / GPM): _____

Disinfected? Yes No

Method of Construction

Cable Tool Diamond Public Commercial Not used
 Rotary (Conventional) Jetting Domestic Municipal Dewatering
 Rotary (Reverse) Driving Livestock Test Hole Monitoring
 Boring Digging Irrigation Cooling & Air Conditioning
 Air percussion Industrial Other, specify _____
 Other, specify: digger

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		Status of Well
			From	To	
2"	PVC	3/16	11	+3	<input type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify _____ <input type="checkbox"/> Other, specify _____
4"	Steel casing	1/8	1	+3	

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	
			From	To
2"	PVC	.010	16	11

Water Details

Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	Hole Diameter	
		Depth (m/ft) From To	Diameter (cm/in)
5		0	16 8

Well Contractor and Well Technician Information

Well Contractor's Licence No.: 4190 Municipality: _____

Address: _____

Well Contractor: LONDON SOIL TEST LTD. 712078 Southgate Sdrd. 71, RR #6 Dundalk, ON N0C 1B0 519-455-5777 info@londonsoil.com

Map of Well Location

Please provide a map below following instructions on the back.

Comments: see attached

Business telephone no. (inc. area code): _____ Name of well technician (Last Name, First Name): WALES MIKE

Well Technician's Licence No.: _____ Signature of Technician and/or Contractor: _____ Date Submitted: _____

Ministry Use Only

Audit No.: 285304

Well owner's information package delivered: Yes No

Date Package Delivered: Y|Y|Y|Y|M|M|D|D

Date Work Completed: _____

20182110998

Long Point Rd

Long Point Rd

Long Point Rd

Long Point Rd

BH3

904-742-2830
285304

Well Owner Information Package

Protect your health and our shared groundwater

Now that you have a well on your property, you are legally responsible for the proper maintenance and abandonment (plugging and sealing) of your well.

A poorly maintained or improperly abandoned well could result in contaminated well water and groundwater, and it could affect your health.

The following tips will help you protect your well:

- Test the quality of your well water on a regular basis and look for changes in the water's appearance (e.g. colour, taste, odour)
- Keep surface water and foreign materials (e.g. insects and mice) from entering the well by securing the well cap in place and checking your well regularly for signs of rust and wear, cracks, holes or gaps in the well's structure
- If materials get in your well, safely remove them
- Keep ponded water, vehicles, pet waste, salt and fertilizer away from the well
- Make sure the ground around your well slopes away from your well
- Ensure the well is accessible for future repairs and maintain the minimum above ground height (typically 40 cm above the surface)
- Check for and identify abnormal sounds. They could indicate wear on the well's pump, waterlines or electrical cables or other issues
- Check the pump's efficiency. If the pump is continually running or losing pressure, it may be a sign of a crack or hole in the waterlines
- Ensure your septic tank system works and is pumped out regularly to prevent contamination of your well water

For information on testing the quality of your well water, visit:

- publichealthontario.ca (search "water testing") to request a drinking water sample collection kit for free bacterial testing
- ontario.ca/page/list-licensed-laboratories to find a licensed laboratory for chemical testing (note: laboratories charge a fee for this service)

Inspecting your well can be dangerous work. If you are not familiar with wells, let an experienced and licensed well technician do the work.

ontario.ca/ministry-environment

Before inspecting a well, make sure to:

- Shut off the power supply to the pump
- Assess the structure of the well and nearby ground to make sure they are stable before approaching the well
- Carefully remove the well cap and take all necessary precautions to make sure people and animals cannot fall into the well

If you no longer use your well or aren't maintaining it for future use as a well, it must be properly abandoned (plugged and sealed).

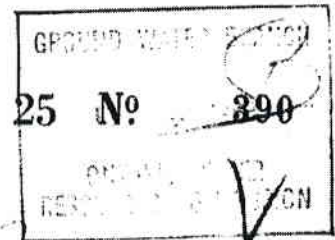
If you have a water quality or quantity problem or your well is in need of repair, upgrade or abandonment, see the licensed well contractor list on ontario.ca/findwellcontractors.

For more information on properly maintaining or abandoning your well:

- visit ontario.ca/propertywells
- call 1-888-396-9355 (WELL)
- email wellshelpdesk@ontario.ca

For more information on your legal obligations, the Wells Regulation (under the Ontario Water Resources Act) is available at ontario.ca/laws.

OFF-SITE HISTORICAL
WELL RECORDS



UTM 1172 5156 108 E

BR 49 29 9 80 N

41A/9/00

The Ontario Water Resources Commission Act

Elev. 5702580

WATER WELL RECORD

Basin 221 Grey

Township, Village, Town or City Collingwood

Con. T Lot 21

Date completed 18 NOV 1961

Address

Casing and Screen Record

Inside diameter of casing 4"

Total length of casing 15

Type of screen -

Length of screen -

Depth to top of screen -

Diameter of finished hole 4"

Pumping Test

Static level 8

Test-pumping rate 2 G.P.M.

Pumping level 10'

Duration of test pumping 1 HR.

Water clear or cloudy at end of test Clear

Recommended pumping rate 2 G.P.M.

with pump setting of 35' feet below ground surface

Well Log

Water Record

Overburden and Bedrock Record

	From ft.	To ft.	Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
T. M. SAND	0	17		
L. M. STONE	17	38	35	FRESH

For what purpose(s) is the water to be used?

COTTAGE

Is well on upland, in valley, or on hillside?

Drilling or Boring Firm

Address P. R. Collingwood

Licence Number 577

Name of Driller or Borer

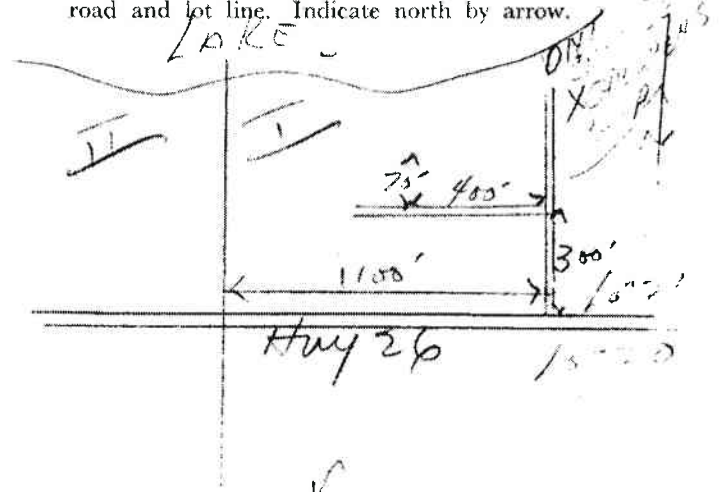
Address S. P. 1/62

Date 11/1/62

(Signature of Licensed Drilling or Boring Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



TM 1 1 7 2 5 5 6 1 0 0
 4 R 4 9 3 0 0 0 0 0
 ev. 1 5 R 0 5 9 0
 basin 2 2 1



Water management in Ontario

The Ontario Water Resources Commission Act

250-2974

41A
9

WATER WELL RECORD

County or District **GREY** Township, Village, Town or City **COLLINGWOOD**

Con. **L** Lot **#22** Date completed **23 June 1969**
(day month year)

Address **TOWNLINE (COLLINGWOOD)**

Casing and Screen Record

Pumping Test

Inside diameter of casing **6"**
 Total length of casing **23'**
 Type of screen **-**
 Length of screen **-**
 Depth to top of screen **-**
 Diameter of finished hole **6"**

Static level **4'**
 Test-pumping rate **10** G.P.M.
 Pumping level **25'**
 Duration of test pumping **1 hr**
 Water clear or cloudy at end of test **clear**
 Recommended pumping rate **10** G.P.M.
 with pump setting of **25'** feet below ground surface

Well Log

Water Record

Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
(some large stones) stoney clay	0	14		
layers of grey shale	14	23		
grey limestone	23	28	28	fresh

For what purpose(s) is the water to be used? **Cottage**

Is well on upland, in valley, or on hillside? **in beside**

Drilling or Boring Firm **Ken Nightow & Sons**

Address **stayner**

Licence Number **3404**

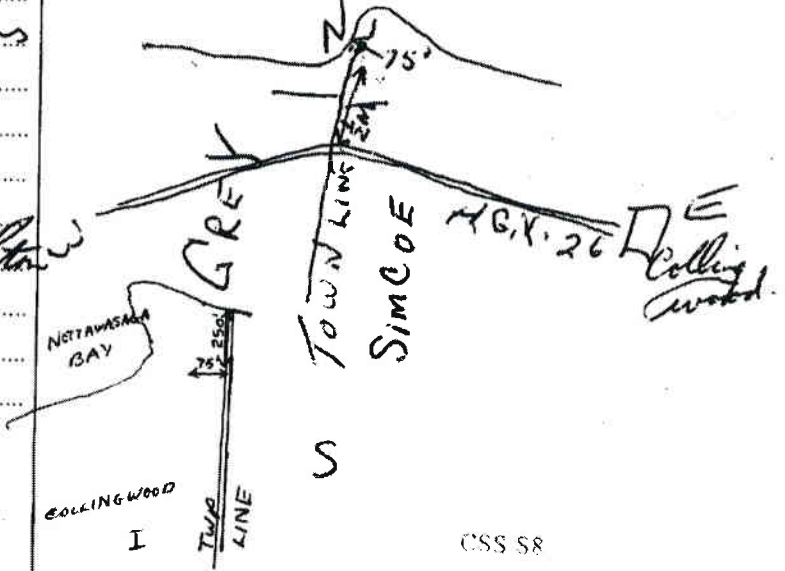
Name of Driller or Borer **Ferry & Ken Nightow**

Address **stayner**

Date **5 July 69**
Ken Nightow
 (Signature of Licensed Drilling or Boring Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



Form 7

OWRC COPY Long Point

CSS 58



The Ontario Water Resources Commission Act

WATER WELL RECORD

41A904
C

Water management in Ontario 1. PRINT ONLY IN SPACES PROVIDED 2. CHECK CORRECT BOX WHERE APPLICABLE

COUNTY OR DISTRICT **GREY** TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE **COLLINGWOOD** CON., BLOCK, TRACT, SURVEY, ETC. **I** LOT **021**

DATE COMPLETED DAY **02** NO. **1001** YR. **70**

R. # **3** COLLINGWOOD, D.T.

RC **30290** ELEVATION **4 0596** NC **5** BASIN CODE **22**

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET	
				FROM	TO
BL.	TOPSOIL			0	1
OR.	SAND	CLAY & STONES		1	7
BL.	CLAY	SAND & STONES		7	17
DARK.	SHALE	CLAY	LAYERS.	17	23
	BEDROCK.		DARK LIMESTONE	23	33'6"

31 **0001802** 32 **00074090512 00178152912 0023 11705T 0034 120**

41 WATER RECORD		51 CASING & OPEN HOLE RECORD		61 PLUGGING & SEALING RECORD	
WATER FOUND AT - FEET	KIND OF WATER	INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM TO
0033	1 <input checked="" type="checkbox"/> FRESH 2 <input checked="" type="checkbox"/> SALTY 3 <input type="checkbox"/> SULPHUR 4 <input type="checkbox"/> MINERAL	04"	1 <input checked="" type="checkbox"/> STEEL 2 <input type="checkbox"/> GALVANIZED 3 <input type="checkbox"/> CONCRETE 4 <input type="checkbox"/> OPEN HOLE	STD.	0 0033 0034
DEPTH SET AT - FEET	MATERIAL AND TYPE	CEMENT GROUT, LEAD PACKER, ETC.			

71 PUMPING TEST METHOD PUMP BAILER

10 PUMPING RATE **0003** GPM

11-14 DURATION OF PUMPING **01** HOURS **00** MINS.

15-18 WATER LEVELS DURING PUMPING

19-21 STATIC LEVEL **-01.7** FEET

22-24 15 MINUTES **26.28** FEET

25-27 30 MINUTES **29.31** FEET

28-30 45 MINUTES **32.34** FEET

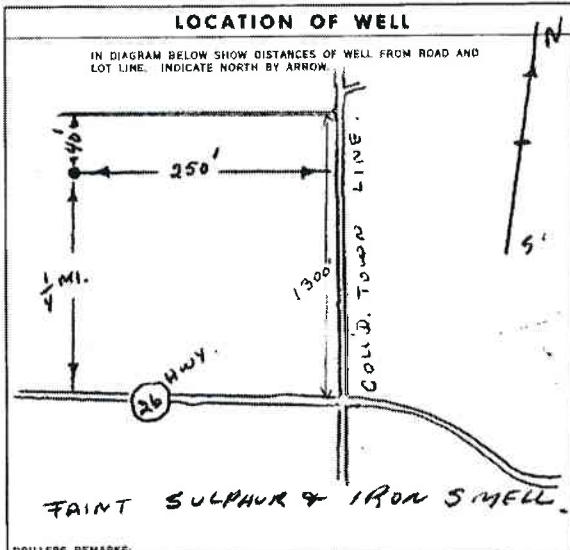
31-33 60 MINUTES **35.37** FEET

34-42 PUMP INTAKE SET AT **030** FEET

43-45 RECOMMENDED PUMP SETTING **030** FEET

46-49 RECOMMENDED PUMPING RATE **2703** GPM

50-53 GPM/FT SPECIFIC CAPACITY



54 FINAL STATUS OF WELL WATER SUPPLY

55-56 WATER USE **01** DOMESTIC

57 METHOD OF DRILLING CABLE TOOL

CONTRACTOR NAME OF WELL CONTRACTOR **F. WRIGHT & SON** LICENCE NUMBER **3605**

ADDRESS **140-6th ST. COLLINGWOOD**

NAME OF DRILLER OR BORER **F. WRIGHT** LICENCE NUMBER **3605**

SIGNATURE OF CONTRACTOR *[Signature]* SUBMISSION DATE **DAY 17** MO **JAN** YR. **70**

OFFICE USE ONLY

DATA SOURCE **1** CONTRACTOR **5510** DATE RECEIVED **130870**

DATE OF INSPECTION **P/L** INSPECTOR **P/L**

REMARKS **529 85 CSS 58**



MINISTRY OF THE ENVIRONMENT
The Ontario Water Resources Act
WATER WELL RECORD

41 A/9W

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK CORRECT BOX WHERE APPLICABLE

2504485 25003 10/11

COUNTY OR DISTRICT: GREY TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: COLLINGWOOD CON. BLOCK, TRACT, QUARTER: Plan 527 LOT: 21-27
DATE COMPLETED: DAY 16 MO 12 YR 73
CRAIKLEITH

2504485 17 556164 4930352 4 600 5 22 OCT 17, 1975 69

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET	
				FROM	TO
Brown	SAND clay			0	6
Brown	stony clay			6	12
Grey	shale			12	18
11'	Limestone		very hard	18	58

OWRG
P.7

31 32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
10-13	1 <input checked="" type="checkbox"/> FRESH 2 <input checked="" type="checkbox"/> SULPHUR 3 <input checked="" type="checkbox"/> SALTY 4 <input checked="" type="checkbox"/> MINERAL
18-21	1 <input checked="" type="checkbox"/> FRESH 2 <input checked="" type="checkbox"/> SULPHUR 3 <input checked="" type="checkbox"/> SALTY 4 <input checked="" type="checkbox"/> MINERAL
20-23	1 <input checked="" type="checkbox"/> FRESH 2 <input checked="" type="checkbox"/> SULPHUR 3 <input checked="" type="checkbox"/> SALTY 4 <input checked="" type="checkbox"/> MINERAL
25-28	1 <input checked="" type="checkbox"/> FRESH 2 <input checked="" type="checkbox"/> SULPHUR 3 <input checked="" type="checkbox"/> SALTY 4 <input checked="" type="checkbox"/> MINERAL
30-33	1 <input checked="" type="checkbox"/> FRESH 2 <input checked="" type="checkbox"/> SULPHUR 3 <input checked="" type="checkbox"/> SALTY 4 <input checked="" type="checkbox"/> MINERAL

51 CASING & OPEN HOLE RECORD

DEPTH - FEET	WELL THICKNESS INCHES	MATERIAL
10-13	1/2"	2 GALVANIZED
18-21	1/2"	2 GALVANIZED
20-23	1/2"	2 GALVANIZED
25-28	1/2"	2 GALVANIZED
30-33	1/2"	2 GALVANIZED

Pulled

SCREEN

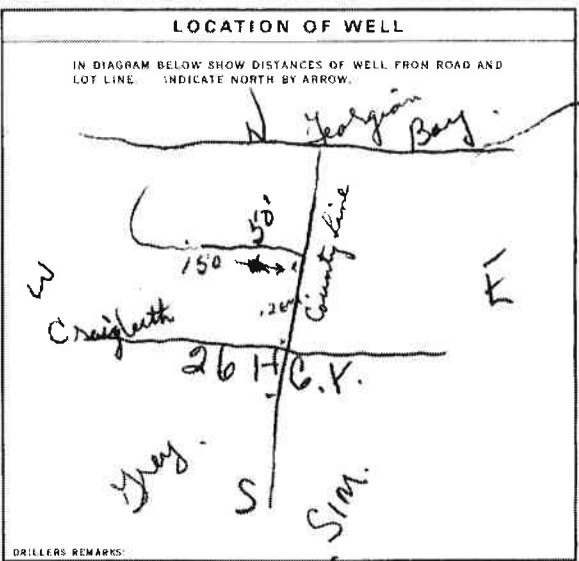
SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET	MATERIAL AND TYPE	CEMENT GROUT LEAD PACKER, ETC.
10-13		
18-21		
20-23		
25-28		
30-33		

71 PUMPING TEST

PUMPING TEST METHOD	PUMP NO RATE	DURATION OF PUMPING
1 <input checked="" type="checkbox"/> PUMP 2 <input checked="" type="checkbox"/> RAISER		15-18 HOURS 19-22 MINS
STATIC WATER LEVEL	WATER LEVELS DURING PUMPING	1 <input type="checkbox"/> PUMPING 2 <input type="checkbox"/> RECOVERY
25-28 FEET	15 MINUTES 30 MINUTES 45 MINUTES 60 MINUTES	
	FEET FEET FEET FEET FEET FEET	
IF FLOODING USE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
	FEET	1 <input type="checkbox"/> CLEAR 2 <input type="checkbox"/> CLOUDY
RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
1 <input type="checkbox"/> SHALLOW 2 <input type="checkbox"/> DEEP	FEET	GPM



81 FINAL STATUS OF WELL

1 WATER SUPPLY 5 ABANDONED, INSUFFICIENT SUPPLY
2 OBSERVATION WELL 6 ABANDONED, POOR QUALITY
3 TEST HOLE 7 UNFINISHED
4 RECHARGE WELL

82 WATER USE

1 DOMESTIC 5 COMMERCIAL
2 STOCK 6 MUNICIPAL
3 IRRIGATION 7 PUBLIC SUPPLY
4 INDUSTRIAL 8 COOLING OR AIR CONDITIONING
 OTHER 9 NOT USED

83 METHOD OF DRILLING

1 CABLE TOOL 6 BORING
2 ROTARY (CONVENTIONAL) 7 DIAMOND
3 ROTARY (REVERSE) 8 JETTING
4 ROTARY (FTW) 9 DRIVING
5 AIR PERCUSSION

CONTRACTOR: KEN MIGHTON 3602
ADDRESS: STAYNER.
NAME OF DRILLER OR BORER: LARRY & KEN MIGHTON
SIGNATURE OF CONTRACTOR: Kenneth A. Mighton
SUBMISSION DATE: DAY _____ MO _____ YR _____

OFFICE USE ONLY

DATA SOURCE: 1 3602 DATE RECEIVED: 160174
DATE OF INSPECTION: 26, 9, 74 INSPECTOR: 71P
REMARKS: [Signature]

CSS.S8



Ontario

MINISTRY OF THE ENVIRONMENT The Ontario Water Resources Act WATER WELL RECORD

4/A
9/11

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK CORRECT BOX WHERE APPLICABLE

11

2504867

25003

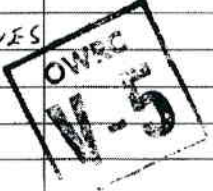
CON

01

COUNTY OR DISTRICT: **PREV** TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: **COLLINGWOOD** 9
 MUNICIPALITY: **COLLINGWOOD** 10 BLOCK, TRACT, SURVEY, ETC.: **1** LOT: **021**
 DATE COMPLETED: DAY **24** MO. **10** YR. **74**
 DISTRICT: **0352** RC: **4** ELEVATION: **595** RC: **5** BASIN CODE: **22** APR 06, 1976

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET	
				FROM	TO
BROWN	TOP SOIL		SHALLOW	0	1
BROWN	SAND	GRAVEL		1	6
GREY	CLAY	GRAVEL STONES		6	28
GREY	SHALE			28	63



31 **000160228** **000662811** **00282051112** **0063217**
 32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
10-13	1 <input type="checkbox"/> FRESH 3 <input type="checkbox"/> SULPHUR 2 <input type="checkbox"/> SALTY 4 <input type="checkbox"/> MINERAL
13-18	1 <input type="checkbox"/> FRESH 3 <input type="checkbox"/> SULPHUR 2 <input type="checkbox"/> SALTY 4 <input type="checkbox"/> MINERAL
20-23	1 <input type="checkbox"/> FRESH 3 <input type="checkbox"/> SULPHUR 2 <input type="checkbox"/> SALTY 4 <input type="checkbox"/> MINERAL
25-28	1 <input type="checkbox"/> FRESH 3 <input type="checkbox"/> SULPHUR 2 <input type="checkbox"/> SALTY 4 <input type="checkbox"/> MINERAL
30-33	1 <input type="checkbox"/> FRESH 3 <input type="checkbox"/> SULPHUR 2 <input type="checkbox"/> SALTY 4 <input type="checkbox"/> MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET
06-10-11	1 <input type="checkbox"/> STEEL 2 <input type="checkbox"/> GALVANIZED 3 <input type="checkbox"/> CONCRETE 4 <input type="checkbox"/> OPEN HOLE		10-18
17-18	1 <input type="checkbox"/> STEEL 2 <input type="checkbox"/> GALVANIZED 3 <input type="checkbox"/> CONCRETE 4 <input type="checkbox"/> OPEN HOLE		20-23
24-25	1 <input type="checkbox"/> STEEL 2 <input type="checkbox"/> GALVANIZED 3 <input type="checkbox"/> CONCRETE 4 <input type="checkbox"/> OPEN HOLE		27-30

REMOVED

SCREEN

SECTION OF OPENING (SLOT NO.)	DIAMETER	LENGTH
31-33	INCHES	FEET
34-38	INCHES	FEET

MATERIAL AND TYPE: _____ DEPTH TO TOP OF SCREEN: 41-44 FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET	MATERIAL AND TYPE	SEGMENT GROUP LEAD PACKER, ETC.
10-13		14-17
18-21		21-25
28-31		30-33

71 PUMPING TEST

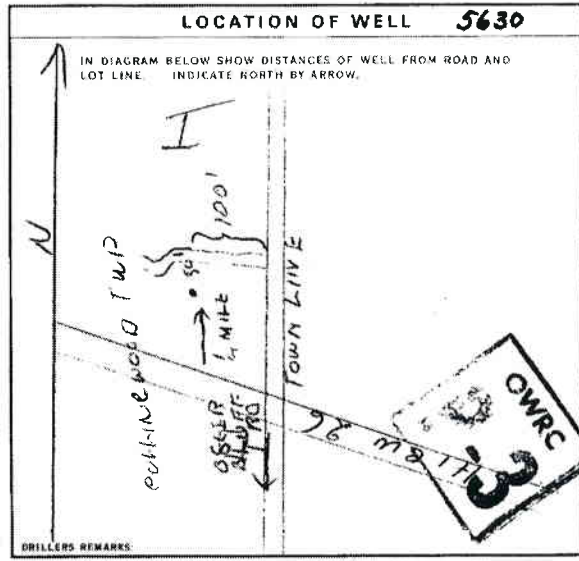
PUMPING TEST METHOD: 1 PUMP 2 BALER

STATIC LEVEL: 19-21 FEET

WATER LEVELS DURING PUMPING:

15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
20-24 FEET	29-31 FEET	32-34 FEET	38-37 FEET

RECOMMENDED PUMP TYPE: SHALLOW DEEP



FINAL STATUS OF WELL 5

1 WATER SUPPLY 2 OBSERVATION WELL 3 TEST HOLE 4 RECHARGE WELL

5 ABANDONED - INSUFFICIENT SUPPLY 6 ABANDONED - POOR QUALITY 7 UNFINISHED

WATER USE 10-16

1 DOMESTIC 2 STOCK 3 IRRIGATION 4 INDUSTRIAL 5 OTHER

6 COMMERCIAL 7 MUNICIPAL 8 PUBLIC SUPPLY 9 COOLING OR AIR CONDITIONING 10 NOT USED

METHOD OF DRILLING 17

1 CABLE TOOL 2 ROTARY (CONVENTIONAL) 3 ROTARY (REVERSE) 4 ROTARY (AIR) 5 AIR PERCUSSION

6 BORING 7 DIAMOND 8 JETTING 9 DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: **DAWSON M SEWELL** LICENCE NUMBER: **4716**

ADDRESS: **RRI DUNTHWON**

NAME OF DRILLER OR BORER: **SAME** LICENCE NUMBER: _____

SIGNATURE OF CONTRACTOR: *Dawson M Sewell* SUBMISSION DATE: DAY **07** MO. **11** YR. **74**

OFFICE USE ONLY

DATA SOURCE: **1** CONTRACTOR: **4716** DATE RECEIVED: **071174**

DATE OF INSPECTION: **June 24/75** INSPECTOR: **J.B.**

PREPARED BY: **P.B.**

CLASS: **WI**



Ministry of the Environment
Ontario

#17

The Ontario Water Resources Act WATER WELL RECORD

41714W

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK CORRECT BOX WHERE APPLICABLE

2507761 MUNICIPAL DISTRICT 25003 CON 01

COUNTY OR DISTRICT: Grey TOWNSHIP BOROUGH CITY TOWN VILLAGE: Collingwood CON. BLOCK TRACT SURVEY ETC.: 1
 DATE COMPLETED: (PART) 023"
04 DAY 08 MO 82 YEAR
 SURFACE ELEVATION: 30400 PC: 5 ELEVATION: 0600 MC: 5 BENCH MARK: 22

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET	
				FROM	TO
BLACK	TOP SOIL			0	2
GREY	CLAY	STONES		2	13
GREY	CLAY	FINE SAND		13	22
BROWN	MEDIUM SAND	CLAY		22	23 1/2
BROWN	LIMESTONE		HARD	23 1/2	30

31 0002802 001320512 002220508 002440995 003061578
 32

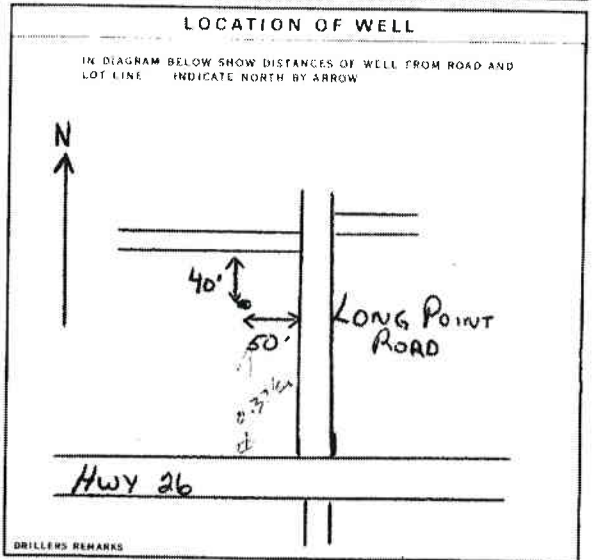
41 WATER RECORD
 WATER FOUND AT - FEET: 0024
 KIND OF WATER:
 1 FRESH 3 SULPHUR
 2 SALTY 4 MINERAL

51 CASING & OPEN HOLE RECORD
 MATERIAL: 188
 DEPTH: 23'8"
 1 STEEL
 2 GALVANIZED
 3 CONCRETE
 4 OPEN HOLE

SCREEN
 SIZE(S) OF OPENING: 1/2"
 DIAMETER: 34-38
 LENGTH: 38-40
 MATERIAL AND TYPE: STEEL

61 PLUGGING & SEALING RECORD
 DEPTH SET AT FEET: 23-28
 MATERIAL AND TYPE: CONCRETE

71 PUMPING TEST METHOD: 1 PUMP RATE: 001 DURATION OF PUMPING: 02
 WATER LEVELS DURING PUMPING:
 15 MINUTES: 024
 30 MINUTES: 028
 45 MINUTES: 028
 60 MINUTES: 028
 RECOMMENDED PUMP TYPE: SHALLOW
 RECOMMENDED PUMP SETTING: 029



FINAL STATUS OF WELL: 1
 WATER USE: 01
 METHOD OF DRILLING: 1

CONTRACTOR: DANIEL M SEWELL LICENCE NUMBER: 4716
 ADDRESS: RAVENHURST DUNTRON
 NAME OF DRILLER OR BOREHOLE: Charles Lowe
 SIGNATURE OF CONTRACTOR: Daniel M Sewell

OFFICE USE ONLY
 CONTRACTOR: 4716 DATE: 01 10 82
 INSPECTOR: W.P. CSS.88

May 10, 2019

Ms. Brittany Robertson, P.Eng.
C.F. Crozier & Associates
40 Huron Street
Suite 301
Collingwood, ON
L9Y 4R3

**Wilson
Associates**

Consulting Hydrogeologists

Dear Ms. Robertson:

Re: Update of Subsurface Characterization Program
Follow-Up Watertable Observations
Proposed Long Point Road Subdivision, Blue Mountains

It is proposed to develop a ±22-lot urban residential subdivision on a ±2.2ha parcel of land located within Part of Lots 20 and 21, Concession 1, Geographic Township of Collingwood, Town of Blue Mountains (Plan 529, Part Lot 85, RP16R2186, Parts 4, 5, 8 & 9).

A subsurface investigation was completed to identify the seasonal high watertable level, the soil profile and the bedrock surface level, and was conducted through the installation of three exploratory boreholes/monitoring wells on June 7, 2018. The results of the 2018 investigation are summarized in the Wilson Associates Report dated July 6, 2018. Figure 1 (attached) shows the location of the site, borehole locations and inferred direction of shallow groundwater flow in June 2018.

To address concerns from the Municipality regarding the characterization of the high watertable surface, two additional sets of water level observations were undertaken December 13, 2018 (after a wet autumn period) and April 10, 2019 (immediately after final snowmelt).

The following table summarizes all water level observations to date.

		BH1	BH2	BH3
Approximate Ground Surface Elevation* (m above sea level)		179.8	180.1	180.7
Approximate Top of Casing Elevation* (m above sea level)		180.78	180.99	181.79
June 28, 2018	Water Level (m below grade)	0.68	0.58	0.81
	Approximate Water Level Elevation* (m above sea level)	179.12	179.52	179.89
December 13, 2018	Water Level (m below grade)	0.16	0.59	0.13
	Approximate Water Level Elevation* (m above sea level)	179.64	179.51	180.57

April 10, 2019	Water Level (m below grade)	0.05	0.43	0.03
	Approximate Water Level Elevation* (m above sea level)	179.75	179.67	180.67

Note: * Ground surface elevation is approximate, and was derived from survey mapping provided by C.F. Crozier & Associates for the property.

As indicated in the July 6, 2018 Report, it was anticipated that high spring water levels will be at or near current grade. The above monitoring data are consistent with this opinion.

Should you have any questions or require further detail, please do not hesitate to contact this office.

Yours sincerely,

IAN D. WILSON ASSOCIATES LIMITED


Geoffrey Rether, P. Geo.



Legend

- Parcels
- Large Scale Roads
- Provincial Highway
- County Road
- Township Road
- Seasonal Road

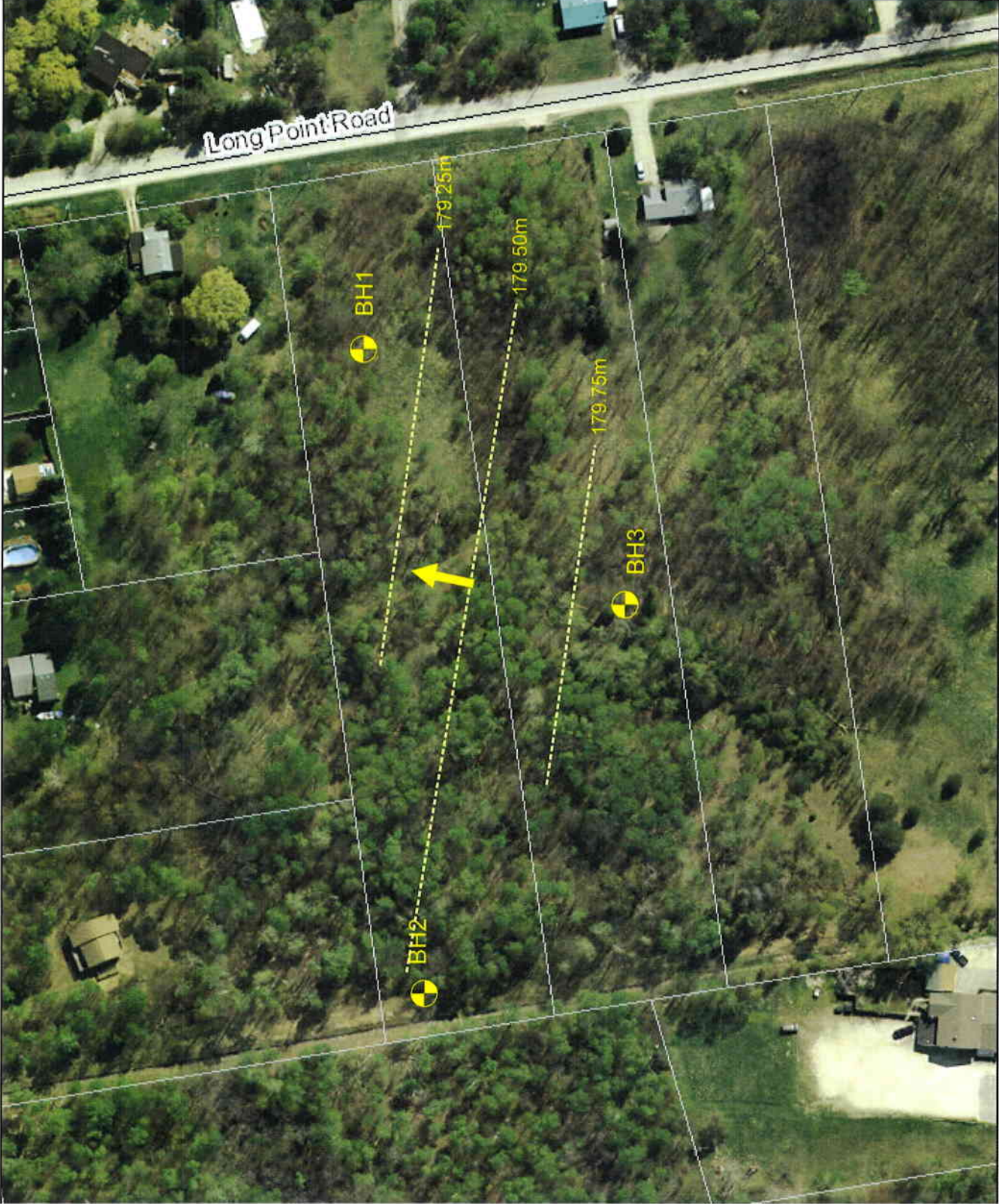
APPROXIMATE LOCATIONS OF EXPLORATORY BOREHOLES, APPROXIMATE (see report) CONTOURS OF THE WATERTABLE SURFACE ON JUNE 28, 2018, AND APPROXIMATE (see report) INFERRED DIRECTION OF SHALLOW GROUNDWATER FLOW

LONG POINT ROAD SUBDIVISION

FIGURE 1

SCALE: AS SHOWN

Notes



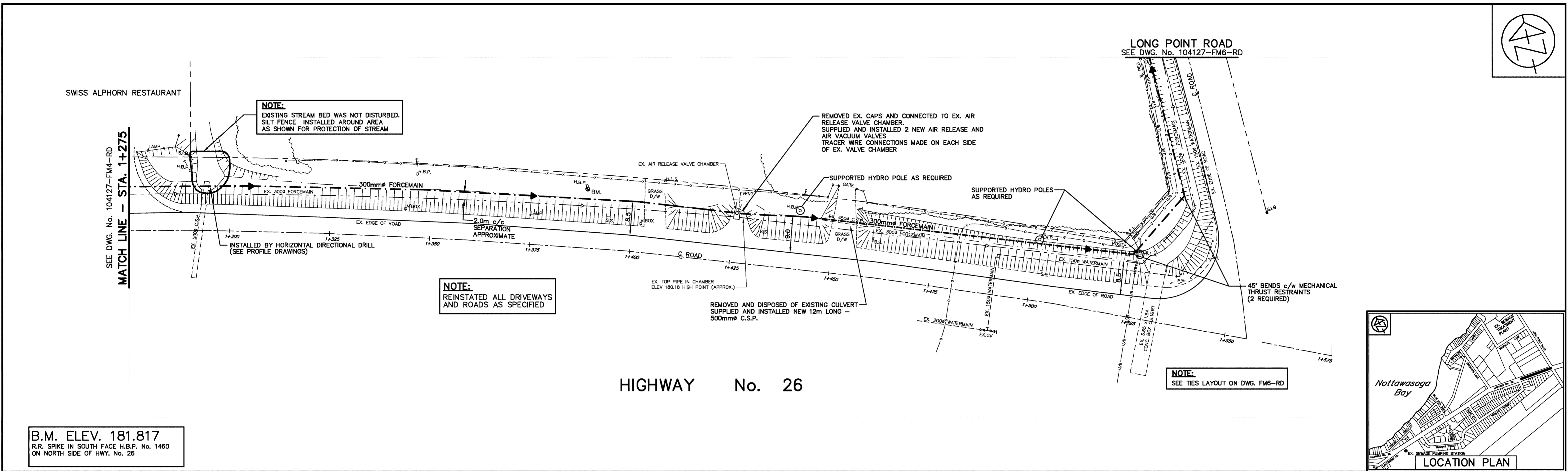
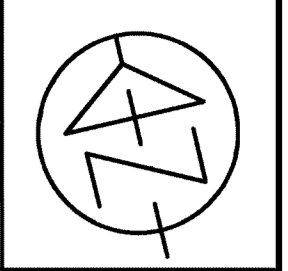
This map is a user generated static output from an internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

0.08 Kilometers

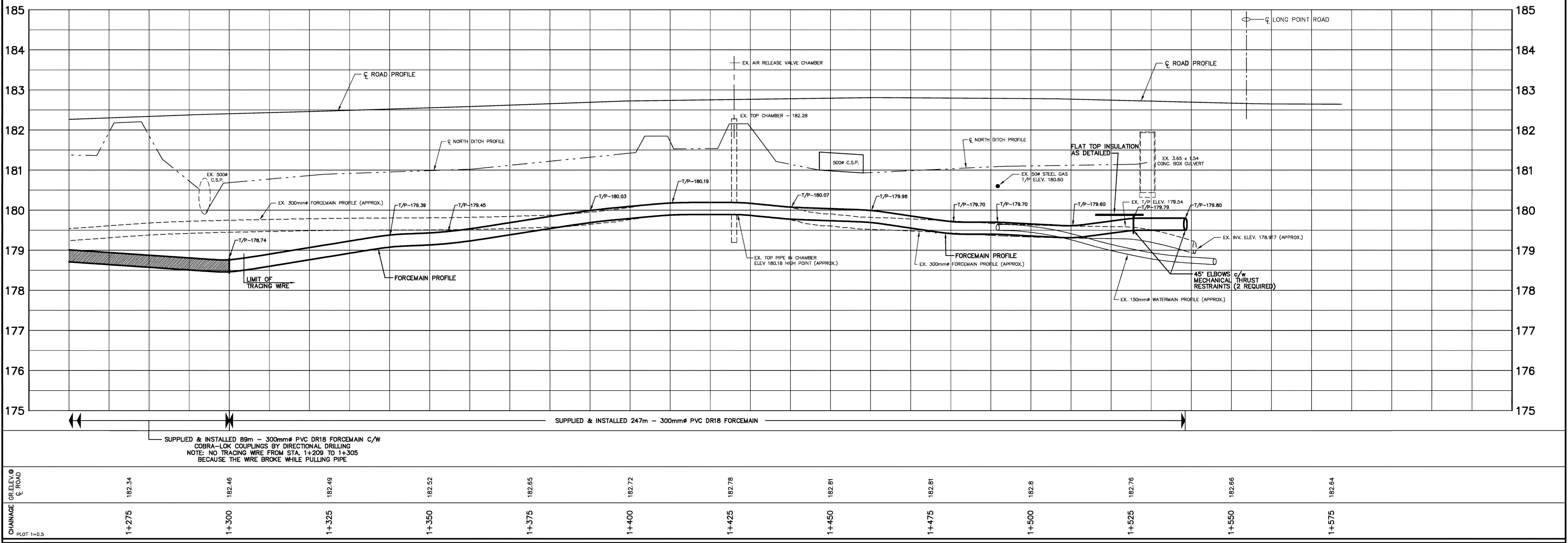
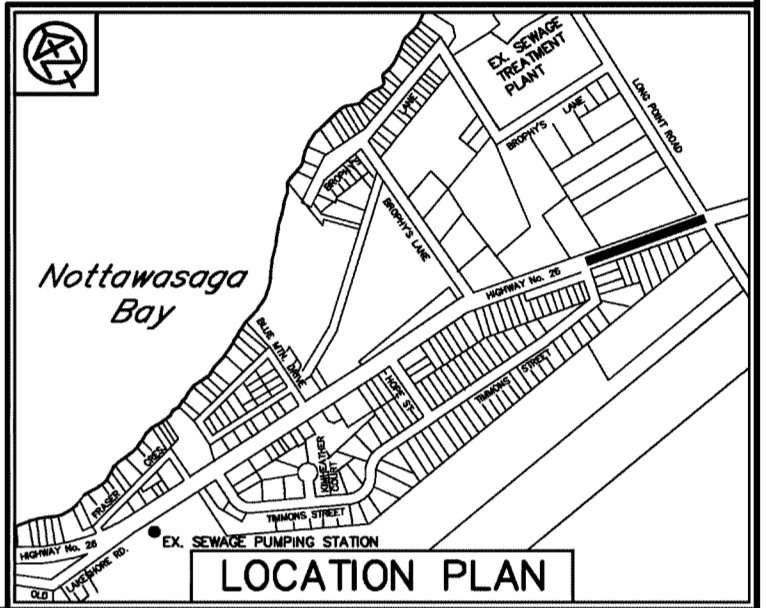


APPENDIX B

As-Constructed Drawings & Boundary Conditions Modeling Investigation



B.M. ELEV. 181.817
 R.R. SPIKE IN SOUTH FACE H.B.P. No. 1460
 ON NORTH SIDE OF HWY. No. 26



LEGEND

- PROPERTY LINE
- U/B BURIED BELL CABLE
- C BURIED GAS MAIN
- EXISTING WATER MAIN AND VALVE
- EXISTING SANITARY SEWER & M.H.
- EXISTING SEWAGE FORCEMAIN
- PROPOSED SEWAGE FORCEMAIN

NOTE: 1) LOCATIONS OF UTILITIES ARE APPROXIMATE.

RECORD DRAWING	
COMPILED BY: D.S.	DATE: SEPT. 2006
CHECKED BY: L.S.	DATE: NOV. 2006
DRAWN BY: P.C.S.	DATE: NOV. 2006
CHECKED BY: R.M.	DATE: DEC. 2006

NO.	REVISIONS	DATE	INITIAL
	REVISED AS RECORD DRAWING	DEC. 2006	R.M.

RECORD DRAWING
 NOTICE TO USERS

Information contained on this drawing may have changed since the completion of construction. Further, this drawing may contain information provided by others. While Ainley & Associates Limited believes this information to be reliable and correct as of the completion of construction, no warranty is provided as to its accuracy and/or completeness. As such, Ainley & Associates Limited shall not be responsible for any errors or omissions which may result from incorporation of the information herein.

SCALE: HORIZ. 1=500
 VERT. 1=50

DESIGN: N.M.S./R.M.

DRAWN: E.K./P.C.S.

CHECKED: M.W.A.

DATE: APR. 2006

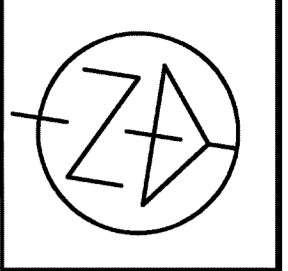


TOWN OF THE BLUE MOUNTAINS
 CRAIGLEITH AREA
 CONTRACT No. TBM-2006-3
 DUPLICATE FORCEMAIN

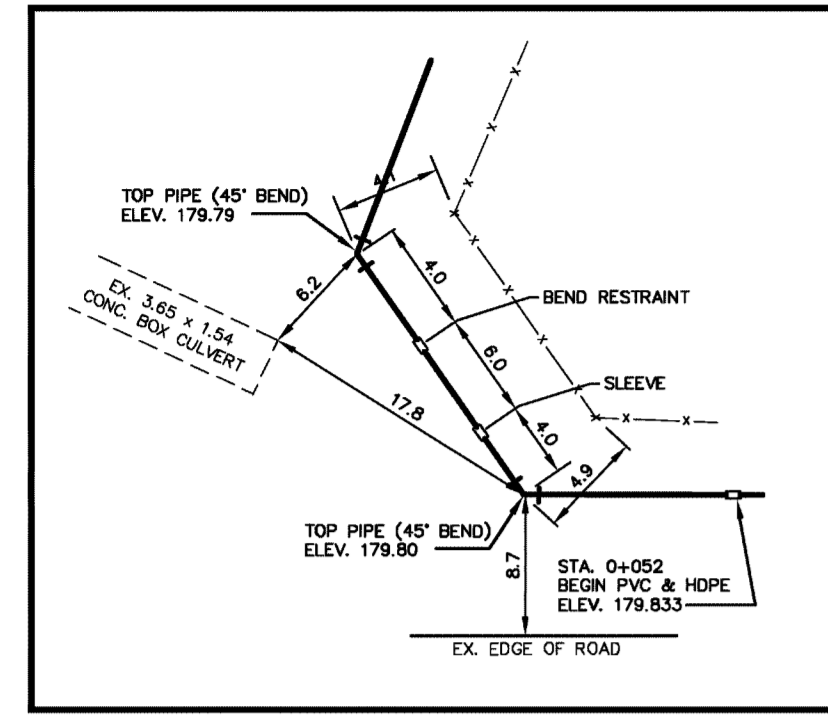
PLAN & PROFILE
 HIGHWAY No. 26
 STA. 1+275 TO LONG POINT ROAD

Ainley CONSULTING ENGINEERS PLANNERS

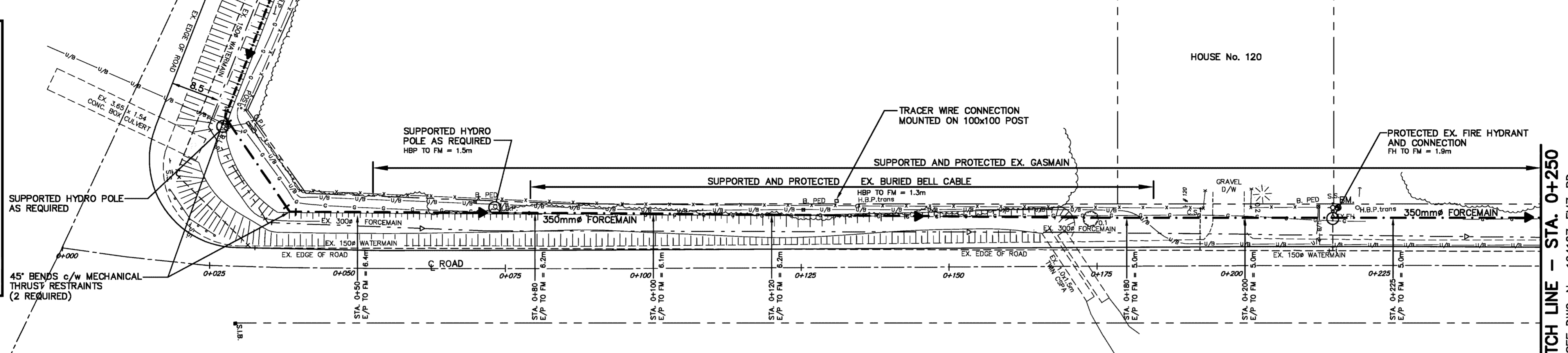
AAL-104127 DWG. FM5-RD



HIGHWAY No. 26
SEE DWG. No. 104127-FM5-RD



TIES LAYOUT

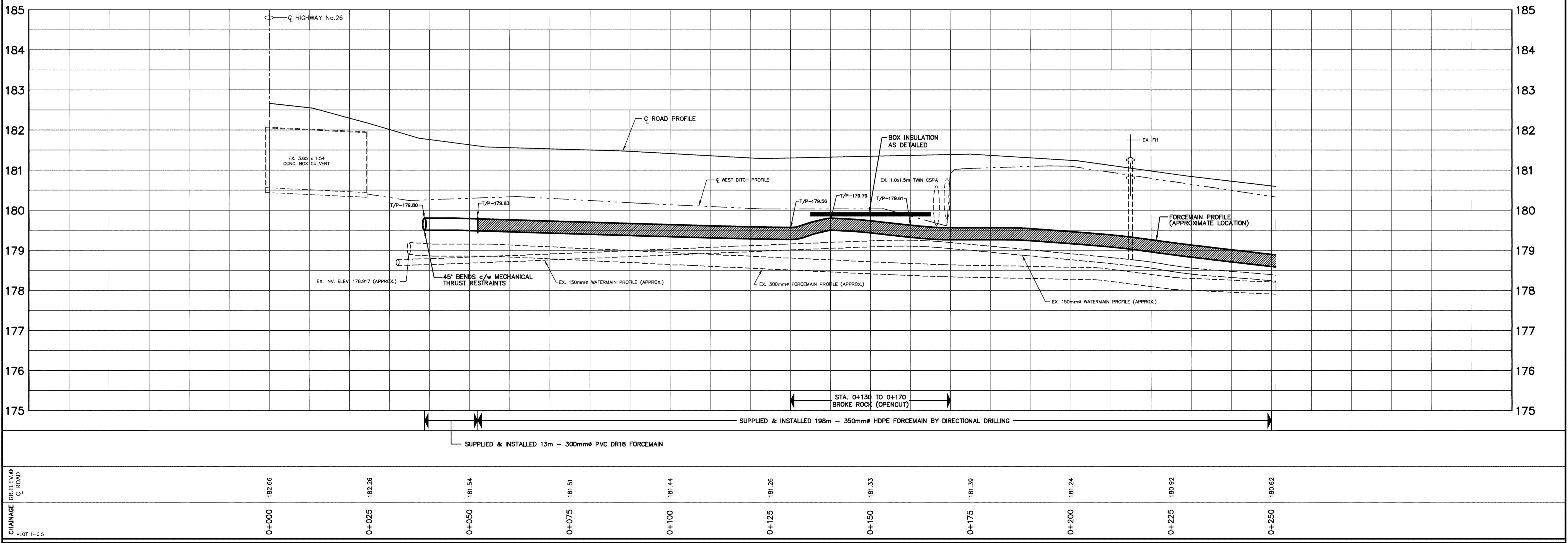
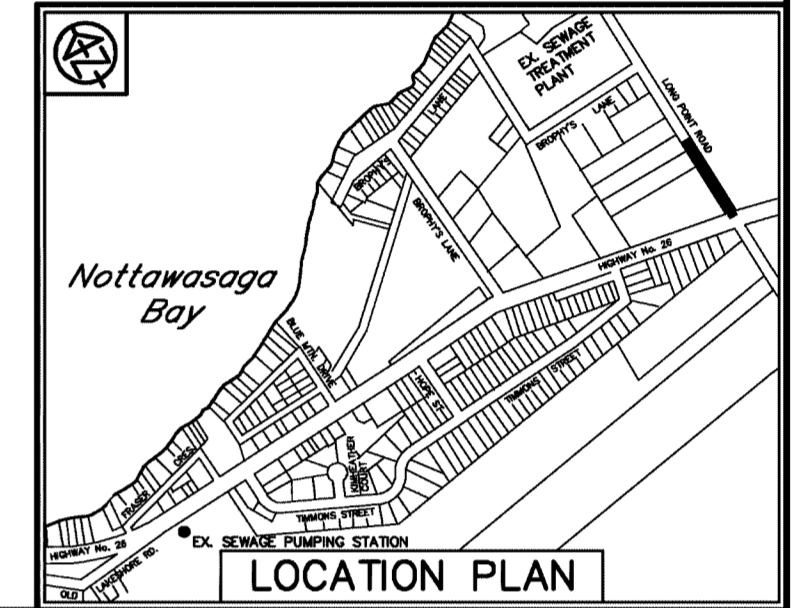


MATCH LINE - STA. 0+250
SEE DWG. No. 104127-FM7-RD

NOTE:
REINSTATE ALL DRIVEWAYS
AND ROADS AS SPECIFIED

LONG POINT ROAD

B.M. ELEV. 181.761
TOP NUT OF FIRE HYDRANT
ON WEST SIDE OF LONG POINT ROAD
IN FRONT OF HOUSE No. 120



LEGEND

- PROPERTY LINE
- U/B BURIED BELL CABLE
- C BURIED GAS MAIN
- EXISTING WATER MAIN AND VALVE
- EXISTING SANITARY SEWER & M.H.
- EXISTING SEWAGE FORCEMAIN
- PROPOSED SEWAGE FORCEMAIN

NOTE: 1) LOCATIONS OF UTILITIES ARE APPROXIMATE.

RECORD DRAWING

COMPILED BY: D.S.	DATE: SEPT. 2006
CHECKED BY: L.S.	DATE: NOV. 2006
DRAWN BY: P.C.S.	DATE: NOV. 2006
CHECKED BY: R.M.	DATE: DEC. 2006

NO.	REVISIONS	DATE	INITIAL
	REVISED AS RECORD DRAWING	DEC. 2006	R.M.

RECORD DRAWING
NOTICE TO USERS

Information contained on this drawing may have changed since the completion of construction. Further, this drawing may contain information provided by others. While Alnley & Associates Limited believes this information to be reliable and correct as of the completion of construction, no warranty is provided as to its accuracy and/or completeness. As such, Alnley & Associates Limited shall not be responsible for any errors or omissions which may result from incorporation of the information herein.

SCALE: HORIZ 1=500
VERT. 1=50

DESIGN: N.M.S./R.M.

DRAWN: E.K./P.C.S.

CHECKED: M.W.A.

DATE: APR. 2006

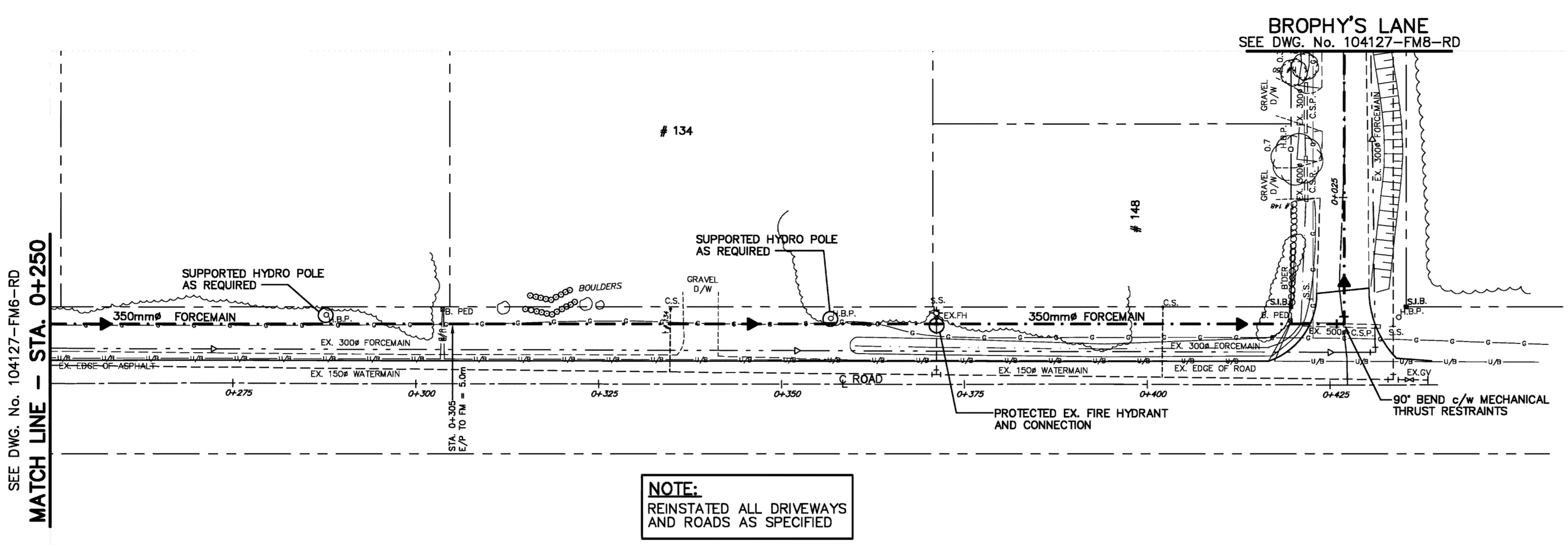
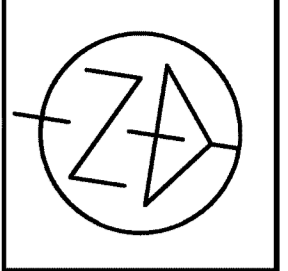


TOWN OF THE BLUE MOUNTAINS
CRAIGLEITH AREA
CONTRACT No. TBM-2006-3
DUPLICATE FORCEMAIN

PLAN & PROFILE
LONG POINT ROAD
HIGHWAY No. 26 TO STA. 0+250

Alnley GROUP CONSULTING ENGINEERS PLANNERS

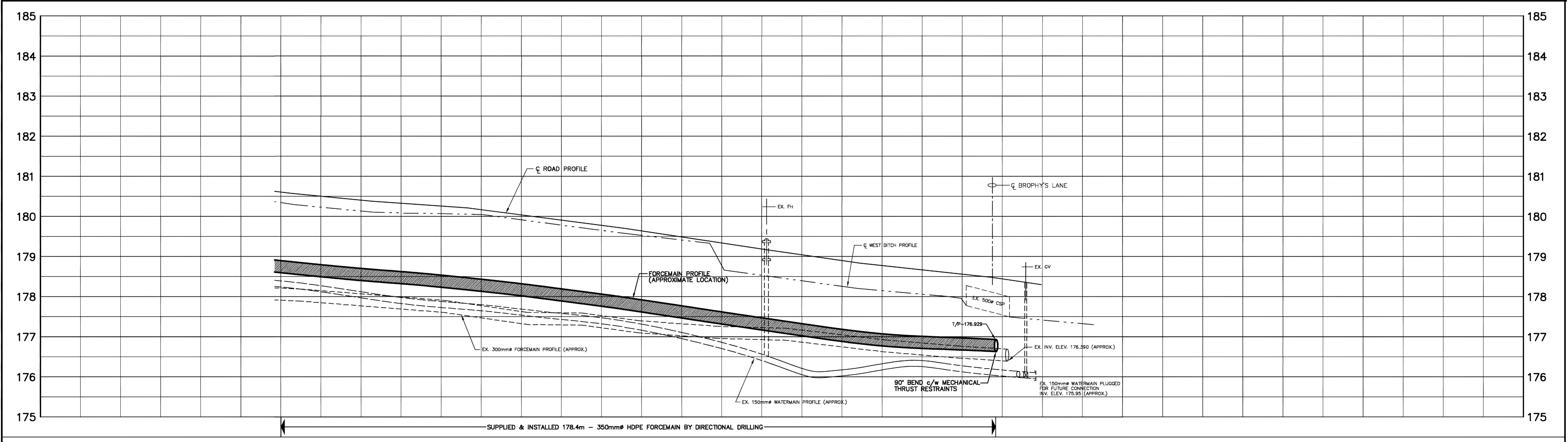
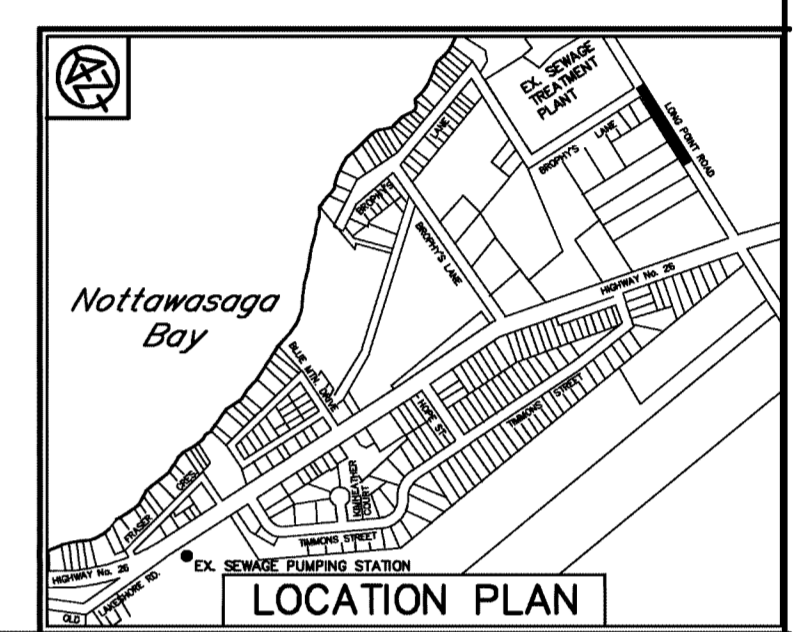
AAL-104127 DWG. FM6-RD



NOTE:
REINSTATED ALL DRIVEWAYS
AND ROADS AS SPECIFIED

LONG POINT ROAD

B.M. ELEV. 181.761
TOP NUT OF FIRE HYDRANT
ON WEST SIDE OF LONG POINT ROAD
IN FRONT OF HOUSE No. 120



CHAINAGE @ 0.5m	0+250	0+275	0+300	0+325	0+350	0+375	0+400	0+425	0+439.5
OR. ELEV. @ 0.5m	180.62	180.36	180.16	179.82	179.48	179.12	178.78	178.49	178.26

LEGEND

- PROPERTY LINE
- U/B BURIED BELL CABLE
- c BURIED GAS MAIN
- EXISTING WATER MAIN AND VALVE
- EXISTING SANITARY SEWER & M.H.
- EXISTING SEWAGE FORCEMAIN
- PROPOSED SEWAGE FORCEMAIN

NOTE : 1) LOCATIONS OF UTILITIES ARE APPROXIMATE.

RECORD DRAWING

COMPILED BY: D.S.	DATE: SEPT. 2006
CHECKED BY: L.S.	DATE: NOV. 2006
DRAWN BY: P.C.S.	DATE: NOV. 2006
CHECKED BY: R.M.	DATE: DEC. 2006

NO.	REVISIONS	DATE	INITIAL
	REVISED AS RECORD DRAWING	DEC. 2006	R.M.

RECORD DRAWING
NOTICE TO USERS

Information contained on this drawing may have changed since the completion of construction. Further, this drawing may contain information provided by others. While Ainley & Associates Limited believes this information to be reliable and correct as of the completion of construction, no warranty is provided as to its accuracy and/or completeness. As such, Ainley & Associates Limited shall not be responsible for any errors or omissions which may result from incorporation of the information herein.

SCALE: HORIZ. 1=500
VERT. 1=50

DESIGN: N.M.S./R.M.

DRAWN: E.K./P.C.S.

CHECKED: M.W.A.

