







water's edge
ENVIRONMENTAL SOLUTIONS TEAM LTD.

Sunvest Development Corporation

720 Erbsville Rd., Waterloo, ON Stormwater Management Report

December 15, 2023

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WE 23014

Mr. Peter de Groot
Sunvest Group of Companies
901 Victoria St N Unit 1
Kitchener, Ontario
N2B 3C3

Dear Mr. de Groot:

Re: Sunvest Development Corporation
720 Erbsville Rd., Waterloo, ON
Stormwater Management Report

1.0 Introduction

Water's Edge has been authorized by Sunvest Development Corporation to conduct functional servicing and SWM modelling for the proposed development at 720 Erbsville Rd, Waterloo. The study area comprises a property of about 9.3 hectares, of which a portion (3.1 hectares) has been designated for development. The development area is bound by residential neighborhoods on the north and south sides. We are assuming for purposes of description in this report that Erbsville Road runs north to south. Erbsville Road runs along the westside of the study area, while Laurel Creek is to its east. The land located east of Laurel Creek has been slated for future development and is currently undergoing a zone change application. **Figure 1** shows the site location, including the development area.

The redevelopment plan proposes to construct stacked townhouse buildings and townhouse blocks. The development will also include an amenity space and on-site parking for residents. This report outlines the design approach and feasibility of the project, specifically in terms of the functional grading and servicing of the development.

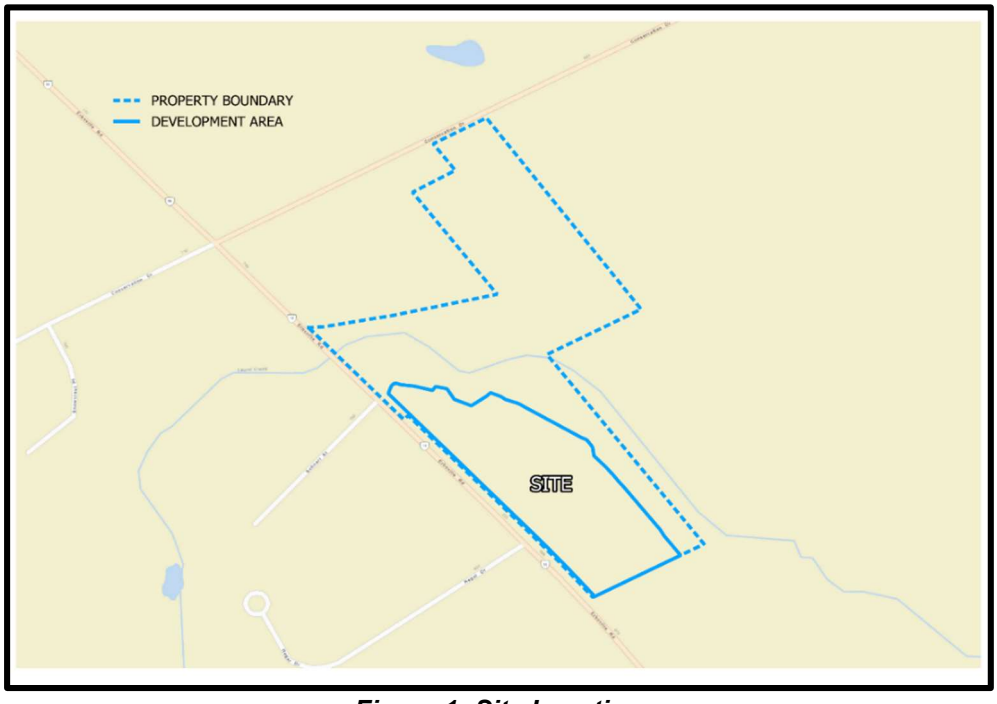


Figure 1: Site Location

2.0 Existing Conditions

Currently, the study area consists of a single detached home, which will be demolished to accommodate the proposed development. Environmental buffer zones will be established to protect Laurel Creek, which runs through the property. **Figure 2** shows the aerial photograph of the site.

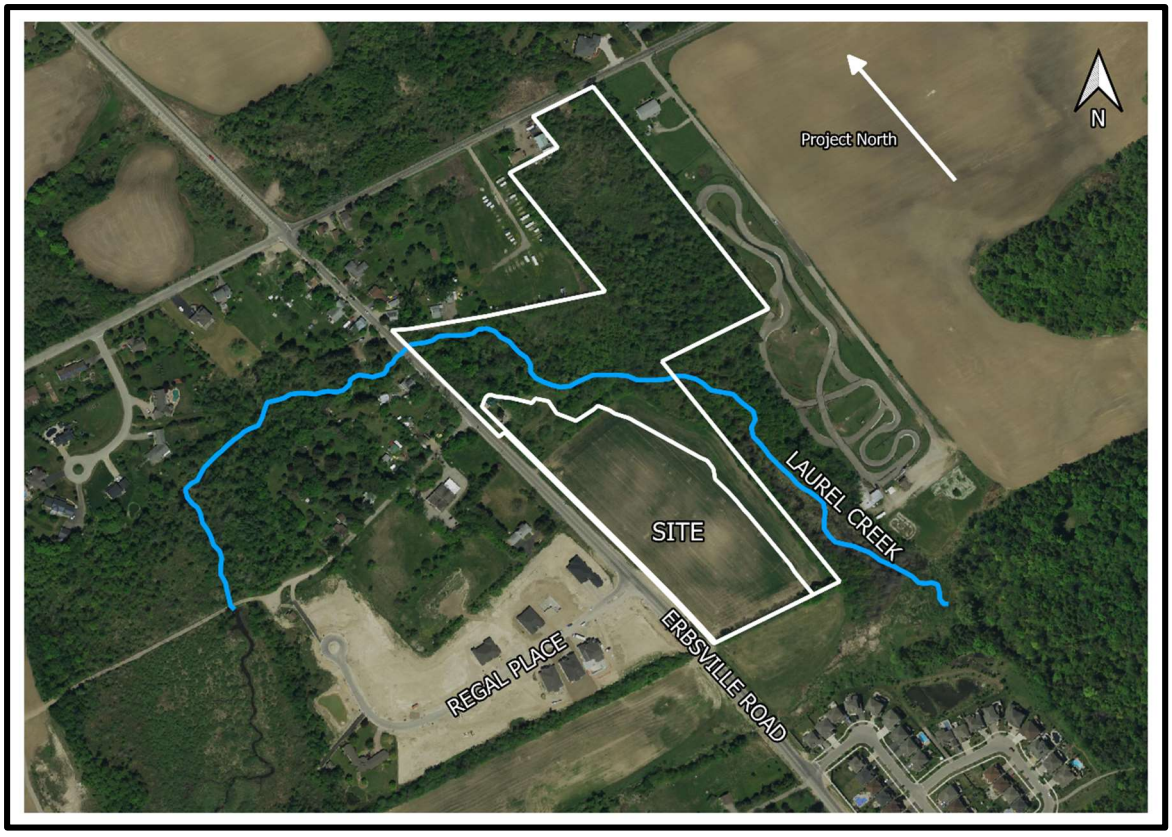


Figure 2: Site Location and Aerial Photo

3.0 Existing Topography and Drainage

The development site is divided by two ridges, with all areas draining east towards Laurel Creek. The Site's pre-development catchment areas are delineated on the Pre-Development Storm Area Drainage Plan.

4.0 Proposed Development

The proposed development plan will comprise of stacked townhouse buildings and townhouse blocks, along with on-site parking and amenity spaces. Existing vegetation will be removed as necessary to facilitate the proposed development. This section describes the SWM design.

The existing regulatory floodplain for Laurel Creek, which is included in the preliminary grading plan, is determined based on the results of HEC-RAS modelling. It will be ensured that the proposed development site is outside the regulatory floodplain. Additionally, the proposed stormwater management pond outlets will be located at an elevation higher than the 100-year floodline.

5.0 Stormwater Management

5.1 Stormwater Management Criteria

The criteria for managing stormwater in the proposed development site are based on previous studies, including the Laurel Creek Watershed Study (LCWS), the Subwatershed Management Plan, Subwatershed Plans #313/309 (Planning Initiatives Ltd., April 1996), and guidelines from the Laurel Creek HEC -RAS model (which follow the GRCA and City of Waterloo requirements). The main criteria listed in the abovementioned sources are:

- The stormwater management facilities must ensure that they control the water quantity (peak flow) for storms with return periods of 2, 5, 25, and 100 years. The objective is to manage the proposed flow conditions to the pre-development levels specified in Table B4.3 of the Subwatershed Report.
- Based on section D1.3.1 of the Subwatershed study, active infiltration measures must be maintained on site to preserve the current annual infiltration rate of 195 mm.
- Grading and servicing design should not adversely impact groundwater or the neighbouring significant natural features.
- Extended detention control is necessary to prevent erosion for runoff rates up to the 100-year runoff, as specified in Table B 4.3 of the Subwatershed Management Plan. The extended detention must be released within 48 hours.
- All development-related work, except for minor encroachment to facilitate the construction of stormwater management facilities, must take place outside the established environmental buffers.

The intent of the surfacewater monitoring for the development is to provide baseline water quality data that can be compared with the LCWS performance targets and postconstruction monitoring results. These targets are summarized below:

With the exception of Total Suspended Solids (TSS), the criteria were established as instream targets, referring to the water quality in Laurel Creek and not the effluent from SWM facilities. Testing and measurement of the following parameters will be included in the Stage II and Stage III Monitoring Programs:

a) Temperature – maintain or reduce instream surfacewater temperatures in Laurel Creek to protect the coldwater fish species upstream of the reservoir (threshold of 22°C instream temperature from April 1 to October 31 and between 4°C and 14°C from November 1 to March 31).
b) Dissolved Oxygen (DO) – maintain an instream minimum dissolved oxygen level 6.0 mg/L or greater upstream of the Laurel Creek Reservoir.
c) Phosphorus (TP) – ninety percent (90%) of the phosphorus should be removed from the runoff from developments discharging to Laurel Creek. The target instream phosphorus concentration above the Laurel Creek Reservoir is 0.03 mg/L.
d) TSS – maintain concentration during rainfall events of less than 25 mg/L for the effluent from SWM facilities to Laurel Creek. No instream target was identified within the LCWS.
e) Bacteria (E.coli) – No E. Coli sampling was conducted by the City for their sampling Site at Erbsville Rd. It is noted that the LCWS target for E.coli is based on Provincial Water Quality Guidelines for bathing beaches. The instream target for E.coli is 100 CFU/100 mL for areas tributary to the Laurel Creek Reservoir. Measures to reduce E. Coli contributions are encouraged.

Table 1 summarizes the specific instream targets that apply to this site:

Table 1: Instream Water Quality Targets for Laurel Creek

Parameter	Target
TSS	No instream target (<25 mg/L for SWM facility effluent)
TP	≤0.03 mg/L
DO	≥6.0 mg/L
E.coli	<100 CFU/100 mL
Temperature	≤22°C (Apr-Oct), 4-14°C (Nov-Mar)

5.2 Stormwater Quantity Control

A stormwater management pond is required to effectively control stormwater quantity for 2, 5, 25, and 100-year storm events. To ensure compliance, GAWSER hydrologic modelling for existing conditions is presented in the Subwatershed Report, which outlines the target release rates for the various storm events ranging from 2 to 100 - Year return periods. The peak flow targets for the developing land areas and any external areas that contribute to the flow into the stormwater management pond are specified in **Table 2** (Peak flow calculations derived from **Table B 4.3**, Page B-38 of the Subwatershed Report).

Table 2: Peak Flow Targets

Sub-catchment	**Area***	**Return Event**			
No.	**(ha)**	**2 Year**	**5 Year**	**25 Year**	**100 Year**
109	1.14	Southwest Flow			
Targets ($m^3/s/ha$)		0.0036	0.0092	0.0290	0.0490
Flow (m^3/s)		0.004	0.010	0.033	0.056
111	1.94	Northwest Flow			
Targets ($m^3/s/ha$)		0.0026	0.0045	0.0083	0.0124
Flow (m^3/s)		0.005	0.009	0.016	0.024
Total Area	**3.15**				
Peak Flow (m^3/s)		**0.009**	**0.019**	**0.049**	**0.080**

The peak discharges from the site during storm events must meet the specified targets in **Table 1**. To ensure compliance, stormwater management controls are required. It is proposed to utilize two SWM ponds and an infiltration swale to provide these controls. SWM modelling for the proposed development site was performed using the MIDUSS computer program, and the corresponding input and output files are presented in **Appendix B**. The residential areas have been estimated to have an imperviousness percentage of 70 for modelling purposes.

The rear yard areas and rear portions of the rooftops along the eastern development limit are low in elevation and cannot be routed to the SWM ponds. As such, these catchments will be routed to an infiltration swale and are assumed to be 50% impermeable. **Table 3** summarizes the modelling variables based on site-specific information.

Table 3: MIDUSS Modelling Variables

DESCRIPTION	AREA (HA)	Over land Slope	%imp	PERV. MANNING'S N	PERVIOUS CN
Developing Lots Draining to Pond B	1.61	2%	70	0.250	68
Developing Lots Draining to Pond A	1.01	2%	70	0.250	68
Rear portion of land draining to Infiltration Swale	0.42	2%	50	0.250	68
Catchment 2 Draining to Laurel Creek	0.04	2%	0	0.250	65
Total	**3.08**				

For the modelling of the 2, 5, 25, and 100-year storm events, a 3-hours Chicago style storm based on the City of Waterloo intensity-duration-frequency (IDF) curve was used. **Table 4** summarizes the resulting rainfall depths for each storm event.

Table 4: Rainfall Depths

RETURN EVENT	DEPTH (MM)
2 Year	32.4
5 Year	47.5
25 Year	69.1
100 Year	89.9

The outlet structure of the stormwater management pond will feature orifice control, consisting of a 75 mm diameter orifice for controlling water quality and erosion extended detention storage, and a 75 mm diameter orifice for controlling storm events up to the 100-year storm. It is important to note that a single outlet will be sufficient to manage the stormwater quantity for all events up to 100-year storm, while maintaining a maximum water level fluctuation of less than 1.2 m for Pond B and 1.6m for Pond A. For events that exceed the 100-year storm, an emergency overflow weir and rip rap protected outlet are included.

Both Pond A and Pond B have been designed conservatively to meet the flow targets. The emergency spillway weirs have been added to provide overflow for flows greater than 100-year. The pond sizing and weir elevations are seen in **Table 5**. The overflow weirs are 5m with 3:1 side slope.

Table 5: Pond Sizing

Pond	Pond Volume (m^3)	Weir Elevation (m)	Orifice 1 (75mmϕ) invert height (m)	Orifice 2 (75mmϕ) invert height (m)
A	898	350.80	349.00	350.50
B	1484	349.70	348.20	349.2

The two stormwater management ponds' outlet structures will be designed to discharge runoff towards Laurel Creek through level stone spreader swales. This type of outlet will help ensure that the site's existing diffused drainage patterns are maintained, and erosion is prevented by slowing and spreading flow over a large area. Furthermore, it will also mitigate thermal impacts by cooling runoff before it discharges overland toward Laurel Creek. The rear yard areas that drain east towards Laurel Creek are too low to drain into the proposed stormwater management ponds. These areas will mainly consist of landscaped areas and rear portions of roofs (the front rooftops and asphalt areas will be channeled towards the proposed sewer system). It is proposed that an infiltration swale of 220 m^3 would be required. The swale has been sized at 230 m in length, 1.8 m bottom width and 3.0 m top width.

The pond volumes and outlet controls required to reduce the proposed development flows and ensure compliance with the prescribed levels were determined using the MIDUSS software. Total discharges from the site are presented in **Table 6**, which indicates that the proposed peak discharges have been effectively controlled and remain below the target levels. **Table 7** shows the ponding volume requirement of the stormwater management pond for all storm events.

Table 6: Peak Discharges

	EXISTING CONDITIONS TARGETS (M^3/S)	Proposed CONDITIONS PRIOR TO NO POND ROUTING (M^3/S)	PROPOSED CONDITIONS AFTER POND ROUTING (M^3/S)
2 Year	0.009	0.157	0.009
5 Year	0.019	0.229	0.018
25 Year	0.049	0.339	0.027
100 Year	0.080	0.458	0.037

Table 7: Storage Characteristics of Stormwater Management Pond

RETURN EVENT	POND A STORAGE VOLUME (M^3)	POND B STORAGE VOLUME (M^3)
2 Year	152	267
5 Year	239	431
25 Year	387	695
100 Year	550	950

The preliminary engineering drawings (**Appendix A**) provides grading details of the SWM ponds and infiltration swale. The pond stage-storage-discharge calculations and MIDUSS modelling can be found in **Appendix B**.

5.2.1 Extended Detention Erosion Control

In accordance with the Subwatershed Report, the stormwater must be capable of retaining the volume of the 100-year storm and gradually discharge it over a period of 48 hours to prevent downstream flooding or erosion.

Given that both facilities use a minimum orifice size of 75 mm due to the size of the contributing sewershed and relatively small quantities of runoff, a full 48-hour detention time is not achievable. A release time of about 28hrs for Pond A and 21 hours for Pond B is achieved via the 75 mm orifices in each pond. As each pond outlets into spreader swales, their lag time will be increased further. Erosion as well as increased flow peaks will be mitigated because flow targets are met from 2 through 100-year storm events.

6.0 Water Budget

The MOE 2003 guidelines state that developers are to mitigate the effects of decreased infiltration. A monthly water budget was calculated based on pre-development and post-development areas.

A monthly water budget was created using weather data from Environment and Climate Change Canada weather station *Waterloo Wellington A (Automated)*. The data inputted was average temperature and precipitation from Canadian Climate Normals 1991-2020 Data. Waterloo Fine Sandy Loam was determined to be the average soil type for the property using Ontario Soil Survey Complex. Moderate rooted crops with fine sandy loam (150mm water holding capacity) were considered for the soil type for existing conditions. For proposed development conditions, fine sandy loam (150mm water holding capacity) as an approximate average to account for added topsoil and some compaction from development.

6.1.1 Input Parameters

Input parameters were based on standard procedures for Thornthwaite Monthly Water Balance and the MOE 2003 manual. Average monthly temperature and precipitation were used from Waterloo Wellington Weather Station.

Table 8: Model Inputs

Parameter	Value Used
Topography	Hilly (0.1 MOE factor)
Soil	Open Sandy Loam (0.4 MOE factor)
Cover	Cultivated (0.1 MOE factor)
Infiltration factor (sum of topography, soil, & cover)	60% infiltration
Soil Moisture - Storage Capacity	150mm
Latitude	43º
Temperature	Climate Normal Monthly Avg.
Precipitation	Climate Normal Monthly Avg.

6.1.2 Model Assumptions

It is assumed that 10% of impervious runoff is evaporated. Additionally, it is assumed that there is no infiltration in winter months. The snow storage is accumulated throughout the winter and then begins to be released when temperatures are above 0ºC. Initially 10% of snow is released in the first warm month and 50% of remaining snow each month after. It is assumed that the soil is saturated in January and again in December.

6.2 Mitigation of Reduced Infiltration

An infiltration swale is proposed along the east side of the property (catchments 4,9,13). This swale is sized at 220m^3. All water will runoff into the infiltration swale (including the roofs in these catchment areas). Additionally, 65% of the runoff from all other catchment rooftop's will be diverted to infiltration galleries. The infiltration gallery sizing of 65% accounts for approximately 8 mm of all rainfall events according to TRCA Rainfall Depth vs Rainfall Amounts in **Figure 3**. There is 5325m^2 of roof top area contributing to infiltration gallery. If 8mm needs to be infiltrated then infiltration gallery should be sized to a minimum of 43m^3.

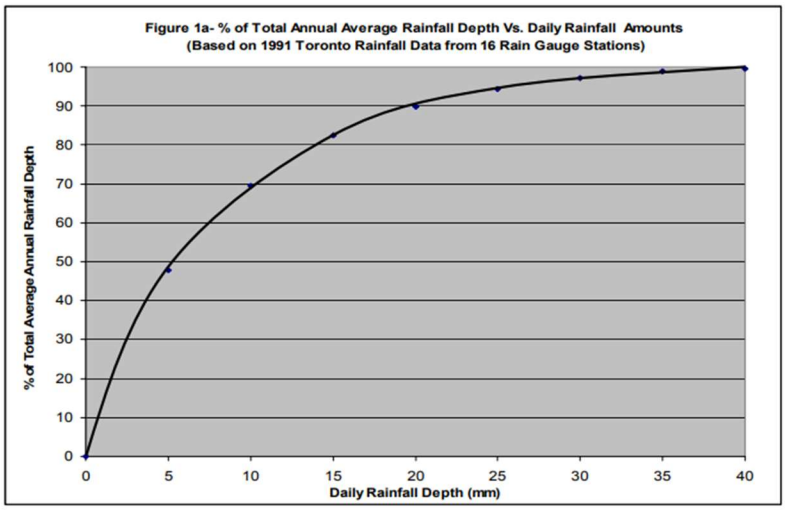


Figure 3: TRCA Annual Average Rainfall Depth vs. Daily Rainfall Amounts

6.3 Model Results

Below in **Table 9** are the annual water balance based on the monthly water balance calculation.

Table 9: Model Results

	Pre-Development	Post Development (no mitigation)	Post Development (with mitigation)
Precipitation (mm)	916	916	916
Precipitation (m^3)	28222	28222	28222
Infiltration to wetland (m^3)	6947	2792	6906
Difference (m^3) (Pre-Post)	0	-4155	-41
% Difference	0	-60%	-1%
Actual ET* (m^3)	16644	8380	7859
Difference (m^3) (Pre-Post)	0	-8264	5024
% Difference	0	-50	-53
Runoff to wetland (m^3)	4631	17050	10254
Difference (m^3) (Pre-Post)	0	12419	5623
% Difference	0	268%	121%

**AET= Precipitation-Runoff-Infiltration*

For detailed summary of modelling results, please refer to **Appendix D**.

7.0 Stormwater Quality Control

7.1 LCWS Water Quality Parameters

Total Suspended Solids (TSS):

Concentrations of TSS collected by the City of Waterloo in 2021 ranged from 3 mg/L to 54 mg/L with only the March 11 and June 26 samples marginally above the LCWS target. Historically, monitoring has shown that TSS concentrations at the City's Station 20 site have been consistently low, as from 2006 to 2020 only 5.2% of TSS samples exceeded the 25 mg/L target, as noted by Stantec. As such, recent TSS results are consistent with historic data and can be representative of future patterns if development adheres to the stated criteria.

The Subwatershed Report requires that a water quality facility be provided to control the first 25 mm of runoff if it is not infiltrated. Based on an Enhanced Protection Level for the downstream receiver, stormwater quality control must be provided to achieve 80 percent Total Suspended Solids (TSS) removal efficiency for 90 percent of annual flows (MOE, 2003). Oil Grit Separators (OGS) are recommended to provide treatment to the runoff. Additionally, sedimentation in the pond from extended detention will provide the required Enhanced Protection Level.

The unit should be inspected and cleaned regularly (typically once every 6 to 12 months) as per the manufacturer's specifications. OGS units are typically credited for a 50 percent TSS removal, therefore the remaining 30 percent TSS removal will be provided by the extended detention of the stormwater management pond. Based on the MOE 2003 guidelines, dry ponds with extended detention can provide a TSS removal of 60 percent. Therefore, the total TSS removal for the site treatment-train is 50 percent for the OGS, and (0.50 X 60% = 30%) for the pond for a total of 80 percent. It is recommended to have two *Stormceptor EFO4* OGS units in parallel for the inlet of each pond. Each unit provides estimated 44% TSS removal. As a result, this will be a conservative design providing adequate water quality control.

Removal of TSS by the proposed Stormceptors and by extended detention in the SWM facility will allow the development to meet TSS targets. This will be confirmed through monitoring.

Dissolved Oxygen (DO):
Stantec also reported that 2021 DO concentrations ranged between 2.73 mg/L and 13.58 mg/L. Four of the eleven samples taken in 2021 were below the minimum target of 6.0 mg/L. Since approximately 28% of samples have historically not met the LCWS target, future monitoring will likely also have results where targets are not met. This will be determined through future monitoring.

Total Phosphorus (TP):
TP results historically fail to meet the target and only a single 2021 sample met the LCWS target of 0.03 mg/L. The TP concentrations ranged from 0.014 mg/L to 0.094 mg/L with an average concentration of 0.037 mg/L. The highest TP concentrations are in the spring, concurrent with spring melt. Stantec has suggested that exceedances may be a result of upstream agricultural practices.

From a practical perspective, Phosphorus is largely linked to sediment and the reduction of sediment in the SWM runoff will limit TP delivery to the creek. Urban land practices are also likely to reduce TP loadings.

E. Coli:
The City does not measure samples for *E.coli* concentrations. The proposed design will minimize the direct transmission of contaminated runoff to Laurel Creek but no future E. Coli monitoring will be conducted.

7.2 Mitigation of Water Temperature Increase
Surfacewater water temperature monitoring results, as conducted by the City of Waterloo and reported by Stantec, show that the temperature ranges from 1 to 21.3°C during the year with no exceedances of the LCWS targets noted. Higher temperatures are noted in the summer months and the data is consistent with historical data trends reported by the City of Waterloo. As such, it is important to maintain these conditions.

Water temperature is assumed to increase because of development (MOE 2003). The subwatershed plan provides water temperature targets for Laurel Creek as follows:

- <22ºC from April 1 to October 31; and
- 4ºC to 14ºC From November 1 to March 31

A mass balance surface temperature-volume calculation was used to estimate the approximate change in surfacewater temperature.

Based on Stantec's sampled water temperature from 2021, and Environment and Climate Change's Kitchener/Waterloo weather station, a relationship of air temperature to water temperature of Laurel Creek was derived (See **Table 10**).

Table 10 Relationship of Air Temperature to Water Temperature of Laurel Creek

Date	Stantec Recorded Surface Temp of Laurel Creek (ºC)	ECCC Kitchener/Waterloo Temperature (ºC)	Difference Between Mean (Daily) Air Temp and Water Sampled Instantaneous) Temp (ºC)	Absolute Value Difference Between Mean (Daily) Air Temp and Water Sampled Instantaneous) Temp ºC)	Precipitation (mm)
2021-03-11	1.0	0.8	-0.2	0.2	0.0
2021-05-05	5.0	5.8	0.8	0.8	0.0
2021-05-19	18.5	16.7	-1.8	1.8	0.0
2021-05-28	8.7	5.2	-3.5	3.5	17.8
2021-06-03	15.9	19.2	3.3	3.3	1.2
2021-06-21	18.7	17.8	-0.9	0.9	0.0
2021-06-26	18.1	22.7	4.6	4.6	0.0
2021-07-07	20.6	19.6	-1.0	1.0	3.3
2021-07-26	21.3	20.7	-0.6	0.6	0.0
2021-08-04	17.7	18.4	0.7	0.7	0.0
2021-08-17	18.6	21.7	3.1	3.1	0.0
AVERAGE	**14.92**	**15.33**	**0.41**	***1.86***	**2.03**

It was concluded that Laurel Creek water temperature would be within +/- 1.86ºC of the air temperature. A range of +/-1.86ºC is used in the relationship between air temperature and water temperature as it is not always independently related relationship (dependent on upstream inputs, solar radiation, and precipitation). It is estimated pre-development water temperature of Laurel Creek would be below the targets. Throughout the report water temperature estimates of Laurel Creek will be referred to as Laurel Creek Water Temperature (+1.86ºC)/ Laurel Creek Water Temperature (-1.86ºC). During winter months when the average air temperature was below 0ºC Laurel Creek was estimated to be 0ºC.

From **Table 11** it is noted that June, July, and August are the most susceptible to breaching the targets being within 2.54ºC of the target. To estimate the temperature, affect of development, Water's Edge considered All-Weather Ground Surface Temperature Model (W.R. Herb et. al) and shifted the surface temperatures linearly based on the difference in each month's air temperature from the DNR MN to Waterloo Average temperatures (2004) to adjust to the following surface temperature estimates in **Table 12**. The model considered months from April to September which are the ones most affecting runoff. Based on the monthly air temperature in months October to March, the surface temperature of Laurel Creek would be below the targets and therefore will not be modelled.

From **Table 12** a weighted temperature volume balance could be calculated based on monthly flows from the monthly water balance. **Figure 3** determines the influence of the runoff on meeting the targets for surfacewater temperature. It is assumed that the runoff will be at the same temperature as the surficial material that receives precipitation.

Table 11 Surface Temperature Estimates and Targets

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A	Climate normal Air Temp (ºC)	-6.5	-5.5	-1	6.2	12.5	17.6	20	18.9	14.5	8.2	2.5	-3.3
B	Laurel Creek Max Temp Target (ºC)	14	14	14	22	22	22	22	22	22	22	14	14
C	Estimated Laurel Creek water temp (+ 1.8ºC from air temp)	0	0	0.9	8.1	14.4	19.5	21.9	20.8	16.4	10.1	4.4	0
D	Exceedance from Target **(D-B)**	-14	-14	-13.1	-13.9	-7.6	-2.5	-0.1	-1.2	-5.6	-11.9	-9.6	-14
E	Estimated Laurel Creek Surface temp (Water temp - 1.8ºC from air temp)	0	0	0	4.3	10.6	15.7	18.1	17.0	12.6	6.3	0.6	0
F	Exceedance from Target **(E-B)**	-14	-14	-14	-17.7	-11.4	-6.3	-3.9	-5.0	-9.4	-15.7	-13.4	-14

Table 12 Estimate of Surface Temperatures

All Temps in (ºC)	Apr.	May	Jun.	July	Aug.	Sep.
Waterloo Climate Normal Temp	6.2	12.5	17.6	20	18.9	14.5
Adjustments From St. Paul MN to Waterloo, ON	-3.7	-1.2	-1.0	-2.3	-0.2	-5.2
Asphalt	13.9	20.5	27.8	30.3	27.1	20.5
Res. Roof	8.8	15.5	22.6	24.8	21.6	15.1
Pond	7.5	13.9	20.2	22.9	21.2	13.7
Sod	5.3	12.1	17.1	19.2	19.0	11.1
Corn	6.5	13.3	18.0	18.9	18.0	11.5

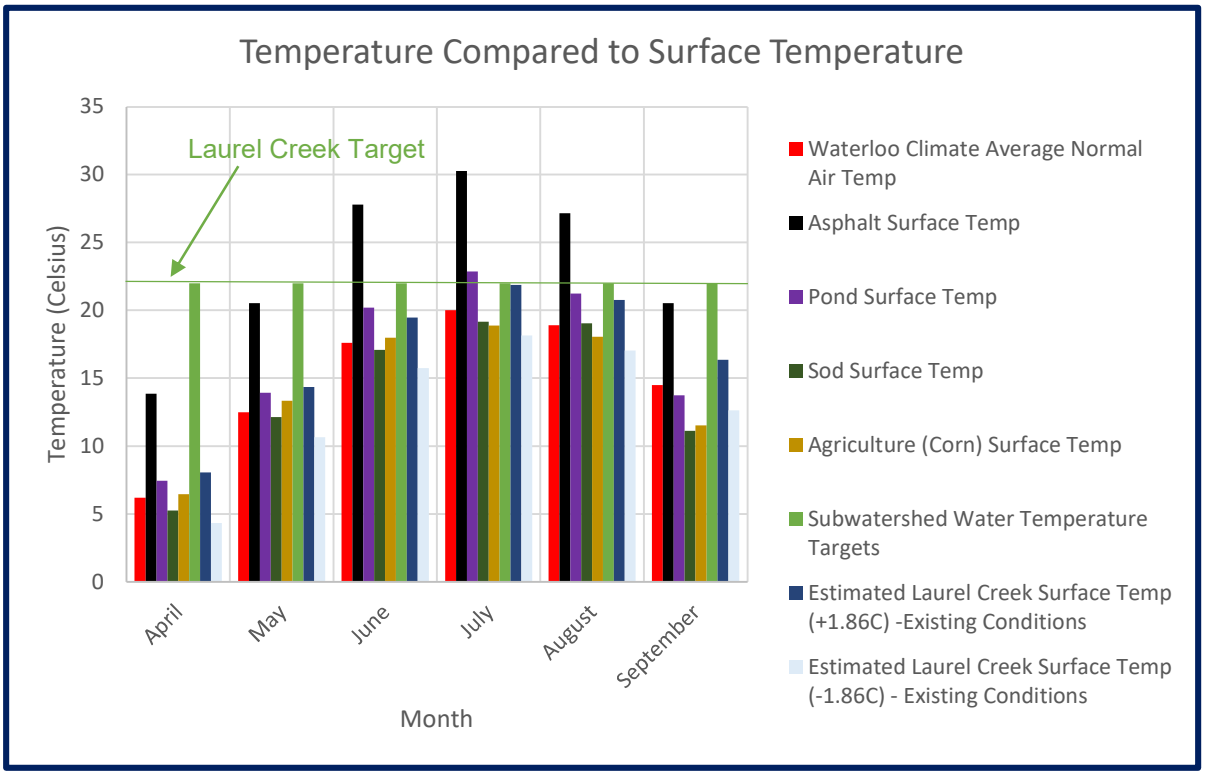


Figure 3: Air Temperature Compared to Surface Temperature Targets and Estimates

A summary of **Figure 3** is discussed as follows:

Non-Growing Season Months (October - March): Surface temperatures were not studied; however the estimated water temperature difference was the greatest from the targets in these months and the flows are lower. (See **Table 8)**

April: Every surface temperature is below the target in April. There is the largest gap between target and creek temperature. Asphalt runoff will increase temperature compared to creak temperatures. All other surface temps are within the range of the estimated predevelopment Laurel Creek temperature.

