Stormwater Management Report for

Just Store It

2495 Spragues Road,

Township of North Dumfries, Ontario

November 27, 2024

Project Reference Number 22-304

K. SMART ASSOCIATES LIMITED

CONSULTING ENGINEERS & PLANNERS

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Introduction

This Stormwater Management Report provides details on the stormwater management design for the proposed development at 2495 Sprague Road in the Township of North Dumfries, Region of Waterloo, Ontario.

The subject property is currently developed with one building providing self-storage services and five outdoor storage containers at the rear of the building. It is proposed to expand the storage unit business and construct five additional storage buildings on the vacant portion of the site.

Background Information

The subject property is located on the east side of Sprague Road and north of Brant Waterloo Road. The property is currently zoned rural residential with site specific exemption 20.1.206 permitting self-storage facility use. It is bounded by vacant agricultural lands to the north and east, residential lands to the south and the Hillside Lake Park Family Campground to the west.

The site location is shown in Figure 1.

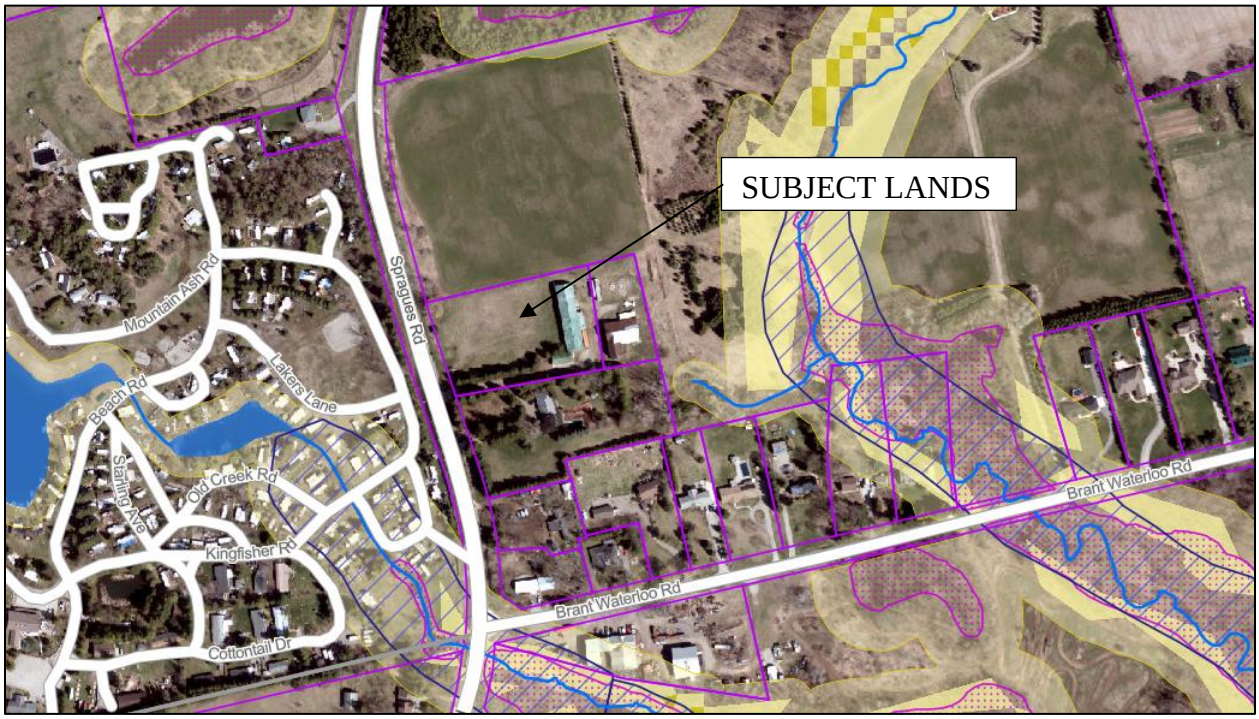

Figure 1: Location of 2495 Sprague Road, Township of North Dumfries (GRCA Interactive Mapping)

Geotechnical Information

A Geotechnical Investigation completed for the site by LVM Inc. dated July 12, 2011 identified soils as brown silt, underlain by brown sand with some dark brown fibrous peat encountered at the test pits at the south and west area of the site. Groundwater was present in the boreholes west of the building at a depth of 1.5m. Based on a particle size distribution analysis conducted on a sample of the surficial fill on the western area of the site, the percolation rate was determined to be 30 mm/hr. The Geotechnical Report is included in Appendix A.

Existing Site Drainage Conditions

There is an external area north of the site that flows overland, across the subject lands, toward the existing road ditch southwest of the site. The subject property generally slopes to the west, draining overland toward the existing road ditch. There are no on-site storm sewers or any stormwater management components to the existing drainage system.

Proposed Site Drainage Conditions

The proposed development consists of five additional storage buildings west of the existing building.

To provide conveyance for the runoff from the external lands, it is proposed to install storm sewers sized for the 100 year storm event to route the runoff from the external drainage area to the north around the perimeter of the proposed development area to the existing road ditch.

The site will be graded to direct runoff to new on-site catchbasins which convey runoff towards the proposed stormwater management pond and the new storm sewers south of the site. The SWM pond will provide stormwater storage with an orifice-controlled discharge to the existing road ditch. A riprap overflow from the pond is installed for major storm events.

SWM Design Criteria

The stormwater management design criteria for the proposed development area are summarized here.

1. Quantity Control:
   Attenuation of the 2-year through 100-year storm events to existing conditions.
2. External Lands Drainage Conveyance
   Convey drainage from external contributing drainage around safely to outfall.

Quantity Control

Quantity control of runoff will be provided through the SWM pond for storage and orifice-controlled discharge at the outlet.

The computer model MIDUSS has been used to model the existing condition and the proposed development with stormwater controls. The modeling demonstrates that the proposed design can provide adequate quantity control of runoff.

Stormwater Model Input Parameters

The design storm hyetographs are derived using IDF parameters for the City of Cambridge which have been fitted to the 3-hour Chicago Storm distribution. The IDF parameters used in the MIDUSS model are shown here.

$$i_{2year} = \frac{573.1}{(t_d+5)^{0.761}} \qquad i_{5year} = \frac{1219.8}{(t_d+10.5)^{0.823}} \qquad i_{100year} = \frac{3015.1}{(t_d+21)^{0.870}}$$

Table 1 below shows the catchment area parameters input into the model under the existing condition and the proposed condition. Catchment area drawings and model output files are included in Appendix B.

Table 1: Model Input Parameters

Catchment	Description	Area	Percent Impervious	Overland Slope	Flow Length
Existing Conditions					
1001	External Area North of Site	2.784 ha	0%	2.0%	130 m
101	Existing Site	0.741 ha	15%	1.0%	80 m
Proposed Conditions					
201	Proposed Site to Stormwater Pond	0.741 ha	85%	1.0%	70 m
1001	External Areas to the North	2.784 ha	0%	2.0%	130 m

The proposed SWM pond stage storage discharge curve was calculated based on the stormwater pond dimensions and the flow equation for a 75mm diameter orifice.

The MIDUSS computer modeling results are summarized below. Model output and stage storage discharge curves are included in Appendix B.

Table 2: Performance of Stormwater Storage Facility

	2 Year Storm Event	5 Year Storm Event	100 Year Storm Event
Stormwater Management Pond (Catchment 201)			
Storage Volume Provided	346.23 m^3		
Bottom Elevation	294.8 m		
Top Elevation	295.5 m		
Orifice Location	DICB1		
Overflow Elevation	295.4 m		
Peak Inflow	0.118 m^3/s	0.168 m^3/s	0.254 m^3/s
Peak Outflow	0.014 m^3/s	0.015 m^3/s	0.073 m^3/s
Max Water Level	295.06 m	295.22 m	295.45 m
Maximum Storage	88.88 m^3	172.863 m^3	309.92 m^3
Stormwater Pipe (Catchment 1001)			
Manning's n	0.013		
Pipe Diameter	525 mm		
Pipe slope	0.5 %		
Pipe Length	125.5 m		
Pipe Capacity	0.304 m^3/s		
Peak Inflow	0.015 m^3/s	0.057 m^3/s	0.259 m^3/s
Peak Outflow	0.015 m^3/s	0.057 m^3/s	0.257 m^3/s
Depth of Flow	0.078 m	0.154 m	0.372 m
Critical Depth	0.078 m	0.157 m	0.344 m

Table 3: MIDUSS Model Results Summary

	To Road Ditch	
	Existing	**Proposed**
2 Year Storm	0.022 m^3/s	0.028 m^3/s
5 Year Storm	0.075 m^3/s	0.072 m^3/s
100 Year Storm	0.333 m^3/s	0.330 m^3/s

Under proposed conditions, the peak flow to the road ditch is less than under Existing Conditions for 5 to 100 year storm events. The peak flow is slightly higher under proposed conditions for the 2-year storm event. However, the 0.006 m^3/s can be considered to be within acceptable modeling error.

The SWM Pond has been sized to provide sufficient storage volume to store the entirety of the 100 year storm event. During major storm events that exceed the volume of the SWM Pond, storm water will overflow to the existing ditch.

The peak flows to the existing road ditch during the 5-year and 100-year storm events are reduced from existing conditions. The proposed stormwater management plan will provide sufficient quantity control of runoff from the site.

Maintenance Procedures

The following maintenance is recommended.

SWM Component	Function	Maintenance Activity	Maintenance Frequency
Catchbasins	Provide inlet into the on site storm sewers	• Ensure CB Grates are clear of debris	• After major rainfall events
Stormwater Pond	Provide ponding area during rainfall events	• Maintain vegetation by mowing and weeding • Remove accumulated sediments	• Bi-weekly or as required
75mm dia. Orifice at DICB1	Provide restricted discharge rate to existing road ditch	• Inspect for debris and dirt clogging orifice	• Annually and after major rain events

Conclusions

In summary, the proposed development will reduce the peak discharge rates to the existing road ditch through the implementation of SWM pond storage with orifice control at the outlet.