DATE: APR. 2006

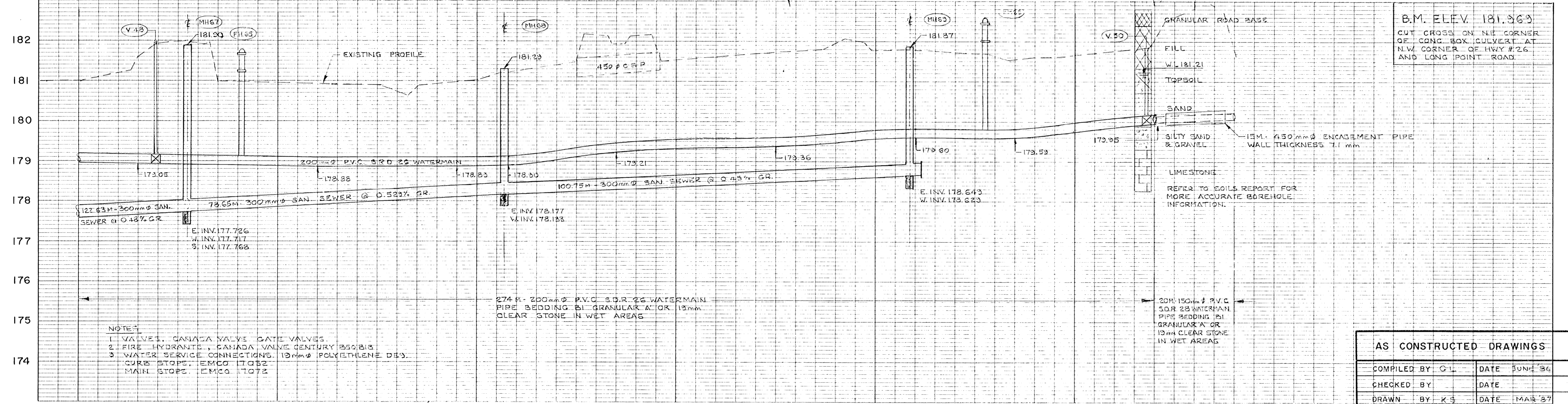
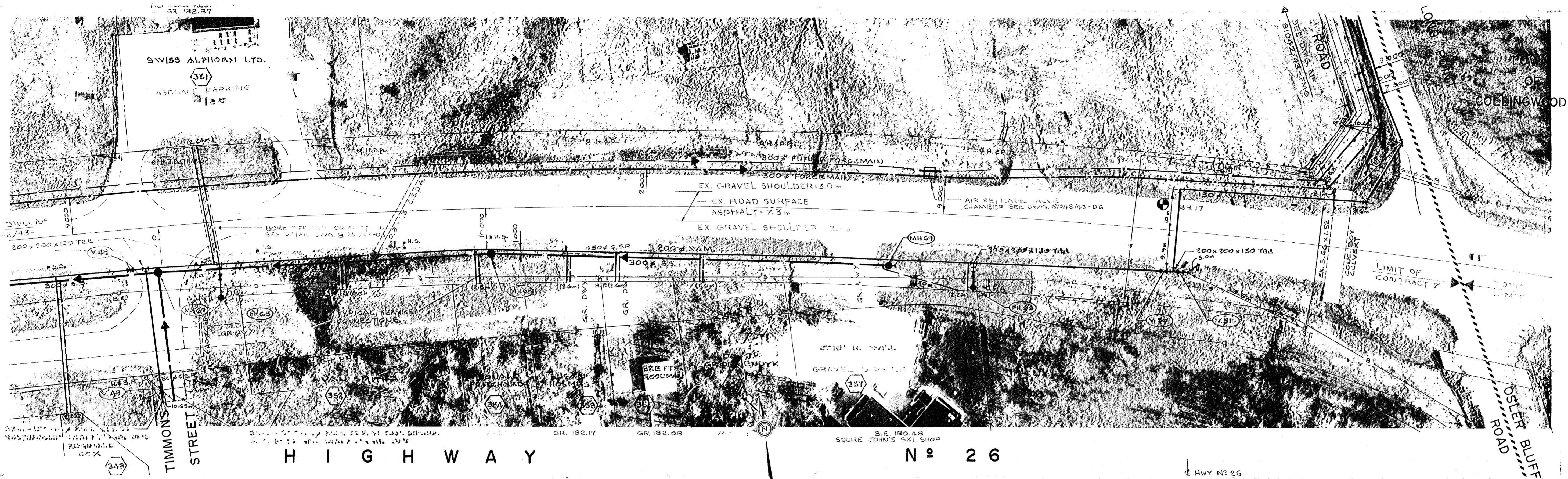


TOWN OF THE BLUE MOUNTAINS
CRAIGLEITH AREA
CONTRACT No. TBM-2006-3
DUPLICATE FORCEMAIN

PLAN & PROFILE
LONG POINT ROAD
STA. 0+250 TO BROPHY'S LANE

Ainley GROUP CONSULTING ENGINEERS PLANNERS

AAL-104127 DWG. FM7-RD



B.M. ELEV. 181.565
 CUT CROSS ON NE CORNER
 OF CONC. BOX CULVERT AT
 NW CORNER OF HWY #26
 AND LONG POINT ROAD

NOTE:
 1 VALVES, CANADA VALVE DATE VALVES
 2 FIRE HYDRANTS, CANADA VALVE CENTURY 1350/313
 3 WATER SERVICE CONNECTIONS, 13mm POLYETHYLENE D.E.
 CURB STOPS, EMCO 11052
 MAIN STOPS, EMCO 11072

AS CONSTRUCTED DRAWINGS	
COMPILED BY G.L.	DATE JUNE '86
CHECKED BY	DATE
DRAWN BY K.S.	DATE MAR '87
CHECKED BY R.M.	DATE MAR '87

CHAINAGE	EXISTING ELEV.	CHANGES	PROPOSED ELEV.
1+200	180.95		
287+			
50	180.92		
+300	180.99		
0739			
50	181.50		
+400	181.76		
0814			
50	181.63		

Notes:

LEGEND	
GR 199.89	Ground Elevation 199.89
BE 197.57	Basement Elevation 197.57
[---]	Basement Elevation Right of Centre Line
[---]	Basement Elevation Left of Centre Line
[•]	Borehole
[---]	Watermain
[---]	Buried Bell Cable
[---]	Gasmain
[---]	Existing Watermain
[---]	Sanitary Sewer
[---]	Forcemain

NO.	REVISIONS	DATE	INITIAL
2	SECOND SUBMISSION	MAR. 1985	C.K.K.
1	DRAWING REDRAFTED	JULY 1984	C.K.K.

Approved

TOWNSHIP OF COLLINGWOOD
 (CRAIGLEITH CAMPERDOWN AREA)
 ONTARIO MINISTRY OF THE ENVIRONMENT
 DIRECT GRANT PROJECTS N° 3-0174 & 7-0242

PLAN AND PROFILE
 HWY. N° 26 - STA. 1+200 TO STA. 1+490

Ainley and Associates Ltd.
 Consulting Engineers and Planners
 Collingwood — Barrie — Belleville

SCALE: HORIZ. 1:500 METRIC
 VERT. 1:50

DESIGN WBL CHECKED CKK
 DRAWN G.M./D.O. DATE JULY 1984

CONTRACT 7
 DWG. N° 81042/43-SW5

APPENDIX C

Domestic Water and Sanitary Flow Calculations



File: 1988-5783
Date: 2021.05.25
By: JL'A
Check By: KV

LONG POINT ROAD - WATER DEMAND CALCULATIONS

Developed Site Area	2.20 ha
Number of Residential Units	22 units
Person Per Residential Unit (Town of the Blue Mountains Development Standards)	2.3 persons/unit
Residential Population	51 persons
<u>Domestic Water Design Flows</u>	
Residential (Town of the Blue Mountains Development Standards)	450 L/C-day
<u>Total Domestic Water Design Flows</u>	
Average Residential Daily Flow (Town of the Blue Mountains Development Standards)	0.26 L/sec
Max Day Peak Factor (Town of the Blue Mountains Development Standards)	2.00
Max Day Demand Flow	0.53 L/sec
Peak Hour Factor (Town of the Blue Mountains Development Standards)	4.50
Peak Hour Flow	1.19 L/sec
Fire Flow Demand (per FUS and OBC)	100 L/sec
Design Flow (per FUS and OBC)	100.53 L/sec

**Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey**

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \text{sqrt } A$$

where

- F = the required fire flow in litres per minute
- C = coefficient related to the type of construction
 - = 1.5 for wood frame construction (structure essentially all combustible)
 - = 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
 - = 0.8 for non-combustible construction (unprotected metal structural components)
 - = 0.6 for fire-resistive construction (fully protected frame, floors, roof)
- A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Buildings	Wood Frame Construction
2 number of floors	1.0 C
207 sq.m. floor area	413 sq.m. total floor area
100% Floor 1	
100% Floor 2	

413 sq.m. total floor area

Therefore F= 4,000 L/min (rounded to nearest 1000 L/min)

- Fire flow determined above shall not exceed:
- 30,000 L/min for wood frame construction
 - 30,000 L/min for ordinary construction
 - 25,000 L/min for non-combustible construction
 - 25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Buring	25%
Combustible	No Charge		

Low fire Hazard occupancy for dwellings	15% reduction
---	---------------

600 L/min reduction

Therefore UPDATED F= 3,000 L/min (rounded to nearest 1000 L/min)

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above maybe reduce by up to 50% for complete automatic sprinkler protection.

Sprinkler System Assume 0% reduction
0 L/min reduction

**Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey**

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%		

Exposed buildings

Name	Distance		
Front	32	5%	150
Left	1.8	25%	750
Right	1.8	25%	750

1,650 L/min Surcharge

Determine Required Fire Flow

No.1	4,000
No. 2	600 reduction
No. 3	0 reduction
No. 4	<u>1,650</u> surcharge

Required Flow: 6,250 L/min
Rounded to nearest 1000L/min: 6,000 L/min or 100.0 L/s
 1,585 USGPM

Required Duration of Fire Flow

Flow Required L/min	Duration (hours)
2,000 or less	1.0
3,000	1.25
4,000	1.5
5,000	1.75
6,000	2.0
8,000	2.0
10,000	2.0
12,000	2.5
14,000	3.0
16,000	3.5
18,000	4.0
20,000	4.5
22,000	5.0
24,000	5.5
26,000	6.0
28,000	6.5
30,000	7.0
32,000	7.5
34,000	8.0
36,000	8.5
38,000	9.0
40,000 and over	9.5

Determine Required Fire Storage Volume

Flow from above 6,000 L/min

Required duration 2.00 hours

Therefore: 720,000 Litres or
 720 cu.m. is the required fire storage volume.

**Fire Protection Water Supply Guideline
Part 3 of the Ontario Building Code (2006)**

$$Q = KVS_{TOT}$$

Q = minimum supply of water in litres (L)
K = water supply coefficient
V = total building volume in cubic metres
S_{TOT} = total of spatial coefficient values from property line exposures on all sides

K = 23.0 Group C/D building with combustible construction (Table 1)
V = 1240 413 By 3m height
S_{TOT} = 2 S_{TOT} Need Not Exceed 2.0

Q = 57040 L

Based on ranges listed in Table 2, the required minimum water supply flow rate is

1800	L/min
30	L/s



File: 1988-5783
Date: 2021.02.19
By: JL'A
Check By: KV

LONG POINT ROAD - SANITARY DEMAND CALCULATIONS

Developed Site Area		2.20 ha
Number of Residential Units		22 units
Person Per Residential Unit	<i>(Town of The Blue Mountains Development Standards)</i>	2.30 persons/unit
Residential Population		51 persons
<u>Sanitary Design Flows</u>		
Residential	<i>(Town of The Blue Mountains Development Standards)</i>	450 L/C-day
Infiltration (typical)		0.23 L/s/ha
<u>Total Sanitary Design Flows</u>		
Average Daily Residential Flow		0.26 L/sec
Max Day Peak Factor	<i>(Harmon Formula)</i>	4.3
Infiltration		0.51 L/sec
Total Daily Peak Flow	<i>(Town of The Blue Mountain Development Standards)</i>	1.64 L/sec

APPENDIX D

Quality Control Measures & Stormwater Flow Calculations



Project Name: Longpoint Rd.
 Project Number: 1988-5783
 Date: 2021.12.21
 By: JL'A

D.A. NAME P-2
 D.A. AREA (ha) 2.2

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment P-2

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic	% Area	Area
Granby Sand	Gs	C	100.0%	2.2
				0
				0
				0
Total Area				2.2

Impervious Landuses Present:

Soils	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
	Area	CN	Area	CN	Area	CN	Area (ha)	CN	Area	CN	Area	A*CN
Gs	0	98	0	98	0	98	0.000	98	0	98	0.00	0.00
	0	98		98		98		98		98	0	0
	0	98		98		98		98		98	0	0
	0	98		98		98		98		98	0	0
Subtotal Area	0		0		0		0		0			

Pervious Landuses Present:

Soils	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
	Area	CN	Area	CN	Area	CN	Area (ha)	CN	Area	CN	Area	A*CN
Gs	2.11	73	0.09	76	0.00	50	0.00	79	0.0	82	2.20	160.87
	0	0.00	0.00		0.00		0.00		0.00		0.00	0.00
	0	0.00	0.00		0.00		0.00		0.00		0.00	0.00
	0	0.00	0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area	2.11		0.09		0.00		0.00		0.0			

Composite Area Calculations		Total Pervious Area	2.2
		Total Impervious Area	0.0
		% Impervious	0.0%
		Composite Curve Number	73.1
		Total Area Check	2.2

Initial Abstraction and Tp Calculations

Landuse	Initial Abstraction			Composite Curve Number								
	IA (mm)	Area (ha)	A * IA	Granby Sand		0		0		0		A*RC
			RC	Area	RC	Area	RC	Area	RC	Area		
Woodland	10	2.11	21.1	0.35	2.11		0		0		0	0.7385
Meadow	8	0.09	0.72	0.40	0.09		0		0		0	0.036
Wetland	16	0	0	0.05	0		0		0		0	0
Lawn	5	0	0	0.40	0		0		0		0	0.000
Cultivated	7	0	0	0.55	0		0		0		0	0.000
Impervious	2	0	0	0.95	0		0		0		0	0.000
Composite IA		2.2	9.91818	Composite Runoff Coefficient								0.352

Flow Path Description	Time to Peak Inputs					Uplands			Bransby Williams		Airport	
	Length (m)	Drop (m)	Slope (%)	V/S ^{0.5}	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Forest	183	1	0.55%	0.6	0.04	1.15	0.77	0.77	0.18	0.12	0.67	0.45

Appropriate calculated time to 0.45 Appropriate Method: Airport



Project Name: Longpoint Road
 Project Number: 1988-5783
 Date: 2021.12.16
 By: NS

D.A. NAME 1A
 D.A. AREA (ha) 0.13

Hydrologic Parameters: CALIB STANDHYD Command
Post Development Drainage Area: Catchment 1A
Controlled to OGS

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic Group	% Area	Area
Granby Sand	Gs	C	100	0.13
				0
				0
				0
Total Area Check				0.13

Impervious Landuses Present:												
Soils	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Gs	0.015	98		98	0.013	98	0.040	98		50	0.068	6.664
	0	98		98		98		98		50	0	0
	0	98		98		98		98		98	0	0
	0	98		98		98		98		98	0	0
Subtotal Area	0.015		0		0.013		0.040		0			

Pervious Landuses Present:												
Soils	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Gs	0	73	0	76	0	50	0.062	79	0	82	0.062	4.898
	0		0		0		0		0		0	0
	0		0		0		0		0		0	0
	0		0		0		0		0		0	0
Subtotal Area	0		0		0		0.062		0			

	Pervious Area Calculations	Total Pervious Area	0.062
		Composite Pervious Curve Number	79
	Impervious Area Calculations	Total Directly Connected Area	0.028
		Total Indirectly Connected Area	0.040
		Total Impervious Area	0.068
		% X imp	21.5385
		% T imp	52.3
Total Area Check			0.13

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Wetland	16	0	0
Lawn	5	0.062	0.31
Cultivated	7	0	0

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.0	2	30	0.25
Impervious	2.0	0.5	29	0.013



Project Name: Longpoint Road
 Project Number: 1988-5783
 Date: 2021.12.16
 By: NS

D.A. NAME: 1B
 D.A. AREA (ha): 0.60

Hydrologic Parameters: CALIB STANDHYD Command
Post Development Drainage Area: Catchment 1B
Controlled to OGS

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic Group	% Area	Area
Granby Sand	Gs	C	100	0.6
				0
				0
				0
Total Area Check				0.6

Impervious Landuses Present:

Soils	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Gs	0.070	98		98	0.070	98	0.213	98		50	0.353	34.594
	0	98		98		98		98		50	0	0
	0	98		98		98		98		98	0	0
	0	98		98		98		98		98	0	0
Subtotal Area	0.07		0		0.07		0.213		0			

Pervious Landuses Present:

Soils	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Gs	0	73	0	76	0	50	0.247	79	0	82	0.247	19.513
	0		0		0		0		0		0	0
	0		0		0		0		0		0	0
	0		0		0		0		0		0	0
Subtotal Area	0		0		0		0.247		0			

Pervious Area Calculations	Total Pervious Area	0.247
	Composite Pervious Curve Number	79
Impervious Area Calculations	Total Directly Connected Area	0.14
	Total Indirectly Connected Area	0.213
	Total Impervious Area	0.353
	% X imp	23.3333
	% T imp	58.8
Total Area Check		0.6

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Wetland	16	0	0
Lawn	5	0.25	1.235
Cultivated	7	0	0

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.0	2	30	0.25
Impervious	2.0	0.5	63	0.013



Project Name: Longpoint Road
 Project Number: 1988-5783
 Date: 2021.12.16
 By: NS

D.A. NAME 1C
 D.A. AREA (ha) 0.67

Hydrologic Parameters: CALIB STANDHYD Command
Post Development Drainage Area: Catchment 1C
Controlled to OGS

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic Group	% Area	Area
Granby Sand	Gs	C	100	0.67
				0
				0
				0
Total Area Check				0.67

Impervious Landuses Present:

Soils	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Gs	0.104	98		98	0.070	98	0.225	98		50	0.399	39.102
	0	98		98		98		98		50	0	0
	0	98		98		98		98		98	0	0
	0	98		98		98		98		98	0	0
Subtotal Area	0.104		0		0.07		0.225		0			

Pervious Landuses Present:

Soils	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
Gs	0	73	0	76	0	50	0.271	79	0	82	0.271	21.409
	0		0		0		0		0		0	0
	0		0		0		0		0		0	0
	0		0		0		0		0		0	0
Subtotal Area	0		0		0		0.271		0			

Pervious Area Calculations	Total Pervious Area	0.271
	Composite Pervious Curve Number	79
Impervious Area Calculations	Total Directly Connected Area	0.174
	Total Indirectly Connected Area	0.225
	Total Impervious Area	0.399
	% X imp	25.9701
	% T imp	59.6
Total Area Check		0.67

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Wetland	16	0	0
Lawn	5	0.27	1.355
Cultivated	7	0	0

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.0	2	30	0.25
Impervious	2.0	0.5	67	0.013



Project Name: Longpoint Road
 Project Number: 1988-5783
 Date: 2021.12.16
 By: NS

D.A. NAME 1D
 D.A. AREA (ha) 0.79

Hydrologic Parameters: CALIB NASHYD Command
Post Development Drainage Area: Catchment 1D
Uncontrolled

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic	% Area	Area
Granby Sand	Gs	C	100.0%	0.79
				0
				0
				0
Total Area				0.79

Impervious Landuses Present:

Soils	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
	Area	CN	Area	CN	Area	CN	Area (ha)	CN	Area	CN	Area	A*CN
Gs	0.06	98	0	98	0	98	0	98	0	98	0.06	5.88
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area		0.06	0		0		0		0		0	

Pervious Landuses Present:

Soils	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
	Area	CN	Area	CN	Area	CN	Area (ha)	CN	Area	CN	Area	A*CN
Gs	0.50	73	0.00	76	0.00	50	0.23	79	0.0	82	0.73	54.69
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal Area		0.50	0.00		0.00		0.23		0.0		0.00	

Composite Area Calculations		Total Pervious Area	0.73
		Total Impervious Area	0.06
		% Impervious	7.6%
		Composite Curve Number	76.7
		Total Area Check	0.79

Initial Abstraction and Tp Calculations

Landuse	Initial Abstraction			Composite Curve Number								
	IA (mm)	Area (ha)	A * IA	Granby Sand		0		0		0		A*RC
			RC	Area	RC	Area	RC	Area	RC	Area		
Woodland	10	0.50	4.964	0.35	0.50		0		0		0	0.17374
Meadow	8	0	0	0.40	0.00		0		0		0	0
Wetland	16	0	0	0.05	0.00		0		0		0	0
Lawn	5	0.2336	1.168	0.40	0.23		0		0		0	0.093
Cultivated	7	0	0	0.55	0.00		0		0		0	0.000
Impervious	2	0.06	0.12	0.95	0.06		0		0		0	0.057
Composite IA		0.79	7.91392	Composite Runoff Coefficient								0.4

Flow Path Description	Time to Peak Inputs					Uplands			Bransby Williams		Airport	
	Length (m)	Drop (m)	Slope (%)	V/S ^{0.5}	Velocity (m/s)	Tc (hr)	Tp (hr)	TOTAL Tp (hr)	Tc (hr)	Tp (hr)	Tc (hr)	Tp (hr)
Woodland	75	1.5	2.00%	0.6	0.08	0.25	0.16	0.16	0.06	0.04	0.26	0.17

Appropriate calculated time to 0.17 Appropriate Method: Airport

SWM Storage Structure Stage Storage Outflow Calculations

ED Outlet Structure Dimensions

Orifice Diameter 0.025 m
Orifice Invert Elevation 179.5 m

Outlet Structure #1 Dimensions

Orifice Diameter 0.05 m
Orifice Invert Elevation 180.15 m

Outlet Structure #3 Dimensions

Orifice Diameter 0.055 m
Orifice Invert Elevation 180.45 m

Outlet Structure #5 Dimensions

Orifice Diameter 0 m
Orifice Invert Elevation 0 m

V-Notch Outlet Structure Dimensions

V-Notch Weir Angle deg
Constant 0.00
Invert 0 m

Outlet Structure #2 Dimensions

Orifice Diameter 0.055 m
Orifice Invert Elevation 180.35 m

Outlet Structure #4 Dimensions

Orifice Diameter 0 m
Orifice Invert Elevation 0 m

Outlet Structure #6 Dimensions

Orifice Diameter 0 m
Orifice Invert Elevation 0 m

Rect. Weir Outlet Structure Dimensions

Rect Weir Width 0 m
Rect Weir Invert 0 m

Storage Structure Dimensions					Outlet Structure Discharge										Total	
Elev. (m)	Depth Above PP (m)	Main Storage		With Extra	ED Outlet Discharge (cu.m/s)	Outlet #1 Discharge (cu.m/s)	Outlet #2 Discharge (cu.m/s)	Outlet #3 Discharge (cu.m/s)	Outlet #4 Discharge (cu.m/s)	Outlet #5 Discharge (cu.m/s)	Outlet #6 Discharge (cu.m/s)	Rect. Weir Discharge (cu.m/s)	V Notch Weir Discharge (cu.m/s)	Total Discharge (cu.m/s)	Total Discharge (cu.m/s)	Storage (ha-m)
		Area (sqm)	Storage Volume (cu.m)	Storage Volume (cu.m)												
179.50	0.00	769	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000
179.60	0.10	769	77	77	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.008
179.70	0.20	769	154	154	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.001	0.001	0.015
179.80	0.30	769	231	231	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.001	0.001	0.023
179.90	0.40	769	308	308	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.001	0.001	0.031
180.00	0.50	769	384	384	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.001	0.001	0.038
180.10	0.60	769	461	461	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.001	0.001	0.046
180.20	0.70	769	538	538	0.001	0.005	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.006	0.006	0.054
180.30	0.80	769	615	615	0.001	0.005	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.006	0.006	0.062
180.40	0.90	769	692	692	0.001	0.005	0.006	0.000	0.000	0.000	0.000	0.00	0.000	0.013	0.013	0.069
180.50	1.00	769	769	769	0.001	0.005	0.007	0.007	0.000	0.000	0.000	0.00	0.000	0.020	0.020	0.077
180.60	1.10			769	0.001	0.006	0.007	0.007	0.000	0.000	0.000	0.00	0.000	0.021	0.021	0.077
180.70	1.20			769	0.002	0.006	0.007	0.007	0.000	0.000	0.000	0.00	0.000	0.022	0.022	0.077
180.80	1.30			770	0.002	0.006	0.008	0.008	0.000	0.000	0.000	0.00	0.000	0.023	0.023	0.077
180.90	1.40			770	0.002	0.007	0.008	0.008	0.000	0.000	0.000	0.00	0.000	0.024	0.024	0.077
181.00	1.50			770	0.002	0.007	0.008	0.008	0.000	0.000	0.000	0.00	0.000	0.025	0.025	0.077
181.10	1.60			770	0.002	0.007	0.008	0.008	0.000	0.000	0.000	0.00	0.000	0.026	0.026	0.077
181.20	1.70			771	0.002	0.007	0.009	0.009	0.000	0.000	0.000	0.00	0.000	0.026	0.026	0.077
181.30	1.80			771	0.002	0.007	0.009	0.009	0.000	0.000	0.000	0.00	0.000	0.027	0.027	0.077
181.40	1.90			771	0.002	0.008	0.009	0.009	0.000	0.000	0.000	0.00	0.000	0.028	0.028	0.077
181.50	2.00			772	0.002	0.008	0.009	0.009	0.000	0.000	0.000	0.00	0.000	0.029	0.029	0.077
181.60	2.10			772	0.002	0.008	0.010	0.010	0.000	0.000	0.000	0.00	0.000	0.029	0.029	0.077
181.70	2.20			773	0.002	0.008	0.010	0.010	0.000	0.000	0.000	0.00	0.000	0.030	0.030	0.077
181.80	2.30			786	0.002	0.008	0.010	0.010	0.000	0.000	0.000	0.00	0.000	0.031	0.031	0.079
181.85	2.35			793	0.002	0.008	0.010	0.010	0.000	0.000	0.000	0.00	0.000	0.031	0.031	0.079

Pre-Development

 ** SIMULATION:100yr 12hr 15min SCS **

```

-----
|   READ STORM   |      Filename: C:\Users\nsproule\AppData
|                 |      ata\Local\Temp\
|                 |      6c2a7a27-26da-4d22-b0b4-01b99ac0ee04\0305e82d
| Ptotal= 98.03 mm |      Comments: 100yr 12hr 15min SCS
-----
  
```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	3.25	3.92	6.50	17.65	9.75	3.43
0.25	2.45	3.50	3.92	6.75	7.84	10.00	3.43
0.50	2.45	3.75	3.92	7.00	7.84	10.25	1.96
0.75	2.45	4.00	3.92	7.25	5.88	10.50	1.96
1.00	2.45	4.25	5.88	7.50	5.88	10.75	1.96
1.25	2.45	4.50	5.88	7.75	5.88	11.00	1.96
1.50	2.45	4.75	7.84	8.00	5.88	11.25	1.96
1.75	2.45	5.00	7.84	8.25	3.43	11.50	1.96
2.00	2.45	5.25	11.76	8.50	3.43	11.75	1.96
2.25	2.94	5.50	11.76	8.75	3.43	12.00	1.96
2.50	2.94	5.75	47.05	9.00	3.43		
2.75	2.94	6.00	129.40	9.25	3.43		
3.00	2.94	6.25	17.65	9.50	3.43		

```

-----
| CALIB          |
| NASHYD ( 0002) |      Area (ha)= 2.20   Curve Number (CN)= 73.1
| ID= 1 DT= 5.0 min |      Ia (mm)= 9.92   # of Linear Res.(N)= 3.00
-----
|                 |      U.H. Tp(hrs)= 0.45
  
```

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

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.94	6.250	129.40	9.33	3.43
0.167	0.00	3.250	2.94	6.333	17.65	9.42	3.43
0.250	0.00	3.333	3.92	6.417	17.65	9.50	3.43
0.333	2.45	3.417	3.92	6.500	17.65	9.58	3.43
0.417	2.45	3.500	3.92	6.583	17.65	9.67	3.43
0.500	2.45	3.583	3.92	6.667	17.65	9.75	3.43
0.583	2.45	3.667	3.92	6.750	17.65	9.83	3.43
0.667	2.45	3.750	3.92	6.833	7.84	9.92	3.43
0.750	2.45	3.833	3.92	6.917	7.84	10.00	3.43
0.833	2.45	3.917	3.92	7.000	7.84	10.08	3.43

0.917	2.45	4.000	3.92	7.083	7.84	10.17	3.43
1.000	2.45	4.083	3.92	7.167	7.84	10.25	3.43
1.083	2.45	4.167	3.92	7.250	7.84	10.33	1.96
1.167	2.45	4.250	3.92	7.333	5.88	10.42	1.96
1.250	2.45	4.333	5.88	7.417	5.88	10.50	1.96
1.333	2.45	4.417	5.88	7.500	5.88	10.58	1.96
1.417	2.45	4.500	5.88	7.583	5.88	10.67	1.96
1.500	2.45	4.583	5.88	7.667	5.88	10.75	1.96
1.583	2.45	4.667	5.88	7.750	5.88	10.83	1.96
1.667	2.45	4.750	5.88	7.833	5.88	10.92	1.96
1.750	2.45	4.833	7.84	7.917	5.88	11.00	1.96
1.833	2.45	4.917	7.84	8.000	5.88	11.08	1.96
1.917	2.45	5.000	7.84	8.083	5.88	11.17	1.96
2.000	2.45	5.083	7.84	8.167	5.88	11.25	1.96
2.083	2.45	5.167	7.84	8.250	5.88	11.33	1.96
2.167	2.45	5.250	7.84	8.333	3.43	11.42	1.96
2.250	2.45	5.333	11.76	8.417	3.43	11.50	1.96
2.333	2.94	5.417	11.76	8.500	3.43	11.58	1.96
2.417	2.94	5.500	11.76	8.583	3.43	11.67	1.96
2.500	2.94	5.583	11.76	8.667	3.43	11.75	1.96
2.583	2.94	5.667	11.76	8.750	3.43	11.83	1.96
2.667	2.94	5.750	11.76	8.833	3.43	11.92	1.96
2.750	2.94	5.833	47.05	8.917	3.43	12.00	1.96
2.833	2.94	5.917	47.05	9.000	3.43	12.08	1.96
2.917	2.94	6.000	47.06	9.083	3.43	12.17	1.96
3.000	2.94	6.083	129.40	9.167	3.43	12.25	1.96
3.083	2.94	6.167	129.40	9.250	3.43		

Unit Hyd Qpeak (cms)= 0.187

PEAK FLOW (cms)= 0.161 (i)

TIME TO PEAK (hrs)= 6.583

RUNOFF VOLUME (mm)= 42.751

TOTAL RAINFALL (mm)= 98.030

RUNOFF COEFFICIENT = 0.436

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

 ** SIMULATION:100yr 4hr 10min Chicago **

 | CHICAGO STORM |
Ptotal= 70.40 mm

IDF curve parameters: A= 811.794
 B= 0.000
 C= 0.699

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 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	5.92	1.00	28.01	2.00	11.70	3.00	6.82
0.17	6.61	1.17	162.35	2.17	10.34	3.17	6.42
0.33	7.55	1.33	34.38	2.33	9.30	3.33	6.08
0.50	8.89	1.50	21.68	2.50	8.49	3.50	5.77
0.67	11.01	1.67	16.53	2.67	7.83	3.67	5.50
0.83	15.06	1.83	13.62	2.83	7.28	3.83	5.26

```

-----
| CALIB |
| NASHYD ( 0002) | Area (ha)= 2.20 Curve Number (CN)= 73.1
| ID= 1 DT= 5.0 min | Ia (mm)= 9.92 # of Linear Res.(N)= 3.00
-----
| U.H. Tp(hrs)= 0.45

```

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	5.92	1.083	28.01	2.083	11.70	3.08	6.82
0.167	5.92	1.167	28.01	2.167	11.70	3.17	6.82
0.250	6.61	1.250	162.35	2.250	10.34	3.25	6.42
0.333	6.61	1.333	162.35	2.333	10.34	3.33	6.42
0.417	7.55	1.417	34.38	2.417	9.30	3.42	6.08
0.500	7.55	1.500	34.38	2.500	9.30	3.50	6.08
0.583	8.89	1.583	21.68	2.583	8.49	3.58	5.77
0.667	8.89	1.667	21.68	2.667	8.49	3.67	5.77
0.750	11.01	1.750	16.53	2.750	7.83	3.75	5.50
0.833	11.01	1.833	16.53	2.833	7.83	3.83	5.50
0.917	15.06	1.917	13.62	2.917	7.28	3.92	5.26
1.000	15.06	2.000	13.62	3.000	7.28	4.00	5.26

Unit Hyd Qpeak (cms)= 0.187

PEAK FLOW (cms)= 0.084 (i)

TIME TO PEAK (hrs)= 1.833

RUNOFF VOLUME (mm)= 23.758

TOTAL RAINFALL (mm)= 70.401

RUNOFF COEFFICIENT = 0.337

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

** SIMULATION:10yr 12hr 15min SCS **

```

-----
|   READ STORM   |   Filename: C:\Users\nsproule\AppData
|                 |   ata\Local\Temp\
|                 |   6c2a7a27-26da-4d22-b0b4-01b99ac0ee04\f97f9269
| Ptotal= 68.03 mm |   Comments: 10yr 12hr 15min SCS
-----
  
```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	3.25	2.72	6.50	12.25	9.75	2.38
0.25	1.70	3.50	2.72	6.75	5.44	10.00	2.38
0.50	1.70	3.75	2.72	7.00	5.44	10.25	1.36
0.75	1.70	4.00	2.72	7.25	4.08	10.50	1.36
1.00	1.70	4.25	4.08	7.50	4.08	10.75	1.36
1.25	1.70	4.50	4.08	7.75	4.08	11.00	1.36
1.50	1.70	4.75	5.44	8.00	4.08	11.25	1.36
1.75	1.70	5.00	5.44	8.25	2.38	11.50	1.36
2.00	1.70	5.25	8.16	8.50	2.38	11.75	1.36
2.25	2.04	5.50	8.16	8.75	2.38	12.00	1.36
2.50	2.04	5.75	32.65	9.00	2.38		
2.75	2.04	6.00	89.80	9.25	2.38		
3.00	2.04	6.25	12.25	9.50	2.38		

```

-----
| CALIB          |
| NASHYD ( 0002) |   Area (ha)= 2.20   Curve Number (CN)= 73.1
| ID= 1 DT= 5.0 min |   Ia (mm)= 9.92   # of Linear Res.(N)= 3.00
-----
|                 |   U.H. Tp(hrs)= 0.45
  
```

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

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.04	6.250	89.80	9.33	2.38
0.167	0.00	3.250	2.04	6.333	12.25	9.42	2.38
0.250	0.00	3.333	2.72	6.417	12.25	9.50	2.38
0.333	1.70	3.417	2.72	6.500	12.25	9.58	2.38
0.417	1.70	3.500	2.72	6.583	12.25	9.67	2.38
0.500	1.70	3.583	2.72	6.667	12.25	9.75	2.38
0.583	1.70	3.667	2.72	6.750	12.25	9.83	2.38
0.667	1.70	3.750	2.72	6.833	5.44	9.92	2.38
0.750	1.70	3.833	2.72	6.917	5.44	10.00	2.38
0.833	1.70	3.917	2.72	7.000	5.44	10.08	2.38
0.917	1.70	4.000	2.72	7.083	5.44	10.17	2.38

1.000	1.70	4.083	2.72	7.167	5.44	10.25	2.38
1.083	1.70	4.167	2.72	7.250	5.44	10.33	1.36
1.167	1.70	4.250	2.72	7.333	4.08	10.42	1.36
1.250	1.70	4.333	4.08	7.417	4.08	10.50	1.36
1.333	1.70	4.417	4.08	7.500	4.08	10.58	1.36
1.417	1.70	4.500	4.08	7.583	4.08	10.67	1.36
1.500	1.70	4.583	4.08	7.667	4.08	10.75	1.36
1.583	1.70	4.667	4.08	7.750	4.08	10.83	1.36
1.667	1.70	4.750	4.08	7.833	4.08	10.92	1.36
1.750	1.70	4.833	5.44	7.917	4.08	11.00	1.36
1.833	1.70	4.917	5.44	8.000	4.08	11.08	1.36
1.917	1.70	5.000	5.44	8.083	4.08	11.17	1.36
2.000	1.70	5.083	5.44	8.167	4.08	11.25	1.36
2.083	1.70	5.167	5.44	8.250	4.08	11.33	1.36
2.167	1.70	5.250	5.44	8.333	2.38	11.42	1.36
2.250	1.70	5.333	8.16	8.417	2.38	11.50	1.36
2.333	2.04	5.417	8.16	8.500	2.38	11.58	1.36
2.417	2.04	5.500	8.16	8.583	2.38	11.67	1.36
2.500	2.04	5.583	8.16	8.667	2.38	11.75	1.36
2.583	2.04	5.667	8.16	8.750	2.38	11.83	1.36
2.667	2.04	5.750	8.16	8.833	2.38	11.92	1.36
2.750	2.04	5.833	32.65	8.917	2.38	12.00	1.36
2.833	2.04	5.917	32.65	9.000	2.38	12.08	1.36
2.917	2.04	6.000	32.66	9.083	2.38	12.17	1.36
3.000	2.04	6.083	89.80	9.167	2.38	12.25	1.36
3.083	2.04	6.167	89.80	9.250	2.38		

Unit Hyd Qpeak (cms)= 0.187

PEAK FLOW (cms)= 0.081 (i)

TIME TO PEAK (hrs)= 6.583

RUNOFF VOLUME (mm)= 22.275

TOTAL RAINFALL (mm)= 68.030

RUNOFF COEFFICIENT = 0.327

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

 ** SIMULATION:10yr 4hr 10min Chicago **

 | CHICAGO STORM |
Ptotal= 48.86 mm

IDF curve parameters: A= 563.357
 B= 0.000
 C= 0.699

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 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	4.11	1.00	19.44	2.00	8.12	3.00	4.73
0.17	4.59	1.17	112.66	2.17	7.17	3.17	4.46
0.33	5.24	1.33	23.86	2.33	6.46	3.33	4.22
0.50	6.17	1.50	15.04	2.50	5.89	3.50	4.01
0.67	7.64	1.67	11.47	2.67	5.43	3.67	3.82
0.83	10.45	1.83	9.45	2.83	5.05	3.83	3.65

```

-----
| CALIB |
| NASHYD ( 0002) | Area (ha)= 2.20 Curve Number (CN)= 73.1
| ID= 1 DT= 5.0 min | Ia (mm)= 9.92 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.45

```

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	4.11	1.083	19.44	2.083	8.12	3.08	4.73
0.167	4.11	1.167	19.44	2.167	8.12	3.17	4.73
0.250	4.59	1.250	112.66	2.250	7.17	3.25	4.46
0.333	4.59	1.333	112.66	2.333	7.17	3.33	4.46
0.417	5.24	1.417	23.86	2.417	6.46	3.42	4.22
0.500	5.24	1.500	23.86	2.500	6.46	3.50	4.22
0.583	6.17	1.583	15.04	2.583	5.89	3.58	4.01
0.667	6.17	1.667	15.04	2.667	5.89	3.67	4.01
0.750	7.64	1.750	11.47	2.750	5.43	3.75	3.82
0.833	7.64	1.833	11.47	2.833	5.43	3.83	3.82
0.917	10.45	1.917	9.45	2.917	5.05	3.92	3.65
1.000	10.45	2.000	9.45	3.000	5.05	4.00	3.65

Unit Hyd Qpeak (cms)= 0.187

PEAK FLOW (cms)= 0.037 (i)

TIME TO PEAK (hrs)= 1.917

RUNOFF VOLUME (mm)= 11.448

TOTAL RAINFALL (mm)= 48.856

RUNOFF COEFFICIENT = 0.234

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

```

-----
*****
** SIMULATION:25mm Water Quality **

```

| READ STORM |
Ptotal= 24.99 mm

Filename: C:\Users\nsproule\AppData\Local\Temp\6c2a7a27-26da-4d22-b0b4-01b99ac0ee04\8d1f0d74
Comments: 25mm

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	1.36	1.00	6.91	2.00	4.18	3.00	1.86
0.08	1.45	1.08	11.02	2.08	3.77	3.08	1.78
0.17	1.55	1.17	26.16	2.17	3.43	3.17	1.71
0.25	1.67	1.25	76.07	2.25	3.16	3.25	1.64
0.33	1.81	1.33	33.71	2.33	2.92	3.33	1.58
0.42	1.99	1.42	18.64	2.42	2.72	3.42	1.52
0.50	2.20	1.50	12.61	2.50	2.55	3.50	1.47
0.58	2.47	1.58	9.46	2.58	2.39	3.58	1.43
0.67	2.82	1.67	7.55	2.67	2.26	3.67	1.38
0.75	3.29	1.75	6.28	2.75	2.14	3.75	1.34
0.83	3.97	1.83	5.38	2.83	2.04	3.83	1.30
0.92	5.03	1.92	4.70	2.92	1.94	3.92	1.26

| CALIB |
| NASHYD (0002) |
ID= 1 DT= 5.0 min

Area (ha)= 2.20 Curve Number (CN)= 73.1
Ia (mm)= 9.92 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.45

Unit Hyd Qpeak (cms)= 0.187
PEAK FLOW (cms)= 0.007 (i)
TIME TO PEAK (hrs)= 2.167
RUNOFF VOLUME (mm)= 2.092
TOTAL RAINFALL (mm)= 24.991
RUNOFF COEFFICIENT = 0.084

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

** SIMULATION:25yr 12hr 15min SCS **

| READ STORM |
| |

Filename: C:\Users\nsproule\AppData\Local\Temp\6c2a7a27-26da-4d22-b0b4-01b99ac0ee04\ece626b5

| Ptotal= 80.07 mm | Comments: 25yr 12hr 15min SCS

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	'	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.00	3.25	3.20	'	6.50	14.41	9.75	2.80
0.25	2.00	3.50	3.20	'	6.75	6.41	10.00	2.80
0.50	2.00	3.75	3.20	'	7.00	6.41	10.25	1.60
0.75	2.00	4.00	3.20	'	7.25	4.80	10.50	1.60
1.00	2.00	4.25	4.80	'	7.50	4.80	10.75	1.60
1.25	2.00	4.50	4.80	'	7.75	4.80	11.00	1.60
1.50	2.00	4.75	6.41	'	8.00	4.80	11.25	1.60
1.75	2.00	5.00	6.41	'	8.25	2.80	11.50	1.60
2.00	2.00	5.25	9.61	'	8.50	2.80	11.75	1.60
2.25	2.40	5.50	9.61	'	8.75	2.80	12.00	1.60
2.50	2.40	5.75	38.43	'	9.00	2.80		
2.75	2.40	6.00	105.69	'	9.25	2.80		
3.00	2.40	6.25	14.41	'	9.50	2.80		

CALIB		Area (ha)= 2.20		Curve Number (CN)= 73.1	
NASHYD (0002)		Ia (mm)= 9.92		# of Linear Res.(N)= 3.00	
ID= 1 DT= 5.0 min		U.H. Tp(hrs)= 0.45			

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	0.00	3.167	2.40	'	6.250	105.69	9.33	2.80
0.167	0.00	3.250	2.40	'	6.333	14.41	9.42	2.80
0.250	0.00	3.333	3.20	'	6.417	14.41	9.50	2.80
0.333	2.00	3.417	3.20	'	6.500	14.41	9.58	2.80
0.417	2.00	3.500	3.20	'	6.583	14.41	9.67	2.80
0.500	2.00	3.583	3.20	'	6.667	14.41	9.75	2.80
0.583	2.00	3.667	3.20	'	6.750	14.41	9.83	2.80
0.667	2.00	3.750	3.20	'	6.833	6.41	9.92	2.80
0.750	2.00	3.833	3.20	'	6.917	6.41	10.00	2.80
0.833	2.00	3.917	3.20	'	7.000	6.41	10.08	2.80
0.917	2.00	4.000	3.20	'	7.083	6.41	10.17	2.80
1.000	2.00	4.083	3.20	'	7.167	6.41	10.25	2.80
1.083	2.00	4.167	3.20	'	7.250	6.41	10.33	1.60
1.167	2.00	4.250	3.20	'	7.333	4.80	10.42	1.60
1.250	2.00	4.333	4.80	'	7.417	4.80	10.50	1.60
1.333	2.00	4.417	4.80	'	7.500	4.80	10.58	1.60
1.417	2.00	4.500	4.80	'	7.583	4.80	10.67	1.60
1.500	2.00	4.583	4.80	'	7.667	4.80	10.75	1.60

1.583	2.00	4.667	4.80	7.750	4.80	10.83	1.60
1.667	2.00	4.750	4.80	7.833	4.80	10.92	1.60
1.750	2.00	4.833	6.41	7.917	4.80	11.00	1.60
1.833	2.00	4.917	6.41	8.000	4.80	11.08	1.60
1.917	2.00	5.000	6.41	8.083	4.80	11.17	1.60
2.000	2.00	5.083	6.41	8.167	4.80	11.25	1.60
2.083	2.00	5.167	6.41	8.250	4.80	11.33	1.60
2.167	2.00	5.250	6.41	8.333	2.80	11.42	1.60
2.250	2.00	5.333	9.61	8.417	2.80	11.50	1.60
2.333	2.40	5.417	9.61	8.500	2.80	11.58	1.60
2.417	2.40	5.500	9.61	8.583	2.80	11.67	1.60
2.500	2.40	5.583	9.61	8.667	2.80	11.75	1.60
2.583	2.40	5.667	9.61	8.750	2.80	11.83	1.60
2.667	2.40	5.750	9.61	8.833	2.80	11.92	1.60
2.750	2.40	5.833	38.43	8.917	2.80	12.00	1.60
2.833	2.40	5.917	38.43	9.000	2.80	12.08	1.60
2.917	2.40	6.000	38.44	9.083	2.80	12.17	1.60
3.000	2.40	6.083	105.69	9.167	2.80	12.25	1.60
3.083	2.40	6.167	105.69	9.250	2.80		

Unit Hyd Qpeak (cms)= 0.187

PEAK FLOW (cms)= 0.112 (i)
 TIME TO PEAK (hrs)= 6.583
 RUNOFF VOLUME (mm)= 30.073
 TOTAL RAINFALL (mm)= 80.070
 RUNOFF COEFFICIENT = 0.376

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

 ** SIMULATION:25yr 4hr 10min Chicago **

 | CHICAGO STORM |
Ptotal= 57.50 mm

IDF curve parameters: A= 663.082
 B= 0.000
 C= 0.699

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 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	4.83	1.00	22.88	2.00	9.56	3.00	5.57
0.17	5.40	1.17	132.61	2.17	8.44	3.17	5.25
0.33	6.17	1.33	28.08	2.33	7.60	3.33	4.96
0.50	7.26	1.50	17.71	2.50	6.93	3.50	4.72

0.67	8.99	1.67	13.50	2.67	6.40	3.67	4.50
0.83	12.30	1.83	11.12	2.83	5.95	3.83	4.30

```

-----
| CALIB |
| NASHYD ( 0002) | Area (ha)= 2.20 Curve Number (CN)= 73.1
| ID= 1 DT= 5.0 min | Ia (mm)= 9.92 # of Linear Res.(N)= 3.00
-----
| U.H. Tp(hrs)= 0.45

```

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 4.83 | 1.083 22.88 | 2.083 9.56 | 3.08 5.57
0.167 4.83 | 1.167 22.88 | 2.167 9.56 | 3.17 5.57
0.250 5.40 | 1.250 132.61 | 2.250 8.44 | 3.25 5.25
0.333 5.40 | 1.333 132.61 | 2.333 8.44 | 3.33 5.25
0.417 6.17 | 1.417 28.08 | 2.417 7.60 | 3.42 4.96
0.500 6.17 | 1.500 28.08 | 2.500 7.60 | 3.50 4.96
0.583 7.26 | 1.583 17.71 | 2.583 6.93 | 3.58 4.72
0.667 7.26 | 1.667 17.71 | 2.667 6.93 | 3.67 4.72
0.750 8.99 | 1.750 13.50 | 2.750 6.40 | 3.75 4.50
0.833 8.99 | 1.833 13.50 | 2.833 6.40 | 3.83 4.50
0.917 12.30 | 1.917 11.12 | 2.917 5.95 | 3.92 4.30
1.000 12.30 | 2.000 11.12 | 3.000 5.95 | 4.00 4.30

```

Unit Hyd Qpeak (cms)= 0.187

PEAK FLOW (cms)= 0.055 (i)
 TIME TO PEAK (hrs)= 1.917
 RUNOFF VOLUME (mm)= 16.051
 TOTAL RAINFALL (mm)= 57.504
 RUNOFF COEFFICIENT = 0.279

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

```

*****
** SIMULATION:2yr 12hr 15min SCS **
*****

```

```

-----
| READ STORM | Filename: C:\Users\nsproule\AppData
| | Local\Temp\
| | 6c2a7a27-26da-4d22-b0b4-01b99ac0ee04\276c3a00
| Ptotal= 43.73 mm | Comments: 2yr 12hr 15min SCS

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	3.25	1.75	6.50	7.87	9.75	1.53
0.25	1.09	3.50	1.75	6.75	3.50	10.00	1.53
0.50	1.09	3.75	1.75	7.00	3.50	10.25	0.87
0.75	1.09	4.00	1.75	7.25	2.62	10.50	0.87
1.00	1.09	4.25	2.62	7.50	2.62	10.75	0.87
1.25	1.09	4.50	2.62	7.75	2.62	11.00	0.87
1.50	1.09	4.75	3.50	8.00	2.62	11.25	0.87
1.75	1.09	5.00	3.50	8.25	1.53	11.50	0.87
2.00	1.09	5.25	5.25	8.50	1.53	11.75	0.87
2.25	1.31	5.50	5.25	8.75	1.53	12.00	0.87
2.50	1.31	5.75	20.99	9.00	1.53		
2.75	1.31	6.00	57.72	9.25	1.53		
3.00	1.31	6.25	7.87	9.50	1.53		

CALIB			
NASHYD (0002)	Area (ha)=	2.20	Curve Number (CN)= 73.1
ID= 1 DT= 5.0 min	Ia (mm)=	9.92	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)=	0.45	

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

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	1.31	6.250	57.72	9.33	1.53
0.167	0.00	3.250	1.31	6.333	7.87	9.42	1.53
0.250	0.00	3.333	1.75	6.417	7.87	9.50	1.53
0.333	1.09	3.417	1.75	6.500	7.87	9.58	1.53
0.417	1.09	3.500	1.75	6.583	7.87	9.67	1.53
0.500	1.09	3.583	1.75	6.667	7.87	9.75	1.53
0.583	1.09	3.667	1.75	6.750	7.87	9.83	1.53
0.667	1.09	3.750	1.75	6.833	3.50	9.92	1.53
0.750	1.09	3.833	1.75	6.917	3.50	10.00	1.53
0.833	1.09	3.917	1.75	7.000	3.50	10.08	1.53
0.917	1.09	4.000	1.75	7.083	3.50	10.17	1.53
1.000	1.09	4.083	1.75	7.167	3.50	10.25	1.53
1.083	1.09	4.167	1.75	7.250	3.50	10.33	0.87
1.167	1.09	4.250	1.75	7.333	2.62	10.42	0.87
1.250	1.09	4.333	2.62	7.417	2.62	10.50	0.87
1.333	1.09	4.417	2.62	7.500	2.62	10.58	0.87
1.417	1.09	4.500	2.62	7.583	2.62	10.67	0.87
1.500	1.09	4.583	2.62	7.667	2.62	10.75	0.87
1.583	1.09	4.667	2.62	7.750	2.62	10.83	0.87

1.667	1.09	4.750	2.62	7.833	2.62	10.92	0.87
1.750	1.09	4.833	3.50	7.917	2.62	11.00	0.87
1.833	1.09	4.917	3.50	8.000	2.62	11.08	0.87
1.917	1.09	5.000	3.50	8.083	2.62	11.17	0.87
2.000	1.09	5.083	3.50	8.167	2.62	11.25	0.87
2.083	1.09	5.167	3.50	8.250	2.62	11.33	0.87
2.167	1.09	5.250	3.50	8.333	1.53	11.42	0.87
2.250	1.09	5.333	5.25	8.417	1.53	11.50	0.87
2.333	1.31	5.417	5.25	8.500	1.53	11.58	0.87
2.417	1.31	5.500	5.25	8.583	1.53	11.67	0.87
2.500	1.31	5.583	5.25	8.667	1.53	11.75	0.87
2.583	1.31	5.667	5.25	8.750	1.53	11.83	0.87
2.667	1.31	5.750	5.25	8.833	1.53	11.92	0.87
2.750	1.31	5.833	20.99	8.917	1.53	12.00	0.87
2.833	1.31	5.917	20.99	9.000	1.53	12.08	0.87
2.917	1.31	6.000	20.99	9.083	1.53	12.17	0.87
3.000	1.31	6.083	57.72	9.167	1.53	12.25	0.87
3.083	1.31	6.167	57.72	9.250	1.53		

Unit Hyd Qpeak (cms)= 0.187

PEAK FLOW (cms)= 0.030 (i)
 TIME TO PEAK (hrs)= 6.667
 RUNOFF VOLUME (mm)= 8.980
 TOTAL RAINFALL (mm)= 43.730
 RUNOFF COEFFICIENT = 0.205

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

 ** SIMULATION:2yr 4hr 10min Chicago **

 | CHICAGO STORM | IDF curve parameters: A= 362.158
 | Ptotal= 31.41 mm | B= 0.000
 C= 0.699
 used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 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	2.64	1.00	12.50	2.00	5.22	3.00	3.04
0.17	2.95	1.17	72.43	2.17	4.61	3.17	2.87
0.33	3.37	1.33	15.34	2.33	4.15	3.33	2.71
0.50	3.96	1.50	9.67	2.50	3.79	3.50	2.58
0.67	4.91	1.67	7.37	2.67	3.49	3.67	2.46

0.83 6.72 | 1.83 6.07 | 2.83 3.25 | 3.83 2.35

```

-----
| CALIB |
| NASHYD ( 0002) | Area (ha)= 2.20 Curve Number (CN)= 73.1
| ID= 1 DT= 5.0 min | Ia (mm)= 9.92 # of Linear Res.(N)= 3.00
-----
| U.H. Tp(hrs)= 0.45

```

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	2.64	1.083	12.50	2.083	5.22	3.08	3.04
0.167	2.64	1.167	12.50	2.167	5.22	3.17	3.04
0.250	2.95	1.250	72.43	2.250	4.61	3.25	2.87
0.333	2.95	1.333	72.43	2.333	4.61	3.33	2.87
0.417	3.37	1.417	15.34	2.417	4.15	3.42	2.71
0.500	3.37	1.500	15.34	2.500	4.15	3.50	2.71
0.583	3.96	1.583	9.67	2.583	3.79	3.58	2.58
0.667	3.96	1.667	9.67	2.667	3.79	3.67	2.58
0.750	4.91	1.750	7.37	2.750	3.49	3.75	2.46
0.833	4.91	1.833	7.37	2.833	3.49	3.83	2.46
0.917	6.72	1.917	6.07	2.917	3.25	3.92	2.35
1.000	6.72	2.000	6.07	3.000	3.25	4.00	2.35

Unit Hyd Qpeak (cms)= 0.187

PEAK FLOW (cms)= 0.011 (i)

TIME TO PEAK (hrs)= 2.000

RUNOFF VOLUME (mm)= 4.016

TOTAL RAINFALL (mm)= 31.407

RUNOFF COEFFICIENT = 0.128

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

```

*****
** SIMULATION:50yr 12hr 15min SCS **
*****

```

```

-----
| READ STORM | Filename: C:\Users\nsproule\AppData
|            |   ata\Local\Temp\
|            |   6c2a7a27-26da-4d22-b0b4-01b99ac0ee04\cc40fda0
| Ptotal= 89.16 mm | Comments: 50yr 12hr 15min SCS
-----

```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.00	3.25	3.57	6.50	16.05	9.75	3.12
0.25	2.23	3.50	3.57	6.75	7.13	10.00	3.12
0.50	2.23	3.75	3.57	7.00	7.13	10.25	1.78
0.75	2.23	4.00	3.57	7.25	5.35	10.50	1.78
1.00	2.23	4.25	5.35	7.50	5.35	10.75	1.78
1.25	2.23	4.50	5.35	7.75	5.35	11.00	1.78
1.50	2.23	4.75	7.13	8.00	5.35	11.25	1.78
1.75	2.23	5.00	7.13	8.25	3.12	11.50	1.78
2.00	2.23	5.25	10.70	8.50	3.12	11.75	1.78
2.25	2.67	5.50	10.70	8.75	3.12	12.00	1.78
2.50	2.67	5.75	42.80	9.00	3.12		
2.75	2.67	6.00	117.69	9.25	3.12		
3.00	2.67	6.25	16.05	9.50	3.12		

CALIB			
NASHYD (0002)	Area (ha)=	2.20	Curve Number (CN)= 73.1
ID= 1 DT= 5.0 min	Ia (mm)=	9.92	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)=	0.45	

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	0.00	3.167	2.67	6.250	117.69	9.33	3.12
0.167	0.00	3.250	2.67	6.333	16.05	9.42	3.12
0.250	0.00	3.333	3.57	6.417	16.05	9.50	3.12
0.333	2.23	3.417	3.57	6.500	16.05	9.58	3.12
0.417	2.23	3.500	3.57	6.583	16.05	9.67	3.12
0.500	2.23	3.583	3.57	6.667	16.05	9.75	3.12
0.583	2.23	3.667	3.57	6.750	16.05	9.83	3.12
0.667	2.23	3.750	3.57	6.833	7.13	9.92	3.12
0.750	2.23	3.833	3.57	6.917	7.13	10.00	3.12
0.833	2.23	3.917	3.57	7.000	7.13	10.08	3.12
0.917	2.23	4.000	3.57	7.083	7.13	10.17	3.12
1.000	2.23	4.083	3.57	7.167	7.13	10.25	3.12
1.083	2.23	4.167	3.57	7.250	7.13	10.33	1.78
1.167	2.23	4.250	3.57	7.333	5.35	10.42	1.78
1.250	2.23	4.333	5.35	7.417	5.35	10.50	1.78
1.333	2.23	4.417	5.35	7.500	5.35	10.58	1.78
1.417	2.23	4.500	5.35	7.583	5.35	10.67	1.78
1.500	2.23	4.583	5.35	7.667	5.35	10.75	1.78
1.583	2.23	4.667	5.35	7.750	5.35	10.83	1.78
1.667	2.23	4.750	5.35	7.833	5.35	10.92	1.78

1.750	2.23	4.833	7.13	7.917	5.35	11.00	1.78
1.833	2.23	4.917	7.13	8.000	5.35	11.08	1.78
1.917	2.23	5.000	7.13	8.083	5.35	11.17	1.78
2.000	2.23	5.083	7.13	8.167	5.35	11.25	1.78
2.083	2.23	5.167	7.13	8.250	5.35	11.33	1.78
2.167	2.23	5.250	7.13	8.333	3.12	11.42	1.78
2.250	2.23	5.333	10.70	8.417	3.12	11.50	1.78
2.333	2.67	5.417	10.70	8.500	3.12	11.58	1.78
2.417	2.67	5.500	10.70	8.583	3.12	11.67	1.78
2.500	2.67	5.583	10.70	8.667	3.12	11.75	1.78
2.583	2.67	5.667	10.70	8.750	3.12	11.83	1.78
2.667	2.67	5.750	10.70	8.833	3.12	11.92	1.78
2.750	2.67	5.833	42.80	8.917	3.12	12.00	1.78
2.833	2.67	5.917	42.80	9.000	3.12	12.08	1.78
2.917	2.67	6.000	42.80	9.083	3.12	12.17	1.78
3.000	2.67	6.083	117.69	9.167	3.12	12.25	1.78
3.083	2.67	6.167	117.69	9.250	3.12		

Unit Hyd Qpeak (cms)= 0.187

PEAK FLOW (cms)= 0.136 (i)
 TIME TO PEAK (hrs)= 6.583
 RUNOFF VOLUME (mm)= 36.352
 TOTAL RAINFALL (mm)= 89.160
 RUNOFF COEFFICIENT = 0.408

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

 ** SIMULATION:50yr 4hr 10min Chicago **

 | CHICAGO STORM | IDF curve parameters: A= 738.312
 | Ptotal= 64.03 mm | B= 0.000
 C= 0.699
 used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 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	5.38	1.00	25.48	2.00	10.64	3.00	6.20
0.17	6.02	1.17	147.65	2.17	9.40	3.17	5.84
0.33	6.87	1.33	31.27	2.33	8.46	3.33	5.53
0.50	8.08	1.50	19.71	2.50	7.72	3.50	5.25
0.67	10.01	1.67	15.03	2.67	7.12	3.67	5.01
0.83	13.70	1.83	12.38	2.83	6.62	3.83	4.79

```

-----
| CALIB |
| NASHYD ( 0002) | Area (ha)= 2.20 Curve Number (CN)= 73.1
| ID= 1 DT= 5.0 min | Ia (mm)= 9.92 # of Linear Res.(N)= 3.00
-----
| U.H. Tp(hrs)= 0.45

```

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	5.38	1.083	25.48	2.083	10.64	3.08	6.20
0.167	5.38	1.167	25.48	2.167	10.64	3.17	6.20
0.250	6.02	1.250	147.65	2.250	9.40	3.25	5.84
0.333	6.02	1.333	147.65	2.333	9.40	3.33	5.84
0.417	6.87	1.417	31.27	2.417	8.46	3.42	5.53
0.500	6.87	1.500	31.27	2.500	8.46	3.50	5.53
0.583	8.08	1.583	19.71	2.583	7.72	3.58	5.25
0.667	8.08	1.667	19.71	2.667	7.72	3.67	5.25
0.750	10.01	1.750	15.03	2.750	7.12	3.75	5.01
0.833	10.01	1.833	15.03	2.833	7.12	3.83	5.01
0.917	13.70	1.917	12.38	2.917	6.62	3.92	4.79
1.000	13.70	2.000	12.38	3.000	6.62	4.00	4.79

Unit Hyd Qpeak (cms)= 0.187

PEAK FLOW (cms)= 0.069 (i)
 TIME TO PEAK (hrs)= 1.833
 RUNOFF VOLUME (mm)= 19.837
 TOTAL RAINFALL (mm)= 64.028
 RUNOFF COEFFICIENT = 0.310

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

```

*****
** SIMULATION:5yr 12hr 15min SCS **
*****

```

```

-----
| READ STORM | Filename: C:\Users\nsproule\AppData
|            |   ata\Local\Temp\
|            |   6c2a7a27-26da-4d22-b0b4-01b99ac0ee04\efb79bd0
| Ptotal= 58.31 mm | Comments: 5yr 12hr 15min SCS
-----

```

TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN

0.00	0.00	3.25	2.33	6.50	10.50	9.75	2.04
0.25	1.46	3.50	2.33	6.75	4.66	10.00	2.04
0.50	1.46	3.75	2.33	7.00	4.66	10.25	1.17
0.75	1.46	4.00	2.33	7.25	3.50	10.50	1.17
1.00	1.46	4.25	3.50	7.50	3.50	10.75	1.17
1.25	1.46	4.50	3.50	7.75	3.50	11.00	1.17
1.50	1.46	4.75	4.66	8.00	3.50	11.25	1.17
1.75	1.46	5.00	4.66	8.25	2.04	11.50	1.17
2.00	1.46	5.25	7.00	8.50	2.04	11.75	1.17
2.25	1.75	5.50	7.00	8.75	2.04	12.00	1.17
2.50	1.75	5.75	27.99	9.00	2.04		
2.75	1.75	6.00	76.97	9.25	2.04		
3.00	1.75	6.25	10.50	9.50	2.04		