May: Asphalt runoff will increase temperature compared to creek temperatures. Asphalt surface temperature is close to subwatershed target. All other surface temps are within the range of the estimated predevelopment Laurel Creek temperature.

June: Asphalt runoff is higher than subwatershed targets. All other ones are close to targets. Estimated Laurel Creek still has a few degrees buffer in temperature compared to target. All other surface temps are within the range of the estimated predevelopment Laurel Creek temperature.

July: This month estimated Laurel Creek temperature is close to the target. Asphalt and Ponds are higher than the target. All other surface temps are within the range of the estimated predevelopment Laurel Creek temperature.

August: This month estimated Laurel Creek temperature has cooled and is further from the target. Asphalt temperatures are higher than the target. All other surface temps are within the range of the estimated predevelopment Laurel Creek temperature.

September: Every land cover surface temperature is below the targets. The estimated Laurel Creek temperature is far below the target.

June, July, and August are most likely to raise the temperature of Laurel Creek as surface temperatures during these months are sufficiently higher. A weighted temperature volume graph is displayed in **Figure 4** showing estimated pre-development conditions, post development conditions, and post development conditions with cooling (via spreader swales). The spreader swales used to cool water can be assumed to cool the runoff up to the 2-year storm. According to **Figure 3,** this accounts for 95% of the flow. It is assumed that the temperature of this flow will be cooled to 8ºC by the spreader swales. It is assumed that the remaining 5% will be at the estimated temperature of the surficial material (**Table 10**).

The weighted temperature balance was derived from volumes of runoff from the monthly water balance model. It is assumed that recharge will not warm the creek because it is mixed with groundwater. From this assumption of cooling, April, August, and September will have higher temperatures and flows than pre-development.

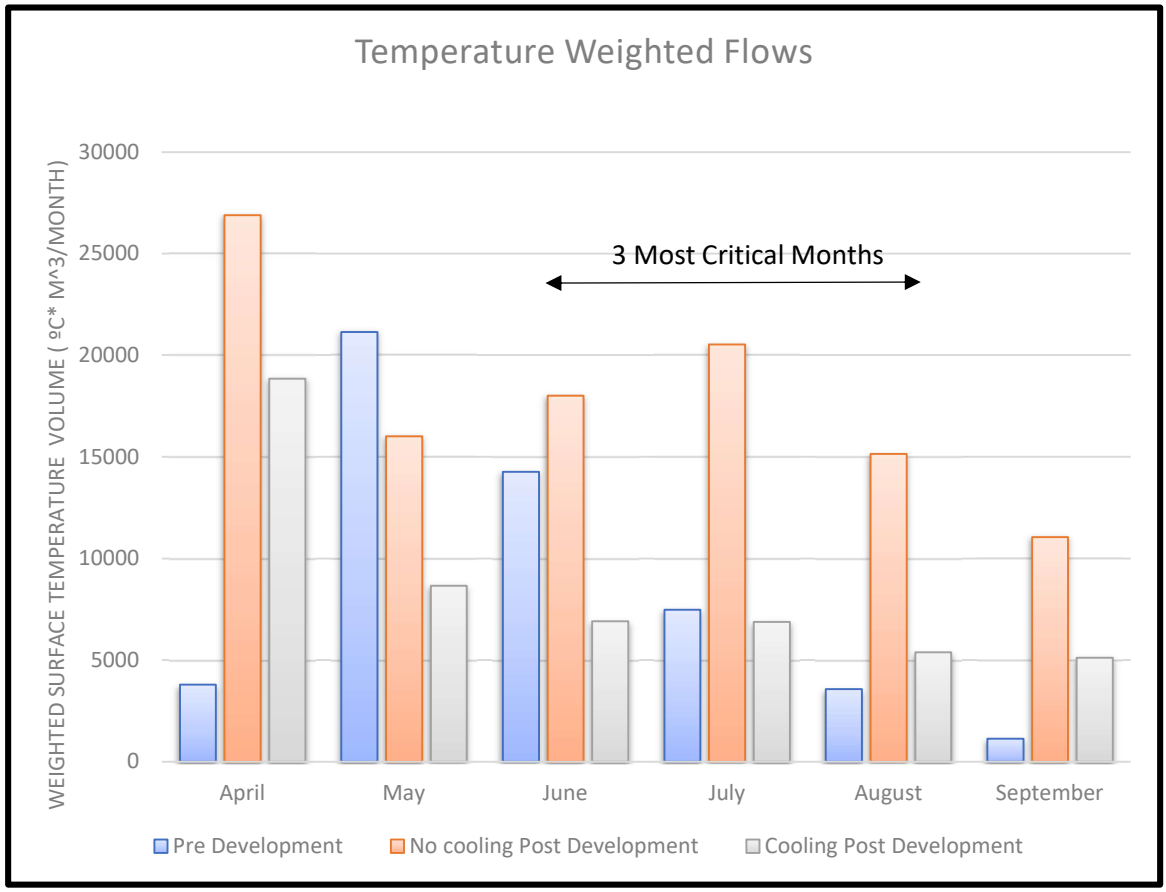


Figure 4: Monthly Weighted Temperature Comparison.

The following additional strategies will be used to mitigate the impacts of development on water temperature:

- Tree planting around ponds to shade stormwater pond. This will provide passive cooling to the water by minimizing solar radiation.

- Utilizing a bottom draw orifice will reduce thermal impacts to the receiving waterbody.
- Utilizing infiltration swales at the rear property to promote surfacewater to mix with groundwater and cool runoff (not accounted for in runoff balance.
- Subsurface outlets will be used for the ponds into the spreader swale to utilize the ground to cool the water.

We can conclude that in the months October - March, the target will not be breached because the creek temperature is far below 14ºC. June, July, and August in the summer months are the most sensitive months and closest to the targets. With cooling of the spreader swale, it is estimated that the Laurel will only have an increase temperature from April, August, and September.

7.3 Water Quantity and Temperature Summary

Monthly volumes from the GRCA Laurel Creek near Erbsville streamflow gauge were calculated and averaged for three years (2021-2023). Monthly volumes could be calculated for each month. The outlet volumes from Pond A, Pond B, and Catchment 2 (draining into the creek) are summarized in **Table 13**.

Table 13 Quantity of Runoff Compared to Laurel Creek

	April	May	June	July	August	September
Laurel Creek Monthly Streamflow Volume (m^3) (GRCA data) (2021-2013)	698945	386643	230477	243537	204490	322676
Pond A Outlet Volume (m^3)	1663	568	486	524	431	440
% of Laurel Creek monthly Volume	0.24%	0.15%	0.21%	0.22%	0.21%	0.14%
Pond B Outlet Volume (m^3)	2483	1110	843	823	653	647
% of Laurel Creek monthly Volume	0.36%	0.29%	0.37%	0.34%	0.32%	0.20%
Catchment 2 Draining to Creek Volume (m^3)	7.6	20.6	10.3	5.2	2.6	1.3
% of Laurel Creek monthly Volume	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%

It is noted that in there is 121% (**Table 9**) overall increase in runoff in post development conditions annually. Specifically, there is an 422% increase in runoff in April (**Appendix D**). **Table 13** shows that even with these increases of runoff, these volumes account for less than 1% of Laurel Creek's monthly volume. In April, the ground will be saturated due to snowmelt and the additional flows are expected to have no negative impact whether runoff goes directly to Laurel Creek and/or its adjacent riparian area. Thus, having the ponds outlet into spreader swales will not have any negative consequences in terms of volume to the contributing areas.

Using the weighted temperature-volume balance it is possible to estimate the temperature of the creek using the following equation:

$$\bar{T}_{Laurel\ Creek\ Post\ Development} = \frac{\left[V_{Laurel\ Creek\ Pre\ Development} \times \bar{T}_{Laurel\ Creek}\right] + \left[V_{Post\ Development\ Runnoff} \times T_{Temperature\ of\ 720\ Erbsville\ Runoff}\right]}{V_{Laurel\ Creek\ Pre\ Development} + V_{Post\ Development\ Runnoff}}$$

Estimated temperatures of Laurel Creek are shown in **Table 14** and shows that development will have no impact on the creek temperatures with or without cooling assumptions.

Table 14 Laurel Creek Water Temperatures

	April	May	June	July	August	September
Pre-Development (Max water temp +1.86C)	8.1	14.4	19.5	21.9	20.8	16.4
Post Development Without Cooling (Max water Temp of Laurel Creek)	8.1	14.4	19.5	21.9	20.8	16.4
Post Development with Cooling (Max water Temp of Laurel Creek)	8.1	14.4	19.4	21.8	20.7	16.4
Pre-Development (Min water temp -1.86C)	4.3	10.6	15.7	18.1	17	12.6
Post Development Without Cooling (Min Water Temp of Laurel Creek)	4.3	10.6	15.7	18.1	17.0	12.6
Post Development with Cooling (Min Water Temp of Laurel Creek)	4.3	10.6	15.6	18.0	16.9	12.6

Note: Unshaded is maximum Laurel Creek Temperature and shaded is minimum Laurel Creek Temperature.

Overall, the development has negligible impact on the water temperature or the water volumes of Laurel Creek.

8.0 MONITORING

A monitoring program is to be designed and implemented by the developer. The plan will serve to ensure that the mitigation measures proposed within the development are implemented and performing at an acceptable level, and will also help to communicate performance and understand potential impacts.

Based on the framework provided in the LCWS, the City of Waterloo has implemented the following monitoring strategy:

1) ***System (watershed wide) Monitoring*** – undertaken by the City
2) ***Development / During Construction Monitoring*** – The developer is responsible for monitoring during the development process and includes 3 stages;
   a) Pre-Construction Monitoring
   b) During-Construction Monitoring
   c) Post-Construction Monitoring
3) ***Post Development Monitoring*** – the City is responsible for monitoring facilities following municipal assumption.

8.1 Pre-Construction Monitoring Program

With reference to the NWSSS, the pre-construction monitoring program consists of stream temperature monitoring, water quality sampling (surface and groundwater), groundwater level monitoring, and streamflow rate monitoring. This stage of the monitoring program has been completed by Stantec with annual monitoring reports prepared since 2014.

8.2 During-Construction Monitoring Program

This stage will begin at the commencement of area grading of the subdivision and will continue until 90% stabilization of the SWM Facility contributing catchment area is achieved (buildings are constructed, lots are sodded). Monitoring will include:

1) **Stormwater Management Facility** - Standard inspection of vegetation, structures, and general operation of hydraulic controls (observations of drawdown) within the Stormwater Management Facility. These inspections are to occur seasonally and typically after a significant rainfall event. Pressure transducers will be installed in each facility to monitor water levels and drawdown.
2) **Erosion and Sediment Control** – per ESC Plans.
3) **Groundwater** – monitoring will include levels.

8.3 Post-Construction Monitoring Program

This period of the monitoring will begin following full build-out of the subdivision (i.e. houses are constructed, lots are sodded, open spaces are stabilized) for a duration of 2 years. The purpose of this stage of the monitoring is to ensure that the SWM Facility continues to operate as designed and that the groundwater elevations within the site are within acceptable levels of what was predicted. Monitoring during this stage will include:

1) **Stormwater Management Facility** - Standard inspection of vegetation, structures, and general operation of hydraulic controls (observations of drawdown) within the Stormwater Management Facility. These inspections are to occur seasonally and typically after a significant rainfall event. Pressure transducers will be installed in each facility to monitor water levels and drawdown.
2) **Groundwater** – monitoring will include levels.

9.0 SUMMARY

Based on design and modelling, we conclude the following:

1. Two proposed stormwater management ponds and an infiltration swale will provide stormwater quantity and erosion control for the developing area and ensure pre-devlopment quality control targets are achieved.
2. OGS units at the inlet of each pond in conjunction with the stormwater management pond will provide a treatment-train for stormwater quality control to provide 80 percent TSS removal.
3. Water temperature, erosion crontrol, and infiltration have all all been considered when analysing the effects of development on stormwater and the proposed development's design has implemented measures to manage the effects.
4. Infiltration gallery directing 65% of roof runoff (or 8mm per event) will be installed to mitigate impacts of increased imperviousness.

Respectfully submitted,





Ed Gazendam, Ph.D., P.Eng.,
President, Sr. Geomorphologist

Tim Antonio, B.A.Sc., (Eng.)
Water Resources Scientist

Water's Edge Environmental Solutions Team Ltd.

Attachments:

Appendix A: Catchment Area Drawings
Appendix B: Modelling Outputs
Appendix C: OGS Sizing Report and Specifications.
Appendix D: Water Balance Summary

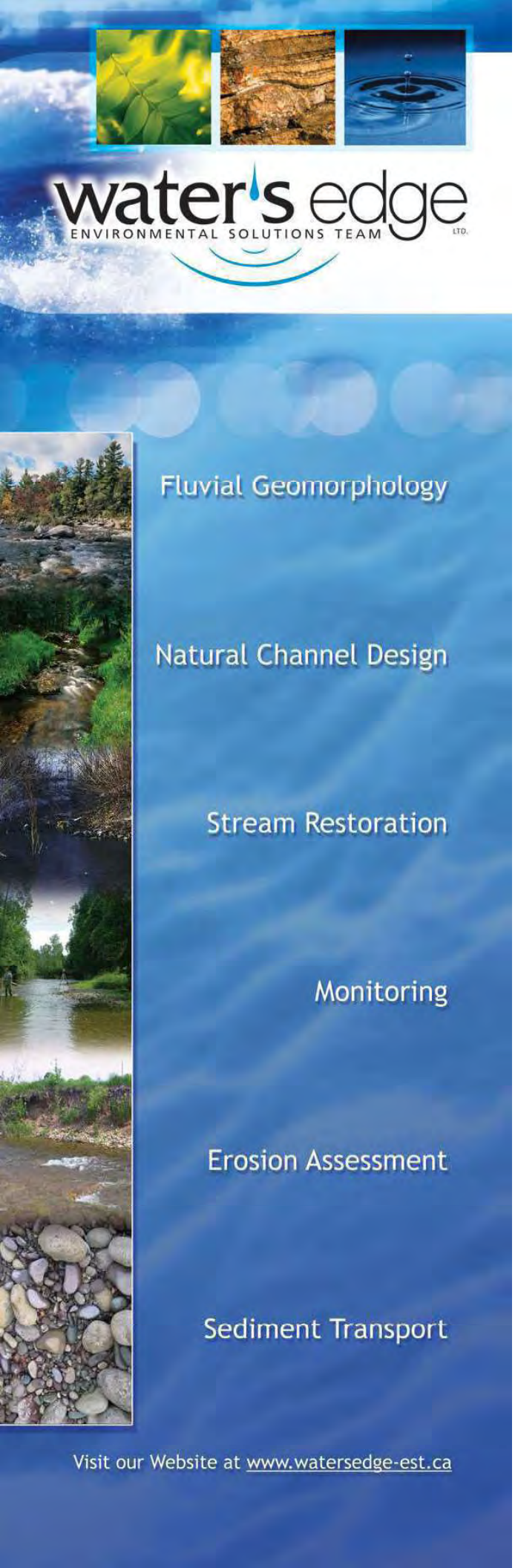
REFERENCES

MOE. (2003). Stormwater Management Planning and Design Manual. *Ministry of the Environment*.

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W.R. Herb et. (2006) Al. All-Weather Ground Surface Temperature Simulation, University of Minnesota, https://conservancy.umn.edu/bitstream/handle/11299/113684/pr478.pdf?sequence=1&isAllowed=



APPENDIX A:

Catchment Area Drawings



PROJECT NORTH

TRUE NORTH

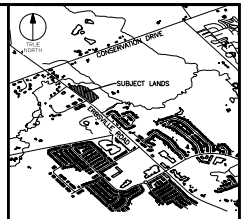
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2. ALL SERVICING LOCATIONS AND INVERTS ARE APPROXIMATE AND MUST BE FIELD VERIFIED PRIOR TO CONSTRUCTION.
3. PRIOR TO CONSTRUCTION, CONTRACTOR TO LOCATE EXISTING SANITARY AND WATER SERVICES TO AVOID CONFLICTS.
4. ANY DISCREPANCIES MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER, PRIOR TO ANY CONSTRUCTION.

LEGEND

CATCHMENT AREA NUMBER — RUNOFF CO-EFFICIENT — AREA IN HECTARES (20 | 70 | 0.24ha)

Ex. MAJOR OVERLAND FLOW DIRECTION

PROPOSED CATCHMENT AREA BOUNDARY



KEY PLAN N.T.S.

GENERAL NOTES & DISCLAIMER:

- UNTIL APPROVED BY THE MUNICIPALITY, THIS PLAN IS NOT FOR CONSTRUCTION.
- THIS IS NOT A LEGAL PLAN OF SURVEY.
- USERS OF THIS DRAWING SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS, ELEVATIONS, AND CONDITIONS ON THE SITE.
- ANY INFORMATION SHALL BE INTERPRETED WHOLLY OR IN PART BY USERS OF EXISTING CONDITIONS SHOWN ON THIS PLAN.
- WRITTEN DIMENSIONS SHALL HAVE PRECEDENCE OVER SCALED DIMENSIONS.
- DISTANCES HEREON ARE IN METRES & CONVERT TO FEET & DECIMAL BY 3.281.
- THE LOCATION OF UTILITIES (BELL, ENBRIDGE, WATERMAIN, SEWERS AND OTHER UNDERGROUND AND OVERHEAD SERVICES AND APPURTENANCES) AS SHOWN ON THIS PLAN ARE APPROXIMATE ONLY AND THEIR ACCURACY IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL OBTAIN, LOCATE AND UNDERTAKE THEIR OWN INVESTIGATION OF THE EXACT LOCATION OF ALL UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY CONFLICTS OR DAMAGE TO THEM.

NOT FOR TENDER

#	INITIAL		2023.02.23
REV.#	BY:	DESCRIPTION:	DATE

JPE ENGINEERING
www.jpe-engineering.ca
info@jpe-engineering.ca
519-577-2238

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CLIENT:

Project:

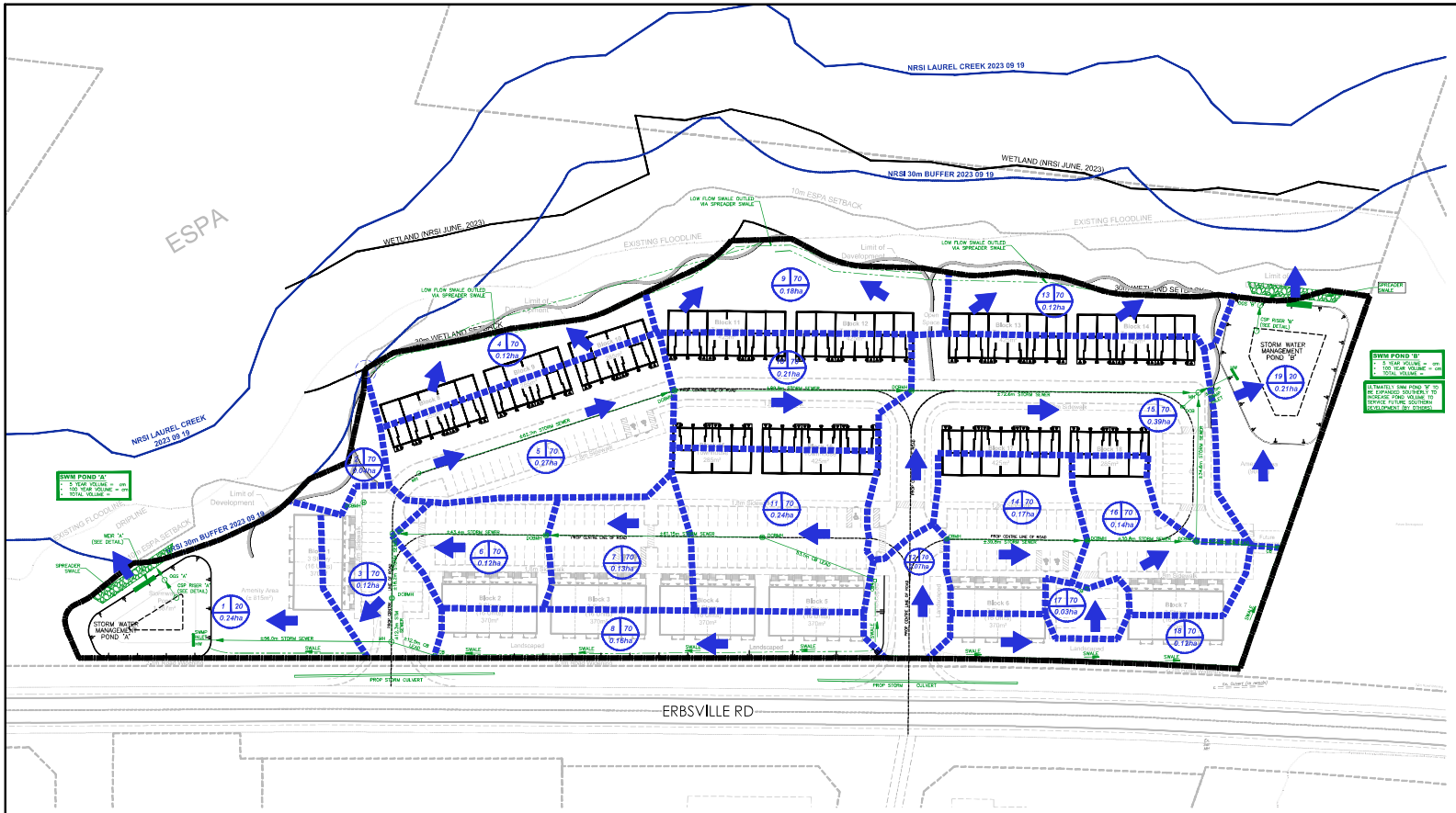
720 ERBSVILLE ROAD,
WATERLOO, ON

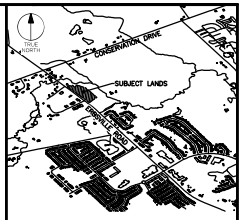
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PRE-DEVELOPMENT
STORM AREA
DRAINAGE PLAN

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Drawn By: MES	Checked By: JP
Project #: JPE-1027	Dwg #: C03-STM-PRE	Rev #: 0

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KEY PLAN

N.T.S.

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1. UNTIL APPROVED BY THE MUNICIPALITY, THIS PLAN IS NOT FOR CONSTRUCTION.
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3. USERS OF THIS DRAWING SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS, ELEVATIONS, AND CONDITIONS ON THE SITE.
4. JPE SHOULD BE SHALL BE INFORMED IMMEDIATELY OF ANY VARIATIONS OF EXISTING CONDITIONS SHOWN ON THIS PLAN.
5. WRITTEN DIMENSIONS SHALL HAVE PRECEDENCE OVER SCALED DIMENSIONS.
6. DISTANCES HEREON ARE IN METRES, TO CONVERT TO FEET DIVIDE BY 0.305.
7. THE POSITION OF UTILITIES AS SHOWN ON THIS PLAN (WHETHER OVERHEAD, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERHEAD UTILITIES AND APPURTENANCES) IS NOT GUARANTEED TO BE ACCURATE OR COMPLETE AND THE USER OF THIS PLAN SHALL NOT RELY ON THE ACCURACY OR COMPLETENESS OF THIS INFORMATION. IT IS NOT GUARANTEED THAT ALL UTILITIES ARE SHOWN ON THIS PLAN. BEFORE STARTING WORK, THE CONTRACTOR SHALL OBTAIN LOCATES AND UNDERTAKE THEIR OWN INVESTIGATION OF THE EXACT LOCATION OF ALL UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY CONFLICTS OR DAMAGE TO THEM.

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Project:

720 ERBSVILLE ROAD,
WATERLOO, ON

Drawing Title:

POST-DEVELOPMENT
STORM AREA
DRAINAGE PLAN

Scale: 1:600	Date: 2023-10-19
Drawn By: MES	Checked By: JP
Project #: JPE-1027	Dwg #: C03-POST-STM
	Rev #: 0

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2. ALL SERVICING LOCATIONS AND INVERTS ARE APPROXIMATE AND MUST BE FIELD VERIFIED PRIOR TO CONSTRUCTION.
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4. ANY DISCREPANCIES MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER, PRIOR TO ANY CONSTRUCTION.

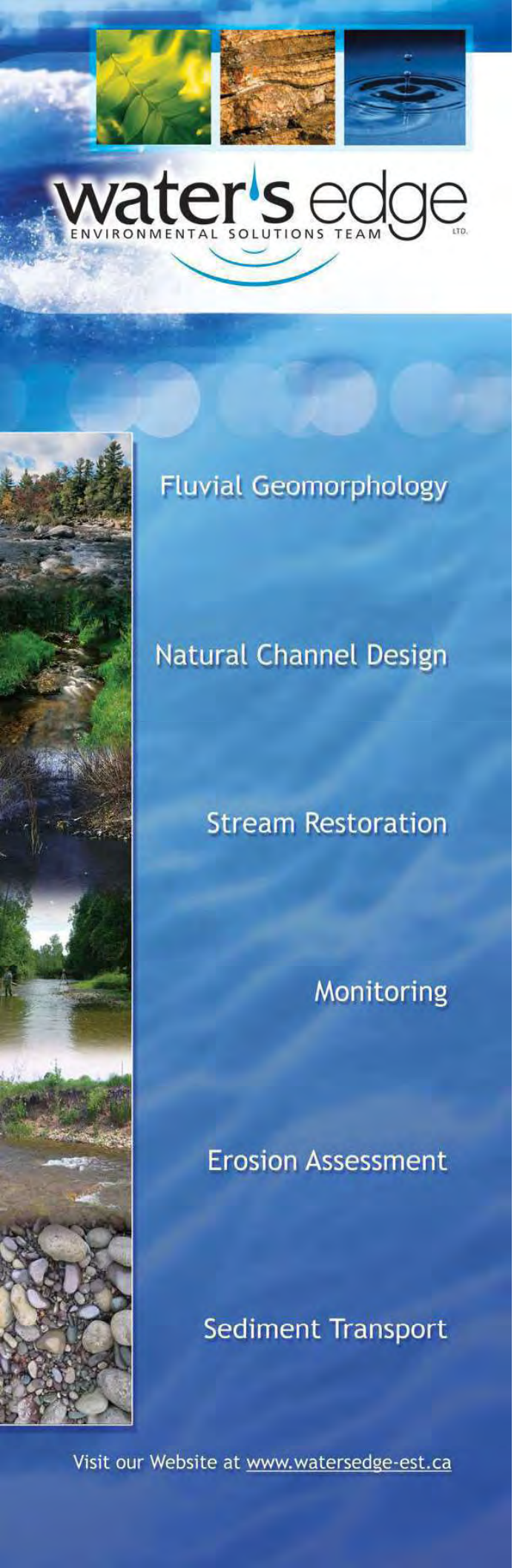
LEGEND

CATCHMENT AREA NUMBER — RUNOFF CO-EFFICIENT — AREA IN HECTARES

MAJOR OVERLAND FLOW DIRECTION

PROPOSED CATCHMENT AREA BOUNDARY

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APPENDIX B:

MIDUSS MODELLING Output

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"            Rainfall losses       50.059     6.653      19.675     mm"
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"                0.012    0.107    0.107    0.000"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"                0.012    0.107    0.107    0.000"
" 33       CATCHMENT 16"
"        1  Triangular SCS"
"        3  Specify values"
"        1  SCS method"
"       16  16"
"      70.000   % Impervious"
"       0.140   Total Area"
"      37.000   Flow length"
"       2.000   Overland Slope"
"       0.042   Pervious Area"
"      45.000   Pervious length"
"       2.000   Pervious slope"
"       0.098   Impervious Area"
"      45.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious SCS Curve No."
"       0.444   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"       8.467   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.926   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                0.055    0.107    0.107    0.000 c.m/sec"
"          Catchment 16          Pervious   Impervious Total Area "
"          Surface Area         0.042    0.098    0.140    hectare"
"          Time of concentration  14.899    2.007    4.202    minutes"
"          Time to Centroid       111.812   86.797   91.057   minutes"
"          Rainfall depth        89.960    89.960    89.960    mm"
"          Rainfall volume       37.78     88.16     125.94    c.m"
"          Rainfall losses       50.059    6.653     19.675    mm"
"          Runoff depth          39.901    83.307    70.285    mm"
"          Runoff volume         16.76     81.64     98.40     c.m"
"          Runoff coefficient    0.444     0.926     0.781     "
"          Maximum flow          0.007     0.054     0.055     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4  Add Runoff "
"                0.055    0.162    0.107    0.000"
```

```
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.055    0.162    0.162    0.000"
" 40        HYDROGRAPH Next link "
"          5  Next link "
"                0.055    0.162    0.162    0.000"
" 33        CATCHMENT 15"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"         15  15S"
"     70.000  % Impervious"
"      0.040  Total Area"
"     45.000  Flow length"
"      2.000  Overland Slope"
"      0.012  Pervious Area"
"     45.000  Pervious length"
"      2.000  Pervious slope"
"      0.028  Impervious Area"
"     45.000  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     75.000  Pervious SCS Curve No."
"      0.444  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"      8.467  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.926  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"                0.016    0.162    0.162    0.000 c.m/sec"
"           Catchment 15          Pervious   Impervious Total Area "
"           Surface Area          0.012      0.028      0.040      hectare"
"           Time of concentration 14.899     2.007      4.202      minutes"
"           Time to Centroid      111.812    86.797     91.057     minutes"
"           Rainfall depth        89.960     89.960     89.960     mm"
"           Rainfall volume       10.80      25.19      35.98      c.m"
"           Rainfall losses       50.059     6.653      19.675     mm"
"           Runoff depth          39.901     83.307     70.285     mm"
"           Runoff volume         4.79       23.33      28.11      c.m"
"           Runoff coefficient    0.444      0.926      0.781      "
"           Maximum flow          0.002      0.015      0.016      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.016    0.178    0.162    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.016    0.178    0.178    0.000"
" 40        HYDROGRAPH   Combine   19"
"          6  Combine "
"         19  Node #"
"             Inflow to 19"
"           Maximum flow              0.226   c.m/sec"
"           Hydrograph volume         400.624   c.m"
"                0.016    0.178    0.178    0.226"
" 40        HYDROGRAPH Start - New Tributary"
"          2  Start - New Tributary"
"                0.016    0.000    0.178    0.226"
" 33        CATCHMENT 5"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"          5  5"
"     70.000  % Impervious"
"      0.270  Total Area"
"     83.000  Flow length"
"      2.000  Overland Slope"
"      0.081  Pervious Area"
"     45.000  Pervious length"
```