All of which is respectfully submitted:

Sandra Swanton, P.Eng.
K. Smart Associates Limited

Appendix A

Geotechnical Report by LVM Inc, July 12, 2011

LVM 1961 2011

SPH Engineering

Proposed Commercial Storage Building
Regional Road 78
Township of North Dumfries, Ontario

Geotechnical Investigation Report

Prepared by:

William Loghrin, P.Eng.
Project Engineer

Reviewed by :

Dave S. Naylor, P.Eng.
Senior Consulting Engineer

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Appendices

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Test results mentioned herein are only valid for the sample(s) stated in this report.

LVM inc.'s subcontractors who may have accomplished work either on site or in laboratory are duly qualified as stated in our Quality Manual's procurement procedure. Should you require any further information, please contact your Project Manager."

Client:
SPH Engineering
65 Springbank Avenue North
Woodstock, Ontario N4S 8V8
Attention: Mr. Sean Panjer P.Eng.

REVISION AND PUBLICATION REGISTER		
Revision N°	**Date**	**Modification And/Or Publication Details**
00	2011-07-26	Report Issued

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INTRODUCTION

LVM inc. (LVM) was retained by SPH Engineering to carry out a geotechnical investigation at the site of the proposed storage facility development in the Township of North Dumfries, Ontario. This work was authorized by Mr Sean Panjer, P.Eng. in an email dated June 17, 2011, following submission of a fee proposal for the geotechnical investigation

The project involves the proposed construction of multiple single story storage buildings, to be built on a parcel of land located in the Township of North Dumfries, at the site shown on the appended Location Plan.

The purpose of the investigation was to explore the subsurface soil and groundwater conditions at the site. Based on that information, we have prepared this engineering report with geotechnical recommendations pertaining to development. Specific considerations include site grading, excavations, building foundations and floor slabs, and stormwater infiltration.

1 INVESTIGATION METHODOLOGY

The fieldwork for this investigation was carried out on July 12, 2011 and involved seven test pits advanced to depths between 2.0 and 2.6 m below existing grade. The test pit locations are shown the appended Site Plan.

The test pits were excavated by CTS Excavating, working under the direction of a member of our engineering staff. LVM established the test pit locations, documented the subsurface soil and groundwater conditions encountered, and processed recovered samples.

Representative samples of the overburden were recovered throughout the depths explored. Soil samples secured during this investigation were returned to our laboratory for further visual examination, as well as moisture content tests. The moisture content test results are plotted on the appended test pit logs. One particle size distribution analysis was also conducted on soil likely to be used for on-site infiltration, and the results are presented on Figure 1.

2 SUMMARIZED FINDINGS

We refer to the appended test pit logs for detailed soil descriptions and stratigraphies; moisture content profiles; and, groundwater observations. In general, the subsurface stratigraphy comprised respective layers of fill, over native sand and silt.

2.1 FILL

Surficial fill was encountered in Test Pits 03-11 to 07-11 to depths between 0.4 to 1.7 m below existing grades. The fill generally comprised 150 to 400 mm of topsoil, underlain by sand. Numerous pieces of wood were encountered in the fill at Test Pit 04-11.

2.2 TOPSOIL AND BURIED PEAT

Surficial topsoil was encountered in Test Pit 02-11, located at the east side of the site. Buried coarse fibrous peat was encountered below the fill, at the west side of the site, in Test Pits 04-11 and 06-11.

2.3 SILT AND SAND

Compact sand and silt soils were encountered below the near surface soils (fill, topsoil, and peat) in all of the test holes. These soils were typically moist above 1.5 m depth and wet below, corresponding to moisture contents between 2 and 20%.

As per the Ontario Building Code, a seismic site Class D may be used for design.

The founding subgrade should be inspected and approved prior to concrete placement. Any soft areas encountered during proof-rolling should be subexcavated and backfilled with structural fill. Lean mix concrete may be used in place of structural fill.

The slabs should be wet-cured to minimize problems associated with shrinkage and curling. The wet-curing procedure typically involves placing water over the slab then covering the slab with burlap or moisture vapour barrier. The wet burlap or moisture vapour barrier should be left-in-place for at least ninety-six hours.

Given the proposed foundation system, the founding soils will not have the minimum 1.2 m of earth necessary for frost protection. At least 50 mm of polystyrene insulation will be required over the founding subgrade to provide to the necessary thermal protection.

3.4 STORMWATER MANAGEMENT

At-source infiltration is being considered. One particle size distribution analysis was conducted on a sample of the surficial fill (from Test Pit 06-11), to determine its infiltration parameters, the results are appended. Based on the results, a percolation rate of 30 mm/hr may be used for design of infiltration systems in the onsite sand fill.

Generally, soak-away pits or can be used when located in areas where the natural groundwater level is below the bottom of the pit and the native soils are relatively free-draining. Soak-away pits generally require a minimum separation between the bottom of the pit to the seasonally high water table of 1 m.

Based on the investigation findings, conventional buried infiltrations systems are generally feasible for buildings constructed on the high ground found at the east side of the site (Test Pits 01-11 and 02-11). At the west side of the site, the infiltration system design must consider the typical 1.5 m depth to groundwater. Moreover, it may not be possible to provide the appropriate separation and earth cover to infiltration pipes in this area. Alternative systems including surface storage and infiltration ponds or ditching may be considered for at-source infiltration.

The soak-away pits must be checked by LVM at the time of construction to confirm satisfactory soil conditions, and to check that the pits are being constructed in accordance with the specifications.

D=14

4 CONSTRUCTION INSPECTION AND TESTING

Geotechnical inspections and insitu density testing should be conducted during site grading in order to verify that all loose fill and organics have been properly stripped and to ensure that all fill materials are being adequately compacted. For footings, the founding subsoils must be field reviewed by LVM to ensure that the founding soil is consistent with the design bearing intended by the geotechnical engineer. During the placement of concrete, testing should be performed to determine the slump and air content of the concrete; and, concrete cylinders should be cast for compressive strength testing.

LVM operates a Canadian Council of Independent Laboratories (CCIL) certified soils and aggregates laboratory in, Brantford, Kitchener, London, and Stratford. LVM is a licensed operator of appropriate nuclear density gauges for on-site compaction testing work. LVM staff also provide quality testing services for building envelope, structural steel, reinforcing steel and roofing.

5 STATEMENT OF LIMITATIONS

The geotechnical recommendations provided in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known at the time of report preparation, we recommend that we be retained during the final design stage to verify that the geotechnical recommendations have been correctly interpreted in the design. We also recommend that we be retained during construction to confirm that the subsurface conditions do not deviate materially from those encountered in the test pits and to ensure that our recommendations are properly understood.

The geotechnical recommendations provided in this report are applicable only to the project described in the text and are intended for the use of the project designer. They are not intended as specifications or instructions to contractors. Any use which a contractor makes of this report, or decisions made based on it, are the responsibility of the contractor. The contractor must also accept the responsibility for means and methods of construction, seek additional information if required, and draw their own conclusions as to how the subsurface conditions may affect them.

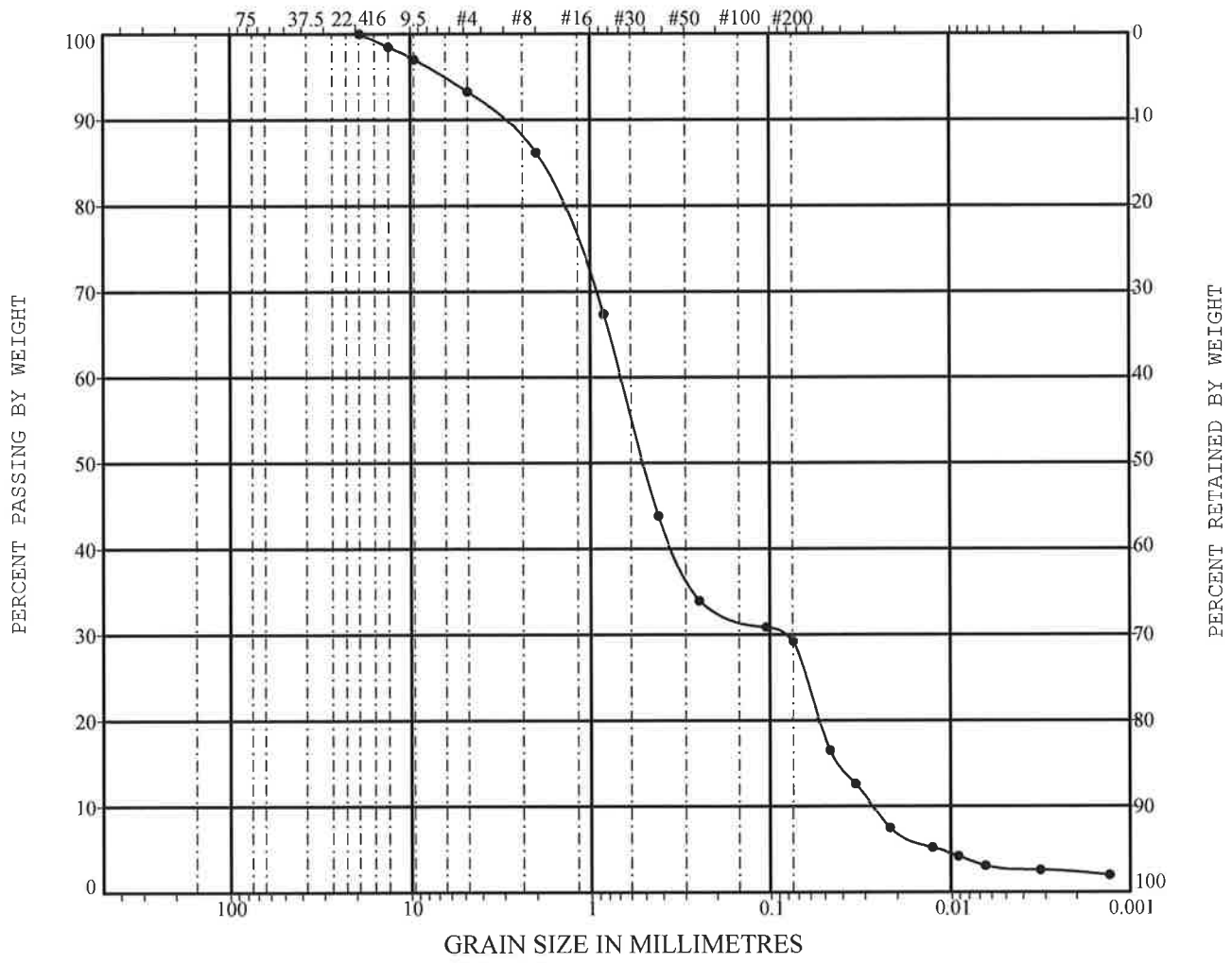
It is important to note that the geotechnical investigation involves a limited sampling of the site gathered at specific test hole locations and the conclusions in this report are based on this information gathered. The subsurface conditions between and beyond the test holes will differ from those encountered at the test holes. Should subsurface conditions be encountered which differ materially from those indicated at the test holes, we request that we be notified in order to assess the additional information and determine whether or not changes should be made as a result of the conditions.