CALIB		Area	(ha)= 2.20	Curve Number	(CN)= 73.1
NASHYD (0002)		Ia	(mm)= 9.92	# of Linear Res.(N)= 3.00	
ID= 1 DT= 5.0 min		U.H. Tp	(hrs)= 0.45		

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

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	1.75	6.250	76.97	9.33	2.04
0.167	0.00	3.250	1.75	6.333	10.50	9.42	2.04
0.250	0.00	3.333	2.33	6.417	10.50	9.50	2.04
0.333	1.46	3.417	2.33	6.500	10.50	9.58	2.04
0.417	1.46	3.500	2.33	6.583	10.50	9.67	2.04
0.500	1.46	3.583	2.33	6.667	10.50	9.75	2.04
0.583	1.46	3.667	2.33	6.750	10.50	9.83	2.04
0.667	1.46	3.750	2.33	6.833	4.66	9.92	2.04
0.750	1.46	3.833	2.33	6.917	4.66	10.00	2.04
0.833	1.46	3.917	2.33	7.000	4.66	10.08	2.04
0.917	1.46	4.000	2.33	7.083	4.66	10.17	2.04
1.000	1.46	4.083	2.33	7.167	4.66	10.25	2.04
1.083	1.46	4.167	2.33	7.250	4.66	10.33	1.17
1.167	1.46	4.250	2.33	7.333	3.50	10.42	1.17
1.250	1.46	4.333	3.50	7.417	3.50	10.50	1.17
1.333	1.46	4.417	3.50	7.500	3.50	10.58	1.17
1.417	1.46	4.500	3.50	7.583	3.50	10.67	1.17
1.500	1.46	4.583	3.50	7.667	3.50	10.75	1.17
1.583	1.46	4.667	3.50	7.750	3.50	10.83	1.17
1.667	1.46	4.750	3.50	7.833	3.50	10.92	1.17
1.750	1.46	4.833	4.66	7.917	3.50	11.00	1.17

1.833	1.46	4.917	4.66	8.000	3.50	11.08	1.17
1.917	1.46	5.000	4.66	8.083	3.50	11.17	1.17
2.000	1.46	5.083	4.66	8.167	3.50	11.25	1.17
2.083	1.46	5.167	4.66	8.250	3.50	11.33	1.17
2.167	1.46	5.250	4.66	8.333	2.04	11.42	1.17
2.250	1.46	5.333	7.00	8.417	2.04	11.50	1.17
2.333	1.75	5.417	7.00	8.500	2.04	11.58	1.17
2.417	1.75	5.500	7.00	8.583	2.04	11.67	1.17
2.500	1.75	5.583	7.00	8.667	2.04	11.75	1.17
2.583	1.75	5.667	7.00	8.750	2.04	11.83	1.17
2.667	1.75	5.750	7.00	8.833	2.04	11.92	1.17
2.750	1.75	5.833	27.99	8.917	2.04	12.00	1.17
2.833	1.75	5.917	27.99	9.000	2.04	12.08	1.17
2.917	1.75	6.000	27.99	9.083	2.04	12.17	1.17
3.000	1.75	6.083	76.97	9.167	2.04	12.25	1.17
3.083	1.75	6.167	76.97	9.250	2.04		

Unit Hyd Qpeak (cms)= 0.187

PEAK FLOW (cms)= 0.059 (i)
 TIME TO PEAK (hrs)= 6.583
 RUNOFF VOLUME (mm)= 16.505
 TOTAL RAINFALL (mm)= 58.310
 RUNOFF COEFFICIENT = 0.283

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

 ** SIMULATION:5yr 4hr 10min Chicago **

 | CHICAGO STORM |
Ptotal= 41.88 mm

IDF curve parameters: A= 482.877
 B= 0.000
 C= 0.699

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 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	3.52	1.00	16.66	2.00	6.96	3.00	4.06
0.17	3.93	1.17	96.57	2.17	6.15	3.17	3.82
0.33	4.49	1.33	20.45	2.33	5.53	3.33	3.61
0.50	5.29	1.50	12.89	2.50	5.05	3.50	3.43
0.67	6.55	1.67	9.83	2.67	4.66	3.67	3.27
0.83	8.96	1.83	8.10	2.83	4.33	3.83	3.13

```

-----
| CALIB |
| NASHYD ( 0002) | Area (ha)= 2.20 Curve Number (CN)= 73.1
| ID= 1 DT= 5.0 min | Ia (mm)= 9.92 # of Linear Res.(N)= 3.00
-----
| U.H. Tp(hrs)= 0.45

```

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	3.52	1.083	16.66	2.083	6.96	3.08	4.06
0.167	3.52	1.167	16.66	2.167	6.96	3.17	4.06
0.250	3.93	1.250	96.57	2.250	6.15	3.25	3.82
0.333	3.93	1.333	96.57	2.333	6.15	3.33	3.82
0.417	4.49	1.417	20.45	2.417	5.53	3.42	3.61
0.500	4.49	1.500	20.45	2.500	5.53	3.50	3.61
0.583	5.29	1.583	12.89	2.583	5.05	3.58	3.43
0.667	5.29	1.667	12.89	2.667	5.05	3.67	3.43
0.750	6.55	1.750	9.83	2.750	4.66	3.75	3.27
0.833	6.55	1.833	9.83	2.833	4.66	3.83	3.27
0.917	8.96	1.917	8.10	2.917	4.33	3.92	3.13
1.000	8.96	2.000	8.10	3.000	4.33	4.00	3.13

Unit Hyd Qpeak (cms)= 0.187

PEAK FLOW (cms)= 0.025 (i)

TIME TO PEAK (hrs)= 1.917

RUNOFF VOLUME (mm)= 8.141

TOTAL RAINFALL (mm)= 41.876

RUNOFF COEFFICIENT = 0.194

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

Post-Development Catchment 1A (Controlled)

 ** SIMULATION:100y-C **

```

-----
| CALIB |
| STANDHYD ( 0012) | Area (ha)= 0.13
| ID= 1 DT= 5.0 min | Total Imp(%)= 52.30 Dir. Conn.(%)= 21.50
-----
  
```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.07	0.06
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	29.44	30.00
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	5.92	1.083	28.01	2.083	11.70	3.08	6.82
0.167	5.92	1.167	28.01	2.167	11.70	3.17	6.82
0.250	6.61	1.250	162.35	2.250	10.34	3.25	6.42
0.333	6.61	1.333	162.35	2.333	10.34	3.33	6.42
0.417	7.55	1.417	34.38	2.417	9.30	3.42	6.08
0.500	7.55	1.500	34.38	2.500	9.30	3.50	6.08
0.583	8.89	1.583	21.68	2.583	8.49	3.58	5.77
0.667	8.89	1.667	21.68	2.667	8.49	3.67	5.77
0.750	11.01	1.750	16.53	2.750	7.83	3.75	5.50
0.833	11.01	1.833	16.53	2.833	7.83	3.83	5.50
0.917	15.06	1.917	13.62	2.917	7.28	3.92	5.26
1.000	15.06	2.000	13.62	3.000	7.28	4.00	5.26

Max. Eff. Inten. (mm/hr)=	162.35	193.78
over (min)	5.00	10.00
Storage Coeff. (min)=	1.24 (ii)	5.80 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.33	0.15

TOTALS

PEAK FLOW (cms)=	0.01	0.02	0.035 (iii)
TIME TO PEAK (hrs)=	1.33	1.42	1.33
RUNOFF VOLUME (mm)=	68.40	49.92	53.86
TOTAL RAINFALL (mm)=	70.40	70.40	70.40
RUNOFF COEFFICIENT =	0.97	0.71	0.77

***** 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.

 ** SIMULATION:100y-SCS **

```

-----
| CALIB |
| STANDHYD ( 0012) | Area (ha)= 0.13
| ID= 1 DT= 5.0 min | Total Imp(%)= 52.30 Dir. Conn.(%)= 21.50
-----
  
```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.07	0.06
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	29.44	30.00
Mannings n	=	0.013	0.250

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

----- TRANSFORMED HYETOGRAPH -----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.94	6.250	129.40	9.33	3.43
0.167	0.00	3.250	2.94	6.333	17.65	9.42	3.43
0.250	0.00	3.333	3.92	6.417	17.65	9.50	3.43
0.333	2.45	3.417	3.92	6.500	17.65	9.58	3.43
0.417	2.45	3.500	3.92	6.583	17.65	9.67	3.43
0.500	2.45	3.583	3.92	6.667	17.65	9.75	3.43
0.583	2.45	3.667	3.92	6.750	17.65	9.83	3.43
0.667	2.45	3.750	3.92	6.833	7.84	9.92	3.43
0.750	2.45	3.833	3.92	6.917	7.84	10.00	3.43
0.833	2.45	3.917	3.92	7.000	7.84	10.08	3.43
0.917	2.45	4.000	3.92	7.083	7.84	10.17	3.43
1.000	2.45	4.083	3.92	7.167	7.84	10.25	3.43
1.083	2.45	4.167	3.92	7.250	7.84	10.33	1.96
1.167	2.45	4.250	3.92	7.333	5.88	10.42	1.96
1.250	2.45	4.333	5.88	7.417	5.88	10.50	1.96
1.333	2.45	4.417	5.88	7.500	5.88	10.58	1.96
1.417	2.45	4.500	5.88	7.583	5.88	10.67	1.96
1.500	2.45	4.583	5.88	7.667	5.88	10.75	1.96
1.583	2.45	4.667	5.88	7.750	5.88	10.83	1.96
1.667	2.45	4.750	5.88	7.833	5.88	10.92	1.96
1.750	2.45	4.833	7.84	7.917	5.88	11.00	1.96
1.833	2.45	4.917	7.84	8.000	5.88	11.08	1.96
1.917	2.45	5.000	7.84	8.083	5.88	11.17	1.96
2.000	2.45	5.083	7.84	8.167	5.88	11.25	1.96

2.083	2.45	5.167	7.84	8.250	5.88	11.33	1.96
2.167	2.45	5.250	7.84	8.333	3.43	11.42	1.96
2.250	2.45	5.333	11.76	8.417	3.43	11.50	1.96
2.333	2.94	5.417	11.76	8.500	3.43	11.58	1.96
2.417	2.94	5.500	11.76	8.583	3.43	11.67	1.96
2.500	2.94	5.583	11.76	8.667	3.43	11.75	1.96
2.583	2.94	5.667	11.76	8.750	3.43	11.83	1.96
2.667	2.94	5.750	11.76	8.833	3.43	11.92	1.96
2.750	2.94	5.833	47.05	8.917	3.43	12.00	1.96
2.833	2.94	5.917	47.05	9.000	3.43	12.08	1.96
2.917	2.94	6.000	47.06	9.083	3.43	12.17	1.96
3.000	2.94	6.083	129.40	9.167	3.43	12.25	1.96
3.083	2.94	6.167	129.40	9.250	3.43		

Max.Eff.Inten.(mm/hr)= 129.40 190.28
over (min) 5.00 10.00
Storage Coeff. (min)= 1.36 (ii) 5.95 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.33 0.15

TOTALS

PEAK FLOW (cms)= 0.01 0.03 0.039 (iii)
TIME TO PEAK (hrs)= 6.25 6.25 6.25
RUNOFF VOLUME (mm)= 96.03 75.85 80.16
TOTAL RAINFALL (mm)= 98.03 98.03 98.03
RUNOFF COEFFICIENT = 0.98 0.77 0.82

***** 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.

** SIMULATION:10y-C **

```

-----
| CALIB |
| STANDHYD ( 0012) | Area (ha)= 0.13
| ID= 1 DT= 5.0 min | Total Imp(%)= 52.30 Dir. Conn.(%)= 21.50
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.07	0.06
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	29.44	30.00
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	4.11	1.083	19.44	2.083	8.12	3.08	4.73
0.167	4.11	1.167	19.44	2.167	8.12	3.17	4.73
0.250	4.59	1.250	112.66	2.250	7.17	3.25	4.46
0.333	4.59	1.333	112.66	2.333	7.17	3.33	4.46
0.417	5.24	1.417	23.86	2.417	6.46	3.42	4.22
0.500	5.24	1.500	23.86	2.500	6.46	3.50	4.22
0.583	6.17	1.583	15.04	2.583	5.89	3.58	4.01
0.667	6.17	1.667	15.04	2.667	5.89	3.67	4.01
0.750	7.64	1.750	11.47	2.750	5.43	3.75	3.82
0.833	7.64	1.833	11.47	2.833	5.43	3.83	3.82
0.917	10.45	1.917	9.45	2.917	5.05	3.92	3.65
1.000	10.45	2.000	9.45	3.000	5.05	4.00	3.65

Max.Eff.Inten.(mm/hr)= 112.66 115.44
over (min) 5.00 10.00
Storage Coeff. (min)= 1.44 (ii) 7.05 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.33 0.14

TOTALS

PEAK FLOW (cms)= 0.01 0.01 0.021 (iii)
TIME TO PEAK (hrs)= 1.33 1.42 1.33
RUNOFF VOLUME (mm)= 46.86 30.58 34.04
TOTAL RAINFALL (mm)= 48.86 48.86 48.86
RUNOFF COEFFICIENT = 0.96 0.63 0.70

***** 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.

** SIMULATION:10y-SCS **

```

-----
| CALIB |
| STANDHYD ( 0012) | Area (ha)= 0.13
| ID= 1 DT= 5.0 min | Total Imp(%)= 52.30 Dir. Conn.(%)= 21.50
-----

```

Surface Area (ha)= IMPERVIOUS 0.07 PERVIOUS (i) 0.06

Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	29.44	30.00
Mannings n	=	0.013	0.250

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

----- TRANSFORMED HYETOGRAPH -----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.04	6.250	89.80	9.33	2.38
0.167	0.00	3.250	2.04	6.333	12.25	9.42	2.38
0.250	0.00	3.333	2.72	6.417	12.25	9.50	2.38
0.333	1.70	3.417	2.72	6.500	12.25	9.58	2.38
0.417	1.70	3.500	2.72	6.583	12.25	9.67	2.38
0.500	1.70	3.583	2.72	6.667	12.25	9.75	2.38
0.583	1.70	3.667	2.72	6.750	12.25	9.83	2.38
0.667	1.70	3.750	2.72	6.833	5.44	9.92	2.38
0.750	1.70	3.833	2.72	6.917	5.44	10.00	2.38
0.833	1.70	3.917	2.72	7.000	5.44	10.08	2.38
0.917	1.70	4.000	2.72	7.083	5.44	10.17	2.38
1.000	1.70	4.083	2.72	7.167	5.44	10.25	2.38
1.083	1.70	4.167	2.72	7.250	5.44	10.33	1.36
1.167	1.70	4.250	2.72	7.333	4.08	10.42	1.36
1.250	1.70	4.333	4.08	7.417	4.08	10.50	1.36
1.333	1.70	4.417	4.08	7.500	4.08	10.58	1.36
1.417	1.70	4.500	4.08	7.583	4.08	10.67	1.36
1.500	1.70	4.583	4.08	7.667	4.08	10.75	1.36
1.583	1.70	4.667	4.08	7.750	4.08	10.83	1.36
1.667	1.70	4.750	4.08	7.833	4.08	10.92	1.36
1.750	1.70	4.833	5.44	7.917	4.08	11.00	1.36
1.833	1.70	4.917	5.44	8.000	4.08	11.08	1.36
1.917	1.70	5.000	5.44	8.083	4.08	11.17	1.36
2.000	1.70	5.083	5.44	8.167	4.08	11.25	1.36
2.083	1.70	5.167	5.44	8.250	4.08	11.33	1.36
2.167	1.70	5.250	5.44	8.333	2.38	11.42	1.36
2.250	1.70	5.333	8.16	8.417	2.38	11.50	1.36
2.333	2.04	5.417	8.16	8.500	2.38	11.58	1.36
2.417	2.04	5.500	8.16	8.583	2.38	11.67	1.36
2.500	2.04	5.583	8.16	8.667	2.38	11.75	1.36
2.583	2.04	5.667	8.16	8.750	2.38	11.83	1.36
2.667	2.04	5.750	8.16	8.833	2.38	11.92	1.36
2.750	2.04	5.833	32.65	8.917	2.38	12.00	1.36
2.833	2.04	5.917	32.65	9.000	2.38	12.08	1.36
2.917	2.04	6.000	32.66	9.083	2.38	12.17	1.36
3.000	2.04	6.083	89.80	9.167	2.38	12.25	1.36
3.083	2.04	6.167	89.80	9.250	2.38		

Max. Eff. Inten. (mm/hr)=	89.80	122.64
---------------------------	-------	--------

over (min)	5.00	10.00	
Storage Coeff. (min)=	1.58 (ii)	7.05 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.33	0.14	
			TOTALS
PEAK FLOW (cms)=	0.01	0.02	0.025 (iii)
TIME TO PEAK (hrs)=	6.25	6.25	6.25
RUNOFF VOLUME (mm)=	66.03	47.74	51.64
TOTAL RAINFALL (mm)=	68.03	68.03	68.03
RUNOFF COEFFICIENT =	0.97	0.70	0.76

***** 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.

 ** SIMULATION:25mm Water Quality **

CALIB			
STANDHYD (0012)		Area (ha)= 0.13	
ID= 1 DT= 5.0 min		Total Imp(%)= 52.30	Dir. Conn.(%)= 21.50

		IMPERVIOUS	PERVIOUS (i)	
Surface Area (ha)=		0.07	0.06	
Dep. Storage (mm)=		2.00	1.50	
Average Slope (%)=		0.50	2.00	
Length (m)=		29.44	30.00	
Mannings n =		0.013	0.250	
Max.Eff.Inten.(mm/hr)=		76.07	40.73	
over (min)		5.00	15.00	
Storage Coeff. (min)=		1.68 (ii)	10.19 (ii)	
Unit Hyd. Tpeak (min)=		5.00	15.00	
Unit Hyd. peak (cms)=		0.32	0.09	
				TOTALS
PEAK FLOW (cms)=		0.01	0.00	0.007 (iii)
TIME TO PEAK (hrs)=		1.33	1.50	1.33
RUNOFF VOLUME (mm)=		22.99	11.30	13.77
TOTAL RAINFALL (mm)=		24.99	24.99	24.99
RUNOFF COEFFICIENT =		0.92	0.45	0.55

***** 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.

 ** SIMULATION:25y-C **

```

-----
| CALIB |
| STANDHYD ( 0012) | Area (ha)= 0.13
| ID= 1 DT= 5.0 min | Total Imp(%)= 52.30 Dir. Conn.(%)= 21.50
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.07	0.06
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	29.44	30.00
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	4.83	1.083	22.88	2.083	9.56	3.08	5.57
0.167	4.83	1.167	22.88	2.167	9.56	3.17	5.57
0.250	5.40	1.250	132.61	2.250	8.44	3.25	5.25
0.333	5.40	1.333	132.61	2.333	8.44	3.33	5.25
0.417	6.17	1.417	28.08	2.417	7.60	3.42	4.96
0.500	6.17	1.500	28.08	2.500	7.60	3.50	4.96
0.583	7.26	1.583	17.71	2.583	6.93	3.58	4.72
0.667	7.26	1.667	17.71	2.667	6.93	3.67	4.72
0.750	8.99	1.750	13.50	2.750	6.40	3.75	4.50
0.833	8.99	1.833	13.50	2.833	6.40	3.83	4.50
0.917	12.30	1.917	11.12	2.917	5.95	3.92	4.30
1.000	12.30	2.000	11.12	3.000	5.95	4.00	4.30

Max.Eff.Inten.(mm/hr)=	132.61	146.21
over (min)	5.00	10.00
Storage Coeff. (min)=	1.35 (ii)	6.45 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.33	0.14

TOTALS

PEAK FLOW (cms)=	0.01	0.02	0.027 (iii)
TIME TO PEAK (hrs)=	1.33	1.42	1.33
RUNOFF VOLUME (mm)=	55.50	38.21	41.89
TOTAL RAINFALL (mm)=	57.50	57.50	57.50

RUNOFF COEFFICIENT = 0.97 0.66 0.73

***** 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.

** SIMULATION:25y-SCS **

```

-----
| CALIB |
| STANDHYD ( 0012) | Area (ha)= 0.13
| ID= 1 DT= 5.0 min | Total Imp(%)= 52.30 Dir. Conn.(%)= 21.50
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.07	0.06
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	29.44	30.00
Mannings n	=	0.013	0.250

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

```

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

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.40	6.250	105.69	9.33	2.80
0.167	0.00	3.250	2.40	6.333	14.41	9.42	2.80
0.250	0.00	3.333	3.20	6.417	14.41	9.50	2.80
0.333	2.00	3.417	3.20	6.500	14.41	9.58	2.80
0.417	2.00	3.500	3.20	6.583	14.41	9.67	2.80
0.500	2.00	3.583	3.20	6.667	14.41	9.75	2.80
0.583	2.00	3.667	3.20	6.750	14.41	9.83	2.80
0.667	2.00	3.750	3.20	6.833	6.41	9.92	2.80
0.750	2.00	3.833	3.20	6.917	6.41	10.00	2.80
0.833	2.00	3.917	3.20	7.000	6.41	10.08	2.80
0.917	2.00	4.000	3.20	7.083	6.41	10.17	2.80
1.000	2.00	4.083	3.20	7.167	6.41	10.25	2.80
1.083	2.00	4.167	3.20	7.250	6.41	10.33	1.60
1.167	2.00	4.250	3.20	7.333	4.80	10.42	1.60
1.250	2.00	4.333	4.80	7.417	4.80	10.50	1.60
1.333	2.00	4.417	4.80	7.500	4.80	10.58	1.60
1.417	2.00	4.500	4.80	7.583	4.80	10.67	1.60
1.500	2.00	4.583	4.80	7.667	4.80	10.75	1.60

1.583	2.00	4.667	4.80	7.750	4.80	10.83	1.60
1.667	2.00	4.750	4.80	7.833	4.80	10.92	1.60
1.750	2.00	4.833	6.41	7.917	4.80	11.00	1.60
1.833	2.00	4.917	6.41	8.000	4.80	11.08	1.60
1.917	2.00	5.000	6.41	8.083	4.80	11.17	1.60
2.000	2.00	5.083	6.41	8.167	4.80	11.25	1.60
2.083	2.00	5.167	6.41	8.250	4.80	11.33	1.60
2.167	2.00	5.250	6.41	8.333	2.80	11.42	1.60
2.250	2.00	5.333	9.61	8.417	2.80	11.50	1.60
2.333	2.40	5.417	9.61	8.500	2.80	11.58	1.60
2.417	2.40	5.500	9.61	8.583	2.80	11.67	1.60
2.500	2.40	5.583	9.61	8.667	2.80	11.75	1.60
2.583	2.40	5.667	9.61	8.750	2.80	11.83	1.60
2.667	2.40	5.750	9.61	8.833	2.80	11.92	1.60
2.750	2.40	5.833	38.43	8.917	2.80	12.00	1.60
2.833	2.40	5.917	38.43	9.000	2.80	12.08	1.60
2.917	2.40	6.000	38.44	9.083	2.80	12.17	1.60
3.000	2.40	6.083	105.69	9.167	2.80	12.25	1.60
3.083	2.40	6.167	105.69	9.250	2.80		

Max.Eff.Inten.(mm/hr)= 105.69 149.75
over (min) 5.00 10.00
Storage Coeff. (min)= 1.48 (ii) 6.53 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.33 0.14

TOTALS

PEAK FLOW (cms)= 0.01 0.02 0.030 (iii)
TIME TO PEAK (hrs)= 6.25 6.25 6.25
RUNOFF VOLUME (mm)= 78.07 58.89 62.99
TOTAL RAINFALL (mm)= 80.07 80.07 80.07
RUNOFF COEFFICIENT = 0.98 0.74 0.79

***** 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.

** SIMULATION:2yr-c **

| CALIB |
| STANDHYD (0012) | Area (ha)= 0.13
| ID= 1 DT= 5.0 min | Total Imp(%)= 52.30 Dir. Conn.(%)= 21.50

IMPERVIOUS PERVIOUS (i)

Surface Area (ha)= 0.07 0.06
 Dep. Storage (mm)= 2.00 1.50
 Average Slope (%)= 0.50 2.00
 Length (m)= 29.44 30.00
 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	2.64	1.083	12.50	2.083	5.22	3.08	3.04
0.167	2.64	1.167	12.50	2.167	5.22	3.17	3.04
0.250	2.95	1.250	72.43	2.250	4.61	3.25	2.87
0.333	2.95	1.333	72.43	2.333	4.61	3.33	2.87
0.417	3.37	1.417	15.34	2.417	4.15	3.42	2.71
0.500	3.37	1.500	15.34	2.500	4.15	3.50	2.71
0.583	3.96	1.583	9.67	2.583	3.79	3.58	2.58
0.667	3.96	1.667	9.67	2.667	3.79	3.67	2.58
0.750	4.91	1.750	7.37	2.750	3.49	3.75	2.46
0.833	4.91	1.833	7.37	2.833	3.49	3.83	2.46
0.917	6.72	1.917	6.07	2.917	3.25	3.92	2.35
1.000	6.72	2.000	6.07	3.000	3.25	4.00	2.35

Max.Eff.Inten.(mm/hr)= 72.43 58.15
 over (min) 5.00 10.00
 Storage Coeff. (min)= 1.72 (ii) 9.09 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.32 0.12

TOTALS

PEAK FLOW (cms)= 0.01 0.01 0.011 (iii)
 TIME TO PEAK (hrs)= 1.33 1.42 1.33
 RUNOFF VOLUME (mm)= 29.41 16.11 18.92
 TOTAL RAINFALL (mm)= 31.41 31.41 31.41
 RUNOFF COEFFICIENT = 0.94 0.51 0.60

***** 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.

 ** SIMULATION:2y-SCS **

| CALIB |
 | STANDHYD (0012) |
 | ID= 1 DT= 5.0 min |

Area (ha)= 0.13
 Total Imp(%)= 52.30 Dir. Conn.(%)= 21.50

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.07	0.06
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	29.44	30.00
Mannings n	=	0.013	0.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	1.31	6.250	57.72	9.33	1.53
0.167	0.00	3.250	1.31	6.333	7.87	9.42	1.53
0.250	0.00	3.333	1.75	6.417	7.87	9.50	1.53
0.333	1.09	3.417	1.75	6.500	7.87	9.58	1.53
0.417	1.09	3.500	1.75	6.583	7.87	9.67	1.53
0.500	1.09	3.583	1.75	6.667	7.87	9.75	1.53
0.583	1.09	3.667	1.75	6.750	7.87	9.83	1.53
0.667	1.09	3.750	1.75	6.833	3.50	9.92	1.53
0.750	1.09	3.833	1.75	6.917	3.50	10.00	1.53
0.833	1.09	3.917	1.75	7.000	3.50	10.08	1.53
0.917	1.09	4.000	1.75	7.083	3.50	10.17	1.53
1.000	1.09	4.083	1.75	7.167	3.50	10.25	1.53
1.083	1.09	4.167	1.75	7.250	3.50	10.33	0.87
1.167	1.09	4.250	1.75	7.333	2.62	10.42	0.87
1.250	1.09	4.333	2.62	7.417	2.62	10.50	0.87
1.333	1.09	4.417	2.62	7.500	2.62	10.58	0.87
1.417	1.09	4.500	2.62	7.583	2.62	10.67	0.87
1.500	1.09	4.583	2.62	7.667	2.62	10.75	0.87
1.583	1.09	4.667	2.62	7.750	2.62	10.83	0.87
1.667	1.09	4.750	2.62	7.833	2.62	10.92	0.87
1.750	1.09	4.833	3.50	7.917	2.62	11.00	0.87
1.833	1.09	4.917	3.50	8.000	2.62	11.08	0.87
1.917	1.09	5.000	3.50	8.083	2.62	11.17	0.87
2.000	1.09	5.083	3.50	8.167	2.62	11.25	0.87
2.083	1.09	5.167	3.50	8.250	2.62	11.33	0.87
2.167	1.09	5.250	3.50	8.333	1.53	11.42	0.87
2.250	1.09	5.333	5.25	8.417	1.53	11.50	0.87
2.333	1.31	5.417	5.25	8.500	1.53	11.58	0.87
2.417	1.31	5.500	5.25	8.583	1.53	11.67	0.87
2.500	1.31	5.583	5.25	8.667	1.53	11.75	0.87
2.583	1.31	5.667	5.25	8.750	1.53	11.83	0.87
2.667	1.31	5.750	5.25	8.833	1.53	11.92	0.87
2.750	1.31	5.833	20.99	8.917	1.53	12.00	0.87

2.833	1.31	5.917	20.99	9.000	1.53	12.08	0.87
2.917	1.31	6.000	20.99	9.083	1.53	12.17	0.87
3.000	1.31	6.083	57.72	9.167	1.53	12.25	0.87
3.083	1.31	6.167	57.72	9.250	1.53		

Max.Eff.Inten.(mm/hr)= 57.72 68.84
over (min) 5.00 10.00
Storage Coeff. (min)= 1.88 (ii) 8.78 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.32 0.12

TOTALS

PEAK FLOW (cms)= 0.00 0.01 0.014 (iii)
TIME TO PEAK (hrs)= 6.25 6.25 6.25
RUNOFF VOLUME (mm)= 41.73 26.17 29.46
TOTAL RAINFALL (mm)= 43.73 43.73 43.73
RUNOFF COEFFICIENT = 0.95 0.60 0.67

***** 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.

** SIMULATION:50y-C **

```

-----
| CALIB |
| STANDHYD ( 0012) | Area (ha)= 0.13
| ID= 1 DT= 5.0 min | Total Imp(%)= 52.30 Dir. Conn.(%)= 21.50
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.07	0.06
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	29.44	30.00
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	5.38	1.083	25.48	2.083	10.64	3.08	6.20
0.167	5.38	1.167	25.48	2.167	10.64	3.17	6.20
0.250	6.02	1.250	147.65	2.250	9.40	3.25	5.84

0.333	6.02	1.333	147.65	2.333	9.40	3.33	5.84
0.417	6.87	1.417	31.27	2.417	8.46	3.42	5.53
0.500	6.87	1.500	31.27	2.500	8.46	3.50	5.53
0.583	8.08	1.583	19.71	2.583	7.72	3.58	5.25
0.667	8.08	1.667	19.71	2.667	7.72	3.67	5.25
0.750	10.01	1.750	15.03	2.750	7.12	3.75	5.01
0.833	10.01	1.833	15.03	2.833	7.12	3.83	5.01
0.917	13.70	1.917	12.38	2.917	6.62	3.92	4.79
1.000	13.70	2.000	12.38	3.000	6.62	4.00	4.79

Max.Eff.Inten.(mm/hr)= 147.65 170.07
over (min) 5.00 10.00
Storage Coeff. (min)= 1.29 (ii) 6.09 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.33 0.15

TOTALS

PEAK FLOW (cms)= 0.01 0.02 0.031 (iii)
TIME TO PEAK (hrs)= 1.33 1.42 1.33
RUNOFF VOLUME (mm)= 62.03 44.09 47.91
TOTAL RAINFALL (mm)= 64.03 64.03 64.03
RUNOFF COEFFICIENT = 0.97 0.69 0.75

***** 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.

** SIMULATION:50y-SCS **

| CALIB |
| STANDHYD (0012) | Area (ha)= 0.13
| ID= 1 DT= 5.0 min | Total Imp(%)= 52.30 Dir. Conn.(%)= 21.50

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.07	0.06
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	29.44	30.00
Mannings n	=	0.013	0.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.67	6.250	117.69	9.33	3.12
0.167	0.00	3.250	2.67	6.333	16.05	9.42	3.12
0.250	0.00	3.333	3.57	6.417	16.05	9.50	3.12
0.333	2.23	3.417	3.57	6.500	16.05	9.58	3.12
0.417	2.23	3.500	3.57	6.583	16.05	9.67	3.12
0.500	2.23	3.583	3.57	6.667	16.05	9.75	3.12
0.583	2.23	3.667	3.57	6.750	16.05	9.83	3.12
0.667	2.23	3.750	3.57	6.833	7.13	9.92	3.12
0.750	2.23	3.833	3.57	6.917	7.13	10.00	3.12
0.833	2.23	3.917	3.57	7.000	7.13	10.08	3.12
0.917	2.23	4.000	3.57	7.083	7.13	10.17	3.12
1.000	2.23	4.083	3.57	7.167	7.13	10.25	3.12
1.083	2.23	4.167	3.57	7.250	7.13	10.33	1.78
1.167	2.23	4.250	3.57	7.333	5.35	10.42	1.78
1.250	2.23	4.333	5.35	7.417	5.35	10.50	1.78
1.333	2.23	4.417	5.35	7.500	5.35	10.58	1.78
1.417	2.23	4.500	5.35	7.583	5.35	10.67	1.78
1.500	2.23	4.583	5.35	7.667	5.35	10.75	1.78
1.583	2.23	4.667	5.35	7.750	5.35	10.83	1.78
1.667	2.23	4.750	5.35	7.833	5.35	10.92	1.78
1.750	2.23	4.833	7.13	7.917	5.35	11.00	1.78
1.833	2.23	4.917	7.13	8.000	5.35	11.08	1.78
1.917	2.23	5.000	7.13	8.083	5.35	11.17	1.78
2.000	2.23	5.083	7.13	8.167	5.35	11.25	1.78
2.083	2.23	5.167	7.13	8.250	5.35	11.33	1.78
2.167	2.23	5.250	7.13	8.333	3.12	11.42	1.78
2.250	2.23	5.333	10.70	8.417	3.12	11.50	1.78
2.333	2.67	5.417	10.70	8.500	3.12	11.58	1.78
2.417	2.67	5.500	10.70	8.583	3.12	11.67	1.78
2.500	2.67	5.583	10.70	8.667	3.12	11.75	1.78
2.583	2.67	5.667	10.70	8.750	3.12	11.83	1.78
2.667	2.67	5.750	10.70	8.833	3.12	11.92	1.78
2.750	2.67	5.833	42.80	8.917	3.12	12.00	1.78
2.833	2.67	5.917	42.80	9.000	3.12	12.08	1.78
2.917	2.67	6.000	42.80	9.083	3.12	12.17	1.78
3.000	2.67	6.083	117.69	9.167	3.12	12.25	1.78
3.083	2.67	6.167	117.69	9.250	3.12		

Max.Eff.Inten.(mm/hr)=	117.69	170.26
over (min)	5.00	10.00
Storage Coeff. (min)=	1.41 (ii)	6.22 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.33	0.15

TOTALS

PEAK FLOW (cms)=	0.01	0.03	0.035 (iii)
TIME TO PEAK (hrs)=	6.25	6.25	6.25
RUNOFF VOLUME (mm)=	87.16	67.44	71.64
TOTAL RAINFALL (mm)=	89.16	89.16	89.16

RUNOFF COEFFICIENT = 0.98 0.76 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.

** SIMULATION:5y-C **

```

-----
| CALIB |
| STANDHYD ( 0012) | Area (ha)= 0.13
| ID= 1 DT= 5.0 min | Total Imp(%)= 52.30 Dir. Conn.(%)= 21.50
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.07	0.06
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	29.44	30.00
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	3.52	1.083	16.66	2.083	6.96	3.08	4.06
0.167	3.52	1.167	16.66	2.167	6.96	3.17	4.06
0.250	3.93	1.250	96.57	2.250	6.15	3.25	3.82
0.333	3.93	1.333	96.57	2.333	6.15	3.33	3.82
0.417	4.49	1.417	20.45	2.417	5.53	3.42	3.61
0.500	4.49	1.500	20.45	2.500	5.53	3.50	3.61
0.583	5.29	1.583	12.89	2.583	5.05	3.58	3.43
0.667	5.29	1.667	12.89	2.667	5.05	3.67	3.43
0.750	6.55	1.750	9.83	2.750	4.66	3.75	3.27
0.833	6.55	1.833	9.83	2.833	4.66	3.83	3.27
0.917	8.96	1.917	8.10	2.917	4.33	3.92	3.13
1.000	8.96	2.000	8.10	3.000	4.33	4.00	3.13

Max.Eff.Inten.(mm/hr)=	96.57	91.58
over (min)	5.00	10.00
Storage Coeff. (min)=	1.53 (ii)	7.68 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.33	0.13

				TOTALS
PEAK FLOW	(cms)=	0.01	0.01	0.017 (iii)
TIME TO PEAK	(hrs)=	1.33	1.42	1.33
RUNOFF VOLUME	(mm)=	39.88	24.61	27.85
TOTAL RAINFALL	(mm)=	41.88	41.88	41.88
RUNOFF COEFFICIENT	=	0.95	0.59	0.66

***** 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.

** SIMULATION:5y-SCS **

```

-----
| CALIB |
| STANDHYD ( 0012) | Area (ha)= 0.13
| ID= 1 DT= 5.0 min | Total Imp(%)= 52.30 Dir. Conn.(%)= 21.50
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.07	0.06
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	29.44	30.00
Mannings n	=	0.013	0.250

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

```

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

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	1.75	6.250	76.97	9.33	2.04
0.167	0.00	3.250	1.75	6.333	10.50	9.42	2.04
0.250	0.00	3.333	2.33	6.417	10.50	9.50	2.04
0.333	1.46	3.417	2.33	6.500	10.50	9.58	2.04
0.417	1.46	3.500	2.33	6.583	10.50	9.67	2.04
0.500	1.46	3.583	2.33	6.667	10.50	9.75	2.04
0.583	1.46	3.667	2.33	6.750	10.50	9.83	2.04
0.667	1.46	3.750	2.33	6.833	4.66	9.92	2.04
0.750	1.46	3.833	2.33	6.917	4.66	10.00	2.04
0.833	1.46	3.917	2.33	7.000	4.66	10.08	2.04
0.917	1.46	4.000	2.33	7.083	4.66	10.17	2.04
1.000	1.46	4.083	2.33	7.167	4.66	10.25	2.04
1.083	1.46	4.167	2.33	7.250	4.66	10.33	1.17

1.167	1.46	4.250	2.33	7.333	3.50	10.42	1.17
1.250	1.46	4.333	3.50	7.417	3.50	10.50	1.17
1.333	1.46	4.417	3.50	7.500	3.50	10.58	1.17
1.417	1.46	4.500	3.50	7.583	3.50	10.67	1.17
1.500	1.46	4.583	3.50	7.667	3.50	10.75	1.17
1.583	1.46	4.667	3.50	7.750	3.50	10.83	1.17
1.667	1.46	4.750	3.50	7.833	3.50	10.92	1.17
1.750	1.46	4.833	4.66	7.917	3.50	11.00	1.17
1.833	1.46	4.917	4.66	8.000	3.50	11.08	1.17
1.917	1.46	5.000	4.66	8.083	3.50	11.17	1.17
2.000	1.46	5.083	4.66	8.167	3.50	11.25	1.17
2.083	1.46	5.167	4.66	8.250	3.50	11.33	1.17
2.167	1.46	5.250	4.66	8.333	2.04	11.42	1.17
2.250	1.46	5.333	7.00	8.417	2.04	11.50	1.17
2.333	1.75	5.417	7.00	8.500	2.04	11.58	1.17
2.417	1.75	5.500	7.00	8.583	2.04	11.67	1.17
2.500	1.75	5.583	7.00	8.667	2.04	11.75	1.17
2.583	1.75	5.667	7.00	8.750	2.04	11.83	1.17
2.667	1.75	5.750	7.00	8.833	2.04	11.92	1.17
2.750	1.75	5.833	27.99	8.917	2.04	12.00	1.17
2.833	1.75	5.917	27.99	9.000	2.04	12.08	1.17
2.917	1.75	6.000	27.99	9.083	2.04	12.17	1.17
3.000	1.75	6.083	76.97	9.167	2.04	12.25	1.17
3.083	1.75	6.167	76.97	9.250	2.04		

Max.Eff.Inten.(mm/hr)=	76.97	100.90
over (min)	5.00	10.00
Storage Coeff. (min)=	1.68 (ii)	7.59 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.32	0.13

TOTALS

PEAK FLOW (cms)=	0.01	0.01	0.020 (iii)
TIME TO PEAK (hrs)=	6.25	6.25	6.25
RUNOFF VOLUME (mm)=	56.31	38.93	42.63
TOTAL RAINFALL (mm)=	58.31	58.31	58.31
RUNOFF COEFFICIENT =	0.97	0.67	0.73

***** 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.

Post-Development Catchment 1B (Controlled)

 ** SIMULATION:100y-C **

```

-----
| CALIB |
| STANDHYD ( 0013) | Area (ha)= 0.60
| ID= 1 DT= 5.0 min | Total Imp(%)= 58.80 Dir. Conn.(%)= 23.30
-----
  
```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.35	0.25
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	63.25	30.00
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	5.92	1.083	28.01	2.083	11.70	3.08	6.82
0.167	5.92	1.167	28.01	2.167	11.70	3.17	6.82
0.250	6.61	1.250	162.35	2.250	10.34	3.25	6.42
0.333	6.61	1.333	162.35	2.333	10.34	3.33	6.42
0.417	7.55	1.417	34.38	2.417	9.30	3.42	6.08
0.500	7.55	1.500	34.38	2.500	9.30	3.50	6.08
0.583	8.89	1.583	21.68	2.583	8.49	3.58	5.77
0.667	8.89	1.667	21.68	2.667	8.49	3.67	5.77
0.750	11.01	1.750	16.53	2.750	7.83	3.75	5.50
0.833	11.01	1.833	16.53	2.833	7.83	3.83	5.50
0.917	15.06	1.917	13.62	2.917	7.28	3.92	5.26
1.000	15.06	2.000	13.62	3.000	7.28	4.00	5.26

Max. Eff. Inten. (mm/hr)=	162.35	228.67
over (min)	5.00	10.00
Storage Coeff. (min)=	1.97 (ii)	6.23 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.31	0.15

TOTALS

PEAK FLOW (cms)=	0.06	0.11	0.167 (iii)
TIME TO PEAK (hrs)=	1.33	1.42	1.33
RUNOFF VOLUME (mm)=	68.40	51.71	55.59
TOTAL RAINFALL (mm)=	70.40	70.40	70.40
RUNOFF COEFFICIENT =	0.97	0.73	0.79

***** 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.

 ** SIMULATION:100y-SCS **

```

-----
| CALIB |
| STANDHYD ( 0013) | Area (ha)= 0.60
| ID= 1 DT= 5.0 min | Total Imp(%)= 58.80 Dir. Conn.(%)= 23.30
-----
  
```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.35	0.25
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	63.25	30.00
Mannings n	=	0.013	0.250

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

----- TRANSFORMED HYETOGRAPH -----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.94	6.250	129.40	9.33	3.43
0.167	0.00	3.250	2.94	6.333	17.65	9.42	3.43
0.250	0.00	3.333	3.92	6.417	17.65	9.50	3.43
0.333	2.45	3.417	3.92	6.500	17.65	9.58	3.43
0.417	2.45	3.500	3.92	6.583	17.65	9.67	3.43
0.500	2.45	3.583	3.92	6.667	17.65	9.75	3.43
0.583	2.45	3.667	3.92	6.750	17.65	9.83	3.43
0.667	2.45	3.750	3.92	6.833	7.84	9.92	3.43
0.750	2.45	3.833	3.92	6.917	7.84	10.00	3.43
0.833	2.45	3.917	3.92	7.000	7.84	10.08	3.43
0.917	2.45	4.000	3.92	7.083	7.84	10.17	3.43
1.000	2.45	4.083	3.92	7.167	7.84	10.25	3.43
1.083	2.45	4.167	3.92	7.250	7.84	10.33	1.96
1.167	2.45	4.250	3.92	7.333	5.88	10.42	1.96
1.250	2.45	4.333	5.88	7.417	5.88	10.50	1.96
1.333	2.45	4.417	5.88	7.500	5.88	10.58	1.96
1.417	2.45	4.500	5.88	7.583	5.88	10.67	1.96
1.500	2.45	4.583	5.88	7.667	5.88	10.75	1.96
1.583	2.45	4.667	5.88	7.750	5.88	10.83	1.96
1.667	2.45	4.750	5.88	7.833	5.88	10.92	1.96
1.750	2.45	4.833	7.84	7.917	5.88	11.00	1.96
1.833	2.45	4.917	7.84	8.000	5.88	11.08	1.96
1.917	2.45	5.000	7.84	8.083	5.88	11.17	1.96
2.000	2.45	5.083	7.84	8.167	5.88	11.25	1.96

2.083	2.45	5.167	7.84	8.250	5.88	11.33	1.96
2.167	2.45	5.250	7.84	8.333	3.43	11.42	1.96
2.250	2.45	5.333	11.76	8.417	3.43	11.50	1.96
2.333	2.94	5.417	11.76	8.500	3.43	11.58	1.96
2.417	2.94	5.500	11.76	8.583	3.43	11.67	1.96
2.500	2.94	5.583	11.76	8.667	3.43	11.75	1.96
2.583	2.94	5.667	11.76	8.750	3.43	11.83	1.96
2.667	2.94	5.750	11.76	8.833	3.43	11.92	1.96
2.750	2.94	5.833	47.05	8.917	3.43	12.00	1.96
2.833	2.94	5.917	47.05	9.000	3.43	12.08	1.96
2.917	2.94	6.000	47.06	9.083	3.43	12.17	1.96
3.000	2.94	6.083	129.40	9.167	3.43	12.25	1.96
3.083	2.94	6.167	129.40	9.250	3.43		

Max.Eff.Inten.(mm/hr)= 129.40 219.28
over (min) 5.00 10.00
Storage Coeff. (min)= 2.16 (ii) 6.49 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.31 0.14

TOTALS

PEAK FLOW (cms)= 0.05 0.13 0.181 (iii)
TIME TO PEAK (hrs)= 6.25 6.25 6.25
RUNOFF VOLUME (mm)= 96.03 77.93 82.14
TOTAL RAINFALL (mm)= 98.03 98.03 98.03
RUNOFF COEFFICIENT = 0.98 0.79 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.

** SIMULATION:10y-C **

```

-----
| CALIB |
| STANDHYD ( 0013) | Area (ha)= 0.60
| ID= 1 DT= 5.0 min | Total Imp(%)= 58.80 Dir. Conn.(%)= 23.30
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.35	0.25
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	63.25	30.00
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	4.11	1.083	19.44	2.083	8.12	3.08	4.73
0.167	4.11	1.167	19.44	2.167	8.12	3.17	4.73
0.250	4.59	1.250	112.66	2.250	7.17	3.25	4.46
0.333	4.59	1.333	112.66	2.333	7.17	3.33	4.46
0.417	5.24	1.417	23.86	2.417	6.46	3.42	4.22
0.500	5.24	1.500	23.86	2.500	6.46	3.50	4.22
0.583	6.17	1.583	15.04	2.583	5.89	3.58	4.01
0.667	6.17	1.667	15.04	2.667	5.89	3.67	4.01
0.750	7.64	1.750	11.47	2.750	5.43	3.75	3.82
0.833	7.64	1.833	11.47	2.833	5.43	3.83	3.82
0.917	10.45	1.917	9.45	2.917	5.05	3.92	3.65
1.000	10.45	2.000	9.45	3.000	5.05	4.00	3.65

Max.Eff.Inten.(mm/hr)= 112.66 138.14
over (min) 5.00 10.00
Storage Coeff. (min)= 2.28 (ii) 7.50 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.30 0.13

TOTALS

PEAK FLOW (cms)= 0.04 0.06 0.100 (iii)
TIME TO PEAK (hrs)= 1.33 1.42 1.33
RUNOFF VOLUME (mm)= 46.86 32.01 35.46
TOTAL RAINFALL (mm)= 48.86 48.86 48.86
RUNOFF COEFFICIENT = 0.96 0.66 0.73

***** 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.

** SIMULATION:10y-SCS **

```

-----
| CALIB |
| STANDHYD ( 0013) | Area (ha)= 0.60
| ID= 1 DT= 5.0 min | Total Imp(%)= 58.80 Dir. Conn.(%)= 23.30
-----

```

Surface Area (ha)= IMPERVIOUS 0.35 PERVIOUS (i) 0.25

Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	63.25	30.00
Mannings n	=	0.013	0.250

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

----- TRANSFORMED HYETOGRAPH -----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.04	6.250	89.80	9.33	2.38
0.167	0.00	3.250	2.04	6.333	12.25	9.42	2.38
0.250	0.00	3.333	2.72	6.417	12.25	9.50	2.38
0.333	1.70	3.417	2.72	6.500	12.25	9.58	2.38
0.417	1.70	3.500	2.72	6.583	12.25	9.67	2.38
0.500	1.70	3.583	2.72	6.667	12.25	9.75	2.38
0.583	1.70	3.667	2.72	6.750	12.25	9.83	2.38
0.667	1.70	3.750	2.72	6.833	5.44	9.92	2.38
0.750	1.70	3.833	2.72	6.917	5.44	10.00	2.38
0.833	1.70	3.917	2.72	7.000	5.44	10.08	2.38
0.917	1.70	4.000	2.72	7.083	5.44	10.17	2.38
1.000	1.70	4.083	2.72	7.167	5.44	10.25	2.38
1.083	1.70	4.167	2.72	7.250	5.44	10.33	1.36
1.167	1.70	4.250	2.72	7.333	4.08	10.42	1.36
1.250	1.70	4.333	4.08	7.417	4.08	10.50	1.36
1.333	1.70	4.417	4.08	7.500	4.08	10.58	1.36
1.417	1.70	4.500	4.08	7.583	4.08	10.67	1.36
1.500	1.70	4.583	4.08	7.667	4.08	10.75	1.36
1.583	1.70	4.667	4.08	7.750	4.08	10.83	1.36
1.667	1.70	4.750	4.08	7.833	4.08	10.92	1.36
1.750	1.70	4.833	5.44	7.917	4.08	11.00	1.36
1.833	1.70	4.917	5.44	8.000	4.08	11.08	1.36
1.917	1.70	5.000	5.44	8.083	4.08	11.17	1.36
2.000	1.70	5.083	5.44	8.167	4.08	11.25	1.36
2.083	1.70	5.167	5.44	8.250	4.08	11.33	1.36
2.167	1.70	5.250	5.44	8.333	2.38	11.42	1.36
2.250	1.70	5.333	8.16	8.417	2.38	11.50	1.36
2.333	2.04	5.417	8.16	8.500	2.38	11.58	1.36
2.417	2.04	5.500	8.16	8.583	2.38	11.67	1.36
2.500	2.04	5.583	8.16	8.667	2.38	11.75	1.36
2.583	2.04	5.667	8.16	8.750	2.38	11.83	1.36
2.667	2.04	5.750	8.16	8.833	2.38	11.92	1.36
2.750	2.04	5.833	32.65	8.917	2.38	12.00	1.36
2.833	2.04	5.917	32.65	9.000	2.38	12.08	1.36
2.917	2.04	6.000	32.66	9.083	2.38	12.17	1.36
3.000	2.04	6.083	89.80	9.167	2.38	12.25	1.36
3.083	2.04	6.167	89.80	9.250	2.38		

Max. Eff. Inten. (mm/hr)=	89.80	142.73
---------------------------	-------	--------

over (min)	5.00	10.00	
Storage Coeff. (min)=	2.49 (ii)	7.65 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.29	0.13	
			TOTALS
PEAK FLOW (cms)=	0.03	0.08	0.115 (iii)
TIME TO PEAK (hrs)=	6.25	6.25	6.25
RUNOFF VOLUME (mm)=	66.03	49.50	53.34
TOTAL RAINFALL (mm)=	68.03	68.03	68.03
RUNOFF COEFFICIENT =	0.97	0.73	0.78

***** 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.

 ** SIMULATION:25mm Water Quality **

CALIB			
STANDHYD (0013)	Area (ha)=	0.60	
ID= 1 DT= 5.0 min	Total Imp(%)=	58.80	Dir. Conn.(%)= 23.30

	IMPERVIOUS	PERVIOUS (i)	
Surface Area (ha)=	0.35	0.25	
Dep. Storage (mm)=	2.00	1.50	
Average Slope (%)=	0.50	2.00	
Length (m)=	63.25	30.00	
Mannings n =	0.013	0.250	
Max.Eff.Inten.(mm/hr)=	76.07	49.95	
over (min)	5.00	15.00	
Storage Coeff. (min)=	2.67 (ii)	10.50 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	0.29	0.09	
			TOTALS
PEAK FLOW (cms)=	0.03	0.02	0.033 (iii)
TIME TO PEAK (hrs)=	1.33	1.50	1.33
RUNOFF VOLUME (mm)=	22.99	12.12	14.64
TOTAL RAINFALL (mm)=	24.99	24.99	24.99
RUNOFF COEFFICIENT =	0.92	0.48	0.59

***** 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.

 ** SIMULATION:25y-C **

 | CALIB |
 | STANDHYD (0013) | Area (ha)= 0.60
 | ID= 1 DT= 5.0 min | Total Imp(%)= 58.80 Dir. Conn.(%)= 23.30

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.35	0.25
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	63.25	30.00
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	4.83	1.083	22.88	2.083	9.56	3.08	5.57
0.167	4.83	1.167	22.88	2.167	9.56	3.17	5.57
0.250	5.40	1.250	132.61	2.250	8.44	3.25	5.25
0.333	5.40	1.333	132.61	2.333	8.44	3.33	5.25
0.417	6.17	1.417	28.08	2.417	7.60	3.42	4.96
0.500	6.17	1.500	28.08	2.500	7.60	3.50	4.96
0.583	7.26	1.583	17.71	2.583	6.93	3.58	4.72
0.667	7.26	1.667	17.71	2.667	6.93	3.67	4.72
0.750	8.99	1.750	13.50	2.750	6.40	3.75	4.50
0.833	8.99	1.833	13.50	2.833	6.40	3.83	4.50
0.917	12.30	1.917	11.12	2.917	5.95	3.92	4.30
1.000	12.30	2.000	11.12	3.000	5.95	4.00	4.30

Max.Eff.Inten.(mm/hr)=	132.61	173.85
over (min)	5.00	10.00
Storage Coeff. (min)=	2.13 (ii)	6.89 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.31	0.14

TOTALS

PEAK FLOW (cms)=	0.05	0.08	0.126 (iii)
TIME TO PEAK (hrs)=	1.33	1.42	1.33
RUNOFF VOLUME (mm)=	55.50	39.80	43.45
TOTAL RAINFALL (mm)=	57.50	57.50	57.50

RUNOFF COEFFICIENT = 0.97 0.69 0.76

***** 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.

** SIMULATION:25y-SCS **

```

-----
| CALIB |
| STANDHYD ( 0013) | Area (ha)= 0.60
| ID= 1 DT= 5.0 min | Total Imp(%)= 58.80 Dir. Conn.(%)= 23.30
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.35	0.25
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	63.25	30.00
Mannings n	=	0.013	0.250

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

```

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

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.40	6.250	105.69	9.33	2.80
0.167	0.00	3.250	2.40	6.333	14.41	9.42	2.80
0.250	0.00	3.333	3.20	6.417	14.41	9.50	2.80
0.333	2.00	3.417	3.20	6.500	14.41	9.58	2.80
0.417	2.00	3.500	3.20	6.583	14.41	9.67	2.80
0.500	2.00	3.583	3.20	6.667	14.41	9.75	2.80
0.583	2.00	3.667	3.20	6.750	14.41	9.83	2.80
0.667	2.00	3.750	3.20	6.833	6.41	9.92	2.80
0.750	2.00	3.833	3.20	6.917	6.41	10.00	2.80
0.833	2.00	3.917	3.20	7.000	6.41	10.08	2.80
0.917	2.00	4.000	3.20	7.083	6.41	10.17	2.80
1.000	2.00	4.083	3.20	7.167	6.41	10.25	2.80
1.083	2.00	4.167	3.20	7.250	6.41	10.33	1.60
1.167	2.00	4.250	3.20	7.333	4.80	10.42	1.60
1.250	2.00	4.333	4.80	7.417	4.80	10.50	1.60
1.333	2.00	4.417	4.80	7.500	4.80	10.58	1.60
1.417	2.00	4.500	4.80	7.583	4.80	10.67	1.60
1.500	2.00	4.583	4.80	7.667	4.80	10.75	1.60

1.583	2.00	4.667	4.80	7.750	4.80	10.83	1.60
1.667	2.00	4.750	4.80	7.833	4.80	10.92	1.60
1.750	2.00	4.833	6.41	7.917	4.80	11.00	1.60
1.833	2.00	4.917	6.41	8.000	4.80	11.08	1.60
1.917	2.00	5.000	6.41	8.083	4.80	11.17	1.60
2.000	2.00	5.083	6.41	8.167	4.80	11.25	1.60
2.083	2.00	5.167	6.41	8.250	4.80	11.33	1.60
2.167	2.00	5.250	6.41	8.333	2.80	11.42	1.60
2.250	2.00	5.333	9.61	8.417	2.80	11.50	1.60
2.333	2.40	5.417	9.61	8.500	2.80	11.58	1.60
2.417	2.40	5.500	9.61	8.583	2.80	11.67	1.60
2.500	2.40	5.583	9.61	8.667	2.80	11.75	1.60
2.583	2.40	5.667	9.61	8.750	2.80	11.83	1.60
2.667	2.40	5.750	9.61	8.833	2.80	11.92	1.60
2.750	2.40	5.833	38.43	8.917	2.80	12.00	1.60
2.833	2.40	5.917	38.43	9.000	2.80	12.08	1.60
2.917	2.40	6.000	38.44	9.083	2.80	12.17	1.60
3.000	2.40	6.083	105.69	9.167	2.80	12.25	1.60
3.083	2.40	6.167	105.69	9.250	2.80		

Max.Eff.Inten.(mm/hr)= 105.69 173.46
over (min) 5.00 10.00
Storage Coeff. (min)= 2.34 (ii) 7.10 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.30 0.14

TOTALS

PEAK FLOW (cms)= 0.04 0.10 0.141 (iii)
TIME TO PEAK (hrs)= 6.25 6.25 6.25
RUNOFF VOLUME (mm)= 78.07 60.80 64.81
TOTAL RAINFALL (mm)= 80.07 80.07 80.07
RUNOFF COEFFICIENT = 0.98 0.76 0.81

***** 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.

** SIMULATION:2yr-c **

| CALIB |
| STANDHYD (0013) | Area (ha)= 0.60
| ID= 1 DT= 5.0 min | Total Imp(%)= 58.80 Dir. Conn.(%)= 23.30

IMPERVIOUS PERVIOUS (i)

Surface Area (ha)= 0.35 0.25
 Dep. Storage (mm)= 2.00 1.50
 Average Slope (%)= 0.50 2.00
 Length (m)= 63.25 30.00
 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	2.64	1.083	12.50	2.083	5.22	3.08	3.04
0.167	2.64	1.167	12.50	2.167	5.22	3.17	3.04
0.250	2.95	1.250	72.43	2.250	4.61	3.25	2.87
0.333	2.95	1.333	72.43	2.333	4.61	3.33	2.87
0.417	3.37	1.417	15.34	2.417	4.15	3.42	2.71
0.500	3.37	1.500	15.34	2.500	4.15	3.50	2.71
0.583	3.96	1.583	9.67	2.583	3.79	3.58	2.58
0.667	3.96	1.667	9.67	2.667	3.79	3.67	2.58
0.750	4.91	1.750	7.37	2.750	3.49	3.75	2.46
0.833	4.91	1.833	7.37	2.833	3.49	3.83	2.46
0.917	6.72	1.917	6.07	2.917	3.25	3.92	2.35
1.000	6.72	2.000	6.07	3.000	3.25	4.00	2.35

Max.Eff.Inten.(mm/hr)= 72.43 70.90
 over (min) 5.00 10.00
 Storage Coeff. (min)= 2.72 (ii) 9.53 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.29 0.12

TOTALS

PEAK FLOW (cms)= 0.03 0.03 0.053 (iii)
 TIME TO PEAK (hrs)= 1.33 1.42 1.33
 RUNOFF VOLUME (mm)= 29.41 17.13 19.98
 TOTAL RAINFALL (mm)= 31.41 31.41 31.41
 RUNOFF COEFFICIENT = 0.94 0.55 0.64

***** 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.

 ** SIMULATION:2y-SCS **

| CALIB |
 | STANDHYD (0013) |
 | ID= 1 DT= 5.0 min |

Area (ha)= 0.60
 Total Imp(%)= 58.80 Dir. Conn.(%)= 23.30

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.35	0.25
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	63.25	30.00
Mannings n	=	0.013	0.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	1.31	6.250	57.72	9.33	1.53
0.167	0.00	3.250	1.31	6.333	7.87	9.42	1.53
0.250	0.00	3.333	1.75	6.417	7.87	9.50	1.53
0.333	1.09	3.417	1.75	6.500	7.87	9.58	1.53
0.417	1.09	3.500	1.75	6.583	7.87	9.67	1.53
0.500	1.09	3.583	1.75	6.667	7.87	9.75	1.53
0.583	1.09	3.667	1.75	6.750	7.87	9.83	1.53
0.667	1.09	3.750	1.75	6.833	3.50	9.92	1.53
0.750	1.09	3.833	1.75	6.917	3.50	10.00	1.53
0.833	1.09	3.917	1.75	7.000	3.50	10.08	1.53
0.917	1.09	4.000	1.75	7.083	3.50	10.17	1.53
1.000	1.09	4.083	1.75	7.167	3.50	10.25	1.53
1.083	1.09	4.167	1.75	7.250	3.50	10.33	0.87
1.167	1.09	4.250	1.75	7.333	2.62	10.42	0.87
1.250	1.09	4.333	2.62	7.417	2.62	10.50	0.87
1.333	1.09	4.417	2.62	7.500	2.62	10.58	0.87
1.417	1.09	4.500	2.62	7.583	2.62	10.67	0.87
1.500	1.09	4.583	2.62	7.667	2.62	10.75	0.87
1.583	1.09	4.667	2.62	7.750	2.62	10.83	0.87
1.667	1.09	4.750	2.62	7.833	2.62	10.92	0.87
1.750	1.09	4.833	3.50	7.917	2.62	11.00	0.87
1.833	1.09	4.917	3.50	8.000	2.62	11.08	0.87
1.917	1.09	5.000	3.50	8.083	2.62	11.17	0.87
2.000	1.09	5.083	3.50	8.167	2.62	11.25	0.87
2.083	1.09	5.167	3.50	8.250	2.62	11.33	0.87
2.167	1.09	5.250	3.50	8.333	1.53	11.42	0.87
2.250	1.09	5.333	5.25	8.417	1.53	11.50	0.87
2.333	1.31	5.417	5.25	8.500	1.53	11.58	0.87
2.417	1.31	5.500	5.25	8.583	1.53	11.67	0.87
2.500	1.31	5.583	5.25	8.667	1.53	11.75	0.87
2.583	1.31	5.667	5.25	8.750	1.53	11.83	0.87
2.667	1.31	5.750	5.25	8.833	1.53	11.92	0.87
2.750	1.31	5.833	20.99	8.917	1.53	12.00	0.87

2.833	1.31	5.917	20.99	9.000	1.53	12.08	0.87
2.917	1.31	6.000	20.99	9.083	1.53	12.17	0.87
3.000	1.31	6.083	57.72	9.167	1.53	12.25	0.87
3.083	1.31	6.167	57.72	9.250	1.53		

Max.Eff.Inten.(mm/hr)= 57.72 81.34
over (min) 5.00 10.00
Storage Coeff. (min)= 2.98 (ii) 9.43 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.28 0.12

TOTALS

PEAK FLOW (cms)= 0.02 0.04 0.064 (iii)
TIME TO PEAK (hrs)= 6.25 6.25 6.25
RUNOFF VOLUME (mm)= 41.73 27.50 30.80
TOTAL RAINFALL (mm)= 43.73 43.73 43.73
RUNOFF COEFFICIENT = 0.95 0.63 0.70

***** 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.

** SIMULATION:50y-C **