```
"      2.000  Pervious slope"
"      0.189  Impervious Area"
"     45.000  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     75.000  Pervious SCS Curve No."
"      0.444  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"      8.467  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.926  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"                0.107    0.000    0.178    0.226 c.m/sec"
"           Catchment 5           Pervious   Impervious Total Area "
"           Surface Area          0.081      0.189      0.270      hectare"
"           Time of concentration 14.899     2.007      4.202      minutes"
"           Time to Centroid      111.812    86.797     91.057     minutes"
"           Rainfall depth        89.960     89.960     89.960     mm"
"           Rainfall volume       72.87      170.02     242.89     c.m"
"           Rainfall losses       50.059     6.653      19.675     mm"
"           Runoff depth          39.901     83.307     70.285     mm"
"           Runoff volume         32.32      157.45     189.77     c.m"
"           Runoff coefficient    0.444      0.926      0.781      "
"           Maximum flow          0.014      0.104      0.107      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.107    0.107    0.178    0.226"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.107    0.107    0.107    0.226"
" 40        HYDROGRAPH Next link "
"          5  Next link "
"                0.107    0.107    0.107    0.226"
" 33        CATCHMENT 10"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"         10  10"
"     70.000  % Impervious"
"      0.210  Total Area"
"     66.000  Flow length"
"      2.000  Overland Slope"
"      0.063  Pervious Area"
"     45.000  Pervious length"
"      2.000  Pervious slope"
"      0.147  Impervious Area"
"     45.000  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     75.000  Pervious SCS Curve No."
"      0.444  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"      8.467  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.926  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"                0.083    0.107    0.107    0.226 c.m/sec"
"           Catchment 10          Pervious   Impervious Total Area "
"           Surface Area          0.063      0.147      0.210      hectare"
"           Time of concentration 14.899     2.007      4.202      minutes"
"           Time to Centroid      111.812    86.797     91.057     minutes"
"           Rainfall depth        89.960     89.960     89.960     mm"
"           Rainfall volume       56.67      132.24     188.92     c.m"
"           Rainfall losses       50.059     6.653      19.675     mm"
"           Runoff depth          39.901     83.307     70.285     mm"
"           Runoff volume         25.14      122.46     147.60     c.m"
```

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"          Runoff coefficient    0.444     0.926     0.781     "
"          Maximum flow          0.011     0.081     0.083     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.083     0.190     0.107     0.226"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.083     0.190     0.190     0.226"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"                0.083     0.190     0.190     0.226"
" 33       CATCHMENT 51"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"          51  15N"
"       70.000  % Impervious"
"        0.350  Total Area"
"      118.000  Flow length"
"        2.000  Overland Slope"
"        0.105  Pervious Area"
"       45.000  Pervious length"
"        2.000  Pervious slope"
"        0.245  Impervious Area"
"       45.000  Impervious length"
"        2.000  Impervious slope"
"        0.250  Pervious Manning 'n'"
"       75.000  Pervious SCS Curve No."
"        0.444  Pervious Runoff coefficient"
"        0.100  Pervious Ia/S coefficient"
"        8.467  Pervious Initial abstraction"
"        0.015  Impervious Manning 'n'"
"       98.000  Impervious SCS Curve No."
"        0.926  Impervious Runoff coefficient"
"        0.100  Impervious Ia/S coefficient"
"        0.518  Impervious Initial abstraction"
"                0.138     0.190     0.190     0.226 c.m/sec"
"          Catchment 51          Pervious   Impervious Total Area "
"          Surface Area          0.105     0.245     0.350     hectare"
"          Time of concentration  14.899     2.007     4.202     minutes"
"          Time to Centroid       111.812    86.797    91.057    minutes"
"          Rainfall depth        89.960    89.960    89.960    mm"
"          Rainfall volume       94.46     220.40    314.86    c.m"
"          Rainfall losses       50.059    6.653     19.675    mm"
"          Runoff depth          39.901    83.307    70.285    mm"
"          Runoff volume         41.90     204.10    246.00    c.m"
"          Runoff coefficient    0.444     0.926     0.781     "
"          Maximum flow          0.018     0.135     0.138     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.138     0.328     0.190     0.226"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.138     0.328     0.328     0.226"
" 40       HYDROGRAPH   Combine   19"
"          6  Combine "
"          19  Node #"
"            Inflow to 19"
"          Maximum flow              0.554    c.m/sec"
"          Hydrograph volume         983.988    c.m"
"                0.138     0.328     0.328     0.554"
" 40       HYDROGRAPH   Confluence   19"
"          7  Confluence "
"          19  Node #"
"            Inflow to 19"
"          Maximum flow              0.554    c.m/sec"
"          Hydrograph volume         983.988    c.m"
"                0.138     0.554     0.328     0.000"
" 33       CATCHMENT 19"
"          1  Triangular SCS"
```



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"          3  Specify values"
"          1  SCS method"
"          19  19"
"       20.000  % Impervious"
"        0.210  Total Area"
"       70.000  Flow length"
"        2.000  Overland Slope"
"        0.168  Pervious Area"
"       45.000  Pervious length"
"        2.000  Pervious slope"
"        0.042  Impervious Area"
"       45.000  Impervious length"
"        2.000  Impervious slope"
"        0.250  Pervious Manning 'n'"
"       75.000  Pervious SCS Curve No."
"        0.444  Pervious Runoff coefficient"
"        0.100  Pervious Ia/S coefficient"
"        8.467  Pervious Initial abstraction"
"        0.015  Impervious Manning 'n'"
"       98.000  Impervious SCS Curve No."
"        0.926  Impervious Runoff coefficient"
"        0.100  Impervious Ia/S coefficient"
"        0.518  Impervious Initial abstraction"
"                0.039     0.554     0.328     0.000 c.m/sec"
"          Catchment 19          Pervious   Impervious Total Area "
"          Surface Area          0.168     0.042     0.210     hectare"
"          Time of concentration  14.899     2.007     10.478    minutes"
"          Time to Centroid       111.812    86.797    103.233   minutes"
"          Rainfall depth        89.960    89.960    89.960    mm"
"          Rainfall volume       151.13    37.78     188.92    c.m"
"          Rainfall losses       50.059    6.653     41.378    mm"
"          Runoff depth          39.901    83.307    48.582    mm"
"          Runoff volume         67.03     34.99     102.02    c.m"
"          Runoff coefficient    0.444     0.926     0.540     "
"          Maximum flow          0.029     0.023     0.039     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.039     0.582     0.328     0.000"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.039     0.582     0.582     0.000"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"                0.039     0.582     0.582     0.000"
" 81       ADD COMMENT==========================================================="
"          1  Lines of comment"
"          POND B"
" 54       POND DESIGN"
"        0.582  Current peak flow    c.m/sec"
"        0.005  Target outflow    c.m/sec"
"       1086.0  Hydrograph volume    c.m"
"          19.  Number of stages"
"      348.200  Minimum water level    metre"
"      350.000  Maximum water level    metre"
"      348.200  Starting water level    metre"
"          0  Keep Design Data: 1 = True; 0 = False"
"            Level Discharge    Volume"
"          348.200    0.000    0.000"
"          348.300    0.00276    43.650"
"          348.400    0.00477    260.000"
"          348.500    0.00616    300.000"
"          348.600    0.00729    350.000"
"          348.700    0.00827    400.000"
"          348.800    0.00914    450.000"
"          348.900    0.00994    470.000"
"          349.000    0.01068    500.000"
"          349.100    0.01137    567.240"
"          349.200    0.01202    657.150"
"          349.300    0.01539    753.090"
"          349.400    0.01800    855.230"
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"            349.500   0.01995   963.760"
"            349.600   0.02162  1078.000"
"            349.700   0.02312  1108.000"
"            349.800   0.4749   1227.000"
"            349.900    1.354   1352.000"
"            350.000    2.568   1484.000"
"       1.  WEIRS"
"             Crest     Weir     Crest     Left     Right"
"         elevation coefficie   breadth sideslope sideslope"
"           349.700    1.600     5.000    3.000    3.000"
"       2.  ORIFICES"
"            Orifice   Orifice   Orifice Number of"
"             invert coefficie  diameter  orifices"
"           348.200    0.630    0.0750     1.000"
"           349.200    0.630    0.0750     1.000"
"         Peak outflow              0.020   c.m/sec"
"         Maximum level           349.487   metre"
"         Maximum storage           949.985   c.m"
"         Centroidal lag             14.222   hours"
"            0.039    0.582    0.020    0.000 c.m/sec"
" 40     HYDROGRAPH   Combine   100"
"       6  Combine "
"     100  Node #"
"          Laurel Creek"
"         Maximum flow              0.020   c.m/sec"
"         Hydrograph volume         1085.848   c.m"
"              0.039    0.582    0.020    0.020"
" 40     HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"              0.039    0.000    0.020    0.020"
" 33     CATCHMENT 2"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       2  2"
"    0.000  % Impervious"
"    0.040  Total Area"
"   12.000  Flow length"
"    2.000  Overland Slope"
"    0.040  Pervious Area"
"   45.000  Pervious length"
"    2.000  Pervious slope"
"    0.000  Impervious Area"
"   45.000  Impervious length"
"    2.000  Impervious slope"
"    0.250  Pervious Manning 'n'"
"   75.000  Pervious SCS Curve No."
"    0.444  Pervious Runoff coefficient"
"    0.100  Pervious Ia/S coefficient"
"    8.467  Pervious Initial abstraction"
"    0.015  Impervious Manning 'n'"
"   98.000  Impervious SCS Curve No."
"    0.000  Impervious Runoff coefficient"
"    0.100  Impervious Ia/S coefficient"
"    0.518  Impervious Initial abstraction"
"            0.007    0.000    0.020    0.020 c.m/sec"
"         Catchment 2          Pervious   Impervious Total Area "
"         Surface Area          0.040     0.000     0.040     hectare"
"         Time of concentration  14.899     2.007     14.899     minutes"
"         Time to Centroid       111.812   86.797    111.812   minutes"
"         Rainfall depth        89.960    89.960    89.960    mm"
"         Rainfall volume       35.98     0.00      35.98     c.m"
"         Rainfall losses       50.059    6.653     50.059    mm"
"         Runoff depth          39.901    83.307    39.901    mm"
"         Runoff volume         15.96     0.00      15.96     c.m"
"         Runoff coefficient    0.444     0.000     0.444     "
"         Maximum flow          0.007     0.000     0.007     c.m/sec"
" 40     HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.007    0.007    0.020    0.020"
```



```
" 40     HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.007    0.007    0.007    0.020"
" 40     HYDROGRAPH   Combine   100"
"       6  Combine "
"     100  Node #"
"          Laurel Creek"
"         Maximum flow              0.021   c.m/sec"
"         Hydrograph volume         1101.808   c.m"
"              0.007    0.007    0.007    0.021"
" 40     HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"              0.007    0.000    0.007    0.021"
" 33     CATCHMENT 8"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       8  8"
"    70.000  % Impervious"
"    0.160  Total Area"
"   119.000  Flow length"
"    2.000  Overland Slope"
"    0.048  Pervious Area"
"   45.000  Pervious length"
"    2.000  Pervious slope"
"    0.112  Impervious Area"
"   45.000  Impervious length"
"    2.000  Impervious slope"
"    0.250  Pervious Manning 'n'"
"   75.000  Pervious SCS Curve No."
"    0.444  Pervious Runoff coefficient"
"    0.100  Pervious Ia/S coefficient"
"    8.467  Pervious Initial abstraction"
"    0.015  Impervious Manning 'n'"
"   98.000  Impervious SCS Curve No."
"    0.926  Impervious Runoff coefficient"
"    0.100  Impervious Ia/S coefficient"
"    0.518  Impervious Initial abstraction"
"            0.063    0.000    0.007    0.021 c.m/sec"
"         Catchment 8          Pervious   Impervious Total Area "
"         Surface Area          0.048     0.112     0.160     hectare"
"         Time of concentration  14.899     2.007     4.202     minutes"
"         Time to Centroid       111.812   86.797    91.057    minutes"
"         Rainfall depth        89.960    89.960    89.960    mm"
"         Rainfall volume       43.18     100.76    143.94    c.m"
"         Rainfall losses       50.059    6.653     19.675    mm"
"         Runoff depth          39.901    83.307    70.285    mm"
"         Runoff volume         19.15     93.30     112.46    c.m"
"         Runoff coefficient    0.444     0.926     0.781     "
"         Maximum flow          0.008     0.062     0.063     c.m/sec"
" 40     HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.063    0.063    0.007    0.021"
" 40     HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.063    0.063    0.063    0.021"
" 40     HYDROGRAPH   Combine   3"
"       6  Combine "
"       3  Node #"
"          3 input"
"         Maximum flow              0.063   c.m/sec"
"         Hydrograph volume         112.456   c.m"
"              0.063    0.063    0.063    0.063"
" 40     HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"              0.063    0.000    0.063    0.063"
" 33     CATCHMENT 11"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
```

```
"         11  11"
"      70.000  % Impervious"
"       0.240  Total Area"
"      50.000  Flow length"
"       2.000  Overland Slope"
"       0.072  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.168  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.444  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.926  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.095    0.000    0.063    0.063 c.m/sec"
"          Catchment 11          Pervious   Impervious Total Area "
"          Surface Area          0.072      0.168      0.240      hectare"
"          Time of concentration  14.899     2.007      4.202      minutes"
"          Time to Centroid       111.812    86.797     91.057     minutes"
"          Rainfall depth         89.960     89.960     89.960     mm"
"          Rainfall volume        64.77      151.13     215.90     c.m"
"          Rainfall losses        50.059     6.653      19.675     mm"
"          Runoff depth           39.901     83.307     70.285     mm"
"          Runoff volume          28.73      139.96     168.68     c.m"
"          Runoff coefficient     0.444      0.926      0.781      "
"          Maximum flow           0.012      0.093      0.095      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"              0.095    0.095    0.063    0.063"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"              0.095    0.095    0.095    0.063"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"              0.095    0.095    0.095    0.063"
" 33       CATCHMENT 7"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"          7  7"
"      70.000  % Impervious"
"       0.130  Total Area"
"      38.500  Flow length"
"       2.000  Overland Slope"
"       0.039  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.091  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.444  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.926  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.051    0.095    0.095    0.063 c.m/sec"
"          Catchment 7           Pervious   Impervious Total Area "
"          Surface Area          0.039      0.091      0.130      hectare"
```



```
"          Time of concentration  14.899     2.007      4.202      minutes"
"          Time to Centroid       111.812    86.797     91.057     minutes"
"          Rainfall depth         89.960     89.960     89.960     mm"
"          Rainfall volume        35.08      81.86      116.95     c.m"
"          Rainfall losses        50.059     6.653      19.675     mm"
"          Runoff depth           39.901     83.307     70.285     mm"
"          Runoff volume          15.56      75.81      91.37      c.m"
"          Runoff coefficient     0.444      0.926      0.781      "
"          Maximum flow           0.007      0.050      0.051      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"              0.051    0.146    0.095    0.063"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"              0.051    0.146    0.146    0.063"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"              0.051    0.146    0.146    0.063"
" 33       CATCHMENT 6"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"          6  6"
"      70.000  % Impervious"
"       0.120  Total Area"
"      42.000  Flow length"
"       2.000  Overland Slope"
"       0.036  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.084  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.444  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.926  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.047    0.146    0.146    0.063 c.m/sec"
"          Catchment 6           Pervious   Impervious Total Area "
"          Surface Area          0.036      0.084      0.120      hectare"
"          Time of concentration  14.899     2.007      4.202      minutes"
"          Time to Centroid       111.812    86.797     91.057     minutes"
"          Rainfall depth         89.960     89.960     89.960     mm"
"          Rainfall volume        32.39      75.57      107.95     c.m"
"          Rainfall losses        50.059     6.653      19.675     mm"
"          Runoff depth           39.901     83.307     70.285     mm"
"          Runoff volume          14.36      69.98      84.34      c.m"
"          Runoff coefficient     0.444      0.926      0.781      "
"          Maximum flow           0.006      0.046      0.047      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"              0.047    0.194    0.146    0.063"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"              0.047    0.194    0.194    0.063"
" 40       HYDROGRAPH  Combine   3"
"          6  Combine "
"          3  Node #"
"             3 input"
"          Maximum flow              0.257    c.m/sec"
"          Hydrograph volume         456.852  c.m"
"              0.047    0.194    0.194    0.257"
" 40       HYDROGRAPH  Confluence   3"
"          7  Confluence "
```

```
"          3   Node #"
"            3 input"
"          Maximum flow              0.257    c.m/sec"
"          Hydrograph volume          456.852    c.m"
"                0.047    0.257    0.194    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.047    0.257    0.257    0.000"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"                0.047    0.257    0.257    0.000"
" 33        CATCHMENT 3"
"          1   Triangular SCS"
"          3   Specify values"
"          1   SCS method"
"          3   3"
"       70.000   % Impervious"
"        0.120   Total Area"
"       37.000   Flow length"
"        2.000   Overland Slope"
"        0.036   Pervious Area"
"       45.000   Pervious length"
"        2.000   Pervious slope"
"        0.084   Impervious Area"
"       45.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.444   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.926   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                0.047    0.257    0.257    0.000 c.m/sec"
"            Catchment 3          Pervious   Impervious Total Area "
"            Surface Area          0.036      0.084      0.120      hectare"
"            Time of concentration 14.899     2.007      4.202      minutes"
"            Time to Centroid       111.812    86.797     91.057     minutes"
"            Rainfall depth        89.960     89.960     89.960     mm"
"            Rainfall volume        32.39      75.57     107.95     c.m"
"            Rainfall losses       50.059      6.653     19.675     mm"
"            Runoff depth          39.901     83.307     70.285     mm"
"            Runoff volume          14.36      69.98      84.34     c.m"
"            Runoff coefficient     0.444      0.926      0.781     "
"            Maximum flow           0.006      0.046      0.047     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.047    0.305    0.257    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.047    0.305    0.305    0.000"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"                0.047    0.305    0.305    0.000"
" 33        CATCHMENT 1"
"          1   Triangular SCS"
"          3   Specify values"
"          1   SCS method"
"          1   1"
"       20.000   % Impervious"
"        0.240   Total Area"
"       71.000   Flow length"
"        2.000   Overland Slope"
"        0.192   Pervious Area"
"       45.000   Pervious length"
"        2.000   Pervious slope"
"        0.048   Impervious Area"
```



```
"       45.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.444   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.926   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                0.045    0.305    0.305    0.000 c.m/sec"
"            Catchment 1          Pervious   Impervious Total Area "
"            Surface Area          0.192      0.048      0.240      hectare"
"            Time of concentration 14.899     2.007      10.478     minutes"
"            Time to Centroid       111.812    86.797     103.233    minutes"
"            Rainfall depth        89.960     89.960     89.960     mm"
"            Rainfall volume        172.72     43.18      215.90     c.m"
"            Rainfall losses       50.059     6.653      41.378     mm"
"            Runoff depth          39.901     83.307     48.582     mm"
"            Runoff volume          76.61      39.99      116.60     c.m"
"            Runoff coefficient     0.444      0.926      0.540     "
"            Maximum flow           0.033      0.026      0.045      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.045    0.337    0.305    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.045    0.337    0.337    0.000"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"                0.045    0.337    0.337    0.000"
" 81        ADD COMMENT==========================================================="
"          1   Lines of comment"
"            POND A"
" 54        POND DESIGN"
"        0.337   Current peak flow    c.m/sec"
"        0.005   Target outflow    c.m/sec"
"        657.8   Hydrograph volume    c.m"
"          21.   Number of stages"
"      349.000   Minimum water level    metre"
"      351.000   Maximum water level    metre"
"      349.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                Level Discharge    Volume"
"              349.000    0.000    0.000"
"              349.100    0.00276  100.000"
"              349.200    0.00478  195.000"
"              349.300    0.00616  200.000"
"              349.400    0.00729  210.000"
"              349.500    0.00827  215.000"
"              349.600    0.00914  250.000"
"              349.700    0.00994  295.000"
"              349.800    0.01068  305.000"
"              349.900    0.01137  310.000"
"              350.000    0.01202  320.000"
"              350.100    0.01263  330.000"
"              350.200    0.01322  343.000"
"              350.300    0.01378  396.000"
"              350.400    0.01432  453.000"
"              350.500    0.01485  515.000"
"              350.600    0.01811  581.000"
"              350.700    0.02061  652.000"
"              350.800    0.02247  729.000"
"              350.900    0.4747   811.000"
"              351.000    1.354    898.000"
"          1.  WEIRS"
"                Crest     Weir     Crest     Left      Right"
"            elevation coefficie   breadth sideslope sideslope"
```

```
"            350.800    1.600    5.000    3.000    3.000"
"        2.  ORIFICES"
"            Orifice  Orifice  Orifice Number of"
"             invert coefficie  diameter  orifices"
"            349.000    0.630    0.0750    1.000"
"            350.500    0.630    0.0750    1.000"
"           Peak outflow              0.017   c.m/sec"
"           Maximum level           350.552   metre"
"           Maximum storage          549.556   c.m"
"           Centroidal lag            10.597   hours"
"              0.045    0.337    0.017    0.000 c.m/sec"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"              0.045    0.017    0.017    0.000"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"              0.045    0.017    0.017    0.000"
" 40       HYDROGRAPH   Combine   100"
"          6  Combine "
"         100  Node #"
"            Laurel Creek"
"           Maximum flow              0.037   c.m/sec"
"           Hydrograph volume         1759.663   c.m"
"              0.045    0.017    0.017    0.037"
" 40       HYDROGRAPH Start - New Tributary"
"          2  Start - New Tributary"
"              0.045    0.000    0.017    0.037"
" 33       CATCHMENT 4"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"          4  4"
"      36.000  % Impervious"
"       0.120  Total Area"
"      28.000  Flow length"
"       2.000  Overland Slope"
"       0.077  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.043  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.444  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.926  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.027    0.000    0.017    0.037 c.m/sec"
"           Catchment 4          Pervious   Impervious Total Area "
"           Surface Area          0.077      0.043      0.120      hectare"
"           Time of concentration  14.899     2.007      7.936      minutes"
"           Time to Centroid       111.812    86.797     98.301     minutes"
"           Rainfall depth         89.960     89.960     89.960     mm"
"           Rainfall volume        69.09      38.86      107.95     c.m"
"           Rainfall losses        50.059     6.653      34.433     mm"
"           Runoff depth           39.901     83.307     55.527     mm"
"           Runoff volume          30.64      35.99      66.63      c.m"
"           Runoff coefficient     0.444      0.926      0.617      "
"           Maximum flow           0.013      0.024      0.027      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"              0.027    0.027    0.017    0.037"
" 33       CATCHMENT 9"
"          1  Triangular SCS"
"          3  Specify values"
```



```
"          1  SCS method"
"          9  9"
"      20.000  % Impervious"
"       0.180  Total Area"
"      44.000  Flow length"
"       2.000  Overland Slope"
"       0.144  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.036  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.444  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.926  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.033    0.027    0.017    0.037 c.m/sec"
"           Catchment 9          Pervious   Impervious Total Area "
"           Surface Area          0.144      0.036      0.180      hectare"
"           Time of concentration  14.899     2.007      10.478     minutes"
"           Time to Centroid       111.812    86.797     103.233    minutes"
"           Rainfall depth         89.960     89.960     89.960     mm"
"           Rainfall volume        129.54     32.39      161.93     c.m"
"           Rainfall losses        50.059     6.653      41.378     mm"
"           Runoff depth           39.901     83.307     48.582     mm"
"           Runoff volume          57.46      29.99      87.45      c.m"
"           Runoff coefficient     0.444      0.926      0.540      "
"           Maximum flow           0.025      0.020      0.033      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"              0.033    0.058    0.017    0.037"
" 33       CATCHMENT 33"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"         33  13"
"      20.000  % Impervious"
"       0.120  Total Area"
"      23.000  Flow length"
"       2.000  Overland Slope"
"       0.096  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.024  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.444  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.926  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.022    0.058    0.017    0.037 c.m/sec"
"           Catchment 33         Pervious   Impervious Total Area "
"           Surface Area          0.096      0.024      0.120      hectare"
"           Time of concentration  14.899     2.007      10.478     minutes"
"           Time to Centroid       111.812    86.797     103.233    minutes"
"           Rainfall depth         89.960     89.960     89.960     mm"
"           Rainfall volume        86.36      21.59      107.95     c.m"
"           Rainfall losses        50.059     6.653      41.378     mm"
```

```
"          Runoff depth          39.901    83.307    48.582    mm"
"          Runoff volume          38.30     19.99     58.30    c.m"
"          Runoff coefficient     0.444     0.926     0.540    "
"          Maximum flow           0.016     0.013     0.022    c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4  Add Runoff "
"              0.022    0.080    0.017    0.037"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"              0.022    0.080    0.080    0.037"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"              0.022    0.080    0.080    0.037"
" 57       TRENCH Design d/s of 33"
"      0.080  Peak inflow"
"    212.378  Hydrograph volume"
"     14.000  Ground elevation"
"     13.000  Downstream trench invert"
"      1.000  Trench height"
"     12.000  Water table elevation"
"      3.000  Trench top width"
"      1.800  Trench bottom width"
"     40.000  Voids ratio (%)"
"     50.000  Hydraulic conductivity"
"      0.000  Trench gradient (%)"
"    230.000  Trench length"
"      1.000  Include base width"
"       21.  Number of stages"
"            Level Discharge   Volume"
"           13.000   0.000     0.0"
"           13.050   0.000     8.6"
"           13.100   0.000    17.3"
"           13.150   0.000    26.3"
"           13.200   0.000    35.5"
"           13.250   0.000    45.0"
"           13.300   0.000    54.8"
"           13.350   0.000    64.9"
"           13.400   0.000    75.3"
"           13.450   0.000    85.9"
"           13.500   0.000    96.8"
"           13.550   0.000   108.0"
"           13.600   0.000   119.4"
"           13.650   0.000   131.1"
"           13.700   0.000   143.2"
"           13.750   0.000   155.4"
"           13.800   0.000   168.0"
"           13.850   7.015   180.8"
"           13.900  19.840   193.9"
"           13.950  36.449   207.3"
"           14.000  56.116   221.0"
"        1.  WEIRS"
"             Crest     Weir    Crest     Left     Right"
"          elevation coefficie  breadth sideslope sideslope"
"             13.800    1.600  230.000    0.000    0.000"
"        2.  TRENCH PIPES"
"          Downstream     Pipe     Pipe     Pipe Perf'ted?   Offset"
"              Invert   length    diam.   grade%   0=Yes  distance"
"           12.500   10.000    0.200    0.300    0.000    0.000"
"           13.250    3.000    0.000    0.500    1.000    0.000"
"        1.  MANHOLE"
"            Access"
"          diameter"
"             1.200"
"          Peak outflow              0.000   c.m/sec"
"          Outflow volume            0.002   c.m"
"          Peak exfiltration         0.014   c.m/sec"
"          Exfiltration volume     212.370   c.m"
"          Maximum level            13.656   metre"
"          Maximum storage         132.585   c.m"
"          Centroidal lag            3.902   hours"
```



```
"          Infiltration area 2 sides   351.896   sq.metre"
"          Infiltration Base area      414.000   sq.metre"
"              0.022    0.080    0.000    0.014 c.m/sec"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"              0.022    0.000    0.000    0.014"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"              0.022    0.000    0.000    0.014"
" 40       HYDROGRAPH  Combine   100"
"        6  Combine "
"      100  Node #"
"           Laurel Creek"
"          Maximum flow              0.037   c.m/sec"
"          Hydrograph volume      1759.665   c.m"
"              0.022    0.000    0.000    0.037"
" 40       HYDROGRAPH  Confluence   100"
"        7  Confluence "
"      100  Node #"
"           Laurel Creek"
"          Maximum flow              0.037   c.m/sec"
"          Hydrograph volume      1759.665   c.m"
"              0.022    0.037    0.000    0.000"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"              0.022    0.037    0.037    0.000"
" 38       START/RE-START TOTALS 100"
"        3  Runoff Totals on EXIT"
"          Total Catchment area              3.080   hectare"
"          Total Impervious area             1.712   hectare"
"          Total % impervious               55.591"
" 19       EXIT"
```

```
"             MIDUSS Output ------------------------------------------------>"
"             MIDUSS version                    Version 2.25  rev. 473"
"             MIDUSS created                    February 7, 2010"
"          10  Units used:                      ie METRIC"
"             Job folder:              C:\Users\TimAntonio\Water's Edge\"
"             Water's Edge Team Site - Documents\2023 Projects\23014 - 720 Erbsville Rd\10 Modelling\20231025\correct % impervious"
"             Output filename:         23014_25YRChicago_20231025_1614.out"
"             Licensee name:                    Water's Edge"
"             Company                           Water's Edge"
"             Date & Time last used:            2023-10-25 at 4:14:06 PM"
" 31        TIME PARAMETERS"
"       5.000  Time Step"
"     180.000  Max. Storm length"
"    5760.000  Max. Hydrograph"
" 32        STORM Chicago storm"
"           1  Chicago storm"
"    3261.000  Coefficient A"
"      16.190  Constant B"
"       0.938  Exponent C"
"       0.400  Fraction R"
"     180.000  Duration"
"       1.000  Time step multiplier"
"           Maximum intensity          185.969    mm/hr"
"           Total depth                69.174    mm"
"           6  005hyd  Hydrograph extension used in this file"
" 33        CATCHMENT 18"
"           1  Triangular SCS"
"           3  Specify values"
"           1  SCS method"
"          18  18"
"      70.000  % Impervious"
"       0.120  Total Area"
"     104.000  Flow length"
"       2.000  Overland Slope"
"       0.036  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.084  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.366  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.909  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.036    0.000    0.000    0.000 c.m/sec"
"           Catchment 18          Pervious   Impervious Total Area "
"           Surface Area          0.036      0.084      0.120      hectare"
"           Time of concentration 18.141     2.230      4.574      minutes"
"           Time to Centroid      117.351    87.803     92.155     minutes"
"           Rainfall depth        69.174     69.174     69.174     mm"
"           Rainfall volume       24.90      58.11      83.01      c.m"
"           Rainfall losses       43.838     6.323      17.578     mm"
"           Runoff depth          25.335     62.851     51.596     mm"
"           Runoff volume         9.12       52.79      61.92      c.m"
"           Runoff coefficient    0.366      0.909      0.746      "
"           Maximum flow          0.003      0.035      0.036      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"           4  Add Runoff "
"              0.036    0.036    0.000    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"           8  Copy to Outflow"
"              0.036    0.036    0.036    0.000"
" 40        HYDROGRAPH   Combine   19"
"           6  Combine "
```



```
"          19  Node #"
"              Inflow to 19"
"           Maximum flow              0.036    c.m/sec"
"           Hydrograph volume         61.915    c.m"
"              0.036    0.036    0.036    0.036"
" 40        HYDROGRAPH Start - New Tributary"
"           2  Start - New Tributary"
"              0.036    0.000    0.036    0.036"
" 33        CATCHMENT 12"
"           1  Triangular SCS"
"           3  Specify values"
"           1  SCS method"
"          12  12"
"      70.000  % Impervious"
"       0.070  Total Area"
"      33.800  Flow length"
"       2.000  Overland Slope"
"       0.021  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.049  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.366  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.909  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.021    0.000    0.036    0.036 c.m/sec"
"           Catchment 12          Pervious   Impervious Total Area "
"           Surface Area          0.021      0.049      0.070      hectare"
"           Time of concentration 18.141     2.230      4.574      minutes"
"           Time to Centroid      117.351    87.803     92.155     minutes"
"           Rainfall depth        69.174     69.174     69.174     mm"
"           Rainfall volume       14.53      33.90      48.42      c.m"
"           Rainfall losses       43.838     6.323      17.578     mm"
"           Runoff depth          25.335     62.851     51.596     mm"
"           Runoff volume         5.32       30.80      36.12      c.m"
"           Runoff coefficient    0.366      0.909      0.746      "
"           Maximum flow          0.002      0.020      0.021      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"           4  Add Runoff "
"              0.021    0.021    0.036    0.036"
" 40        HYDROGRAPH Copy to Outflow"
"           8  Copy to Outflow"
"              0.021    0.021    0.021    0.036"
" 40        HYDROGRAPH Next link "
"           5  Next link "
"              0.021    0.021    0.021    0.036"
" 33        CATCHMENT 14"
"           1  Triangular SCS"
"           3  Specify values"
"           1  SCS method"
"          14  14"
"      70.000  % Impervious"
"       0.170  Total Area"
"      39.000  Flow length"
"       2.000  Overland Slope"
"       0.051  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.119  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
```