Appendix 1 Figures

Figure 1: Particle Size Distribution Analysis

UNIFIED SOIL CLASSIFICATION

COBBLES	*GRAVEL*		*SAND*			*SILT OR CLAY*
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN MILLIMETRES			U.S. STANDARD SIEVE No.			HYDROMETER



PROJECT Proposed Storage Buildings

LOCATION Sprague Road, Township of North Dumfries, Ontario JOB NO. P041419-100

CURVE ID	BOREHOLE/ TEST PIT	SAMPLE NO.	DEPTH (m)	SOIL DESCRIPTION
●	TP 06-11	Sa1	0.15-1.7	Silty SAND, trace Gravel

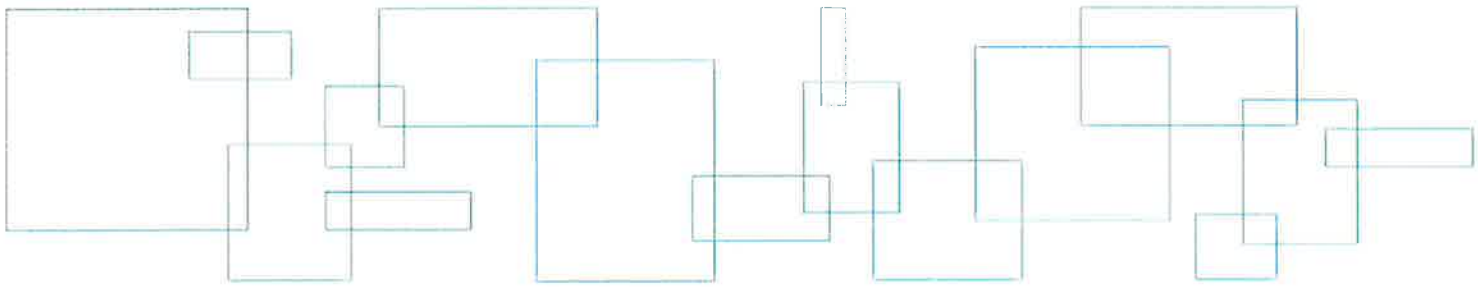
REMARKS

LVM

Figure No. 1

Appendix 2 Test Logs

List of Abbreviations
Test Pits 01-11 to 07-11



LIST OF ABBREVIATIONS

The abbreviations commonly employed on the borehole logs, on the figures, and in the text of the report, are as follows:

Sample Types		Soil Tests and Properties	
AS	auger sample	SPT	Standard Penetration Test
CS	chunk sample	UC	unconfined compression
RC	rock core	FV	field vane test
SS	split spoon	ø	angle of internal friction
TW	thin-walled, open	γ	unit weight
WS	wash sample	w_p	plastic limit
		w	water content
		w_l	liquid limit
		I_L	liquidity index
		I_p	plasticity index
		PP	pocket penetrometer

Penetration Resistances	
Dynamic Penetration Resistance	The number of blows by a 63.5 kg (140 lb.) hammer dropped 0.76 m (30 in.) required to drive a 50 mm (2 in.) diameter 60° cone a distance 0.30 m (12 in.). The cone is attached to 'A' size drill rods and casing is not used.
Standard Penetration Resistance, N (ASTM D1586)	The number of blows by a 63.5 kg. (140 lb.) hammer dropped 0.76 m (30 in.) required to drive a standard split spoon sampler 0.30 m (12 in.)
WH	sampler advanced by static weight of hammer
PH	sampler advanced by hydraulic pressure
PM	sampler advanced by manual pressure

Soil Description		
Cohesionless Soils	**SPT N-Value**	**D_r (%)**
Relative Density (D_r)	(blows per 0.30 m)	
Very Loose	0 to 4	0 to 20
Loose	4 to 10	20 to 40
Compact	10 to 30	40 to 60
Dense	30 to 50	60 to 80
Very Dense	over 50	80 to 100
Cohesive Soils	Undrained Shear Strength (C_u)	
Consistency	**kPa**	**psf**
Very Soft	less than 12	less than 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very Stiff	100 to 200	2000 to 4000
Hard	over 200	over 4000
DTPL	Drier than plastic limit	
APL	About plastic limit	
WTPL	Wetter than plastic limit	

LVM

Test Pit Number: 01-11

Ground Elevation: *N/A*

Project: *Proposed Storage Buildings*

Job No.: *P041419-100*

Location: *Just Store It - Spragues Road, Township of North Dumfries, ON*

Excavation Date: *2011-07-11*

SOIL PROFILE				SAMPLE		
Depth (m)	Description	Symbol	Elevation (m)	Number	WP — Water Content (%) — WL (10, 20, 30)	Groundwater Observations and Measurements (m)
0,00	Ground Elevation		0,00			
	SAND: loose to compact brown gravelly sand, trace silt, moist		-0,50			
1,00			-1,00			
			-1,50			
2,00			-2,00			
	Test Pit terminated at 2.1 m		-2,50			Upon completion of excavation, test pit sidewalls stable No free groundwater encountered

Reviewed by: *WLoghrin*

Drafted by: *SMeteer*

Field Tech: *WLoghrin*

Sheet: *1 of 1*

Notes:

LVM

Test Pit Number: 02-11

Ground Elevation: *N/A*

Project: *Proposed Storage Buildings*

Job No.: *P041419-100*

Location: *Just Store It - Spragues Road, Township of North Dumfries, ON*

Excavation Date: *2011-07-11*

SOIL PROFILE				SAMPLE		
Depth (m)	Description	Symbol	Elevation (m)	Number	WP — Water Content (%) — WL (10, 20, 30)	Groundwater Observations and Measurements (m)
0,00	Ground Elevation		0,00			
	TOPSOIL: dark brown silty sand, moist					
	SAND: compact brown silty sand, moist		-0,50			
	trace to some silt					
1,00			-1,00			
			-1,50			
2,00	Test Pit terminated at 2.0 m		-2,00			Upon completion of excavation, test pit sidewalls stable No free groundwater encountered
			-2,50			

Reviewed by: *WLoghrin*

Drafted by: *SMeteer*

Field Tech: *WLoghrin*

Sheet: *1 of 1*

Notes:

LVM

Test Pit Number: 03-11

Ground Elevation: *N/A*

Project: *Proposed Storage Buildings*

Job No.: *P041419-100*

Location: *Just Store It - Spragues Road, Township of North Dumfries, ON*

Excavation Date: *2011-07-11*

SOIL PROFILE				SAMPLE		
Depth (m)	Description	Symbol	Elevation (m)	Number	WP — Water Content (%) — WL (10, 20, 30)	Groundwater Observations and Measurements (m)
0,00	Ground Elevation		0,00			
	FILL: dark brown sand (topsoil), some gravel and silt, moist		-0,50			
	SAND: sand, some silt and gravel, moist					
1,00			-1,00			
	wet		-1,50			Major groundwater seepage encountered at 1.5 m
2,00	Test Pit terminated at 2.0 m		-2,00			Upon completion of excavation, test pit sidewalls unstable with cave at 1.5 m
			-2,50			

Reviewed by: *WLoghrin*

Drafted by: *SMeteer*

Field Tech: *WLoghrin*

Sheet: *1 of 1*

Notes:

LVM

Test Pit Number: 04-11

Ground Elevation: *N/A*

Project: *Proposed Storage Buildings*

Job No.: *P041419-100*

Location: *Just Store It - Spragues Road, Township of North Dumfries, ON*

Excavation Date: *2011-07-11*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Water Content (%) WP / WL	Groundwater Observations and Measurements (m)
0,00	Ground Elevation		0,00		WP WL; 10 20 30	
	FILL: dark brown silt (topsoil), moist					
	brown silt, some sand, numerous pieces of wood		-0,50			
1,00	***PEAT:*** dark brown coarse fibrous peat, wet		-1,00	1		
	SAND: grey sand, some silt, wet		-1,50			
2,00			-2,00	2		
	Test Pit terminated at 2.2 m		-2,50			Upon completion of excavation, test pit sidewalls unstable with cave at 1.8 m

Reviewed by: *WLoghrin*

Field Tech: *WLoghrin*

Notes:

Drafted by: *SMeteer*

Sheet: *1 of 1*

LVM

Test Pit Number: 05-11

Ground Elevation: *N/A*

Project: *Proposed Storage Buildings*

Job No.: *P041419-100*

Location: *Just Store It - Spragues Road, Township of North Dumfries, ON*

Excavation Date: *2011-07-11*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Water Content (%) (WP / WL; 10, 20, 30)	Groundwater Observations and Measurements (m)
0,00	Ground Elevation		0,00			
	FILL: brown sandy silt, some topsoil					
	SILT: compact brown sandy silt		-0,50			
	SAND: compact brown sand, moist					
1,00			-1,00			
	becoming wet		-1,50			Major groundwater seepage encountered at 1.5 m
2,00	Test Pit terminated at 2.0 m		-2,00			Upon completion of excavation, test pit sidewalls unstable with cave at 1.5 m
			-2,50			

Reviewed by: *WLoghrin*

Drafted by: *SMeteer*

Field Tech: *WLoghrin*

Sheet: *1 of 1*

Notes:

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Test Pit Number: 06-11

Ground Elevation: *N/A*

Project: *Proposed Storage Buildings*

Job No.: *P041419-100*

Location: *Just Store It - Spragues Road, Township of North Dumfries, ON*

Excavation Date: *2011-07-11*

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Water Content (%) (WP / WL; 10, 20, 30)	Groundwater Observations and Measurements (m)
	Ground Elevation		0,00			
0,00	***FILL:*** brown silt (topsoil)					
	compact sand, some gravel and silt, moist		-0,50			
1,00			-1,00			
	becoming silty, wet		-1,50	1		Major groundwater seepage encountered at 1.5 m
	PEAT: dark brown fibrous peat, wet					
2,00	***SILT:*** grey clayey silt, some sand, APL		-2,00	2		
			-2,50	3		
	Test Pit terminated at 2.6 m					Upon completion of excavation, test pit sidewalls unstable with cave at 2.3 m

Reviewed by: *WLoghrin*

Drafted by: *SMeteer*

Field Tech: *WLoghrin*

Sheet: *1 of 1*

Notes:

LVM

Test Pit Number: 07-11

Ground Elevation: *N/A*

Project: *Proposed Storage Buildings*

Job No.: *P041419-100*

Location: *Just Store It - Sprague Road, Township of North Dumfries, ON*

Excavation Date: *2011-07-11*

SOIL PROFILE				SAMPLE		
Depth (m)	Description	Symbol	Elevation (m)	Number	WP — Water Content (%) — WL (10, 20, 30)	Groundwater Observations and Measurements (m)
0,00	Ground Elevation		0,00			
	FILL: dark brown sandy silt (topsoil), damp					
	loose sand, some silt, moist		-0,50			
1,00			-1,00			
	SILT: brown sandy silt, moist			1		
	SAND: brown sand, some silt, wet		-1,50			Major groundwater seepage encountered at 1.5 m
2,00	Test Pit terminated at 2.0 m		-2,00			Upon completion of excavation, test pit sidewalls unstable with cave at 1.4 m
			-2,50			

Reviewed by: *WLoghrin*

Drafted by: *SMeteer*

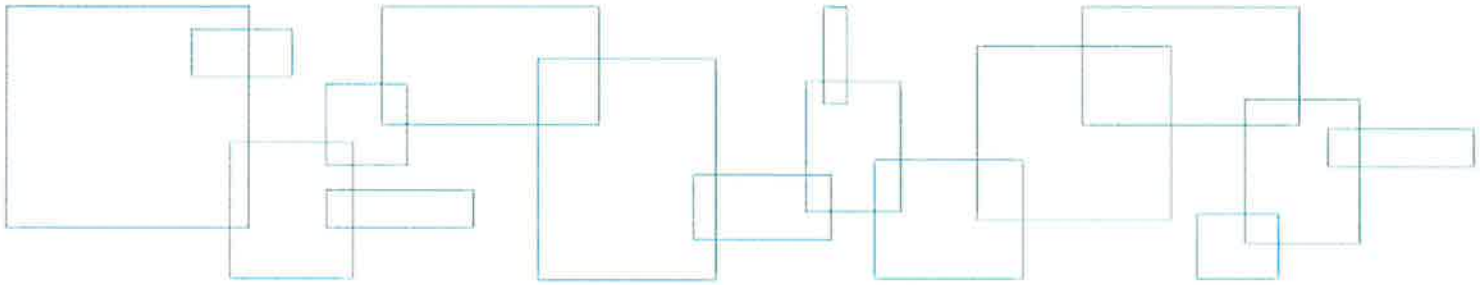
Field Tech: *WLoghrin*

Sheet: *1 of 1*

Notes:

Appendix 3 Drawings

Drawing 1: Location Plan
Drawing 2: Site Plan
Drawing 3: Typical Structural Fill Pad



NOTES :
1-REFERENCES : GRAND RIVER CONSERVATION AUTHORITY, 2006 aerial photography (2011).

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G:\160\P041419\Z5_CAD\P041419_100_01.DWG

Project

Proposed Storage Buildings

Sprague Road, Township of North Dumfries, Ontario

Title

LOCATION PLAN

LVM inc.
353, Bridge Street East
Kitchener (Ontario) N2K 2Y5
Telephone : 519.741.1313
Fax : 519.741.5422

Prepared	SMeteer	Discipline	GEOTECHNICAL	Project manager	WLoghrin
Drawn	SMeteer	Scale	1:10000	Sequence no.	01 of 03
Checked	WLoghrin	Date	2011-07-19		

M. dept.	Project	Work pckg.	Sub-w.p.	Disc.	Drawing no.	Rev.
160	P041419	100		GE	01	00

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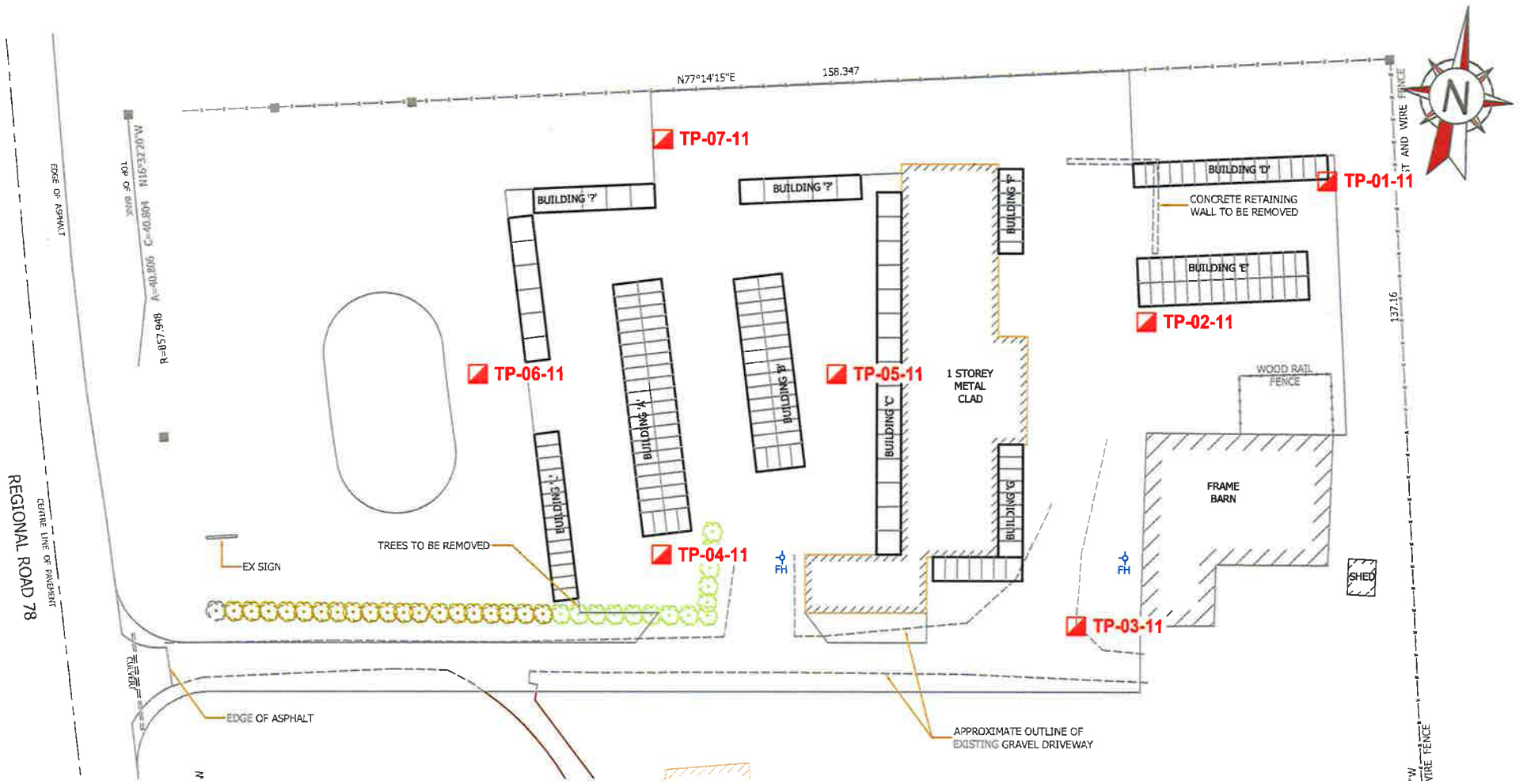

LEGEND :

TEST PIT LOCATION

NOTES :

1-REFERENCES : SPH ENGINEERING INC., Project 11013, Drawing P1, 2011-03-30

Project

Proposed Storage Buildings

Sprague Road, Township of North Dumfries, Ontario

Title

SITE PLAN

LVM inc.
353, Bridge Street East
Kitchener (Ontario) N2K 2Y5
Telephone : 519.741.1313
Fax : 519.741.5422

Prepared	SMeteer	Discipline	GEOTECHNICAL	Project manager	WLoghrin
Drawn	SMeteer	Scale	1:750	Sequence no.	02 of 03
Checked	WLoghrin	Date	2011-07-19		

M. dept.	Project	Work pckg.	Sub-w.p.	Disc.	Drawing no.	Rev.
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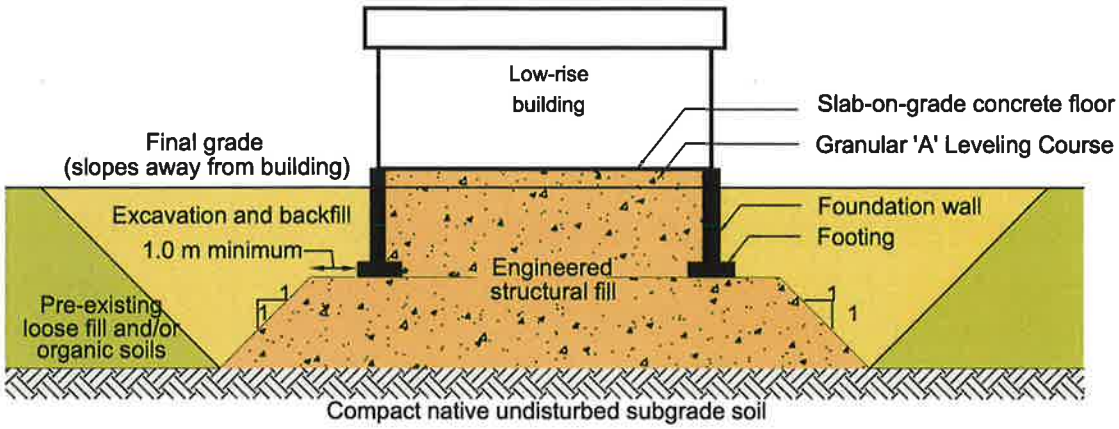


GENERAL REQUIREMENTS FOR ENGINEERED STRUCTURAL FILL

1. The area must be excavated of all pre-existing loose fill, topsoil, and/or organic soil until compact native undisturbed soil is reached.