```

-----
| CALIB |
| STANDHYD ( 0013) | Area (ha)= 0.60
| ID= 1 DT= 5.0 min | Total Imp(%)= 58.80 Dir. Conn.(%)= 23.30
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.35	0.25
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	63.25	30.00
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	5.38	1.083	25.48	2.083	10.64	3.08	6.20
0.167	5.38	1.167	25.48	2.167	10.64	3.17	6.20
0.250	6.02	1.250	147.65	2.250	9.40	3.25	5.84

0.333	6.02	1.333	147.65	2.333	9.40	3.33	5.84
0.417	6.87	1.417	31.27	2.417	8.46	3.42	5.53
0.500	6.87	1.500	31.27	2.500	8.46	3.50	5.53
0.583	8.08	1.583	19.71	2.583	7.72	3.58	5.25
0.667	8.08	1.667	19.71	2.667	7.72	3.67	5.25
0.750	10.01	1.750	15.03	2.750	7.12	3.75	5.01
0.833	10.01	1.833	15.03	2.833	7.12	3.83	5.01
0.917	13.70	1.917	12.38	2.917	6.62	3.92	4.79
1.000	13.70	2.000	12.38	3.000	6.62	4.00	4.79

Max.Eff.Inten.(mm/hr)= 147.65 201.39
over (min) 5.00 10.00
Storage Coeff. (min)= 2.04 (ii) 6.53 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.31 0.14

TOTALS

PEAK FLOW (cms)= 0.06 0.10 0.147 (iii)
TIME TO PEAK (hrs)= 1.33 1.42 1.33
RUNOFF VOLUME (mm)= 62.03 45.79 49.56
TOTAL RAINFALL (mm)= 64.03 64.03 64.03
RUNOFF COEFFICIENT = 0.97 0.72 0.77

***** 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.

** SIMULATION:50y-SCS **

| CALIB |
| STANDHYD (0013) | Area (ha)= 0.60
| ID= 1 DT= 5.0 min | Total Imp(%)= 58.80 Dir. Conn.(%)= 23.30

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.35	0.25
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	63.25	30.00
Mannings n	=	0.013	0.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.67	6.250	117.69	9.33	3.12
0.167	0.00	3.250	2.67	6.333	16.05	9.42	3.12
0.250	0.00	3.333	3.57	6.417	16.05	9.50	3.12
0.333	2.23	3.417	3.57	6.500	16.05	9.58	3.12
0.417	2.23	3.500	3.57	6.583	16.05	9.67	3.12
0.500	2.23	3.583	3.57	6.667	16.05	9.75	3.12
0.583	2.23	3.667	3.57	6.750	16.05	9.83	3.12
0.667	2.23	3.750	3.57	6.833	7.13	9.92	3.12
0.750	2.23	3.833	3.57	6.917	7.13	10.00	3.12
0.833	2.23	3.917	3.57	7.000	7.13	10.08	3.12
0.917	2.23	4.000	3.57	7.083	7.13	10.17	3.12
1.000	2.23	4.083	3.57	7.167	7.13	10.25	3.12
1.083	2.23	4.167	3.57	7.250	7.13	10.33	1.78
1.167	2.23	4.250	3.57	7.333	5.35	10.42	1.78
1.250	2.23	4.333	5.35	7.417	5.35	10.50	1.78
1.333	2.23	4.417	5.35	7.500	5.35	10.58	1.78
1.417	2.23	4.500	5.35	7.583	5.35	10.67	1.78
1.500	2.23	4.583	5.35	7.667	5.35	10.75	1.78
1.583	2.23	4.667	5.35	7.750	5.35	10.83	1.78
1.667	2.23	4.750	5.35	7.833	5.35	10.92	1.78
1.750	2.23	4.833	7.13	7.917	5.35	11.00	1.78
1.833	2.23	4.917	7.13	8.000	5.35	11.08	1.78
1.917	2.23	5.000	7.13	8.083	5.35	11.17	1.78
2.000	2.23	5.083	7.13	8.167	5.35	11.25	1.78
2.083	2.23	5.167	7.13	8.250	5.35	11.33	1.78
2.167	2.23	5.250	7.13	8.333	3.12	11.42	1.78
2.250	2.23	5.333	10.70	8.417	3.12	11.50	1.78
2.333	2.67	5.417	10.70	8.500	3.12	11.58	1.78
2.417	2.67	5.500	10.70	8.583	3.12	11.67	1.78
2.500	2.67	5.583	10.70	8.667	3.12	11.75	1.78
2.583	2.67	5.667	10.70	8.750	3.12	11.83	1.78
2.667	2.67	5.750	10.70	8.833	3.12	11.92	1.78
2.750	2.67	5.833	42.80	8.917	3.12	12.00	1.78
2.833	2.67	5.917	42.80	9.000	3.12	12.08	1.78
2.917	2.67	6.000	42.80	9.083	3.12	12.17	1.78
3.000	2.67	6.083	117.69	9.167	3.12	12.25	1.78
3.083	2.67	6.167	117.69	9.250	3.12		

Max.Eff.Inten.(mm/hr)=	117.69	196.66
over (min)	5.00	10.00
Storage Coeff. (min)=	2.24 (ii)	6.77 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.30	0.14

TOTALS

PEAK FLOW (cms)=	0.05	0.12	0.161 (iii)
TIME TO PEAK (hrs)=	6.25	6.25	6.25
RUNOFF VOLUME (mm)=	87.16	69.43	73.55
TOTAL RAINFALL (mm)=	89.16	89.16	89.16

RUNOFF COEFFICIENT = 0.98 0.78 0.82

***** 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.

** SIMULATION:5y-C **

```

-----
| CALIB |
| STANDHYD ( 0013) | Area (ha)= 0.60
| ID= 1 DT= 5.0 min | Total Imp(%)= 58.80 Dir. Conn.(%)= 23.30
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.35	0.25
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	63.25	30.00
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	3.52	1.083	16.66	2.083	6.96	3.08	4.06
0.167	3.52	1.167	16.66	2.167	6.96	3.17	4.06
0.250	3.93	1.250	96.57	2.250	6.15	3.25	3.82
0.333	3.93	1.333	96.57	2.333	6.15	3.33	3.82
0.417	4.49	1.417	20.45	2.417	5.53	3.42	3.61
0.500	4.49	1.500	20.45	2.500	5.53	3.50	3.61
0.583	5.29	1.583	12.89	2.583	5.05	3.58	3.43
0.667	5.29	1.667	12.89	2.667	5.05	3.67	3.43
0.750	6.55	1.750	9.83	2.750	4.66	3.75	3.27
0.833	6.55	1.833	9.83	2.833	4.66	3.83	3.27
0.917	8.96	1.917	8.10	2.917	4.33	3.92	3.13
1.000	8.96	2.000	8.10	3.000	4.33	4.00	3.13

Max.Eff.Inten.(mm/hr)=	96.57	110.28
over (min)	5.00	10.00
Storage Coeff. (min)=	2.42 (ii)	8.13 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.30	0.13

				TOTALS
PEAK FLOW	(cms)=	0.04	0.05	0.080 (iii)
TIME TO PEAK	(hrs)=	1.33	1.42	1.33
RUNOFF VOLUME	(mm)=	39.88	25.89	29.14
TOTAL RAINFALL	(mm)=	41.88	41.88	41.88
RUNOFF COEFFICIENT	=	0.95	0.62	0.70

***** 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.

** SIMULATION:5y-SCS **

```

-----
| CALIB |
| STANDHYD ( 0013) | Area (ha)= 0.60
| ID= 1 DT= 5.0 min | Total Imp(%)= 58.80 Dir. Conn.(%)= 23.30
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.35	0.25
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	63.25	30.00
Mannings n	=	0.013	0.250

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

```

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

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	1.75	6.250	76.97	9.33	2.04
0.167	0.00	3.250	1.75	6.333	10.50	9.42	2.04
0.250	0.00	3.333	2.33	6.417	10.50	9.50	2.04
0.333	1.46	3.417	2.33	6.500	10.50	9.58	2.04
0.417	1.46	3.500	2.33	6.583	10.50	9.67	2.04
0.500	1.46	3.583	2.33	6.667	10.50	9.75	2.04
0.583	1.46	3.667	2.33	6.750	10.50	9.83	2.04
0.667	1.46	3.750	2.33	6.833	4.66	9.92	2.04
0.750	1.46	3.833	2.33	6.917	4.66	10.00	2.04
0.833	1.46	3.917	2.33	7.000	4.66	10.08	2.04
0.917	1.46	4.000	2.33	7.083	4.66	10.17	2.04
1.000	1.46	4.083	2.33	7.167	4.66	10.25	2.04
1.083	1.46	4.167	2.33	7.250	4.66	10.33	1.17

1.167	1.46	4.250	2.33	7.333	3.50	10.42	1.17
1.250	1.46	4.333	3.50	7.417	3.50	10.50	1.17
1.333	1.46	4.417	3.50	7.500	3.50	10.58	1.17
1.417	1.46	4.500	3.50	7.583	3.50	10.67	1.17
1.500	1.46	4.583	3.50	7.667	3.50	10.75	1.17
1.583	1.46	4.667	3.50	7.750	3.50	10.83	1.17
1.667	1.46	4.750	3.50	7.833	3.50	10.92	1.17
1.750	1.46	4.833	4.66	7.917	3.50	11.00	1.17
1.833	1.46	4.917	4.66	8.000	3.50	11.08	1.17
1.917	1.46	5.000	4.66	8.083	3.50	11.17	1.17
2.000	1.46	5.083	4.66	8.167	3.50	11.25	1.17
2.083	1.46	5.167	4.66	8.250	3.50	11.33	1.17
2.167	1.46	5.250	4.66	8.333	2.04	11.42	1.17
2.250	1.46	5.333	7.00	8.417	2.04	11.50	1.17
2.333	1.75	5.417	7.00	8.500	2.04	11.58	1.17
2.417	1.75	5.500	7.00	8.583	2.04	11.67	1.17
2.500	1.75	5.583	7.00	8.667	2.04	11.75	1.17
2.583	1.75	5.667	7.00	8.750	2.04	11.83	1.17
2.667	1.75	5.750	7.00	8.833	2.04	11.92	1.17
2.750	1.75	5.833	27.99	8.917	2.04	12.00	1.17
2.833	1.75	5.917	27.99	9.000	2.04	12.08	1.17
2.917	1.75	6.000	27.99	9.083	2.04	12.17	1.17
3.000	1.75	6.083	76.97	9.167	2.04	12.25	1.17
3.083	1.75	6.167	76.97	9.250	2.04		

Max.Eff.Inten.(mm/hr)=	76.97	118.00
over (min)	5.00	10.00
Storage Coeff. (min)=	2.65 (ii)	8.21 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.29	0.13

TOTALS

PEAK FLOW (cms)=	0.03	0.06	0.095 (iii)
TIME TO PEAK (hrs)=	6.25	6.25	6.25
RUNOFF VOLUME (mm)=	56.31	40.53	44.20
TOTAL RAINFALL (mm)=	58.31	58.31	58.31
RUNOFF COEFFICIENT =	0.97	0.70	0.76

***** 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.

Post-Development Catchment 1C (Controlled)

 ** SIMULATION:100y-C **

```

-----
| CALIB |
| STANDHYD ( 0014) | Area (ha)= 0.67
| ID= 1 DT= 5.0 min | Total Imp(%)= 59.60 Dir. Conn.(%)= 26.00
-----
  
```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.40	0.27
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	66.83	30.00
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	5.92	1.083	28.01	2.083	11.70	3.08	6.82
0.167	5.92	1.167	28.01	2.167	11.70	3.17	6.82
0.250	6.61	1.250	162.35	2.250	10.34	3.25	6.42
0.333	6.61	1.333	162.35	2.333	10.34	3.33	6.42
0.417	7.55	1.417	34.38	2.417	9.30	3.42	6.08
0.500	7.55	1.500	34.38	2.500	9.30	3.50	6.08
0.583	8.89	1.583	21.68	2.583	8.49	3.58	5.77
0.667	8.89	1.667	21.68	2.667	8.49	3.67	5.77
0.750	11.01	1.750	16.53	2.750	7.83	3.75	5.50
0.833	11.01	1.833	16.53	2.833	7.83	3.83	5.50
0.917	15.06	1.917	13.62	2.917	7.28	3.92	5.26
1.000	15.06	2.000	13.62	3.000	7.28	4.00	5.26

Max. Eff. Inten. (mm/hr)=	162.35	223.79
over (min)	5.00	10.00
Storage Coeff. (min)=	2.03 (ii)	6.34 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.31	0.15

			TOTALS
PEAK FLOW (cms)=	0.08	0.12	0.189 (iii)
TIME TO PEAK (hrs)=	1.33	1.42	1.33
RUNOFF VOLUME (mm)=	68.40	51.48	55.87
TOTAL RAINFALL (mm)=	70.40	70.40	70.40
RUNOFF COEFFICIENT =	0.97	0.73	0.79

***** 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.

 ** SIMULATION:100y-SCS **

```

-----
| CALIB |
| STANDHYD ( 0014) | Area (ha)= 0.67
| ID= 1 DT= 5.0 min | Total Imp(%)= 59.60 Dir. Conn.(%)= 26.00
-----
  
```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.40	0.27
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	66.83	30.00
Mannings n	=	0.013	0.250

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

----- TRANSFORMED HYETOGRAPH -----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.94	6.250	129.40	9.33	3.43
0.167	0.00	3.250	2.94	6.333	17.65	9.42	3.43
0.250	0.00	3.333	3.92	6.417	17.65	9.50	3.43
0.333	2.45	3.417	3.92	6.500	17.65	9.58	3.43
0.417	2.45	3.500	3.92	6.583	17.65	9.67	3.43
0.500	2.45	3.583	3.92	6.667	17.65	9.75	3.43
0.583	2.45	3.667	3.92	6.750	17.65	9.83	3.43
0.667	2.45	3.750	3.92	6.833	7.84	9.92	3.43
0.750	2.45	3.833	3.92	6.917	7.84	10.00	3.43
0.833	2.45	3.917	3.92	7.000	7.84	10.08	3.43
0.917	2.45	4.000	3.92	7.083	7.84	10.17	3.43
1.000	2.45	4.083	3.92	7.167	7.84	10.25	3.43
1.083	2.45	4.167	3.92	7.250	7.84	10.33	1.96
1.167	2.45	4.250	3.92	7.333	5.88	10.42	1.96
1.250	2.45	4.333	5.88	7.417	5.88	10.50	1.96
1.333	2.45	4.417	5.88	7.500	5.88	10.58	1.96
1.417	2.45	4.500	5.88	7.583	5.88	10.67	1.96
1.500	2.45	4.583	5.88	7.667	5.88	10.75	1.96
1.583	2.45	4.667	5.88	7.750	5.88	10.83	1.96
1.667	2.45	4.750	5.88	7.833	5.88	10.92	1.96
1.750	2.45	4.833	7.84	7.917	5.88	11.00	1.96
1.833	2.45	4.917	7.84	8.000	5.88	11.08	1.96
1.917	2.45	5.000	7.84	8.083	5.88	11.17	1.96
2.000	2.45	5.083	7.84	8.167	5.88	11.25	1.96

2.083	2.45	5.167	7.84	8.250	5.88	11.33	1.96
2.167	2.45	5.250	7.84	8.333	3.43	11.42	1.96
2.250	2.45	5.333	11.76	8.417	3.43	11.50	1.96
2.333	2.94	5.417	11.76	8.500	3.43	11.58	1.96
2.417	2.94	5.500	11.76	8.583	3.43	11.67	1.96
2.500	2.94	5.583	11.76	8.667	3.43	11.75	1.96
2.583	2.94	5.667	11.76	8.750	3.43	11.83	1.96
2.667	2.94	5.750	11.76	8.833	3.43	11.92	1.96
2.750	2.94	5.833	47.05	8.917	3.43	12.00	1.96
2.833	2.94	5.917	47.05	9.000	3.43	12.08	1.96
2.917	2.94	6.000	47.06	9.083	3.43	12.17	1.96
3.000	2.94	6.083	129.40	9.167	3.43	12.25	1.96
3.083	2.94	6.167	129.40	9.250	3.43		

Max.Eff.Inten.(mm/hr)= 129.40 215.26
over (min) 5.00 10.00
Storage Coeff. (min)= 2.23 (ii) 6.60 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.30 0.14

TOTALS

PEAK FLOW (cms)= 0.06 0.14 0.202 (iii)
TIME TO PEAK (hrs)= 6.25 6.25 6.25
RUNOFF VOLUME (mm)= 96.03 77.66 82.43
TOTAL RAINFALL (mm)= 98.03 98.03 98.03
RUNOFF COEFFICIENT = 0.98 0.79 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.

** SIMULATION:10y-C **

```

-----
| CALIB |
| STANDHYD ( 0014) | Area (ha)= 0.67
| ID= 1 DT= 5.0 min | Total Imp(%)= 59.60 Dir. Conn.(%)= 26.00
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.40	0.27
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	66.83	30.00
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	4.11	1.083	19.44	2.083	8.12	3.08	4.73
0.167	4.11	1.167	19.44	2.167	8.12	3.17	4.73
0.250	4.59	1.250	112.66	2.250	7.17	3.25	4.46
0.333	4.59	1.333	112.66	2.333	7.17	3.33	4.46
0.417	5.24	1.417	23.86	2.417	6.46	3.42	4.22
0.500	5.24	1.500	23.86	2.500	6.46	3.50	4.22
0.583	6.17	1.583	15.04	2.583	5.89	3.58	4.01
0.667	6.17	1.667	15.04	2.667	5.89	3.67	4.01
0.750	7.64	1.750	11.47	2.750	5.43	3.75	3.82
0.833	7.64	1.833	11.47	2.833	5.43	3.83	3.82
0.917	10.45	1.917	9.45	2.917	5.05	3.92	3.65
1.000	10.45	2.000	9.45	3.000	5.05	4.00	3.65

Max.Eff.Inten.(mm/hr)= 112.66 134.96
over (min) 5.00 10.00
Storage Coeff. (min)= 2.35 (ii) 7.62 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.30 0.13

TOTALS

PEAK FLOW (cms)= 0.05 0.07 0.114 (iii)
TIME TO PEAK (hrs)= 1.33 1.42 1.33
RUNOFF VOLUME (mm)= 46.86 31.82 35.73
TOTAL RAINFALL (mm)= 48.86 48.86 48.86
RUNOFF COEFFICIENT = 0.96 0.65 0.73

***** 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.

** SIMULATION:10y-SCS **

```

-----
| CALIB |
| STANDHYD ( 0014) | Area (ha)= 0.67
| ID= 1 DT= 5.0 min | Total Imp(%)= 59.60 Dir. Conn.(%)= 26.00
-----

```

Surface Area (ha)= IMPERVIOUS 0.40 PERVIOUS (i) 0.27

Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	66.83	30.00
Mannings n	=	0.013	0.250

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

----- TRANSFORMED HYETOGRAPH -----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.04	6.250	89.80	9.33	2.38
0.167	0.00	3.250	2.04	6.333	12.25	9.42	2.38
0.250	0.00	3.333	2.72	6.417	12.25	9.50	2.38
0.333	1.70	3.417	2.72	6.500	12.25	9.58	2.38
0.417	1.70	3.500	2.72	6.583	12.25	9.67	2.38
0.500	1.70	3.583	2.72	6.667	12.25	9.75	2.38
0.583	1.70	3.667	2.72	6.750	12.25	9.83	2.38
0.667	1.70	3.750	2.72	6.833	5.44	9.92	2.38
0.750	1.70	3.833	2.72	6.917	5.44	10.00	2.38
0.833	1.70	3.917	2.72	7.000	5.44	10.08	2.38
0.917	1.70	4.000	2.72	7.083	5.44	10.17	2.38
1.000	1.70	4.083	2.72	7.167	5.44	10.25	2.38
1.083	1.70	4.167	2.72	7.250	5.44	10.33	1.36
1.167	1.70	4.250	2.72	7.333	4.08	10.42	1.36
1.250	1.70	4.333	4.08	7.417	4.08	10.50	1.36
1.333	1.70	4.417	4.08	7.500	4.08	10.58	1.36
1.417	1.70	4.500	4.08	7.583	4.08	10.67	1.36
1.500	1.70	4.583	4.08	7.667	4.08	10.75	1.36
1.583	1.70	4.667	4.08	7.750	4.08	10.83	1.36
1.667	1.70	4.750	4.08	7.833	4.08	10.92	1.36
1.750	1.70	4.833	5.44	7.917	4.08	11.00	1.36
1.833	1.70	4.917	5.44	8.000	4.08	11.08	1.36
1.917	1.70	5.000	5.44	8.083	4.08	11.17	1.36
2.000	1.70	5.083	5.44	8.167	4.08	11.25	1.36
2.083	1.70	5.167	5.44	8.250	4.08	11.33	1.36
2.167	1.70	5.250	5.44	8.333	2.38	11.42	1.36
2.250	1.70	5.333	8.16	8.417	2.38	11.50	1.36
2.333	2.04	5.417	8.16	8.500	2.38	11.58	1.36
2.417	2.04	5.500	8.16	8.583	2.38	11.67	1.36
2.500	2.04	5.583	8.16	8.667	2.38	11.75	1.36
2.583	2.04	5.667	8.16	8.750	2.38	11.83	1.36
2.667	2.04	5.750	8.16	8.833	2.38	11.92	1.36
2.750	2.04	5.833	32.65	8.917	2.38	12.00	1.36
2.833	2.04	5.917	32.65	9.000	2.38	12.08	1.36
2.917	2.04	6.000	32.66	9.083	2.38	12.17	1.36
3.000	2.04	6.083	89.80	9.167	2.38	12.25	1.36
3.083	2.04	6.167	89.80	9.250	2.38		

Max. Eff. Inten. (mm/hr)=	89.80	139.94
---------------------------	-------	--------

over (min)	5.00	10.00	
Storage Coeff. (min)=	2.58 (ii)	7.77 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.29	0.13	
			TOTALS
PEAK FLOW (cms)=	0.04	0.09	0.129 (iii)
TIME TO PEAK (hrs)=	6.25	6.25	6.25
RUNOFF VOLUME (mm)=	66.03	49.27	53.62
TOTAL RAINFALL (mm)=	68.03	68.03	68.03
RUNOFF COEFFICIENT =	0.97	0.72	0.79

***** 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.

** SIMULATION:25mm Water Quality **

CALIB			
STANDHYD (0014)	Area (ha)=	0.67	
ID= 1 DT= 5.0 min	Total Imp(%)=	59.60	Dir. Conn.(%)= 26.00

	IMPERVIOUS	PERVIOUS (i)	
Surface Area (ha)=	0.40	0.27	
Dep. Storage (mm)=	2.00	1.50	
Average Slope (%)=	0.50	2.00	
Length (m)=	66.83	30.00	
Mannings n =	0.013	0.250	
Max.Eff.Inten.(mm/hr)=	76.07	48.64	
over (min)	5.00	15.00	
Storage Coeff. (min)=	2.76 (ii)	10.68 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	0.28	0.09	
			TOTALS
PEAK FLOW (cms)=	0.03	0.02	0.040 (iii)
TIME TO PEAK (hrs)=	1.33	1.50	1.33
RUNOFF VOLUME (mm)=	22.99	12.01	14.85
TOTAL RAINFALL (mm)=	24.99	24.99	24.99
RUNOFF COEFFICIENT =	0.92	0.48	0.59

***** 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.

 ** SIMULATION:25y-C **

 | CALIB |
 | STANDHYD (0014) | Area (ha)= 0.67
 | ID= 1 DT= 5.0 min | Total Imp(%)= 59.60 Dir. Conn.(%)= 26.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.40	0.27
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	66.83	30.00
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	4.83	1.083	22.88	2.083	9.56	3.08	5.57
0.167	4.83	1.167	22.88	2.167	9.56	3.17	5.57
0.250	5.40	1.250	132.61	2.250	8.44	3.25	5.25
0.333	5.40	1.333	132.61	2.333	8.44	3.33	5.25
0.417	6.17	1.417	28.08	2.417	7.60	3.42	4.96
0.500	6.17	1.500	28.08	2.500	7.60	3.50	4.96
0.583	7.26	1.583	17.71	2.583	6.93	3.58	4.72
0.667	7.26	1.667	17.71	2.667	6.93	3.67	4.72
0.750	8.99	1.750	13.50	2.750	6.40	3.75	4.50
0.833	8.99	1.833	13.50	2.833	6.40	3.83	4.50
0.917	12.30	1.917	11.12	2.917	5.95	3.92	4.30
1.000	12.30	2.000	11.12	3.000	5.95	4.00	4.30

Max.Eff.Inten.(mm/hr)=	132.61	169.98
over (min)	5.00	10.00
Storage Coeff. (min)=	2.21 (ii)	7.01 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.30	0.14

TOTALS

PEAK FLOW (cms)=	0.06	0.09	0.144 (iii)
TIME TO PEAK (hrs)=	1.33	1.42	1.33
RUNOFF VOLUME (mm)=	55.50	39.59	43.72
TOTAL RAINFALL (mm)=	57.50	57.50	57.50

RUNOFF COEFFICIENT = 0.97 0.69 0.76

***** 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.

** SIMULATION:25y-SCS **

```

-----
| CALIB |
| STANDHYD ( 0014) | Area (ha)= 0.67
| ID= 1 DT= 5.0 min | Total Imp(%)= 59.60 Dir. Conn.(%)= 26.00
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.40	0.27
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	66.83	30.00
Mannings n	=	0.013	0.250

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

```

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

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.40	6.250	105.69	9.33	2.80
0.167	0.00	3.250	2.40	6.333	14.41	9.42	2.80
0.250	0.00	3.333	3.20	6.417	14.41	9.50	2.80
0.333	2.00	3.417	3.20	6.500	14.41	9.58	2.80
0.417	2.00	3.500	3.20	6.583	14.41	9.67	2.80
0.500	2.00	3.583	3.20	6.667	14.41	9.75	2.80
0.583	2.00	3.667	3.20	6.750	14.41	9.83	2.80
0.667	2.00	3.750	3.20	6.833	6.41	9.92	2.80
0.750	2.00	3.833	3.20	6.917	6.41	10.00	2.80
0.833	2.00	3.917	3.20	7.000	6.41	10.08	2.80
0.917	2.00	4.000	3.20	7.083	6.41	10.17	2.80
1.000	2.00	4.083	3.20	7.167	6.41	10.25	2.80
1.083	2.00	4.167	3.20	7.250	6.41	10.33	1.60
1.167	2.00	4.250	3.20	7.333	4.80	10.42	1.60
1.250	2.00	4.333	4.80	7.417	4.80	10.50	1.60
1.333	2.00	4.417	4.80	7.500	4.80	10.58	1.60
1.417	2.00	4.500	4.80	7.583	4.80	10.67	1.60
1.500	2.00	4.583	4.80	7.667	4.80	10.75	1.60

1.583	2.00	4.667	4.80	7.750	4.80	10.83	1.60
1.667	2.00	4.750	4.80	7.833	4.80	10.92	1.60
1.750	2.00	4.833	6.41	7.917	4.80	11.00	1.60
1.833	2.00	4.917	6.41	8.000	4.80	11.08	1.60
1.917	2.00	5.000	6.41	8.083	4.80	11.17	1.60
2.000	2.00	5.083	6.41	8.167	4.80	11.25	1.60
2.083	2.00	5.167	6.41	8.250	4.80	11.33	1.60
2.167	2.00	5.250	6.41	8.333	2.80	11.42	1.60
2.250	2.00	5.333	9.61	8.417	2.80	11.50	1.60
2.333	2.40	5.417	9.61	8.500	2.80	11.58	1.60
2.417	2.40	5.500	9.61	8.583	2.80	11.67	1.60
2.500	2.40	5.583	9.61	8.667	2.80	11.75	1.60
2.583	2.40	5.667	9.61	8.750	2.80	11.83	1.60
2.667	2.40	5.750	9.61	8.833	2.80	11.92	1.60
2.750	2.40	5.833	38.43	8.917	2.80	12.00	1.60
2.833	2.40	5.917	38.43	9.000	2.80	12.08	1.60
2.917	2.40	6.000	38.44	9.083	2.80	12.17	1.60
3.000	2.40	6.083	105.69	9.167	2.80	12.25	1.60
3.083	2.40	6.167	105.69	9.250	2.80		

Max.Eff.Inten.(mm/hr)= 105.69 170.16
over (min) 5.00 10.00
Storage Coeff. (min)= 2.42 (ii) 7.22 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.30 0.14

TOTALS

PEAK FLOW (cms)= 0.05 0.11 0.158 (iii)
TIME TO PEAK (hrs)= 6.25 6.25 6.25
RUNOFF VOLUME (mm)= 78.07 60.55 65.10
TOTAL RAINFALL (mm)= 80.07 80.07 80.07
RUNOFF COEFFICIENT = 0.98 0.76 0.81

***** 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.

** SIMULATION:2yr-c **

| CALIB |
| STANDHYD (0014) | Area (ha)= 0.67
| ID= 1 DT= 5.0 min | Total Imp(%)= 59.60 Dir. Conn.(%)= 26.00

IMPERVIOUS PERVIOUS (i)

Surface Area (ha)= 0.40 0.27
 Dep. Storage (mm)= 2.00 1.50
 Average Slope (%)= 0.50 2.00
 Length (m)= 66.83 30.00
 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	2.64	1.083	12.50	2.083	5.22	3.08	3.04
0.167	2.64	1.167	12.50	2.167	5.22	3.17	3.04
0.250	2.95	1.250	72.43	2.250	4.61	3.25	2.87
0.333	2.95	1.333	72.43	2.333	4.61	3.33	2.87
0.417	3.37	1.417	15.34	2.417	4.15	3.42	2.71
0.500	3.37	1.500	15.34	2.500	4.15	3.50	2.71
0.583	3.96	1.583	9.67	2.583	3.79	3.58	2.58
0.667	3.96	1.667	9.67	2.667	3.79	3.67	2.58
0.750	4.91	1.750	7.37	2.750	3.49	3.75	2.46
0.833	4.91	1.833	7.37	2.833	3.49	3.83	2.46
0.917	6.72	1.917	6.07	2.917	3.25	3.92	2.35
1.000	6.72	2.000	6.07	3.000	3.25	4.00	2.35

Max.Eff.Inten.(mm/hr)= 72.43 69.09
 over (min) 5.00 10.00
 Storage Coeff. (min)= 2.81 (ii) 9.70 (ii)
 Unit Hyd. Tpeak (min)= 5.00 10.00
 Unit Hyd. peak (cms)= 0.28 0.11

TOTALS

PEAK FLOW (cms)= 0.03 0.03 0.061 (iii)
 TIME TO PEAK (hrs)= 1.33 1.42 1.33
 RUNOFF VOLUME (mm)= 29.41 16.99 20.21
 TOTAL RAINFALL (mm)= 31.41 31.41 31.41
 RUNOFF COEFFICIENT = 0.94 0.54 0.64

***** 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.

 ** SIMULATION:2y-SCS **

CALIB
 STANDHYD (0014)
 ID= 1 DT= 5.0 min

Area (ha)= 0.67
 Total Imp(%)= 59.60 Dir. Conn.(%)= 26.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.40	0.27
Dep. Storage (mm)=	2.00	1.50
Average Slope (%)=	0.50	2.00
Length (m)=	66.83	30.00
Mannings n =	0.013	0.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	1.31	6.250	57.72	9.33	1.53
0.167	0.00	3.250	1.31	6.333	7.87	9.42	1.53
0.250	0.00	3.333	1.75	6.417	7.87	9.50	1.53
0.333	1.09	3.417	1.75	6.500	7.87	9.58	1.53
0.417	1.09	3.500	1.75	6.583	7.87	9.67	1.53
0.500	1.09	3.583	1.75	6.667	7.87	9.75	1.53
0.583	1.09	3.667	1.75	6.750	7.87	9.83	1.53
0.667	1.09	3.750	1.75	6.833	3.50	9.92	1.53
0.750	1.09	3.833	1.75	6.917	3.50	10.00	1.53
0.833	1.09	3.917	1.75	7.000	3.50	10.08	1.53
0.917	1.09	4.000	1.75	7.083	3.50	10.17	1.53
1.000	1.09	4.083	1.75	7.167	3.50	10.25	1.53
1.083	1.09	4.167	1.75	7.250	3.50	10.33	0.87
1.167	1.09	4.250	1.75	7.333	2.62	10.42	0.87
1.250	1.09	4.333	2.62	7.417	2.62	10.50	0.87
1.333	1.09	4.417	2.62	7.500	2.62	10.58	0.87
1.417	1.09	4.500	2.62	7.583	2.62	10.67	0.87
1.500	1.09	4.583	2.62	7.667	2.62	10.75	0.87
1.583	1.09	4.667	2.62	7.750	2.62	10.83	0.87
1.667	1.09	4.750	2.62	7.833	2.62	10.92	0.87
1.750	1.09	4.833	3.50	7.917	2.62	11.00	0.87
1.833	1.09	4.917	3.50	8.000	2.62	11.08	0.87
1.917	1.09	5.000	3.50	8.083	2.62	11.17	0.87
2.000	1.09	5.083	3.50	8.167	2.62	11.25	0.87
2.083	1.09	5.167	3.50	8.250	2.62	11.33	0.87
2.167	1.09	5.250	3.50	8.333	1.53	11.42	0.87
2.250	1.09	5.333	5.25	8.417	1.53	11.50	0.87
2.333	1.31	5.417	5.25	8.500	1.53	11.58	0.87
2.417	1.31	5.500	5.25	8.583	1.53	11.67	0.87
2.500	1.31	5.583	5.25	8.667	1.53	11.75	0.87
2.583	1.31	5.667	5.25	8.750	1.53	11.83	0.87
2.667	1.31	5.750	5.25	8.833	1.53	11.92	0.87
2.750	1.31	5.833	20.99	8.917	1.53	12.00	0.87

2.833	1.31	5.917	20.99	9.000	1.53	12.08	0.87
2.917	1.31	6.000	20.99	9.083	1.53	12.17	0.87
3.000	1.31	6.083	57.72	9.167	1.53	12.25	0.87
3.083	1.31	6.167	57.72	9.250	1.53		

Max.Eff.Inten.(mm/hr)= 57.72 79.59
over (min) 5.00 10.00
Storage Coeff. (min)= 3.08 (ii) 9.58 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.27 0.11

TOTALS

PEAK FLOW (cms)= 0.03 0.04 0.072 (iii)
TIME TO PEAK (hrs)= 6.25 6.25 6.25
RUNOFF VOLUME (mm)= 41.73 27.33 31.06
TOTAL RAINFALL (mm)= 43.73 43.73 43.73
RUNOFF COEFFICIENT = 0.95 0.62 0.71

***** 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.

** SIMULATION:50y-C **

```

-----
| CALIB |
| STANDHYD ( 0014) | Area (ha)= 0.67
| ID= 1 DT= 5.0 min | Total Imp(%)= 59.60 Dir. Conn.(%)= 26.00
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.40	0.27
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	66.83	30.00
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	5.38	1.083	25.48	2.083	10.64	3.08	6.20
0.167	5.38	1.167	25.48	2.167	10.64	3.17	6.20
0.250	6.02	1.250	147.65	2.250	9.40	3.25	5.84

0.333	6.02	1.333	147.65	2.333	9.40	3.33	5.84
0.417	6.87	1.417	31.27	2.417	8.46	3.42	5.53
0.500	6.87	1.500	31.27	2.500	8.46	3.50	5.53
0.583	8.08	1.583	19.71	2.583	7.72	3.58	5.25
0.667	8.08	1.667	19.71	2.667	7.72	3.67	5.25
0.750	10.01	1.750	15.03	2.750	7.12	3.75	5.01
0.833	10.01	1.833	15.03	2.833	7.12	3.83	5.01
0.917	13.70	1.917	12.38	2.917	6.62	3.92	4.79
1.000	13.70	2.000	12.38	3.000	6.62	4.00	4.79

Max.Eff.Inten.(mm/hr)= 147.65 197.01
over (min) 5.00 10.00
Storage Coeff. (min)= 2.11 (ii) 6.64 (ii)
Unit Hyd. Tpeak (min)= 5.00 10.00
Unit Hyd. peak (cms)= 0.31 0.14

TOTALS

PEAK FLOW (cms)= 0.07 0.10 0.167 (iii)
TIME TO PEAK (hrs)= 1.33 1.42 1.33
RUNOFF VOLUME (mm)= 62.03 45.57 49.84
TOTAL RAINFALL (mm)= 64.03 64.03 64.03
RUNOFF COEFFICIENT = 0.97 0.71 0.78

***** 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.

** SIMULATION:50y-SCS **

| CALIB |
| STANDHYD (0014) | Area (ha)= 0.67
| ID= 1 DT= 5.0 min | Total Imp(%)= 59.60 Dir. Conn.(%)= 26.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	0.40	0.27
Dep. Storage (mm)=	2.00	1.50
Average Slope (%)=	0.50	2.00
Length (m)=	66.83	30.00
Mannings n =	0.013	0.250

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

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.67	6.250	117.69	9.33	3.12
0.167	0.00	3.250	2.67	6.333	16.05	9.42	3.12
0.250	0.00	3.333	3.57	6.417	16.05	9.50	3.12
0.333	2.23	3.417	3.57	6.500	16.05	9.58	3.12
0.417	2.23	3.500	3.57	6.583	16.05	9.67	3.12
0.500	2.23	3.583	3.57	6.667	16.05	9.75	3.12
0.583	2.23	3.667	3.57	6.750	16.05	9.83	3.12
0.667	2.23	3.750	3.57	6.833	7.13	9.92	3.12
0.750	2.23	3.833	3.57	6.917	7.13	10.00	3.12
0.833	2.23	3.917	3.57	7.000	7.13	10.08	3.12
0.917	2.23	4.000	3.57	7.083	7.13	10.17	3.12
1.000	2.23	4.083	3.57	7.167	7.13	10.25	3.12
1.083	2.23	4.167	3.57	7.250	7.13	10.33	1.78
1.167	2.23	4.250	3.57	7.333	5.35	10.42	1.78
1.250	2.23	4.333	5.35	7.417	5.35	10.50	1.78
1.333	2.23	4.417	5.35	7.500	5.35	10.58	1.78
1.417	2.23	4.500	5.35	7.583	5.35	10.67	1.78
1.500	2.23	4.583	5.35	7.667	5.35	10.75	1.78
1.583	2.23	4.667	5.35	7.750	5.35	10.83	1.78
1.667	2.23	4.750	5.35	7.833	5.35	10.92	1.78
1.750	2.23	4.833	7.13	7.917	5.35	11.00	1.78
1.833	2.23	4.917	7.13	8.000	5.35	11.08	1.78
1.917	2.23	5.000	7.13	8.083	5.35	11.17	1.78
2.000	2.23	5.083	7.13	8.167	5.35	11.25	1.78
2.083	2.23	5.167	7.13	8.250	5.35	11.33	1.78
2.167	2.23	5.250	7.13	8.333	3.12	11.42	1.78
2.250	2.23	5.333	10.70	8.417	3.12	11.50	1.78
2.333	2.67	5.417	10.70	8.500	3.12	11.58	1.78
2.417	2.67	5.500	10.70	8.583	3.12	11.67	1.78
2.500	2.67	5.583	10.70	8.667	3.12	11.75	1.78
2.583	2.67	5.667	10.70	8.750	3.12	11.83	1.78
2.667	2.67	5.750	10.70	8.833	3.12	11.92	1.78
2.750	2.67	5.833	42.80	8.917	3.12	12.00	1.78
2.833	2.67	5.917	42.80	9.000	3.12	12.08	1.78
2.917	2.67	6.000	42.80	9.083	3.12	12.17	1.78
3.000	2.67	6.083	117.69	9.167	3.12	12.25	1.78
3.083	2.67	6.167	117.69	9.250	3.12		

Max.Eff.Inten.(mm/hr)=	117.69	193.00
over (min)	5.00	10.00
Storage Coeff. (min)=	2.31 (ii)	6.88 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.30	0.14

TOTALS

PEAK FLOW (cms)=	0.06	0.12	0.181 (iii)
TIME TO PEAK (hrs)=	6.25	6.25	6.25
RUNOFF VOLUME (mm)=	87.16	69.18	73.85
TOTAL RAINFALL (mm)=	89.16	89.16	89.16

RUNOFF COEFFICIENT = 0.98 0.78 0.83

***** 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.

** SIMULATION:5y-C **

```

-----
| CALIB |
| STANDHYD ( 0014) | Area (ha)= 0.67
| ID= 1 DT= 5.0 min | Total Imp(%)= 59.60 Dir. Conn.(%)= 26.00
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.40	0.27
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	66.83	30.00
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	3.52	1.083	16.66	2.083	6.96	3.08	4.06
0.167	3.52	1.167	16.66	2.167	6.96	3.17	4.06
0.250	3.93	1.250	96.57	2.250	6.15	3.25	3.82
0.333	3.93	1.333	96.57	2.333	6.15	3.33	3.82
0.417	4.49	1.417	20.45	2.417	5.53	3.42	3.61
0.500	4.49	1.500	20.45	2.500	5.53	3.50	3.61
0.583	5.29	1.583	12.89	2.583	5.05	3.58	3.43
0.667	5.29	1.667	12.89	2.667	5.05	3.67	3.43
0.750	6.55	1.750	9.83	2.750	4.66	3.75	3.27
0.833	6.55	1.833	9.83	2.833	4.66	3.83	3.27
0.917	8.96	1.917	8.10	2.917	4.33	3.92	3.13
1.000	8.96	2.000	8.10	3.000	4.33	4.00	3.13

Max.Eff.Inten.(mm/hr)=	96.57	107.65
over (min)	5.00	10.00
Storage Coeff. (min)=	2.50 (ii)	8.27 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.29	0.13

				TOTALS
PEAK FLOW	(cms)=	0.05	0.05	0.092 (iii)
TIME TO PEAK	(hrs)=	1.33	1.42	1.33
RUNOFF VOLUME	(mm)=	39.88	25.72	29.40
TOTAL RAINFALL	(mm)=	41.88	41.88	41.88
RUNOFF COEFFICIENT	=	0.95	0.61	0.70

***** 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.

** SIMULATION:5y-SCS **

```

-----
| CALIB |
| STANDHYD ( 0014) | Area (ha)= 0.67
| ID= 1 DT= 5.0 min | Total Imp(%)= 59.60 Dir. Conn.(%)= 26.00
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.40	0.27
Dep. Storage	(mm)=	2.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	66.83	30.00
Mannings n	=	0.013	0.250

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

```

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

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	1.75	6.250	76.97	9.33	2.04
0.167	0.00	3.250	1.75	6.333	10.50	9.42	2.04
0.250	0.00	3.333	2.33	6.417	10.50	9.50	2.04
0.333	1.46	3.417	2.33	6.500	10.50	9.58	2.04
0.417	1.46	3.500	2.33	6.583	10.50	9.67	2.04
0.500	1.46	3.583	2.33	6.667	10.50	9.75	2.04
0.583	1.46	3.667	2.33	6.750	10.50	9.83	2.04
0.667	1.46	3.750	2.33	6.833	4.66	9.92	2.04
0.750	1.46	3.833	2.33	6.917	4.66	10.00	2.04
0.833	1.46	3.917	2.33	7.000	4.66	10.08	2.04
0.917	1.46	4.000	2.33	7.083	4.66	10.17	2.04
1.000	1.46	4.083	2.33	7.167	4.66	10.25	2.04
1.083	1.46	4.167	2.33	7.250	4.66	10.33	1.17

1.167	1.46	4.250	2.33	7.333	3.50	10.42	1.17
1.250	1.46	4.333	3.50	7.417	3.50	10.50	1.17
1.333	1.46	4.417	3.50	7.500	3.50	10.58	1.17
1.417	1.46	4.500	3.50	7.583	3.50	10.67	1.17
1.500	1.46	4.583	3.50	7.667	3.50	10.75	1.17
1.583	1.46	4.667	3.50	7.750	3.50	10.83	1.17
1.667	1.46	4.750	3.50	7.833	3.50	10.92	1.17
1.750	1.46	4.833	4.66	7.917	3.50	11.00	1.17
1.833	1.46	4.917	4.66	8.000	3.50	11.08	1.17
1.917	1.46	5.000	4.66	8.083	3.50	11.17	1.17
2.000	1.46	5.083	4.66	8.167	3.50	11.25	1.17
2.083	1.46	5.167	4.66	8.250	3.50	11.33	1.17
2.167	1.46	5.250	4.66	8.333	2.04	11.42	1.17
2.250	1.46	5.333	7.00	8.417	2.04	11.50	1.17
2.333	1.75	5.417	7.00	8.500	2.04	11.58	1.17
2.417	1.75	5.500	7.00	8.583	2.04	11.67	1.17
2.500	1.75	5.583	7.00	8.667	2.04	11.75	1.17
2.583	1.75	5.667	7.00	8.750	2.04	11.83	1.17
2.667	1.75	5.750	7.00	8.833	2.04	11.92	1.17
2.750	1.75	5.833	27.99	8.917	2.04	12.00	1.17
2.833	1.75	5.917	27.99	9.000	2.04	12.08	1.17
2.917	1.75	6.000	27.99	9.083	2.04	12.17	1.17
3.000	1.75	6.083	76.97	9.167	2.04	12.25	1.17
3.083	1.75	6.167	76.97	9.250	2.04		

Max.Eff.Inten.(mm/hr)=	76.97	115.62
over (min)	5.00	10.00
Storage Coeff. (min)=	2.74 (ii)	8.35 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	0.28	0.12

TOTALS

PEAK FLOW (cms)=	0.04	0.07	0.106 (iii)
TIME TO PEAK (hrs)=	6.25	6.25	6.25
RUNOFF VOLUME (mm)=	56.31	40.33	44.48
TOTAL RAINFALL (mm)=	58.31	58.31	58.31
RUNOFF COEFFICIENT =	0.97	0.69	0.76

***** 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.

Post-Development Storage System (Route Reservoir)

 ** SIMULATION:100y-C **

RESERVOIR(0019)		OVERFLOW IS OFF			
IN= 2---> OUT= 1		OUTFLOW		STORAGE	
DT= 5.0 min		(cms)	(ha.m.)	(cms)	(ha.m.)
		0.0000	0.0000	0.0130	0.0690
		0.0010	0.0150	0.0300	0.0770
		0.0010	0.0310	0.0300	0.0770
		0.0010	0.0460	0.0310	0.0790
		0.0060	0.0620	0.0310	0.0790
		AREA	QPEAK	TPEAK	R.V.
		(ha)	(cms)	(hrs)	(mm)
INFLOW :	ID= 2 (0015)	1.400	0.392	1.33	55.56
OUTFLOW:	ID= 1 (0019)	1.400	0.014	4.08	52.84

PEAK FLOW REDUCTION [Qout/Qin](%)= 3.69
 TIME SHIFT OF PEAK FLOW (min)=165.00
 MAXIMUM STORAGE USED (ha.m.)= 0.0697

 ** SIMULATION:100y-SCS **

RESERVOIR(0019)		OVERFLOW IS OFF			
IN= 2---> OUT= 1		OUTFLOW		STORAGE	
DT= 5.0 min		(cms)	(ha.m.)	(cms)	(ha.m.)
		0.0000	0.0000	0.0130	0.0690
		0.0010	0.0150	0.0300	0.0770
		0.0010	0.0310	0.0300	0.0770
		0.0010	0.0460	0.0310	0.0790
		0.0060	0.0620	0.0310	0.0790
		AREA	QPEAK	TPEAK	R.V.
		(ha)	(cms)	(hrs)	(mm)
INFLOW :	ID= 2 (0015)	1.400	0.422	6.25	82.09
OUTFLOW:	ID= 1 (0019)	1.400	0.031	6.67	NaN

PEAK FLOW REDUCTION [Qout/Qin](%)= 7.22
 TIME SHIFT OF PEAK FLOW (min)= 25.00
 MAXIMUM STORAGE USED (ha.m.)= 0.0787

 ** SIMULATION:10y-C **

```

-----
| RESERVOIR( 0019) | 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   |   0.0130    0.0690
      0.0010    0.0150   |   0.0300    0.0770
      0.0010    0.0310   |   0.0300    0.0770
      0.0010    0.0460   |   0.0310    0.0790
      0.0060    0.0620   |   0.0310    0.0790

                        AREA   QPEAK   TPEAK   R.V.
                        (ha)   (cms)   (hrs)   (mm)
INFLOW : ID= 2 ( 0015)  1.400   0.236   1.33    35.46
OUTFLOW: ID= 1 ( 0019)  1.400   0.002   4.25    32.73

      PEAK FLOW REDUCTION [Qout/Qin](%)= 0.74
      TIME SHIFT OF PEAK FLOW           (min)=175.00
      MAXIMUM STORAGE USED              (ha.m.)= 0.0484

```

** SIMULATION:10y-SCS **

```

-----
| RESERVOIR( 0019) | 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   |   0.0130    0.0690
      0.0010    0.0150   |   0.0300    0.0770
      0.0010    0.0310   |   0.0300    0.0770
      0.0010    0.0460   |   0.0310    0.0790
      0.0060    0.0620   |   0.0310    0.0790

                        AREA   QPEAK   TPEAK   R.V.
                        (ha)   (cms)   (hrs)   (mm)
INFLOW : ID= 2 ( 0015)  1.400   0.269   6.25    53.32
OUTFLOW: ID= 1 ( 0019)  1.400   0.007  10.33    50.26

      PEAK FLOW REDUCTION [Qout/Qin](%)= 2.56
      TIME SHIFT OF PEAK FLOW           (min)=245.00
      MAXIMUM STORAGE USED              (ha.m.)= 0.0629

```

** SIMULATION:25mm Water Quality **

```

| RESERVOIR( 0019) |
| 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	0.0130	0.0690
0.0010	0.0150	0.0300	0.0770
0.0010	0.0310	0.0300	0.0770
0.0010	0.0460	0.0310	0.0790
0.0060	0.0620	0.0310	0.0790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0015)	1.400	0.080	1.33	14.66
OUTFLOW: ID= 1 (0019)	1.400	0.001	2.17	11.94

PEAK FLOW REDUCTION [Qout/Qin](%)= 1.25
 TIME SHIFT OF PEAK FLOW (min)= 50.00
 MAXIMUM STORAGE USED (ha.m.)= 0.0195

```

-----
*****
** SIMULATION:25y-C          **
*****

```

```

| RESERVOIR( 0019) |
| 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	0.0130	0.0690
0.0010	0.0150	0.0300	0.0770
0.0010	0.0310	0.0300	0.0770
0.0010	0.0460	0.0310	0.0790
0.0060	0.0620	0.0310	0.0790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0015)	1.400	0.297	1.33	43.44
OUTFLOW: ID= 1 (0019)	1.400	0.005	4.17	40.71

PEAK FLOW REDUCTION [Qout/Qin](%)= 1.60
 TIME SHIFT OF PEAK FLOW (min)=170.00
 MAXIMUM STORAGE USED (ha.m.)= 0.0580

```

-----
*****
** SIMULATION:25y-SCS      **
*****

```

```

| RESERVOIR( 0019) |
| IN= 2---> OUT= 1 |

```

OVERFLOW IS OFF

DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0130	0.0690
	0.0010	0.0150	0.0300	0.0770
	0.0010	0.0310	0.0300	0.0770
	0.0010	0.0460	0.0310	0.0790
	0.0060	0.0620	0.0310	0.0790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0015)	1.400	0.330	6.25	64.78
OUTFLOW: ID= 1 (0019)	1.400	0.015	8.33	61.64

PEAK FLOW REDUCTION [Qout/Qin](%)= 4.52
 TIME SHIFT OF PEAK FLOW (min)=125.00
 MAXIMUM STORAGE USED (ha.m.)= 0.0699

 ** SIMULATION:2yr-c **

RESERVOIR(0019)	OVERFLOW IS OFF	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
IN= 2---> OUT= 1		0.0000	0.0000	0.0130	0.0690
DT= 5.0 min		0.0010	0.0150	0.0300	0.0770
		0.0010	0.0310	0.0300	0.0770
		0.0010	0.0460	0.0310	0.0790
		0.0060	0.0620	0.0310	0.0790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0015)	1.400	0.124	1.33	19.99
OUTFLOW: ID= 1 (0019)	1.400	0.001	1.67	17.27

PEAK FLOW REDUCTION [Qout/Qin](%)= 0.80
 TIME SHIFT OF PEAK FLOW (min)= 20.00
 MAXIMUM STORAGE USED (ha.m.)= 0.0269

 ** SIMULATION:2y-SCS **

RESERVOIR(0019)	OVERFLOW IS OFF	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
IN= 2---> OUT= 1					
DT= 5.0 min					

0.0000	0.0000		0.0130	0.0690
0.0010	0.0150		0.0300	0.0770
0.0010	0.0310		0.0300	0.0770
0.0010	0.0460		0.0310	0.0790
0.0060	0.0620		0.0310	0.0790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0015)	1.400	0.150	6.25	30.80
OUTFLOW: ID= 1 (0019)	1.400	0.001	6.25	28.08

PEAK FLOW REDUCTION [Qout/Qin](%)= 0.67
 TIME SHIFT OF PEAK FLOW (min)= 0.00
 MAXIMUM STORAGE USED (ha.m.)= 0.0406

 ** SIMULATION:50y-C **

 | RESERVOIR(0019) |
 | 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		0.0130	0.0690
0.0010	0.0150		0.0300	0.0770
0.0010	0.0310		0.0300	0.0770
0.0010	0.0460		0.0310	0.0790
0.0060	0.0620		0.0310	0.0790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0015)	1.400	0.345	1.33	49.54
OUTFLOW: ID= 1 (0019)	1.400	0.009	4.08	46.82

PEAK FLOW REDUCTION [Qout/Qin](%)= 2.50
 TIME SHIFT OF PEAK FLOW (min)=165.00
 MAXIMUM STORAGE USED (ha.m.)= 0.0647

 ** SIMULATION:50y-SCS **

 | RESERVOIR(0019) |
 | 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		0.0130	0.0690
0.0010	0.0150		0.0300	0.0770

0.0010	0.0310		0.0300	0.0770
0.0010	0.0460		0.0310	0.0790
0.0060	0.0620		0.0310	0.0790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0015)	1.400	0.377	6.25	73.52
OUTFLOW: ID= 1 (0019)	1.400	0.025	7.33	70.35

PEAK FLOW REDUCTION [Qout/Qin](%)= 6.57
 TIME SHIFT OF PEAK FLOW (min)= 65.00
 MAXIMUM STORAGE USED (ha.m.)= 0.0745

 ** SIMULATION:5y-C **

RESERVOIR(0019)	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		0.0130	0.0690
	0.0010	0.0150		0.0300	0.0770
	0.0010	0.0310		0.0300	0.0770
	0.0010	0.0460		0.0310	0.0790
	0.0060	0.0620		0.0310	0.0790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0015)	1.400	0.189	1.33	29.14
OUTFLOW: ID= 1 (0019)	1.400	0.001	1.50	26.42

PEAK FLOW REDUCTION [Qout/Qin](%)= 0.53
 TIME SHIFT OF PEAK FLOW (min)= 10.00
 MAXIMUM STORAGE USED (ha.m.)= 0.0397

 ** SIMULATION:5y-SCS **

RESERVOIR(0019)	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		0.0130	0.0690
	0.0010	0.0150		0.0300	0.0770
	0.0010	0.0310		0.0300	0.0770
	0.0010	0.0460		0.0310	0.0790

0.0060 0.0620 | 0.0310 0.0790

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0015)	1.400	0.221	6.25	44.19
OUTFLOW: ID= 1 (0019)	1.400	0.004	12.25	41.40

PEAK FLOW REDUCTION [Qout/Qin](%)= 1.74
TIME SHIFT OF PEAK FLOW (min)=360.00
MAXIMUM STORAGE USED (ha.m.)= 0.0551

Post-Development Catchment 1D (Uncontrolled)

 ** SIMULATION:100y-C **

```

-----
| CHICAGO STORM | IDF curve parameters: A= 811.794
| Ptotal= 70.40 mm | B= 0.000
-----
                        C= 0.699
used in:  INTENSITY = A / (t + B)^C

Duration of storm = 4.00 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	5.92	1.00	28.01	2.00	11.70	3.00	6.82
0.17	6.61	1.17	162.35	2.17	10.34	3.17	6.42
0.33	7.55	1.33	34.38	2.33	9.30	3.33	6.08
0.50	8.89	1.50	21.68	2.50	8.49	3.50	5.77
0.67	11.01	1.67	16.53	2.67	7.83	3.67	5.50
0.83	15.06	1.83	13.62	2.83	7.28	3.83	5.26

```

-----
| CALIB |
| NASHYD ( 0017) | Area (ha)= 0.79 Curve Number (CN)= 76.7
| ID= 1 DT= 5.0 min | Ia (mm)= 7.90 # 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	5.92	1.083	28.01	2.083	11.70	3.08	6.82
0.167	5.92	1.167	28.01	2.167	11.70	3.17	6.82
0.250	6.61	1.250	162.35	2.250	10.34	3.25	6.42
0.333	6.61	1.333	162.35	2.333	10.34	3.33	6.42
0.417	7.55	1.417	34.38	2.417	9.30	3.42	6.08
0.500	7.55	1.500	34.38	2.500	9.30	3.50	6.08
0.583	8.89	1.583	21.68	2.583	8.49	3.58	5.77
0.667	8.89	1.667	21.68	2.667	8.49	3.67	5.77
0.750	11.01	1.750	16.53	2.750	7.83	3.75	5.50
0.833	11.01	1.833	16.53	2.833	7.83	3.83	5.50
0.917	15.06	1.917	13.62	2.917	7.28	3.92	5.26
1.000	15.06	2.000	13.62	3.000	7.28	4.00	5.26

Unit Hyd Qpeak (cms)= 0.177

0.083	0.00	3.167	2.94	6.250	129.40	9.33	3.43
0.167	0.00	3.250	2.94	6.333	17.65	9.42	3.43
0.250	0.00	3.333	3.92	6.417	17.65	9.50	3.43
0.333	2.45	3.417	3.92	6.500	17.65	9.58	3.43
0.417	2.45	3.500	3.92	6.583	17.65	9.67	3.43
0.500	2.45	3.583	3.92	6.667	17.65	9.75	3.43
0.583	2.45	3.667	3.92	6.750	17.65	9.83	3.43
0.667	2.45	3.750	3.92	6.833	7.84	9.92	3.43
0.750	2.45	3.833	3.92	6.917	7.84	10.00	3.43
0.833	2.45	3.917	3.92	7.000	7.84	10.08	3.43
0.917	2.45	4.000	3.92	7.083	7.84	10.17	3.43
1.000	2.45	4.083	3.92	7.167	7.84	10.25	3.43
1.083	2.45	4.167	3.92	7.250	7.84	10.33	1.96
1.167	2.45	4.250	3.92	7.333	5.88	10.42	1.96
1.250	2.45	4.333	5.88	7.417	5.88	10.50	1.96
1.333	2.45	4.417	5.88	7.500	5.88	10.58	1.96
1.417	2.45	4.500	5.88	7.583	5.88	10.67	1.96
1.500	2.45	4.583	5.88	7.667	5.88	10.75	1.96
1.583	2.45	4.667	5.88	7.750	5.88	10.83	1.96
1.667	2.45	4.750	5.88	7.833	5.88	10.92	1.96
1.750	2.45	4.833	7.84	7.917	5.88	11.00	1.96
1.833	2.45	4.917	7.84	8.000	5.88	11.08	1.96
1.917	2.45	5.000	7.84	8.083	5.88	11.17	1.96
2.000	2.45	5.083	7.84	8.167	5.88	11.25	1.96
2.083	2.45	5.167	7.84	8.250	5.88	11.33	1.96
2.167	2.45	5.250	7.84	8.333	3.43	11.42	1.96
2.250	2.45	5.333	11.76	8.417	3.43	11.50	1.96
2.333	2.94	5.417	11.76	8.500	3.43	11.58	1.96
2.417	2.94	5.500	11.76	8.583	3.43	11.67	1.96
2.500	2.94	5.583	11.76	8.667	3.43	11.75	1.96
2.583	2.94	5.667	11.76	8.750	3.43	11.83	1.96
2.667	2.94	5.750	11.76	8.833	3.43	11.92	1.96
2.750	2.94	5.833	47.05	8.917	3.43	12.00	1.96
2.833	2.94	5.917	47.05	9.000	3.43	12.08	1.96
2.917	2.94	6.000	47.06	9.083	3.43	12.17	1.96
3.000	2.94	6.083	129.40	9.167	3.43	12.25	1.96
3.083	2.94	6.167	129.40	9.250	3.43		

Unit Hyd Qpeak (cms)= 0.177

PEAK FLOW (cms)= 0.123 (i)

TIME TO PEAK (hrs)= 6.250

RUNOFF VOLUME (mm)= 48.385

TOTAL RAINFALL (mm)= 98.030

RUNOFF COEFFICIENT = 0.494

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

** SIMULATION:10y-C **

 | CHICAGO STORM |
Ptotal= 48.86 mm

IDF curve parameters: A= 563.357
 B= 0.000
 C= 0.699
 used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 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	4.11	1.00	19.44	2.00	8.12	3.00	4.73
0.17	4.59	1.17	112.66	2.17	7.17	3.17	4.46
0.33	5.24	1.33	23.86	2.33	6.46	3.33	4.22
0.50	6.17	1.50	15.04	2.50	5.89	3.50	4.01
0.67	7.64	1.67	11.47	2.67	5.43	3.67	3.82
0.83	10.45	1.83	9.45	2.83	5.05	3.83	3.65

 | CALIB |
 | NASHYD (0017) |
ID= 1 DT= 5.0 min

Area (ha)= 0.79 Curve Number (CN)= 76.7
 Ia (mm)= 7.90 # 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	4.11	1.083	19.44	2.083	8.12	3.08	4.73
0.167	4.11	1.167	19.44	2.167	8.12	3.17	4.73
0.250	4.59	1.250	112.66	2.250	7.17	3.25	4.46
0.333	4.59	1.333	112.66	2.333	7.17	3.33	4.46
0.417	5.24	1.417	23.86	2.417	6.46	3.42	4.22
0.500	5.24	1.500	23.86	2.500	6.46	3.50	4.22
0.583	6.17	1.583	15.04	2.583	5.89	3.58	4.01
0.667	6.17	1.667	15.04	2.667	5.89	3.67	4.01
0.750	7.64	1.750	11.47	2.750	5.43	3.75	3.82
0.833	7.64	1.833	11.47	2.833	5.43	3.83	3.82
0.917	10.45	1.917	9.45	2.917	5.05	3.92	3.65
1.000	10.45	2.000	9.45	3.000	5.05	4.00	3.65

Unit Hyd Qpeak (cms)= 0.177

PEAK FLOW (cms)= 0.032 (i)
 TIME TO PEAK (hrs)= 1.417
 RUNOFF VOLUME (mm)= 14.150
 TOTAL RAINFALL (mm)= 48.856
 RUNOFF COEFFICIENT = 0.290

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

 ** SIMULATION:10y-SCS **

READ STORM Ptotal= 68.03 mm	Filename: C:\Users\nsproule\AppData Local\Temp\ 3b95b129-2886-4b23-8141-d26b7162f4fb\c015fecc Comments: 10yr 12hr 15min SCS
--------------------------------	--

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	3.25	2.72	6.50	12.25	9.75	2.38
0.25	1.70	3.50	2.72	6.75	5.44	10.00	2.38
0.50	1.70	3.75	2.72	7.00	5.44	10.25	1.36
0.75	1.70	4.00	2.72	7.25	4.08	10.50	1.36
1.00	1.70	4.25	4.08	7.50	4.08	10.75	1.36
1.25	1.70	4.50	4.08	7.75	4.08	11.00	1.36
1.50	1.70	4.75	5.44	8.00	4.08	11.25	1.36
1.75	1.70	5.00	5.44	8.25	2.38	11.50	1.36
2.00	1.70	5.25	8.16	8.50	2.38	11.75	1.36
2.25	2.04	5.50	8.16	8.75	2.38	12.00	1.36
2.50	2.04	5.75	32.65	9.00	2.38		
2.75	2.04	6.00	89.80	9.25	2.38		
3.00	2.04	6.25	12.25	9.50	2.38		