```
"      75.000   Pervious SCS Curve No."
"       0.366   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"       8.467   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.909   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                0.050    0.021    0.021    0.036 c.m/sec"
"          Catchment 14          Pervious   Impervious Total Area "
"          Surface Area         0.051     0.119     0.170     hectare"
"          Time of concentration  18.141    2.230     4.574     minutes"
"          Time to Centroid       117.351   87.803    92.155    minutes"
"          Rainfall depth        69.174    69.174    69.174    mm"
"          Rainfall volume       35.28     82.32     117.60    c.m"
"          Rainfall losses       43.838    6.323     17.578    mm"
"          Runoff depth          25.335    62.850    51.596    mm"
"          Runoff volume         12.92     74.79     87.71     c.m"
"          Runoff coefficient    0.366     0.909     0.746     "
"          Maximum flow          0.005     0.050     0.050     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4   Add Runoff "
"                0.050    0.071    0.021    0.036"
" 40       HYDROGRAPH Copy to Outflow"
"        8   Copy to Outflow"
"                0.050    0.071    0.071    0.036"
" 40       HYDROGRAPH   Combine    16"
"        6   Combine "
"       16   Node #"
"            16 inflow"
"          Maximum flow                0.071    c.m/sec"
"          Hydrograph volume           123.830    c.m"
"                0.050    0.071    0.071    0.071"
" 40       HYDROGRAPH Start - New Tributary"
"        2   Start - New Tributary"
"                0.050    0.000    0.071    0.071"
" 33       CATCHMENT 17"
"        1   Triangular SCS"
"        3   Specify values"
"        1   SCS method"
"       17   17"
"      70.000   % Impervious"
"       0.030   Total Area"
"      45.000   Flow length"
"       2.000   Overland Slope"
"       0.009   Pervious Area"
"      45.000   Pervious length"
"       2.000   Pervious slope"
"       0.021   Impervious Area"
"      45.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious SCS Curve No."
"       0.366   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"       8.467   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.909   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                0.009    0.000    0.071    0.071 c.m/sec"
"          Catchment 17          Pervious   Impervious Total Area "
"          Surface Area         0.009     0.021     0.030     hectare"
"          Time of concentration  18.141    2.230     4.574     minutes"
"          Time to Centroid       117.351   87.803    92.155    minutes"
"          Rainfall depth        69.174    69.174    69.174    mm"
"          Rainfall volume       6.23      14.53     20.75     c.m"
"          Rainfall losses       43.838    6.323     17.578    mm"
```



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"          Runoff depth          25.335    62.851    51.596    mm"
"          Runoff volume         2.28      13.20     15.48     c.m"
"          Runoff coefficient    0.366     0.909     0.746     "
"          Maximum flow          0.001     0.009     0.009     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4   Add Runoff "
"                0.009    0.009    0.071    0.071"
" 40       HYDROGRAPH Copy to Outflow"
"        8   Copy to Outflow"
"                0.009    0.009    0.009    0.071"
" 40       HYDROGRAPH   Combine    16"
"        6   Combine "
"       16   Node #"
"            16 inflow"
"          Maximum flow                0.080    c.m/sec"
"          Hydrograph volume           139.309    c.m"
"                0.009    0.009    0.009    0.080"
" 40       HYDROGRAPH   Confluence    16"
"        7   Confluence "
"       16   Node #"
"            16 inflow"
"          Maximum flow                0.080    c.m/sec"
"          Hydrograph volume           139.309    c.m"
"                0.009    0.080    0.009    0.000"
" 40       HYDROGRAPH Copy to Outflow"
"        8   Copy to Outflow"
"                0.009    0.080    0.080    0.000"
" 40       HYDROGRAPH Next link "
"        5   Next link "
"                0.009    0.080    0.080    0.000"
" 33       CATCHMENT 16"
"        1   Triangular SCS"
"        3   Specify values"
"        1   SCS method"
"       16   16"
"      70.000   % Impervious"
"       0.140   Total Area"
"      37.000   Flow length"
"       2.000   Overland Slope"
"       0.042   Pervious Area"
"      45.000   Pervious length"
"       2.000   Pervious slope"
"       0.098   Impervious Area"
"      45.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious SCS Curve No."
"       0.366   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"       8.467   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.909   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                0.042    0.080    0.080    0.000 c.m/sec"
"          Catchment 16          Pervious   Impervious Total Area "
"          Surface Area         0.042     0.098     0.140     hectare"
"          Time of concentration  18.141    2.230     4.574     minutes"
"          Time to Centroid       117.351   87.803    92.155    minutes"
"          Rainfall depth        69.174    69.174    69.174    mm"
"          Rainfall volume       29.05     67.79     96.84     c.m"
"          Rainfall losses       43.838    6.323     17.578    mm"
"          Runoff depth          25.335    62.851    51.596    mm"
"          Runoff volume         10.64     61.59     72.23     c.m"
"          Runoff coefficient    0.366     0.909     0.746     "
"          Maximum flow          0.004     0.041     0.042     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4   Add Runoff "
"                0.042    0.122    0.080    0.000"
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" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"             0.042    0.122    0.122    0.000"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"             0.042    0.122    0.122    0.000"
" 33       CATCHMENT 15"
"        1  Triangular SCS"
"        3  Specify values"
"        1  SCS method"
"       15  15S"
"    70.000  % Impervious"
"     0.040  Total Area"
"    45.000  Flow length"
"     2.000  Overland Slope"
"     0.012  Pervious Area"
"    45.000  Pervious length"
"     2.000  Pervious slope"
"     0.028  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.366  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.909  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"             0.012    0.122    0.122    0.000 c.m/sec"
"          Catchment 15          Pervious   Impervious Total Area "
"          Surface Area          0.012      0.028      0.040      hectare"
"          Time of concentration 18.141     2.230      4.574      minutes"
"          Time to Centroid      117.351    87.803     92.155     minutes"
"          Rainfall depth        69.174     69.174     69.174     mm"
"          Rainfall volume       8.30       19.37      27.67      c.m"
"          Rainfall losses       43.838     6.323      17.578     mm"
"          Runoff depth          25.335     62.851     51.596     mm"
"          Runoff volume         3.04       17.60      20.64      c.m"
"          Runoff coefficient    0.366      0.909      0.746      "
"          Maximum flow          0.001      0.012      0.012      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4  Add Runoff "
"             0.012    0.133    0.122    0.000"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"             0.012    0.133    0.133    0.000"
" 40       HYDROGRAPH   Combine   19"
"        6  Combine "
"       19  Node #"
"           Inflow to 19"
"          Maximum flow              0.169    c.m/sec"
"          Hydrograph volume         294.097  c.m"
"             0.012    0.133    0.133    0.169"
" 40       HYDROGRAPH Start - New Tributary"
"        2  Start - New Tributary"
"             0.012    0.000    0.133    0.169"
" 33       CATCHMENT 5"
"        1  Triangular SCS"
"        3  Specify values"
"        1  SCS method"
"        5  5"
"    70.000  % Impervious"
"     0.270  Total Area"
"    83.000  Flow length"
"     2.000  Overland Slope"
"     0.081  Pervious Area"
"    45.000  Pervious length"
```



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"     2.000  Pervious slope"
"     0.189  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.366  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.909  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"             0.080    0.000    0.133    0.169 c.m/sec"
"          Catchment 5           Pervious   Impervious Total Area "
"          Surface Area          0.081      0.189      0.270      hectare"
"          Time of concentration 18.141     2.230      4.574      minutes"
"          Time to Centroid      117.351    87.803     92.155     minutes"
"          Rainfall depth        69.174     69.174     69.174     mm"
"          Rainfall volume       56.03      130.74     186.77     c.m"
"          Rainfall losses       43.838     6.323      17.578     mm"
"          Runoff depth          25.335     62.851     51.596     mm"
"          Runoff volume         20.52      118.79     139.31     c.m"
"          Runoff coefficient    0.366      0.909      0.746      "
"          Maximum flow          0.008      0.079      0.080      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4  Add Runoff "
"             0.080    0.080    0.133    0.169"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"             0.080    0.080    0.080    0.169"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"             0.080    0.080    0.080    0.169"
" 33       CATCHMENT 10"
"        1  Triangular SCS"
"        3  Specify values"
"        1  SCS method"
"       10  10"
"    70.000  % Impervious"
"     0.210  Total Area"
"    66.000  Flow length"
"     2.000  Overland Slope"
"     0.063  Pervious Area"
"    45.000  Pervious length"
"     2.000  Pervious slope"
"     0.147  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.366  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.909  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"             0.062    0.080    0.080    0.169 c.m/sec"
"          Catchment 10          Pervious   Impervious Total Area "
"          Surface Area          0.063      0.147      0.210      hectare"
"          Time of concentration 18.141     2.230      4.574      minutes"
"          Time to Centroid      117.351    87.803     92.155     minutes"
"          Rainfall depth        69.174     69.174     69.174     mm"
"          Rainfall volume       43.58      101.69     145.26     c.m"
"          Rainfall losses       43.838     6.323      17.578     mm"
"          Runoff depth          25.335     62.850     51.596     mm"
"          Runoff volume         15.96      92.39      108.35     c.m"
```

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"          Runoff coefficient    0.366     0.909     0.746     "
"          Maximum flow          0.006     0.061     0.062     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"               0.062     0.142     0.080     0.169"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"               0.062     0.142     0.142     0.169"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"               0.062     0.142     0.142     0.169"
" 33       CATCHMENT 51"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"          51  15N"
"       70.000  % Impervious"
"        0.350  Total Area"
"      118.000  Flow length"
"        2.000  Overland Slope"
"        0.105  Pervious Area"
"       45.000  Pervious length"
"        2.000  Pervious slope"
"        0.245  Impervious Area"
"       45.000  Impervious length"
"        2.000  Impervious slope"
"        0.250  Pervious Manning 'n'"
"       75.000  Pervious SCS Curve No."
"        0.366  Pervious Runoff coefficient"
"        0.100  Pervious Ia/S coefficient"
"        8.467  Pervious Initial abstraction"
"        0.015  Impervious Manning 'n'"
"       98.000  Impervious SCS Curve No."
"        0.909  Impervious Runoff coefficient"
"        0.100  Impervious Ia/S coefficient"
"        0.518  Impervious Initial abstraction"
"               0.104     0.142     0.142     0.169 c.m/sec"
"            Catchment 51          Pervious   Impervious Total Area "
"            Surface Area          0.105     0.245     0.350     hectare"
"            Time of concentration  18.141    2.230     4.574     minutes"
"            Time to Centroid       117.351   87.803    92.155    minutes"
"            Rainfall depth        69.174    69.174    69.174    mm"
"            Rainfall volume       72.63     169.48    242.11    c.m"
"            Rainfall losses       43.838    6.323     17.578    mm"
"            Runoff depth          25.335    62.851    51.596    mm"
"            Runoff volume         26.60     153.98    180.59    c.m"
"            Runoff coefficient    0.366     0.909     0.746     "
"            Maximum flow          0.010     0.102     0.104     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"               0.104     0.246     0.142     0.169"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"               0.104     0.246     0.246     0.169"
" 40       HYDROGRAPH   Combine   19"
"          6  Combine "
"          19  Node #"
"            Inflow to 19"
"          Maximum flow              0.415    c.m/sec"
"          Hydrograph volume         722.344    c.m"
"               0.104     0.246     0.246     0.415"
" 40       HYDROGRAPH   Confluence   19"
"          7  Confluence "
"          19  Node #"
"            Inflow to 19"
"          Maximum flow              0.415    c.m/sec"
"          Hydrograph volume         722.344    c.m"
"               0.104     0.415     0.246     0.000"
" 33       CATCHMENT 19"
"          1  Triangular SCS"
```



```
"          3  Specify values"
"          1  SCS method"
"          19  19"
"       20.000  % Impervious"
"        0.210  Total Area"
"       70.000  Flow length"
"        2.000  Overland Slope"
"        0.168  Pervious Area"
"       45.000  Pervious length"
"        2.000  Pervious slope"
"        0.042  Impervious Area"
"       45.000  Impervious length"
"        2.000  Impervious slope"
"        0.250  Pervious Manning 'n'"
"       75.000  Pervious SCS Curve No."
"        0.366  Pervious Runoff coefficient"
"        0.100  Pervious Ia/S coefficient"
"        8.467  Pervious Initial abstraction"
"        0.015  Impervious Manning 'n'"
"       98.000  Impervious SCS Curve No."
"        0.909  Impervious Runoff coefficient"
"        0.100  Impervious Ia/S coefficient"
"        0.518  Impervious Initial abstraction"
"               0.022     0.415     0.246     0.000 c.m/sec"
"            Catchment 19          Pervious   Impervious Total Area "
"            Surface Area          0.168     0.042     0.210     hectare"
"            Time of concentration  18.141    2.230     12.051    minutes"
"            Time to Centroid       117.351   87.803    106.040   minutes"
"            Rainfall depth        69.174    69.174    69.174    mm"
"            Rainfall volume       116.21    29.05     145.26    c.m"
"            Rainfall losses       43.838    6.323     36.335    mm"
"            Runoff depth          25.335    62.851    32.838    mm"
"            Runoff volume         42.56     26.40     68.96     c.m"
"            Runoff coefficient    0.366     0.909     0.475     "
"            Maximum flow          0.016     0.018     0.022     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"               0.022     0.435     0.246     0.000"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"               0.022     0.435     0.435     0.000"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"               0.022     0.435     0.435     0.000"
" 81       ADD COMMENT==========================================================="
"          1  Lines of comment"
"          POND B"
" 54       POND DESIGN"
"        0.435  Current peak flow    c.m/sec"
"        0.005  Target outflow    c.m/sec"
"        791.3  Hydrograph volume    c.m"
"          19.  Number of stages"
"      348.200  Minimum water level    metre"
"      350.000  Maximum water level    metre"
"      348.200  Starting water level    metre"
"            0  Keep Design Data: 1 = True; 0 = False"
"             Level Discharge    Volume"
"           348.200    0.000    0.000"
"           348.300    0.00276    43.650"
"           348.400    0.00477    260.000"
"           348.500    0.00616    300.000"
"           348.600    0.00729    350.000"
"           348.700    0.00827    400.000"
"           348.800    0.00914    450.000"
"           348.900    0.00994    470.000"
"           349.000    0.01068    500.000"
"           349.100    0.01137    567.240"
"           349.200    0.01202    657.150"
"           349.300    0.01539    753.090"
"           349.400    0.01800    855.230"
```

```
"            349.500  0.01995  963.760"
"            349.600  0.02162  1078.000"
"            349.700  0.02312  1108.000"
"            349.800  0.4749  1227.000"
"            349.900  1.354  1352.000"
"            350.000  2.568  1484.000"
"       1.  WEIRS"
"             Crest    Weir    Crest    Left    Right"
"         elevation coefficie  breadth sideslope sideslope"
"            349.700  1.600    5.000    3.000    3.000"
"       2.  ORIFICES"
"            Orifice  Orifice  Orifice Number of"
"             invert coefficie  diameter  orifices"
"            348.200  0.630  0.0750    1.000"
"            349.200  0.630  0.0750    1.000"
"         Peak outflow              0.013   c.m/sec"
"         Maximum level           349.240   metre"
"         Maximum storage           695.459   c.m"
"         Centroidal lag           14.064   hours"
"              0.022    0.435    0.013    0.000 c.m/sec"
" 40     HYDROGRAPH   Combine   100"
"       6  Combine "
"     100  Node #"
"          Laurel Creek"
"         Maximum flow              0.013   c.m/sec"
"         Hydrograph volume         791.369   c.m"
"              0.022    0.435    0.013    0.013"
" 40     HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"              0.022    0.000    0.013    0.013"
" 33     CATCHMENT 2"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       2  2"
"    0.000  % Impervious"
"    0.040  Total Area"
"   12.000  Flow length"
"    2.000  Overland Slope"
"    0.040  Pervious Area"
"   45.000  Pervious length"
"    2.000  Pervious slope"
"    0.000  Impervious Area"
"   45.000  Impervious length"
"    2.000  Impervious slope"
"    0.250  Pervious Manning 'n'"
"   75.000  Pervious SCS Curve No."
"    0.366  Pervious Runoff coefficient"
"    0.100  Pervious Ia/S coefficient"
"    8.467  Pervious Initial abstraction"
"    0.015  Impervious Manning 'n'"
"   98.000  Impervious SCS Curve No."
"    0.000  Impervious Runoff coefficient"
"    0.100  Impervious Ia/S coefficient"
"    0.518  Impervious Initial abstraction"
"              0.004    0.000    0.013    0.013 c.m/sec"
"         Catchment 2          Pervious   Impervious Total Area "
"         Surface Area          0.040     0.000     0.040     hectare"
"         Time of concentration  18.141    2.230    18.141    minutes"
"         Time to Centroid       117.351   87.803   117.351   minutes"
"         Rainfall depth        69.174    69.174    69.174    mm"
"         Rainfall volume       27.67     0.00      27.67     c.m"
"         Rainfall losses       43.838    6.323     43.838    mm"
"         Runoff depth          25.335    62.851    25.335    mm"
"         Runoff volume         10.13     0.00      10.13     c.m"
"         Runoff coefficient    0.366     0.000     0.366     "
"         Maximum flow          0.004     0.000     0.004     c.m/sec"
" 40     HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.004    0.004    0.013    0.013"
```



```
" 40     HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.004    0.004    0.004    0.013"
" 40     HYDROGRAPH   Combine   100"
"       6  Combine "
"     100  Node #"
"          Laurel Creek"
"         Maximum flow              0.015   c.m/sec"
"         Hydrograph volume         801.503   c.m"
"              0.004    0.004    0.004    0.015"
" 40     HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"              0.004    0.000    0.004    0.015"
" 33     CATCHMENT 8"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       8  8"
"    70.000  % Impervious"
"    0.160  Total Area"
"   119.000  Flow length"
"    2.000  Overland Slope"
"    0.048  Pervious Area"
"   45.000  Pervious length"
"    2.000  Pervious slope"
"    0.112  Impervious Area"
"   45.000  Impervious length"
"    2.000  Impervious slope"
"    0.250  Pervious Manning 'n'"
"   75.000  Pervious SCS Curve No."
"    0.366  Pervious Runoff coefficient"
"    0.100  Pervious Ia/S coefficient"
"    8.467  Pervious Initial abstraction"
"    0.015  Impervious Manning 'n'"
"   98.000  Impervious SCS Curve No."
"    0.909  Impervious Runoff coefficient"
"    0.100  Impervious Ia/S coefficient"
"    0.518  Impervious Initial abstraction"
"              0.047    0.000    0.004    0.015 c.m/sec"
"         Catchment 8          Pervious   Impervious Total Area "
"         Surface Area          0.048     0.112     0.160     hectare"
"         Time of concentration  18.141    2.230     4.574     minutes"
"         Time to Centroid       117.351   87.803    92.155    minutes"
"         Rainfall depth        69.174    69.174    69.174    mm"
"         Rainfall volume       33.20     77.47     110.68    c.m"
"         Rainfall losses       43.838    6.323     17.578    mm"
"         Runoff depth          25.335    62.851    51.596    mm"
"         Runoff volume         12.16     70.39     82.55     c.m"
"         Runoff coefficient    0.366     0.909     0.746     "
"         Maximum flow          0.004     0.047     0.047     c.m/sec"
" 40     HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.047    0.047    0.004    0.015"
" 40     HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.047    0.047    0.047    0.015"
" 40     HYDROGRAPH   Combine   3"
"       6  Combine "
"       3  Node #"
"          3 input"
"         Maximum flow              0.047   c.m/sec"
"         Hydrograph volume         82.554   c.m"
"              0.047    0.047    0.047    0.047"
" 40     HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"              0.047    0.000    0.047    0.047"
" 33     CATCHMENT 11"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
```

```
"          11  11"
"      70.000  % Impervious"
"       0.240  Total Area"
"      50.000  Flow length"
"       2.000  Overland Slope"
"       0.072  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.168  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.366  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.909  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.071    0.000    0.047    0.047 c.m/sec"
"         Catchment 11          Pervious   Impervious Total Area "
"         Surface Area          0.072      0.168      0.240      hectare"
"         Time of concentration  18.141     2.230      4.574      minutes"
"         Time to Centroid       117.351    87.803     92.155     minutes"
"         Rainfall depth         69.174     69.174     69.174     mm"
"         Rainfall volume        49.81      116.21     166.02     c.m"
"         Rainfall losses        43.838     6.323      17.578     mm"
"         Runoff depth           25.335     62.851     51.596     mm"
"         Runoff volume          18.24      105.59     123.83     c.m"
"         Runoff coefficient     0.366      0.909      0.746      "
"         Maximum flow           0.007      0.070      0.071      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.071    0.071    0.047    0.047"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.071    0.071    0.071    0.047"
" 40      HYDROGRAPH Next link "
"       5  Next link "
"              0.071    0.071    0.071    0.047"
" 33      CATCHMENT 7"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       7  7"
"      70.000  % Impervious"
"       0.130  Total Area"
"      38.500  Flow length"
"       2.000  Overland Slope"
"       0.039  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.091  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.366  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.909  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.039    0.071    0.071    0.047 c.m/sec"
"         Catchment 7           Pervious   Impervious Total Area "
"         Surface Area          0.039      0.091      0.130      hectare"
```



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"         Time of concentration  18.141     2.230      4.574      minutes"
"         Time to Centroid       117.351    87.803     92.155     minutes"
"         Rainfall depth         69.174     69.174     69.174     mm"
"         Rainfall volume        26.98      62.95      89.93      c.m"
"         Rainfall losses        43.838     6.323      17.578     mm"
"         Runoff depth           25.335     62.851     51.596     mm"
"         Runoff volume          9.88       57.19      67.07      c.m"
"         Runoff coefficient     0.366      0.909      0.746      "
"         Maximum flow           0.004      0.038      0.039      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.039    0.110    0.071    0.047"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.039    0.110    0.110    0.047"
" 40      HYDROGRAPH Next link "
"       5  Next link "
"              0.039    0.110    0.110    0.047"
" 33      CATCHMENT 6"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       6  6"
"      70.000  % Impervious"
"       0.120  Total Area"
"      42.000  Flow length"
"       2.000  Overland Slope"
"       0.036  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.084  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.366  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.909  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.036    0.110    0.110    0.047 c.m/sec"
"         Catchment 6           Pervious   Impervious Total Area "
"         Surface Area          0.036      0.084      0.120      hectare"
"         Time of concentration  18.141     2.230      4.574      minutes"
"         Time to Centroid       117.351    87.803     92.155     minutes"
"         Rainfall depth         69.174     69.174     69.174     mm"
"         Rainfall volume        24.90      58.11      83.01      c.m"
"         Rainfall losses        43.838     6.323      17.578     mm"
"         Runoff depth           25.335     62.851     51.596     mm"
"         Runoff volume          9.12       52.79      61.92      c.m"
"         Runoff coefficient     0.366      0.909      0.746      "
"         Maximum flow           0.003      0.035      0.036      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.036    0.145    0.110    0.047"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.036    0.145    0.145    0.047"
" 40      HYDROGRAPH  Combine   3"
"       6  Combine "
"       3  Node #"
"          3 input"
"         Maximum flow              0.193    c.m/sec"
"         Hydrograph volume         335.374  c.m"
"              0.036    0.145    0.145    0.193"
" 40      HYDROGRAPH  Confluence   3"
"       7  Confluence "
```

```
"          3   Node #"
"            3 input"
"          Maximum flow              0.193    c.m/sec"
"          Hydrograph volume         335.374    c.m"
"                0.036    0.193    0.145    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.036    0.193    0.193    0.000"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"                0.036    0.193    0.193    0.000"
" 33        CATCHMENT 3"
"          1   Triangular SCS"
"          3   Specify values"
"          1   SCS method"
"          3   3"
"      70.000   % Impervious"
"       0.120   Total Area"
"      37.000   Flow length"
"       2.000   Overland Slope"
"       0.036   Pervious Area"
"      45.000   Pervious length"
"       2.000   Pervious slope"
"       0.084   Impervious Area"
"      45.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious SCS Curve No."
"       0.366   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"       8.467   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.909   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                0.036    0.193    0.193    0.000 c.m/sec"
"           Catchment 3          Pervious   Impervious Total Area "
"           Surface Area          0.036     0.084     0.120     hectare"
"           Time of concentration 18.141    2.230     4.574     minutes"
"           Time to Centroid       117.351   87.803    92.155    minutes"
"           Rainfall depth        69.174    69.174    69.174    mm"
"           Rainfall volume       24.90     58.11     83.01     c.m"
"           Rainfall losses       43.838    6.323     17.578    mm"
"           Runoff depth          25.335    62.851    51.596    mm"
"           Runoff volume          9.12     52.79     61.92     c.m"
"           Runoff coefficient     0.366    0.909     0.746     "
"           Maximum flow           0.003    0.035     0.036     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.036    0.228    0.193    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.036    0.228    0.228    0.000"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"                0.036    0.228    0.228    0.000"
" 33        CATCHMENT 1"
"          1   Triangular SCS"
"          3   Specify values"
"          1   SCS method"
"          1   1"
"      20.000   % Impervious"
"       0.240   Total Area"
"      71.000   Flow length"
"       2.000   Overland Slope"
"       0.192   Pervious Area"
"      45.000   Pervious length"
"       2.000   Pervious slope"
"       0.048   Impervious Area"
```



```
"      45.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious SCS Curve No."
"       0.366   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"       8.467   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.909   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                0.025    0.228    0.228    0.000 c.m/sec"
"           Catchment 1          Pervious   Impervious Total Area "
"           Surface Area          0.192     0.048     0.240     hectare"
"           Time of concentration 18.141    2.230     12.051    minutes"
"           Time to Centroid       117.351   87.803    106.040   minutes"
"           Rainfall depth        69.174    69.174    69.174    mm"
"           Rainfall volume       132.81    33.20     166.02    c.m"
"           Rainfall losses       43.838    6.323     36.335    mm"
"           Runoff depth          25.335    62.850    32.838    mm"
"           Runoff volume         48.64     30.17     78.81     c.m"
"           Runoff coefficient     0.366    0.909     0.475     "
"           Maximum flow           0.018    0.020     0.025     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.025    0.251    0.228    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                0.025    0.251    0.251    0.000"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"                0.025    0.251    0.251    0.000"
" 81        ADD COMMENT==========================================================="
"          1   Lines of comment"
"            POND A"
" 54        POND DESIGN"
"       0.251   Current peak flow    c.m/sec"
"       0.005   Target outflow    c.m/sec"
"       476.1   Hydrograph volume    c.m"
"          21.   Number of stages"
"     349.000   Minimum water level    metre"
"     351.000   Maximum water level    metre"
"     349.000   Starting water level    metre"
"           0   Keep Design Data: 1 = True; 0 = False"
"               Level Discharge    Volume"
"             349.000    0.000    0.000"
"             349.100    0.00276  100.000"
"             349.200    0.00478  195.000"
"             349.300    0.00616  200.000"
"             349.400    0.00729  210.000"
"             349.500    0.00827  215.000"
"             349.600    0.00914  250.000"
"             349.700    0.00994  295.000"
"             349.800    0.01068  305.000"
"             349.900    0.01137  310.000"
"             350.000    0.01202  320.000"
"             350.100    0.01263  330.000"
"             350.200    0.01322  343.000"
"             350.300    0.01378  396.000"
"             350.400    0.01432  453.000"
"             350.500    0.01485  515.000"
"             350.600    0.01811  581.000"
"             350.700    0.02061  652.000"
"             350.800    0.02247  729.000"
"             350.900    0.4747   811.000"
"             351.000    1.354    898.000"
"          1.  WEIRS"
"               Crest     Weir     Crest     Left      Right"
"            elevation coefficie  breadth sideslope sideslope"
```

```
"          350.800    1.600    5.000    3.000    3.000"
"       2.  ORIFICES"
"           Orifice  Orifice  Orifice Number of"
"            invert coefficie  diameter  orifices"
"           349.000    0.630    0.0750    1.000"
"           350.500    0.630    0.0750    1.000"
"         Peak outflow              0.014   c.m/sec"
"         Maximum level           350.284   metre"
"         Maximum storage          387.482   c.m"
"         Centroidal lag            10.420   hours"
"            0.025    0.251    0.014    0.000 c.m/sec"
" 40      HYDROGRAPH Next link "
"       5  Next link "
"            0.025    0.014    0.014    0.000"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"            0.025    0.014    0.014    0.000"
" 40      HYDROGRAPH  Combine   100"
"       6  Combine "
"      100  Node #"
"           Laurel Creek"
"         Maximum flow              0.027   c.m/sec"
"         Hydrograph volume        1277.411   c.m"
"            0.025    0.014    0.014    0.027"
" 40      HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"            0.025    0.000    0.014    0.027"
" 33      CATCHMENT 4"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       4  4"
"    36.000  % Impervious"
"     0.120  Total Area"
"    28.000  Flow length"
"     2.000  Overland Slope"
"     0.077  Pervious Area"
"    45.000  Pervious length"
"     2.000  Pervious slope"
"     0.043  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.366  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.909  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"            0.019    0.000    0.014    0.027 c.m/sec"
"         Catchment 4          Pervious  Impervious Total Area "
"         Surface Area          0.077     0.043     0.120     hectare"
"         Time of concentration  18.141    2.230     8.872     minutes"
"         Time to Centroid       117.351   87.803    100.138   minutes"
"         Rainfall depth        69.174    69.174    69.174    mm"
"         Rainfall volume       53.13     29.88     83.01     c.m"
"         Rainfall losses       43.838    6.323     30.333    mm"
"         Runoff depth          25.335    62.851    38.841    mm"
"         Runoff volume         19.46     27.15     46.61     c.m"
"         Runoff coefficient    0.366     0.909     0.561     "
"         Maximum flow          0.007     0.018     0.019     c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"            0.019    0.019    0.014    0.027"
" 33      CATCHMENT 9"
"       1  Triangular SCS"
"       3  Specify values"
```



```
"       1  SCS method"
"       9  9"
"    20.000  % Impervious"
"     0.180  Total Area"
"    44.000  Flow length"
"     2.000  Overland Slope"
"     0.144  Pervious Area"
"    45.000  Pervious length"
"     2.000  Pervious slope"
"     0.036  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.366  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.909  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"            0.019    0.019    0.014    0.027 c.m/sec"
"         Catchment 9          Pervious  Impervious Total Area "
"         Surface Area          0.144     0.036     0.180     hectare"
"         Time of concentration  18.141    2.230     12.051    minutes"
"         Time to Centroid       117.351   87.803    106.040   minutes"
"         Rainfall depth        69.174    69.174    69.174    mm"
"         Rainfall volume       99.61     24.90     124.51    c.m"
"         Rainfall losses       43.838    6.323     36.335    mm"
"         Runoff depth          25.335    62.850    32.838    mm"
"         Runoff volume         36.48     22.63     59.11     c.m"
"         Runoff coefficient    0.366     0.909     0.475     "
"         Maximum flow          0.013     0.015     0.019     c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"            0.019    0.038    0.014    0.027"
" 33      CATCHMENT 33"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"      33  13"
"    20.000  % Impervious"
"     0.120  Total Area"
"    23.000  Flow length"
"     2.000  Overland Slope"
"     0.096  Pervious Area"
"    45.000  Pervious length"
"     2.000  Pervious slope"
"     0.024  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.366  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.909  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"            0.013    0.038    0.014    0.027 c.m/sec"
"         Catchment 33         Pervious  Impervious Total Area "
"         Surface Area          0.096     0.024     0.120     hectare"
"         Time of concentration  18.141    2.230     12.051    minutes"
"         Time to Centroid       117.351   87.803    106.040   minutes"
"         Rainfall depth        69.174    69.174    69.174    mm"
"         Rainfall volume       66.41     16.60     83.01     c.m"
"         Rainfall losses       43.838    6.323     36.335    mm"
```

```
"          Runoff depth          25.335    62.850    32.838    mm"
"          Runoff volume          24.32     15.08     39.41    c.m"
"          Runoff coefficient     0.366     0.909     0.475    "
"          Maximum flow           0.009     0.010     0.013    c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4  Add Runoff "
"              0.013    0.050    0.014    0.027"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"              0.013    0.050    0.050    0.027"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"              0.013    0.050    0.050    0.027"
" 57       TRENCH Design d/s of 33"
"      0.050  Peak inflow"
"    145.124  Hydrograph volume"
"     14.000  Ground elevation"
"     13.000  Downstream trench invert"
"      1.000  Trench height"
"     12.000  Water table elevation"
"      3.000  Trench top width"
"      1.800  Trench bottom width"
"     40.000  Voids ratio (%)"
"     50.000  Hydraulic conductivity"
"      0.000  Trench gradient (%)"
"    230.000  Trench length"
"      1.000  Include base width"
"       21.  Number of stages"
"            Level Discharge   Volume"
"           13.000   0.000     0.0"
"           13.050   0.000     8.6"
"           13.100   0.000    17.3"
"           13.150   0.000    26.3"
"           13.200   0.000    35.5"
"           13.250   0.000    45.0"
"           13.300   0.000    54.8"
"           13.350   0.000    64.9"
"           13.400   0.000    75.3"
"           13.450   0.000    85.9"
"           13.500   0.000    96.8"
"           13.550   0.000   108.0"
"           13.600   0.000   119.4"
"           13.650   0.000   131.1"
"           13.700   0.000   143.2"
"           13.750   0.000   155.4"
"           13.800   0.000   168.0"
"           13.850   7.015   180.8"
"           13.900  19.840   193.9"
"           13.950  36.449   207.3"
"           14.000  56.116   221.0"
"        1.  WEIRS"
"            Crest     Weir    Crest     Left     Right"
"          elevation coefficie  breadth sideslope sideslope"
"           13.800    1.600  230.000    0.000    0.000"
"        2.  TRENCH PIPES"
"          Downstream     Pipe     Pipe     Pipe Perf'ted?   Offset"
"            Invert    length    diam.   grade%    0=Yes  distance"
"           12.500   10.000    0.200    0.300    0.000    0.000"
"           13.250    3.000    0.000    0.500    1.000    0.000"
"        1.  MANHOLE"
"            Access"
"           diameter"
"            1.200"
"          Peak outflow              0.000   c.m/sec"
"          Outflow volume            0.002   c.m"
"          Peak exfiltration         0.011   c.m/sec"
"          Exfiltration volume     145.097   c.m"
"          Maximum level            13.434   metre"
"          Maximum storage          82.401   c.m"
"          Centroidal lag            3.381   hours"
```