2. The excavation should allow for the structural fill to extend 1.0 m beyond the outside edge of the building footings and down to the approved subgrade soil at a slope of 1 horizontal to 1 vertical (45 °).

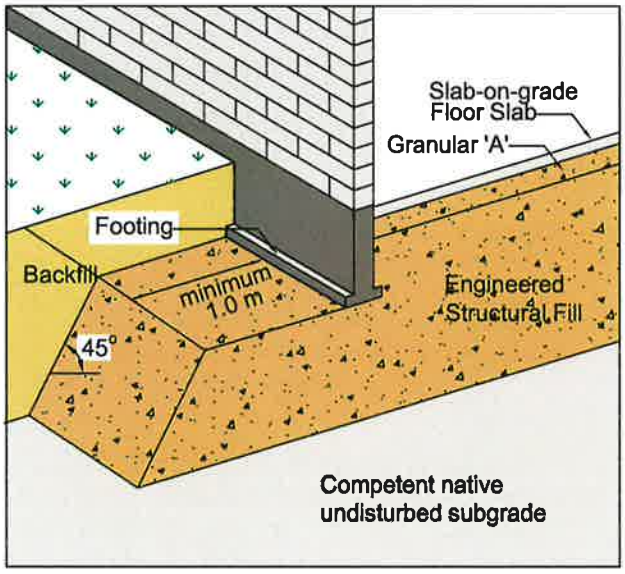
3. The subgrade below the engineered fill should be inspected and approved by a geotechnical engineer prior to fill construction. Fill placement and compaction operations to be carried out under full-time geotechnical supervision.

4. The structural fill should comprise sand and gravel aggregate placed in 300 mm thick lifts and compacted to at least 100% Standard Proctor Maximum Dry Density (SPMDD). The exterior backfill should consist of approved inorganic soil also placed in 300 mm thick lifts and compacted to minimum 95% SPMDD.

5. A minimum 150 mm thick layer of Granular 'A' should be placed directly below the floor slab for leveling and support purposes.

6. Exterior footings should be provided with minimum 1.2 m of soil cover for frost protection, or equivalent insulation

7. All excavations must be carried out in conformance with the current Ontario Occupational Health and Safety Act and Regulations 213/91 for construction projects.



Project

Proposed Storage Buildings

Sprague Road, Township of North Dumfries, Ontario

Title

TYPICAL STRUCTURAL FILL PAD

LVM inc.
353, Bridge Street East
Kitchener (Ontario) N2K 2Y5
Telephone : 519.741.1313
Fax : 519.741.5422

Prepared	SMeteer	Discipline	GEOTECHNICAL	Project manager	WLoghrin
Drawn	SMeteer	Scale	NTS	Sequence no.	03 of 03
Checked	WLoghrin	Date	2011-07-19		

M. dept.	Project	Work pckg.	Sub-w.p.	Disc.	Drawing no.	Rev.
160	P041419	100		GE	03	00

G:\160\P041419\25_CAD\P041419_100_03.DWG

Appendix B

Catchment Area Plans
Pond Design Calculations
MIDUSS Model Output Files

STORMWATER CALCULATIONS
2495 Spragues Road, Township of North Dumfries, Ontario

K. Smart Associatest Limited
Ref. Number 22-304
Date 04-Oct-24

Pond

Bottom Elevation	294.8	m
Bottom Grade	0.20%	
Bottom Length	50	m
Bottom Width	7	m
Side Slopes	4	:1

Orifice #1

Orifice Flow	**Q=CA(2gh)^0.5**		
C	Coefficient	0.65	
d	diameter	0.075	m
A	Area	0.004417865	m2
g	Gravitational Acc'n	9.81	m/s2
Invert	invert	293.9	m

Spillway Weir Q=CLH^1.5

Weir Length	1.5	m
Weir Elevation	295.4	
Coefficient	1.84	Sharp Crested Weir

Stormwater Storage Calculations

	Pond						
Elevation	**Bottom Width (m)**	**Bottom Length (m)**	**Total End Area (m^2)**	**Incremental Volume (m^3)**	**Cumulative Volume (m^3)**	**Orifice Flow (m^3/s)**	**Weir Flow (m^3/s)**
293.90	0.6	0.6	0.36			0.0000	
294.80	7.0	0	0	0.3	0.3	0.0121	
294.85	7.4	25.0	185.00	4.6	4.9	0.0124	
294.90	7.8	50.8	396.24	14.5	19.5	0.0127	
294.95	8.2	51.2	419.84	20.4	39.9	0.0130	
295.00	8.6	51.6	443.76	21.6	61.5	0.0133	
295.05	9.0	52	468	22.8	84.3	0.0136	
295.10	9.4	52.4	492.56	24.0	108.3	0.0139	
295.15	9.8	52.8	517.44	25.3	133.5	0.0142	
295.20	10.2	53.2	542.64	26.5	160.0	0.0145	
295.25	10.6	53.6	568.16	27.8	187.8	0.0148	
295.30	11.0	54	594	29.1	216.9	0.0151	
295.35	11.4	54.4	620.16	30.4	247.2	0.0153	
295.40	11.8	54.8	646.64	31.7	278.9	0.0156	0.00
295.45	12.2	55.2	673.44	33.0	311.9	0.0467	0.03
295.50	12.6	55.6	700.56	34.4	346.2	0.1034	0.09

MIDUSS - Stage Storage Discharge Table

Stage (m)	**Discharge (m^3/s)**	**Storage (m^3)**
293.90	0.0000	0
294.80	0.0121	0.324
294.85	0.0124	4.949
294.90	0.0127	19.480
294.95	0.0130	39.882
295.00	0.0133	61.472
295.05	0.0136	84.266
295.10	0.0139	108.280
295.15	0.0142	133.530
295.20	0.0145	160.032
295.25	0.0148	187.802
295.30	0.0151	216.856
295.35	0.0153	247.210
295.40	0.0156	278.880
295.45	0.0776	311.882
295.50	0.1906	346.232

Map Centre (X,Y): 549925.15, 4792592.35 | Map Link

This map is not to be used for navigation | 2020 Ortho (ON)

Grand River Conservation Authority

Date: Nov 28, 2024

GRCA Web-GIS

Legend

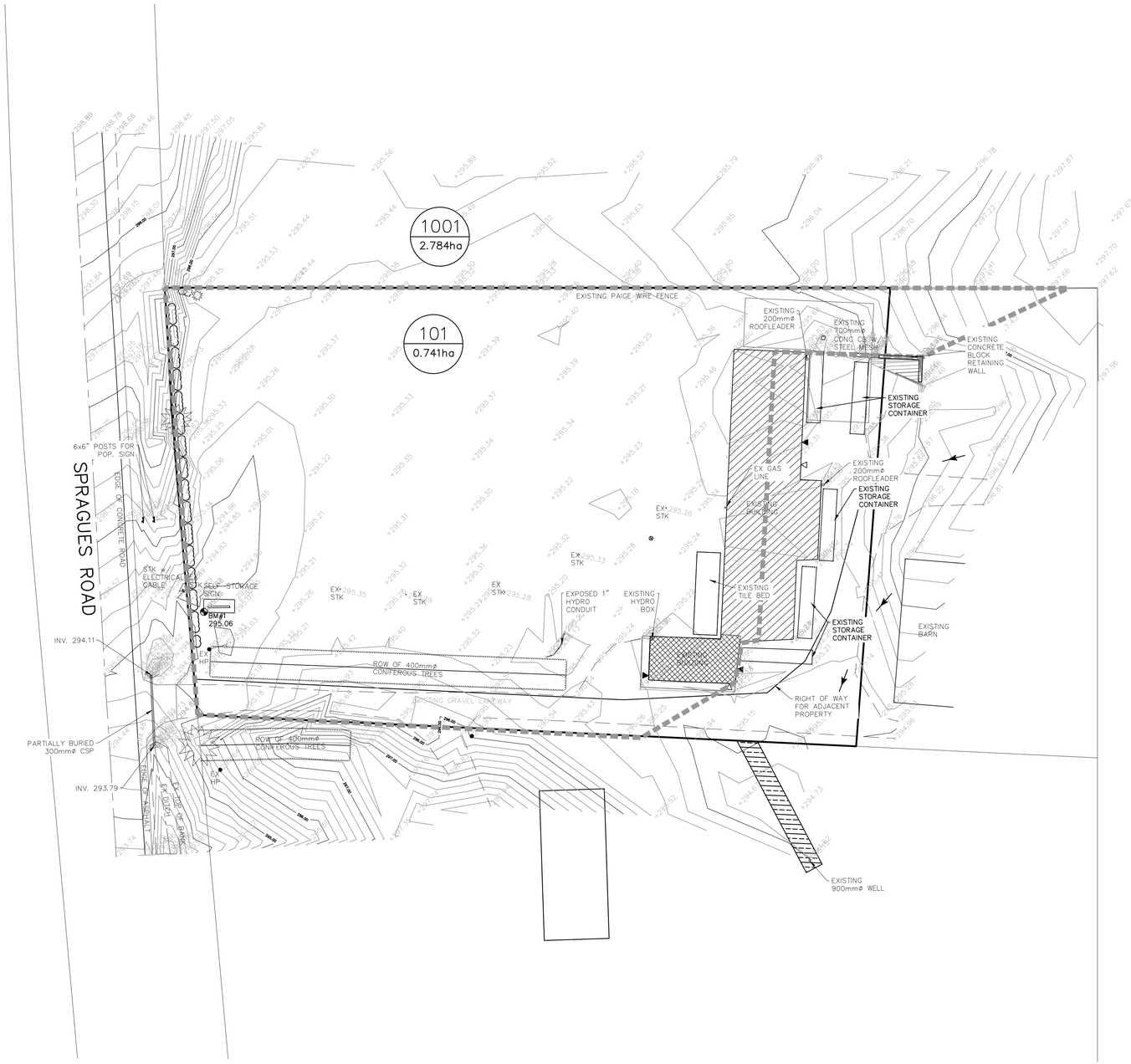
- Parcel - Assessment (MPAC/MNRF)
- Contour 0.5m - CGVD2013 (GRCA)

Copyright Grand River Conservation Authority, 2024.