CALIB NASHYD (0017) ID= 1 DT= 5.0 min	Area (ha)= 0.79 Ia (mm)= 7.90 U.H. Tp(hrs)= 0.17	Curve Number (CN)= 76.7 # of Linear Res.(N)= 3.00
--	--	--

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

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

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	0.00	3.167	2.04	6.250	89.80	9.33	2.38

0.167	0.00	3.250	2.04	6.333	12.25	9.42	2.38
0.250	0.00	3.333	2.72	6.417	12.25	9.50	2.38
0.333	1.70	3.417	2.72	6.500	12.25	9.58	2.38
0.417	1.70	3.500	2.72	6.583	12.25	9.67	2.38
0.500	1.70	3.583	2.72	6.667	12.25	9.75	2.38
0.583	1.70	3.667	2.72	6.750	12.25	9.83	2.38
0.667	1.70	3.750	2.72	6.833	5.44	9.92	2.38
0.750	1.70	3.833	2.72	6.917	5.44	10.00	2.38
0.833	1.70	3.917	2.72	7.000	5.44	10.08	2.38
0.917	1.70	4.000	2.72	7.083	5.44	10.17	2.38
1.000	1.70	4.083	2.72	7.167	5.44	10.25	2.38
1.083	1.70	4.167	2.72	7.250	5.44	10.33	1.36
1.167	1.70	4.250	2.72	7.333	4.08	10.42	1.36
1.250	1.70	4.333	4.08	7.417	4.08	10.50	1.36
1.333	1.70	4.417	4.08	7.500	4.08	10.58	1.36
1.417	1.70	4.500	4.08	7.583	4.08	10.67	1.36
1.500	1.70	4.583	4.08	7.667	4.08	10.75	1.36
1.583	1.70	4.667	4.08	7.750	4.08	10.83	1.36
1.667	1.70	4.750	4.08	7.833	4.08	10.92	1.36
1.750	1.70	4.833	5.44	7.917	4.08	11.00	1.36
1.833	1.70	4.917	5.44	8.000	4.08	11.08	1.36
1.917	1.70	5.000	5.44	8.083	4.08	11.17	1.36
2.000	1.70	5.083	5.44	8.167	4.08	11.25	1.36
2.083	1.70	5.167	5.44	8.250	4.08	11.33	1.36
2.167	1.70	5.250	5.44	8.333	2.38	11.42	1.36
2.250	1.70	5.333	8.16	8.417	2.38	11.50	1.36
2.333	2.04	5.417	8.16	8.500	2.38	11.58	1.36
2.417	2.04	5.500	8.16	8.583	2.38	11.67	1.36
2.500	2.04	5.583	8.16	8.667	2.38	11.75	1.36
2.583	2.04	5.667	8.16	8.750	2.38	11.83	1.36
2.667	2.04	5.750	8.16	8.833	2.38	11.92	1.36
2.750	2.04	5.833	32.65	8.917	2.38	12.00	1.36
2.833	2.04	5.917	32.65	9.000	2.38	12.08	1.36
2.917	2.04	6.000	32.66	9.083	2.38	12.17	1.36
3.000	2.04	6.083	89.80	9.167	2.38	12.25	1.36
3.083	2.04	6.167	89.80	9.250	2.38		

Unit Hyd Qpeak (cms)= 0.177

PEAK FLOW (cms)= 0.066 (i)

TIME TO PEAK (hrs)= 6.333

RUNOFF VOLUME (mm)= 26.241

TOTAL RAINFALL (mm)= 68.030

RUNOFF COEFFICIENT = 0.386

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

** SIMULATION:25mm Water Quality **

| READ STORM |
Ptotal= 24.99 mm

Filename: C:\Users\nsproule\AppData\Local\Temp\3b95b129-2886-4b23-8141-d26b7162f4fb\8d1f0d74
Comments: 25mm

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	1.36	1.00	6.91	2.00	4.18	3.00	1.86
0.08	1.45	1.08	11.02	2.08	3.77	3.08	1.78
0.17	1.55	1.17	26.16	2.17	3.43	3.17	1.71
0.25	1.67	1.25	76.07	2.25	3.16	3.25	1.64
0.33	1.81	1.33	33.71	2.33	2.92	3.33	1.58
0.42	1.99	1.42	18.64	2.42	2.72	3.42	1.52
0.50	2.20	1.50	12.61	2.50	2.55	3.50	1.47
0.58	2.47	1.58	9.46	2.58	2.39	3.58	1.43
0.67	2.82	1.67	7.55	2.67	2.26	3.67	1.38
0.75	3.29	1.75	6.28	2.75	2.14	3.75	1.34
0.83	3.97	1.83	5.38	2.83	2.04	3.83	1.30
0.92	5.03	1.92	4.70	2.92	1.94	3.92	1.26

| CALIB |
| NASHYD (0017) |
ID= 1 DT= 5.0 min

Area (ha)= 0.79 Curve Number (CN)= 76.7
Ia (mm)= 7.90 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.17

Unit Hyd Qpeak (cms)= 0.177

PEAK FLOW (cms)= 0.006 (i)
TIME TO PEAK (hrs)= 1.583
RUNOFF VOLUME (mm)= 3.087
TOTAL RAINFALL (mm)= 24.991
RUNOFF COEFFICIENT = 0.124

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

** SIMULATION:25y-C **

| CHICAGO STORM |
Ptotal= 57.50 mm

IDF curve parameters: A= 663.082
B= 0.000
C= 0.699
used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 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	4.83	1.00	22.88	2.00	9.56	3.00	5.57
0.17	5.40	1.17	132.61	2.17	8.44	3.17	5.25
0.33	6.17	1.33	28.08	2.33	7.60	3.33	4.96
0.50	7.26	1.50	17.71	2.50	6.93	3.50	4.72
0.67	8.99	1.67	13.50	2.67	6.40	3.67	4.50
0.83	12.30	1.83	11.12	2.83	5.95	3.83	4.30

 | CALIB |
 | NASHYD (0017) | Area (ha)= 0.79 Curve Number (CN)= 76.7
 | ID= 1 DT= 5.0 min | Ia (mm)= 7.90 # 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	4.83	1.083	22.88	2.083	9.56	3.08	5.57
0.167	4.83	1.167	22.88	2.167	9.56	3.17	5.57
0.250	5.40	1.250	132.61	2.250	8.44	3.25	5.25
0.333	5.40	1.333	132.61	2.333	8.44	3.33	5.25
0.417	6.17	1.417	28.08	2.417	7.60	3.42	4.96
0.500	6.17	1.500	28.08	2.500	7.60	3.50	4.96
0.583	7.26	1.583	17.71	2.583	6.93	3.58	4.72
0.667	7.26	1.667	17.71	2.667	6.93	3.67	4.72
0.750	8.99	1.750	13.50	2.750	6.40	3.75	4.50
0.833	8.99	1.833	13.50	2.833	6.40	3.83	4.50
0.917	12.30	1.917	11.12	2.917	5.95	3.92	4.30
1.000	12.30	2.000	11.12	3.000	5.95	4.00	4.30

Unit Hyd Qpeak (cms)= 0.177

PEAK FLOW (cms)= 0.046 (i)

TIME TO PEAK (hrs)= 1.417

RUNOFF VOLUME (mm)= 19.341

TOTAL RAINFALL (mm)= 57.504

RUNOFF COEFFICIENT = 0.336

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

 ** SIMULATION:25y-SCS **

 | READ STORM | Filename: C:\Users\nsproule\AppData
 | | ata\Local\Temp\
 | | 3b95b129-2886-4b23-8141-d26b7162f4fb\c2103e42
 | Ptotal= 80.07 mm | Comments: 25yr 12hr 15min SCS

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	3.25	3.20	6.50	14.41	9.75	2.80
0.25	2.00	3.50	3.20	6.75	6.41	10.00	2.80
0.50	2.00	3.75	3.20	7.00	6.41	10.25	1.60
0.75	2.00	4.00	3.20	7.25	4.80	10.50	1.60
1.00	2.00	4.25	4.80	7.50	4.80	10.75	1.60
1.25	2.00	4.50	4.80	7.75	4.80	11.00	1.60
1.50	2.00	4.75	6.41	8.00	4.80	11.25	1.60
1.75	2.00	5.00	6.41	8.25	2.80	11.50	1.60
2.00	2.00	5.25	9.61	8.50	2.80	11.75	1.60
2.25	2.40	5.50	9.61	8.75	2.80	12.00	1.60
2.50	2.40	5.75	38.43	9.00	2.80		
2.75	2.40	6.00	105.69	9.25	2.80		
3.00	2.40	6.25	14.41	9.50	2.80		

 | CALIB |
 | NASHYD (0017) | Area (ha)= 0.79 Curve Number (CN)= 76.7
 | ID= 1 DT= 5.0 min | Ia (mm)= 7.90 # 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	0.00	3.167	2.40	6.250	105.69	9.33	2.80
0.167	0.00	3.250	2.40	6.333	14.41	9.42	2.80
0.250	0.00	3.333	3.20	6.417	14.41	9.50	2.80
0.333	2.00	3.417	3.20	6.500	14.41	9.58	2.80
0.417	2.00	3.500	3.20	6.583	14.41	9.67	2.80
0.500	2.00	3.583	3.20	6.667	14.41	9.75	2.80
0.583	2.00	3.667	3.20	6.750	14.41	9.83	2.80
0.667	2.00	3.750	3.20	6.833	6.41	9.92	2.80

0.750	2.00	3.833	3.20	6.917	6.41	10.00	2.80
0.833	2.00	3.917	3.20	7.000	6.41	10.08	2.80
0.917	2.00	4.000	3.20	7.083	6.41	10.17	2.80
1.000	2.00	4.083	3.20	7.167	6.41	10.25	2.80
1.083	2.00	4.167	3.20	7.250	6.41	10.33	1.60
1.167	2.00	4.250	3.20	7.333	4.80	10.42	1.60
1.250	2.00	4.333	4.80	7.417	4.80	10.50	1.60
1.333	2.00	4.417	4.80	7.500	4.80	10.58	1.60
1.417	2.00	4.500	4.80	7.583	4.80	10.67	1.60
1.500	2.00	4.583	4.80	7.667	4.80	10.75	1.60
1.583	2.00	4.667	4.80	7.750	4.80	10.83	1.60
1.667	2.00	4.750	4.80	7.833	4.80	10.92	1.60
1.750	2.00	4.833	6.41	7.917	4.80	11.00	1.60
1.833	2.00	4.917	6.41	8.000	4.80	11.08	1.60
1.917	2.00	5.000	6.41	8.083	4.80	11.17	1.60
2.000	2.00	5.083	6.41	8.167	4.80	11.25	1.60
2.083	2.00	5.167	6.41	8.250	4.80	11.33	1.60
2.167	2.00	5.250	6.41	8.333	2.80	11.42	1.60
2.250	2.00	5.333	9.61	8.417	2.80	11.50	1.60
2.333	2.40	5.417	9.61	8.500	2.80	11.58	1.60
2.417	2.40	5.500	9.61	8.583	2.80	11.67	1.60
2.500	2.40	5.583	9.61	8.667	2.80	11.75	1.60
2.583	2.40	5.667	9.61	8.750	2.80	11.83	1.60
2.667	2.40	5.750	9.61	8.833	2.80	11.92	1.60
2.750	2.40	5.833	38.43	8.917	2.80	12.00	1.60
2.833	2.40	5.917	38.43	9.000	2.80	12.08	1.60
2.917	2.40	6.000	38.44	9.083	2.80	12.17	1.60
3.000	2.40	6.083	105.69	9.167	2.80	12.25	1.60
3.083	2.40	6.167	105.69	9.250	2.80		

Unit Hyd Qpeak (cms)= 0.177

PEAK FLOW (cms)= 0.088 (i)

TIME TO PEAK (hrs)= 6.250

RUNOFF VOLUME (mm)= 34.754

TOTAL RAINFALL (mm)= 80.070

RUNOFF COEFFICIENT = 0.434

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

 ** SIMULATION:2yr-c **

 | CHICAGO STORM |
Ptotal= 31.41 mm

IDF curve parameters: A= 362.158
 B= 0.000
 C= 0.699

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 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	2.64	1.00	12.50	2.00	5.22	3.00	3.04
0.17	2.95	1.17	72.43	2.17	4.61	3.17	2.87
0.33	3.37	1.33	15.34	2.33	4.15	3.33	2.71
0.50	3.96	1.50	9.67	2.50	3.79	3.50	2.58
0.67	4.91	1.67	7.37	2.67	3.49	3.67	2.46
0.83	6.72	1.83	6.07	2.83	3.25	3.83	2.35

 | CALIB |
 | NASHYD (0017) |
ID= 1 DT= 5.0 min

Area (ha)= 0.79 Curve Number (CN)= 76.7
 Ia (mm)= 7.90 # 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	2.64	1.083	12.50	2.083	5.22	3.08	3.04
0.167	2.64	1.167	12.50	2.167	5.22	3.17	3.04
0.250	2.95	1.250	72.43	2.250	4.61	3.25	2.87
0.333	2.95	1.333	72.43	2.333	4.61	3.33	2.87
0.417	3.37	1.417	15.34	2.417	4.15	3.42	2.71
0.500	3.37	1.500	15.34	2.500	4.15	3.50	2.71
0.583	3.96	1.583	9.67	2.583	3.79	3.58	2.58
0.667	3.96	1.667	9.67	2.667	3.79	3.67	2.58
0.750	4.91	1.750	7.37	2.750	3.49	3.75	2.46
0.833	4.91	1.833	7.37	2.833	3.49	3.83	2.46
0.917	6.72	1.917	6.07	2.917	3.25	3.92	2.35
1.000	6.72	2.000	6.07	3.000	3.25	4.00	2.35

Unit Hyd Qpeak (cms)= 0.177

PEAK FLOW (cms)= 0.010 (i)

TIME TO PEAK (hrs)= 1.500

RUNOFF VOLUME (mm)= 5.469

TOTAL RAINFALL (mm)= 31.407

RUNOFF COEFFICIENT = 0.174

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

 ** SIMULATION: 2y-SCS **

 | READ STORM |
Ptotal= 43.73 mm

Filename: C:\Users\nsproule\AppData\Local\Temp\3b95b129-2886-4b23-8141-d26b7162f4fb\b6481ba7
 Comments: 2yr 12hr 15min SCS

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	3.25	1.75	6.50	7.87	9.75	1.53
0.25	1.09	3.50	1.75	6.75	3.50	10.00	1.53
0.50	1.09	3.75	1.75	7.00	3.50	10.25	0.87
0.75	1.09	4.00	1.75	7.25	2.62	10.50	0.87
1.00	1.09	4.25	2.62	7.50	2.62	10.75	0.87
1.25	1.09	4.50	2.62	7.75	2.62	11.00	0.87
1.50	1.09	4.75	3.50	8.00	2.62	11.25	0.87
1.75	1.09	5.00	3.50	8.25	1.53	11.50	0.87
2.00	1.09	5.25	5.25	8.50	1.53	11.75	0.87
2.25	1.31	5.50	5.25	8.75	1.53	12.00	0.87
2.50	1.31	5.75	20.99	9.00	1.53		
2.75	1.31	6.00	57.72	9.25	1.53		
3.00	1.31	6.25	7.87	9.50	1.53		

 | CALIB |
 | NASHYD (0017) |
ID= 1 DT= 5.0 min

Area (ha)= 0.79 Curve Number (CN)= 76.7
 Ia (mm)= 7.90 # 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	0.00	3.167	1.31	6.250	57.72	9.33	1.53
0.167	0.00	3.250	1.31	6.333	7.87	9.42	1.53
0.250	0.00	3.333	1.75	6.417	7.87	9.50	1.53
0.333	1.09	3.417	1.75	6.500	7.87	9.58	1.53
0.417	1.09	3.500	1.75	6.583	7.87	9.67	1.53
0.500	1.09	3.583	1.75	6.667	7.87	9.75	1.53
0.583	1.09	3.667	1.75	6.750	7.87	9.83	1.53
0.667	1.09	3.750	1.75	6.833	3.50	9.92	1.53
0.750	1.09	3.833	1.75	6.917	3.50	10.00	1.53

0.833	1.09	3.917	1.75	7.000	3.50	10.08	1.53
0.917	1.09	4.000	1.75	7.083	3.50	10.17	1.53
1.000	1.09	4.083	1.75	7.167	3.50	10.25	1.53
1.083	1.09	4.167	1.75	7.250	3.50	10.33	0.87
1.167	1.09	4.250	1.75	7.333	2.62	10.42	0.87
1.250	1.09	4.333	2.62	7.417	2.62	10.50	0.87
1.333	1.09	4.417	2.62	7.500	2.62	10.58	0.87
1.417	1.09	4.500	2.62	7.583	2.62	10.67	0.87
1.500	1.09	4.583	2.62	7.667	2.62	10.75	0.87
1.583	1.09	4.667	2.62	7.750	2.62	10.83	0.87
1.667	1.09	4.750	2.62	7.833	2.62	10.92	0.87
1.750	1.09	4.833	3.50	7.917	2.62	11.00	0.87
1.833	1.09	4.917	3.50	8.000	2.62	11.08	0.87
1.917	1.09	5.000	3.50	8.083	2.62	11.17	0.87
2.000	1.09	5.083	3.50	8.167	2.62	11.25	0.87
2.083	1.09	5.167	3.50	8.250	2.62	11.33	0.87
2.167	1.09	5.250	3.50	8.333	1.53	11.42	0.87
2.250	1.09	5.333	5.25	8.417	1.53	11.50	0.87
2.333	1.31	5.417	5.25	8.500	1.53	11.58	0.87
2.417	1.31	5.500	5.25	8.583	1.53	11.67	0.87
2.500	1.31	5.583	5.25	8.667	1.53	11.75	0.87
2.583	1.31	5.667	5.25	8.750	1.53	11.83	0.87
2.667	1.31	5.750	5.25	8.833	1.53	11.92	0.87
2.750	1.31	5.833	20.99	8.917	1.53	12.00	0.87
2.833	1.31	5.917	20.99	9.000	1.53	12.08	0.87
2.917	1.31	6.000	20.99	9.083	1.53	12.17	0.87
3.000	1.31	6.083	57.72	9.167	1.53	12.25	0.87
3.083	1.31	6.167	57.72	9.250	1.53		

Unit Hyd Qpeak (cms)= 0.177

PEAK FLOW (cms)= 0.028 (i)
 TIME TO PEAK (hrs)= 6.333
 RUNOFF VOLUME (mm)= 11.321
 TOTAL RAINFALL (mm)= 43.730
 RUNOFF COEFFICIENT = 0.259

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

 ** SIMULATION:50y-C **

 | CHICAGO STORM |
Ptotal= 64.03 mm

IDF curve parameters: A= 738.312
 B= 0.000
 C= 0.699

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 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	5.38	1.00	25.48	2.00	10.64	3.00	6.20
0.17	6.02	1.17	147.65	2.17	9.40	3.17	5.84
0.33	6.87	1.33	31.27	2.33	8.46	3.33	5.53
0.50	8.08	1.50	19.71	2.50	7.72	3.50	5.25
0.67	10.01	1.67	15.03	2.67	7.12	3.67	5.01
0.83	13.70	1.83	12.38	2.83	6.62	3.83	4.79

CALIB			
NASHYD (0017)	Area (ha)=	0.79	Curve Number (CN)= 76.7
ID= 1 DT= 5.0 min	Ia (mm)=	7.90	# 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	5.38	1.083	25.48	2.083	10.64	3.08	6.20
0.167	5.38	1.167	25.48	2.167	10.64	3.17	6.20
0.250	6.02	1.250	147.65	2.250	9.40	3.25	5.84
0.333	6.02	1.333	147.65	2.333	9.40	3.33	5.84
0.417	6.87	1.417	31.27	2.417	8.46	3.42	5.53
0.500	6.87	1.500	31.27	2.500	8.46	3.50	5.53
0.583	8.08	1.583	19.71	2.583	7.72	3.58	5.25
0.667	8.08	1.667	19.71	2.667	7.72	3.67	5.25
0.750	10.01	1.750	15.03	2.750	7.12	3.75	5.01
0.833	10.01	1.833	15.03	2.833	7.12	3.83	5.01
0.917	13.70	1.917	12.38	2.917	6.62	3.92	4.79
1.000	13.70	2.000	12.38	3.000	6.62	4.00	4.79

Unit Hyd Qpeak (cms)= 0.177

PEAK FLOW (cms)= 0.058 (i)
 TIME TO PEAK (hrs)= 1.417
 RUNOFF VOLUME (mm)= 23.551
 TOTAL RAINFALL (mm)= 64.028
 RUNOFF COEFFICIENT = 0.368

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

 ** SIMULATION:50y-SCS **

```

-----
|   READ STORM   |      Filename: C:\Users\nsproule\AppData
|                 |      ata\Local\Temp\
|                 |      3b95b129-2886-4b23-8141-d26b7162f4fb\073b614d
| Ptotal= 89.16 mm |      Comments: 50yr 12hr 15min SCS
-----
  
```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	3.25	3.57	6.50	16.05	9.75	3.12
0.25	2.23	3.50	3.57	6.75	7.13	10.00	3.12
0.50	2.23	3.75	3.57	7.00	7.13	10.25	1.78
0.75	2.23	4.00	3.57	7.25	5.35	10.50	1.78
1.00	2.23	4.25	5.35	7.50	5.35	10.75	1.78
1.25	2.23	4.50	5.35	7.75	5.35	11.00	1.78
1.50	2.23	4.75	7.13	8.00	5.35	11.25	1.78
1.75	2.23	5.00	7.13	8.25	3.12	11.50	1.78
2.00	2.23	5.25	10.70	8.50	3.12	11.75	1.78
2.25	2.67	5.50	10.70	8.75	3.12	12.00	1.78
2.50	2.67	5.75	42.80	9.00	3.12		
2.75	2.67	6.00	117.69	9.25	3.12		
3.00	2.67	6.25	16.05	9.50	3.12		

```

-----
| CALIB          |
| NASHYD ( 0017) | Area (ha)= 0.79 Curve Number (CN)= 76.7
| ID= 1 DT= 5.0 min | Ia (mm)= 7.90 # 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	0.00	3.167	2.67	6.250	117.69	9.33	3.12
0.167	0.00	3.250	2.67	6.333	16.05	9.42	3.12
0.250	0.00	3.333	3.57	6.417	16.05	9.50	3.12
0.333	2.23	3.417	3.57	6.500	16.05	9.58	3.12
0.417	2.23	3.500	3.57	6.583	16.05	9.67	3.12
0.500	2.23	3.583	3.57	6.667	16.05	9.75	3.12
0.583	2.23	3.667	3.57	6.750	16.05	9.83	3.12
0.667	2.23	3.750	3.57	6.833	7.13	9.92	3.12
0.750	2.23	3.833	3.57	6.917	7.13	10.00	3.12
0.833	2.23	3.917	3.57	7.000	7.13	10.08	3.12

0.917	2.23	4.000	3.57	7.083	7.13	10.17	3.12
1.000	2.23	4.083	3.57	7.167	7.13	10.25	3.12
1.083	2.23	4.167	3.57	7.250	7.13	10.33	1.78
1.167	2.23	4.250	3.57	7.333	5.35	10.42	1.78
1.250	2.23	4.333	5.35	7.417	5.35	10.50	1.78
1.333	2.23	4.417	5.35	7.500	5.35	10.58	1.78
1.417	2.23	4.500	5.35	7.583	5.35	10.67	1.78
1.500	2.23	4.583	5.35	7.667	5.35	10.75	1.78
1.583	2.23	4.667	5.35	7.750	5.35	10.83	1.78
1.667	2.23	4.750	5.35	7.833	5.35	10.92	1.78
1.750	2.23	4.833	7.13	7.917	5.35	11.00	1.78
1.833	2.23	4.917	7.13	8.000	5.35	11.08	1.78
1.917	2.23	5.000	7.13	8.083	5.35	11.17	1.78
2.000	2.23	5.083	7.13	8.167	5.35	11.25	1.78
2.083	2.23	5.167	7.13	8.250	5.35	11.33	1.78
2.167	2.23	5.250	7.13	8.333	3.12	11.42	1.78
2.250	2.23	5.333	10.70	8.417	3.12	11.50	1.78
2.333	2.67	5.417	10.70	8.500	3.12	11.58	1.78
2.417	2.67	5.500	10.70	8.583	3.12	11.67	1.78
2.500	2.67	5.583	10.70	8.667	3.12	11.75	1.78
2.583	2.67	5.667	10.70	8.750	3.12	11.83	1.78
2.667	2.67	5.750	10.70	8.833	3.12	11.92	1.78
2.750	2.67	5.833	42.80	8.917	3.12	12.00	1.78
2.833	2.67	5.917	42.80	9.000	3.12	12.08	1.78
2.917	2.67	6.000	42.80	9.083	3.12	12.17	1.78
3.000	2.67	6.083	117.69	9.167	3.12	12.25	1.78
3.083	2.67	6.167	117.69	9.250	3.12		

Unit Hyd Qpeak (cms)= 0.177

PEAK FLOW (cms)= 0.106 (i)

TIME TO PEAK (hrs)= 6.250

RUNOFF VOLUME (mm)= 41.532

TOTAL RAINFALL (mm)= 89.160

RUNOFF COEFFICIENT = 0.466

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

 ** SIMULATION:5y-C **

 | CHICAGO STORM |
Ptotal= 41.88 mm

IDF curve parameters: A= 482.877
 B= 0.000
 C= 0.699

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 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	3.52	1.00	16.66	2.00	6.96	3.00	4.06
0.17	3.93	1.17	96.57	2.17	6.15	3.17	3.82
0.33	4.49	1.33	20.45	2.33	5.53	3.33	3.61
0.50	5.29	1.50	12.89	2.50	5.05	3.50	3.43
0.67	6.55	1.67	9.83	2.67	4.66	3.67	3.27
0.83	8.96	1.83	8.10	2.83	4.33	3.83	3.13

```

-----
| CALIB |
| NASHYD ( 0017) | Area (ha)= 0.79 Curve Number (CN)= 76.7
| ID= 1 DT= 5.0 min | Ia (mm)= 7.90 # 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	3.52	1.083	16.66	2.083	6.96	3.08	4.06
0.167	3.52	1.167	16.66	2.167	6.96	3.17	4.06
0.250	3.93	1.250	96.57	2.250	6.15	3.25	3.82
0.333	3.93	1.333	96.57	2.333	6.15	3.33	3.82
0.417	4.49	1.417	20.45	2.417	5.53	3.42	3.61
0.500	4.49	1.500	20.45	2.500	5.53	3.50	3.61
0.583	5.29	1.583	12.89	2.583	5.05	3.58	3.43
0.667	5.29	1.667	12.89	2.667	5.05	3.67	3.43
0.750	6.55	1.750	9.83	2.750	4.66	3.75	3.27
0.833	6.55	1.833	9.83	2.833	4.66	3.83	3.27
0.917	8.96	1.917	8.10	2.917	4.33	3.92	3.13
1.000	8.96	2.000	8.10	3.000	4.33	4.00	3.13

Unit Hyd Qpeak (cms)= 0.177

PEAK FLOW (cms)= 0.022 (i)

TIME TO PEAK (hrs)= 1.500

RUNOFF VOLUME (mm)= 10.350

TOTAL RAINFALL (mm)= 41.876

RUNOFF COEFFICIENT = 0.247

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

** SIMULATION:5y-SCS **

```

-----
|   READ STORM   |      Filename: C:\Users\nsproule\AppData
|                 |      ata\Local\Temp\
|                 |      3b95b129-2886-4b23-8141-d26b7162f4fb\08d4e07d
| Ptotal= 58.31 mm |      Comments: 5yr 12hr 15min SCS
-----
  
```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	0.00	3.25	2.33	6.50	10.50	9.75	2.04
0.25	1.46	3.50	2.33	6.75	4.66	10.00	2.04
0.50	1.46	3.75	2.33	7.00	4.66	10.25	1.17
0.75	1.46	4.00	2.33	7.25	3.50	10.50	1.17
1.00	1.46	4.25	3.50	7.50	3.50	10.75	1.17
1.25	1.46	4.50	3.50	7.75	3.50	11.00	1.17
1.50	1.46	4.75	4.66	8.00	3.50	11.25	1.17
1.75	1.46	5.00	4.66	8.25	2.04	11.50	1.17
2.00	1.46	5.25	7.00	8.50	2.04	11.75	1.17
2.25	1.75	5.50	7.00	8.75	2.04	12.00	1.17
2.50	1.75	5.75	27.99	9.00	2.04		
2.75	1.75	6.00	76.97	9.25	2.04		
3.00	1.75	6.25	10.50	9.50	2.04		

```

-----
| CALIB          |
| NASHYD ( 0017) |      Area (ha)= 0.79      Curve Number (CN)= 76.7
| ID= 1 DT= 5.0 min |      Ia (mm)= 7.90      # 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	0.00	3.167	1.75	6.250	76.97	9.33	2.04
0.167	0.00	3.250	1.75	6.333	10.50	9.42	2.04
0.250	0.00	3.333	2.33	6.417	10.50	9.50	2.04
0.333	1.46	3.417	2.33	6.500	10.50	9.58	2.04
0.417	1.46	3.500	2.33	6.583	10.50	9.67	2.04
0.500	1.46	3.583	2.33	6.667	10.50	9.75	2.04
0.583	1.46	3.667	2.33	6.750	10.50	9.83	2.04
0.667	1.46	3.750	2.33	6.833	4.66	9.92	2.04
0.750	1.46	3.833	2.33	6.917	4.66	10.00	2.04
0.833	1.46	3.917	2.33	7.000	4.66	10.08	2.04
0.917	1.46	4.000	2.33	7.083	4.66	10.17	2.04

1.000	1.46	4.083	2.33	7.167	4.66	10.25	2.04
1.083	1.46	4.167	2.33	7.250	4.66	10.33	1.17
1.167	1.46	4.250	2.33	7.333	3.50	10.42	1.17
1.250	1.46	4.333	3.50	7.417	3.50	10.50	1.17
1.333	1.46	4.417	3.50	7.500	3.50	10.58	1.17
1.417	1.46	4.500	3.50	7.583	3.50	10.67	1.17
1.500	1.46	4.583	3.50	7.667	3.50	10.75	1.17
1.583	1.46	4.667	3.50	7.750	3.50	10.83	1.17
1.667	1.46	4.750	3.50	7.833	3.50	10.92	1.17
1.750	1.46	4.833	4.66	7.917	3.50	11.00	1.17
1.833	1.46	4.917	4.66	8.000	3.50	11.08	1.17
1.917	1.46	5.000	4.66	8.083	3.50	11.17	1.17
2.000	1.46	5.083	4.66	8.167	3.50	11.25	1.17
2.083	1.46	5.167	4.66	8.250	3.50	11.33	1.17
2.167	1.46	5.250	4.66	8.333	2.04	11.42	1.17
2.250	1.46	5.333	7.00	8.417	2.04	11.50	1.17
2.333	1.75	5.417	7.00	8.500	2.04	11.58	1.17
2.417	1.75	5.500	7.00	8.583	2.04	11.67	1.17
2.500	1.75	5.583	7.00	8.667	2.04	11.75	1.17
2.583	1.75	5.667	7.00	8.750	2.04	11.83	1.17
2.667	1.75	5.750	7.00	8.833	2.04	11.92	1.17
2.750	1.75	5.833	27.99	8.917	2.04	12.00	1.17
2.833	1.75	5.917	27.99	9.000	2.04	12.08	1.17
2.917	1.75	6.000	27.99	9.083	2.04	12.17	1.17
3.000	1.75	6.083	76.97	9.167	2.04	12.25	1.17
3.083	1.75	6.167	76.97	9.250	2.04		

Unit Hyd Qpeak (cms)= 0.177

PEAK FLOW (cms)= 0.050 (i)

TIME TO PEAK (hrs)= 6.333

RUNOFF VOLUME (mm)= 19.848

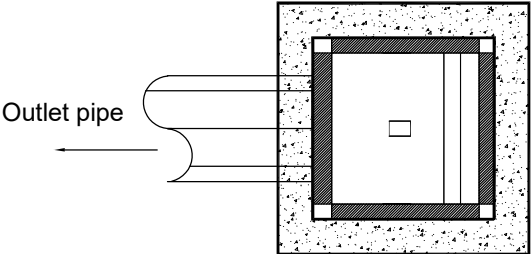
TOTAL RAINFALL (mm)= 58.310

RUNOFF COEFFICIENT = 0.340

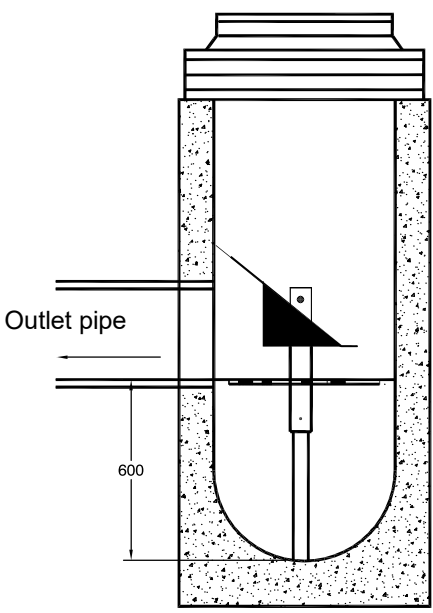
(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

Notes

- 1. CB Shield can be installed at any time. In a non frozen condition.
- 2. The frame and cover should be well aligned with the catchbasin for proper installation
- 3. The catchbasin sump must be clean before installation
- 4. The grate should be at the same level as the standing water in the sump.
- 5. Pipes must be cut flush with inside walls



Top view



Profile view



CB Shield (600mm Sump)

SPECIFICATION FOR CATCH BASIN INSERT

PART 1-PRODUCT

1.1 GENERAL:

- 1.1.1** The catch basin insert must be able to fit reasonably tight to the catch basin and shall be square and vertically upright within it once placed. A top sloped plate shall direct flows toward the rear of the catch basin where the majority of flow shall be directed across a grate to allow sediment to drop out, with flows exiting at the outlet pipe of the catch basin.
- 1.1.2** The insert shall be supported by a “leg” that in turn supports the grate and top slope. The leg will be telescopic, allowing adjustment of the grate to be equal with the invert of the outgoing pipe from the catch basin.
- 1.1.3** The telescopic leg shall allow for adjustments in sump depths from 150 to 900 mm.
- 1.1.4** The catch basin insert must be easily removed to allow maintenance of the catch basin.
- 1.1.5** The insert should be fabricated from either fiberglass or co-polymer polypropylene.
- 1.1.6** The insert shall not include a flow through membrane to trap sediment.

1.2 FIBERGLASS:

A fiberglass insert should be fabricated in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks

1.3 CO-POLYMER POLYPROPYLENE:

A co-polymer polypropylene insert shall conform to a tensile strength of 4000 psi (ASTM D-683), an Izod impact value of 2.5 (ASTM D-792), a flexural modulus of 195000 (ASTM D-790) , A heat distortion temperature of 190° F (ASTM 648) and a Rockwell hardness of 74 (ASTM D-785)

1.4 FASTENERS:

The insert parts shall be fastened together with stainless steel hardware Grade 304 or 316.

PART 2 – PERFORMANCE

2.1 GENERAL

The catch basin insert shall facilitate removal of sediment from stormwater by settling in the catch basin sump during frequent rain and snowmelt events. The insert shall prevent re-suspension of captured material during higher flow events, with sediment to remain in place until suitably removed with appropriate catch basin cleaning equipment. The insert shall not impede flows through the catch basin, and shall not be prone to blockage.

2.2 TOTAL SUSPENDED SOLIDS and PARTICLE SIZE DISTRIBUTION:

- 2.2.1** The catch basin insert shall enhance and not impede the catch basin’s ability to capture sediment. Depending on site conditions, the system shall generally be capable of capturing and retaining a long term average of 50% to 60% of incoming total suspended solids (TSS) loading. Sediment/TSS removal calculations shall be based on the particle size distribution associated with the ETV Canada definition of test sediment as outlined in their protocol for testing of Oil Grit Separator type devices.

- 2.2.2** The catch basin insert performance shall be determined through independent laboratory testing with protocols based on (and in general conformance with) the Canadian ETV program's protocol for TSS removal and scour for Oil Grit Separator type devices (as authored by Toronto Region Conservation Authority, revised June 2014).
- 2.2.3** Alternative long term removal rates associated with assuming a different PSD for incoming TSS (such as for sediment consistent with the City of Toronto's Wet Weather Flow Management Guidelines) will be provided by CB Shield Inc. if assumed in design calculations.

2.3 SITE SPECIFIC DESIGN AND PERFORMANCE

- 2.3.1** The catch basin insert shall enhance a catch basin's ability to capture TSS, with actual long term sediment removal performance based on the drainage area required for treatment and the level of imperviousness. ,
- 2.3.2** The anticipated long term TSS removal performance for site specific installations shall be determined and stamped by a licensed engineer.
- 2.3.3** For a **double catch basin**. There will be two standard CB Shield inserts and one center spacer installed. The first insert is installed with the high part of the slope facing the outlet hole. The center spacer complete with foot is then installed directly below the double catch basin center beam. The second insert is installed in the section that does not have an outlet pipe. This insert will have the high point of the slope face either 90 or 180 degrees away from the outlet pipe.

CB Shield Contact Info:

39 Uplands Drive
Brantford, Ontario
N3R5H5
Ph - 519-212-9161
msmith@c-i-p.ca

Canadian ETV Verification Report

Performance Testing of Catch Basin Shield Technology

FINAL – STRICTLY CONFIDENTIAL

Date: 17 October 2016

Prepared For:

GLOBE Performance Solutions
World Trade Centre
404 – 999 Canada Place
Vancouver, British Columbia
V6C 3E2
Canada

Prepared By:

Toronto and Region Conservation Authority
101 Exchange Ave
Concord, Ontario
L4K 5R6
Canada



Authentication

Dated: 17 October 2016

Approved by:

A handwritten signature in black ink, appearing to read "Tim Van Seters". The signature is written in a cursive style with a large initial "T" and "V".

Name: Tim Van Seters

Title/Position: Senior Manager

Department: Sustainable Technologies,

Organization: Toronto and Region Conservation Authority

Verification Report Outline for CB Shield Inc.

Catch Basin Shield Technology

Contents

Disclaimer	4
Executive Summary	5
1. Introduction	6
1.1 Objectives	6
1.2 Scope	6
2. Review of the Application.....	6
2.1 Introduction	6
2.2 Applicant Organization	6
2.3 Documents Reviewed.....	7
3. Review of the Technology	10
3.1 Technology Review Criteria	10
4. Review of Test Plan, Test Execution and Data	12
4.1 Review of Test Plan and Execution of Test Plan	12
4.3 Data Validity Checklist	16
4.5 Data Analysis Checklist	17
4.7 Data Interpretation Checklist	18
5. Statistical Evaluation of Claims	20
5.1 Statistical Evaluation of Claim #1: Capture test	20
5.1.1 Raw Data	20
5.1.2 Assessing Normality	20
5.1.3 Testing if the Mean is Equal to Specified Value.....	20
5.2 Statistical Evaluation of Claim #2: Scour Test	20
5.2.1 Raw Data	20
5.2.2 Mixed model analysis: Testing for significant difference between scour test effluent loads of control and CB Shield treatment using	20
5.2.3 Calculating the 95% confidence interval for the effluent load mean quotient of the two treatments	21
6. Audit Trail	22
7. Conclusion.....	23
8. References	23
Appendices	24
Appendix A. Statistical Analysis	24
A.1 Claim 1: Capture Test.....	24
A.2 Claim 2: Scour Test.....	24
A.2.1 Mixed model analysis: Testing for significant difference between scour test effluent loads of control and CB Shield treatment using	24
A.2.2 Calculating the 95% confidence interval for the effluent load mean quotient of the two treatments	26
Appendix B. Supplemental Verification Checklist Pursuant to ISO/FDIS 14034:2015.....	27
Appendix C. Verification Guidance Pursuant to ISO/FDIS 14034:2015	31
Appendix D. Raw data	35

Disclaimer

The Toronto and Region Conservation Authority (“TRCA”) including its employees and Directors, (the “Verifier”) has participated in the Canadian Environmental Technology Verification (ETV) Program verification of the CB Shield (the “Vendor”) Catch Basin Shield Technology.

Any reference to the “Technology” refers to the Vendor’s Catch Basin Shield Technology.

The Verifier is in no way affiliated with the Vendor.

The Vendor shall not edit or modify the report in any way or make any attempt to misrepresent data to the benefit of the Vendor. Selectively using sections of the report in order to change or misrepresent its overall meaning is also prohibited.

Claim verification by the Verifier does not represent any guarantee of the performance or safety of the Technology.

The Verifier shall not be liable in any way in the event that the Technology fails to perform as advertised by the Vendor and/or CB Shield Technology does not meet government-mandated health and safety standards.

To the extent permitted by law, the Verifier denies all liability to the Vendor or to any other person or entity for any loss, damage, costs, expenses and/or other compensation, arising directly or indirectly from the use of the report (in whole or on part) and/or any information contained therein.

The Vendor is wholly responsible for ensuring that the Technology complies with all applicable legislation, regulations, and other authorities.

Executive Summary

The CB Shield Technology was subjected to verification in accordance with the Canadian ETV Program General Verification Protocol, and taking into account the current draft of the proposed FDIS ISO 14034.

The verification process was mutually agreed upon by GLOBE Performance Solutions, the Verification Body, and Toronto and Region Conservation Authority (“TRCA”), the subcontracted Verification Expert. The purpose of this verification is to provide objective and quality-assured performance data on environmental technologies, so that users, developers, regulators, and consultants can make informed decisions about purchasing and applying these technologies.

This report, prepared by TRCA according to the criteria and guidelines set out in the Canadian ETV Program General Verification Protocol (GVP) of June 2012, is an official audit of the testing report generated through the performance testing of the CB Shield technology. The report is based on the Canadian ETV Program.

In addition, through guidance provided by GPS, the TRCA completed its verification of the CB Shield technology performance taking into account the principles and requirements of FDIS ISO 14034.

Performance testing for this verification took place at Good Harbour Laboratories in Mississauga, Ontario, Canada. Good Harbour Laboratories conducted the testing and followed the test sediment particle size distribution and many of the methods outlined in the *Procedure for Laboratory Testing of Oil-Grit Separators* developed by Toronto and Region Conservation Authority for the Canadian ETV Program.

CB Shield Technology is based on established scientific and technical principles in the field of fluid dynamics, sedimentation/settling, hydrology and sediment transport.

The technology incorporates an insert for catchbasins that aims to deflect and reduce the energy of inflows and thereby increase capture and reduce scour of sediment found in stormwater runoff.

After examination and audit of the test report and based on the test data submitted, the TRCA has concluded that the CB Shield insert provides an environmental benefit related to capture and scour prevention of suspended sediments in stormwater runoff.

Accordingly, the TRCA recommends that the performance claims be worded as follows:

1. During the sediment capture test, for a catch basin with a false floor set to 50% of the manufacturer’s recommended maximum sediment storage depth and a constant influent sediment concentration of 200 mg/L, the catch basin with a CB Shield insert removed 64, 59.9, 52.4, 42.6, 25.2, and 26.7 percent of influent sediment by mass at inflow rates of 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s, respectively.
2. For a catchbasin filled to three quarters of the manufacturer's recommended maximum sediment storage depth, with the CB Shield™ insert, scouring of test sediment is at most 8% of the control catchbasin during a continuous 30 minute scour test run with 5 minute duration inflows of 1.2, 4.8, 8.4, 12.0, and 15.6 L/s.

1. Introduction

GLOBE Performance Solutions (GPS) which operates the Canadian ETV Program on behalf of Environment Canada has engaged the Toronto and Region Conservation Authority ("TRCA") to verify the performance of CB Shield Technology within the framework of a subcontracted agreement. The CB Shield technology is a technology for capturing sediment from storm water runoff when inserted inside street drains (catchbasins) and retaining sediment by preventing scour and re-suspension.

GLOBE Performance Solutions, in collaboration with the TRCA, has further agreed to prepare a verification report and verification statement that will meet the requirements of the Canadian ETV Program.

This verification report, prepared by the TRCA (the Verifier), in its capacity as a Canadian ETV Program Verification Expert (VE), constitutes a review of the application of the CB Shield technology based on the Canadian ETV Program General Verification Protocol (GVP) and taking into account the principles and requirements of FDIS ISO 14034.

The verification report is a summary record of the audit undertaken by the TRCA to verify the Vendor's technology performance claim.

CB Shield applied for technology verification through GLOBE Performance Solutions. Testing was carried out by the Good Harbour Laboratories in accordance with ISO 17025 requirements. TRCA examined the test report and prepared the verification report.

The CB Shield Technology is based on established scientific and technical principles in the field of fluid dynamics, sedimentation/settling, hydrology and sediment transport. The technology incorporates an insert for catchbasins that deflects incoming water to the sidewalls dissipating its energy and passing it over a grate where velocity is decreased and residence time is increased allowing sediments to drop out of suspension and be captured. The dissipation of influent water energy also reduces scouring of already captured sediment during subsequent storms.

CB Shield's performance claims as submitted were:

1. For a catch basin containing sediment up to 150mm below the outlet invert, use of a CB Shield™ reduces scour of ETV sediment by a factor of at least 20 for stormwater inflows from 1.2-15.6L/s.
2. In addition use of CB Shield™ increases capture of ETV test sediment in all cases and by at least 370% to 490% respectively for flows of 2.4L/s and 8.4L/s.

Results showed that the initial claim for capture test could not be verified for individual flow rates as independence between samples of different flow rates could not be maintained since the captured sediment was not removed between the tests of different flow rates. A re-test was requested for the capture test. The re-test was done on a catchbasin with CB Shield insert without reference to a control catch basin. Results showed removal efficiencies ranging from 64.0 - 26.7% for inflow rates ranging from 0.24 - 8.40 L/s respectively.

The scour test was evaluated as a continuous test. Comparing the CB Shield to the Control treatment indicated that the CB Shield scoured much less than the control catch basin at 5 minute duration inflow rates of 1.2, 4.8, 8.4, 12.0, and 15.6 L/s.

1.1 Objectives

The objective of this report is to verify the performance claim made by CB Shield for the Catch Basin Shield Technology. This report summarizes the findings of the Canadian ETV Program Verification Expert, the TRCA, based on information and data contained in the Formal Application submitted by CB Shield to GLOBE Performance Solutions.

1.2 Scope

This verification was conducted by the TRCA using the June 2012 Canadian ETV Program General Verification Protocol and the most recent version (June 2015) of the international ETV standard (FDIS ISO 14034).

2. Review of the Application

2.1 Introduction

This section provides a summary of the information provided by the applicant included with the pre-screening application and formal application forms submitted to GLOBE Performance Solutions and reviewed by the TRCA pursuant to the Canadian ETV Program and the new international ETV standard (FDIS ISO 14034).

2.2 Applicant Organization

CB Shield Inc.
233 Cross Avenue, Suite 302
Oakville, ON L6J 2W9

2.3 Documents Reviewed

The technology and all information provided by the Applicant with the Formal Application, the formal application binder and all subsequent transmittals to the Verification Expert were reviewed. The results of this Application Review are summarized in the Application Review Checklist (Table 1) below.

Table 1: Application Review Checklist – Mandatory Information

Ref.	Criteria	Yes	No	Verifier Comments
1.1	Signed Formal Application.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
1.2	Signed Declaration Regarding Codes & Standards submitted with signed formal application.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
1.3	Technology provides an environmental benefit.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	When installed in storm water catch basin, the device reduces souring and re-suspension of retained sediment, thereby reducing discharge of sediment into the environment.
1.4	A copy of "Claim to be Verified" for each performance claim to be verified included with the Formal Application.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	"Claim to be Verified" submitted with application.
1.5	Performance Claim composed in a way that satisfies "Criteria for Specifying Claims":	<input type="checkbox"/>	<input type="checkbox"/>	
1.5.1	Include Technology name (and model number)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	CB Shield™
1.5.2	Include application of the technology	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Applied as an insert into catchbasins to improve capture and reduce scour of stormwater runoff sediment.
1.5.3	Include specific operating conditions during testing	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Test sediment: ETV test sediment <u>Capture (Claim 1):</u> Constant influent concentration of 200 mg/L. False floor set to 50% of the manufacturer's recommended maximum sediment storage (300 mm below the outlet invert) Inflow rates of 0.24, 0.48, 1.20, 2.40, 6.00 and 8.40 L/s. <u>Scour (Claim 2):</u> Catchbasin filled to ¾ of the manufacturer's recommended maximum sediment storage depth Claim based on continuous 30 minute test with 5 minute duration inflows of 1.2, 4.8, 8.4, 12.0, and 15.6 L/s.
1.5.4	Does it meet the minimum requirement for the majority of Canadian Standards / Guidelines?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Signed Declaration Regarding Codes & Standards submitted with signed formal
1.5.5	Does it specify the performance achievable by the technology?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<u>Capture:</u> Removal efficiencies of 64, 59.9, 52.4, 42.6, 25.2, and 26.7 for inflow rates of 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s respectively with a constant influent sediment concentration of 200 mg/L. <u>Scour:</u> Scouring is at most 8% of the control catchbasin during a continuous 30 minute scour test run with 5 minute duration inflows of 1.2, 4.8, 8.4, 12.0, and 15.6 L/s.

1.5.6	Is the performance measurable?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Capture:</u> To measure the capture performance at each flow rate, a modified mass balance calculation is required, which can be done using mass of the sediment added to the sediment feeder, mass of sediment remaining in the feeder, and mass of captured sediment.</p> <p><u>Scour:</u> To compare scouring potential for the continuous test between the control and CB Shield treatments the total effluent load is calculated for the entire duration of the test based on flow rate, duration, and sediment concentration of individual samples.</p>
1.6	Standard operating practices and a description of operating conditions for each individual performance claim specified.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>Tests are done in a lab on a simulated street scape with catchbasins clean of litter/debris.</p> <p>In the field, on average there are 5 catch basins per hectare. Therefore, the results from the maximum flow rate (15.6L/s) during the scour test will be meaningful for runoff flows up to 78 L/s per hectare. The range of flows tested is anticipated to match the range of flows expected at most installations.</p> <p>ETV test sediment: AGSCO 1-1000 micron silica sediment blend.</p> <p>Background samples are taken to account for all sources of sediment input.</p> <p><u>Capture Test (Claim 1)</u> Background samples taken at least three times per run to account for all sources of sediment input</p> <p>Influent sediment concentration is constant at 200 mg/L (+/- 25mg/L)</p> <p>Tested flows: 0.24, 0.48, 1.2, 2.4, 6, and 8.4 L/s. These flow rates comply with surface loading rates specified in the CETV OGS testing procedures (40, 80, 200, 400, 1000, and 1400 L/min/m²), based on the effective treatment area (0.36m²) of the device. The specified loading rate of 600 L/min/m² was not tested.</p> <p>Conducted with a false bottom set at 300 mm below the outlet invert.</p> <p>Effluent was not recirculated; single pass through.</p> <p>Sediment injected 16.5 mm away from the inlet</p> <p><u>Scour Test (Claim 2)</u> Tested flows: 1.2, 4.8, 8.4, 12, and 15.6 L/s. These flow rates comply with surface loading rates specified in the CETV OGS testing procedures (200, 800, 1400, 2000, and 2600 L/min/m²), based on the effective treatment area (0.36m²) of the device.</p> <p>Conducted with a false bottom set at 254 mm below the invert and preloaded with sediment up to 152 mm below the outlet invert. Water is filled to the effluent pipe and allowed to settle for 12-24 hours.</p> <p>Initial start time and flow rate transition times shall not exceed 1 minute.</p> <p>Effluent filtered using a 10µm filter before recirculation.</p>

1.7	The proponent has supplied significant references describing or supporting scientific and engineering principles of the technology.	<input type="checkbox"/>	<input type="checkbox"/>	Proponent claimed that scientific principles underlying the CB Shield are based on widely accepted knowledge of fluid dynamics, sedimentation/settling, hydrology and sediment transport. Link to EPA paper was broken.
1.8	Two or more names and contact information of independent experts (with no vested interest in the technology), qualified (backgrounds of experts are needed) to review the scientific and engineering principles on which the technology is based. These experts must be willing to be contacted by the VE.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Greg Williams (Ph.D., P.Eng), Jenn Drake (Ph.D)
1.9	Brief summary of significant human or environmental health and safety issues associated with the technology. (Note: this criterion complements but does not replace the obligation for the applicant to submit a duly signed "Declaration Regarding Codes and Standards")	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Brief descriptions given about health and safety issues associated with the working environment during installation, removal, the cleanout of catchbasins (considering they are confined spaces), and sediment disposal. Persons involved with installing, removing, and or maintaining CB Shield inserts need to be trained in accordance with requirements for servicing regular catchbasins.
1.10	Brief summary of training requirements needed for safe, effective operation of technology, and a list of available documents describing these requirements. (Note: this criterion complements but does not replace the obligation for the applicant to submit a duly signed "Declaration Regarding Codes and Standards")	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Link to video instructions that guides installation and removal of the CB Shield is provided; a list of general practices is also given.
1.11	Process flow diagram(s), design drawings, photographs, equipment specification sheets (including response parameters and operating conditions), and/or other information identifying the unit processes or specific operating steps in the technology. If feasible, a site visit to inspect the process should be part of the technology assessment.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Photographs of lab setup, flow diagrams of water flow through the simulated streetscape, and links to videos showing test runs and sampling methods were provided.
1.12	Supplemental materials (optional) have been supplied which offer additional insight into the technology application integrity and performance, including one or more of the following:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	A copy of patent(s) for the technology, patent pending or submitted.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	User manual(s).	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Maintenance manuals.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Operator manuals.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Quality assurance procedures.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Sensor/monitor calibration program.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Certification for ISO 9001, ISO 14000, or similar.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Material Safety Data Sheet (MSDS) information.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Workplace Hazardous Materials Information System (WHMIS) information.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Health and Safety plan.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Emergency response plan.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Protective equipment identified.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Technical brochures.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Website link provided with technical drawings and information.
1.13	The applicant provided adequate documentation and data. There is sufficient information on the technology and performance claim for the verification. [Note: The Verifier should communicate with the Canadian ETV Program, through GPS, to request copies of the necessary documentation and required data that are available to support the claims.]	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Adequate documentation given for reviewing testing protocol. All collected data including laboratory work book were submitted. Methodology for testing was clearly outlined in application. Videos of testing protocol, and installation/removal of CB Shield were also provided.

3. Review of the Technology

3.1 Technology Review Criteria

The results of the Technology Review are summarized in the Technology Review Criteria Checklist (Table 2) below.

Table 2: Technology Review Criteria Checklist

Ref	Criteria	Yes	No	Verifier Comments
2.1	The technology is based on scientific and technical principles. (Note: It will be necessary for the Verifier to read the key articles and citations listed in the Formal Application. It may also be necessary to contact the independent experts listed in the Formal Application to obtain additional information)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The technology is a flow deflection device that dissipates the energy of inflows, preventing scour and increasing capture. The scientific principles underlying the technology are based on well-known areas of fluid dynamics, sedimentation/settling, hydrology and sediment transport.
2.2	The technology is supported by peer review technical literature or references. (Note: Peer review literature and texts must be supplied with the Formal Application as well as relevant regulations and standards that are pertinent to the performance claim)	<input type="checkbox"/>	<input type="checkbox"/>	Currently the link to peer review article is inaccessible.
2.3	The technology is designed, manufactured, and/or operated reliably. (Note: Historical data from the applicant, not conforming to all data criteria, may be useful for the Verifier to review to assess the viability of the technology not for verification, but for insight purposes)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	CB Shield is said to be constructed in Canada using quality fiberglass. No details from long term studies to comment on long term reliability.
2.4	The technology is designed to provide an environmental benefit and not create an alternative environmental issue. (e.g., It does not create a more hazardous and/or unmanaged byproduct and it does not result in the transfer of an environmental problem from one media to another media without appropriate management of the subsequent contaminated media)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The technology provides an environmental benefit of controlling sediment washoff at upstream locations by capturing and retaining sediment from stormwater runoff within the catchbasin. However, long term reliability specifically about the clogging of grate opening by debris which would decrease its hydraulic capacity requires further attention.
2.5	The technology conforms to standards for health and safety of workers and the public. (Note: The vendor must submit a signed "Declaration Regarding Codes & Standards", with the Formal Application. The Verifier should ensure that this signed document is included with the information that is reviewed for the performance claim verification)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Signed Declaration Regarding Codes and Standards was submitted.
Environmental Standards				
2.6	Technology achieves federal, provincial, and/or municipal regulations or guidelines for management of contaminated and/or treated soils, sediments, sludges, or other solid-phase materials.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
2.7	Technology achieves federal, provincial, and/or municipal regulations or guidelines for all (contaminated and or treated) aqueous discharges as determined by the applicant's information.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
2.8	Technology achieves federal, provincial, and/or municipal regulations or guidelines for all (direct or indirect) air emissions. If the environmental technology results in the transfer of contaminants directly or indirectly to the atmosphere, then, where required, all regulations or guidelines (at any level of government) relating to the management of air emissions must be satisfied by the applicant's information.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Commercial Readiness				
2.9	Technology and all components (apparatus, processes, products) is full-scale, commercially-available, or alternatively see 2.10 or 2.11, and, data supplied to the Verifier is from the use or demonstration of a commercial unit.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Technology and components used for testing are full-scale and commercially available. At the time of this verification, the vendor has the capacity to produce many hundred units per month.

2.10	Technology is a final prototype design prior to manufacture or supply of commercial units, or alternatively see 2.11. (Note: Verification of the performance claim for the technology is valid if based on a prototype unit, if that prototype is the final design and represents a pre-commercial unit. The verification will apply to any subsequent commercial unit that is based on the prototype unit design. The verification will not be valid for any commercial unit that includes any technology design change from the prototype unit used to generate the supporting data for the verification.	<input type="checkbox"/>	<input type="checkbox"/>	NA
2.11	Technology is a pilot scale unit used to provide data which when used with demonstrated scale up factors, proves that the commercial unit satisfies the performance claim.	<input type="checkbox"/>	<input type="checkbox"/>	NA
Operating Conditions				
2.12	All operating conditions affecting technology performance and the performance claim have been identified.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Operating conditions affecting technology performance were identified. Please see Ref. 1.6.
2.13	The relationships among operating conditions and their impacts on technology performance have been identified. (Note: It is the responsibility of the Verifier to understand the relationship between the operating conditions and the performance of the technology, and to ensure that the impacts of the operating conditions and the responses of the technology are compatible)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Background concentration – needs to be < 20 mg/L to allow for accurate assessment of performance in the laboratory Water temperature – needs to be <25 °C; higher water temperatures have reduced viscosity allowing suspended sediments to settle quicker. However, water temperature has a negligible impact on settling velocity. Standardized test sediment - ensures comparability between units and a fair assessment of performance based on range of sediment sizes. Flow rates - lower flow rates should allow higher percentage of capture and retention. False floor (used storage capacity) – higher false floor will lower capture and retention performance as sediment will be held closer to the outlet invert <u>Capture test</u> Influent sediment concentration - held constant at 200 mg/L; studies have shown this to be a reasonable average sediment concentration in stormwater runoff from paved surfaces. Higher or lower influent concentrations may change the removal efficiencies
2.14	Technology designed to respond predictably when operated at normal conditions (i.e. conditions given in 2.12), and/or alternatively see 2.15. (Note: The Verifier must be satisfied that these data do not demonstrate a performance that is different than the performance indicated in the Performance Claim to be validated)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Based on the test results, the technology does respond predictably when operated at normal conditions. The discrepancy with the S5 run result during the control treatment of the scour test showing the second lowest scour rate for the highest flow rate is likely the result of a lack of finer sediments in the sump to scour.
2.15	Effects of variable operating conditions, including start up and shut down, are important to the performance of the technology and have been described completely as a qualifier to the performance claim under assessment.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	A range of inflow rates were tested and the samples taken when changing from one flow rate to the next were clearly distinguished.
Throughput Parameters				

2.16	Effects of variable contaminant loading or throughput rate must be assessed and input/output limits established for the technology. Note: If the application of the technology is to a variable waste source or expected (designed) variable operating conditions, then it will be necessary to establish acceptable upper and lower ranges for the operating conditions, applications and/or technology responses. Sufficient, quality data must be supplied to validate the performance of the technology at the upper and lower ranges for the operating conditions, applications and or technology responses detailed in the performance claim.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<u>Scour:</u> The tested flow rates were between 1.2 and 15.6 L/s. The catch basins with and without CB Shield were pre-loaded with test sediment. Influent was clean water. Testing was continuous from one flow rate to the next with 1 minute transition periods. <u>Capture:</u> The tested lower and upper throughput rates are 0.24 and 8.40 L/s. Contaminant loading rates were controlled to have a constant inflow sediment concentration of 200mg/L.
Other Relevant Parameters/Variables/Operating Conditions Note: The Verifier is expected to understand the technology and identify and record all relevant criteria, parameters, variables or operating conditions that potentially can or will affect the performance of the technology under assessment. It is practical to include all of these variables in Table 2 (i.e., from 2.17 to ...).		<input checked="" type="checkbox"/>	<input type="checkbox"/>	Parameters mentioned from 2.12 to 2.16 will also affect field performance accordingly (e.g., the false floor represents the accumulated amount of sediment). Additionally, in the field, debris may accumulate and affect performance which was not evaluated in the lab setting but can be evaluated in a field case study.
2.17				
2.18				

4. Review of Test Plan, Test Execution and Data

4.1 Review of Test Plan and Execution of Test Plan

The results of the Test Plan Review are summarized in the Test Plan Design Assessment Criteria Checklist (Table 3) below.

Table 3: Test Plan Design Assessment Criteria Checklist

Ref.	Criteria	<input type="checkbox"/>	<input type="checkbox"/>	Verifier Comments
3.1	Was a statistician, or an expert with specialized capabilities in the design of experiments, consulted prior to the completion of the test program, and if so please provide the contact details	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Greg Williams 416-624-2007 gwilliams@goodharbourlabs.com
3.2	Is a statistically testable hypothesis or hypotheses provided? (such that an objective, specific test is possible)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The testable hypothesis is that a catchbasin with the CB Shield insert will retain more sediment in stormwater runoff than a catch basin without the insert. The hypothesis can be tested by a capture and comparative scour test as follows: <u>Capture test:</u> The OGS testing protocol requires the total amount of sediment to be accounted for by means of a modified mass balance. As a result, statistics will not be required since the whole "population" is taken into account instead of taking samples. <u>Scour test:</u> The scour test is a continuous test where samples taken within and between flow rates are not independent of each other. Since the assumption of independence fails, a mix model approach is required to compare the means between the control and CB shield catchbasin and confirm a significance difference. A measure of difference can be calculated between the two treatments by finding the quotient of their total effluent loads.
3.3a-c	Does the performance test generate data suitable for testing the hypothesis being postulated? Namely:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

3.3a	Does the test measure the parameters used in the performance claim hypothesis?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Capture test:</u> Total amount of sediment added into the feeder is measured as well as the total amount captured after each flow rate test. A modified mass balance is undertaken to calculate exactly how much sediment was fed through the feeder as influent into the catchbasin and what percentage was retained for both treatments.</p> <p><u>Scour test:</u> Performance test measures effluent concentrations of control and CB Shield treatments.</p>
3.3b	Does the performance test control for extraneous variability?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The test was conducted under controlled laboratory conditions, following well defined procedures, thereby limiting extraneous variability. More specifically, influent flow was sampled to account for any background concentrations that would add to the controlled influent sediment feed. Inflow concentration was measured for each flow rate to ensure auger feed rates were synced to influent flow rate to achieve target influent concentrations. When concentrations of samples were analyzed, a blank, 20 mg/L standard, and 100 mg/L standard were also tested to account for instrumental or systematic errors. For sediment re-suspension test, pre-loaded sediment is allowed to settle for 12-24 hours before tests are started. Water temperature were monitored to not exceed 25°C as higher temperature can decrease water viscosity and thereby increase sediment settling velocity.
3.3c	Does the performance test include only those effects attributable to the technology being evaluated?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	To ensure effects are attributable to the technology evaluated, the catchbasin with a CB shield insert is evaluated against a catchbasin without the insert (control) as part of the scour test.
3.4	Does the performance test generate data suitable for analysis using the SAWS? (Note: It is preferable that tests are designed with the SAWS in mind before test plans are written)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	The mixed model approach required to compare control and CB Shield catchbasin scour test results requires a test outside of recommended SAWS (the R statistical program was used)
3.5	Does the performance test generate data suitable for analysis using other generic experimental designs? (Note: Performance testing and verification studies should be designed with the final data analysis in mind to facilitate interpretation and reduce costs)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<u>Capture</u> and <u>scour</u> tests generally followed the experimental design proposed by the OGS testing protocol which do not require statistical analysis. However, scour test claim compares control and CB Shield catchbasin which requires further analysis (mixed model) to prove significance difference between control and CB Shield catchbasin.
3.6	Are the appropriate parameters, specific to the technology and performance claim, measured? (Note: It is essential that the Verifier and the technology developer ensure that all parameters - e.g. temperature, etc - that could affect the performance evaluation are either restricted to pre-specified operating conditions or are measured)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Water temperature, influent flow rate, background concentration <u>Capture test:</u> Influent concentration, total influent mass, total captured mass <u>Scour test:</u> influent flow rate, preloaded sediment mass, effluent concentration
3.7a-d	Are samples representative of process characteristics at specified locations? Namely:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

3.7a	Are samples collected in a manner representative of typical process characteristics at the sampling locations? (e.g., the samples are collected from the source stream fully mixed, etc.)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Capture test:</u> Sampling done according to OGS test Procedure. Upon completion of test, the remaining water from the catchbasin is decanted over a period of less than 30hrs. The total sediment captured is removed, dried and weighed. Mass of sediment remaining in the feeder is weighed and subtracted from total mass of sediment added at the beginning of the test to establish actual amount fed.</p> <p><u>Scour test:</u> Effluent grab samples are taken at the catch basin outlet which will reflect effluent concentrations. A minimum of 500 ml samples was taken in 1000 mL jars that were attempted to be held under the whole effluent stream or passed under the stream such that the sample collection would be complete with a single pass.</p>
3.7b	Is data representative of the current technology?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The data reflects the effect of a CB shield inserted into a normal catchbasin without any other alterations to the catchbasin. The inserted CB Shield is the unit that is currently commercially available.
3.7c	Have samples been collected after a sufficient period of time for the process to stabilize?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>Samples were collected according to OGS testing procedure, which was developed based on scientific principles to ensure, among other things, sampling is conducted in a representative and replicable manner.</p> <p><u>Capture test:</u> Sediment is only fed once target flows are reached and stabilized.</p> <p>A maximum of 30hrs is given to decant remaining water after a test run before captured sediment is removed, dried and weighed.</p> <p><u>Scour:</u> Once sediment is pre-loaded, the device is filled up with water to the invert and allowed to sit for 12-24 hours before starting the tests.</p> <p>Changes in flow rates were done within 60s and an effluent sample was taken at approximately 30s to determine if additional scouring was taking place while flow rates were stabilizing.</p>
3.7d	Have samples been collected over a sufficient period of time to ensure that the samples are representative of process performance?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Capture test:</u> Total captured sediment is collected at the end of each flow run. The test duration for tested flow rates of 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s are 420, 420, 360, 180, 70, and 50 mins respectively.</p> <p><u>Scour test:</u> Effluent samples were taken every 1 minute for test durations of 5 minutes for flow rates of 1.2, 4.8, 8.4, 12.0, and 15.6 L/s. Transition samples were taken within 30 seconds of switching to a new flow rate. The system was shut down between flow rates of 8.4 and 12.0 L/s and between 12.0 and 15.6 L/s due to standpipe overflow.</p>

3.8	Are samples representative of operating conditions? (Note: A time lag occurs between establishing steady state conditions and stabilization of the observed process performance. This time lag depends in part on the time scale of the process)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>Long term operating conditions need to be evaluated. The effect of debris accumulation in an in situ field setting needs to be considered as affecting the performance.</p> <p><u>Capture test:</u> Flow rates are monitored and influent sediment is only added once each target flow is stabilized in order to match performance to specific flow rates that cover the expected range of catchbasin inflow.</p> <p>Performance is representative of catchbasin that has used up 50% of the manufacture recommended Maximum Sediment Storage Depth and a constant inflow concentration of 200 mg/L. Because the sediment is collected at the end of each run, it accounts for the performance of the unit during start up and shut down as well.</p> <p><u>Scour test:</u> Samples are representative for a specific operating condition of having the catch basin $\frac{3}{4}$ full of sediment. Scouring results are from a continuous test where scouring from a previous flow will affect subsequent scouring rates. After pre-loading the sediment time is given for agitated sediments to settle over a period of 12-24 hours. Flow changes are done within 1 minute and a sample is taken at approximately 30s to capture the scouring potential when altering flow rates.</p>
3.9	Are samples representative of known, measured and appropriate operating conditions? (Note: This includes technologies that operate on short cycles and so have start and stop cycles which affects the operation of the technology. If the operating conditions are not vital but are recommended, then the reviewer must evaluate operating conditions)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The device is a passive device working to deflect and reduce the energy of stormwater inflow, which increases capture and reduces scour. The data were collected under controlled laboratory conditions using a test sediment that includes clay, silt and sand sized particles characteristic of stormwater runoff. The effects of debris on performance were not evaluated.
3.10	Were samples and data prepared or provided by a third party? (Note: In some cases, where the expertise rests with the applicant, an independent unbiased third party should witness and audit the collection of information and data about the technology. The witness auditor must not have any vested interest in the technology.)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>Data samples were analyzed and prepared by a third party laboratory (Good Harbour Laboratories). Good Harbour Laboratories 2596 Dunwin Drive, Mississauga ON, L5L 1J5 905 696 7276 goodharbourlabs.com</p>
3.11a-c	Performance Test Design is Acceptable - Namely:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
3.11a	The samples have been collected when the technology was operated under controlled and monitored conditions.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Capture test:</u> flow rate, and influent concentrations were monitored and adjusted as required</p> <p><u>Scour test:</u> flow rates were monitored and adjusted as required</p>
3.11b	The test plan design should have been established prior to testing to ensure that the data were collected using a systematic and rational approach	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Test plan design generally satisfied the OGS testing protocol.

3.11c	The test plan design should have defined the acceptable values or ranges of values for key operating conditions, and the data collection and analysis methodology	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Operating conditions:</u> Flows tested (operating conditions) are the expected general range of flows through a catchbasin: capture test (0.24-8.4L/s), scour test: (1.2-15.6 L/s).</p> <p>Water temperature needs to be below 25°C.</p> <p>Unit tested having 50% of its maximum storage capacity filled.</p> <p><u>Data collection and analysis:</u> follows the OGS testing protocol. However, the scour test is run additionally with a control catch basin for comparison.</p>
-------	---	-------------------------------------	--------------------------	---

4.3 Data Validity Checklist

The results of the Data Validity Review are summarized in the Data Validity Checklist (Table 4) below.

Table 4: Data Validity Checklist

Ref.	Criteria	Yes	No	Verifier Comments
4.1	<p>Were appropriate sample collection methods used (e.g. random, judgmental, systematic etc)? For example: simple grab samples are appropriate if the process characteristics at a sampling location remain constant over time. Composites of aliquots instead may be suitable for flows with fluctuating process characteristics at a sampling location. (Note: Sampling methods appropriate for specific processes may sometimes be described in federal, provincial or local monitoring regulations)</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Capture test:</u> The mass of sediments fed into the catchbasin and captured is measured in order to carry out a modified mass balance.</p> <p><u>Scour test:</u> Multiple effluent grab samples are appropriate to evaluate the effluent concentrations and thereby the scouring potential at each flow rate.</p>
4.2	<p>Were apparatus and/or facilities for the test(s) adequate for generation of relevant data? (i.e. testing was performed at a location and under operating conditions and environmental conditions for which the performance claim has been defined)</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>Facility/apparatus sufficiently simulated a streetscape with a catchbasin with and without a CB Shield insert. Slurry feeder was calibrated and the auger feed rate was monitored. The facility had the capacity to manage the large amounts of water required for testing.</p>
4.3	<p>Were operating conditions during the test monitored and documented and provided?</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>Monitored/ documented operating conditions: background concentration, water temperature, PSD of test sediment</p> <p><u>Capture test:</u> False floor height, flow rates, influent sediment concentration, amount of sediment injected</p> <p><u>Scour test:</u> False floor height, flow rates, time limits, sampling frequency</p>
4.4	<p>Has the information and/or data on operating conditions and measuring equipment measurements and calibrations been supplied to the Verifier?</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>Measurements of monitored flow, water temperature and concentrations of sediment added were provided. Calibration of flow meter and PSD of sediment used were also provided.</p>

4.5	Were acceptable protocols used for sample collection, preservation and transport? (Note: Acceptable protocols include those developed by a recognized authority in environmental testing such as a provincial regulatory body, ASTM, USEPA, Standard Methods)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
4.6	Were Quality Assurance/Quality Control (QA/QC) (e.g. use of field blanks, standards, replicates, spikes etc) procedures followed during sample collection? A formal QA/QC program, although highly desirable, is not essential, if it has been demonstrated by the vendor's information that quality assurance has been applied to the data generation and collection.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Replicates were taken and kept for 7 days (refrigerated) for each sample. Blank, 20 mg/L standard, and 100 mg/L standard run during sample analysis.
4.7	Were samples analyzed using approved analytical protocols? (e.g. samples analyzed using a protocol recognized by an authority in environmental testing such as Standard Methods, EPA, ASTM etc. Were the chemical analyses at the site in conformance with the SOPs (Standard Operating Procedures)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The SSC samples were analyzed by GHG as detailed in ASTM D3977-97 (2013), Standard Test Methods for Determining Sediment Concentration in Water Samples.
4.8	Were samples analysed within recommended analysis times (especially for time sensitive analysis such as bacteria)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Recommended storage time is 7 days but samples were analyzed within 2.
4.9 a-e	Were QA/QC procedures followed during sample analysis? Namely:	<input type="checkbox"/>	<input type="checkbox"/>	
4.9a	Maintaining control charts	<input checked="" type="checkbox"/>	<input type="checkbox"/>	QA/QC (e.g. flow rates monitored to not vary more than expected COV (<0.04)
4.9b	Establishing minimum detection limits	<input checked="" type="checkbox"/>	<input type="checkbox"/>	MDL is 1.26 mg/L.
4.9c	Establishing recovery values	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4.9d	Determining precision for analytical results	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4.9e	Determining accuracy for analytical results	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4.10 a-c	Was a chain-of-custody (full tracing of the sample from collection to analysis) methodology used for sample handling and analysis - Namely:	<input type="checkbox"/>	<input type="checkbox"/>	
4.10a	Are completed and signed chain-of-custody forms used for each sample submitted from the field to the analytical lab provided for inspection by the Verifier?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Chain of custody provided for ETV test sediment analysis. Sampling and analyzing were done by GHG in their laboratory.
4.10b	Are completed and easily readable field logbooks available for the Verifier to inspect?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Field logbook from GHG was made available to the verifier.
4.10c	Are there other chain-of-custody methodology actions and documentation recorded/available (e.g. sample labels, sample seals, sample submission sheet, sample receipt log and assignment for analysis)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	GHG provided certificate of analysis for effluent concentration of the scour test.
4.11	Experimental Data Set is Acceptable (i.e., the quality of the data submitted is established using the best professional judgment of the Verifier)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The Verifier believes that the experimental data quality set is acceptable as overseen by Good Harbour Laboratories.

4.5 Data Analysis Checklist

The intent of the data analysis checklist is to ensure that the appropriate statistical tools can be used in a rigorous, defensible manner (Environment Canada 2012). The checklist also emphasizes that an initial performance claim may be rewritten and updated to better reflect what the data support, using the expertise of the Verifier and other pertinent resources. In this case, the performance claims were modified and restated by the Verifier. The updated performance claims are presented in the conclusion of this report.

Table 5: Data Analysis Checklist

Ref.	Criteria	Yes	No	Verifier Comments

5.1	Does the analysis test the performance claim being postulated? (Note: When conducting performance evaluations, under the Canadian ETV program, the alternative hypothesis of a “significant difference” without stating the direction of the expected difference will usually be unacceptable)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Capture test:</u> analysis not required since modified mass balance will be done.</p> <p><u>Scour test:</u> mixed model is used to evaluate whether there is a significant difference in effluent concentrations between CB shield and Control treatments.</p> <p>A confidence interval for the quotient of means between the control and CB Shield treatment will be calculated for comparison. The standard error of the distributions that is required to calculate the confidence intervals is calculated using a bootstrap method in R statistical program. This method is less stringent on the assumption of normality which the data set does not fully satisfy.</p>
5.2	Does the analysis fit into a generic verification study design? For example, many other “generic” designs exist that are not explicitly covered by the Canadian ETV Program (e.g. ANOVA, ANCOVA, regression, etc.) that are potentially useful.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Capture test:</u> Since there are no replications, results of the tests are presented as they are.</p> <p><u>Scour test:</u> Mixed model analysis is carried to determine if there is a significant difference, a type of comparison of means taking into account non-independence. The quotient between the Control and the CB Shield treatments are used to compare the treatments.</p>
5.2 a-c	Are the assumptions of the analysis met? Namely: (Note: A negative response means the Verifier needs to request further information)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Scour test:</u> assumptions for a linear model include:</p> <ol style="list-style-type: none"> 1. Linearity – dependent variable is the result of a linear combination of independent variable(s) 2. Absence of collinearity – fixed effects should not be collinear to each other 3. Homoskedasticity – variance of your data should be approximately equal across the range of predicted values 4. Normality or residuals (least important) – residuals of the regression need to be normally distributed 5. Absence of influential data points 6. Independence – most important for a linear model. Samples need to be independent. Since this assumption is not satisfied, a mixed model is used in place of a linear model. The mixed model allows for non-independent samples.
5.2.a	Did the data analyst check the assumptions of the statistical test used?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
5.2.b	Are the tests of assumptions presented?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
5.2.c	Do the tests of the assumptions validate the use of the test and hence the validity of the inferences?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
5.3	Data Analysis is Acceptable The data analysis is acceptable if the statistical test employed tests the hypothesis being postulated by the technology developer, the assumptions of the statistical test is met and the test is performed correctly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Data analysis is acceptable.

4.7 Data Interpretation Checklist

The intent of the data interpretation checklist is to ensure that the data analyses results are reviewed in a manner that emphasizes the applicability to the specific performance claim and the statistical power of the performance test.

Table 6: Data Interpretation Checklist

Ref	Criteria	Yes	No	Verifier Comments

6.1a	<p>Are the results statistically or operationally significant? Did the performance test result in a statistically significant test of hypothesis?</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Capture test:</u> Results are operationally significant. Removal efficiencies ranged from 64 to 26.7% for flow rates of 0.24 – 8.40 L/s.</p> <p><u>Scour test:</u> results reflect comparison between control and CB Shield for a continuous scour test of different flow rates (0.24-8.4L/s) at 5 minute intervals. Under a mixed model analysis that takes into account non-independence between samples (since it is a continuous test, the previous sample will affect subsequent sample) it was shown that the treatment (control vs. CB Shield) had a significant effect on scouring.</p>
6.1b	<p>To be operationally significant, does the technology meet regulatory guidelines and applicable laws?</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>Declaration regarding codes & standards have been signed.</p>
6.2	<p>Does the performance test have sufficient power to support the claim being made? Note: For performance test designs where acceptance of the null hypothesis results in a performance claim being met, the statistical power of the test must be determined (Note: A statistical power of at least 0.8 is the target. If the power of the verification experiment is less than this value, the Verifier should contact the Canadian ETV Program to discuss an appropriate course of action)</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Capture test:</u> No statistical tests were conducted. Instead, a mass balance approach was used, which is regarded as a direct and robust and scientifically valid means of evaluating capture in stormwater sedimentation devices.</p> <p><u>Scour test:</u> No suitable method of testing the power of a mixed model statistical test was available. However, the differences between the control catch basin and CB shield catch basin were very significant, and the number of effluent samples collected was suitable for the selected statistical method of evaluation.</p>
6.3	<p>Is the interpretation phrased in a defensible manner? Note: The final performance claim should reflect any changes to the claim made during the course of the analyses, variations or restrictions on operating conditions, etc. that changed the scope of the performance claim. The initial performance claim should be viewed as a tentative claim that is subject to modification as the verification progresses. A thoughtful open-minded verification will in the end, prove to be of greatest benefit to the technology developer.</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p><u>Both claims were revised</u></p> <p><u>Capture test:</u> Results for the capture test cannot undergo a statistical test due to a lack of replicates. However, since the analysis was performed in a control laboratory setting, it is assumed that results would be replicable and therefore interpreted as results for a given set of testing conditions.</p> <p><u>Scour test:</u> Since the scour test was run as a continuous test, comparison between specific flow rates cannot be made, but rather on the entire series. Using mixed models to account for non-independence between samples, a significant difference was found between the two treatments. The interpretation is specific to testing conditions, but can be generalized to state the CB Shield scours much less than the control catchbasin.</p>
6.4	<p>Data Interpretation is Acceptable The data interpretation is acceptable if the data analyses results are reviewed in a manner that emphasizes the applicability to the specific performance claim and the statistical power of the verification experiment.</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>In general, the data interpretation is acceptable.</p>

5. Statistical Evaluation of Claims

The statistical evaluation of the claims put forward by the Vendor was carried out using the R statistical software based on some of the principles presented in Statistical Analysis Worksheets (SAWs) provided by GPS (as per Environment Canada 2012). The first claim (capture test) does not require a statistical evaluation since the entire “population” is sampled (total mass of influent and captured sediments are accounted for) and $n = 1$ for each flow rate. The capture test follows the OGS protocol published by CETV and the analysis of which specifies a modified mass balance approach.

The data set resulting from the scour test does not satisfy the assumption of independence. Therefore, the second claim (scour test) cannot be evaluated statistically using the provided standard SAWs that require normality. A mixed model approach is taken to confirm significant difference between results of control catchbasin and one with a CB Shield. A bootstrap simulation method is used in R to calculate the standard deviation from which confidence intervals for their quotient is derived to make estimates of the minimum performance limit.

5.1 Statistical Evaluation of Claim #1: Capture test

A modified mass balance approach is taken to analyze the treatment performance of capturing suspended sediments at various loading rates. Each flow rate is run only once due to feasibility related to testing duration and cost, but the total influent sediment and total captured sediment is weighed and accounted for. Since there are no repeated tests, statistical analysis is not carried out but rather the results of the modified mass balance is given as is.

5.1.1 Raw Data

The raw data provided by the Vendor is presented in Appendix D of the formal application.

5.1.2 Assessing Normality

This procedure is used to determine if the data variable is normally distributed or log-normally distributed. This is important as the assumption of normality is often invoked in subsequent calculations.

– Not applicable

Assumptions:

- Not applicable

5.1.3 Testing if the Mean is Equal to Specified Value

This test is used to determine at a level of 95% confidence that the mean is not equal to some pre-specified value, μ_0 . The value μ_0 will often be the performance that a technology is claiming to achieve.

$H_0 : \mu_1 = \mu_0$

– Not applicable

Assumptions:

- Not applicable

Inferences:

No statistical inferences are made. Based on the modified mass balance approach, under specified operating conditions of a false floor set to 50% of the manufacturer’s recommended maximum sediment storage depth and a constant influent sediment concentration of 200 mg/L, the catch basin with a CB Shield insert removed 64, 59.9, 52.4, 42.6, 25.2, and 26.7 percent of influent sediment by mass at inflow rates of 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s, respectively.

Table Z1: Summary of Acceptable Data Sets for Verification

Acceptable Data Set(s) Identification	SAWs Used	Supports Claim (Y/N)
Table 9. Removal efficiency based on mass balance (from Performance testing of the CB Shield for the enhancement of catch basin sediment capture – 24 Aug 2016)	Not applicable	Yes

5.2 Statistical Evaluation of Claim #2: Scour Test

5.2.1 Raw Data

The raw data provided by the Vendor is presented in Appendix D of the formal application.

5.2.2 Mixed model analysis: Testing for significant difference between scour test effluent loads of control and CB Shield treatment using

The scour test is run continuously with test sediment of a specified PSD preloaded and having flow rates altered at 5 minute intervals (1.2, 4.8, 8.4, 12.0, and 15.6 L/s). Effluent loads of the two treatments cannot be compared separately at each flow rate since preceding flow rates affect the amount of sediment left to scour during subsequent flow rates. As a result, for each treatment all collected effluent concentrations are treated as part of a single dataset. However, conventional statistics used for comparison of means analysis (i.e., t-test) requires each sample to be independent of

each other, put forth as the assumption of independence. Since data from the scour test fails to meet this assumption, a mixed model approach is taken.

A mix model is a linear model that includes a “mix” of fixed and random effects. Effects that are constant for each sample are fixed effects (i.e., the treatment) while effects that are variable for each sample (run/flow rate) are random effects and in part treated as a random error term. A “full” model is created with all fixed and random effects along with a “null” model that excludes the fixed effect that is in question of having a significant effect. The treatment effect (CB Shield vs. control) will be excluded in the null model. An ANOVA is used to compare the two models which if determined to be significantly different from each other identifies the fixed effect in question (i.e., treatment) to be a significant effect.

Assumptions:

- **Linearity:** The dependent variable has to be a result of a linear combination of the independent variables. A residual plot can be used as an indicator. Residuals should not exhibit a recognizable pattern (e.g., exhibit an increase or decrease or a curved relationship)
- **Homoscedasticity:** Variance of the data should be approximately equal across the range of predicted values. Residuals on a residual plot should be approximately equal distance from the Y=0 line.
- **Absence of collinearity:** Fixed effects should not be collinear (very closely related) to each other so that it would not be difficult to distinguish between their effects.
- **Normality of residuals:** Linear model are relatively robust against violations of normality assumption so this is the least important assumption to satisfy. Normality of residuals can be checked using a q-q plot.
- **Absence of influential data points**

5.2.3 Calculating the 95% confidence interval for the effluent load mean quotient of the two treatments

To make a claim on the effluent load performance of the CB Shield relative to the control treatment, the quotient of the mean effluent loads is calculated and expressed as a percentage. The 95% confidence interval of the quotient of means is calculated and the lower limit is used in the claim to reference the minimum performance as required by CETV instead of the mean performance.

A bootstrap simulation method is used in R to calculate the standard deviation of the distribution of effluent loads of the two treatments as an effective means of correcting for non-normal distribution. The calculated standard deviation is used with GraphPad’s web application (<http://www.graphpad.com/quickcalcs/errorProp1/>) to estimate the 95% confidence intervals of the quotient. The application assumes normal distributions for the datasets, which although not satisfied, the robust bootstrapping method used to calculate the standard deviations is believed to give very good estimates of the minimum performance without introducing complications of transforming and retransforming variables.

Assumptions:

- **Data set is normally distributed:** although not satisfied, the robust bootstrapping method used to calculate the standard deviations is believed to give good estimates of the calculated minimum performance without introducing abstractions of transforming and retransforming variables.

Inferences:

Based upon the above inferences, it can be concluded that for a catchbasin filled to three quarters of the manufacturer's recommended maximum sediment storage depth, with the CB Shield™ insert, scouring of test sediment is at most 8% of the control catchbasin during a continuous 30 minute scour test run with 5 minute duration inflows of 1.2, 4.8, 8.4, 12.0, and 15.6 L/s.

Table Z2: Summary of Acceptable Data Sets for Verification

Acceptable Data Set(s) Identification	Analysis Used	Supports Claim (Y/N)
Table 2. Scour test results for CB Shield protected and control catch basins (from Environmental Technology Verification (ETV): Supporting documentation for Canadian ETV program formal application – October 2015)	Mixed model regression is used (R statistical package)	Y
Table 2. Scour test results for CB Shield protected and control catch basins (from Environmental Technology Verification (ETV): Supporting documentation for Canadian ETV program formal application – October 2015)	Bootstrap simulation is run in R to find the standard error for the mean percent change (between scour results of the control and CB Shield treatments)	Y

Table 2. Scour test results for CB Shield protected and control catch basins (from Environmental Technology Verification (ETV): Supporting documentation for Canadian ETV program formal application – October 2015)	GraphPad web application is used to calculate 95% confidence interval of the quotient of mean effluent loads of the two treatments.	Y
--	---	---

6. Audit Trail

The items in Table 8 are useful in determining reasons for data discrepancies.

Table 8: Key documents

Raw data sheets and summary data	Yes
Signature pages	Yes
Signed Formal Application	Yes
Declaration Regarding Codes & Standards	Yes
Patent(s)	NA (Patent Pending)
Sample security: e.g. chain of custody sheets for each sample	Chain of custody for sediment, not for effluent sample since collected and analyzed by same lab.
Operation and maintenance manual	Operation and maintenance videos.
Field notebooks	Provided
Certificate of accreditation of laboratories	GHL not accredited but allowed by the verifier since an internal verification documented in the validation report TR-AA20120409-01.

7. Conclusion

CB Shield's technology performance claims have been verified as follows:

1. Capture test:

During the sediment capture test, for a catch basin with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent sediment concentration of 200 mg/L, the catch basin with a CB Shield insert removed 64, 59.9, 52.4, 42.6, 25.2, and 26.7 percent of influent sediment by mass at inflow rates of 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s, respectively.

2. Scour Test:

For a catchbasin filled to three quarters of the manufacturer's recommended maximum sediment storage depth, with the CB Shield™ insert, scouring of test sediment is lowered by at least 81% compared to a control catchbasin during a continuous 30 minute scour test run with 5 minute duration inflows of 1.2, 4.8, 8.4, 12.0, and 15.6 L/s.

The verified claims concur with the verification report.

8. References

Environment Canada. 2012. Environmental Technology Verification – General Verification Protocol (GVP). Review of Application & Assessment of Technology. [online] http://etvcanada.ca/wp-content/uploads/2013/05/General-Verification-Protocol_Canadian-ETV-Program_June2012-May2013.pdf [accessed June 2016]. Environment Canada, Science and Technology Programs, Science and Technologies Strategies Directorate, Science and Technology Branch, Gatineau, QC.

ISO/FDIS 14034:2015, Environmental management – Environmental technology verification (ETV)

ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories

Appendices

Appendix A. Statistical Analysis

Appendix A contains the detailed worksheets of the statistical analysis undertaken to confirm the CB Shield Technology performance claims.

A.1 Claim 1: Capture Test

No statistical analysis performed. It is not feasible to do repeated tests for the capture test. Instead, a modified mass balance is calculated by weighing the mass of all influent and captured materials to arrive at removal efficiencies.

A.2 Claim 2: Scour Test

A.2.1 Mixed model analysis: Testing for significant difference between scour test effluent loads of control and CB Shield treatment using

A “linear mixed model” approach is taken to compare the effluent loads of the CB Shield and Control treatment.

The scour test is run continuously with test sediment of a specified PSD preloaded and having flow rates altered at 5 minute intervals (1.2, 4.8, 8.4, 12.0, and 15.6 L/s). Effluent loads of the two treatments cannot be compared separately at each flow rate since preceding flow rates affect the amount of sediment left to scour during subsequent flow rates. As a result, for each treatment all collected effluent concentrations are treated as part of a single dataset. However, conventional statics used for comparison of means analysis (i.e., t-test) requires each sample to be independent of each other, put forth as the assumption of independence. Since data from the scour test fails to meet this assumption, a mixed model approach is taken.

A mixed model can represent a “mix” of fixed and random variables. In our study, treatment will be a fixed effect while each run (different flow rate) will be treated as a random effect. More specifically, we account for the interaction of the treatment and run factor as the random effect. The analysis is carried out in “R” statistical software using the “lmer” function of the “lme4” package. To assess if the fixed factor “treatment” (CB Shield, Control) has a significant effect on the model, both a “full” model and a “null” model are created, with and without the fixed effect of “treatment” respectively. An ANOVA is run to compare the “full” and “null” model and a significant difference between the two models indicates that the fixed factor “treatment” is a significant effect. This indicates a significant difference in the responses (effluent loads) of the two treatments.

There are 6 assumptions for linear models:

1. **Linearity:** The dependent variable has to be a result of a linear combination of the independent variables. A residual plot can be used as an indicator. Residuals should not exhibit a recognizable pattern (e.g., exhibit an increase or decrease or a curved relationship)
2. **Homoscedasticity:** Variance of the data should be approximately equal across the range of predicted values. Residuals on a residual plot should be approximately equal distance from the Y=0 line.
3. **Absence of collinearity:** Fixed effects should not be collinear (very closely related) to each other so that it would not be difficult to distinguish between them.
4. **Normality of residuals:** Linear model are relatively robust against violations of normality assumption so this is the least important assumption to satisfy. Normality of residuals can be check using a q-q plot.
5. **Absence of influential data points:** Influential data points can change interpretation of results. The “influence” and “dfbetas” function for the “influence.ME” package can be used in R to check for this.
6. **Independence:** This is the most important assumption for a linear model. If the assumption is not satisfied, and linear “mixed model” is used.

The “full” and “null” models are built using the following codes. Notice that loads is the response variable, treatment is the fixed effect (constant for samples) and the interaction of the treatment and run variables is the random effect (varies for each sample).