```
"          Infiltration area 2 sides   232.604   sq.metre"
"          Infiltration Base area      414.000   sq.metre"
"              0.013    0.050    0.000    0.011 c.m/sec"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"              0.013    0.000    0.000    0.011"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"              0.013    0.000    0.000    0.011"
" 40       HYDROGRAPH  Combine   100"
"        6  Combine "
"      100  Node #"
"           Laurel Creek"
"          Maximum flow              0.027   c.m/sec"
"          Hydrograph volume      1277.412   c.m"
"              0.013    0.000    0.000    0.027"
" 40       HYDROGRAPH  Confluence   100"
"        7  Confluence "
"      100  Node #"
"           Laurel Creek"
"          Maximum flow              0.027   c.m/sec"
"          Hydrograph volume      1277.412   c.m"
"              0.013    0.027    0.000    0.000"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"              0.013    0.027    0.027    0.000"
" 38       START/RE-START TOTALS 100"
"        3  Runoff Totals on EXIT"
"          Total Catchment area              3.080   hectare"
"          Total Impervious area             1.712   hectare"
"          Total % impervious               55.591"
" 19       EXIT"
```

```
"            MIDUSS Output ------------------------------------------------>"
"            MIDUSS version                    Version 2.25  rev. 473"
"            MIDUSS created                    February 7, 2010"
"         10 Units used:                       ie METRIC"
"            Job folder:              C:\Users\TimAntonio\Water's Edge\"
"            Water's Edge Team Site - Documents\2023 Projects\23014 - 720 Erbsville Rd\10 Modelling\20231025\correct % impervious"
"            Output filename:         23014_5YRChicago_20231025_1617.out"
"            Licensee name:                    Water's Edge"
"            Company                           Water's Edge"
"            Date & Time last used:            2023-10-25 at 4:17:39 PM"
" 31       TIME PARAMETERS"
"       5.000  Time Step"
"     180.000  Max. Storm length"
"    5760.000  Max. Hydrograph"
" 32       STORM Chicago storm"
"          1  Chicago storm"
"    1755.000  Coefficient A"
"      12.347  Constant B"
"       0.895  Exponent C"
"       0.400  Fraction R"
"     180.000  Duration"
"       1.000  Time step multiplier"
"           Maximum intensity         136.512    mm/hr"
"           Total depth               47.549    mm"
"         6  005hyd  Hydrograph extension used in this file"
" 33       CATCHMENT 18"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"         18  18"
"      70.000  % Impervious"
"       0.120  Total Area"
"     104.000  Flow length"
"       2.000  Overland Slope"
"       0.036  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.084  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.259  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.874  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"                 0.024     0.000     0.000     0.000 c.m/sec"
"            Catchment 18          Pervious   Impervious Total Area "
"            Surface Area          0.036      0.084      0.120      hectare"
"            Time of concentration 24.529     2.546      5.027      minutes"
"            Time to Centroid      127.824    89.496     93.822     minutes"
"            Rainfall depth        47.549     47.549     47.549     mm"
"            Rainfall volume       17.12      39.94      57.06      c.m"
"            Rainfall losses       35.214     6.002      14.766     mm"
"            Runoff depth          12.335     41.547     32.783     mm"
"            Runoff volume         4.44       34.90      39.34      c.m"
"            Runoff coefficient    0.259      0.874      0.689      "
"            Maximum flow          0.001      0.024      0.024      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                 0.024     0.024     0.000     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                 0.024     0.024     0.024     0.000"
" 40         HYDROGRAPH   Combine   19"
"          6  Combine "
```



```
"         19  Node #"
"             Inflow to 19"
"           Maximum flow              0.024    c.m/sec"
"           Hydrograph volume         39.340   c.m"
"                 0.024     0.024     0.024     0.024"
" 40         HYDROGRAPH Start - New Tributary"
"          2  Start - New Tributary"
"                 0.024     0.000     0.024     0.024"
" 33       CATCHMENT 12"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"         12  12"
"      70.000  % Impervious"
"       0.070  Total Area"
"      33.800  Flow length"
"       2.000  Overland Slope"
"       0.021  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.049  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.259  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.874  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"                 0.014     0.000     0.024     0.024 c.m/sec"
"            Catchment 12          Pervious   Impervious Total Area "
"            Surface Area          0.021      0.049      0.070      hectare"
"            Time of concentration 24.529     2.546      5.027      minutes"
"            Time to Centroid      127.824    89.496     93.822     minutes"
"            Rainfall depth        47.549     47.549     47.549     mm"
"            Rainfall volume       9.99       23.30      33.28      c.m"
"            Rainfall losses       35.214     6.002      14.766     mm"
"            Runoff depth          12.335     41.547     32.783     mm"
"            Runoff volume         2.59       20.36      22.95      c.m"
"            Runoff coefficient    0.259      0.874      0.689      "
"            Maximum flow          0.001      0.014      0.014      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                 0.014     0.014     0.024     0.024"
" 40         HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                 0.014     0.014     0.014     0.024"
" 40         HYDROGRAPH Next link "
"          5  Next link "
"                 0.014     0.014     0.014     0.024"
" 33       CATCHMENT 14"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"         14  14"
"      70.000  % Impervious"
"       0.170  Total Area"
"      39.000  Flow length"
"       2.000  Overland Slope"
"       0.051  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.119  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
```

```
"      75.000  Pervious SCS Curve No."
"       0.259  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.874  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.034    0.014    0.014    0.024 c.m/sec"
"         Catchment 14          Pervious   Impervious Total Area "
"         Surface Area         0.051    0.119    0.170     hectare"
"         Time of concentration  24.529    2.546    5.027     minutes"
"         Time to Centroid      127.824   89.496   93.822     minutes"
"         Rainfall depth        47.549   47.549   47.549     mm"
"         Rainfall volume       24.25    56.58    80.83     c.m"
"         Rainfall losses       35.214   6.002    14.766     mm"
"         Runoff depth          12.335   41.547   32.783     mm"
"         Runoff volume          6.29    49.44    55.73     c.m"
"         Runoff coefficient     0.259    0.874    0.689     "
"         Maximum flow           0.002    0.034    0.034     c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.034    0.048    0.014    0.024"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.034    0.048    0.048    0.024"
" 40      HYDROGRAPH  Combine   16"
"       6  Combine "
"      16  Node #"
"          16 inflow"
"         Maximum flow                0.048    c.m/sec"
"         Hydrograph volume           78.680   c.m"
"              0.034    0.048    0.048    0.048"
" 40      HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"              0.034    0.000    0.048    0.048"
" 33      CATCHMENT 17"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"      17  17"
"      70.000  % Impervious"
"       0.030  Total Area"
"      45.000  Flow length"
"       2.000  Overland Slope"
"       0.009  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.021  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.259  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.874  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.006    0.000    0.048    0.048 c.m/sec"
"         Catchment 17          Pervious   Impervious Total Area "
"         Surface Area         0.009    0.021    0.030     hectare"
"         Time of concentration  24.529    2.546    5.027     minutes"
"         Time to Centroid      127.824   89.496   93.822     minutes"
"         Rainfall depth        47.549   47.549   47.549     mm"
"         Rainfall volume        4.28     9.99    14.26     c.m"
"         Rainfall losses       35.214   6.002    14.766     mm"
```



```
"         Runoff depth          12.335   41.547   32.783     mm"
"         Runoff volume          1.11     8.72     9.84     c.m"
"         Runoff coefficient     0.259    0.874    0.689     "
"         Maximum flow           0.000    0.006    0.006     c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.006    0.006    0.048    0.048"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.006    0.006    0.006    0.048"
" 40      HYDROGRAPH  Combine   16"
"       6  Combine "
"      16  Node #"
"          16 inflow"
"         Maximum flow                0.055    c.m/sec"
"         Hydrograph volume           88.515   c.m"
"              0.006    0.006    0.006    0.055"
" 40      HYDROGRAPH  Confluence   16"
"       7  Confluence "
"      16  Node #"
"          16 inflow"
"         Maximum flow                0.055    c.m/sec"
"         Hydrograph volume           88.515   c.m"
"              0.006    0.055    0.006    0.000"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.006    0.055    0.055    0.000"
" 40      HYDROGRAPH Next link "
"       5  Next link "
"              0.006    0.055    0.055    0.000"
" 33      CATCHMENT 16"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"      16  16"
"      70.000  % Impervious"
"       0.140  Total Area"
"      37.000  Flow length"
"       2.000  Overland Slope"
"       0.042  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.098  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.259  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.874  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.028    0.055    0.055    0.000 c.m/sec"
"         Catchment 16          Pervious   Impervious Total Area "
"         Surface Area         0.042    0.098    0.140     hectare"
"         Time of concentration  24.529    2.546    5.027     minutes"
"         Time to Centroid      127.824   89.496   93.822     minutes"
"         Rainfall depth        47.549   47.549   47.549     mm"
"         Rainfall volume       19.97    46.60    66.57     c.m"
"         Rainfall losses       35.214   6.002    14.766     mm"
"         Runoff depth          12.335   41.547   32.783     mm"
"         Runoff volume          5.18    40.72    45.90     c.m"
"         Runoff coefficient     0.259    0.874    0.689     "
"         Maximum flow           0.002    0.028    0.028     c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.028    0.083    0.055    0.000"
```

```
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"             0.028    0.083    0.083    0.000"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"             0.028    0.083    0.083    0.000"
" 33       CATCHMENT 15"
"        1  Triangular SCS"
"        3  Specify values"
"        1  SCS method"
"       15  15S"
"    70.000  % Impervious"
"     0.040  Total Area"
"    45.000  Flow length"
"     2.000  Overland Slope"
"     0.012  Pervious Area"
"    45.000  Pervious length"
"     2.000  Pervious slope"
"     0.028  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.259  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.874  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"             0.008    0.083    0.083    0.000 c.m/sec"
"          Catchment 15        Pervious   Impervious Total Area "
"          Surface Area        0.012      0.028      0.040      hectare"
"          Time of concentration  24.529     2.546      5.027      minutes"
"          Time to Centroid       127.824    89.496     93.822     minutes"
"          Rainfall depth         47.549     47.549     47.549     mm"
"          Rainfall volume        5.71       13.31      19.02      c.m"
"          Rainfall losses        35.214     6.002      14.766     mm"
"          Runoff depth           12.335     41.547     32.783     mm"
"          Runoff volume          1.48       11.63      13.11      c.m"
"          Runoff coefficient     0.259      0.874      0.689      "
"          Maximum flow           0.000      0.008      0.008      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4  Add Runoff "
"             0.008    0.091    0.083    0.000"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"             0.008    0.091    0.091    0.000"
" 40       HYDROGRAPH   Combine   19"
"        6  Combine "
"       19  Node #"
"          Inflow to 19"
"          Maximum flow              0.115   c.m/sec"
"          Hydrograph volume         186.865   c.m"
"             0.008    0.091    0.091    0.115"
" 40       HYDROGRAPH Start - New Tributary"
"        2  Start - New Tributary"
"             0.008    0.000    0.091    0.115"
" 33       CATCHMENT 5"
"        1  Triangular SCS"
"        3  Specify values"
"        1  SCS method"
"        5  5"
"    70.000  % Impervious"
"     0.270  Total Area"
"    83.000  Flow length"
"     2.000  Overland Slope"
"     0.081  Pervious Area"
"    45.000  Pervious length"
```



```
"     2.000  Pervious slope"
"     0.189  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.259  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.874  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"             0.055    0.000    0.091    0.115 c.m/sec"
"          Catchment 5         Pervious   Impervious Total Area "
"          Surface Area        0.081      0.189      0.270      hectare"
"          Time of concentration  24.529     2.546      5.027      minutes"
"          Time to Centroid       127.824    89.496     93.822     minutes"
"          Rainfall depth         47.549     47.549     47.549     mm"
"          Rainfall volume        38.51      89.87      128.38     c.m"
"          Rainfall losses        35.214     6.002      14.766     mm"
"          Runoff depth           12.335     41.547     32.783     mm"
"          Runoff volume          9.99       78.52      88.52      c.m"
"          Runoff coefficient     0.259      0.874      0.689      "
"          Maximum flow           0.003      0.054      0.055      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4  Add Runoff "
"             0.055    0.055    0.091    0.115"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"             0.055    0.055    0.055    0.115"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"             0.055    0.055    0.055    0.115"
" 33       CATCHMENT 10"
"        1  Triangular SCS"
"        3  Specify values"
"        1  SCS method"
"       10  10"
"    70.000  % Impervious"
"     0.210  Total Area"
"    66.000  Flow length"
"     2.000  Overland Slope"
"     0.063  Pervious Area"
"    45.000  Pervious length"
"     2.000  Pervious slope"
"     0.147  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.259  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.874  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"             0.042    0.055    0.055    0.115 c.m/sec"
"          Catchment 10        Pervious   Impervious Total Area "
"          Surface Area        0.063      0.147      0.210      hectare"
"          Time of concentration  24.529     2.546      5.027      minutes"
"          Time to Centroid       127.824    89.496     93.822     minutes"
"          Rainfall depth         47.549     47.549     47.549     mm"
"          Rainfall volume        29.96      69.90      99.85      c.m"
"          Rainfall losses        35.214     6.002      14.766     mm"
"          Runoff depth           12.335     41.547     32.783     mm"
"          Runoff volume          7.77       61.07      68.85      c.m"
```

```
"          Runoff coefficient    0.259     0.874     0.689     "
"          Maximum flow          0.002     0.042     0.042     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.042     0.097     0.055     0.115"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.042     0.097     0.097     0.115"
" 40        HYDROGRAPH Next link "
"          5  Next link "
"                0.042     0.097     0.097     0.115"
" 33        CATCHMENT 51"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"         51  15N"
"      70.000  % Impervious"
"       0.350  Total Area"
"     118.000  Flow length"
"       2.000  Overland Slope"
"       0.105  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.245  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.259  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.874  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"                0.071     0.097     0.097     0.115 c.m/sec"
"           Catchment 51          Pervious   Impervious Total Area "
"           Surface Area          0.105     0.245     0.350     hectare"
"           Time of concentration 24.529     2.546     5.027     minutes"
"           Time to Centroid      127.824   89.496    93.822    minutes"
"           Rainfall depth        47.549    47.549    47.549    mm"
"           Rainfall volume       49.93     116.50    166.42    c.m"
"           Rainfall losses       35.214    6.002     14.766    mm"
"           Runoff depth          12.335    41.547    32.783    mm"
"           Runoff volume         12.95     101.79    114.74    c.m"
"           Runoff coefficient    0.259     0.874     0.689     "
"           Maximum flow          0.004     0.070     0.071     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.071     0.168     0.097     0.115"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.071     0.168     0.168     0.115"
" 40        HYDROGRAPH   Combine   19"
"          6  Combine "
"         19  Node #"
"           Inflow to 19"
"          Maximum flow              0.283    c.m/sec"
"          Hydrograph volume         458.967   c.m"
"                0.071     0.168     0.168     0.283"
" 40        HYDROGRAPH   Confluence   19"
"          7  Confluence "
"         19  Node #"
"           Inflow to 19"
"          Maximum flow              0.283    c.m/sec"
"          Hydrograph volume         458.967   c.m"
"                0.071     0.283     0.168     0.000"
" 33        CATCHMENT 19"
"          1  Triangular SCS"
```



```
"          3  Specify values"
"          1  SCS method"
"         19  19"
"      20.000  % Impervious"
"       0.210  Total Area"
"      70.000  Flow length"
"       2.000  Overland Slope"
"       0.168  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.042  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.259  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.874  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"                0.013     0.283     0.168     0.000 c.m/sec"
"           Catchment 19          Pervious   Impervious Total Area "
"           Surface Area          0.168     0.042     0.210     hectare"
"           Time of concentration 24.529     2.546     14.480    minutes"
"           Time to Centroid      127.824   89.496    110.303   minutes"
"           Rainfall depth        47.549    47.549    47.549    mm"
"           Rainfall volume       79.88     19.97     99.85     c.m"
"           Rainfall losses       35.214    6.002     29.372    mm"
"           Runoff depth          12.335    41.547    18.177    mm"
"           Runoff volume         20.72     17.45     38.17     c.m"
"           Runoff coefficient    0.259     0.874     0.382     "
"           Maximum flow          0.006     0.012     0.013     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.013     0.295     0.168     0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.013     0.295     0.295     0.000"
" 40        HYDROGRAPH Next link "
"          5  Next link "
"                0.013     0.295     0.295     0.000"
" 81        ADD COMMENT==========================================================="
"          1  Lines of comment"
"           POND B"
" 54        POND DESIGN"
"       0.295  Current peak flow    c.m/sec"
"       0.005  Target outflow    c.m/sec"
"       497.1  Hydrograph volume    c.m"
"          19.  Number of stages"
"     348.200  Minimum water level    metre"
"     350.000  Maximum water level    metre"
"     348.200  Starting water level    metre"
"           0  Keep Design Data: 1 = True; 0 = False"
"              Level Discharge    Volume"
"             348.200   0.000    0.000"
"             348.300   0.00276   43.650"
"             348.400   0.00477  260.000"
"             348.500   0.00616  300.000"
"             348.600   0.00729  350.000"
"             348.700   0.00827  400.000"
"             348.800   0.00914  450.000"
"             348.900   0.00994  470.000"
"             349.000   0.01068  500.000"
"             349.100   0.01137  567.240"
"             349.200   0.01202  657.150"
"             349.300   0.01539  753.090"
"             349.400   0.01800  855.230"
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"            349.500   0.01995   963.760"
"            349.600   0.02162  1078.000"
"            349.700   0.02312  1108.000"
"            349.800   0.4749   1227.000"
"            349.900    1.354   1352.000"
"            350.000    2.568   1484.000"
"       1.  WEIRS"
"             Crest     Weir     Crest     Left     Right"
"         elevation coefficie   breadth sideslope sideslope"
"            349.700    1.600    5.000    3.000    3.000"
"       2.  ORIFICES"
"            Orifice   Orifice   Orifice Number of"
"             invert coefficie  diameter  orifices"
"            348.200    0.630    0.0750    1.000"
"            349.200    0.630    0.0750    1.000"
"          Peak outflow              0.009   c.m/sec"
"          Maximum level           348.764   metre"
"          Maximum storage         431.839   c.m"
"          Centroidal lag           13.083   hours"
"             0.013    0.295    0.009    0.000 c.m/sec"
" 40      HYDROGRAPH   Combine   100"
"       6  Combine "
"     100  Node #"
"          Laurel Creek"
"          Maximum flow              0.009   c.m/sec"
"          Hydrograph volume       497.118   c.m"
"             0.013    0.295    0.009    0.009"
" 40      HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"             0.013    0.000    0.009    0.009"
" 33      CATCHMENT 2"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       2  2"
"    0.000  % Impervious"
"    0.040  Total Area"
"   12.000  Flow length"
"    2.000  Overland Slope"
"    0.040  Pervious Area"
"   45.000  Pervious length"
"    2.000  Pervious slope"
"    0.000  Impervious Area"
"   45.000  Impervious length"
"    2.000  Impervious slope"
"    0.250  Pervious Manning 'n'"
"   75.000  Pervious SCS Curve No."
"    0.259  Pervious Runoff coefficient"
"    0.100  Pervious Ia/S coefficient"
"    8.467  Pervious Initial abstraction"
"    0.015  Impervious Manning 'n'"
"   98.000  Impervious SCS Curve No."
"    0.000  Impervious Runoff coefficient"
"    0.100  Impervious Ia/S coefficient"
"    0.518  Impervious Initial abstraction"
"             0.001    0.000    0.009    0.009 c.m/sec"
"          Catchment 2          Pervious   Impervious Total Area "
"          Surface Area          0.040     0.000     0.040     hectare"
"          Time of concentration  24.529     2.546    24.529     minutes"
"          Time to Centroid       127.824   89.496   127.824    minutes"
"          Rainfall depth        47.549    47.549    47.549     mm"
"          Rainfall volume       19.02     0.00      19.02      c.m"
"          Rainfall losses       35.214    6.002     35.214     mm"
"          Runoff depth          12.335    41.547    12.335     mm"
"          Runoff volume         4.93      0.00      4.93       c.m"
"          Runoff coefficient    0.259     0.000     0.259      "
"          Maximum flow          0.001     0.000     0.001      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"             0.001    0.001    0.009    0.009"
```



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" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"             0.001    0.001    0.001    0.009"
" 40      HYDROGRAPH   Combine   100"
"       6  Combine "
"     100  Node #"
"          Laurel Creek"
"          Maximum flow              0.009   c.m/sec"
"          Hydrograph volume       502.052   c.m"
"             0.001    0.001    0.001    0.009"
" 40      HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"             0.001    0.000    0.001    0.009"
" 33      CATCHMENT 8"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       8  8"
"   70.000  % Impervious"
"    0.160  Total Area"
"  119.000  Flow length"
"    2.000  Overland Slope"
"    0.048  Pervious Area"
"   45.000  Pervious length"
"    2.000  Pervious slope"
"    0.112  Impervious Area"
"   45.000  Impervious length"
"    2.000  Impervious slope"
"    0.250  Pervious Manning 'n'"
"   75.000  Pervious SCS Curve No."
"    0.259  Pervious Runoff coefficient"
"    0.100  Pervious Ia/S coefficient"
"    8.467  Pervious Initial abstraction"
"    0.015  Impervious Manning 'n'"
"   98.000  Impervious SCS Curve No."
"    0.874  Impervious Runoff coefficient"
"    0.100  Impervious Ia/S coefficient"
"    0.518  Impervious Initial abstraction"
"             0.032    0.000    0.001    0.009 c.m/sec"
"          Catchment 8          Pervious   Impervious Total Area "
"          Surface Area          0.048     0.112     0.160     hectare"
"          Time of concentration  24.529     2.546     5.027     minutes"
"          Time to Centroid       127.824   89.496    93.822    minutes"
"          Rainfall depth        47.549    47.549    47.549     mm"
"          Rainfall volume       22.82     53.25     76.08      c.m"
"          Rainfall losses       35.214    6.002     14.766     mm"
"          Runoff depth          12.335    41.547    32.783     mm"
"          Runoff volume         5.92      46.53     52.45      c.m"
"          Runoff coefficient    0.259     0.874     0.689      "
"          Maximum flow          0.002     0.032     0.032      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"             0.032    0.032    0.001    0.009"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"             0.032    0.032    0.032    0.009"
" 40      HYDROGRAPH   Combine   3"
"       6  Combine "
"       3  Node #"
"          3 input"
"          Maximum flow              0.032   c.m/sec"
"          Hydrograph volume        52.453   c.m"
"             0.032    0.032    0.032    0.032"
" 40      HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"             0.032    0.000    0.032    0.032"
" 33      CATCHMENT 11"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
```

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"          11  11"
"      70.000  % Impervious"
"       0.240  Total Area"
"      50.000  Flow length"
"       2.000  Overland Slope"
"       0.072  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.168  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.259  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.874  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.048    0.000    0.032    0.032 c.m/sec"
"         Catchment 11          Pervious   Impervious Total Area "
"         Surface Area          0.072      0.168      0.240      hectare"
"         Time of concentration 24.529     2.546      5.027      minutes"
"         Time to Centroid      127.824    89.496     93.822     minutes"
"         Rainfall depth        47.549     47.549     47.549     mm"
"         Rainfall volume       34.24      79.88      114.12     c.m"
"         Rainfall losses       35.214     6.002      14.766     mm"
"         Runoff depth          12.335     41.547     32.783     mm"
"         Runoff volume         8.88       69.80      78.68      c.m"
"         Runoff coefficient    0.259      0.874      0.689      "
"         Maximum flow          0.003      0.048      0.048      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.048    0.048    0.032    0.032"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.048    0.048    0.048    0.032"
" 40      HYDROGRAPH Next link "
"       5  Next link "
"              0.048    0.048    0.048    0.032"
" 33      CATCHMENT 7"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       7  7"
"      70.000  % Impervious"
"       0.130  Total Area"
"      38.500  Flow length"
"       2.000  Overland Slope"
"       0.039  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.091  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.259  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.874  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.026    0.048    0.048    0.032 c.m/sec"
"         Catchment 7           Pervious   Impervious Total Area "
"         Surface Area          0.039      0.091      0.130      hectare"
```



```
"         Time of concentration 24.529     2.546      5.027      minutes"
"         Time to Centroid      127.824    89.496     93.822     minutes"
"         Rainfall depth        47.549     47.549     47.549     mm"
"         Rainfall volume       18.54      43.27      61.81      c.m"
"         Rainfall losses       35.214     6.002      14.766     mm"
"         Runoff depth          12.335     41.547     32.783     mm"
"         Runoff volume         4.81       37.81      42.62      c.m"
"         Runoff coefficient    0.259      0.874      0.689      "
"         Maximum flow          0.001      0.026      0.026      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.026    0.075    0.048    0.032"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.026    0.075    0.075    0.032"
" 40      HYDROGRAPH Next link "
"       5  Next link "
"              0.026    0.075    0.075    0.032"
" 33      CATCHMENT 6"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       6  6"
"      70.000  % Impervious"
"       0.120  Total Area"
"      42.000  Flow length"
"       2.000  Overland Slope"
"       0.036  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.084  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.259  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.874  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.024    0.075    0.075    0.032 c.m/sec"
"         Catchment 6           Pervious   Impervious Total Area "
"         Surface Area          0.036      0.084      0.120      hectare"
"         Time of concentration 24.529     2.546      5.027      minutes"
"         Time to Centroid      127.824    89.496     93.822     minutes"
"         Rainfall depth        47.549     47.549     47.549     mm"
"         Rainfall volume       17.12      39.94      57.06      c.m"
"         Rainfall losses       35.214     6.002      14.766     mm"
"         Runoff depth          12.335     41.547     32.783     mm"
"         Runoff volume         4.44       34.90      39.34      c.m"
"         Runoff coefficient    0.259      0.874      0.689      "
"         Maximum flow          0.001      0.024      0.024      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.024    0.099    0.075    0.032"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.024    0.099    0.099    0.032"
" 40      HYDROGRAPH Combine   3"
"       6  Combine "
"       3  Node #"
"          3 input"
"         Maximum flow              0.131    c.m/sec"
"         Hydrograph volume         213.092  c.m"
"              0.024    0.099    0.099    0.131"
" 40      HYDROGRAPH Confluence   3"
"       7  Confluence "
```

```
"          3  Node #"
"             3 input"
"           Maximum flow              0.131    c.m/sec"
"           Hydrograph volume         213.092    c.m"
"                0.024    0.131    0.099    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.024    0.131    0.131    0.000"
" 40        HYDROGRAPH Next link "
"          5  Next link "
"                0.024    0.131    0.131    0.000"
" 33        CATCHMENT 3"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"          3  3"
"      70.000  % Impervious"
"       0.120  Total Area"
"      37.000  Flow length"
"       2.000  Overland Slope"
"       0.036  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.084  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.259  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.874  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"                0.024    0.131    0.131    0.000 c.m/sec"
"           Catchment 3          Pervious   Impervious Total Area "
"           Surface Area          0.036     0.084     0.120     hectare"
"           Time of concentration 24.529    2.546     5.027     minutes"
"           Time to Centroid      127.824   89.496    93.822    minutes"
"           Rainfall depth        47.549    47.549    47.549    mm"
"           Rainfall volume       17.12     39.94     57.06     c.m"
"           Rainfall losses       35.214    6.002     14.766    mm"
"           Runoff depth          12.335    41.547    32.783    mm"
"           Runoff volume         4.44      34.90     39.34     c.m"
"           Runoff coefficient    0.259     0.874     0.689     "
"           Maximum flow          0.001     0.024     0.024     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.024    0.156    0.131    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.024    0.156    0.156    0.000"
" 40        HYDROGRAPH Next link "
"          5  Next link "
"                0.024    0.156    0.156    0.000"
" 33        CATCHMENT 1"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"          1  1"
"      20.000  % Impervious"
"       0.240  Total Area"
"      71.000  Flow length"
"       2.000  Overland Slope"
"       0.192  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.048  Impervious Area"
```



```
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.259  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.874  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"                0.014    0.156    0.156    0.000 c.m/sec"
"           Catchment 1          Pervious   Impervious Total Area "
"           Surface Area          0.192     0.048     0.240     hectare"
"           Time of concentration 24.529    2.546     14.480    minutes"
"           Time to Centroid      127.824   89.496    110.303   minutes"
"           Rainfall depth        47.549    47.549    47.549    mm"
"           Rainfall volume       91.29     22.82     114.12    c.m"
"           Rainfall losses       35.214    6.002     29.372    mm"
"           Runoff depth          12.335    41.547    18.177    mm"
"           Runoff volume         23.68     19.94     43.63     c.m"
"           Runoff coefficient    0.259     0.874     0.382     "
"           Maximum flow          0.007     0.014     0.014     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.014    0.170    0.156    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.014    0.170    0.170    0.000"
" 40        HYDROGRAPH Next link "
"          5  Next link "
"                0.014    0.170    0.170    0.000"
" 81        ADD COMMENT==========================================================="
"          1  Lines of comment"
"             POND A"
" 54         POND DESIGN"
"       0.170  Current peak flow    c.m/sec"
"       0.005  Target outflow    c.m/sec"
"       296.1  Hydrograph volume    c.m"
"          21.  Number of stages"
"     349.000  Minimum water level    metre"
"     351.000  Maximum water level    metre"
"     349.000  Starting water level    metre"
"           0  Keep Design Data: 1 = True; 0 = False"
"                Level Discharge    Volume"
"              349.000    0.000    0.000"
"              349.100    0.00276  100.000"
"              349.200    0.00478  195.000"
"              349.300    0.00616  200.000"
"              349.400    0.00729  210.000"
"              349.500    0.00827  215.000"
"              349.600    0.00914  250.000"
"              349.700    0.00994  295.000"
"              349.800    0.01068  305.000"
"              349.900    0.01137  310.000"
"              350.000    0.01202  320.000"
"              350.100    0.01263  330.000"
"              350.200    0.01322  343.000"
"              350.300    0.01378  396.000"
"              350.400    0.01432  453.000"
"              350.500    0.01485  515.000"
"              350.600    0.01811  581.000"
"              350.700    0.02061  652.000"
"              350.800    0.02247  729.000"
"              350.900    0.4747   811.000"
"              351.000    1.354    898.000"
"          1.  WEIRS"
"                Crest     Weir    Crest     Left     Right"
"             elevation coefficie  breadth sideslope sideslope"
```