Disclaimer: This map is for illustrative purposes only. Information contained herein is not a substitute for professional review or a site survey and is subject to change without notice. The Grand River Conservation Authority takes no responsibility for, nor guarantees, the accuracy of the information contained on this map. Any interpretations or conclusions drawn from this map are the sole responsibility of the user.
The source for each data layer is shown in parentheses in the map legend.
See Sources and Citations for details.

Scale 1:3,746

NAD83 UTM zone 17 (EPSG:26917)



KEY PLAN

NOTES:

101 / 0.000ha — EXISTING CATCHMENT AREA I.D.

CATCHMENT AREA

CATCHMENT AREA BOUNDARY

No.	REVISIONS	BY	DATE
	CONSTRUCTION		
	TENDER		
	ISSUE FOR APPROVALS		
	ISSUE BLOCK		

JUST STORE IT

2495 SPRAGUES ROAD

TOWNSHIP OF NORTH DUMFRIES — REGION OF WATERLOO

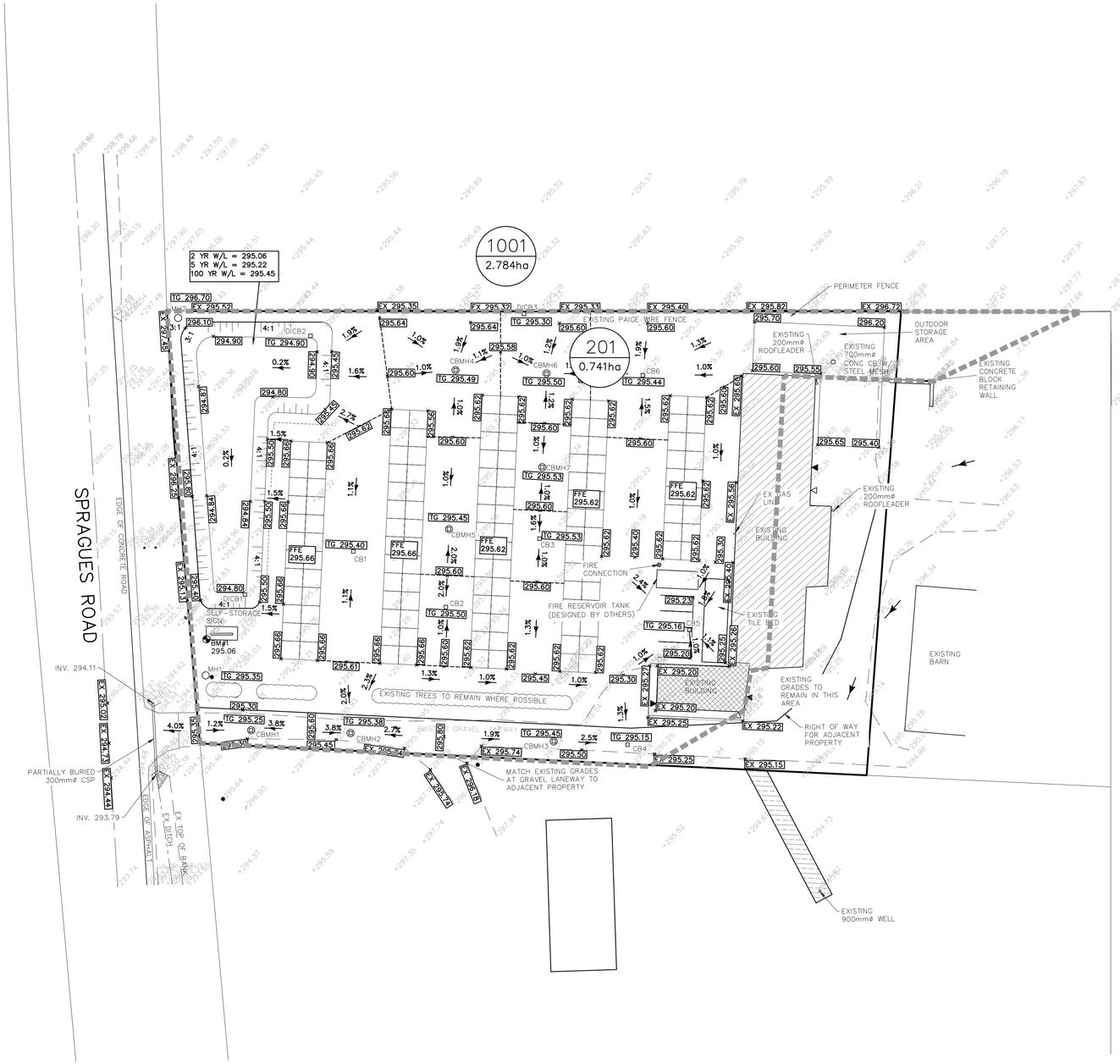
EXISTING CATCHMENT PLAN

K. SMART ASSOCIATES LIMITED
CONSULTING ENGINEERS AND PLANNERS
KITCHENER — SUDBURY

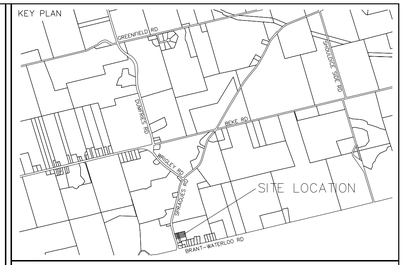
LICENSED PROFESSIONAL ENGINEER — SANDRA SWANTON — 100119707 — NOV 28/24 — PROVINCE OF ONTARIO

CERTIFIED ENGINEERING TECHNOLOGIST — OACETT — ONTARIO — SEAN LICITTI — Nº 913130

DESIGNED BY: S.S.	0 8 16	DATE: NOV 28, 2024
CHECKED BY: S.S.	SCALE 1:400	
DRAWN BY: G.C.		SHEET 1 OF 1
CHECKED BY: S.S.	REVISION No.	
FILE No. 22-304		



KEY PLAN



NOTES:

101
0.000ha — PROPOSED CATCHMENT AREA I.D.

CATCHMENT AREA

CATCHMENT AREA BOUNDARY

No.	REVISIONS	BY	DATE
	CONSTRUCTION		
	TENDER		
	ISSUE FOR APPROVALS		
	ISSUE BLOCK		

JUST STORE IT

2495 SPRAGUES ROAD

TOWNSHIP OF NORTH DUMFRIES — REGION OF WATERLOO

PROPOSED CATCHMENT PLAN

K. SMART ASSOCIATES LIMITED
CONSULTING ENGINEERS AND PLANNERS
KITCHENER — SUDBURY

LICENSED PROFESSIONAL ENGINEER — SANDRA SWANTON — 100119707 — NOV 28/24 — PROVINCE OF ONTARIO

CERTIFIED ENGINEERING TECHNOLOGISTS — OACETT — ONTARIO — SEAN LICHTI — NO 913130

DESIGNED BY: S.S.	0 8 16	DATE: NOV 28, 2024
CHECKED BY: S.S.	SCALE 1:400	
DRAWN BY: G.C.		SHEET
CHECKED BY: S.S.	REVISION No.	1 OF 1
FILE No. 22-304		