```
Code [  
  model_full = lmer(loads_g ~ treatment + (treatment|run), data=test.data, REML=FALSE)  
  model_null = lmer(loads_g ~ (1|run), data=test.data, REML=FALSE)  
  ]
```

Assumptions 1 and 2: Linearity and homoscedasticity

Both assumption 1 and 2 can be checked using a residual plot.

```
Code [  
  ]
```

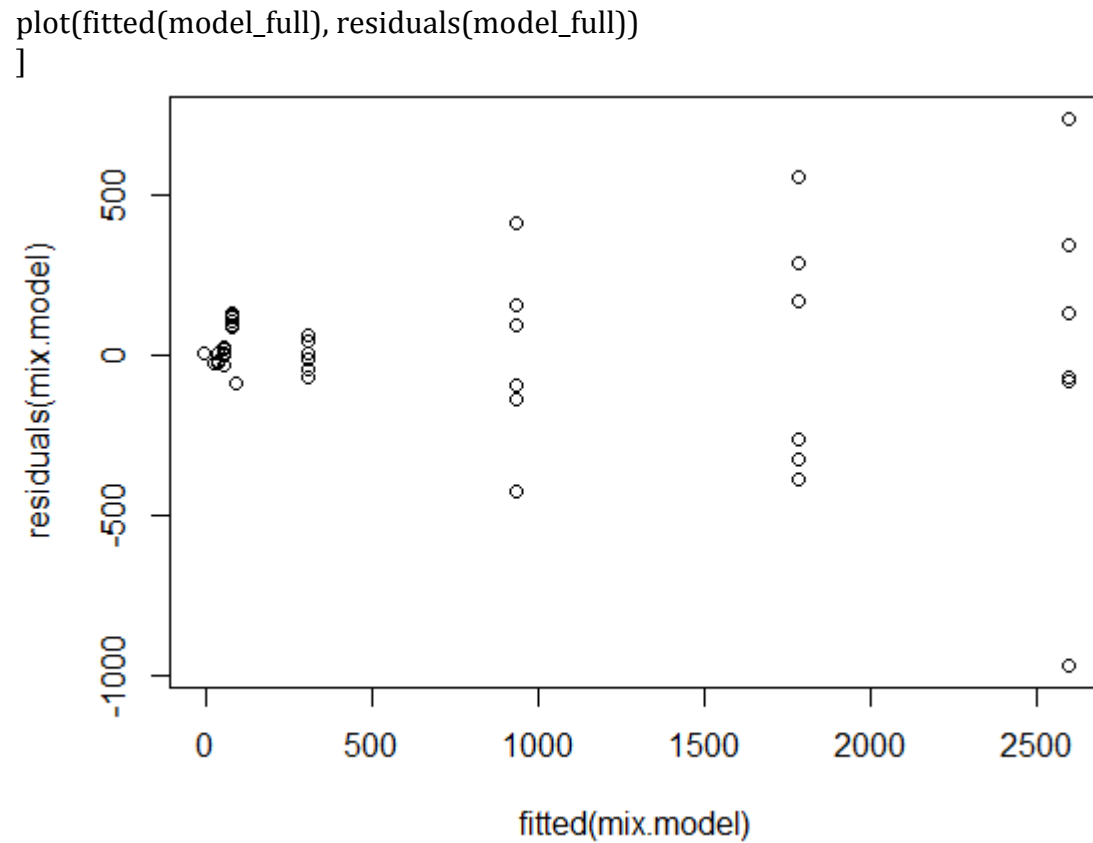


Figure A1. Residual vs. fitted model.

There seems to be a pattern where the residuals of this model are increasingly dispersed. As a result, the response variable (loads) is transformed logarithmically and the assumptions are re-tested.

```
Code [
model_full = lmer(loads_g_log ~ treatment + (treatment|run), data=test.data, REML=FALSE)
model_null = lmer(loads_g_log ~ (1|run), data=test.data, REML=FALSE)

plot(fitted(model_full), residuals(model_full))
]
```

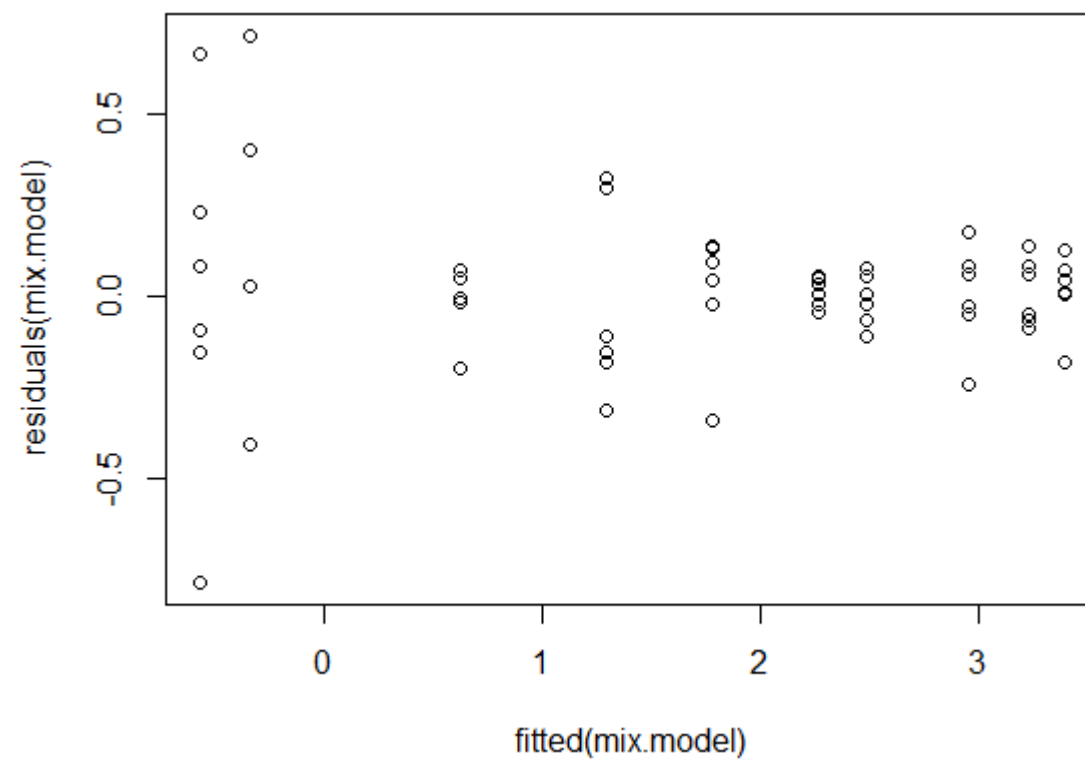


Figure A2. Residual vs. fitted model with log transformed response variable.

This model satisfactorily meets the assumptions 1 and 2. Residuals do not exhibit a clear recognizable pattern and are relatively equidistant from the Y=0 line.

Assumption 3: Absence of collinearity

This assumption is satisfied as the model only identifies one fixed effect with no other closely related variables.

Assumption 4: Normality of residuals

```
Code[
# LOAD LIBRARY
library(fitdistrplus)

# PLOT THE FITTED MODEL AGAINST THE NORMAL DISTRIBUTION
fit.norm <- fitdist(residuals(model_full), "norm")
```

```
plot(fit.norm)
]
```

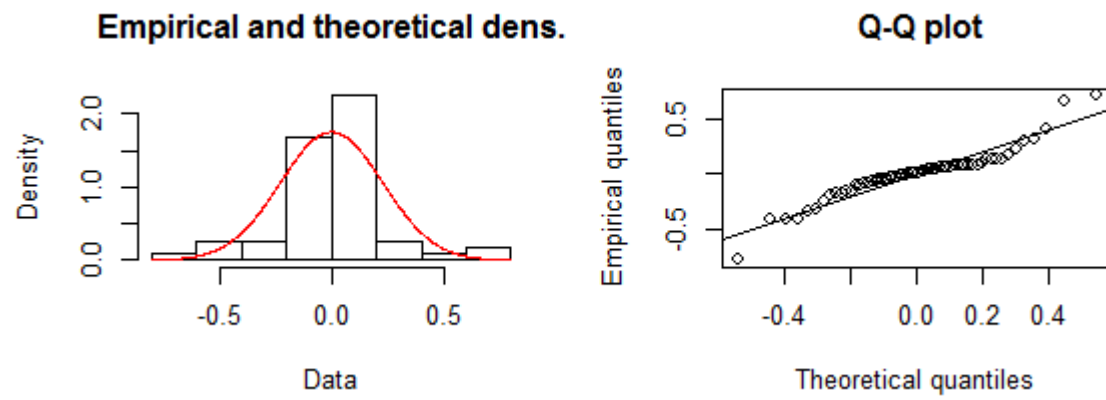


Figure A3. Histogram and Q-Q plot of residuals

Based on figure A3, the model satisfies assumption 4.

Assumption 5: Absence of influential data points

```
Code[
#LOAD LIBRARY
library(influence.ME)

# DFBETA VALUES SHOULD NOT BE MORE THAN 2/sqrt of n; "n" BEING NUMBER OF VALUES
FOR THE GROUPING FACTOR (THERE ARE 5 RUNS/FLOW RATES)
2/(sqrt(5)) # equals 0.8944272

estex.mix.model <- influence(mix.model, "run")
dfbetas(estex.mix.model, parameter =c(0))
]
```

Table A1. DFBETAS values fixed factor by runs.

Run/flow rates	Intercept	treatmentControl
S1	-0.64651330	-0.02705247
S2	-0.50157391	0.88798512
S3	-0.05102875	0.34856408
S4	0.45949187	-0.29719975
S5	0.81812841	-0.93360428

All DFBETA values are less than 2/sqrt of n ($2/(\sqrt{5}) = 0.8944272$); "n" being number of values for the grouping factor (there are 5 runs/flow rates). Assumption 5 is also satisfied.

ANOVA comparing the full and null model, with and without the fixed factor of treatment respectively