```
"          350.800    1.600    5.000    3.000    3.000"
"       2.  ORIFICES"
"          Orifice  Orifice  Orifice Number of"
"           invert coefficie  diameter  orifices"
"          349.000    0.630   0.0750    1.000"
"          350.500    0.630   0.0750    1.000"
"        Peak outflow              0.009   c.m/sec"
"        Maximum level           349.570   metre"
"        Maximum storage         239.462   c.m"
"        Centroidal lag           11.172   hours"
"           0.014    0.170    0.009    0.000 c.m/sec"
" 40     HYDROGRAPH Next link "
"        5  Next link "
"           0.014    0.009    0.009    0.000"
" 40     HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"           0.014    0.009    0.009    0.000"
" 40     HYDROGRAPH  Combine   100"
"        6  Combine "
"       100  Node #"
"          Laurel Creek"
"        Maximum flow             0.018   c.m/sec"
"        Hydrograph volume      798.119   c.m"
"           0.014    0.009    0.009    0.018"
" 40     HYDROGRAPH Start - New Tributary"
"        2  Start - New Tributary"
"           0.014    0.000    0.009    0.018"
" 33     CATCHMENT 4"
"        1  Triangular SCS"
"        3  Specify values"
"        1  SCS method"
"        4  4"
"     36.000  % Impervious"
"      0.120  Total Area"
"     28.000  Flow length"
"      2.000  Overland Slope"
"      0.077  Pervious Area"
"     45.000  Pervious length"
"      2.000  Pervious slope"
"      0.043  Impervious Area"
"     45.000  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     75.000  Pervious SCS Curve No."
"      0.259  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"      8.467  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.874  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"           0.013    0.000    0.009    0.018 c.m/sec"
"        Catchment 4          Pervious   Impervious Total Area "
"        Surface Area          0.077     0.043     0.120     hectare"
"        Time of concentration 24.529     2.546     10.140    minutes"
"        Time to Centroid      127.824   89.496    102.737   minutes"
"        Rainfall depth        47.549    47.549    47.549    mm"
"        Rainfall volume       36.52     20.54     57.06     c.m"
"        Rainfall losses       35.214    6.002     24.698    mm"
"        Runoff depth          12.335    41.547    22.851    mm"
"        Runoff volume         9.47      17.95     27.42     c.m"
"        Runoff coefficient    0.259     0.874     0.481     "
"        Maximum flow          0.003     0.012     0.013     c.m/sec"
" 40     HYDROGRAPH Add Runoff "
"        4  Add Runoff "
"           0.013    0.013    0.009    0.018"
" 33     CATCHMENT 9"
"        1  Triangular SCS"
"        3  Specify values"
```



```
"        1  SCS method"
"        9  9"
"     20.000  % Impervious"
"      0.180  Total Area"
"     44.000  Flow length"
"      2.000  Overland Slope"
"      0.144  Pervious Area"
"     45.000  Pervious length"
"      2.000  Pervious slope"
"      0.036  Impervious Area"
"     45.000  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     75.000  Pervious SCS Curve No."
"      0.259  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"      8.467  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.874  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"           0.011    0.013    0.009    0.018 c.m/sec"
"        Catchment 9          Pervious   Impervious Total Area "
"        Surface Area          0.144     0.036     0.180     hectare"
"        Time of concentration 24.529     2.546     14.480    minutes"
"        Time to Centroid      127.824   89.496    110.303   minutes"
"        Rainfall depth        47.549    47.549    47.549    mm"
"        Rainfall volume       68.47     17.12     85.59     c.m"
"        Rainfall losses       35.214    6.002     29.372    mm"
"        Runoff depth          12.335    41.547    18.177    mm"
"        Runoff volume         17.76     14.96     32.72     c.m"
"        Runoff coefficient    0.259     0.874     0.382     "
"        Maximum flow          0.005     0.010     0.011     c.m/sec"
" 40     HYDROGRAPH Add Runoff "
"        4  Add Runoff "
"           0.011    0.023    0.009    0.018"
" 33     CATCHMENT 33"
"        1  Triangular SCS"
"        3  Specify values"
"        1  SCS method"
"       33  13"
"     20.000  % Impervious"
"      0.120  Total Area"
"     23.000  Flow length"
"      2.000  Overland Slope"
"      0.096  Pervious Area"
"     45.000  Pervious length"
"      2.000  Pervious slope"
"      0.024  Impervious Area"
"     45.000  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     75.000  Pervious SCS Curve No."
"      0.259  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"      8.467  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.874  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"           0.007    0.023    0.009    0.018 c.m/sec"
"        Catchment 33         Pervious   Impervious Total Area "
"        Surface Area          0.096     0.024     0.120     hectare"
"        Time of concentration 24.529     2.546     14.480    minutes"
"        Time to Centroid      127.824   89.496    110.303   minutes"
"        Rainfall depth        47.549    47.549    47.549    mm"
"        Rainfall volume       45.65     11.41     57.06     c.m"
"        Rainfall losses       35.214    6.002     29.372    mm"
```

```
"          Runoff depth          12.335    41.547    18.177    mm"
"          Runoff volume          11.84     9.97     21.81    c.m"
"          Runoff coefficient     0.259     0.874     0.382     "
"          Maximum flow           0.003     0.007     0.007    c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4  Add Runoff "
"              0.007    0.031    0.009    0.018"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"              0.007    0.031    0.031    0.018"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"              0.007    0.031    0.031    0.018"
" 57       TRENCH Design d/s of 33"
"      0.031  Peak inflow"
"     81.953  Hydrograph volume"
"     14.000  Ground elevation"
"     13.000  Downstream trench invert"
"      1.000  Trench height"
"     12.000  Water table elevation"
"      3.000  Trench top width"
"      1.800  Trench bottom width"
"     40.000  Voids ratio (%)"
"     50.000  Hydraulic conductivity"
"      0.000  Trench gradient (%)"
"    230.000  Trench length"
"      1.000  Include base width"
"       21.  Number of stages"
"            Level Discharge   Volume"
"           13.000   0.000     0.0"
"           13.050   0.000     8.6"
"           13.100   0.000    17.3"
"           13.150   0.000    26.3"
"           13.200   0.000    35.5"
"           13.250   0.000    45.0"
"           13.300   0.000    54.8"
"           13.350   0.000    64.9"
"           13.400   0.000    75.3"
"           13.450   0.000    85.9"
"           13.500   0.000    96.8"
"           13.550   0.000   108.0"
"           13.600   0.000   119.4"
"           13.650   0.000   131.1"
"           13.700   0.000   143.2"
"           13.750   0.000   155.4"
"           13.800   0.000   168.0"
"           13.850   7.015   180.8"
"           13.900  19.840   193.9"
"           13.950  36.449   207.3"
"           14.000  56.116   221.0"
"        1.  WEIRS"
"            Crest     Weir    Crest     Left     Right"
"          elevation coefficie  breadth sideslope sideslope"
"           13.800    1.600  230.000    0.000    0.000"
"        2.  TRENCH PIPES"
"          Downstream     Pipe     Pipe     Pipe Perf'ted?   Offset"
"            Invert     length    diam.    grade%    0=Yes  distance"
"           12.500   10.000    0.200    0.300    0.000    0.000"
"           13.250    3.000    0.000    0.500    1.000    0.000"
"        1.  MANHOLE"
"            Access"
"           diameter"
"            1.200"
"          Peak outflow              0.000    c.m/sec"
"          Outflow volume            0.001    c.m"
"          Peak exfiltration         0.008    c.m/sec"
"          Exfiltration volume      82.023    c.m"
"          Maximum level            13.207    metre"
"          Maximum storage          36.863    c.m"
"          Centroidal lag            2.732    hours"
```



```
"          Infiltration area 2 sides   111.082   sq.metre"
"          Infiltration Base area      414.000   sq.metre"
"              0.007    0.031    0.000    0.008 c.m/sec"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"              0.007    0.000    0.000    0.008"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"              0.007    0.000    0.000    0.008"
" 40       HYDROGRAPH  Combine   100"
"        6  Combine "
"      100  Node #"
"           Laurel Creek"
"          Maximum flow              0.018    c.m/sec"
"          Hydrograph volume       798.120    c.m"
"              0.007    0.000    0.000    0.018"
" 40       HYDROGRAPH  Confluence   100"
"        7  Confluence "
"      100  Node #"
"           Laurel Creek"
"          Maximum flow              0.018    c.m/sec"
"          Hydrograph volume       798.120    c.m"
"              0.007    0.018    0.000    0.000"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"              0.007    0.018    0.018    0.000"
" 38       START/RE-START TOTALS 100"
"        3  Runoff Totals on EXIT"
"          Total Catchment area              3.080    hectare"
"          Total Impervious area             1.712    hectare"
"          Total % impervious               55.591"
" 19       EXIT"
```

```
"            MIDUSS Output ------------------------------------------------>"
"            MIDUSS version                    Version 2.25  rev. 473"
"            MIDUSS created                    February 7, 2010"
"         10 Units used:                       ie METRIC"
"            Job folder:              C:\Users\TimAntonio\Water's Edge\"
"            Water's Edge Team Site - Documents\2023 Projects\23014 - 720 Erbsville Rd\10 Modelling\20231025\correct % impervious"
"            Output filename:         23014_2YRChicago_20231025_1558.out"
"            Licensee name:                    Water's Edge"
"            Company                           Water's Edge"
"            Date & Time last used:            2023-10-25 at 3:59:01 PM"
" 31       TIME PARAMETERS"
"       5.000  Time Step"
"     180.000  Max. Storm length"
"    5760.000  Max. Hydrograph"
" 32       STORM Chicago storm"
"          1  Chicago storm"
"    1101.000  Coefficient A"
"       9.258  Constant B"
"       0.882  Exponent C"
"       0.400  Fraction R"
"     180.000  Duration"
"       1.000  Time step multiplier"
"           Maximum intensity         105.659    mm/hr"
"           Total depth               32.400    mm"
"          6  005hyd  Hydrograph extension used in this file"
" 33       CATCHMENT 18"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"         18  18"
"     70.000  % Impervious"
"      0.120  Total Area"
"    104.000  Flow length"
"      2.000  Overland Slope"
"      0.036  Pervious Area"
"     45.000  Pervious length"
"      2.000  Pervious slope"
"      0.084  Impervious Area"
"     45.000  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     75.000  Pervious SCS Curve No."
"      0.163  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"      8.467  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.831  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"                0.017    0.000    0.000    0.000 c.m/sec"
"           Catchment 18          Pervious   Impervious Total Area "
"           Surface Area          0.036      0.084      0.120      hectare"
"           Time of concentration 35.723     2.866      5.410      minutes"
"           Time to Centroid      141.926    90.631     94.603     minutes"
"           Rainfall depth        32.400     32.400     32.400     mm"
"           Rainfall volume       11.66      27.22      38.88      c.m"
"           Rainfall losses       27.128     5.479      11.973     mm"
"           Runoff depth          5.273      26.921     20.427     mm"
"           Runoff volume         1.90       22.61      24.51      c.m"
"           Runoff coefficient    0.163      0.831      0.630      "
"           Maximum flow          0.000      0.017      0.017      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.017    0.017    0.000    0.000"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.017    0.017    0.017    0.000"
" 40       HYDROGRAPH   Combine   19"
"          6  Combine "
```



```
"         19  Node #"
"             Inflow to 19"
"           Maximum flow            0.017    c.m/sec"
"           Hydrograph volume         24.512    c.m"
"                0.017    0.017    0.017    0.017"
" 40       HYDROGRAPH Start - New Tributary"
"          2  Start - New Tributary"
"                0.017    0.000    0.017    0.017"
" 33       CATCHMENT 12"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"         12  12"
"     70.000  % Impervious"
"      0.070  Total Area"
"     33.800  Flow length"
"      2.000  Overland Slope"
"      0.021  Pervious Area"
"     45.000  Pervious length"
"      2.000  Pervious slope"
"      0.049  Impervious Area"
"     45.000  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     75.000  Pervious SCS Curve No."
"      0.163  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"      8.467  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.831  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"                0.010    0.000    0.017    0.017 c.m/sec"
"           Catchment 12          Pervious   Impervious Total Area "
"           Surface Area          0.021      0.049      0.070      hectare"
"           Time of concentration 35.724     2.866      5.410      minutes"
"           Time to Centroid      141.926    90.631     94.603     minutes"
"           Rainfall depth        32.400     32.400     32.400     mm"
"           Rainfall volume       6.80       15.88      22.68      c.m"
"           Rainfall losses       27.128     5.479      11.973     mm"
"           Runoff depth          5.273      26.921     20.427     mm"
"           Runoff volume         1.11       13.19      14.30      c.m"
"           Runoff coefficient    0.163      0.831      0.630      "
"           Maximum flow          0.000      0.010      0.010      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.010    0.010    0.017    0.017"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.010    0.010    0.010    0.017"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"                0.010    0.010    0.010    0.017"
" 33       CATCHMENT 14"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"         14  14"
"     70.000  % Impervious"
"      0.170  Total Area"
"     39.000  Flow length"
"      2.000  Overland Slope"
"      0.051  Pervious Area"
"     45.000  Pervious length"
"      2.000  Pervious slope"
"      0.119  Impervious Area"
"     45.000  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
```

```
"      75.000  Pervious SCS Curve No."
"       0.163  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.831  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.024    0.010    0.010    0.017 c.m/sec"
"         Catchment 14          Pervious   Impervious Total Area "
"         Surface Area         0.051    0.119    0.170     hectare"
"         Time of concentration  35.724    2.866    5.410     minutes"
"         Time to Centroid      141.926   90.631   94.603     minutes"
"         Rainfall depth        32.400   32.400   32.400     mm"
"         Rainfall volume       16.52    38.56    55.08     c.m"
"         Rainfall losses       27.128    5.479   11.973     mm"
"         Runoff depth           5.273   26.921   20.427     mm"
"         Runoff volume          2.69    32.04    34.73     c.m"
"         Runoff coefficient     0.163    0.831    0.630     "
"         Maximum flow           0.001    0.024    0.024     c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.024    0.033    0.010    0.017"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.024    0.033    0.033    0.017"
" 40      HYDROGRAPH  Combine   16"
"       6  Combine "
"      16  Node #"
"          16 inflow"
"         Maximum flow                0.033   c.m/sec"
"         Hydrograph volume          49.024   c.m"
"              0.024    0.033    0.033    0.033"
" 40      HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"              0.024    0.000    0.033    0.033"
" 33      CATCHMENT 17"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"      17  17"
"      70.000  % Impervious"
"       0.030  Total Area"
"      45.000  Flow length"
"       2.000  Overland Slope"
"       0.009  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.021  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.163  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.831  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.004    0.000    0.033    0.033 c.m/sec"
"         Catchment 17          Pervious   Impervious Total Area "
"         Surface Area         0.009    0.021    0.030     hectare"
"         Time of concentration  35.724    2.866    5.410     minutes"
"         Time to Centroid      141.926   90.631   94.603     minutes"
"         Rainfall depth        32.400   32.400   32.400     mm"
"         Rainfall volume        2.92     6.80     9.72     c.m"
"         Rainfall losses       27.128    5.479   11.973     mm"
```



```
"         Runoff depth           5.273   26.921   20.427     mm"
"         Runoff volume          0.47     5.65     6.13     c.m"
"         Runoff coefficient     0.163    0.831    0.630     "
"         Maximum flow           0.000    0.004    0.004     c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.004    0.004    0.033    0.033"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.004    0.004    0.004    0.033"
" 40      HYDROGRAPH  Combine   16"
"       6  Combine "
"      16  Node #"
"          16 inflow"
"         Maximum flow                0.038   c.m/sec"
"         Hydrograph volume          55.152   c.m"
"              0.004    0.004    0.004    0.038"
" 40      HYDROGRAPH  Confluence   16"
"       7  Confluence "
"      16  Node #"
"          16 inflow"
"         Maximum flow                0.038   c.m/sec"
"         Hydrograph volume          55.152   c.m"
"              0.004    0.038    0.004    0.000"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"              0.004    0.038    0.038    0.000"
" 40      HYDROGRAPH Next link "
"       5  Next link "
"              0.004    0.038    0.038    0.000"
" 33      CATCHMENT 16"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"      16  16"
"      70.000  % Impervious"
"       0.140  Total Area"
"      37.000  Flow length"
"       2.000  Overland Slope"
"       0.042  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.098  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.163  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.831  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"              0.019    0.038    0.038    0.000 c.m/sec"
"         Catchment 16          Pervious   Impervious Total Area "
"         Surface Area         0.042    0.098    0.140     hectare"
"         Time of concentration  35.724    2.866    5.410     minutes"
"         Time to Centroid      141.926   90.631   94.603     minutes"
"         Rainfall depth        32.400   32.400   32.400     mm"
"         Rainfall volume       13.61    31.75    45.36     c.m"
"         Rainfall losses       27.128    5.479   11.973     mm"
"         Runoff depth           5.273   26.921   20.427     mm"
"         Runoff volume          2.21    26.38    28.60     c.m"
"         Runoff coefficient     0.163    0.831    0.630     "
"         Maximum flow           0.001    0.019    0.019     c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"              0.019    0.057    0.038    0.000"
```

```
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"             0.019    0.057    0.057    0.000"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"             0.019    0.057    0.057    0.000"
" 33       CATCHMENT 15"
"        1  Triangular SCS"
"        3  Specify values"
"        1  SCS method"
"       15  15S"
"    70.000  % Impervious"
"     0.040  Total Area"
"    45.000  Flow length"
"     2.000  Overland Slope"
"     0.012  Pervious Area"
"    45.000  Pervious length"
"     2.000  Pervious slope"
"     0.028  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.163  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.831  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"             0.006    0.057    0.057    0.000 c.m/sec"
"          Catchment 15        Pervious   Impervious Total Area "
"          Surface Area        0.012      0.028      0.040      hectare"
"          Time of concentration  35.724     2.866      5.410      minutes"
"          Time to Centroid       141.926    90.631     94.603     minutes"
"          Rainfall depth         32.400     32.400     32.400     mm"
"          Rainfall volume        3.89       9.07       12.96      c.m"
"          Rainfall losses        27.128     5.479      11.973     mm"
"          Runoff depth           5.273      26.921     20.427     mm"
"          Runoff volume          0.63       7.54       8.17       c.m"
"          Runoff coefficient     0.163      0.831      0.630      "
"          Maximum flow           0.000      0.006      0.006      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4  Add Runoff "
"             0.006    0.063    0.057    0.000"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"             0.006    0.063    0.063    0.000"
" 40       HYDROGRAPH   Combine   19"
"        6  Combine "
"       19  Node #"
"           Inflow to 19"
"          Maximum flow              0.079   c.m/sec"
"          Hydrograph volume         116.432   c.m"
"             0.006    0.063    0.063    0.079"
" 40       HYDROGRAPH Start - New Tributary"
"        2  Start - New Tributary"
"             0.006    0.000    0.063    0.079"
" 33       CATCHMENT 5"
"        1  Triangular SCS"
"        3  Specify values"
"        1  SCS method"
"        5  5"
"    70.000  % Impervious"
"     0.270  Total Area"
"    83.000  Flow length"
"     2.000  Overland Slope"
"     0.081  Pervious Area"
"    45.000  Pervious length"
```



```
"     2.000  Pervious slope"
"     0.189  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.163  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.831  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"             0.038    0.000    0.063    0.079 c.m/sec"
"          Catchment 5         Pervious   Impervious Total Area "
"          Surface Area        0.081      0.189      0.270      hectare"
"          Time of concentration  35.724     2.866      5.410      minutes"
"          Time to Centroid       141.926    90.631     94.603     minutes"
"          Rainfall depth         32.400     32.400     32.400     mm"
"          Rainfall volume        26.24      61.24      87.48      c.m"
"          Rainfall losses        27.128     5.479      11.973     mm"
"          Runoff depth           5.273      26.921     20.427     mm"
"          Runoff volume          4.27       50.88      55.15      c.m"
"          Runoff coefficient     0.163      0.831      0.630      "
"          Maximum flow           0.001      0.037      0.038      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"        4  Add Runoff "
"             0.038    0.038    0.063    0.079"
" 40       HYDROGRAPH Copy to Outflow"
"        8  Copy to Outflow"
"             0.038    0.038    0.038    0.079"
" 40       HYDROGRAPH Next link "
"        5  Next link "
"             0.038    0.038    0.038    0.079"
" 33       CATCHMENT 10"
"        1  Triangular SCS"
"        3  Specify values"
"        1  SCS method"
"       10  10"
"    70.000  % Impervious"
"     0.210  Total Area"
"    66.000  Flow length"
"     2.000  Overland Slope"
"     0.063  Pervious Area"
"    45.000  Pervious length"
"     2.000  Pervious slope"
"     0.147  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.163  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.831  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"             0.029    0.038    0.038    0.079 c.m/sec"
"          Catchment 10        Pervious   Impervious Total Area "
"          Surface Area        0.063      0.147      0.210      hectare"
"          Time of concentration  35.724     2.866      5.410      minutes"
"          Time to Centroid       141.926    90.631     94.603     minutes"
"          Rainfall depth         32.400     32.400     32.400     mm"
"          Rainfall volume        20.41      47.63      68.04      c.m"
"          Rainfall losses        27.128     5.479      11.973     mm"
"          Runoff depth           5.273      26.921     20.427     mm"
"          Runoff volume          3.32       39.57      42.90      c.m"
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"          Runoff coefficient    0.163     0.831     0.630     "
"          Maximum flow          0.001     0.029     0.029     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"               0.029     0.067     0.038     0.079"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"               0.029     0.067     0.067     0.079"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"               0.029     0.067     0.067     0.079"
" 33       CATCHMENT 51"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"         51  15N"
"      70.000  % Impervious"
"       0.350  Total Area"
"     118.000  Flow length"
"       2.000  Overland Slope"
"       0.105  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.245  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.163  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.831  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"               0.049     0.067     0.067     0.079 c.m/sec"
"          Catchment 51          Pervious   Impervious Total Area "
"          Surface Area          0.105     0.245     0.350     hectare"
"          Time of concentration 35.724    2.866     5.410     minutes"
"          Time to Centroid      141.926   90.631    94.603    minutes"
"          Rainfall depth        32.400    32.400    32.400    mm"
"          Rainfall volume       34.02     79.38     113.40    c.m"
"          Rainfall losses       27.128    5.479     11.973    mm"
"          Runoff depth          5.273     26.921    20.427    mm"
"          Runoff volume         5.54      65.96     71.49     c.m"
"          Runoff coefficient    0.163     0.831     0.630     "
"          Maximum flow          0.001     0.049     0.049     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"               0.049     0.115     0.067     0.079"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"               0.049     0.115     0.115     0.079"
" 40       HYDROGRAPH   Combine   19"
"          6  Combine "
"         19  Node #"
"             Inflow to 19"
"          Maximum flow              0.195    c.m/sec"
"          Hydrograph volume         285.973  c.m"
"               0.049     0.115     0.115     0.195"
" 40       HYDROGRAPH   Confluence   19"
"          7  Confluence "
"         19  Node #"
"             Inflow to 19"
"          Maximum flow              0.195    c.m/sec"
"          Hydrograph volume         285.973  c.m"
"               0.049     0.195     0.115     0.000"
" 33       CATCHMENT 19"
"          1  Triangular SCS"
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"          3  Specify values"
"          1  SCS method"
"         19  19"
"      20.000  % Impervious"
"       0.210  Total Area"
"      70.000  Flow length"
"       2.000  Overland Slope"
"       0.168  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.042  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.163  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.831  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"               0.008     0.195     0.115     0.000 c.m/sec"
"          Catchment 19          Pervious   Impervious Total Area "
"          Surface Area          0.168     0.042     0.210     hectare"
"          Time of concentration 35.724    2.866     17.299    minutes"
"          Time to Centroid      141.926   90.631    113.163   minutes"
"          Rainfall depth        32.400    32.400    32.400    mm"
"          Rainfall volume       54.43     13.61     68.04     c.m"
"          Rainfall losses       27.128    5.479     22.798    mm"
"          Runoff depth          5.273     26.921    9.602     mm"
"          Runoff volume         8.86      11.31     20.16     c.m"
"          Runoff coefficient    0.163     0.831     0.296     "
"          Maximum flow          0.002     0.008     0.008     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"               0.008     0.203     0.115     0.000"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"               0.008     0.203     0.203     0.000"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"               0.008     0.203     0.203     0.000"
" 81       ADD COMMENT==================================================="
"          1  Lines of comment"
"          POND B"
" 54       POND DESIGN"
"       0.203  Current peak flow    c.m/sec"
"       0.005  Target outflow    c.m/sec"
"      306.1  Hydrograph volume    c.m"
"          19.  Number of stages"
"     348.200  Minimum water level    metre"
"     350.000  Maximum water level    metre"
"     348.200  Starting water level    metre"
"          0  Keep Design Data: 1 = True; 0 = False"
"             Level Discharge    Volume"
"           348.200    0.000    0.000"
"           348.300    0.00276    43.650"
"           348.400    0.00477    260.000"
"           348.500    0.00616    300.000"
"           348.600    0.00729    350.000"
"           348.700    0.00827    400.000"
"           348.800    0.00914    450.000"
"           348.900    0.00994    470.000"
"           349.000    0.01068    500.000"
"           349.100    0.01137    567.240"
"           349.200    0.01202    657.150"
"           349.300    0.01539    753.090"
"           349.400    0.01800    855.230"
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"            349.500  0.01995  963.760"
"            349.600  0.02162  1078.000"
"            349.700  0.02312  1108.000"
"            349.800  0.4749  1227.000"
"            349.900  1.354  1352.000"
"            350.000  2.568  1484.000"
"       1.  WEIRS"
"             Crest    Weir    Crest    Left    Right"
"         elevation coefficie  breadth sideslope sideslope"
"            349.700  1.600    5.000    3.000    3.000"
"       2.  ORIFICES"
"            Orifice  Orifice  Orifice Number of"
"             invert coefficie  diameter  orifices"
"            348.200  0.630  0.0750  1.000"
"            349.200  0.630  0.0750  1.000"
"          Peak outflow              0.005  c.m/sec"
"          Maximum level           348.417  metre"
"          Maximum storage          266.744  c.m"
"          Centroidal lag           11.940  hours"
"             0.008  0.203  0.005  0.000 c.m/sec"
" 40      HYDROGRAPH  Combine  100"
"       6  Combine "
"     100  Node #"
"          Laurel Creek"
"          Maximum flow             0.005  c.m/sec"
"          Hydrograph volume        306.115  c.m"
"             0.008  0.203  0.005  0.005"
" 40      HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"             0.008  0.000  0.005  0.005"
" 33      CATCHMENT 2"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       2  2"
"    0.000  % Impervious"
"    0.040  Total Area"
"   12.000  Flow length"
"    2.000  Overland Slope"
"    0.040  Pervious Area"
"   45.000  Pervious length"
"    2.000  Pervious slope"
"    0.000  Impervious Area"
"   45.000  Impervious length"
"    2.000  Impervious slope"
"    0.250  Pervious Manning 'n'"
"   75.000  Pervious SCS Curve No."
"    0.163  Pervious Runoff coefficient"
"    0.100  Pervious Ia/S coefficient"
"    8.467  Pervious Initial abstraction"
"    0.015  Impervious Manning 'n'"
"   98.000  Impervious SCS Curve No."
"    0.000  Impervious Runoff coefficient"
"    0.100  Impervious Ia/S coefficient"
"    0.518  Impervious Initial abstraction"
"             0.000  0.000  0.005  0.005 c.m/sec"
"          Catchment 2          Pervious  Impervious Total Area "
"          Surface Area         0.040    0.000    0.040    hectare"
"          Time of concentration  35.724    2.866    35.723    minutes"
"          Time to Centroid      141.926   90.631   141.925   minutes"
"          Rainfall depth       32.400   32.400   32.400   mm"
"          Rainfall volume      12.96    0.00     12.96    c.m"
"          Rainfall losses      27.128   5.479    27.128   mm"
"          Runoff depth         5.273    26.921   5.273    mm"
"          Runoff volume        2.11     0.00     2.11     c.m"
"          Runoff coefficient   0.163    0.000    0.163    "
"          Maximum flow         0.000    0.000    0.000    c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"             0.000  0.000  0.005  0.005"
```



```
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"             0.000  0.000  0.000  0.005"
" 40      HYDROGRAPH  Combine  100"
"       6  Combine "
"     100  Node #"
"          Laurel Creek"
"          Maximum flow             0.005  c.m/sec"
"          Hydrograph volume        308.224  c.m"
"             0.000  0.000  0.000  0.005"
" 40      HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"             0.000  0.000  0.000  0.005"
" 33      CATCHMENT 8"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       8  8"
"    70.000  % Impervious"
"    0.160  Total Area"
"  119.000  Flow length"
"    2.000  Overland Slope"
"    0.048  Pervious Area"
"   45.000  Pervious length"
"    2.000  Pervious slope"
"    0.112  Impervious Area"
"   45.000  Impervious length"
"    2.000  Impervious slope"
"    0.250  Pervious Manning 'n'"
"   75.000  Pervious SCS Curve No."
"    0.163  Pervious Runoff coefficient"
"    0.100  Pervious Ia/S coefficient"
"    8.467  Pervious Initial abstraction"
"    0.015  Impervious Manning 'n'"
"   98.000  Impervious SCS Curve No."
"    0.831  Impervious Runoff coefficient"
"    0.100  Impervious Ia/S coefficient"
"    0.518  Impervious Initial abstraction"
"             0.022  0.000  0.000  0.005 c.m/sec"
"          Catchment 8          Pervious  Impervious Total Area "
"          Surface Area         0.048    0.112    0.160    hectare"
"          Time of concentration  35.724    2.866    5.410    minutes"
"          Time to Centroid      141.926   90.631   94.603   minutes"
"          Rainfall depth       32.400   32.400   32.400   mm"
"          Rainfall volume      15.55    36.29    51.84    c.m"
"          Rainfall losses      27.128   5.479    11.973   mm"
"          Runoff depth         5.273    26.921   20.427   mm"
"          Runoff volume        2.53     30.15    32.68    c.m"
"          Runoff coefficient   0.163    0.831    0.630    "
"          Maximum flow         0.001    0.022    0.022    c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"             0.022  0.022  0.000  0.005"
" 40      HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"             0.022  0.022  0.022  0.005"
" 40      HYDROGRAPH  Combine  3"
"       6  Combine "
"       3  Node #"
"          3 input"
"          Maximum flow             0.022  c.m/sec"
"          Hydrograph volume        32.683  c.m"
"             0.022  0.022  0.022  0.022"
" 40      HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"             0.022  0.000  0.022  0.022"
" 33      CATCHMENT 11"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
```

```
"          11  11"
"      70.000  % Impervious"
"       0.240  Total Area"
"      50.000  Flow length"
"       2.000  Overland Slope"
"       0.072  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.168  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.163  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.831  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"                0.033    0.000    0.022    0.022 c.m/sec"
"          Catchment 11          Pervious   Impervious Total Area "
"          Surface Area          0.072      0.168     0.240     hectare"
"          Time of concentration 35.724     2.866     5.410     minutes"
"          Time to Centroid      141.926    90.631    94.603    minutes"
"          Rainfall depth        32.400     32.400    32.400    mm"
"          Rainfall volume       23.33      54.43     77.76     c.m"
"          Rainfall losses       27.128     5.479     11.973    mm"
"          Runoff depth          5.273      26.921    20.427    mm"
"          Runoff volume         3.80       45.23     49.02     c.m"
"          Runoff coefficient    0.163      0.831     0.630     "
"          Maximum flow          0.001      0.033     0.033     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.033    0.033    0.022    0.022"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.033    0.033    0.033    0.022"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"                0.033    0.033    0.033    0.022"
" 33       CATCHMENT 7"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"          7  7"
"      70.000  % Impervious"
"       0.130  Total Area"
"      38.500  Flow length"
"       2.000  Overland Slope"
"       0.039  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.091  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.163  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.831  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"                0.018    0.033    0.033    0.022 c.m/sec"
"          Catchment 7           Pervious   Impervious Total Area "
"          Surface Area          0.039      0.091     0.130     hectare"
```



```
"          Time of concentration 35.724     2.866     5.410     minutes"
"          Time to Centroid      141.926    90.631    94.603    minutes"
"          Rainfall depth        32.400     32.400    32.400    mm"
"          Rainfall volume       12.64      29.48     42.12     c.m"
"          Rainfall losses       27.128     5.479     11.973    mm"
"          Runoff depth          5.273      26.921    20.427    mm"
"          Runoff volume         2.06       24.50     26.55     c.m"
"          Runoff coefficient    0.163      0.831     0.630     "
"          Maximum flow          0.000      0.018     0.018     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.018    0.051    0.033    0.022"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.018    0.051    0.051    0.022"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"                0.018    0.051    0.051    0.022"
" 33       CATCHMENT 6"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"          6  6"
"      70.000  % Impervious"
"       0.120  Total Area"
"      42.000  Flow length"
"       2.000  Overland Slope"
"       0.036  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.084  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.163  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.831  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"                0.017    0.051    0.051    0.022 c.m/sec"
"          Catchment 6           Pervious   Impervious Total Area "
"          Surface Area          0.036      0.084     0.120     hectare"
"          Time of concentration 35.724     2.866     5.410     minutes"
"          Time to Centroid      141.926    90.631    94.603    minutes"
"          Rainfall depth        32.400     32.400    32.400    mm"
"          Rainfall volume       11.66      27.22     38.88     c.m"
"          Rainfall losses       27.128     5.479     11.973    mm"
"          Runoff depth          5.273      26.921    20.427    mm"
"          Runoff volume         1.90       22.61     24.51     c.m"
"          Runoff coefficient    0.163      0.831     0.630     "
"          Maximum flow          0.000      0.017     0.017     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.017    0.068    0.051    0.022"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.017    0.068    0.068    0.022"
" 40       HYDROGRAPH  Combine   3"
"          6  Combine "
"          3  Node #"
"             3 input"
"          Maximum flow              0.090    c.m/sec"
"          Hydrograph volume         132.773  c.m"
"                0.017    0.068    0.068    0.090"
" 40       HYDROGRAPH  Confluence   3"
"          7  Confluence "
```