EXISTING CONDITIONS

2 Year Storm Event

5 Year Storm Event

100 Year Storm Event

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"            1   SCS method"
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"        0.000   % Impervious"
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"        0.170   Pervious Manning 'n'"
"       72.000   Pervious SCS Curve No."
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"        0.100   Pervious Ia/S coefficient"
"        9.878   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"
"                     0.015     0.000     0.000     0.000 c.m/sec"
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"             Time of concentration   65.542     5.550      65.542     minutes"
"             Time to Centroid        180.304    97.422     180.303    minutes"
"             Rainfall depth          32.362     32.362     32.362     mm"
"             Rainfall volume         900.95     0.00       900.96     c.m"
"             Rainfall losses         28.194     5.072      28.194     mm"
"             Runoff depth            4.168      27.289     4.168      mm"
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"            1   Equal length"
"            1   SCS method"
"          101   Existing Site"
"       15.000   % Impervious"
"        0.741   Total Area"
"       80.000   Flow length"
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"        0.630   Pervious Area"
"       80.000   Pervious length"
"        1.000   Pervious slope"
"        0.111   Impervious Area"
"       80.000   Impervious length"
"        1.000   Impervious slope"
"        0.170   Pervious Manning 'n'"
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"        0.100   Pervious Ia/S coefficient"
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"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.021     0.015     0.000     0.000 c.m/sec"
"             Catchment 101           Pervious   Impervious Total Area "
"             Surface Area            0.630      0.111      0.741      hectare"
"             Time of concentration   60.300     5.107      30.720     minutes"
"             Time to Centroid        174.520    96.773     132.853    minutes"
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"             Rainfall volume         203.83     35.97      239.80     c.m"
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"            8   Copy to Outflow"
"                    0.021     0.022     0.022     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Road Ditch"
"             Maximum flow                  0.022    c.m/sec"
"             Hydrograph volume           172.618    c.m"
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"            3   Runoff Totals on EXIT"
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"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"         1001   External Area North of Site"
"        0.000   % Impervious"
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"      130.000   Flow length"
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"        0.518   Impervious Initial abstraction"
"                     0.057     0.000     0.000     0.000 c.m/sec"
"             Catchment 1001          Pervious   Impervious Total Area "
"             Surface Area            2.784      0.000      2.784      hectare"
"             Time of concentration   41.013     4.936      41.013     minutes"
"             Time to Centroid        151.027    94.421     151.027    minutes"
"             Rainfall depth          48.647     48.647     48.647     mm"
"             Rainfall volume         1354.33    0.00       1354.33    c.m"
"             Rainfall losses         37.726     5.542      37.726     mm"
"             Runoff depth            10.921     43.105     10.921     mm"
"             Runoff volume           304.04     0.00       304.04     c.m"
"             Runoff coefficient      0.224      0.000      0.224      "
"             Maximum flow            0.057      0.000      0.057      c.m/sec"
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"            1   SCS method"
"          101   Existing Site"
"       15.000   % Impervious"
"        0.741   Total Area"
"       80.000   Flow length"
"        1.000   Overland Slope"
"        0.630   Pervious Area"
"       80.000   Pervious length"
"        1.000   Pervious slope"
"        0.111   Impervious Area"
"       80.000   Impervious length"
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"        0.170   Pervious Manning 'n'"
"       72.000   Pervious SCS Curve No."
"        0.224   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        9.878   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
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"        0.886   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.032     0.057     0.000     0.000 c.m/sec"
"             Catchment 101           Pervious   Impervious Total Area "
"             Surface Area            0.630      0.111      0.741      hectare"
"             Time of concentration   37.733     4.541      24.103     minutes"
"             Time to Centroid        147.131    93.843     125.249    minutes"
"             Rainfall depth          48.647     48.647     48.647     mm"
"             Rainfall volume         306.40     54.07      360.47     c.m"
"             Rainfall losses         37.726     5.531      32.897     mm"
"             Runoff depth            10.921     43.116     15.750     mm"
"             Runoff volume           68.78      47.92      116.71     c.m"
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"             Runoff coefficient     0.224      0.886      0.324      "
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"                    0.032     0.075     0.075     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Road Ditch"
"             Maximum flow                  0.075    c.m/sec"
"             Hydrograph volume           420.749    c.m"
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"             Total % impervious                        3.153"
" 19          EXIT"
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"       21.000   Constant B"
"        0.870   Exponent C"
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"        2.000   Overland Slope"
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"        2.000   Pervious slope"
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"        9.878   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"
"                     0.259     0.000     0.000     0.000 c.m/sec"
"             Catchment 1001          Pervious   Impervious Total Area "
"             Surface Area            2.784      0.000      2.784      hectare"
"             Time of concentration   26.726     4.281      26.726     minutes"
"             Time to Centroid        130.699    92.253     130.699    minutes"
"             Rainfall depth          89.669     89.669     89.669     mm"
"             Rainfall volume         2496.38    0.00       2496.39    c.m"
"             Rainfall losses         54.039     6.223      54.039     mm"
"             Runoff depth            35.630     83.446     35.630     mm"
"             Runoff volume           991.94     0.00       991.94     c.m"
"             Runoff coefficient      0.397      0.000      0.397      "
"             Maximum flow            0.259      0.000      0.259      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.259     0.259     0.000     0.000"
" 33          CATCHMENT 101"
"             1   Triangular SCS"
"             1   Equal length"
"             1   SCS method"
"           101   Existing Site"
"        15.000   % Impervious"
"         0.741   Total Area"
"        80.000   Flow length"
"         1.000   Overland Slope"
"         0.630   Pervious Area"
"        80.000   Pervious length"
"         1.000   Pervious slope"
"         0.111   Impervious Area"
"        80.000   Impervious length"
"         1.000   Impervious slope"
"         0.170   Pervious Manning 'n'"
"        72.000   Pervious SCS Curve No."
"         0.397   Pervious Runoff coefficient"
"         0.100   Pervious Ia/S coefficient"
"         9.878   Pervious Initial abstraction"
"         0.015   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"         0.928   Impervious Runoff coefficient"
"         0.100   Impervious Ia/S coefficient"
"         0.518   Impervious Initial abstraction"
"                     0.077     0.259     0.000     0.000 c.m/sec"
"             Catchment 101           Pervious   Impervious Total Area "
"             Surface Area            0.630      0.111      0.741      hectare"
"             Time of concentration   24.589     3.939      18.565     minutes"
"             Time to Centroid        128.192    91.802     117.576    minutes"
"             Rainfall depth          89.669     89.669     89.669     mm"
"             Rainfall volume         564.78     99.67      664.45     c.m"
"             Rainfall losses         54.030     6.489      46.899     mm"
"             Runoff depth            35.639     83.181     42.770     mm"
"             Runoff volume           224.47     92.46      316.93     c.m"
```