```
Code[
anova(model_full, model_null)
]
```

Table A2. Results for ANOVA comparing the full and null model with and without the fixed factor of treatment, respectively.

Model	Df	AIC	BIC	logLik	Deviance	Chisq	Pr(>Chisq)
Model_null	3	206.187	212.470	-100.094	200.187		
Model_full	6	59.523	72.089	-23.761	47.523	152.66	<2.2e-16

Based on table A2, there is significant difference between the models with and without the fixed factor of treatment. It can be inferred that the treatment has a significant effect, and therefore a significant difference can be claimed between the effluent loads from the CB Shield and Control treatments.

A.2.2 Calculating the 95% confidence interval for the effluent load mean quotient of the two treatments

Table A3. Calculated total/mean loads, bootstrapped standard error, standard deviation, and variance for the scour test results.

	N	Total load (g)	Mean load (g)	Bootstrap standard error ^a	Standard deviation	Variance
CB Shield	30	1564.42	52.11	12.69	69.52	4832.47
Control	30	33957.38	1131.91	176.50	966.75	934597.15

^aSince datasets are not well suited to satisfy a normal distribution, a bootstrap method was used to calculate standard errors in the R statistical program. The bootstrap method is less stringent on satisfying the normality assumption for calculation of standard errors.

Ratio of mean effluent loads between the control and CB Shield treatments:

Mean of CB Shield/ Mean of Control
 = 52.150/1131.910
 =0.046
 = The mean effluent load of the CB Shield treatment is 5% of the Control treatment.

Confidence Interval:

Using the standard deviation calculated in Table A1, the following GraphPad web application was used to find the confidence interval:
<http://www.graphpad.com/quickcalcs/errorProp1/>

CI of a sum, difference, quotient or product

Mean of CB Shield **divided by** Mean of Control = 0.046

Table A2. Confidence intervals calculated using bootstrapped standard error at the 90, 95, and 99 percentile (using GraphPad web application)

90% CI: 0.026 to 0.073

95% CI: 0.023 to 0.080

99% CI: 0.016 to 0.096

“These results assume that both variables follow a Gaussian distribution and that the measurements of CB Shield are not paired or matched to measurements of Control. Although the datasets are not entirely normally distributed, the standard error used to calculate the standard deviation was derived using a bootstrap method which is assumed to decrease the stringency on the requirement of normality.

Results computed by the method of EC Fieller, Suppl to J.R.Statist.Soc, 7,1-64 summarized [here](#). ”

Based on the calculated confidence interval, the effluent load of the CB Shield during the scour test is at most 8% of that of the Control treatment.

Appendix B. Supplemental Verification Checklist Pursuant to ISO/FDIS 14034:2015

Appendix B provides a supplemental verification checklist pursuant to ISO/FDIS 14034:2015. It may be useful for the verifier to include this completed Appendix in the final Verification Report.

ISO/FDIS 14034:2015 Checklist Principles, procedures and requirements for ETV		
Reference	Requirements (Criteria)	Verifier Comments
1. Applicant Information	1.1 Applicant name(s), address(es) and physical location(s)	Applicant names and addresses provided.
2. Technology Description	2.1 A unique identifier for the technology (e.g., a commercial name, an identification number or applicable version)	The technology is uniquely identified as CB Shield™.
3. Information about the intended application of the technology NOTE: More than one technology purpose, type of material and measurable property can be provided.	3.1 Purpose of the technology	The technology is a flow deflection device that when inserted into catchbasins dissipates the energy of inflows by deflecting flows to the side walls which prevents scour and increases capture of sediments within storm water runoff by increasing its residence time inside the catchbasin.
	3.2 Type of material for which the technology is intended	The technology is intended to catch suspended sediments from stormwater runoff.
	3.3 Measurable property that is affected by the technology and the way in which it is affected	The effluent sediment concentration of stormwater catchbasins is reduced by the technology.
	3.4 Information sufficient to understand the operation and performance of the technology	Applicant has provided sufficient information to understand the operation (i.e., videos and written instructions) and performance of the technology (lab test results).
	3.5 Development status of the	Technology is ready for the market. Production

	technology proposed for verification and its readiness for market (Note: Technology proposed for verification shall be either already available on the market or available at least at a stage where no substantial change affecting its performance will be implemented before market entry)	line is set up to make 100s at a time.
	3.6 Information on relevant alternatives of the technology, including relevant performance and environmental impacts	Current alternatives are in some form of fine mesh either as a guard surrounding the catchbasin inlet or as a pouch directly under the inlet through which all inflow passes through. More similar alternatives to the CB shield include OGS units, but are more expensive to install or retrofit while the CB Shield can be simply inserted into an existing catch basin.
	3.7 Information on significant environmental impacts of the technology proposed for verification and its environmental added value, if applicable.	Yes, the technology will reduce downstream transport of suspended sediment within stormwater runoff received in the catchbasin.
	3.8 Does the technology fulfil the definition of environmental technology?	Definition: "technology that either results in an environmental added value or measures parameters that indicate an environmental impact". The CB Shield inserted into a catchbasin results in an environmental added value of decreased effluent suspended sediment concentration from catchbasins.
4. Operational aspects	4.1 Are the Installation and operating requirements and conditions described?	Yes, installation, operating requirements, and conditions are detailed within the application in addition to links for videos that show installation and lab testing.
	4.2 Are the service and maintenance requirements described?	Yes, service and maintenance would be that required by normal catchbasins in terms of cleanout. The technology is manufactured with strong fiberglass material making it very durable.
	4.3 Is information provided on the expected length of time for which the technology functions under normal operating conditions?	The applicant expects the technology to operate normally given its durability combined with a regular cleanout cycle of less than 2 years; no specific life expectancy is provided.
5. Legal and regulatory context	5.1 Is information provided on the relevant legal requirements and/or standards related to the technology and its use?	Yes.
	5.2 Does the technology adhere to applicable regulatory requirements?	Yes it adheres to requirements for technologies fitted into a catchbasin.
6. Health and Safety	6.1 Are there any applicable health and safety requirements and considerations?	Health and safety requirements follow those set out for cleaning and maintaining regular catchbasins.
7. Performance claim(s) and parameters	7.1 Do the performance claims for the intended application of the technology address the needs of the interested parties?	Yes, the performance claim addresses typical flows that can be expected for a catchbasin and the performance as a result of the CB Shield insert.
	7.2 Is the information on the technology sufficient to review the performance claim(s)?	Yes, the technology is a fairly straight forward flow deflection device and information provided is sufficient to review performance claims.
	7.3 Do the performance claim(s) to be verified include proposed performance parameters and numerical values?	Yes.

	7.4 Are the performance parameters relevant and sufficient for verification of the performance of the environmental technology, and the environmental added value, if applicable?	Yes, the performance parameters indicate the improvement to sediment capture and retention.
	7.5 Can the performance claims be quantitatively verified through testing?	For the claim regarding removal efficiencies determined through the capture test, the results will be simply stated in the form of a claim. For the scour analysis, a significance difference between control and CB shield catchbasin can be verified and the absolute difference stated.
	7.6 Can their numerical values be verified under set operating conditions, using existing verification plans and relevant technical references, including standardized testing methods, preferably based on international standards?	Their numerical values and analysis for the performance claims were attained by 3 rd party Good Harbour Laboratory under set operating conditions following for the greater part the OGS testing protocol published by TRCA.
8. Test data	8.1 Are relevant test data and the methods for acquiring these data provided to support the performance claim?	Testing methodology, videos taken during testing, and relevant test data were provided to support the performance claims.
	8.2 Are specifications of the requirements for the test data provided, including quality and quantity and testing conditions?	Specific testing conditions were listed in report regarding flow rates, time for each run, height of the sump (false floor), and amount of sediment added to list a few.
	8.3 Is a description provided of the methods for the assessment of the test data and their quality?	Description of the methods used to assess test data and its quality were provided.
	8.4 Are the data at a quality level generally accepted by the scientific community for the technology and/or the industrial sector concerned?	Yes.
	8.5 Are the data of sufficient quality in terms of reproducibility, repeatability, ranges of confidence, accuracy, and uncertainties?	Yes for the most part. There were a few discrepancies related to the filter of recycled effluent flow not working optimally which increased the background sediment concentration and not having enough sediment left over for scour in the control catchbasin for the final flow rate.
	8.6 Are other relevant technical references included, such as other existing verification plans, applicable legislation, standardized test methods and international standards?	Yes, applicant referenced OGS testing protocol upon which much of the testing for the CB Shield was based on.
	8.7 Was information provided to explain deviations from the test plan?	Yes deviations from the OGS testing protocol were evident in the testing methodology.
9. Verification	9.1 Were the test data assessed against the performance specified in the verification plan?	Yes.

	9.2 Do the test data confirm the performance of the technology, achieved under the same conditions, constraints and limitations as those specified?	Yes. Few requests made for proof of analysis and for alteration of claim composition were satisfied.
	9.3 Are the performance claims verified as originally stated?	No.
	9.4 If the performance claims are not verified as originally stated, how should they be modified?	<p><u>Capture test:</u> During the sediment capture test, for a catch basin with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent sediment concentration of 200 mg/L, the catch basin with a CB Shield insert removed 64, 59.9, 52.4, 42.6, 25.2, and 26.7 percent of influent test sediment by mass at inflow rates of 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s, respectively.</p> <p><u>Scour test:</u> For a catchbasin filled to three quarters of the manufacturer's recommended maximum sediment storage depth, with the CB Shield™ insert, scouring of test sediment is at most 8% of the control catchbasin during a continuous 30 minute scour test run with 5 minute duration inflows of 1.2, 4.8, 8.4, 12.0, and 15.6 L/s.</p>

Appendix C. Verification Guidance Pursuant to ISO/FDIS 14034:2015

Appendix C provides guidance on performance testing and verification of technologies pursuant to ISO/FDIS 14034:2015

1. Definition of Roles:

Verifier - Organization that performs environmental technology verification

Test body - Organization that performs testing, test-implementation and reporting on the testing of an environmental technology

Applicant - Organization proposing a technology for which performance will be verified through environmental technology verification

2. Terminology

2.1 Terms related to verification

Verification - Confirmation through the provision of objective evidence

Verification Plan - Detailed planning document for implementation of the environmental technology verification

Verification Report - Document detailing the environmental technology verification and its results

Verification Statement - Document summarizing the results of the environmental technology verification

Test Plan - Detailed planning document specifying the principles, testing methods, conditions and procedures, required to carry out testing and to produce test data

Data Quality - Characteristics of data that relate to their ability to satisfy stated requirements [SOURCE: ISO 14040:2006]

Test Report - Document describing conditions and results of testing

2.2 Terms related to technology

Technology - Application of scientific knowledge, tools, techniques, crafts, or systems in order to solve a problem or achieve an objective, which can result in a product or process

Product - Any goods or service [SOURCE: ISO 14050:2009]

Process - Set of interrelated or interacting activities that transforms inputs into outputs [SOURCE: ISO 14001]

Environmental Technology - Technology that either results in an environmental added value or measures parameters that indicate an environmental impact

Environmental Technology Verification - Verification of the performance of an environmental technology by a verifier

Environmental Impact - Change to the environment, whether adverse or beneficial, wholly or partially resulting from material acquisition, design, production, use, or end-of-use of a technology [SOURCE: adapted from ISO 14001]

Environmental Added Value - More beneficial or less adverse environmental impact of a technology with respect to the relevant alternative

Relevant Alternative - Technology applied currently in similar situation as the environmental technology for which performance will be verified through environmental technology verification

2.3 Terms related to performance

Performance - Measurable result; Performance relates to measurable results supported by numerical quantitative findings. [SOURCE: adapted from ISO 14001]

Performance Claim - Statement of the performance of the environmental technology declared by the applicant

Performance Parameter - Numerical or other measurable factor of the performance of a technology

3. General principles and requirements

3.1 Principles

General - The purpose of environmental technology verification is to provide a credible and impartial account of the performance of environmental technologies. Environmental technology verification is based on a number of principles to ensure that verifications are performed and reported accurately, clearly, unambiguously and objectively.

Factual approach - Verification statements are based on factual and relevant evidence collected through an objective confirmation of the performance of environmental technologies.

Sustainability - Environmental technology verification is a tool in support of sustainability, by providing credible information on the performance of environmental technologies.

Transparency and credibility - Environmental technology verification is based on reliable test results and robust procedures. The process is facilitated such that, to the greatest extent feasible, methods and data are fully disclosed and reports are clear, complete, objective and useful to the interested parties.

Flexibility - Environmental technology verification allows for flexibility in the specification of performance parameters and test methods. This is achieved through dialogue among the applicant, verifier and interested parties to maximize utility of environmental technology verification.

3.2 Requirements

When verifying performance of environmental technologies, the requirements of ISO/FDIS 14034 and the current version of ISO/IEC 17020 Conformity assessment – requirements for the operation of various types of bodies performing inspection - shall be applied and demonstrated.

4. Application review

4.1 Administrative review

Administrative review shall ensure that all information requested for the application has been provided in accordance with the requirements specified.

4.2 Technical review

Technical review shall ensure that:

- a) The technology fulfils the definition of environmental technology
- b) The performance claim for the intended application of the technology addresses the needs of the interested parties
- c) The information on the technology is sufficient to review the performance claim.

4.3 Feedback to Applicant

Any issues related to the acceptance or rejection of the application that may arise from the administrative or the technical review shall be resolved prior to the verification. Acceptance or rejection of the application shall be communicated to the applicant with justification.

5. Pre-verification

5.1 Specification of performance to be verified

Performance to be verified shall be specified in consultation with the applicant prior to the establishment of the verification plan.

Performance parameters shall be specified considering that:

- a) They are relevant and sufficient for the verification of the performance of the environmental technology, and the environmental added value, if applicable;
- b) They correspond in full to the needs of the interested parties;
- c) They can be quantitatively verified through testing;
- d) Their numerical values can be verified under set operating conditions, using existing verification plans and relevant technical references, including standardized testing methods, preferably based on international standards.

5.2 Verification plan

The verification plan shall detail the verification procedure specific to the technology and the performance to be verified. The testing conditions specified in the verification plan shall be identical to the operational conditions of the technology defined. The verification plan shall include at a minimum:

- a) Identification of the verifier;

- b) Identification of the applicant;
- c) Unique identification of the verification plan and date of issue;
- d) Description of the technology;
- e) A list of performance parameters and their assigned numerical values and the description of how they will be verified;
- f) Technical and operational details of the planned verification;
- g) Specification of the requirements for the test data, including quality and quantity and testing conditions;
- h) Description of methods for the assessment of the test data and their quality.

NOTE:

- Requirements on data and data quality should refer to the quality level (e.g. regarding reproducibility, repeatability, ranges of confidence, accuracy, uncertainties,) generally accepted by the scientific community for the technology or (by default) in the industrial sector concerned.
- Other existing verification plans, similar relevant technical references including applicable legislation and standardized test methods, preferably international standards, should be used or referred to wherever available.

6. Verification

The verification of the performance shall be organized as follows: i) acceptance of existing test data; ii) generation of additional test data if needed and iii) confirmation of the performance based on the results of test data assessment.

6.1 Acceptance of existing test data

Test data provided by the applicant which were generated prior to verification may be accepted for the verification if they meet the following requirements:

- a) They are relevant for the performance to be verified;
- b) They are produced and reported according to the requirements of ISO/IEC 17025;
- c) They meet the requirements specified in the verification plan.

If the existing test data do not meet the above requirements then additional test data shall be generated. This shall be communicated to the applicant.

6.2 Generation of additional test data

If any additional test data is required, they shall be produced meeting the requirements specified. This shall be communicated to the applicant.

6.3 Confirmation of performance

Existing test data, that is accepted and additional test data that is generated shall be assessed against the performance specified in the verification plan. The result of the assessment shall be a confirmation of the performance of the technology, achieved under the same conditions, constraints and limitations as those specified for the generation of the test data used for verification.

7. Reporting

7.1 Verification report

A verification report shall be developed. It shall adhere to the verification plan and shall include at a minimum:

- a) Identification of the verifier;
- b) Identification of the applicant;
- c) Unique identification of the report and date of issue;
- d) Date of verification;
- e) Description of the technology;
- f) Test results;
- g) Verification results including the verified performance, test conditions, constraints and limitations under which they are met;
- h) Description on how the requirements for the verification of the performance and for the test data, as specified in the verification plan, were met, including reporting of any deviations;
- i) Signature or other indication of approval by verifier;

If it is necessary to include, information not verified under the environmental technology verification, this shall be clearly stated and explained. The report shall be submitted to the applicant for review and comment. The comments may be incorporated as deemed appropriate.

7.2 Verification statement

A short document summarizing the verification report shall be developed. It shall include at a minimum:

- a) Identification of the verifier;
- b) Identification of the applicant;
- c) Unique identification of the statement and date of issue;
- d) A summary description of the technology;
- e) A summary description on how the requirements specified in the verification plan were met;
- f) Verification results including the verified performance;
- g) Description on how the requirements of the verification specified in the verification plan were met including reporting of any deviations
- h) A summary of the verification results including the verified performance, test conditions, constraints and limitations under which they are met;
- i) A statement that the verification plan has been addressed,
- j) Any other information necessary to understand and use the verification statement
- k) Signature or other indication of approval by the verifier.

If it is necessary to include, information not verified under the environmental technology verification this shall be clearly stated and explained. The statement shall be submitted to the applicant for review and comment. The comments may be incorporated as deemed appropriate.

8. Post-verification

8.1 Publication

At a minimum, the verification statement should be made available publicly. The publication shall be included in a publicly available directory (e.g. website).

The applicant shall make the statement available to interested parties in full and shall not use parts of the statement for any purpose.

8.2 Validity of the verification report / verification statement

The applicant shall:

- a) Ensure that the technology which performance has been verified is conforming to the conditions as per its verification, published verification statement and report, if relevant;
- b) Inform the verifier, in writing, of any changes that are made to the technology.

Based on the information provided by the applicant, the verifier shall determine the impact of any changes on the verified performance of the technology to the verification conditions, and therefore the validity of the verification statement and the verification report.

If it is determined that the verification statement and verification report are no longer valid, it shall be communicated to the applicant and made publicly available

8.3 Expiration

An expiration date may be established on the verification statement. After the defined time period, upon demonstration that no changes affecting the verified performance have occurred in the technology, the validity of the verification statement could be extended under the same conditions.

9. References

ISO/IEC 14001, Environmental management systems - Requirements with guidance for use

ISO/IEC 14025, Environmental labels and declarations – Type III environmental declarations – Principles and procedures

ISO/IEC 14040, Environmental management — Life cycle assessment — Principles and framework

ISO/IEC 14050, Environmental management — Vocabulary

ISO/IEC 17020, General criteria for the operation of various types of bodies performing inspection

ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories

ISO Guide 82, Guidelines for addressing sustainability in standards

Appendix D. Raw data

Capture test raw data

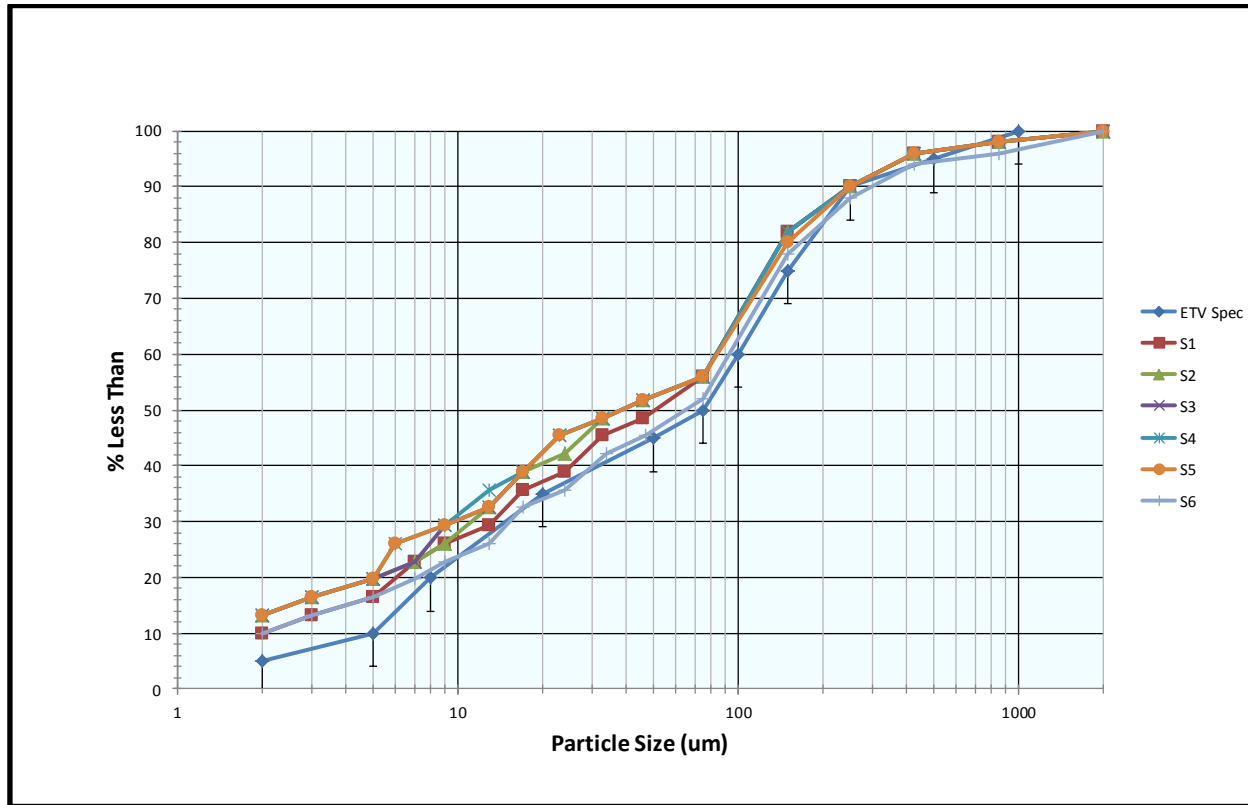


Figure D1. Feed sediment particle size distribution.

Table D1. Removal efficiency based on mass balance.

Run		S1	S2	S3	S4	S5	S6
Target Flow Rate	(L/s)	0.24	0.48	1.2	2.4	6.0	8.4
	(gpm)	3.8	7.7	19.0	38.0	95.1	133
Sediment Mass Added	(kg)	1.217	2.302	5.072	5.150	4.921	4.812
Sediment Captured in Catch Basin	(kg)	0.765	1.368	2.643	2.184	1.238	1.287
Sediment Captured on FCS and Grate	(kg)	0.013	0.010	0.016	0.012	0	0
Total Mass Captured	(kg)	0.778	1.378	2.659	2.196	1.238	1.287
Removal Efficiency	(%)	64.0	59.9	52.4	42.6	25.2	26.7

Scour test raw data

**Run Summary for CB Shield – Simulated Streetscape
- Control (No CB Shield Installed)**

Run Date: March 6th, 2015

Sediment Pre-load:

- The test sediment was the AGSCO silica sand (1-1000 micron)
- Sediment was pre-loaded on March 5th
- The total sediment load was 53 kg
- Following the preload, the sump was filled with water and allowed to sit overnight

Water Temperature:

Temperature at 1:00 minutes into run: 18.1 °C
 Temperature at 7:00 minutes into run: 12.3 °C
 Temperature at 13:00 minutes into run: 11.7 °C
 Temperature at 52:30 minutes into run: 12.5 °C

Run Data:

Target Flow Rate	Run Time	Flow Rate
1.2 L/S (19 GPM)	0:00	19.3 ¹
	0:30	19.7 ¹
	1:00	19.8
	1:30	19.9
	2:00	19.9
	2:30	19.9
	3:00	19.9
	3:30	19.9
	4:00	19.8
	4:30	19.9
	5:00	19.9
	5:30	20.0
	6:00	22.3
	Average Flow Rate (US GPM):	
4.8 L/S (76 GPM)	6:30	74.2 ¹
	7:00	76.3
	7:30	76.3
	8:00	76.3
	8:30	76.2
	9:00	76.2
	9:30	76.2
	10:00	76.0
	10:30	76.2
	11:00	76.1

	11:30	76.0
	12:00	80.7
Average Flow Rate (US GPM):		76.6
¹ Transition flow rate, not included in the average		
Target Flow Rate	Run Time	Flow Rate
8.4 L/S (133 GPM)	12:30	134.6 ¹
	13:00	132.6
	13:30	132.9
	14:00	132.4
	14:30	132.5
	15:00	132.9
	15:30	132.8
	16:00	132.5
	16:30	132.7
	17:00	132.4
	17:30	132.6
	18:00	132.4
Average Flow Rate (US GPM):		132.6
12.0 L/S ² (190 GPM)	25:00	185.2 ¹
	25:30	188.7
	26:00	189.3
	26:30	189.5
	27:00	191.0
	27:30	191.0
	28:00	190.8
	28:30	190.8
	29:00	190.6
	29:30	191.0
	30:00	190.7
	30:30	191.2
Average Flow Rate (US GPM):		190.4
15.6 L/S ³ (247 GPM)	52:00	245.7 ¹
	52:30	249.1
	53:00	248.2
	53:30	248.6
	54:00	248.0
	54:30	247.9
	55:00	247.9
	55:30	247.7
	56:00	248.1
	56:30	247.9
	57:00	247.8
	57:30	247.7
Average Flow Rate (US GPM):		248.1

¹ Transition flow rate, not included in the average

² The system was shut down between flow 8.4 L/s and flow 12.0 L/s due to standpipe overflow

³ The system was shut down between flow 12.0 L/s and flow 15.6 L/s due to standpipe overflow

Effluent Analysis:

Run Time (minutes)	Sample ID	Sample Description	SSC (mg/L)	
			Measured	Corrected ⁴
0:00	Background 1-1	Background sample taken at 1.2 L/s	< MDL	-
0:30	Effluent 1-1	1.2 L/s transition sample #1	94.3	94.3
1:00	Effluent 2-1	1 st sample taken at 1.2 L/s	129.2	129.2
2:00	Effluent 3-1	2 nd sample taken at 1.2 L/s	185.3	185.3
3:00	Effluent 4-1	3 rd sample taken at 1.2 L/s	206.0	206.0
4:00	Effluent 5-1	4 th sample taken at 1.2 L/s	176.0	176.0
5:00	Effluent 6-1	5 th sample taken at 1.2 L/s	523.6	523.6
6:00	Effluent 7-1	6 th sample taken at 1.2 L/s	495.7	495.7
7:00	Background 2-1	Background sample taken at 4.8 L/s	< MDL	-
6:30	Effluent 8-1	4.8 L/s transition sample #1	6420	6420
7:00	Effluent 9-1	1 st sample taken at 4.8 L/s	7164	7164
8:00	Effluent 10-1	2 nd sample taken at 4.8 L/s	8094	8094
9:00	Effluent 11-1	3 rd sample taken at 4.8 L/s	6762	6762
10:00	Effluent 12-1	4 th sample taken at 4.8 L/s	4842	4842
11:00	Effluent 13-1	5 th sample taken at 4.8 L/s	5266	5266
12:00	Effluent 14-1	6 th sample taken at 4.8 L/s	4768	4768
13:00	Background 3-1	Background sample taken at 8.4 L/s	1.8	-
12:30	Effluent 15-1	8.4 L/s transition sample #1	6665	6663
13:00	Effluent 16-1	1 st sample taken at 8.4 L/s	5431	5429
14:00	Effluent 17-1	2 nd sample taken at 8.4 L/s	6649	6648
15:00	Effluent 18-1	3 rd sample taken at 8.4 L/s	5027	5025
16:00	Effluent 19-1	4 th sample taken at 8.4 L/s	5861	5859
17:00	Effluent 20-1	5 th sample taken at 8.4 L/s	5021	5019
18:00	Effluent 21-1	6 th sample taken at 8.4 L/s	3251	3249
The system was shut down due to standpipe overflow				
25:30	Background 4-1	Background sample taken at 12.0 L/s	41.2	-
25:00	Effluent 22-1	12.0 L/s transition sample #1	1569	1528
25:30	Effluent 23-1	1 st sample taken at 12.0 L/s	1927	1886
26:30	Effluent 24-1	2 nd sample taken at 12.0 L/s	1474	1432
27:30	Effluent 25-1	3 rd sample taken at 12.0 L/s	1208	1167
28:30	Effluent 26-1	4 th sample taken at 12.0 L/s	1550	1508
29:30	Effluent 27-1	5 th sample taken at 12.0 L/s	1141	1100
30:30	Effluent 28-1	6 th sample taken at 12.0 L/s	749.5	708
The system was shut down due to standpipe overflow				
52:00	Effluent 29-1	15.6 L/s transition sample #1	Not tested	-
52:30	Background 5-1	1 st Background sample taken at 15.6 L/s	145.6	-
52:30	Effluent 30-1	1 st effluent sample taken at 15.6 L/s	532.5	386.9
53:30	Background 6-1	2 nd Background sample taken at 15.6 L/s	179.2	-
53:30	Effluent 31-1	2 nd effluent sample taken at 15.6 L/s	432.0	252.7
54:30	Background 7-1	3 rd Background sample taken at 15.6 L/s	182.4	-
54:30	Effluent 32-1	3 rd effluent sample taken at 15.6 L/s	554.9	372.5
55:30	Background 8-1	4 th Background sample taken at 15.6 L/s	198.2	-
55:30	Effluent 33-1	4 th effluent sample taken at 15.6 L/s	530.6	332.4

56:30	Background 9-1	5 th Background sample taken at 15.6 L/s	200.3	-
56:30	Effluent 34-1	5 th effluent sample taken at 15.6 L/s	480.1	279.8
57:30	Background 10-1	6 th Background sample taken at 15.6 L/s	210.0	-
57:30	Effluent 35-1	6 th effluent sample taken at 15.6 L/s	520.2	310.2

MDL – Method detection limit

$$^4 \text{SSC}_{\text{corrected}} = \text{SSC}_{\text{measured}} - \text{SSC}_{\text{background}}$$

Run Summary for CB Shield Scour Testing
– Simulated Streetscape - With CB Shield Insert

Run Date: March 13th, 2015

Sediment Pre-load:

- The test sediment was the AGSCO silica sand (1-1000 micron)
- Sediment was pre-loaded on March 12th
- The total sediment load was 53 kg
- Following the preload, the sump was filled with water and allowed to sit overnight

Water Temperature:

Temperature at 1:00 minutes into run: 17.1 °C
 Temperature at 7:00 minutes into run: 10.6 °C
 Temperature at 13:00 minutes into run: 10.0 °C
 Temperature at 19:00 minutes into run: 10.4 °C
 Temperature at 25:00 minutes into run: 10.7 °C

Run Data:

Target Flow Rate	Run Time	Flow Rate
1.2 L/S (19 GPM)	0:00	17.7 ¹
	0:30	18.8 ¹
	1:00	18.8
	1:30	18.9
	2:00	18.9
	2:30	19.0
	3:00	18.9
	3:30	19.0
	4:00	18.9
	4:30	18.9
	5:00	18.9
	5:30	18.9
	6:00	18.9
	Average Flow Rate (US GPM):	
4.8 L/S (76 GPM)	6:30	50.9 ¹
	7:00	76.6
	7:30	76.5
	8:00	76.2
	8:30	76.0
	9:00	75.8
	9:30	76.0
	10:00	76.0
10:30	75.8	

	11:00	75.8
	11:30	76.0
	12:00	75.9
Average Flow Rate (US GPM):		76.1
¹ Transition flow rate, not included in the average		
Target Flow Rate	Run Time	Flow Rate
8.4 L/S (133 GPM)	12:30	131.0 ¹
	13:00	132.6
	13:30	132.5
	14:00	132.8
	14:30	132.7
	15:00	132.6
	15:30	133.0
	16:00	132.8
	16:30	132.8
	17:00	132.8
	17:30	132.8
	18:00	132.6
Average Flow Rate (US GPM):		132.7
12.0 L/S (190 GPM)	25:00	181.9 ¹
	25:30	187.6
	26:00	188.5
	26:30	189.8
	27:00	189.4
	27:30	189.2
	28:00	190.0
	28:30	189.4
	29:00	189.6
	29:30	190.0
	30:00	189.9
	30:30	189.9
Average Flow Rate (US GPM):		189.4
15.6 L/S (247 GPM)	52:00	247.5 ¹
	52:30	248.0
	53:00	247.8
	53:30	247.6
	54:00	247.5
	54:30	247.6
	55:00	247.7
	55:30	247.6
	56:00	247.6
	56:30	247.7
	57:00	247.6
	57:30	247.5
Average Flow Rate (US GPM):		247.7

¹ Transition flow rate, not included in the average

Effluent Analysis:

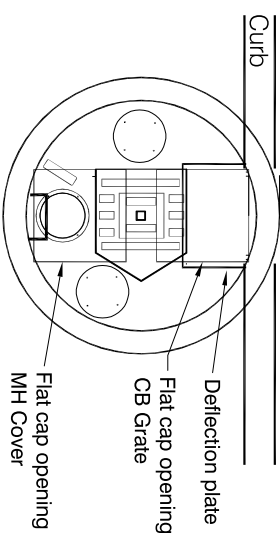
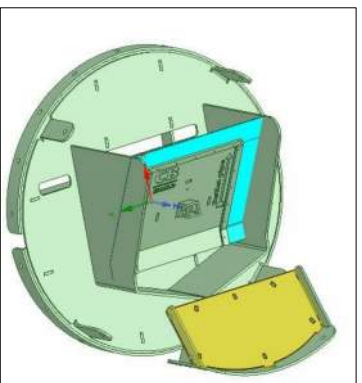
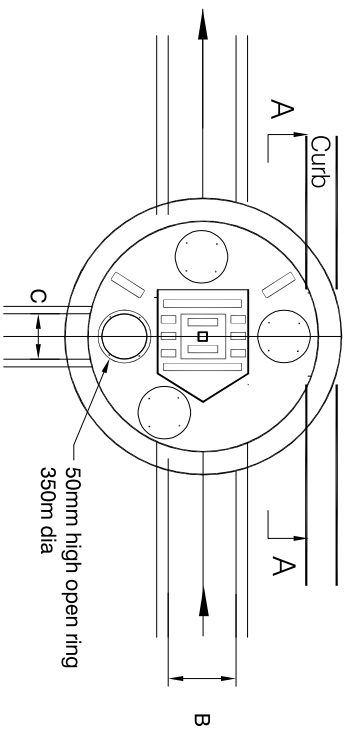
Run Time (minutes)	Sample ID	Sample Description	SSC (mg/L)	
			Measured	Corrected ²
0:00	Background 1-1	Background sample taken at 1.2 L/s	< MDL	-
0:30	Effluent 1-1	1.2 L/s transition sample #1	31.5	31.5
1:00	Effluent 2-1	1 st sample taken at 1.2 L/s	17.7	17.7
2:00	Effluent 3-1	2 nd sample taken at 1.2 L/s	6.5	6.5
3:00	Effluent 4-1	3 rd sample taken at 1.2 L/s	2.7	2.7
4:00	Effluent 5-1	4 th sample taken at 1.2 L/s	3.1	3.1
5:00	Effluent 6-1	5 th sample taken at 1.2 L/s	4.6	4.6
6:00	Effluent 7-1	6 th sample taken at 1.2 L/s	< MDL	< MDL
7:00	Background 2-1	Background sample taken at 4.8 L/s	< MDL	-
6:30	Effluent 8-1	4.8 L/s transition sample #1	3.0	3.0
7:00	Effluent 9-1	1 st sample taken at 4.8 L/s	8.2	8.2
8:00	Effluent 10-1	2 nd sample taken at 4.8 L/s	4.0	4.0
9:00	Effluent 11-1	3 rd sample taken at 4.8 L/s	< MDL	< MDL
10:00	Effluent 12-1	4 th sample taken at 4.8 L/s	< MDL	< MDL
11:00	Effluent 13-1	5 th sample taken at 4.8 L/s	1.7	1.7
12:00	Effluent 14-1	6 th sample taken at 4.8 L/s	< MDL	< MDL
13:00	Background 3-1	Background sample taken at 8.4 L/s	< MDL	-
12:30	Effluent 15-1	8.4 L/s transition sample #1	2.5	2.5
13:00	Effluent 16-1	1 st sample taken at 8.4 L/s	5.4	5.4
14:00	Effluent 17-1	2 nd sample taken at 8.4 L/s	10	10
15:00	Effluent 18-1	3 rd sample taken at 8.4 L/s	9.5	9.5
16:00	Effluent 19-1	4 th sample taken at 8.4 L/s	10	10
17:00	Effluent 20-1	5 th sample taken at 8.4 L/s	8.4	8.4
18:00	Effluent 21-1	6 th sample taken at 8.4 L/s	8.2	8.2
19:00	Background 4-1	Background sample taken at 12.0 L/s	1.6	-
18:30	Effluent 22-1	12.0 L/s transition sample #1	21.1	19.5
19:00	Effluent 23-1	1 st sample taken at 12.0 L/s	40.0	38.4
20:00	Effluent 24-1	2 nd sample taken at 12.0 L/s	81.0	79.4
21:00	Effluent 25-1	3 rd sample taken at 12.0 L/s	115	113
22:00	Effluent 26-1	4 th sample taken at 12.0 L/s	104	103
23:00	Effluent 27-1	5 th sample taken at 12.0 L/s	116	114
24:00	Effluent 28-1	6 th sample taken at 12.0 L/s	93.9	92.3
25:00	Background 5-1	1 st Background sample taken at 15.6 L/s	2.0	-
24:30	Effluent 29-1	15.6 L/s transition sample #1	131.3	128.0
25:00	Effluent 30-1	1 st sample taken at 15.6 L/s	180.8	177.4
26:00	Effluent 31-1	2 nd sample taken at 15.6 L/s	214.9	211.6
27:00	Effluent 32-1	3 rd sample taken at 15.6 L/s	223.7	220.3

28:00	Effluent 33-1	4 th sample taken at 15.6 L/s	191.1	187.8
29:00	Effluent 34-1	5 th sample taken at 15.6 L/s	227.7	224.4
30:00	Effluent 35-1	6 th sample taken at 15.6 L/s	202.5	199.2
30:00	Background 6-1	2 nd Background sample taken at 15.6 L/s	4.6	-

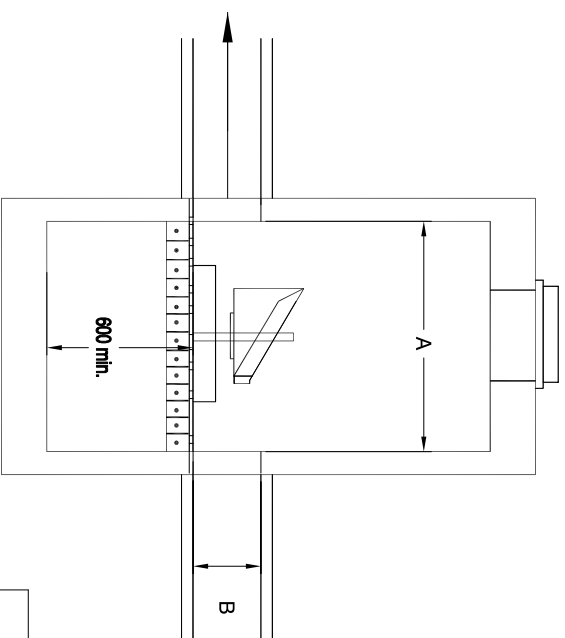
MDL – Method detection limit

² $SSC_{corrected} = SSC_{measured} - SSC_{background}$

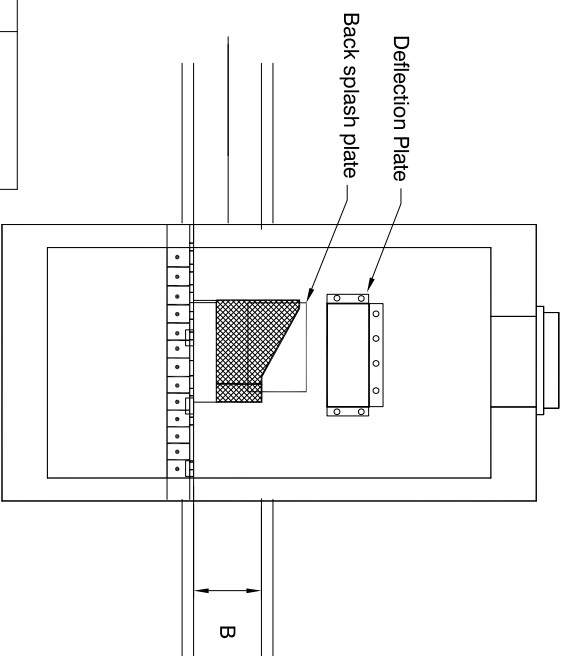
For additional datasets please request for vendor's CETV formal application.



Twin inlet Flat cap



Section A-A

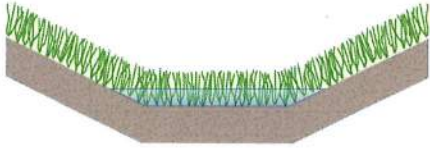


Inlet deflection wall





Sizing					
A	B	C	min depth	Cap type	
1200	600	450	1.2m	Standard	
1500	825	600	1.5m	Twin Inlet	
1800	1050	825	1.8m	Twin Inlet	
2400	1200	600	2.1m	Cap type	
1800 DCBMH	See detail dwg	see detail dwg	1.5m	see detail	



9.12 GRASS SWALES



A grass swale is a stable, parabolic or trapezoidal channel that is lined with turf; it is used to improve water quality and convey stormwater runoff. Grass swales do not rely on the permeability of the underlying soil for pollutant removal; instead, pollutants are removed by settling and filtration through the grass. The maximum total suspended solids (TSS) removal rate is 50%.

N.J.A.C. 7:8 Stormwater Management Rules - Design and Performance Standards		