```
"          3  Node #"
"             3 input"
"           Maximum flow              0.090    c.m/sec"
"           Hydrograph volume         132.773    c.m"
"                0.017    0.090    0.068    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.017    0.090    0.090    0.000"
" 40        HYDROGRAPH Next link "
"          5  Next link "
"                0.017    0.090    0.090    0.000"
" 33        CATCHMENT 3"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"          3  3"
"      70.000  % Impervious"
"       0.120  Total Area"
"      37.000  Flow length"
"       2.000  Overland Slope"
"       0.036  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.084  Impervious Area"
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.163  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.831  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"                0.017    0.090    0.090    0.000 c.m/sec"
"           Catchment 3          Pervious   Impervious Total Area "
"           Surface Area          0.036     0.084     0.120     hectare"
"           Time of concentration 35.724     2.866     5.410     minutes"
"           Time to Centroid       141.926   90.631    94.603    minutes"
"           Rainfall depth        32.400    32.400    32.400    mm"
"           Rainfall volume        11.66     27.22     38.88    c.m"
"           Rainfall losses       27.128    5.479     11.973    mm"
"           Runoff depth          5.273     26.921    20.427    mm"
"           Runoff volume          1.90      22.61     24.51    c.m"
"           Runoff coefficient     0.163     0.831     0.630    "
"           Maximum flow           0.000     0.017     0.017    c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.017    0.107    0.090    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.017    0.107    0.107    0.000"
" 40        HYDROGRAPH Next link "
"          5  Next link "
"                0.017    0.107    0.107    0.000"
" 33        CATCHMENT 1"
"          1  Triangular SCS"
"          3  Specify values"
"          1  SCS method"
"          1  1"
"      20.000  % Impervious"
"       0.240  Total Area"
"      71.000  Flow length"
"       2.000  Overland Slope"
"       0.192  Pervious Area"
"      45.000  Pervious length"
"       2.000  Pervious slope"
"       0.048  Impervious Area"
```



```
"      45.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      75.000  Pervious SCS Curve No."
"       0.163  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"       8.467  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.831  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"                0.010    0.107    0.107    0.000 c.m/sec"
"           Catchment 1          Pervious   Impervious Total Area "
"           Surface Area          0.192     0.048     0.240     hectare"
"           Time of concentration 35.724     2.866     17.299    minutes"
"           Time to Centroid       141.926   90.631    113.163   minutes"
"           Rainfall depth        32.400    32.400    32.400    mm"
"           Rainfall volume        62.21     15.55     77.76    c.m"
"           Rainfall losses       27.128    5.479     22.798    mm"
"           Runoff depth          5.273     26.921    9.602     mm"
"           Runoff volume          10.12     12.92     23.05    c.m"
"           Runoff coefficient     0.163     0.831     0.296    "
"           Maximum flow           0.002     0.010     0.010    c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.010    0.117    0.107    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.010    0.117    0.117    0.000"
" 40        HYDROGRAPH Next link "
"          5  Next link "
"                0.010    0.117    0.117    0.000"
" 81        ADD COMMENT==========================================================="
"          1  Lines of comment"
"           POND A"
" 54        POND DESIGN"
"       0.117  Current peak flow    c.m/sec"
"       0.005  Target outflow    c.m/sec"
"       180.3  Hydrograph volume    c.m"
"          21.  Number of stages"
"     349.000  Minimum water level    metre"
"     351.000  Maximum water level    metre"
"     349.000  Starting water level    metre"
"           0  Keep Design Data: 1 = True; 0 = False"
"              Level Discharge    Volume"
"             349.000    0.000    0.000"
"             349.100    0.00276  100.000"
"             349.200    0.00478  195.000"
"             349.300    0.00616  200.000"
"             349.400    0.00729  210.000"
"             349.500    0.00827  215.000"
"             349.600    0.00914  250.000"
"             349.700    0.00994  295.000"
"             349.800    0.01068  305.000"
"             349.900    0.01137  310.000"
"             350.000    0.01202  320.000"
"             350.100    0.01263  330.000"
"             350.200    0.01322  343.000"
"             350.300    0.01378  396.000"
"             350.400    0.01432  453.000"
"             350.500    0.01485  515.000"
"             350.600    0.01811  581.000"
"             350.700    0.02061  652.000"
"             350.800    0.02247  729.000"
"             350.900    0.4747   811.000"
"             351.000    1.354    898.000"
"          1.  WEIRS"
"              Crest     Weir     Crest     Left      Right"
"           elevation coefficie   breadth sideslope sideslope"
```

```
"          350.800    1.600    5.000    3.000    3.000"
"       2. ORIFICES"
"          Orifice  Orifice  Orifice Number of"
"           invert coefficie  diameter  orifices"
"          349.000    0.630    0.0750    1.000"
"          350.500    0.630    0.0750    1.000"
"        Peak outflow              0.004   c.m/sec"
"        Maximum level           349.154   metre"
"        Maximum storage         151.672   c.m"
"        Centroidal lag           11.928   hours"
"           0.010    0.117    0.004    0.000 c.m/sec"
" 40     HYDROGRAPH Next link "
"       5  Next link "
"           0.010    0.004    0.004    0.000"
" 40     HYDROGRAPH Copy to Outflow"
"       8  Copy to Outflow"
"           0.010    0.004    0.004    0.000"
" 40     HYDROGRAPH  Combine   100"
"       6  Combine "
"      100  Node #"
"          Laurel Creek"
"        Maximum flow              0.009   c.m/sec"
"        Hydrograph volume       488.539   c.m"
"           0.010    0.004    0.004    0.009"
" 40     HYDROGRAPH Start - New Tributary"
"       2  Start - New Tributary"
"           0.010    0.000    0.004    0.009"
" 33      CATCHMENT 4"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"       4  4"
"    36.000  % Impervious"
"     0.120  Total Area"
"    28.000  Flow length"
"     2.000  Overland Slope"
"     0.077  Pervious Area"
"    45.000  Pervious length"
"     2.000  Pervious slope"
"     0.043  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.163  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.831  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"           0.009    0.000    0.004    0.009 c.m/sec"
"        Catchment 4          Pervious  Impervious Total Area "
"        Surface Area         0.077     0.043     0.120     hectare"
"        Time of concentration 35.724    2.866     11.351    minutes"
"        Time to Centroid      141.926   90.631    103.878   minutes"
"        Rainfall depth        32.400    32.400    32.400    mm"
"        Rainfall volume       24.88     14.00     38.88     c.m"
"        Rainfall losses       27.128    5.479     19.334    mm"
"        Runoff depth          5.273     26.921    13.066    mm"
"        Runoff volume         4.05      11.63     15.68     c.m"
"        Runoff coefficient    0.163     0.831     0.403     "
"        Maximum flow          0.001     0.009     0.009     c.m/sec"
" 40     HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"           0.009    0.009    0.004    0.009"
" 33      CATCHMENT 9"
"       1  Triangular SCS"
"       3  Specify values"
```



```
"       1  SCS method"
"       9  9"
"    20.000  % Impervious"
"     0.180  Total Area"
"    44.000  Flow length"
"     2.000  Overland Slope"
"     0.144  Pervious Area"
"    45.000  Pervious length"
"     2.000  Pervious slope"
"     0.036  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.163  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.831  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"           0.007    0.009    0.004    0.009 c.m/sec"
"        Catchment 9          Pervious  Impervious Total Area "
"        Surface Area         0.144     0.036     0.180     hectare"
"        Time of concentration 35.724    2.866     17.299    minutes"
"        Time to Centroid      141.926   90.631    113.163   minutes"
"        Rainfall depth        32.400    32.400    32.400    mm"
"        Rainfall volume       46.66     11.66     58.32     c.m"
"        Rainfall losses       27.128    5.479     22.798    mm"
"        Runoff depth          5.273     26.921    9.602     mm"
"        Runoff volume         7.59      9.69      17.28     c.m"
"        Runoff coefficient    0.163     0.831     0.296     "
"        Maximum flow          0.002     0.007     0.007     c.m/sec"
" 40     HYDROGRAPH Add Runoff "
"       4  Add Runoff "
"           0.007    0.016    0.004    0.009"
" 33      CATCHMENT 33"
"       1  Triangular SCS"
"       3  Specify values"
"       1  SCS method"
"      33  13"
"    20.000  % Impervious"
"     0.120  Total Area"
"    23.000  Flow length"
"     2.000  Overland Slope"
"     0.096  Pervious Area"
"    45.000  Pervious length"
"     2.000  Pervious slope"
"     0.024  Impervious Area"
"    45.000  Impervious length"
"     2.000  Impervious slope"
"     0.250  Pervious Manning 'n'"
"    75.000  Pervious SCS Curve No."
"     0.163  Pervious Runoff coefficient"
"     0.100  Pervious Ia/S coefficient"
"     8.467  Pervious Initial abstraction"
"     0.015  Impervious Manning 'n'"
"    98.000  Impervious SCS Curve No."
"     0.831  Impervious Runoff coefficient"
"     0.100  Impervious Ia/S coefficient"
"     0.518  Impervious Initial abstraction"
"           0.005    0.016    0.004    0.009 c.m/sec"
"        Catchment 33         Pervious  Impervious Total Area "
"        Surface Area         0.096     0.024     0.120     hectare"
"        Time of concentration 35.724    2.866     17.299    minutes"
"        Time to Centroid      141.926   90.631    113.163   minutes"
"        Rainfall depth        32.400    32.400    32.400    mm"
"        Rainfall volume       31.10     7.78      38.88     c.m"
"        Rainfall losses       27.128    5.479     22.798    mm"
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"          Runoff depth          5.273     26.921     9.602     mm"
"          Runoff volume          5.06      6.46     11.52     c.m"
"          Runoff coefficient     0.163     0.831     0.296     "
"          Maximum flow           0.001     0.005     0.005     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"                0.005     0.021     0.004     0.009"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.005     0.021     0.021     0.009"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"                0.005     0.021     0.021     0.009"
" 57       TRENCH Design d/s of 33"
"       0.021   Peak inflow"
"      44.486   Hydrograph volume"
"      14.000   Ground elevation"
"      13.000   Downstream trench invert"
"       1.000   Trench height"
"      12.000   Water table elevation"
"       3.000   Trench top width"
"       1.800   Trench bottom width"
"      40.000   Voids ratio (%)"
"      50.000   Hydraulic conductivity"
"       0.000   Trench gradient (%)"
"     230.000   Trench length"
"       1.000   Include base width"
"         21.   Number of stages"
"               Level Discharge   Volume"
"              13.000   0.000     0.0"
"              13.050   0.000     8.6"
"              13.100   0.000     17.3"
"              13.150   0.000     26.3"
"              13.200   0.000     35.5"
"              13.250   0.000     45.0"
"              13.300   0.000     54.8"
"              13.350   0.000     64.9"
"              13.400   0.000     75.3"
"              13.450   0.000     85.9"
"              13.500   0.000     96.8"
"              13.550   0.000     108.0"
"              13.600   0.000     119.4"
"              13.650   0.000     131.1"
"              13.700   0.000     143.2"
"              13.750   0.000     155.4"
"              13.800   0.000     168.0"
"              13.850   7.015     180.8"
"              13.900   19.840    193.9"
"              13.950   36.449    207.3"
"              14.000   56.116    221.0"
"          1.  WEIRS"
"               Crest     Weir     Crest     Left      Right"
"            elevation coefficie   breadth sideslope sideslope"
"              13.800     1.600   230.000     0.000     0.000"
"          2.  TRENCH PIPES"
"           Downstream     Pipe      Pipe      Pipe Perf'ted?   Offset"
"              Invert     length    diam.     grade%    0=Yes  distance"
"              12.500     10.000    0.200     0.300     0.000     0.000"
"              13.250     3.000     0.000     0.500     1.000     0.000"
"          1.  MANHOLE"
"               Access"
"              diameter"
"                1.200"
"           Peak outflow              0.000    c.m/sec"
"           Outflow volume            0.001    c.m"
"           Peak exfiltration         0.007    c.m/sec"
"           Exfiltration volume       44.472   c.m"
"           Maximum level             13.080   metre"
"           Maximum storage           13.760   c.m"
"           Centroidal lag            2.306    hours"
```

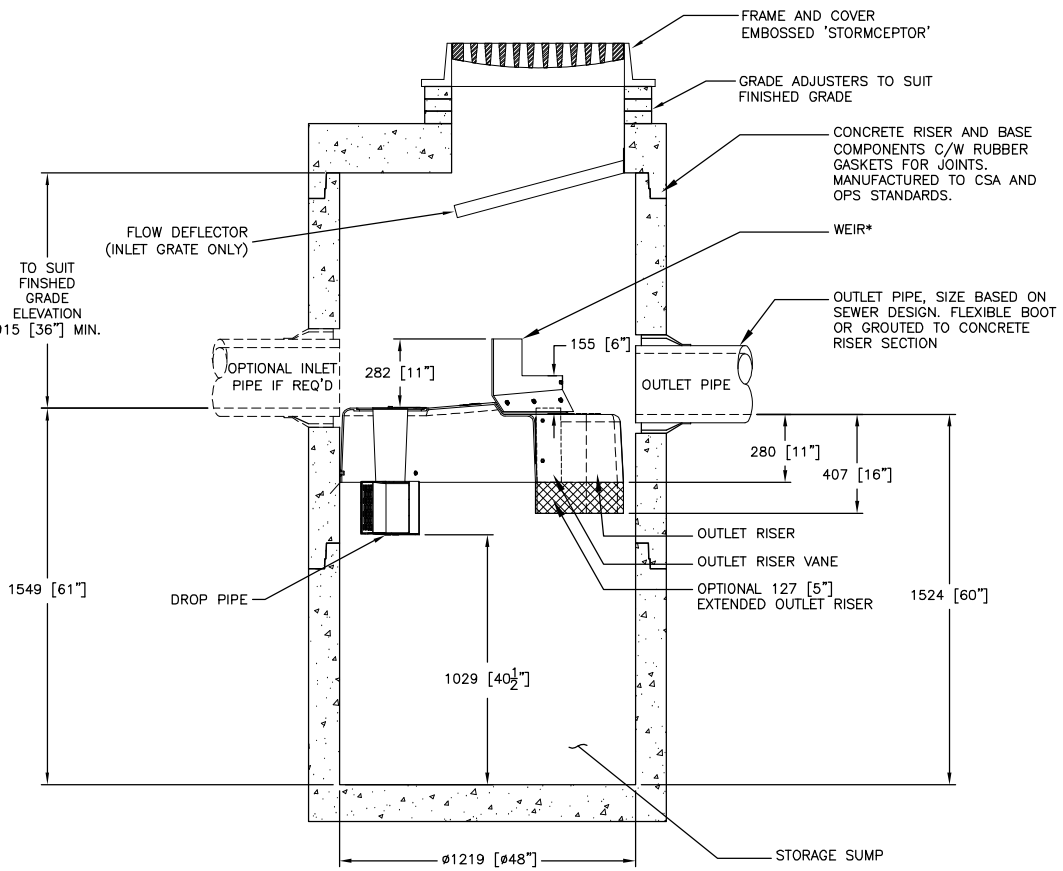