```
"             Runoff coefficient     0.397      0.928      0.477      "
"             Maximum flow           0.062      0.045      0.077      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.077     0.333     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.077     0.333     0.333     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Road Ditch"
"             Maximum flow                  0.333    c.m/sec"
"             Hydrograph volume          1308.866    c.m"
"                    0.077     0.333     0.333     0.333"
" 38          START/RE-START TOTALS 101"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      3.525    hectare"
"             Total Impervious area                     0.111    hectare"
"             Total % impervious                        3.153"
" 19          EXIT"
```

PROPOSED CONDITIONS

2 Year Storm Event

5 Year Storm Event

100 Year Storm Event

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                                   February 7, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:             \\KSFS03\Data\2022\22-304\Engineering\"
"                                                                    MIDUSS\Oct 2024"
"                Output filename:                     Proposed 2 Year Run 5.out"
"                Licensee name:                                 Sandra Swanton"
"                Company                            K. Smart Associates Limited"
"                Date & Time last used:                2024-11-27 at 2:44:47 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      573.100   Coefficient A"
"        5.000   Constant B"
"        0.761   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           99.364    mm/hr"
"             Total depth                 32.362    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Proposed Site to Stormwater Pond"
"       85.000   % Impervious"
"        0.741   Total Area"
"       70.000   Flow length"
"        1.000   Overland Slope"
"        0.111   Pervious Area"
"       70.000   Pervious length"
"        1.000   Pervious slope"
"        0.630   Impervious Area"
"       70.000   Impervious length"
"        1.000   Impervious slope"
"        0.170   Pervious Manning 'n'"
"       72.000   Pervious SCS Curve No."
"        0.129   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        9.878   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.839   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.118     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.111      0.630      0.741      hectare"
"             Time of concentration  55.657     4.713      6.056      minutes"
"             Time to Centroid       169.396    96.189     98.118     minutes"
"             Rainfall depth         32.362     32.362     32.362     mm"
"             Rainfall volume        35.97      203.83     239.80     c.m"
"             Rainfall losses        28.194     5.194      8.644      mm"
"             Runoff depth           4.168      27.168     23.718     mm"
"             Runoff volume          4.63       171.12     175.75     c.m"
"             Runoff coefficient     0.129      0.839      0.733      "
"             Maximum flow           0.001      0.118      0.118      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.118     0.118     0.000     0.000"
" 54          POND DESIGN"
"         0.118   Current peak flow    c.m/sec"
"         0.100   Target outflow    c.m/sec"
"         175.7   Hydrograph volume    c.m"
"           16.   Number of stages"
"         0.000   Minimum water level    metre"
"         3.000   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 293.900     0.000     0.000"
"                 294.800   0.01210    0.3240"
"                 294.850   0.01240     4.949"
"                 294.900   0.01270    19.480"
"                 294.950   0.01300    39.882"
"                 295.000   0.01330    61.472"
"                 295.050   0.01360    84.266"
"                 295.100   0.01390   108.280"
"                 295.150   0.01420   133.530"
"                 295.200   0.01450   160.032"
"                 295.250   0.01480   187.802"
"                 295.300   0.01510   216.856"
"                 295.350   0.01530   247.210"
"                 295.400   0.01560   278.880"
"                 295.450   0.07760   311.882"
"                 295.500    0.1906   346.232"
"              Peak outflow                  0.014    c.m/sec"
"              Maximum level               295.060    metre"
"              Maximum storage              88.883    c.m"
"              Centroidal lag                2.752   hours"
"                   0.118     0.118     0.014     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Road Ditch"
```

```
"             Maximum flow                  0.014    c.m/sec"
"             Hydrograph volume           176.322    c.m"
"                     0.118     0.118     0.014     0.014"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.118     0.000     0.014     0.014"
" 33          CATCHMENT 1001"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"         1001   External Areas to the North"
"        0.000   % Impervious"
"        2.784   Total Area"
"      130.000   Flow length"
"        2.000   Overland Slope"
"        2.784   Pervious Area"
"      130.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      130.000   Impervious length"
"        2.000   Impervious slope"
"        0.170   Pervious Manning 'n'"
"       72.000   Pervious SCS Curve No."
"        0.129   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        9.878   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"
"                     0.015     0.000     0.014     0.014 c.m/sec"
"             Catchment 1001         Pervious   Impervious Total Area "
"             Surface Area           2.784      0.000      2.784      hectare"
"             Time of concentration  65.542     5.550      65.542     minutes"
"             Time to Centroid       180.304    97.422     180.303    minutes"
"             Rainfall depth         32.362     32.362     32.362     mm"
"             Rainfall volume        900.95     0.00       900.96     c.m"
"             Rainfall losses        28.194     5.072      28.194     mm"
"             Runoff depth           4.168      27.289     4.168      mm"
"             Runoff volume          116.04     0.00       116.04     c.m"
"             Runoff coefficient     0.129      0.000      0.129      "
"             Maximum flow           0.015      0.000      0.015      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.015     0.015     0.014     0.014"
" 51          PIPE DESIGN"
"        0.015   Current peak flow    c.m/sec"
"        0.013   Manning 'n'"
"        0.525   Diameter    metre"
"        0.500   Gradient   %"
"             Depth of flow                 0.078    metre"
"             Velocity                      0.724    m/sec"
"             Pipe capacity                 0.304    c.m/sec"
"             Critical depth                0.078    metre"
" 53          ROUTE    Pipe Route 126"
"       125.50      Pipe Route 126 Reach length   ( metre)"
"        0.470   X-factor <= 0.5"
"      129.926   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      100.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  0.015    c.m/sec"
"                     0.015     0.015     0.015     0.014 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Road Ditch"
"             Maximum flow                  0.028    c.m/sec"
"             Hydrograph volume           292.366    c.m"
"                     0.015     0.015     0.015     0.028"
" 38          START/RE-START TOTALS 1001"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      3.525    hectare"
"             Total Impervious area                     0.630    hectare"
"             Total % impervious                       17.868"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                                   February 7, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:             \\KSFS03\Data\2022\22-304\Engineering\"
"                                                                    MIDUSS\Nov 2024"
"                Output filename:                     Proposed 5 Year Run 5.out"
"                Licensee name:                                 Sandra Swanton"
"                Company                             K. Smart Associates Limited"
"                Date & Time last used:                 2024-11-27 at 2:55:32 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1219.800   Coefficient A"
"       10.500   Constant B"
"        0.823   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           127.834    mm/hr"
"             Total depth                  48.647    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Proposed Site to Stormwater Pond"
"       85.000   % Impervious"
"        0.741   Total Area"
"       70.000   Flow length"
"        1.000   Overland Slope"
"        0.111   Pervious Area"
"       70.000   Pervious length"
"        1.000   Pervious slope"
"        0.630   Impervious Area"
"       70.000   Impervious length"
"        1.000   Impervious slope"
"        0.170   Pervious Manning 'n'"
"       72.000   Pervious SCS Curve No."
"        0.224   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        9.878   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.884   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.168     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.111      0.630      0.741      hectare"
"             Time of concentration  34.828     4.191      5.506      minutes"
"             Time to Centroid       143.679    93.359     95.518     minutes"
"             Rainfall depth         48.647     48.647     48.647     mm"
"             Rainfall volume        54.07      306.40     360.47     c.m"
"             Rainfall losses        37.728     5.662      10.472     mm"
"             Runoff depth           10.919     42.985     38.175     mm"
"             Runoff volume          12.14      270.74     282.88     c.m"
"             Runoff coefficient     0.224      0.884      0.785      "
"             Maximum flow           0.003      0.168      0.168      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.168     0.168     0.000     0.000"
" 54          POND DESIGN"
"         0.168   Current peak flow    c.m/sec"
"         0.100   Target outflow    c.m/sec"
"         282.9   Hydrograph volume    c.m"
"           16.   Number of stages"
"         0.000   Minimum water level    metre"
"         3.000   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 293.900     0.000     0.000"
"                 294.800   0.01210    0.3240"
"                 294.850   0.01240     4.949"
"                 294.900   0.01270    19.480"
"                 294.950   0.01300    39.882"
"                 295.000   0.01330    61.472"
"                 295.050   0.01360    84.266"
"                 295.100   0.01390   108.280"
"                 295.150   0.01420   133.530"
"                 295.200   0.01450   160.032"
"                 295.250   0.01480   187.802"
"                 295.300   0.01510   216.856"
"                 295.350   0.01530   247.210"
"                 295.400   0.01560   278.880"
"                 295.450   0.07760   311.882"
"                 295.500    0.1906   346.232"
"              Peak outflow                    0.015    c.m/sec"
"              Maximum level                 295.223    metre"
"              Maximum storage               172.863    c.m"
"              Centroidal lag                  3.568    hours"
"                   0.168     0.168     0.015     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Road Ditch"
```

```
"             Maximum flow                  0.015    c.m/sec"
"             Hydrograph volume           282.243    c.m"
"                    0.168     0.168     0.015     0.015"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.168     0.000     0.015     0.015"
" 33          CATCHMENT 1001"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"         1001   External Areas to the North"
"        0.000   % Impervious"
"        2.784   Total Area"
"      130.000   Flow length"
"        2.000   Overland Slope"
"        2.784   Pervious Area"
"      130.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      130.000   Impervious length"
"        2.000   Impervious slope"
"        0.170   Pervious Manning 'n'"
"       72.000   Pervious SCS Curve No."
"        0.224   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        9.878   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"
"                    0.057     0.000     0.015     0.015 c.m/sec"
"             Catchment 1001         Pervious   Impervious Total Area "
"             Surface Area           2.784      0.000      2.784      hectare"
"             Time of concentration  41.013     4.936      41.013     minutes"
"             Time to Centroid       151.027    94.421     151.027    minutes"
"             Rainfall depth         48.647     48.647     48.647     mm"
"             Rainfall volume        1354.33    0.00       1354.33    c.m"
"             Rainfall losses        37.726     5.542      37.726     mm"
"             Runoff depth           10.921     43.105     10.921     mm"
"             Runoff volume          304.04     0.00       304.04     c.m"
"             Runoff coefficient     0.224      0.000      0.224      "
"             Maximum flow           0.057      0.000      0.057      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.057     0.057     0.015     0.015"
" 51          PIPE DESIGN"
"        0.057   Current peak flow    c.m/sec"
"        0.013   Manning 'n'"
"        0.525   Diameter    metre"
"        0.500   Gradient   %"
"             Depth of flow                 0.154    metre"
"             Velocity                      1.078    m/sec"
"             Pipe capacity                 0.304    c.m/sec"
"             Critical depth                0.157    metre"
" 53          ROUTE    Pipe Route 126"
"       125.50      Pipe Route 126 Reach length   ( metre)"
"        0.434   X-factor <= 0.5"
"       87.328   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"       75.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  0.057    c.m/sec"
"                    0.057     0.057     0.057     0.015 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Road Ditch"
"             Maximum flow                  0.072    c.m/sec"
"             Hydrograph volume           586.284    c.m"
"                    0.057     0.057     0.057     0.072"
" 38          START/RE-START TOTALS 1001"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      3.525    hectare"
"             Total Impervious area                     0.630    hectare"
"             Total % impervious                       17.868"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                                   February 7, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:             \\KSFS03\Data\2022\22-304\Engineering\"
"                                                                    MIDUSS\Nov 2024"
"                Output filename:                   Proposed 100 Year Run 5.out"
"                Licensee name:                                      Sandra Swanton"
"                Company                            K. Smart Associates Limited"
"                Date & Time last used:                2024-11-27 at 2:59:44 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3015.100   Coefficient A"
"       21.000   Constant B"
"        0.870   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          177.123    mm/hr"
"             Total depth                 89.669    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Proposed Site to Stormwater Pond"
"       85.000   % Impervious"
"        0.741   Total Area"
"       70.000   Flow length"
"        1.000   Overland Slope"
"        0.111   Pervious Area"
"       70.000   Pervious length"
"        1.000   Pervious slope"
"        0.630   Impervious Area"
"       70.000   Impervious length"
"        1.000   Impervious slope"
"        0.170   Pervious Manning 'n'"
"       72.000   Pervious SCS Curve No."
"        0.397   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        9.878   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.922   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.254     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.111      0.630      0.741      hectare"
"             Time of concentration  22.695     3.636      4.983      minutes"
"             Time to Centroid       125.967    91.426     93.868     minutes"
"             Rainfall depth         89.669     89.669     89.669     mm"
"             Rainfall volume        99.67      564.78     664.45     c.m"
"             Rainfall losses        54.047     7.033      14.085     mm"
"             Runoff depth           35.622     82.636     75.584     mm"
"             Runoff volume          39.59      520.48     560.08     c.m"
"             Runoff coefficient     0.397      0.922      0.843      "
"             Maximum flow           0.012      0.250      0.254      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.254     0.254     0.000     0.000"
" 54          POND DESIGN"
"         0.254   Current peak flow    c.m/sec"
"         0.100   Target outflow    c.m/sec"
"         560.1   Hydrograph volume    c.m"
"           16.   Number of stages"
"         0.000   Minimum water level    metre"
"         3.000   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 293.900     0.000     0.000"
"                 294.800   0.01210    0.3240"
"                 294.850   0.01240     4.949"
"                 294.900   0.01270    19.480"
"                 294.950   0.01300    39.882"
"                 295.000   0.01330    61.472"
"                 295.050   0.01360    84.266"
"                 295.100   0.01390   108.280"
"                 295.150   0.01420   133.530"
"                 295.200   0.01450   160.032"
"                 295.250   0.01480   187.802"
"                 295.300   0.01510   216.856"
"                 295.350   0.01530   247.210"
"                 295.400   0.01560   278.880"
"                 295.450   0.07760   311.882"
"                 295.500    0.1906   346.232"
"              Peak outflow                  0.073    c.m/sec"
"              Maximum level              295.447    metre"
"              Maximum storage            309.923    c.m"
"              Centroidal lag               3.916   hours"
"                   0.254     0.254     0.073     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Road Ditch"
```

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"             Maximum flow                  0.073    c.m/sec"
"             Hydrograph volume           559.658    c.m"
"                     0.254     0.254     0.073     0.073"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.254     0.000     0.073     0.073"
" 33          CATCHMENT 1001"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"         1001   External Areas to the North"
"        0.000   % Impervious"
"        2.784   Total Area"
"      130.000   Flow length"
"        2.000   Overland Slope"
"        2.784   Pervious Area"
"      130.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      130.000   Impervious length"
"        2.000   Impervious slope"
"        0.170   Pervious Manning 'n'"
"       72.000   Pervious SCS Curve No."
"        0.397   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        9.878   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"
"                     0.259     0.000     0.073     0.073 c.m/sec"
"             Catchment 1001         Pervious   Impervious Total Area "
"             Surface Area           2.784      0.000      2.784      hectare"
"             Time of concentration  26.726     4.281      26.726     minutes"
"             Time to Centroid       130.699    92.253     130.699    minutes"
"             Rainfall depth         89.669     89.669     89.669     mm"
"             Rainfall volume        2496.38    0.00       2496.39    c.m"
"             Rainfall losses        54.039     6.223      54.039     mm"
"             Runoff depth           35.630     83.446     35.630     mm"
"             Runoff volume          991.94     0.00       991.94     c.m"
"             Runoff coefficient     0.397      0.000      0.397      "
"             Maximum flow           0.259      0.000      0.259      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.259     0.259     0.073     0.073"
" 51          PIPE DESIGN"
"        0.259   Current peak flow    c.m/sec"
"        0.013   Manning 'n'"
"        0.525   Diameter    metre"
"        0.500   Gradient   %"
"             Depth of flow                 0.372    metre"
"             Velocity                      1.577    m/sec"
"             Pipe capacity                 0.304    c.m/sec"
"             Critical depth                0.344    metre"
" 53          ROUTE    Pipe Route 126"
"      125.50      Pipe Route 126 Reach length   ( metre)"
"        0.267   X-factor <= 0.5"
"       59.683   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"       75.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  0.257    c.m/sec"
"                     0.259     0.259     0.257     0.073 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Road Ditch"
"             Maximum flow                  0.330    c.m/sec"
"             Hydrograph volume          1551.598    c.m"
"                     0.259     0.259     0.257     0.330"
" 38          START/RE-START TOTALS 1001"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      3.525    hectare"
"             Total Impervious area                     0.630    hectare"
"             Total % impervious                       17.868"
" 19          EXIT"
```