	Nonstructural Strategies	Assist with Strategies #4 and 8; See Page 2
	Water Quantity	Not Allowed
	Groundwater Recharge	Not Allowed
	Water Quality	≤ 50% TSS

Water Quality Mechanisms and Corresponding Criteria	
Settling	
Minimum Length	50 feet
Manning's n value	0.25 for Water Quality Design Storm
Vegetative Uptake and Filtration	
Minimum Density of Vegetation	95%
Grass Height	Between 3 and 6 inches
Longitudinal Slope	Between 2 - 10%
Minimum Required Length	For 50% TSS Removal Rate: 50 Feet - singular point of inflow 200 Feet - continuous inflow along entire length
Flow Characteristics	Maximum 2-inch depth Maximum velocity 0.9 feet/second Must fully drain within 72 hours

Introduction

Grass swales are turf lined channels used to convey and treat stormwater. Swales reduce suspended particles through filtration and settling and are best suited to treat runoff generated from impervious surfaces of small drainage areas. Typically grass swales are installed in low-gradient lawns, median strips, parking lot islands, unused lot areas and utility easements, where downstream flow attenuation is provided to control larger storm events. Grass swales can be used wherever soil conditions, slopes and sunlight permit the establishment and maintenance of a dense stand of vegetation.

Low velocities and shallow depths of runoff generated by the Water Quality Design Storm allow for particulate settling; while at the same time, the blades of grass in the swale filter the suspended solids. Because these pollutant removal mechanisms do not rely on infiltration into the subsoil, soil permeability is not a design consideration. For larger storm events, the swale can be designed to convey stormwater downstream.

Grass swales must have a maintenance plan, and, if privately owned, must be protected by easement, deed restriction, ordinance or other legal measure that prevents its neglect, adverse alteration or removal.

Applications



The nonstructural stormwater management strategies design standard in the Stormwater Management rules must be addressed for all major development, pursuant to N.J.A.C. 7:8-5.3(a). The site evaluation for nonstructural strategies must consider all nine strategies. The design of a grass swale could assist in maximizing the following strategies:

- Strategy #4: The minimization of the decrease in time of concentration;
- Strategy #8: The provision of vegetated, open-channel conveyances.

Additional information on nonstructural stormwater management strategies can be found in *Chapter 2: Low Impact Development Techniques*.



Grass swales may be designed to convey storm events larger than the Water Quality Design Storm; regardless of the design storm chosen, all grass swales must be designed for stability and capacity in accordance with the *Standards for Soil Erosion and Sediment Control in New Jersey*, as required by N.J.A.C. 7:8 Stormwater Management rules.



To receive credit for a maximum of 50% TSS removal rate, grass swales must be designed to treat the Water Quality Design Storm and in accordance with the all of the criteria below.

Design Criteria

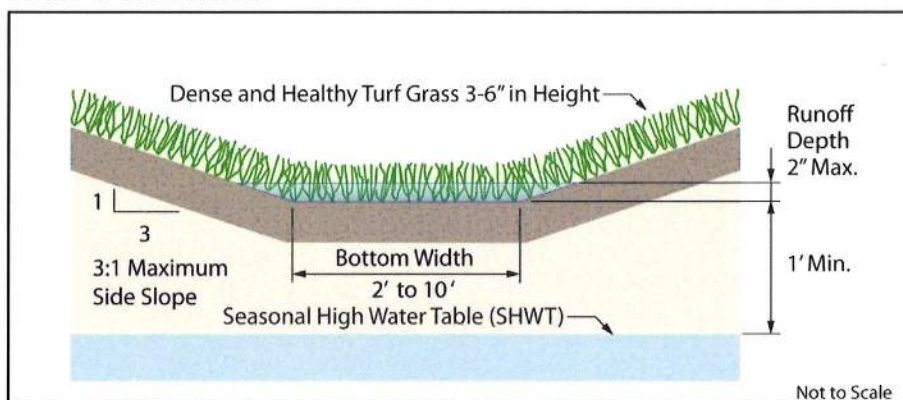
Basic Requirements

There are two categories of grass swales; the following design criteria apply to all categories and must be met in order to receive a TSS removal rate for this BMP. It is critical that all grass swales are designed in accordance with these criteria in order to ensure proper operation, to maximize the functional life of the system, and to ensure public safety. For criteria specific to each category, see the applicable section, beginning on page 6.

Cross-Sectional Geometry

- Grass height must be established and maintained between 3 and 6 inches.
- The swale may be trapezoidal or parabolic, with a bottom width between 2 and 10 feet.
- The maximum allowable side slope is 3:1, with a recommended side slope of 4:1.
- There must be a minimum separation of 1 foot between the bottom of the swale and the seasonal high water table (SHWT).

Swale Cross-Section



Flow Characteristics

- The runoff depth must be calculated using Manning's Equation with a Manning's n value of 0.25. This Manning's n value may only be used with the Water Quality Design Storm for TSS removal.
- The maximum allowable depth of runoff in the swale is 2 inches.
- The maximum allowable velocity is 0.9 feet/second.
- All standing water must drain from the surface of the grass swale within 72 hours.

Longitudinal Geometry

- The minimum longitudinal slope is 2%. In situations where the design criteria cannot be met using the 2% slope, such as when runoff velocity exceeds the maximum of 0.9 feet per second, this slope may be reduced to 1.5%. At this reduced slope, some infiltration of runoff into the subsoil will be necessary in order for the swale to drain in the required 72 hours. Therefore, for any grass swale designed with a slope less than 2%, a minimum 2-foot separation from the SHWT and a field-tested subsoil permeability rate of at least 1 inch/hour in accordance with the soil testing procedures found in Appendix E are required. Grass swales may not be used to meet the groundwater recharge requirement at N.J.A.C. 7:8-5.4(a)2.
- The maximum longitudinal slope is 10%.
- In order to receive the 50% TSS removal rate for the entire length of a Point Inflow Grass Swale, the minimum swale length is 50 feet.
- In order to receive the 50% TSS removal rate for the entire length of a Linear Inflow Grass Swale, the minimum swale length is 200 feet; however, for swales with lengths less than 200 feet, a weighted average may be achieved. See Example 5 for more information on calculating TSS removal rates using a weighted average.

Stability

- Grass swales must be stabilized in accordance with the current version of *Standards for Grassed Waterways in the Standards for Soil Erosion and Sediment Control in New Jersey*.

Types of Grass Swales

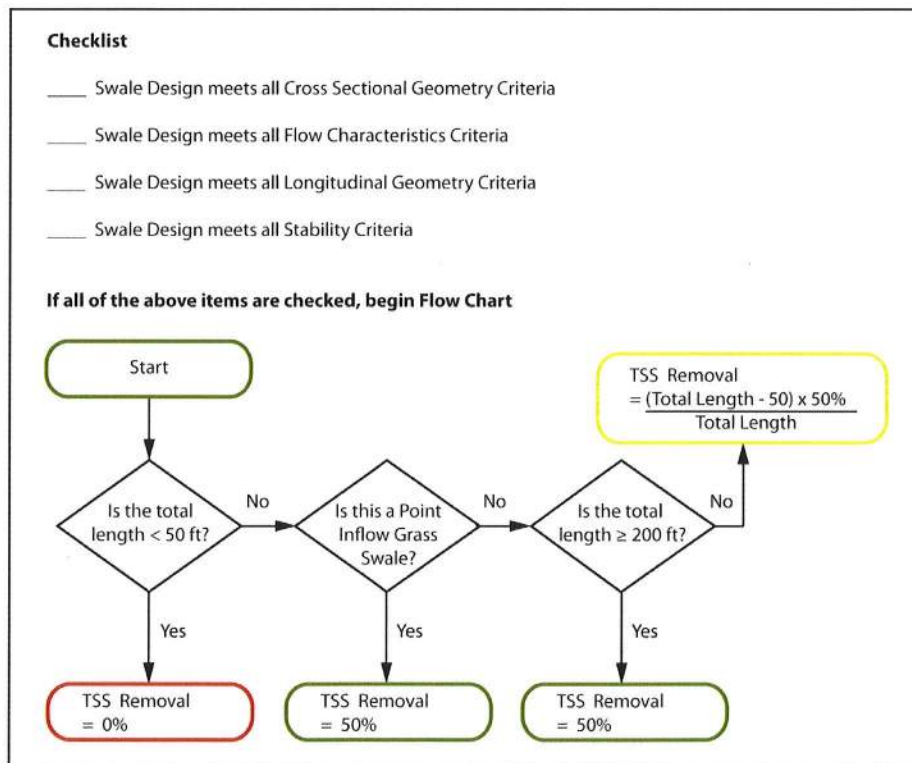
There are two types of grass swales:

1. Point Inflow
2. Linear Inflow

Runoff enters a Point Inflow Grass Swale at a single location, such as a pipe. A Linear Inflow Grass Swale receives distributed runoff along its entire length; a grass-lined ditch along an uncurbed section of roadway is an example of a Linear Inflow Grass Swale.

TSS removal rates vary depending on the type and configuration of the swale. The section beginning on page 6 provides examples of how to calculate the TSS removal rate for different configurations. **Regardless of the design, all of the criteria in the basic requirements section must be met in order for the swale to receive a TSS removal rate.** The following checklist and flowchart may be helpful in determining the TSS removal rate for a particular grass swale.

Grass Swale Checklist and General Flow Chart



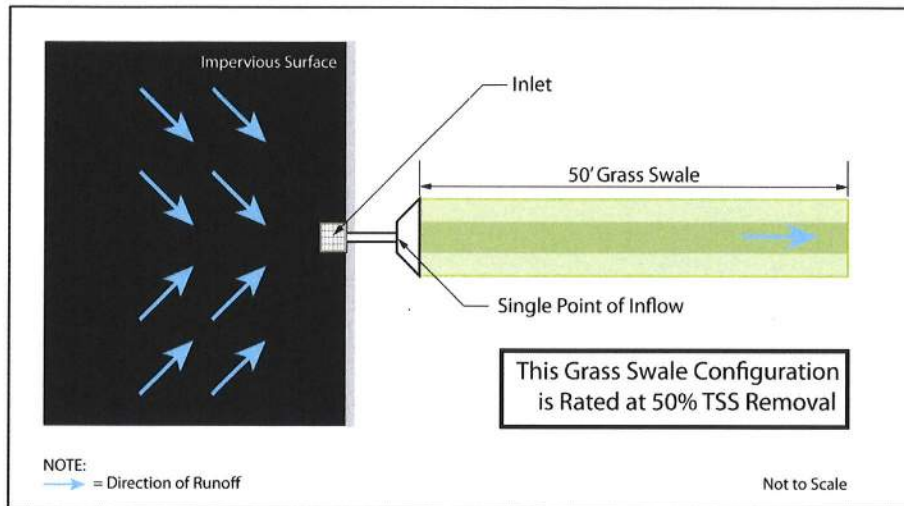
Individual Types of Grass Swales

This section provides detailed design criteria for each grass swale category. The illustrations depict possible configurations and flow paths and are not intended to limit the design.

Point Inflow Grass Swales

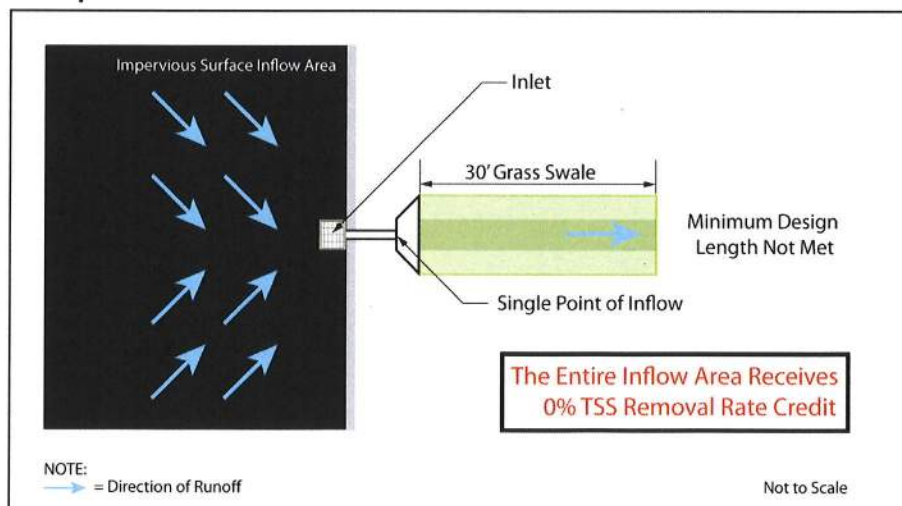
Example 1 shows a 50-foot Point Inflow Grass Swale receiving runoff from an impervious area; the inflow enters at the upstream end of the 50-foot swale. Because all of the runoff produced by the drainage area is collected prior to entering the swale, and assuming that all of the other design criteria for water quality are met, the entire inflow drainage area receives the 50% TSS removal rate.

Example 1:



In Example 2, the swale length does not meet the minimum requirement of 50 feet; therefore, this Point Inflow Grass Swale achieves a TSS removal rate of 0% and no TSS removal credit is allotted to the inflow drainage area.

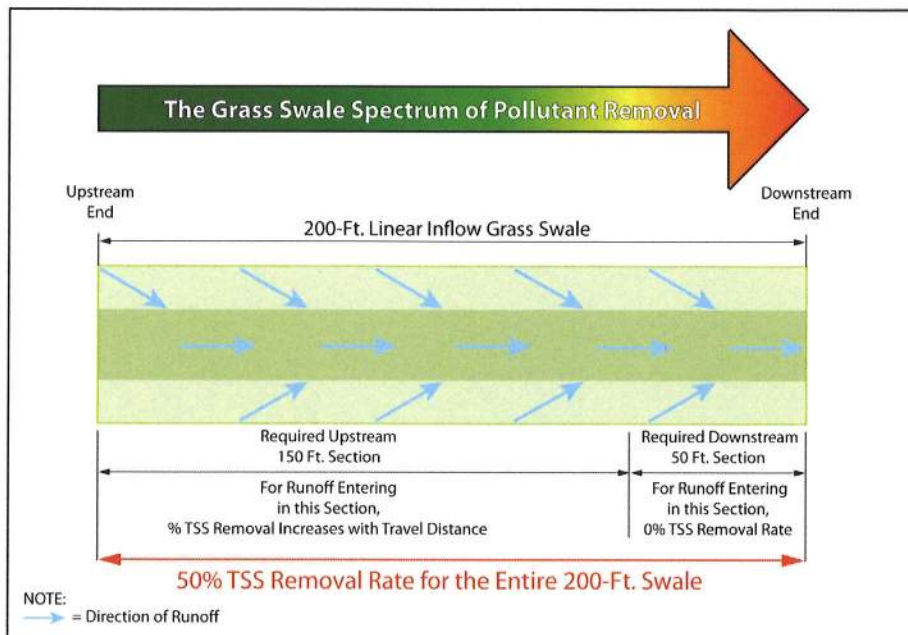
Example 2:



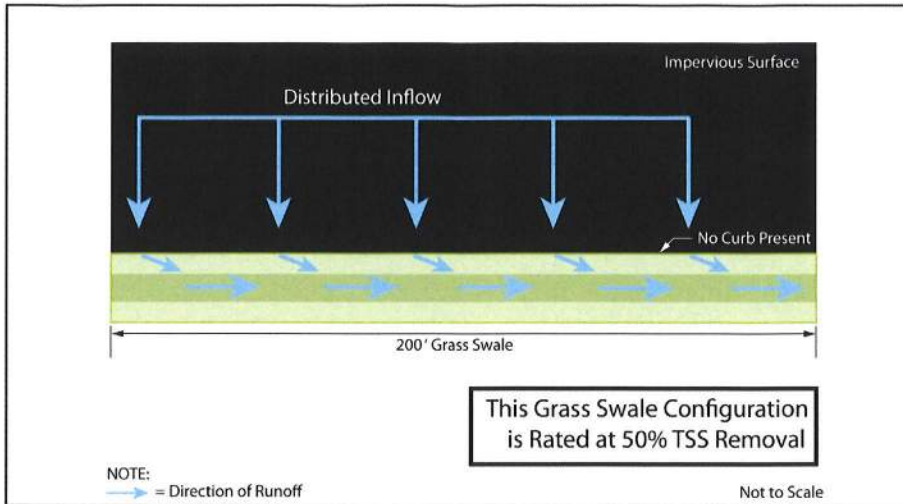
Linear Inflow Grass Swales

The following graphic illustrates the gradient of pollutant removal within a 200 foot Linear Inflow Grass Swale. Because grass swales treat runoff through vegetative uptake and filtration, the amount of treatment increases with increased flow lengths. Runoff entering at the downstream end receives much less treatment than runoff entering upstream. Moreover, runoff must travel farther than 50 feet for adequate treatment. For calculation purposes, the required downstream 50-foot section of a Linear Inflow Grass Swale is awarded a 0% TSS removal rate. However, swales 200 feet in length are awarded a 50% TSS removal rate, provided that they meet all other criteria, because the runoff entering upstream receives enough treatment to compensate for the low level of treatment in the downstream section, as shown in Example 3 on the following page.

Linear Inflow Grass Swale – Pollutant Removal



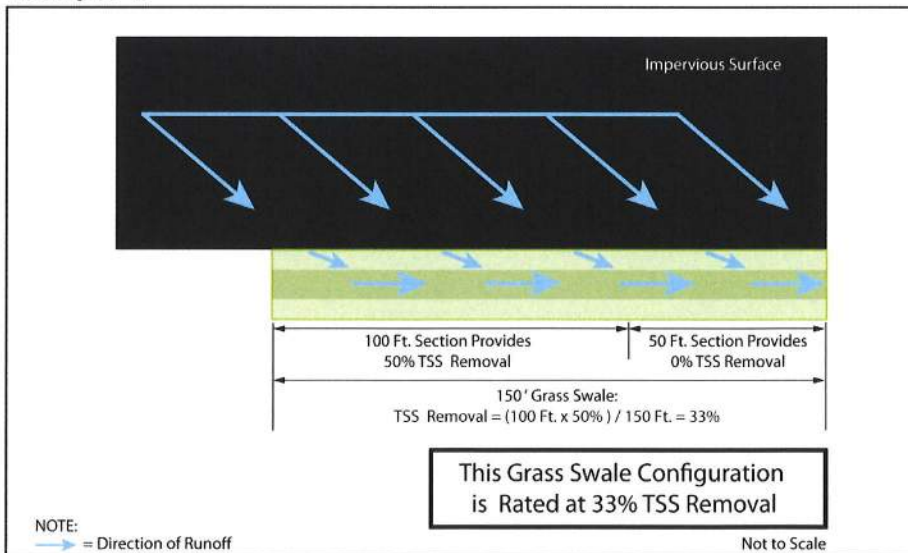
Example 3:



Linear Inflow Grass Swales less than 200 Feet in Length

Example 4 shows a 150-foot Linear Inflow Grass Swale that collects runoff from a roadway. In this example, however, the TSS removal rate for the entire inflow drainage area is less than 50% because the swale is less than 200 feet in length. As mentioned above, the minimum 200-foot length is necessary to offset the 0% TSS removal provided by the 50-foot section of the swale located at the downstream end. When the swale length is less than 200 feet, the two sections are evaluated using the formula from the flowchart depicted on page 5, resulting in a weighted average for TSS removal, as shown below.

Example 4:



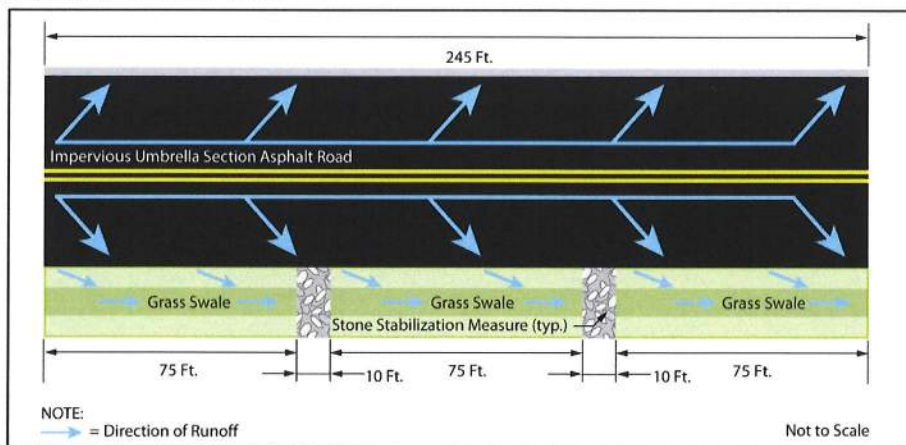
Linear Inflow Grass Swales with Non-Vegetative Stabilization

Example 5 shows a Linear Inflow Grass Swale similar to the swale in Example 4. In this example, however, the swale is constructed with non-vegetative stabilization at periodic intervals. The entire drainage area flowing into this swale will receive the 50% TSS removal rate provided that the design meets the following criteria:

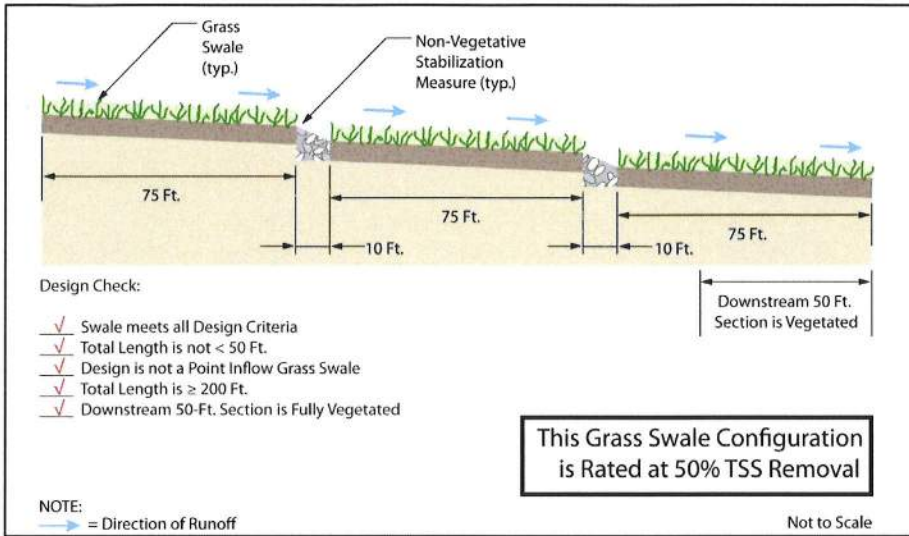
- The swale is at least 200 feet in length; the length and TSS removal rate calculations may not include the sections of the swale that consist of non-vegetative stabilization.
- The 50-foot section of the swale at the downstream end must be fully vegetated and may not consist of non-vegetative stabilization.

The TSS removal rate in this example is based on the three grass segments. The grass segments are each 75 feet in length, with 10 feet of non-vegetative stabilization between each segment. The length of the non-vegetative stabilization is excluded from the length calculation of the swale; therefore, the entire inflow drainage area to this swale receives the 50% TSS removal rate.

Example 5: Plan View



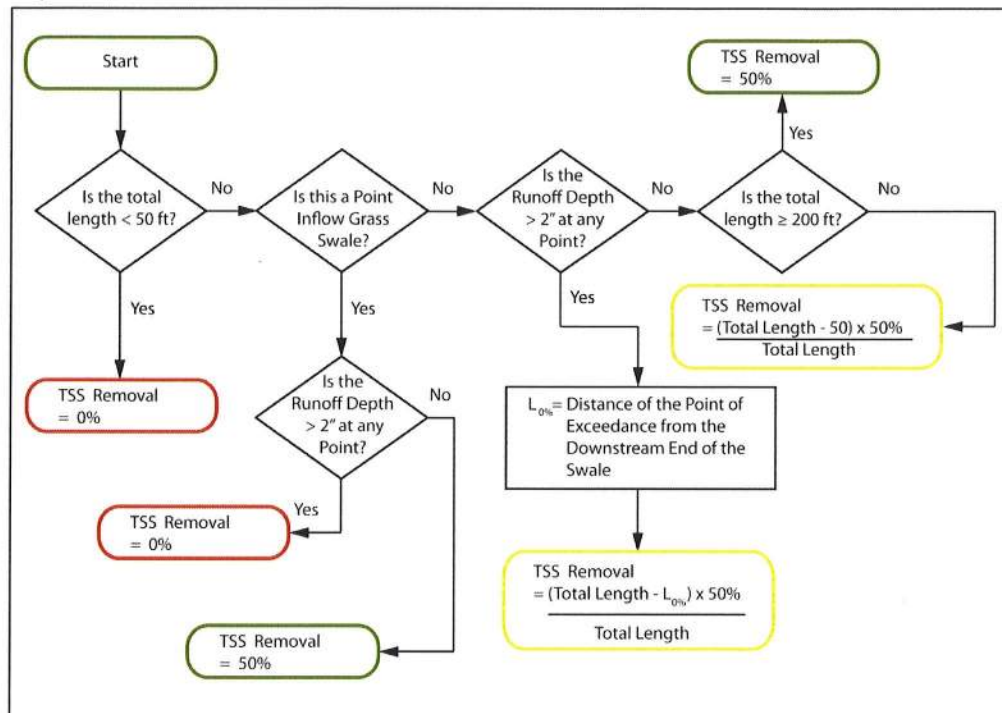
Example 5: Profile View



Reductions in TSS Removal Rate for Excessive Runoff Depth

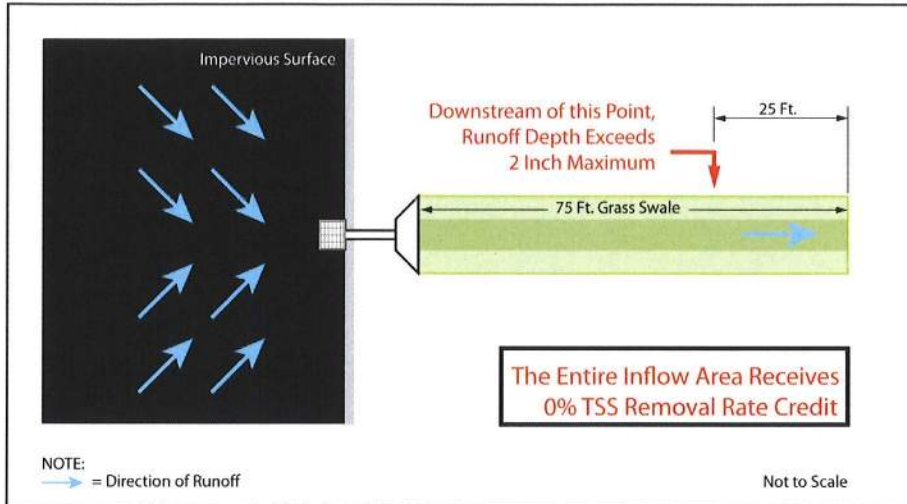
As mentioned in the *Design Criteria* section, to receive 50% TSS removal credit for the entire inflow drainage area, the depth of runoff in any type of grass swale may not exceed 2 inches. If the depth of runoff exceeds 2 inches, the TSS removal rate of the swale is reduced. For a Point Inflow Grass Swale, the entire swale and contributing drainage area receives a TSS removal rate of 0%. For a Linear Inflow Grass Swale, the TSS removal rate calculation depends on the length of the swale and the distance of the point of exceedance from the downstream end of the swale. The flowchart below includes a method for calculating the TSS removal rate for this scenario.

Expanded Flowchart



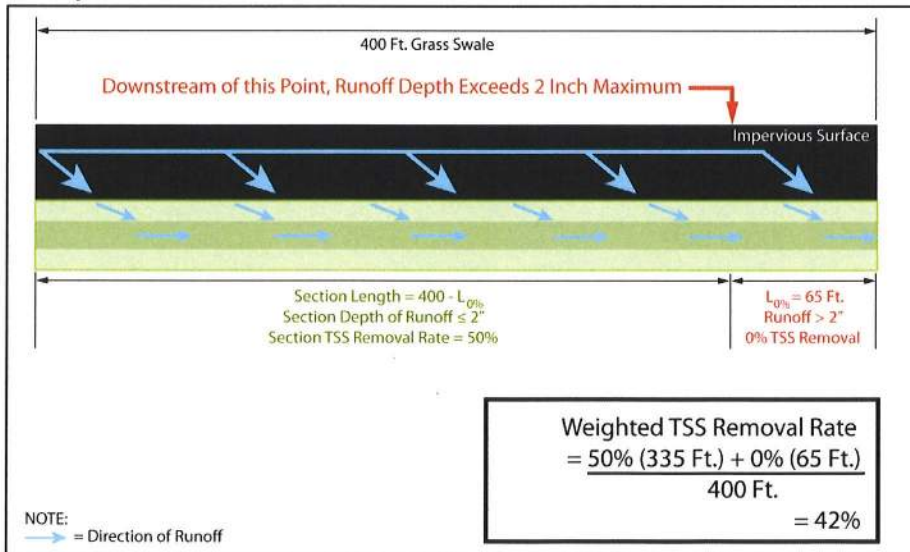
Example 6 shows a Point Inflow Grass Swale with a runoff depth that exceeds the maximum 2 inches. Despite its compliance with all other design criteria, the inflow drainage area treated by this swale receives no TSS removal credit.

Example 6:



Example 7 illustrates the TSS removal rate calculation for a 400-foot Linear Inflow Grass Swale with a runoff depth exceedance beginning at a distance of 65 feet from the downstream end of the swale.

Example 7:



Although the last 65 feet of the roadway in Example 7 does not receive the 50% TSS removal rate, it may qualify as a vegetated conveyance for the purposes of demonstrating compliance with the nonstructural stormwater management strategies, as discussed above. Additional information on nonstructural stormwater management strategies can be found in *Chapter 2: Low Impact Development Techniques*.

TSS Removal Rates for BMPs in Series

The adopted TSS removal rates for grass swales is less than the 80% TSS removal rate typically required in the Stormwater Management rules at N.J.A.C. 7:8. Therefore, it may be necessary to use a series of BMPs to achieve the required TSS removal.

A simplified equation to calculate the total TSS removal rate for two BMPs in series can be found at 7:8-5.5(c). The use of this equation may not be used for two of the same BMPs in series to increase the adopted TSS removal rate of that BMP; however, it may be used to estimate the total TSS removal rate of a swale used in combination with another type of BMP. For more information on BMP in series, see *Chapter 4: Stormwater Pollutant Removal Criteria*.

Considerations

A number of factors should be considered when using a grass swale to treat stormwater, particularly the existing ecology of the site. The siting of a grass swale in proximity to deciduous trees may require additional inspection/maintenance due to the accumulation of leaves, twigs and branches in the swale. The presence of adequate sunlight should also be considered; swales should not be placed in areas with excessive tree canopy because shading may inhibit the growth of vegetation in the swale.

Another factor that must be considered is installation techniques; the use of turf reinforcements, such as erosion mats, can protect the swale and increase both its stability and longevity. Additionally, the use of pegged sod instead of seed allows the vegetation to establish more quickly and reduces the chances of failure.

The location of a grass swale can directly affect the frequency with which it is maintained; the siting of a swale in a visible area can promote maintenance. In addition, the following maintenance methods should be considered when developing a maintenance plan for a swale: the use of an aerator, bagging the plugs, the use of a tractor or power rake, and vacuuming to maintain the design depth. Finally, the safety of maintenance personnel during mowing should be considered when designing the side slopes of the grass swale.

Maintenance

Regular and effective maintenance is crucial to ensure effective grass swale performance; in addition, maintenance plans are required for all stormwater management facilities associated with a major development. There are a number of required elements in all maintenance plans, pursuant to N.J.A.C. 7:8-5.8; these are discussed in more detail in *Chapter 8: Maintenance of Stormwater Management Measures*. Furthermore, maintenance activities are required through various regulations, including the New Jersey Pollutant Discharge Elimination System (NJPDES) Rules, N.J.A.C. 7:14A. Specific maintenance requirements for grass swales are presented below; these requirements must be included in any maintenance plan that includes grass swales; in addition, cross-sectional views of all grass swales constructed on-site should be included.

General Maintenance

- All components must be inspected, at least once annually, for cracking, subsidence, spalling, erosion and deterioration.
- Components expected to receive and/or trap debris must be inspected for clogging at least twice annually.
- Sediment removal should take place when the swale is thoroughly dry and should not result in the loss of vegetation.
- Disposal of debris, trash, sediment and other waste should be done at a suitable disposal/recycling facility and in accordance with all applicable local, state and federal waste regulations.

Vegetated Areas

- Bi-weekly inspections are required when establishing/restoring vegetation.
- A minimum of one inspection during the growing season and one inspection during the non-growing season is required to ensure the health, density and diversity of the vegetation.
- Vegetative cover must be maintained at 95%; damage must be addressed through replanting in accordance with the original specifications.
- Mowing and/or trimming of vegetation should be performed on a regular schedule based on specific site conditions.
- Grass outside of the swale should be mowed at least once a month during growing season.
- Grasses within the swale should be carefully maintained to fall within the required grass height range of 3 to 6 inches.
- Grass clippings should either be removed or sufficiently small to avoid both damage to the turf and the facilitation of mosquito breeding.

- Vegetated areas must be inspected at least once annually for erosion, scour and unwanted growth; any unwanted growth should be removed with minimum disruption to the soil bed and remaining vegetation.
- If disruption to the vegetation occurs, the area must be re-seeded. If ponding in excess of 72 hours occurs, action must be taken to either re-establish the appropriate slope and/or permeability rate of the soil bed.
- All use of fertilizers, mechanical treatments, pesticides and any other means utilized to assure optimum vegetation health should not compromise the intended purpose of the swale.

References

- Barrett, Michael E., e-mail, December 3, 2009. Center for Research in Water Resources, University of Texas. "Request for Data."
- Dorman, M.E., J. Hartigan, R.F. Steg and T. Quasebarth. 1989. Retention, Detention and Overland Flow for Pollutant Removal From Highway Stormwater Runoff. Vol. 1. Research Report. Federal Highway Administration. FHWA/RD 89/202. 179p.
- Goldberg. 1993. Dayton Avenue Swale Biofiltration Study. Seattle Engineering Department. Seattle, WA. 36 p.
- Minton, G. R. 2005. Stormwater Treatment: Biological, Chemical, and Engineering Principles. Seattle, Washington: Resource Planning Associates.
- New Jersey Department of Agriculture. November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.
- Pitt, R., and J. McLean. 1986. Toronto Area Watershed Management Strategy Study: Humber River Pilot Watershed Project. Ontario Ministry of Environment.
- Roosevelt, Daniel S., e-mail, December 11, 2009. Virginia Department of Transportation. "Your Request for Information" and "Route 29 South of Charlottesville, VA."
- Seattle Metro and Washington Department of Ecology. 1992. Biofiltration Swale Performance: Recommendations and Design Considerations. Publication No. 657. Water Pollution Control Department, Seattle Washington. 220 p. Also in: Watershed Protection Techniques. Center for Watershed Protection. Fall 1994. Vol. 1(3): 117-119.
- Walsh, P. M., Barrett, J.F. Malina, and R.J. Charbeneau. October 1997. Use of Vegetative Controls for Treatment of Highway Runoff. Center for Research in Water Resources. University of Texas at Austin. Austin, TX.

Detailed Stormceptor Sizing Report – Long Point Rd.

Project Information & Location			
Project Name	Long Point Rd.	Project Number	1988-5783
City	Collingwood	State/ Province	Ontario
Country	Canada	Date	1/19/2022
Designer Information		EOR Information (optional)	
Name	Brandon O'Leary	Name	Nicholas Sproule
Company	Forterra	Company	C.F. Crozier & Associates Inc.
Phone #	905-630-0359	Phone #	
Email	brandon.oleary@forterrabp.com	Email	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Long Point Rd.
Recommended Stormceptor Model	EFO4
TSS Removal (%) Provided	68
Particle Size Distribution (PSD)	CA ETV
Rainfall Station	OWEN SOUND MOE

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

EFO Sizing Summary			
EFO Model	% TSS Removal Provided	% Runoff Volume Captured Provided	Standard EFO Hydrocarbon Storage Capacity
EFO4	68	99	265 L (70 gal)
EFO6	70	99	610 L (160 gal)
EFO8	70	100	1070 L (280 gal)
EFO10	70	100	1670 L (440 gal)
EFO12	70	100	2475 L (655 gal)
Parallel Units / MAX	Custom	Custom	Custom

For Stormceptor Specifications and Drawings Please Visit:
<http://www.imbriumsystems.com/technical-specifications>

OVERVIEW

Stormceptor® EF is a continuation and evolution of the most globally recognized oil-grit separator (OGS) stormwater treatment technology - **Stormceptor®**. Also known as a hydrodynamic separator, the enhanced flow Stormceptor EF is a high performing oil-grit separator that effectively removes a wide variety of pollutants from stormwater and snowmelt runoff at higher flow rates as compared to the original Stormceptor. Stormceptor EF captures and retains sediment (TSS), free oils, gross pollutants and other pollutants that attach to particles, such as nutrients and metals. Stormceptor EF's patent-pending treatment and scour prevention technology and internal bypass ensures sediment is retained during all rainfall events.

Sizing Methodology

Stormceptor® EF and Stormceptor® EFO are sized using local historical rainfall data for the site of interest, specific site parameters, and a performance curve for TSS removal derived from third-party testing conducted in accordance with the Canadian Environmental Technology Verification (ETV) Program's Procedure for Laboratory Testing of OilGrit Separators. Every Stormceptor unit is designed to achieve the specified target TSS removal, however, for sites where oil/fuel capture and retention is an additional specified water quality objective Stormceptor EFO is the proper selection. The sizing methodology includes various considerations, including:

- Site parameters
- Local historical rainfall data
- Capture of the Canadian ETV particle size distribution
- Requirements for oil/fuel capture and retention
- Performance results from third-party testing and verification

Hydrology Analysis			
PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour). Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.			
Rainfall Station			
State/Province	Ontario	Total Number of Rainfall Events	3762
Rainfall Station Name	OWEN SOUND MOE	Total Rainfall (mm)	18531.0
Station ID #	6132	Average Annual Rainfall (mm)	463.3
Coordinates	44°35'N, 80°56'W	Total Evaporation (mm)	1076.4
Elevation (ft)	580	Total Infiltration (mm)	7638.2
Years of Rainfall Data	40	Total Rainfall that is Runoff (mm)	9816.4
Notes			
<ul style="list-style-type: none"> • Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules. • Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed. • For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance. 			

ONLINE APPLICATION

Stormceptor EF's internal bypass and patent-pending scour prevention technology has demonstrated very effective retention of pollutants in third-party testing and verification following the Canadian ETV's **Procedure for Laboratory Testing of Oil-Grit Separators**. Sediment scour prevention demonstrated an effluent concentration of less than 10 mg/L for sediment particles ranging from 1 to 1,000 microns, even during peak influent flow rates associated with infrequent high intensity storm events. While Stormceptor EF will capture oil, only the Stormceptor EFO configuration has been third-party tested and verified to retain greater than 99% of captured oil. Based on these verified performance attributes, the most efficient and widely accepted application of Stormceptor EF is an online configuration, which allows all upstream conveyance flows to enter and exit the unit. The online application eliminates the need for costly additional bypass structures, piping and installation expense.

FLOW ENTRANCE OPTIONS

Single Inlet Pipe – A common design which includes one inlet pipe and one outlet pipe. A 90-degree (maximum) bend is also accepted with this configuration.

Inlet Grate – Allows surface runoff to enter the unit from grade. The inlet grate option can also be used in conjunction with one inlet pipe or multiple inlet pipes. A removable flow deflector is added in the Stormceptor EF4/EFO4.

Maximum Pipe Diameter		
Model	Inlet (in/mm)	Outlet (in/mm)
EF4 / EFO4	24 / 610	24 / 610
EF6 / EFO6	36 / 915	36 / 915
EF8 / EFO8	48 / 1220	48 / 1220
EF10 / EFO10	72 / 1828	72 / 1828
EF12 / EFO12	72 / 1828	72 / 1828

Multiple Inlet Pipe – Allows for multiple inlet pipes of various diameters to enter the unit.

Maximum Pipe Diameter		
Model	Inlet (in/mm)	Outlet (in/mm)
EF4 / EFO4	18 / 457	24 / 610
EF6 / EFO6	30 / 762	36 / 915
EF8 / EFO8	42 / 1067	48 / 1220
EF10 / EFO10	60 / 1524	72 / 1828
EF12 / EFO12	60 / 1524	72 / 1828

Drainage Area		Up Stream Storage	
Total Area (ha)	1.4	Storage (ha-m)	Discharge (cms)
Imperviousness %	58.6	0.0000	0.000
		0.0407	0.001
		0.0501	0.007
		0.0805	0.038

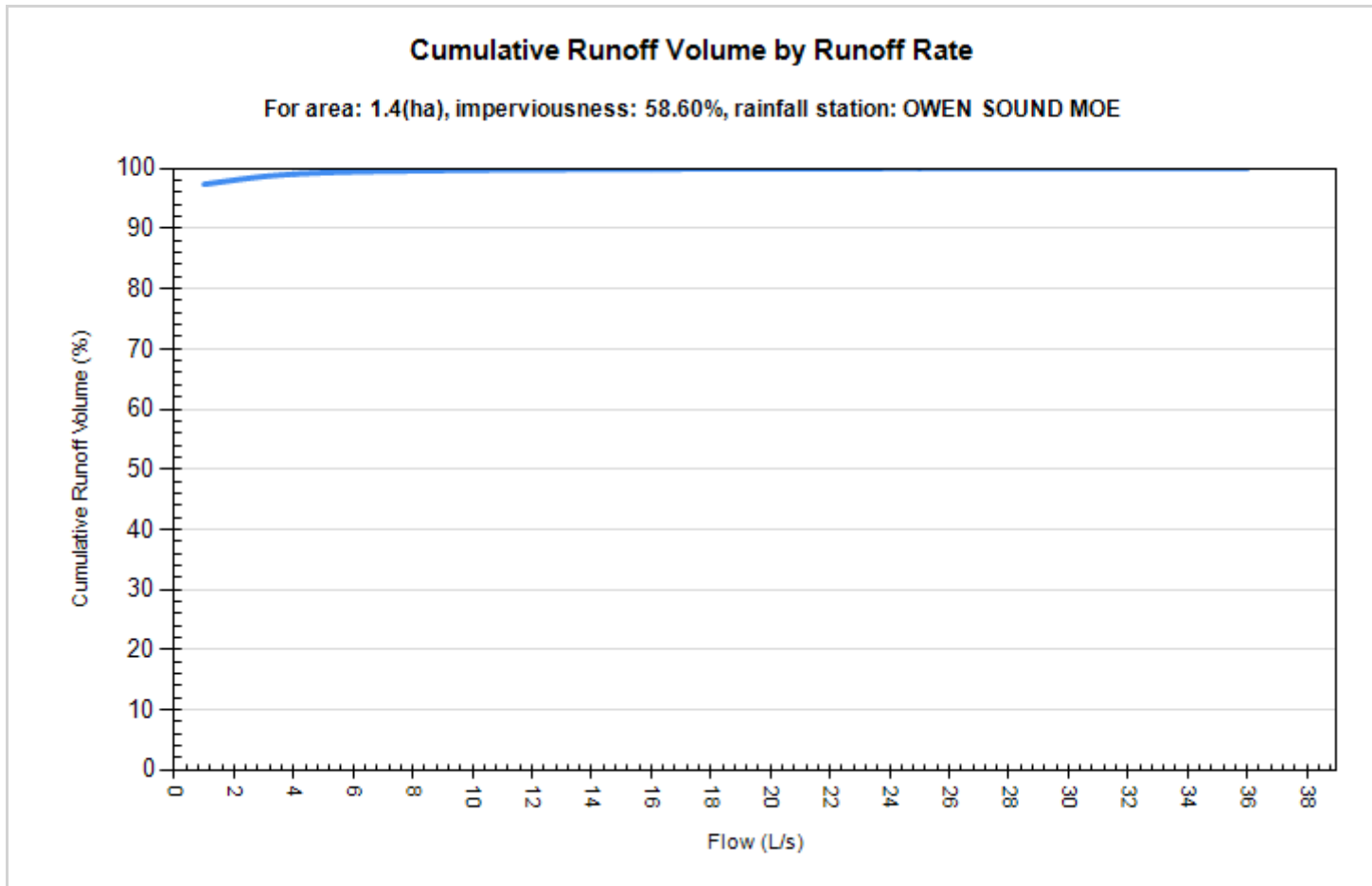
Up Stream Flow Diversion		Design Details	
Max. Flow to Stormceptor (cms)		Stormceptor Inlet Invert Elev (m)	
		Stormceptor Outlet Invert Elev (m)	
		Stormceptor Rim Elev (m)	
		Normal Water Level Elevation (m)	
		Pipe Diameter (mm)	
		Pipe Material	
		Multiple Inlets (Y/N)	No
		Grate Inlet (Y/N)	No

Water Quality Objective	
TSS Removal (%)	60.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	38
Water Quality Flow Rate (L/s)	1

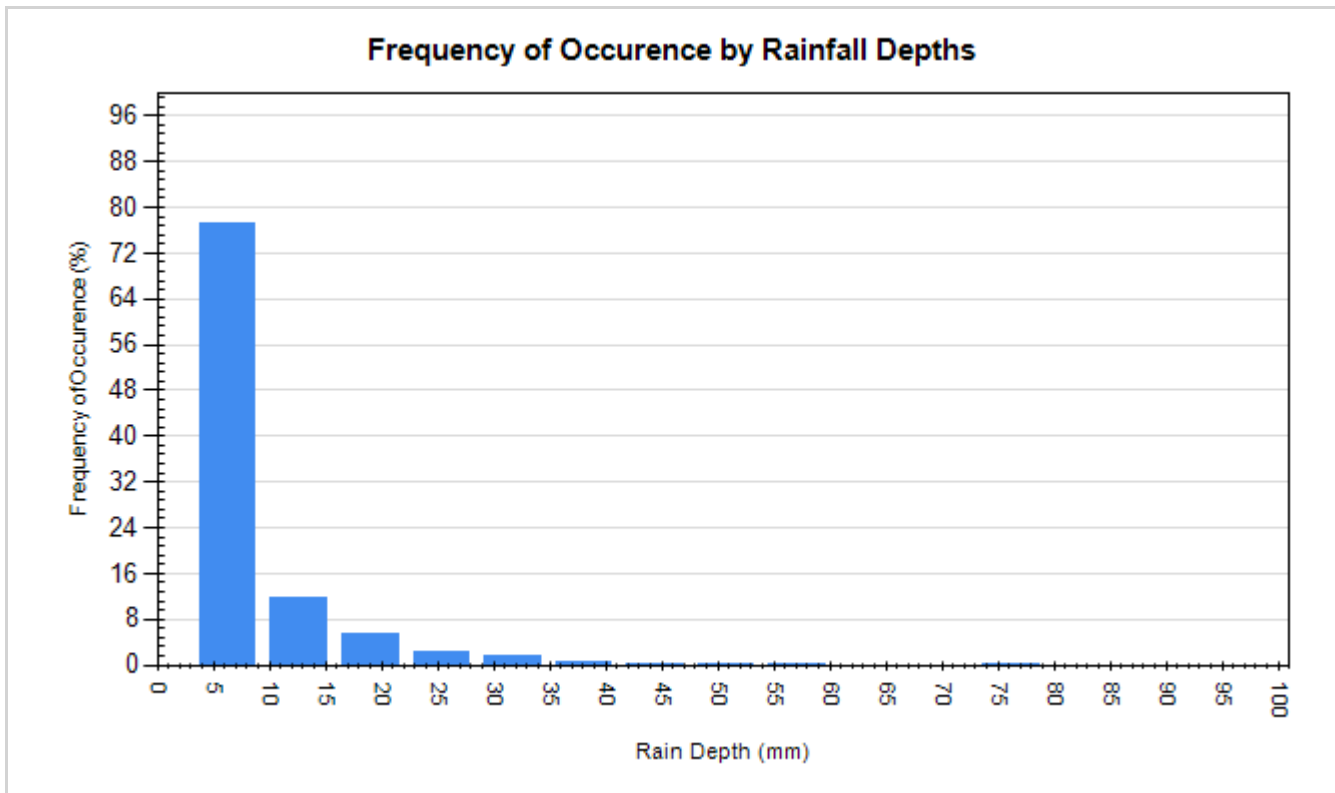
Particle Size Distribution (PSD)		
Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.		
CA ETV		
Particle Diameter (microns)	Distribution %	Specific Gravity
2.0	5.0	2.65
5.0	5.0	2.65
8.0	10.0	2.65
20.0	15.0	2.65
50.0	10.0	2.65
75.0	5.0	2.65
100.0	10.0	2.65
150.0	15.0	2.65
250.0	15.0	2.65
500.0	5.0	2.65
1000.0	5.0	2.65

Site Name		Long Point Rd.	
Site Details			
Drainage Area		Infiltration Parameters	
Total Area (ha)	1.4	Horton's equation is used to estimate infiltration	
Imperviousness %	58.6	Max. Infiltration Rate (mm/hr)	61.98
Oil Spill Capture Volume (L)		Min. Infiltration Rate (mm/hr)	10.16
		Decay Rate (1/sec)	0.00055
		Regeneration Rate (1/sec)	0.01
Surface Characteristics		Evaporation	
Width (m)	237.00	Daily Evaporation Rate (mm/day)	2.54
Slope %	2	Dry Weather Flow	
Impervious Depression Storage (mm)	0.508	Dry Weather Flow (L/s)	0
Pervious Depression Storage (mm)	5.08		
Impervious Manning's n	0.015		
Pervious Manning's n	0.25		
Maintenance Frequency		Winter Months	
Maintenance Frequency (months) >	12	Winter Infiltration	0
TSS Loading Parameters			
TSS Loading Function		Build Up/ Wash-off	
Buildup/Wash off Parameters		TSS Availability Parameters	
Target Event Mean Conc. (EMC) mg/L	125	Availability Constant A	0.057
Exponential Buildup Power	0.40	Availability Factor B	0.04
Exponential Washoff Exponent	0.20	Availability Exponent C	1.10
		Min. Particle Size Affected by Availability (micron)	400

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	Runoff Volume (m ³)	Volume Over (m ³)	Cumulative Runoff Volume (%)
1	134617	3591	97.4
4	136937	1262	99.1
9	137789	405	99.7
16	138098	95	99.9
25	138190	3	100.0
36	138193	0	100.0



Rainfall Event Analysis				
Rainfall Depth (mm)	No. of Events	Percentage of Total Events (%)	Total Volume (mm)	Percentage of Annual Volume (%)
6.35	2901	77.1	5026	27.1
12.70	444	11.8	3983	21.5
19.05	207	5.5	3215	17.4
25.40	90	2.4	1973	10.6
31.75	59	1.6	1656	8.9
38.10	26	0.7	898	4.8
44.45	12	0.3	504	2.7
50.80	10	0.3	470	2.5
57.15	8	0.2	433	2.3
63.50	1	0.0	63	0.3
69.85	0	0.0	0	0.0
76.20	2	0.1	144	0.8
82.55	1	0.0	79	0.4
88.90	1	0.0	87	0.5
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0



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	4ft (1219mm) Diameter OGS Units:	1.19m ³ sediment / 265L oil
	6ft (1829mm) Diameter OGS Units:	3.48m ³ sediment / 609L oil
	8ft (2438mm) Diameter OGS Units:	8.78m ³ sediment / 1,071L oil
	10ft (3048mm) Diameter OGS Units:	17.78m ³ sediment / 1,673L oil
	12ft (3657mm) Diameter OGS Units:	31.23m ³ sediment / 2,476L 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 shall be determined using historical rainfall data and a sediment removal performance curve derived from the actual third-party verified laboratory testing data. 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/m².

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/m² to 2600 L/min/m²) 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.

APPENDIX E

Groundwater Buoyancy Calculations



Project: 1988-5783
 Location: Long Point Road
 Date: 2022-01-21
 Completed By: EF

Buoyancy Calculation for Proposed Box Culvert

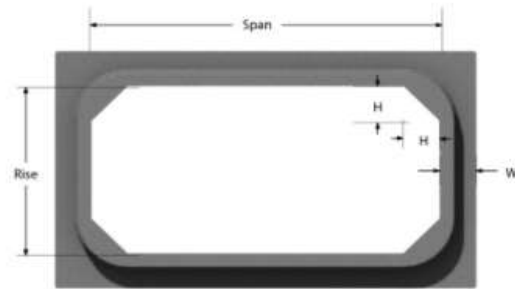
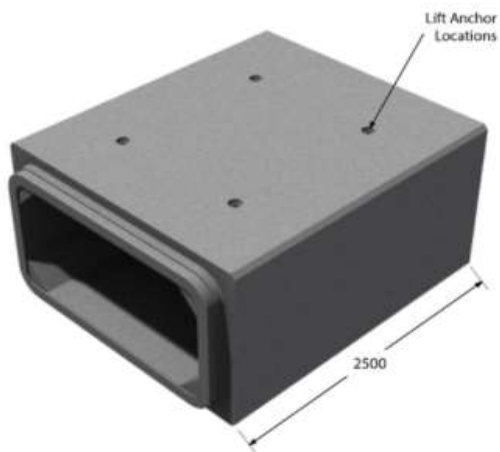
Proposed Culvert: 1000 X 4800 mm Concrete Box

Culvert Mass Estimate 3000 X 1500 mm Concrete Box W/
Based On: 250mm Thickness (OPSD)

	SI Unit	Information		
Buoyant Force (Fb)	N	Volume Displaced Fluid * Density Displaced Fluid * Gravity Acceleration		
Gravitational Force (Fg)	N	Mass * Gravity Acceleration		
Density of Water	kg/m ³	1000		
Density of Compact Soil	kg/m ³	1500		
Gravity Acceleration	m/s ²	9.81		
Culvert Interior	m	1	4.8	
Culver Wall Thickness	m	0.25		
Culvert Exterior	m	1.5	5.3	
Culvert Mass Per 2.5 m	kg	17021		
Minimum Cover	m	1.20		
Road Structure	m	0.68		
		West (BH#3)	Middle (BH#2)	East (BH#1)
Proposed C/L	m (asl)	181.48	181.81	182.19
Proposed T/Culvert	m (asl)	180.28	180.61	180.99
Proposed B/Culvert	m (asl)	178.78	179.11	179.49
GW (2019-4-10)	m (asl)	180.67	179.67	179.75
Depth (Overburden)	m	1.20	1.2	1.2
Submersion (Culvert)	m	1.89	0.56	0.26
Submersion (Overburden)	m	0.39	-0.94	-1.24
Fb / 2.5 m (Culvert)	N / 2.5 m	77989.50	29116.08	13518.18
Fb (Culvert)	N	194973.75	72790.20	33795.45
Fb (Overburden)	N	50693.175	N/A	N/A
Fg (Culvert)	N	166976.01	166976.01	166976.01
Fg (Overburden)	N	233968.50	233968.50	233968.50
Fg (Total)	N	400944.51	400944.51	400944.51
F (Net)	N	205970.76	328154.31	367149.06
F (Net)	kN	205.97	328.15	367.15

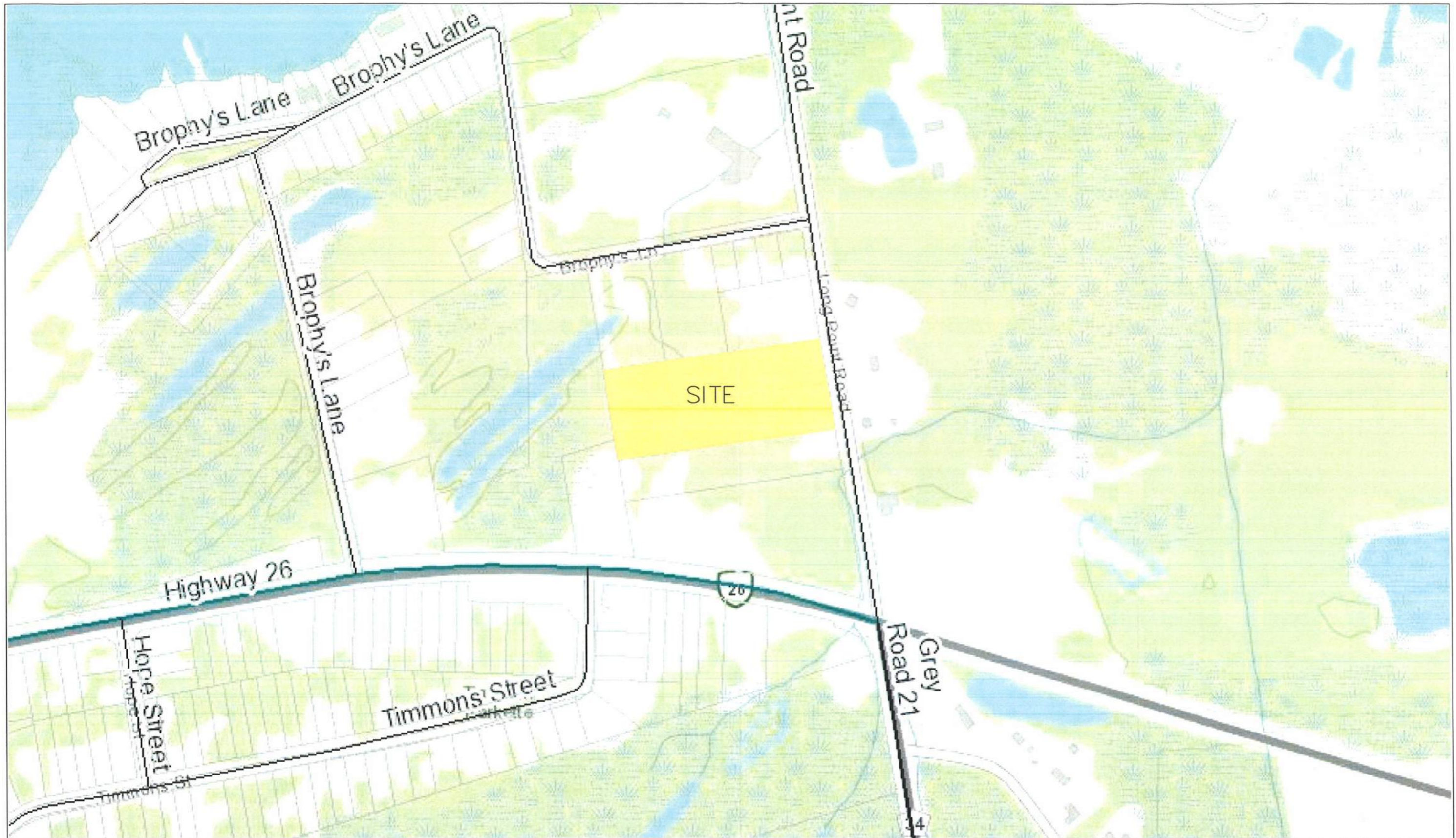
Therefore, the force due to gravity resulting from the culvert and overlying soil structure is in excess of the force due to buoyancy on the culvert and submerged soil. This holds true for all three locations analyzed.

Buoyancy Calculation for Proposed Box Culvert



Designated Size Span X Rise	Wall Thickness (W)	Haunch (H)	Waterway Area	Approximate Mass	Lift Anchor Size	Truckload Lots
mm	mm	mm	m ²	kg	ton	pcs
1800 X 900	200	200	1.54	8579	4	5
1800 X 1200	200	200	2.08	9303	4	4
2400 X 1200	200	200	2.80	10895	4	3
2400 X 1500	200	200	3.52	11688	4	3
2400 X 1800	200	200	4.24	12492	4	3
3000 X 1500	250	250	4.38	17021	8	2
3000 X 1800	250	250	5.28	17971	8	2
3000 X 2100	250	250	6.18	18980	8	2
3000 X 2400	250	250	7.08	19931	8	2

FIGURES



Project
LONG POINT ROAD

Drawing
SITE LOCATION

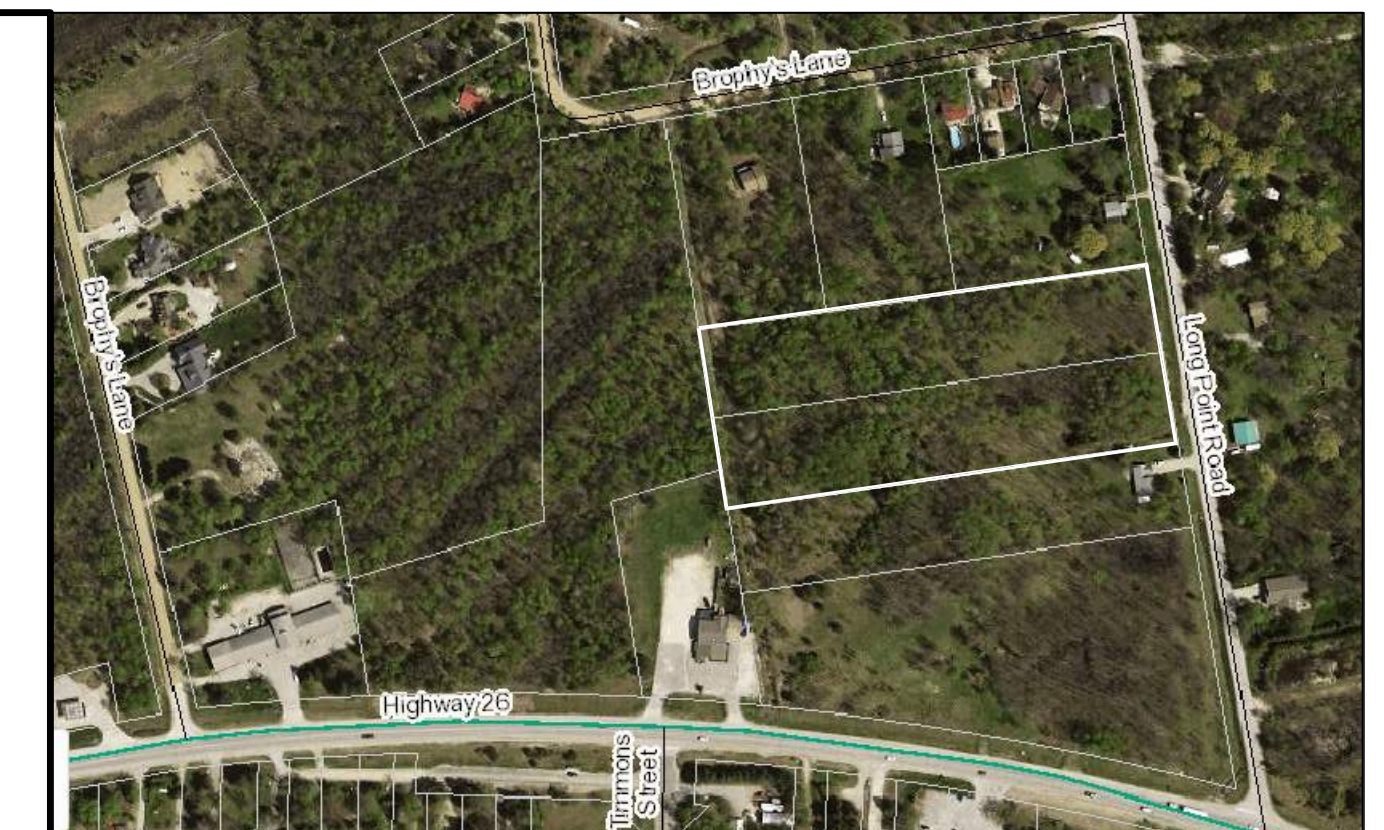
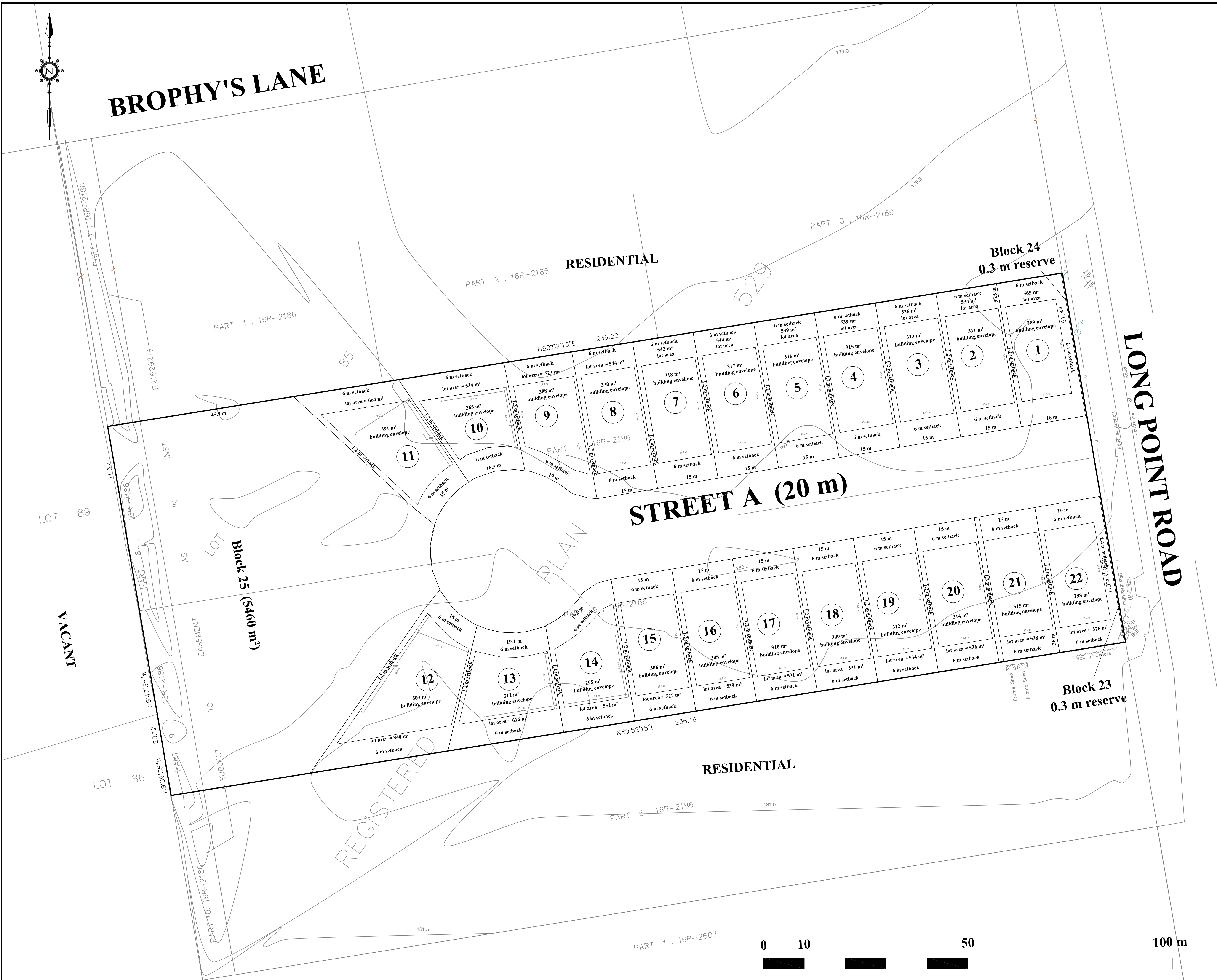


CROZIER & ASSOCIATES
Consulting Engineers

The HarbourEdge Building
40 Huron Street, Suite 301
Cullumwood, OH 44625
L97 4R2

705-446-3510 T
705-446-3520 F
www.crozier.ca
info@crozier.ca

Drawn By	Design By	Project	1988-5783
Scale	Date	Check By	Drawing
N.T.S.			FIGURE 1



Draft Plan of Subdivision Long Point Road

PART OF LOT 85
REGISTERED PLAN 529
TOWN OF THE BLUE MOUNTAINS
(Formerly Township of Collingwood)
COUNTY OF GREY

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.

OCTOBER 29, 2018
PAUL R. THOMSEN O.L.S.
ZUBEK, EMO, PATTEN & THOMSEN LTD

OWNER'S CERTIFICATE

PASCUZZO PLANNING INC. WAS AUTHORIZED BY TONY LESIAK AND ISABELA LEHMANN TO SUBMIT THE PROPOSED PLAN OF SUBDIVISION TO THE COUNTY OF GREY FOR APPROVAL.

OCTOBER 29, 2018
ANDREW PASCUZZO MCIP RPP
PASCUZZO PLANNING INC.

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

- | | |
|---|-------------------------------|
| (a) AS SHOWN ON DRAFT PLAN, | (g) AS SHOWN ON DRAFT PLAN, |
| (b) AS SHOWN ON DRAFT PLAN, | (h) MUNICIPAL WATER SUPPLY, |
| (c) AS SHOWN ON DRAFT AND KEY PLAN, | (i) SAND, |
| (d) THE LAND IS TO BE USED ACCORDING TO THE SCHEDULE OF LAND USE, | (j) AS SHOWN ON DRAFT PLAN, |
| (e) AS SHOWN ON DRAFT PLAN, | (k) MUNICIPAL SANITARY SEWER, |
| (f) AS SHOWN ON DRAFT PLAN, | (l) EASEMENT-MUNICIPAL DRAIN |

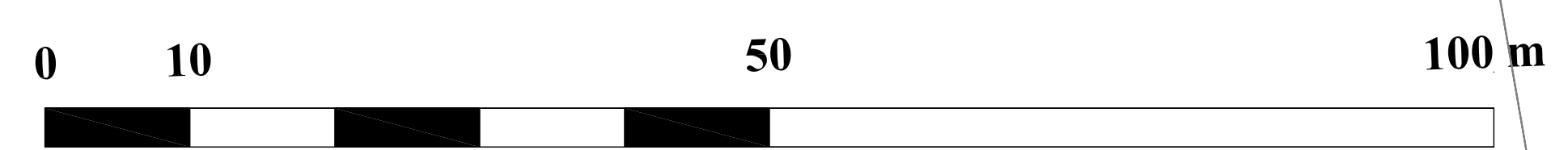
SCHEDULE OF LAND USE

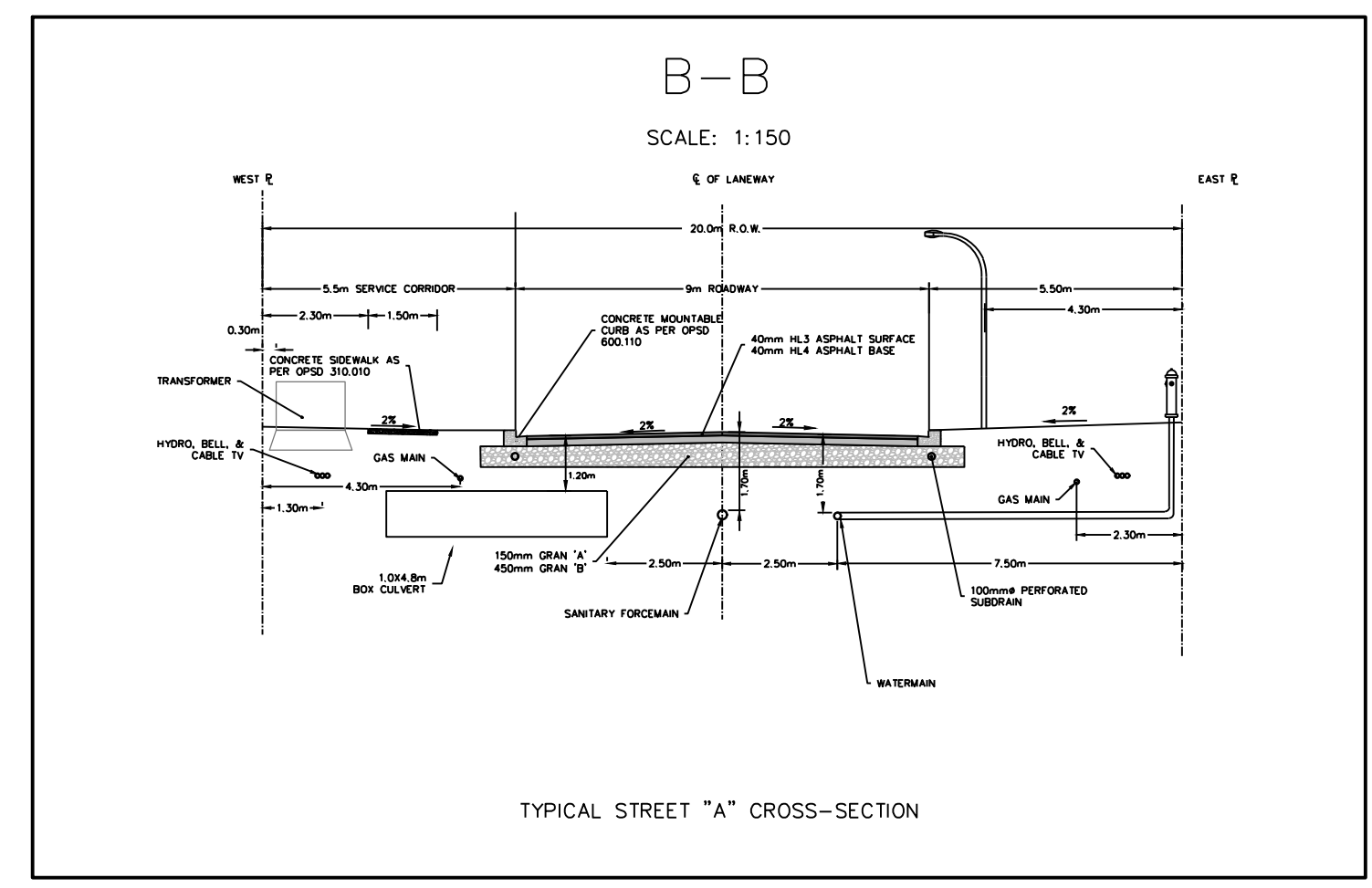
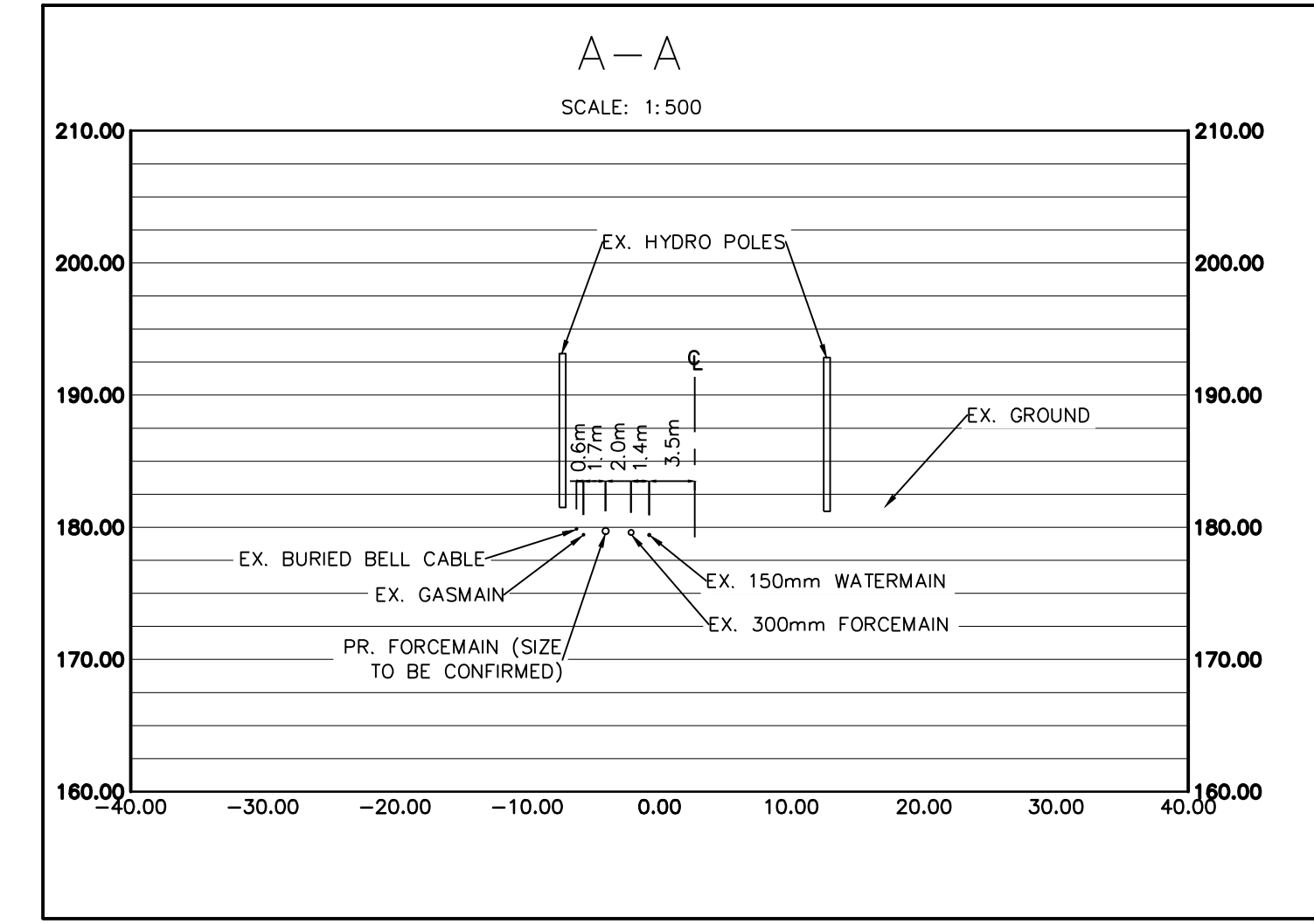
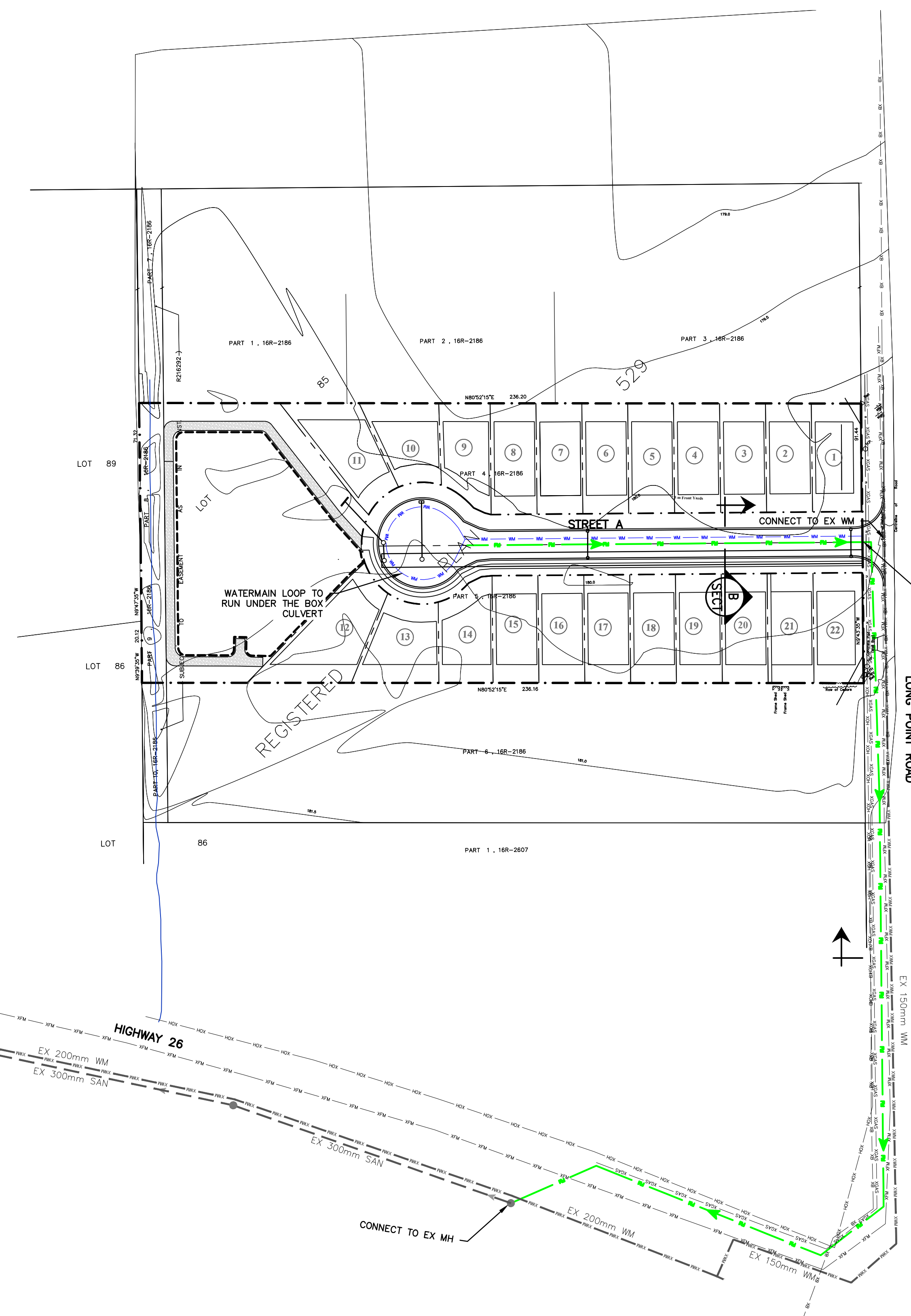
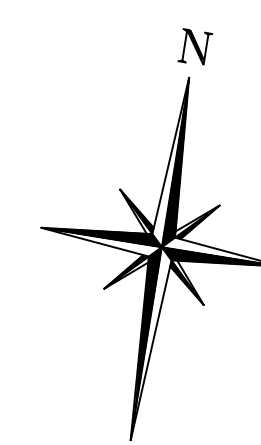
	UNITS	AREA
SINGLE-FAMILY RESIDENTIAL (LOTS 1-22)	22	1.23 ha.
1 FOOT RESERVES (BLOCK 23 and 24)		0.002 ha.
OPEN SPACE (BLOCK 25)		0.55 ha.
ROAD (STREET A)		0.38 ha.
TOTAL	22	2.16 ha.

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048
PROJECT: 892-17 DRAWN: AP JAN 2021

DWG: 892-17-DP8+

PASCUZZO PLANNING INC.





LEGEND

- SITE BOUNDARY
- - - LIMITS OF RETAINED WOODLOT
- PROPOSED WATERMAIN
- PROPOSED SANITARY FORCEMAIN (LOW PRESSURE)
- EXISTING BELL CABLE
- EXISTING SANITARY FORCEMAIN
- EXISTING OVER HEAD HYDRO
- EXISTING GASMAIN

NOTE:
 LOCATION OF EXISTING UTILITIES AND SERVICES IS APPROXIMATE AND BASED ON RECORD DRAWINGS FOR LONG POINT ROAD PREPARED BY ANLEY GROUP DATED DECEMBER 2006. TO BE CONFIRMED WITH AN SUE AT DETAILED DESIGN STAGE - EXACT ALIGNMENT OF PROPOSED FORCEMAIN TO BE DETERMINED AT THAT TIME.

FOR REVIEW
 NOT TO BE USED FOR CONSTRUCTION

OA	ISSUED FOR THIRD SUBMISSION	2022/JAN/21
No.	ISSUE / REVISION	YYYY/MM/DD
1. THIS DRAWING IS THE EXCLUSIVE PROPERTY OF C.F. CROZIER & ASSOCIATES INC. AND THE REPRODUCTION OF ANY PART WITHOUT PRIOR WRITTEN CONSENT OF THIS OFFICE IS STRICTLY PROHIBITED. 2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, LEVELS, AND DATUMS ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO THIS OFFICE PRIOR TO CONSTRUCTION. 3. THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER PLANS AND DOCUMENTS APPLICABLE TO THIS PROJECT. 4. DO NOT SCALE THE DRAWINGS. 5. ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.		

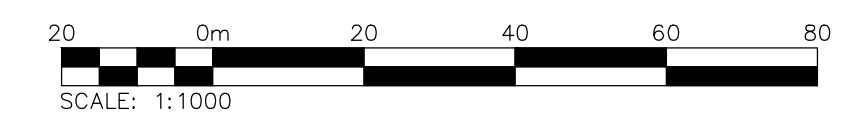
Project
LONG POINT ROAD SUBDIVISION

Drawing
GENERAL SITE SERVICING PLAN

CROZIER
 CONSULTING ENGINEERS

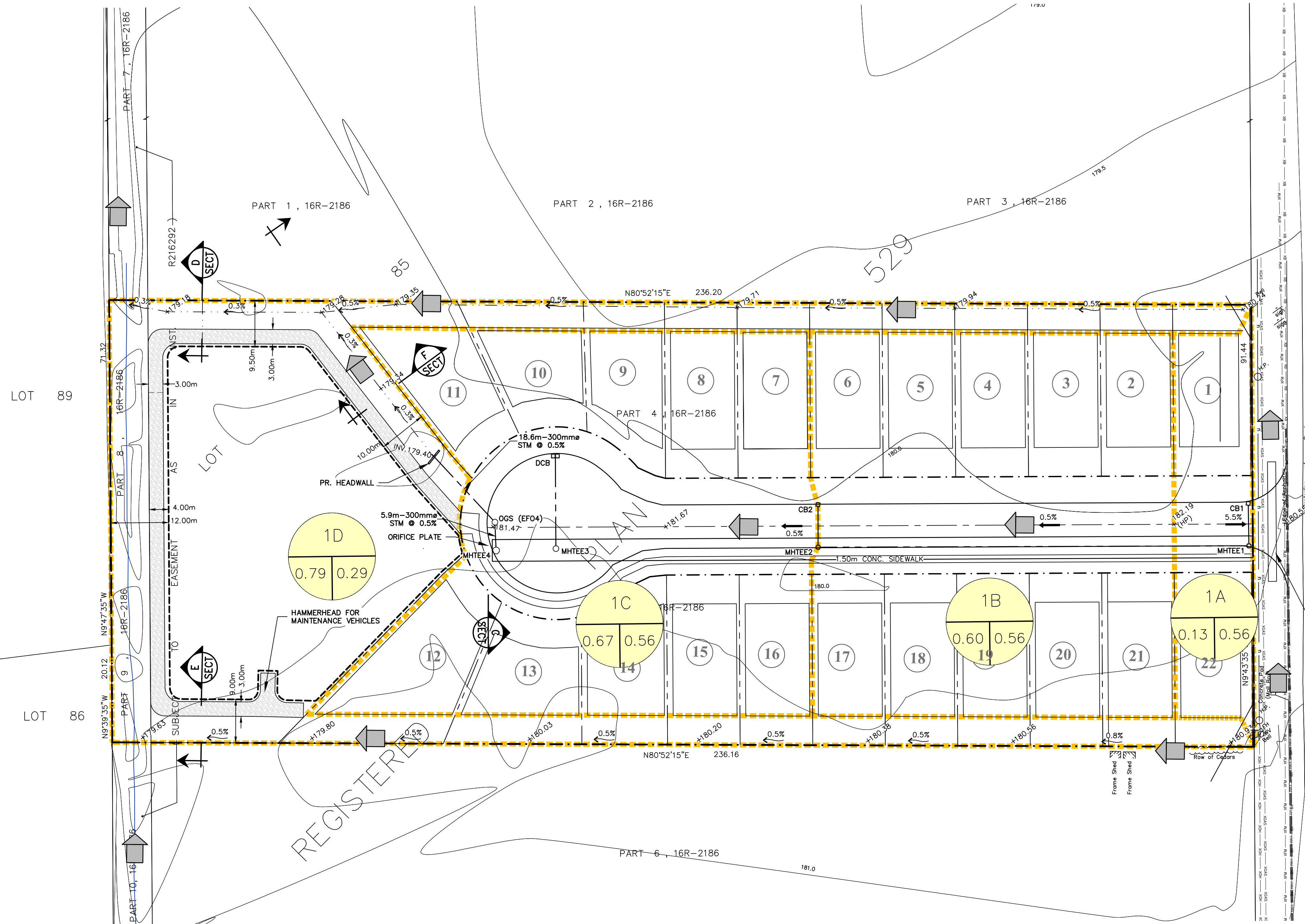
ADMIRAL BUILDING
 1 FIRST STREET, SUITE 200
 COLLINGWOOD, ON, L9Y 1A1
 705-446-3510 T
 705-446-3520 F
 WWW.CFCROZIER.CA
 INFO@CFCROZIER.CA

Drawn	R.L.	Design	J.L.	Project No.	1988-5783
Check	T.G.	Check		Scale	1:1000 Dwg. FIG-3





LEGEND	
	SITE BOUNDARY
	LIMITS OF RETAINED WOODLOT
	PROPOSED SLOPE
	CATCHMENT ID
	RUNOFF COEFFICIENT
	AREA (Ha)
	CATCHMENT AREA LIMITS
	MAJOR FLOW PATH
	PROPOSED STORM SEWER & MANHOLE
	PROPOSED SINGLE / DOUBLE CATCHBASIN
	PROPOSED GRADE
	EXISTING CONTOUR ELEVATION



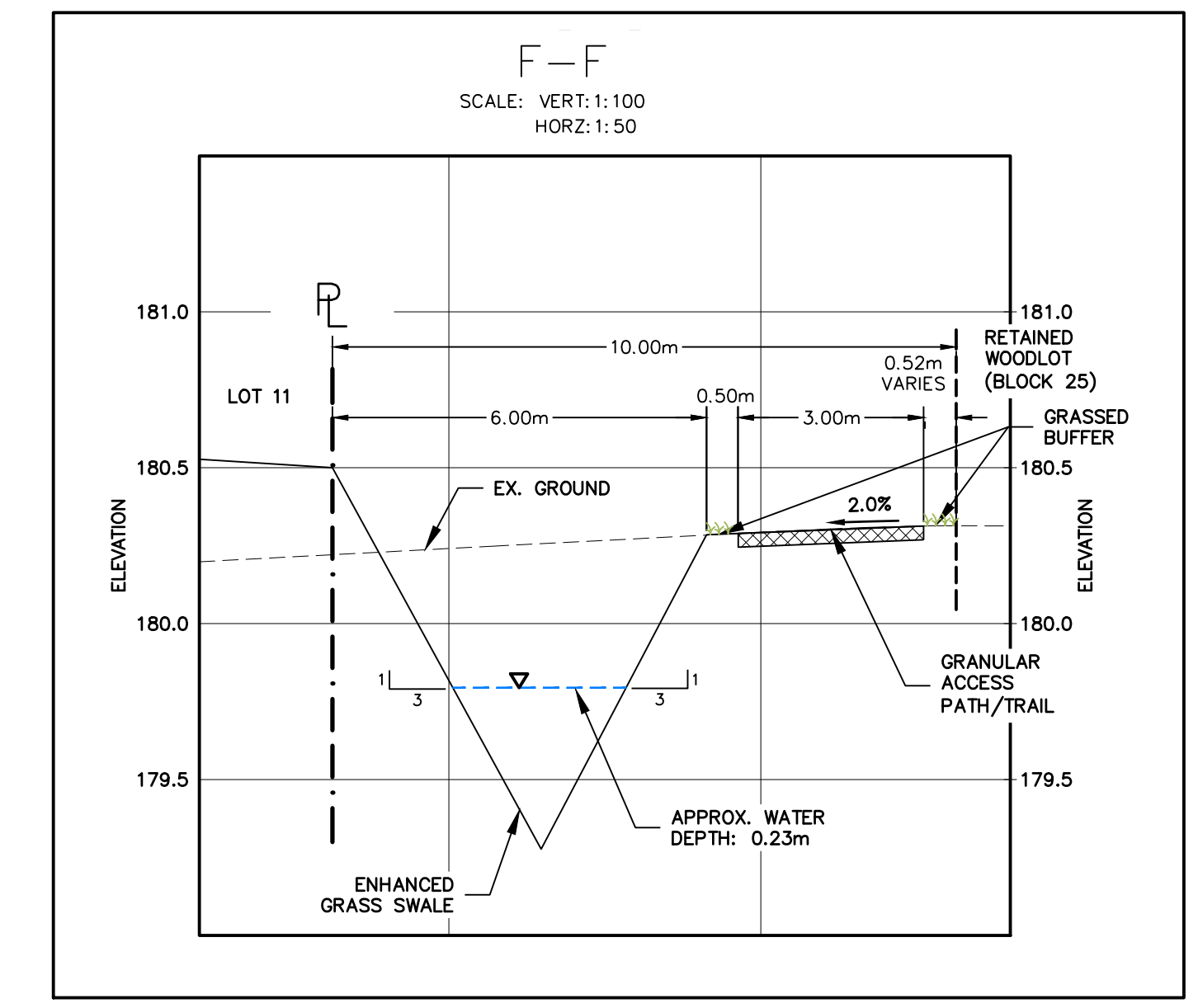
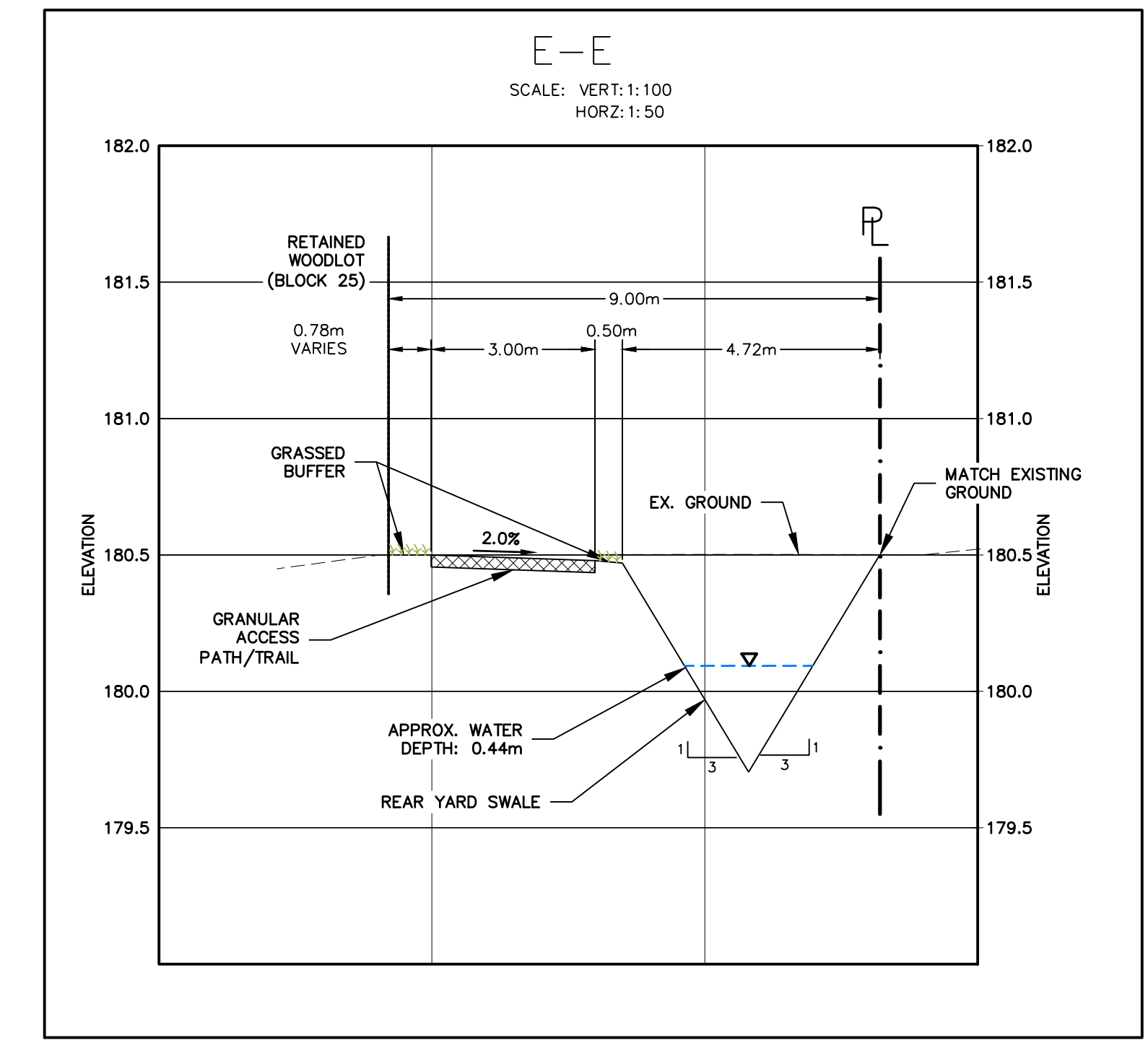
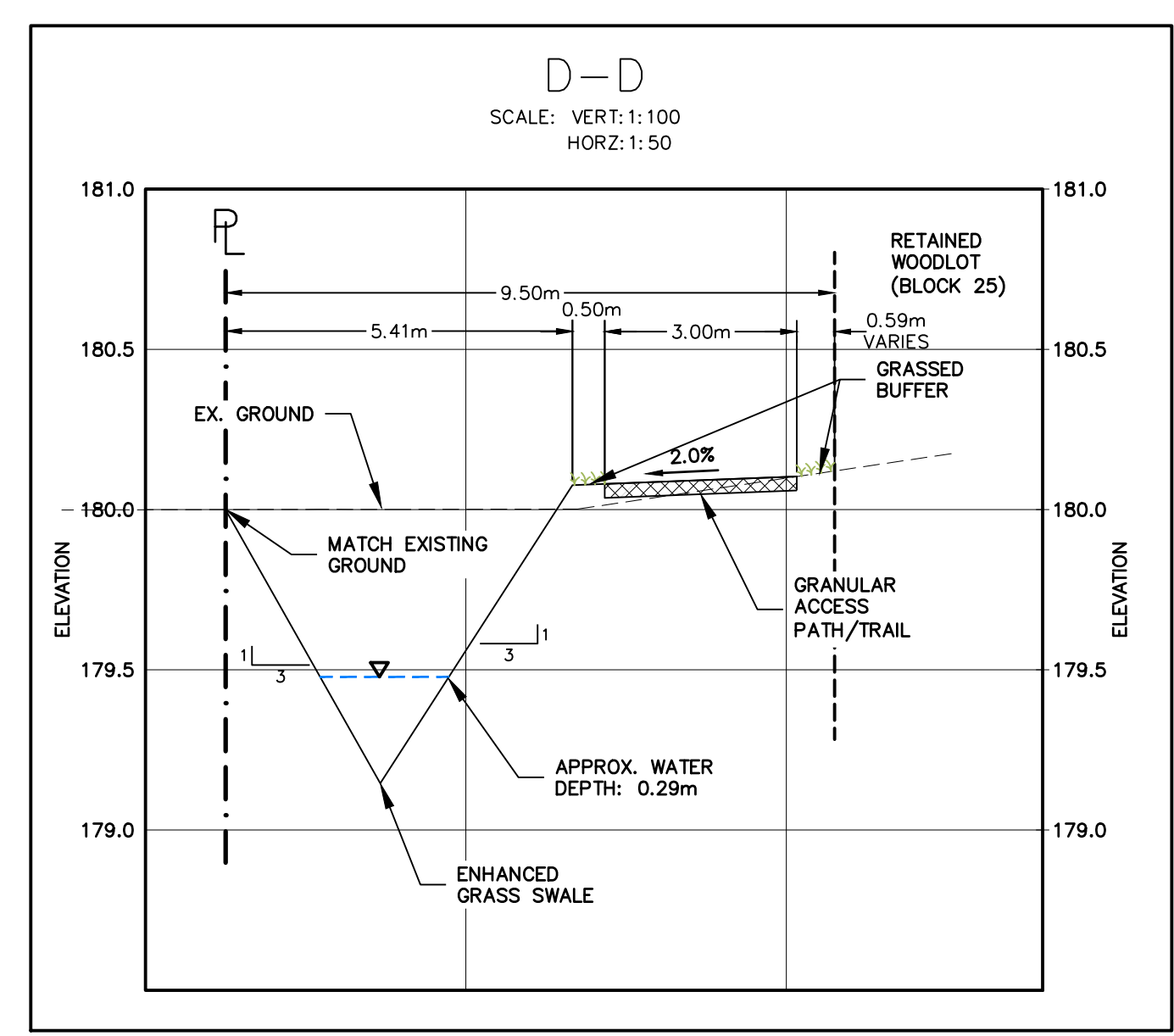
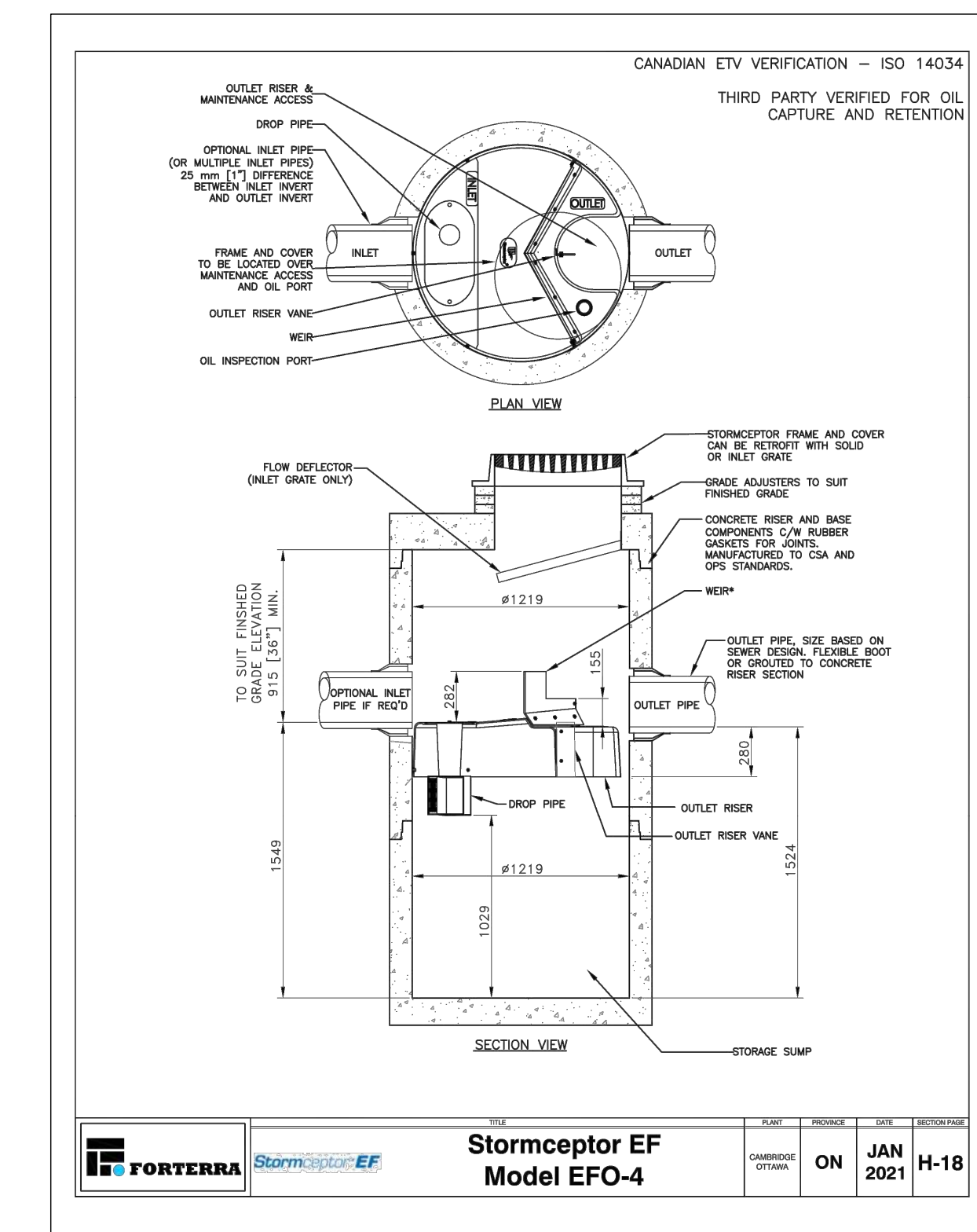
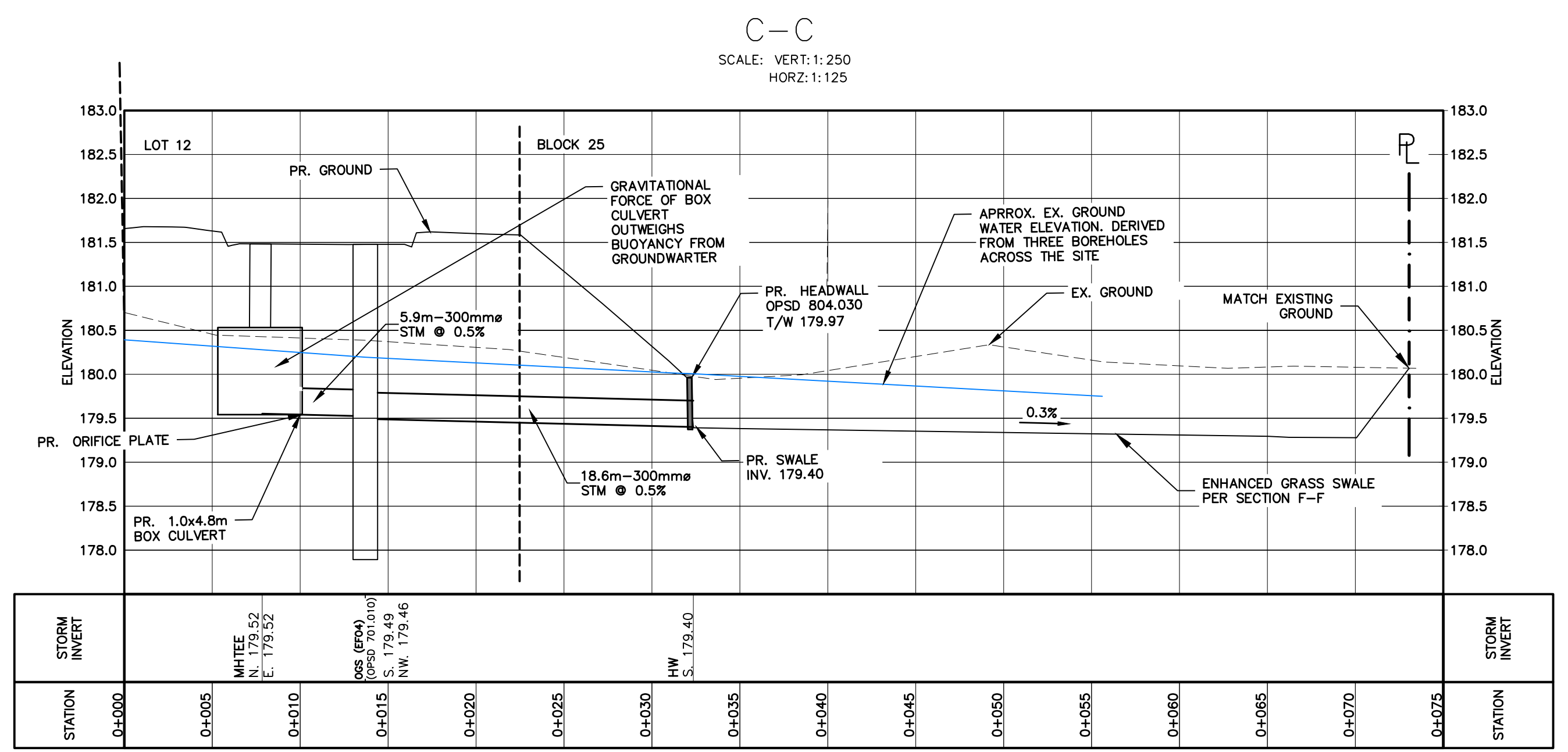
PR. CROSS CULVERT SIZE TO BE CONFIRMED

REGISTERED



FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

OA	ISSUED FOR THIRD SUBMISSION	2022/JAN/21												
No.	ISSUE / REVISION	YYYY/MM/DD												
<p>1. THIS DRAWING IS THE EXCLUSIVE PROPERTY OF C.F. CROZIER & ASSOCIATES INC. AND THE REPRODUCTION OF ANY PART WITHOUT PRIOR WRITTEN CONSENT OF THIS OFFICE IS STRICTLY PROHIBITED.</p> <p>2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, LEVELS, AND DATUMS ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO THIS OFFICE PRIOR TO CONSTRUCTION.</p> <p>3. THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER PLANS AND DOCUMENTS APPLICABLE TO THIS PROJECT.</p> <p>4. DO NOT SCALE THE DRAWINGS.</p> <p>5. ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.</p>														
Project														
LONG POINT ROAD SUBDIVISION														
Drawing														
GRADING AND STORM SEWER														
<table border="1"> <tr> <td>Drawn</td> <td>R.L.</td> <td>Design</td> <td>J.L.</td> <td>Project No.</td> <td>1988-5783</td> </tr> <tr> <td>Check</td> <td>T.G.</td> <td>Check</td> <td>Scale</td> <td>1:500</td> <td>Dwp</td> </tr> </table>			Drawn	R.L.	Design	J.L.	Project No.	1988-5783	Check	T.G.	Check	Scale	1:500	Dwp
Drawn	R.L.	Design	J.L.	Project No.	1988-5783									
Check	T.G.	Check	Scale	1:500	Dwp									
FIG. 4														



NOTE:
BUFFER IN DEPTH OF SWALE WILL BE SUFFICIENT TO CONVEY INFILTRATION OF GROUNDWATER IN SEASONALLY HIGH CONDITIONS.

No.	ISSUE / REVISION	DATE
0A	ISSUED FOR THIRD SUBMISSION	2022/JAN/21
		YYYY/MM/DD

1. THIS DRAWING IS THE EXCLUSIVE PROPERTY OF C.F. CROZIER & ASSOCIATES INC. AND THE REPRODUCTION OF ANY PART WITHOUT PRIOR WRITTEN CONSENT OF THIS OFFICE IS STRICTLY PROHIBITED.
2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, LEVELS, AND DATUMS ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO THIS OFFICE PRIOR TO CONSTRUCTION.
3. THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER PLANS AND DOCUMENTS APPLICABLE TO THIS PROJECT.
4. DO NOT SCALE THE DRAWINGS.
5. ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project
LONG POINT ROAD SUBDIVISION

Drawing
SECTION AND DETAILS

FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

CROZIER
CONSULTING ENGINEERS

Drawn	R.L.	Design	J.L.	Project No.	1988-5783
Check	T.G.	Check	Scale	AS SHOWN	Dwg FIG. 5