```
"          Infiltration area 2 sides   42.721   sq.metre"
"          Infiltration Base area      414.000   sq.metre"
"             0.005     0.021     0.000     0.007 c.m/sec"
" 40       HYDROGRAPH Next link "
"          5  Next link "
"                0.005     0.000     0.000     0.007"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.005     0.000     0.000     0.007"
" 40       HYDROGRAPH  Combine    100"
"          6  Combine "
"        100  Node #"
"             Laurel Creek"
"          Maximum flow              0.009    c.m/sec"
"          Hydrograph volume         488.540   c.m"
"                0.005     0.000     0.000     0.009"
" 40       HYDROGRAPH  Confluence    100"
"          7  Confluence "
"        100  Node #"
"             Laurel Creek"
"          Maximum flow              0.009    c.m/sec"
"          Hydrograph volume         488.540   c.m"
"                0.005     0.009     0.000     0.000"
" 40       HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"                0.005     0.009     0.009     0.000"
" 38       START/RE-START TOTALS 100"
"          3  Runoff Totals on EXIT"
"          Total Catchment area                 3.080    hectare"
"          Total Impervious area                1.712    hectare"
"          Total % impervious                   55.591"
" 19       EXIT"
```

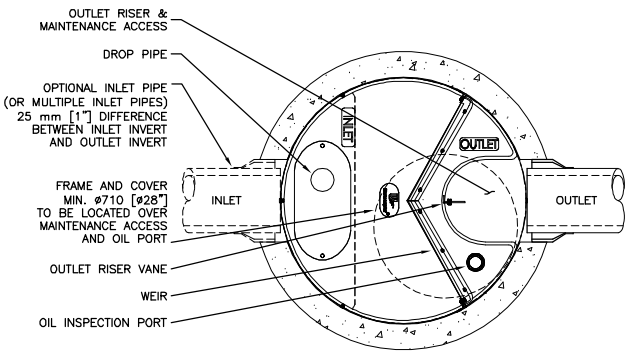


APPENDIX C:

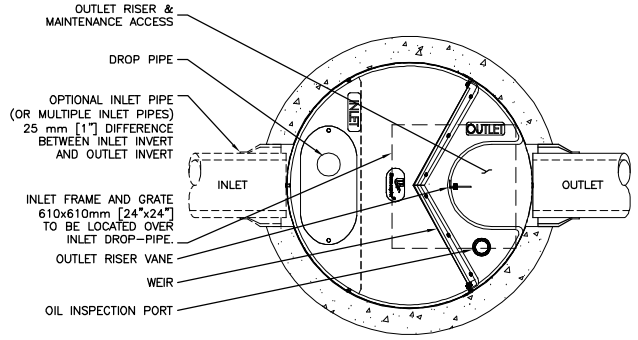
OGS Sizing Report and Specifications



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

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

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF4 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EF04 (OIL CAPTURE CONFIGURATION). WEIR HEIGHT IS 150 mm (6 INCH) FOR EF04.

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

INSTALLATION NOTES

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

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EFO4				
STRUCTURE ID					*
HYDROCARBON STORAGE REQ'D (L)					*
WATER QUALITY FLOW RATE (L/s)					*
PEAK FLOW RATE (L/s)					*
RETURN PERIOD OF PEAK FLOW (yrs)					*
DRAINAGE AREA (HA)					*
DRAINAGE AREA IMPERVIOUSNESS (%)					*
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

MARK	DATE	REVISION DESCRIPTION	BY
1	6/6/18	UPDATES	JSK
0	5/29/17	INITIAL RELEASE	JSK

Stormceptor® EF

SCALE = NTS

imbrium
401 Parkview Drive, Bowmanville, ON L1C 5A6
TF 866-868-4661 CA +1-905-623-6600 INT. +1-416-868-6666

DATE: 10/13/2017
DESIGNED: JSK | DRAWN: JSK
CHECKED: BSF | APPROVED: SP
PROJECT No.: EFO4 | SEQUENCE No.: *
SHEET: 1 OF 1

Stormceptor®

Rinker MATERIALS

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

09/13/2023

Province:	Ontario
City:	Waterloo, ON
Nearest Rainfall Station:	WATERLOO WELLINGTON AP
Climate Station Id:	6149387
Years of Rainfall Data:	34

Site Name:	Pond A

Drainage Area (ha):	1.04
% Imperviousness:	70.00

Runoff Coefficient 'c': 0.72

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	71.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	28.37
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	80.54
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	0
Estimated Average Annual Sediment Volume (L/yr):	0

Project Name:	720 Erbsville Rd Pond A
Project Number:	23014
Designer Name:	Tim Antonio
Designer Company:	Waters Edge
Designer Email:	tim@watersedge-est.ca
Designer Phone:	519-651-2390
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	49
EFO6	57
EFO8	62
EFO10	65
EFO12	67

Recommended Stormceptor EF Model: Parallel Models

Estimated Net Annual Sediment (TSS) Load Reduction (%): Parallel Models

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

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

PERFORMANCE

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

PARTICLE SIZE DISTRIBUTION (PSD)

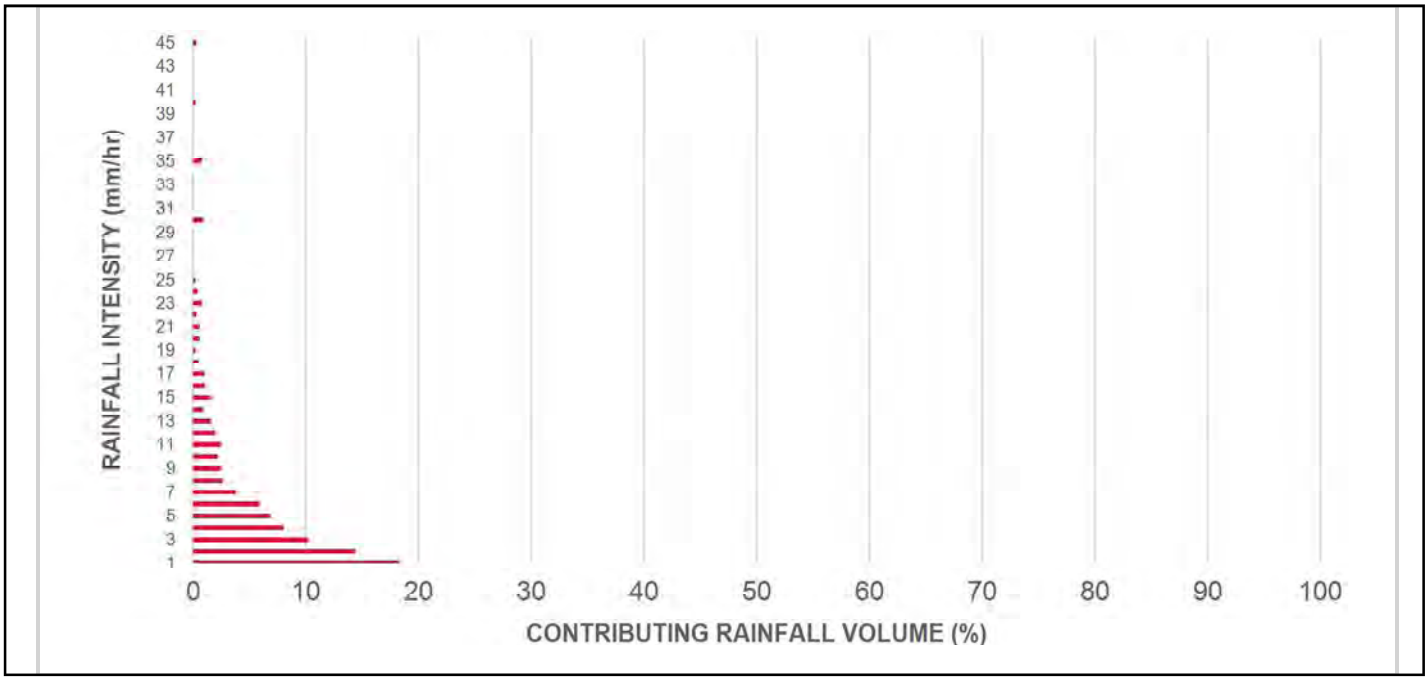
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a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

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

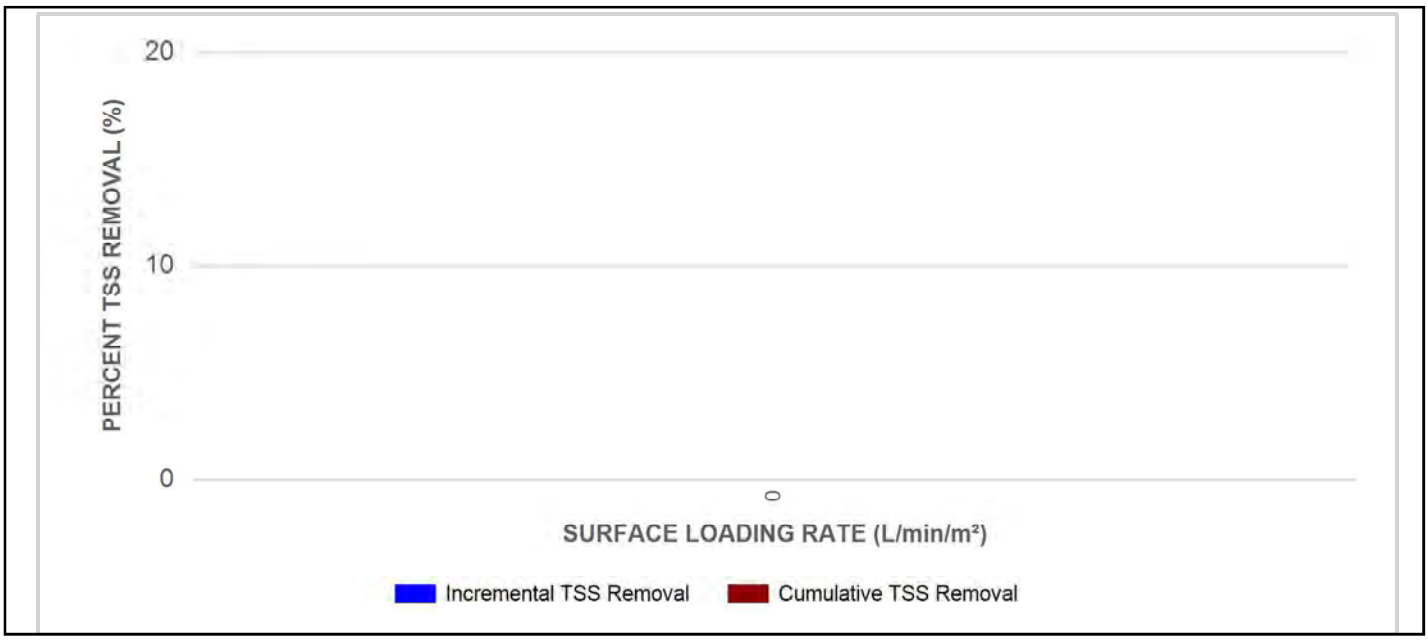
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.5	8.5	1.04	62.0	N/A	N/A	N/A	N/A
1.00	18.3	26.8	2.08	125.0	N/A	N/A	N/A	N/A
2.00	14.4	41.3	4.16	250.0	N/A	N/A	N/A	N/A
3.00	10.2	51.5	6.24	375.0	N/A	N/A	N/A	N/A
4.00	8.0	59.5	8.33	500.0	N/A	N/A	N/A	N/A
5.00	6.9	66.4	10.41	624.0	N/A	N/A	N/A	N/A
6.00	5.9	72.3	12.49	749.0	N/A	N/A	N/A	N/A
7.00	3.8	76.1	14.57	874.0	N/A	N/A	N/A	N/A
8.00	2.6	78.7	16.65	999.0	N/A	N/A	N/A	N/A
9.00	2.5	81.1	18.73	1124.0	N/A	N/A	N/A	N/A
10.00	2.2	83.3	20.82	1249.0	N/A	N/A	N/A	N/A
11.00	2.5	85.8	22.90	1374.0	N/A	N/A	N/A	N/A
12.00	2.0	87.8	24.98	1499.0	N/A	N/A	N/A	N/A
13.00	1.6	89.4	27.06	1624.0	N/A	N/A	N/A	N/A
14.00	0.9	90.4	29.14	1749.0	N/A	N/A	N/A	N/A
15.00	1.6	91.9	31.22	1873.0	N/A	N/A	N/A	N/A
16.00	1.1	93.0	33.31	1998.0	N/A	N/A	N/A	N/A
17.00	1.0	94.0	35.39	2123.0	N/A	N/A	N/A	N/A
18.00	0.5	94.6	37.47	2248.0	N/A	N/A	N/A	N/A
19.00	0.2	94.8	39.55	2373.0	N/A	N/A	N/A	N/A
20.00	0.6	95.4	41.63	2498.0	N/A	N/A	N/A	N/A
21.00	0.6	96.1	43.71	2623.0	N/A	N/A	N/A	N/A
22.00	0.3	96.4	45.80	2748.0	N/A	N/A	N/A	N/A
23.00	0.8	97.2	47.88	2873.0	N/A	N/A	N/A	N/A
24.00	0.4	97.6	49.96	2998.0	N/A	N/A	N/A	N/A
25.00	0.2	97.8	52.04	3122.0	N/A	N/A	N/A	N/A
30.00	0.9	98.7	62.45	3747.0	N/A	N/A	N/A	N/A
35.00	0.8	99.5	72.86	4371.0	N/A	N/A	N/A	N/A
40.00	0.2	99.7	83.27	4996.0	N/A	N/A	N/A	N/A
45.00	0.3	100.0	93.67	5620.0	N/A	N/A	N/A	N/A
Estimated Net Annual Sediment (TSS) Load Reduction =								**0 %**

Climate Station ID: 6149387 *Years of Rainfall Data*: 34

RAINFALL DATA FROM WATERLOO WELLINGTON AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

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

SCOUR PREVENTION AND ONLINE CONFIGURATION

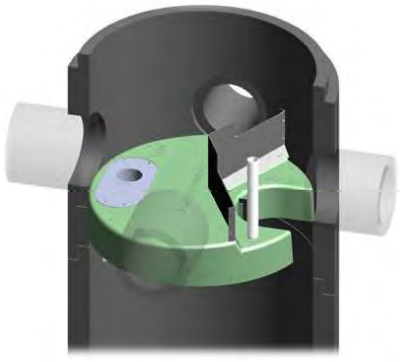
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test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

DESIGN FLEXIBILITY

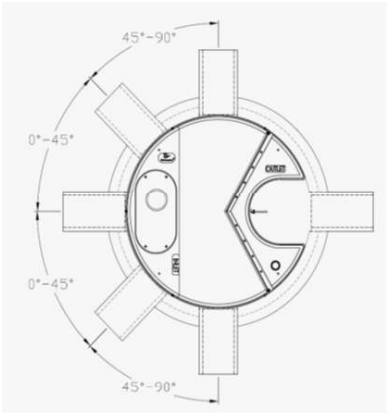
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend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

OIL CAPTURE AND RETENTION

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







INLET-TO-OUTLET DROP

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

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

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

HEAD LOSS

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

Pollutant Capacity

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

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

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

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

STANDARD STORMCEPTOR EF/EFO DRAWINGS

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

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

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

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

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

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

PART 1 – GENERAL

1.1 WORK INCLUDED

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

1.2 REFERENCE STANDARDS & PROCEDURES

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

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

1.3 SUBMITTALS

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

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

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

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

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

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

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

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

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

3.2 SIZING METHODOLOGY

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

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

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

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

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

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

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

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

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

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

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

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

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

Stormceptor® Rinker MATERIALS

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

09/13/2023

Province:	Ontario
City:	Waterloo, ON
Nearest Rainfall Station:	WATERLOO WELLINGTON AP
Climate Station Id:	6149387
Years of Rainfall Data:	34

Site Name:	

Drainage Area (ha):	1.55
% Imperviousness:	70.00

Runoff Coefficient 'c': 0.72

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	71.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	42.28
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	0
Estimated Average Annual Sediment Volume (L/yr):	0

Project Name:	720 Erbsville Rd Pond B
Project Number:	23014
Designer Name:	Tim Antonio
Designer Company:	Waters Edge
Designer Email:	tim@watersedge-est.ca
Designer Phone:	519-651-2390
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	44
EFO6	53
EFO8	59
EFO10	62
EFO12	64

Recommended Stormceptor EF Model: Parallel Models

Estimated Net Annual Sediment (TSS) Load Reduction (%): Parallel Models

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

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

PERFORMANCE

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

PARTICLE SIZE DISTRIBUTION (PSD)

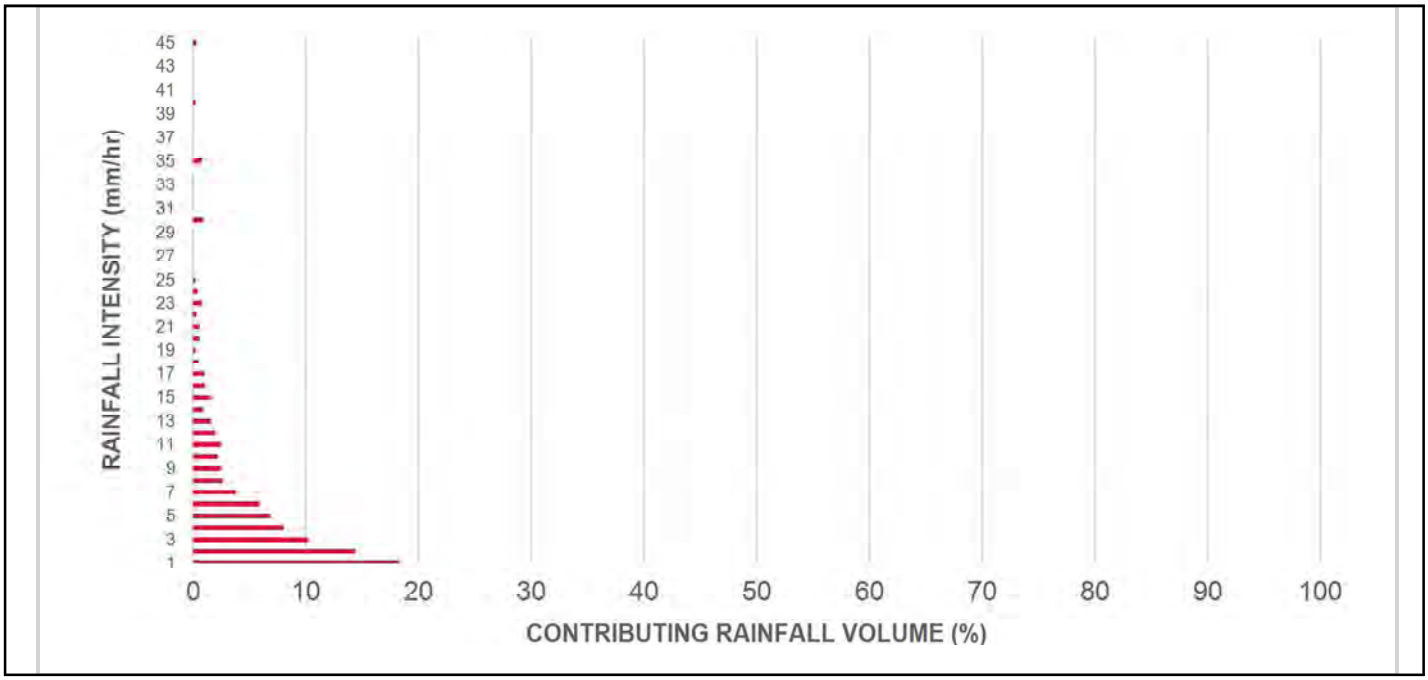
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a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

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

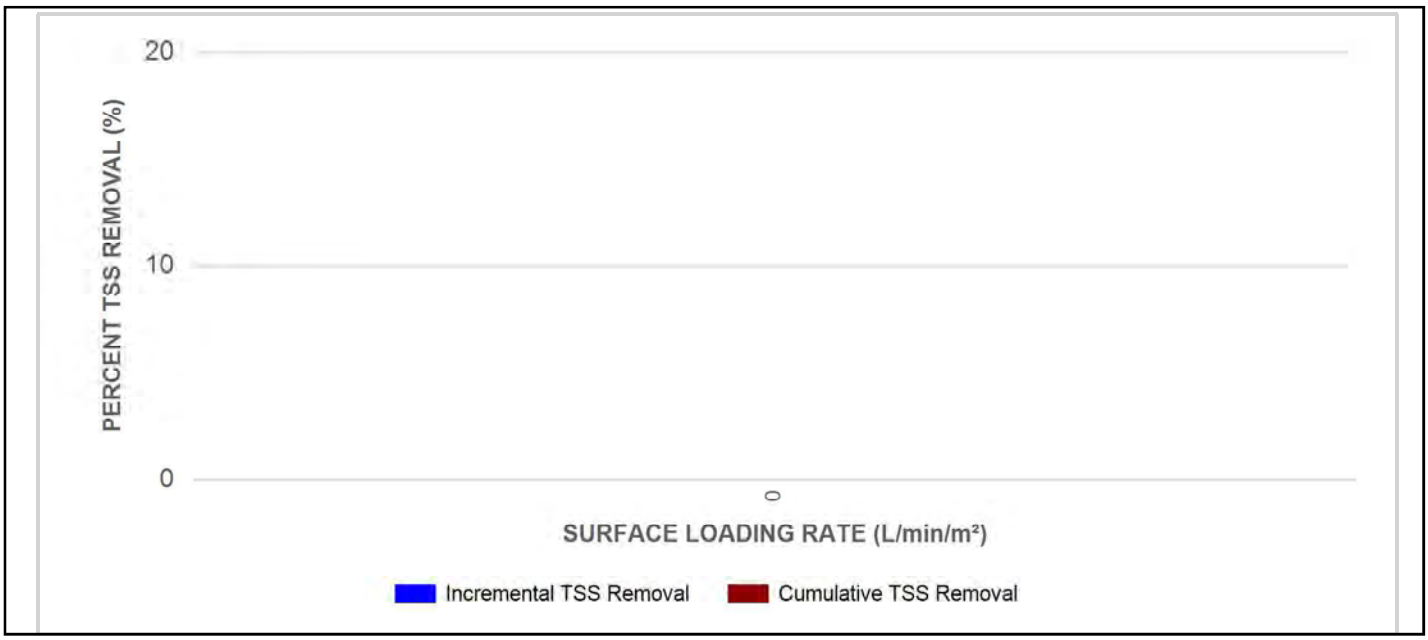
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.5	8.5	1.55	93.0	N/A	N/A	N/A	N/A
1.00	18.3	26.8	3.10	186.0	N/A	N/A	N/A	N/A
2.00	14.4	41.3	6.20	372.0	N/A	N/A	N/A	N/A
3.00	10.2	51.5	9.31	558.0	N/A	N/A	N/A	N/A
4.00	8.0	59.5	12.41	745.0	N/A	N/A	N/A	N/A
5.00	6.9	66.4	15.51	931.0	N/A	N/A	N/A	N/A
6.00	5.9	72.3	18.61	1117.0	N/A	N/A	N/A	N/A
7.00	3.8	76.1	21.72	1303.0	N/A	N/A	N/A	N/A
8.00	2.6	78.7	24.82	1489.0	N/A	N/A	N/A	N/A
9.00	2.5	81.1	27.92	1675.0	N/A	N/A	N/A	N/A
10.00	2.2	83.3	31.02	1861.0	N/A	N/A	N/A	N/A
11.00	2.5	85.8	34.13	2048.0	N/A	N/A	N/A	N/A
12.00	2.0	87.8	37.23	2234.0	N/A	N/A	N/A	N/A
13.00	1.6	89.4	40.33	2420.0	N/A	N/A	N/A	N/A
14.00	0.9	90.4	43.43	2606.0	N/A	N/A	N/A	N/A
15.00	1.6	91.9	46.54	2792.0	N/A	N/A	N/A	N/A
16.00	1.1	93.0	49.64	2978.0	N/A	N/A	N/A	N/A
17.00	1.0	94.0	52.74	3165.0	N/A	N/A	N/A	N/A
18.00	0.5	94.6	55.84	3351.0	N/A	N/A	N/A	N/A
19.00	0.2	94.8	58.95	3537.0	N/A	N/A	N/A	N/A
20.00	0.6	95.4	62.05	3723.0	N/A	N/A	N/A	N/A
21.00	0.6	96.1	65.15	3909.0	N/A	N/A	N/A	N/A
22.00	0.3	96.4	68.25	4095.0	N/A	N/A	N/A	N/A
23.00	0.8	97.2	71.36	4281.0	N/A	N/A	N/A	N/A
24.00	0.4	97.6	74.46	4468.0	N/A	N/A	N/A	N/A
25.00	0.2	97.8	77.56	4654.0	N/A	N/A	N/A	N/A
30.00	0.9	98.7	93.07	5584.0	N/A	N/A	N/A	N/A
35.00	0.8	99.5	108.59	6515.0	N/A	N/A	N/A	N/A
40.00	0.2	99.7	124.10	7446.0	N/A	N/A	N/A	N/A
45.00	0.3	100.0	139.61	8377.0	N/A	N/A	N/A	N/A
Estimated Net Annual Sediment (TSS) Load Reduction =								**0 %**

Climate Station ID: 6149387 *Years of Rainfall Data*: 34

RAINFALL DATA FROM WATERLOO WELLINGTON AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

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

SCOUR PREVENTION AND ONLINE CONFIGURATION

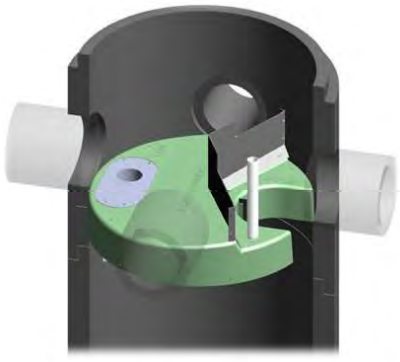
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test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

DESIGN FLEXIBILITY

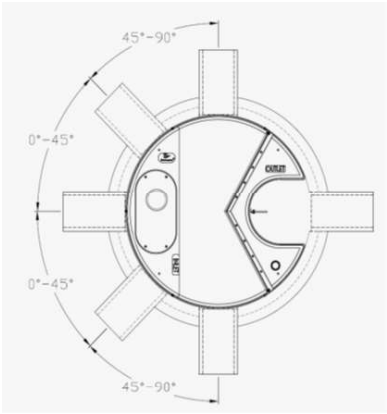
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend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

OIL CAPTURE AND RETENTION

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







INLET-TO-OUTLET DROP

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

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

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

HEAD LOSS

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

Pollutant Capacity

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

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

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

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

STANDARD STORMCEPTOR EF/EFO DRAWINGS

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

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

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

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

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

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

PART 1 – GENERAL

1.1 WORK INCLUDED

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

1.2 REFERENCE STANDARDS & PROCEDURES

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

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

1.3 SUBMITTALS

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

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

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

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

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

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

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

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

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

3.2 SIZING METHODOLOGY

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

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

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

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

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

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

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

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

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

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

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

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

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



APPENDIX D:

Water Balance Summary

720 Erbsville Rd, WATERLOO, ON

Water Budget Summary

January 10, 2024

Without Infiltration Mitigation

Description	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Recharge (m3)													
Pre-Development	6946.9	178	90	44	883	2379	1190	595	297	149	76	711	355
Post-Development	2792.2	72	36	18	355	957	478	239	120	60	30	286	143
Difference	**-4154.7**	-107	-54	-26	-528	-1423	-711	-356	-178	-89	-46	-425	-212
% change	-60%	-60%	-60%	-60%	-60%	-60%	-60%	-60%	-60%	-60%	-61%	-60%	-60%
Runoff (m3)													
Pre-Development	118.9	119	60	29	589	1586	793	397	198	99	51	474	237
Post-Development	17050	48	24	12	5654	2002	1685	1794	1470	1495	1137	1634	95
Difference	12419.0	-71	-36	-18	5065	416	892	1397	1272	1396	1087	1160	-142
% change	10441%	-60%	-60%	-60%	861%	26%	112%	352%	642%	1408%	2151%	245%	-60%

With Infiltration Mitigation

Description	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Recharge (m3)													
Pre-Development	6946.9	178	90	44	883	2379	1190	595	297	149	76	711	355
Post-Development with Mitigation	6906.3	72	36	18	1822	1326	848	682	496	454	333	677	143
Difference	**-40.6**	-106.7	-53.9	-26.4	939.4	-1053.3	-341.4	87.0	198.9	305.3	256.7	-33.9	-212.3
% change	-1%	-60%	-60%	-60%	106%	-44%	-29%	15%	67%	205%	339%	-5%	-60%
Runoff (m3)													
Pre-Development	4631	119	60	29	589	1586	793	397	198	99	51	474	237
Post-Development withn mitigation	10254	66	33	16	3070	1568	1130	1047	814	792	593	993	131
Difference	5623.0	-53.2	-26.9	-13.2	2481.2	-18.3	337.3	650.7	615.9	693.0	542.9	519.6	-105.8
% change	121%	-45%	-45%	-45%	422%	-1%	43%	164%	311%	699%	1075%	110%	-45%

720 Erbsville Rd, WATERLOO, ON

Pre-Development Water Budget Calculations

November 23, 2023

Water Balance Method (Thornthwaite & Mather, 1957)

Precipitation: Waterloo-Wellington Normals (1966-1990), Vegetation: Moderately Rooted Crops, Soil: Silty Sand Loam

Description	Units	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Temperature	deg C	**7.01**	-6.5	-5.5	-1.0	6.2	12.5	17.6	20.0	18.9	14.5	8.2	2.5	-3.3
Heat Index (i)	-	**35.23**	0.00	0.00	0.00	1.38	4.00	6.72	8.16	7.49	5.01	2.11	0.35	0.00
UPET (unadjusted PET)	mm/day	**1.040**	0.00	0.00	0.00	0.94	1.96	2.80	3.19	3.01	2.29	1.26	0.37	0.00
Latitude correction for 43.5 deg (r)	-		24.3	24.4	30.6	33.6	38	38.6	38.9	36	31.2	28.5	24.1	22.9
PET (Potential ET)	mm	**563.0**	0.0	0.0	0.0	31.7	74.4	107.9	124.3	108.4	71.3	36.0	8.8	0.0
Precipitation	mm	**916.3**	65.2	54.9	61	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.1	71.2
P - PET	mm		65.2	54.9	61.0	42.8	7.9	-25.5	-25.7	-24.5	16.5	31.4	78.3	71.2
Accum. Water Loss	mm						0.0	-25.5	-51.2	-75.7				
Soil Moisture Retention (Storage)	mm		150.0	150.0	150.0	150.0	150.0	127.0	100.0	91.0	109.8	144.6	150.0	150.0
Storage Change	mm		0.0	0.0	0.0	0.0	0.0	-23.0	-27.0	-9.0	18.8	34.8	5.4	0.0
AET (Actual ET)	mm	**546.1**	0.0	0.0	0.0	31.7	74.4	105.4	125.6	92.9	71.3	36.0	8.8	0.0
Water Balance as Surplus/Deficit	mm	**370.2**	65.2	54.9	61.0	42.8	7.9	-23.0	-27.0	-9.0	16.5	31.4	78.3	71.2
Determination of Water Balance as 'Combined-Runoff' (Recharge + Direct Runoff) - (using WBM Assumptions)														
Soil Moisture Surplus (SMS)	mm	**117.9**	0.0	0.0	0.0	42.8	7.9	0.0	0.0	0.0	-2.3	-3.4	72.9	0.0
Water Balance from SMS (Assumption 1)	mm	**123.5**	9.2	4.6	2.3	22.5	15.2	7.6	3.8	1.9	1.0	0.5	36.7	18.3
Accumulated Snow Availability (Assumption 2)	mm	**252.3**	0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Balance from Snow (Assumption 3)	mm	**252.3**	0.5	0.3	0.1	25.2	113.5	56.8	28.4	14.2	7.1	3.5	1.8	0.9
Water Balance as 'Combined-Runoff'	mm	**375.9**	9.7	4.9	2.4	47.8	128.8	64.4	32.2	16.1	8.0	4.1	38.5	19.2

Assumptions for Monthly 'Combined-Runoff' Estimations (from WBM):

1 - Combined 'Runoff' from the Soil Moisture Surplus is assumed to be 50% in the first month and then 50% of the remaining soil surplus each following month.

2 - All Snow is Accumulated and Stored throughout Winter Sub-Zero Months (i.e. No melt until first above-zero month)

3 - Combined 'Runoff' from Snowmelt is assumed to be 10% of the Accumulated Snow in the first month and then 50% of the remaining snowmelt in each following month.

MECP Infiltration Factors

Topography		Soil		Cover		Sum of Factors
Hilly	0.10	Open Sandy Loam	0.40	Cultivated	0.10	**60%**

Assumptions for Evapotranspiration/Recharge/Runoff Proportioning:

1 - Pervious Areas - by MOE Infiltration Factor Method (MOE SWM P&DM 2003 - Table 3.1)

RECHARGE: Pre-Development to Wetland

Catchment	Area (m^2)	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Recharge (Based on MECP Inf. Factors)		**225.5**	5.8	2.9	1.4	28.7	77.3	38.6	19.3	9.7	4.8	2.5	23.1	11.5	mm
101 - Pervious	30800	**6946.9**	178.4	90.1	44.1	882.8	2379.4	1189.7	594.8	297.4	148.7	75.8	710.6	355.0	m^3
TOTAL	30800	**6946.9**	178.4	90.1	44.1	882.8	2379.4	1189.7	594.8	297.4	148.7	75.8	710.6	355.0	m^3

RUNOFF: Pre-Development to Wetland

Catchment	Area (m^2)	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Runoff (Based on MECP Inf. Factors)		**150.4**	3.9	2.0	1.0	19.1	51.5	25.8	12.9	6.4	3.2	1.6	15.4	7.7	mm
101 - Pervious	30800	**4631.2**	118.9	60.1	29.4	588.5	1586.3	793.1	396.6	198.3	99.1	50.5	473.7	236.6	m^3
TOTAL	30800	**4631.2**	118.9	60.1	29.4	588.5	1586.3	793.1	396.6	198.3	99.1	50.5	473.7	236.6	m^3

Assumptions for Recharge/Runoff Proportioning:

1 - Pervious Areas - by MOE Infiltration Factor Method (MOE 1995, 2003)

2 - Impervious Areas - Assume 10% lost to Evapotranspiration

water's edge
ENVIRONMENTAL SOLUTIONS TEAM

720 Erbsville Rd, WATERLOO, ON

Post-Development Water Budget Calculations

November 23, 2023

Determination of Evapotranspiration and Water Balance Components - by Water Balance Method (Thornthwaite & Mather, 1957)

Precipitation: Waterloo-Wellington Normals (1966-1990), Vegetation: Mature Grasses with Trees/Shubs, Soil: Silty Sand Loam

Vegetation/Soil: Mature Grasses with Trees & Shubs / Silty Sand Loam

Pervious Areas: Hilly lawns and grassed pasture with Trees and Shubs

Description	Units	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Temperature	deg C	**7.01**	-6.5	-5.5	-1.0	6.2	12.5	17.6	20.0	18.9	14.5	8.2	2.5	-3.3
Heat Index (i)	-	**35.23**	0.00	0.00	0.00	1.38	4.00	6.72	8.16	7.49	5.01	2.11	0.35	0.00
UPET (unadjusted PET)	mm/day	**1.040**	0.00	0.00	0.00	0.94	1.96	2.80	3.19	3.01	2.29	1.26	0.37	0.00
Latitude correction for 43.5 deg (r)	-		24.3	24.4	30.6	33.6	38	38.6	38.9	36	31.2	28.5	24.1	22.9
PET (Potential ET)	mm	**563.0**	0.0	0.0	0.0	31.7	74.4	107.9	124.3	108.4	71.3	36.0	8.8	0.0
Precipitation	mm	**916.3**	65.2	54.9	61	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.1	71.2
P - PET	mm		65.2	54.9	61.0	42.8	7.9	-25.5	-25.7	-24.5	16.5	31.4	78.3	71.2
Accum. Water Loss	mm						0.0	-25.5	-51.2	-75.7				
Soil Moisture Retention (Storage)	mm		150.0	150.0	150.0	150.0	150.0	127.0	100.0	91.0	109.8	144.6	150.0	150.0
Storage Change	mm		0.0	0.0	0.0	0.0	0.0	-23.0	-27.0	-9.0	18.8	34.8	5.4	0.0
AET (Actual ET)	mm	**546.1**	0.0	0.0	0.0	31.7	74.4	105.4	125.6	92.9	71.3	36.0	8.8	0.0
Water Balance as Surplus/Deficit	mm	**370.2**	65.2	54.9	61.0	42.8	7.9	-23.0	-27.0	-9.0	16.5	31.4	78.3	71.2
Determination of Water Balance as 'Combined-Runoff' (Recharge + Direct Runoff) - (using WBM Assumptions)														
Soil Moisture Surplus (SMS)	mm	**117.9**	0.0	0.0	0.0	42.8	7.9	0.0	0.0	0.0	-2.3	-3.4	72.9	0.0
Water Balance from SMS (Assumption 1)	mm	**123.5**	9.2	4.6	2.3	22.5	15.2	7.6	3.8	1.9	1.0	0.5	36.7	18.3
Accumulated Snow (Assumption 2)	mm	**252.3**	0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Balance from Snow (Assumption 3)	mm	**252.3**	0.5	0.3	0.1	25.2	113.5	56.8	28.4	14.2	7.1	3.5	1.8	0.9
Water Balance as 'Combined-Runoff'	mm	**375.8**	9.7	4.9	2.4	47.8	128.8	64.4	32.2	16.1	8.0	4.0	38.5	19.2

Assumptions for Monthly 'Combined-Runoff' Estimations (from WBM):

1 - Combined 'Runoff' from the Soil Moisture Surplus is assumed to be 50% in the first month and then 50% of the remaining soil surplus each following month.

2 - All Snow is Accumulated and Stored throughout Winter Sub-Zero Months (i.e. No melt until first above-zero month)

3 - Combined 'Runoff' from Snowmelt is assumed to be 10% of the Accumulated Snow in the first month and then 50% of the remaining snowmelt in each following month.

MECP Infiltration Factors						
Topography		Soil		Cover		Sum of Factors
Hilly	0.10	Open Sandy Loam	0.40	Cultivated	0.10	**60%**

Assumptions for Evapotranspiration/Recharge/Runoff Proportioning:

1 - Pervious Areas - by MOE Infiltration Factor Method (MOE SWM P&DM 2003 - Table 3.1)

RECHARGE: Post-Development to Wetland

Catchment	Area (m2)	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Recharge (Based on MECP Inf. Factors)		**226**	5.8	2.9	1.4	28.7	77.3	38.6	19.3	9.7	4.8	2.4	23.1	11.5
Snow melt (impervious areas)			0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pervious Areas	12382	**2792**	71.7	36.2	17.7	354.9	956.5	478.3	239.1	119.6	59.8	29.9	285.7	142.7
Impervious Areas (Roofs, Driveways, Ponds)	18418	**0**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TOTAL	30800	**2792**	71.7	36.2	17.7	354.9	956.5	478.3	239.1	119.6	59.8	29.9	285.7	142.7

RUNOFF: Post-Development to Wetland

Catchment	Area (m2)	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Runoff (Based on MECP Inf. Factors)		**150**	3.9	2.0	1.0	19.1	51.5	25.8	12.9	6.4	3.2	1.6	15.4	7.7
Snow melt (impervious areas)			0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
201A - Pervious	12382	**1861**	47.8	24.2	11.8	236.6	637.7	318.8	159.4	79.7	39.9	19.9	190.4	95.1
Impervious Areas	18418	**15189**	0.0	0.0	0.0	5417.1	1364.2	1365.9	1634.4	1390.7	1455.4	1117.2	1443.8	0.0
TOTAL	30800	**17050**	47.8	24.2	11.8	5653.7	2001.9	1684.7	1793.8	1470.5	1495.2	1137.2	1634.2	95.1

water's edge
ENVIRONMENTAL SOLUTIONS TEAM

720 Erbsville Rd, WATERLOO, ON

Post-Development (with mitigation) Water Budget Calculations

January 9 2024

Determination of Evapotranspiration and Water Balance Components - by Water Balance Method (Thornthwaite & Mather, 1957)

Precipitation: Waterloo-Wellington Normals (1966-1990), Vegetation: Mature Grasses with Trees/Shubs, Soil: Silty Sand Loam
Vegetation/Soil: Mature Grasses with Trees & Shubs / Silty Sand Loam
Pervious Areas: Hilly lawns and grassed pasture with Trees and Shubs

Description	Units	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Temperature	deg C	**7.01**	-6.5	-5.5	-1.0	6.2	12.5	17.6	20.0	18.9	14.5	8.2	2.5	-3.3
Heat Index (i)	-	**35.23**	0.00	0.00	0.00	1.38	4.00	6.72	8.16	7.49	5.01	2.11	0.35	0.00
UPET (unadjusted PET)	mm/day	**1.040**	0.00	0.00	0.00	0.94	1.96	2.80	3.19	3.01	2.29	1.26	0.37	0.00
Latitude correction for 43.5 deg (r)	-		24.3	24.4	30.6	33.6	38	38.6	38.9	36	31.2	28.5	24.1	22.9
PET (Potential ET)	mm	**563.0**	0.0	0.0	0.0	31.7	74.4	107.9	124.3	108.4	71.3	36.0	8.8	0.0
Precipitation	mm	**916.3**	65.2	54.9	61	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.1	71.2
P - PET	mm		65.2	54.9	61.0	42.8	7.9	-25.5	-25.7	-24.5	16.5	31.4	78.3	71.2
Accum. Water Loss	mm						0.0	-25.5	-51.2	-75.7				
Soil Moisture Retention (Storage)	mm		150.0	150.0	150.0	150.0	150.0	127.0	100.0	91.0	109.8	144.6	150.0	150.0
Storage Change	mm		0.0	0.0	0.0	0.0	0.0	-23.0	-27.0	-9.0	18.8	34.8	5.4	0.0
AET (Actual ET)	mm	**546.1**	0.0	0.0	0.0	31.7	74.4	105.4	125.6	92.9	71.3	36.0	8.8	0.0
Water Balance as Surplus/Deficit	mm	**370.2**	65.2	54.9	61.0	42.8	7.9	-23.0	-27.0	-9.0	16.5	31.4	78.3	71.2
Determination of Water Balance as 'Combined-Runoff' (Recharge + Direct Runoff) - (using WBM Assumptions)														
Soil Moisture Surplus (SMS)	mm	**117.9**	0.0	0.0	0.0	42.8	7.9	0.0	0.0	0.0	-2.3	-3.4	72.9	0.0
Water Balance from SMS (Assumption 1)	mm	**123.5**	9.2	4.6	2.3	22.5	15.2	7.6	3.8	1.9	1.0	0.5	36.7	18.3
Accumulated Snow (Assumption 2)	mm	**252.3**	0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Balance from Snow (Assumption 3)	mm	**252.3**	0.5	0.3	0.1	25.2	113.5	56.8	28.4	14.2	7.1	3.5	1.8	0.9
Water Balance as 'Combined-Runoff'	mm	**375.8**	9.7	4.9	2.4	47.8	128.8	64.4	32.2	16.1	8.0	4.0	38.5	19.2

Assumptions for Monthly 'Combined-Runoff' Estimations (from WBM):

1 - Combined 'Runoff' from the Soil Moisture Surplus is assumed to be 50% in the first month and then 50% of the remaining soil surplus each following month.

2 - All Snow is Accumulated and Stored throughout Winter Sub-Zero Months (i.e. No melt until first above-zero month)

3 - Combined 'Runoff' from Snowmelt is assumed to be 10% of the Accumulated Snow in the first month and then 50% of the remaining snowmelt in each following month.

MECP Infiltration Factors						
Topography		Soil		Cover		Sum of Factors
Hilly	0.10	Open Sandy Loam	0.40	Cultivated	0.10	**60%**

Assumptions for Evapotranspiration/Recharge/Runoff Proportioning:

1 - Pervious Areas - by MOE Infiltration Factor Method (MOE SWM P&DM 2003 - Table 3.1)

RECHARGE: Post-Development to Wetland

Catchment	Area (m2)	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Recharge (Based on MECP Inf. Factors)		**225.5**	5.8	2.9	1.4	28.7	77.3	38.6	19.3	9.7	4.8	2.4	23.1	11.5	
Snow melt (impervious areas)			0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Pervious Areas for Total Property	12382	**2792.2**	71.7	36.2	17.7	354.9	956.5	478.3	239.1	119.6	59.8	29.9	285.7	142.7	
Rear Lots Roofs 4, 9, 13 directed to infiltration swale	1143	**942.6**	0.0	0.0	0.0	336.2	84.7	84.8	101.4	86.3	90.3	69.3	89.6	0.0	100% infiltrated, remainder is runoff
Rooftops directed to infiltration gallery	5325	**3171.5**	0.0	0.0	0.0	1131.1	284.9	285.2	341.3	290.4	303.9	233.3	301.5	0.0	65% infiltration gallery
Impervious area - no infiltration	11950	**0.0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
TOTAL	30800	**6906.3**	71.7	36.2	17.7	1822.2	1326.1	848.2	681.8	496.3	454.0	332.5	676.7	142.7	100%

RUNOFF: Post-Development to Wetland

Catchment	Area (m2)	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Runoff (Based on MECP Inf. Factors)		**150.3**	3.9	2.0	1.0	19.1	51.5	25.8	12.9	6.4	3.2	1.6	15.4	7.7	
Snow melt (impervious areas)			0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Laurel Creek Streamflow avg (GRCA data) (2021-2023) (CMS)						0.3	0.1	0.1	0.1	0.1	0.1				
Average Monthly Quantity of Laurel Creek Stream flow (m^3)						698945	386643	230477	243537	204490	322676				
Drainage Volume Pond A (m3)	10014.0	**4972.2**	12.3	6.2	3.1	1663.0	568.0	486.2	524.5	431.9	440.7	335.5	476.1	24.6	
% of average volume flow for Laurel Creek	n/a					0.24%	0.15%	0.21%	0.22%	0.21%	0.14%				
Pervious Area Pond A	3196.0	**480.5**	12.3	6.2	3.1	61.1	164.6	82.3	41.1	20.6	10.3	5.1	49.2	24.6	
Impervious Area Pond A	6818.0	**4491.7**	0.0	0.0	0.0	1602.0	403.4	403.9	483.3	411.3	430.4	330.4	427.0	0.0	
Rooftops draining to infiltration Galleries	2244.0	**719.7**	0.0	0.0	0.0	256.7	64.6	64.7	77.4	65.9	69.0	52.9	68.4	0.0	35% diverted away
Remaining impervious (Pond A & sidewalk/pavement)	4574.0	**3772.0**	0.0	0.0	0.0	1345.3	338.8	339.2	405.9	345.4	361.4	277.5	358.6	0.0	from infiltration galleries
Drainage Volume Pond B (m3)	16196.0	**4763.9**	40.1	20.3	9.9	1340.8	822.4	555.4	478.3	360.1	340.3	252.3	464.2	79.8	
% of average volume flow for Laurel Creek	n/a					0.19%	0.21%	0.24%	0.20%	0.18%	0.11%				
Pervious Area Pond B	10382.0	**1560.8**	40.1	20.3	9.9	198.4	534.7	267.3	133.7	66.8	33.4	16.7	159.7	79.8	
Impervious Area Pond B	5814.0	**3203.1**	0.0	0.0	0.0	1142.4	287.7	288.0	344.7	293.3	306.9	235.6	304.5	0.0	
Rooftops draining into infilitration Galleries	3158.0	**1012.8**	0.0	0.0	0.0	361.2	91.0	91.1	109.0	92.7	97.0	74.5	96.3	0.0	35% diverted away
Remaining impervious (Pond A & sidewalk/pavement)	2656.0	**2190.3**	0.0	0.0	0.0	781.2	196.7	197.0	235.7	200.6	209.9	161.1	208.2	0.0	from infiltration galleries
Catchment 2 Draining to Creek Volume (m3)	400.0	**60.1**	1.5	0.8	0.4	7.6	20.6	10.3	5.2	2.6	1.3	0.6	6.2	3.1	
% of average volume flow for Laurel Creek	n/a					0.00%	0.01%	0.00%	0.00%	0.00%	0.00%				
Rear Lots 4,9,13	4190.0	**458.1**	11.8	5.9	2.9	58.2	156.9	78.5	39.2	19.6	9.8	4.9	46.9	23.4	
Rear Lots Roofs 4, 9, 13 directed to infiltration swale	1143.0	**0.0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Rear Lots pervious Area	3047.0	**458.1**	11.8	5.9	2.9	58.2	156.9	78.5	39.2	19.6	9.8	4.9	46.9	23.4	
TOTAL (sum of blue)	30800	10254	66	33	16	3070	1568	1130	1047	814	792	593	993	131	100%

Assumptions for Recharge/Runoff proportioning:

1 - Pervious Areas - by MOE Infiltration Factor Method (MOE 1995, 2003).

2 - Impervious Areas - Assume 10% lost to Evapotranspiration.

3 - Infiltration gallery (per Toronto Wet Weather Flow Management Guidelines):

4 - All rear draining roofs of east lots (catchment 4,9,13) drain into infiltration swale except 10% is assumed to evaporate

5- All rear draining roofs of east lots (catchment 4,9,13) drain into infiltration swale assume no runnoff to wetland

6 - 65% rain from remaining rooftop areas is infiltrated in infiltration galleries and remainder (35% goes to runnoff in wetland)