

FUNCTIONAL SERVICING BRIEF

Submitted to:
The City of
Ottawa Planning
Department

Submitted by:



1. Introduction

Taskforce Engineering has been retained by Waste Management of Canada Corp. to conduct a functional servicing study for a proposed Maintenance Building located at 2413 Carp Rd in Ottawa, ON in support of a site plan amendment application. The purpose of the report is to determine if there is sufficient capacity in the existing systems or if new systems are required to adequately service the proposed building.

2. Existing Conditions

2.1 General

The property is part of a larger property that is known municipally as 2393 Carp Rd which is operating as the WM West Carleton Environmental Centre landfill. The municipal property known as 2413 Carp Rd was acquired by WM and was previously operated by a cabinetry company with office and fabrication facilities located on-site. The properties have not yet been consolidated and as such, this application is in reference to the smaller parcel known as 2413 Carp Rd.

2.2 Water

There are 2 existing drilled wells on the property. One that services the office building and one that services the fabrication shop. The well records for these wells are included in the appendices.

2.3 Septic

There are 2 existing septic systems on the subject property. One that services the office building and one that services the fabrication shop. The available records for these systems are included in the appendices.

2.4 Stormwater

There is a large stormwater system with infiltration basins that was designed and installed in conjunction with the landfill expansion, which was constructed in 2024. A copy of the stormwater management report for that facility is included in the appendices.

3. Proposed Building

The proposed building is a 1,025 SM maintenance building with 662 SM of shop area and 363 SM of accessory space including storage, offices and washroom facilities. The shop area will be constructed using a pre-engineered building system while the auxiliary spaces will be constructed using conventional construction with load bearing block and wood roof trusses.

4. Servicing

4.1 Fire Protection

The site does not have municipal servicing and as such, an on-site supplemental water supply is required. The volume of on-site water that is required is calculated below in accordance with the *OFM-TG-03-1999 Fire Protection Water Supply Guideline for Part 3 in the Ontario Building Code*.

$$Q = K V S_{\text{tot}}$$

Q = minimum supply of water in litres

K = water supply coefficient – 17 (F2 non-combustible construction)

V = total building volume in cubic metres – 8,364 m³

S_{tot} = total of spatial coefficients from property line exposures – 1.0 (all LD > 10m)

$$Q = 142,188 \text{ L}$$

From Table 2, Q_{tot} = 4,500 L/min x 30 min duration = 135,000 L Req'd

In accordance with the Ottawa Design Guidelines – Water Distribution, Rural Fire Flow Calculation Process, as Q is calculated to be 4,500 L/min, a reduction of 57,000 L to Q_{tot} is permitted.

Therefore, Q_{tot} = 135,000 – 57,000 = **78,000 L** of supplementary on-site water storage is required.

It is proposed to provide 2 – 40,000 L precast holding tanks complete with a dry hydrant for a total of 80,000 L of on-site water supply for fire protection.

4.2 Domestic Water

The existing well within existing fabrication shop is a 6" drilled well that is 200' deep with a ½ HP pump installed 150' below finished floor. A pump test that was performed this well on March 17, 2024 produced a sustained flow of 10 GPM at 40 psi of the 6 hr test with minimal drawdown (1.3'). It recovered 90% of its initial static level of 33'-6" within 90 minutes.

Fixture	Hydraulic Load, Fixture Units	Quantity of Fixtures	Total Fixture Units
Water Closet	5	7	35
Lavatory	2	6	12
Shower	5	2	10
Dish Sink	2	2	4
Hose Bib	2.5	2	5
Mop Sink	3	1	3
TOTAL			69

Based on the total fixture units listed above which include the fixture units for the scale house constructed in 2024, using the ASHRAE Modified Hunter Curve: D, the approximate water flow is 13 GPM. This exceeds the sustained flow rate of 10 GPM resulting from the above noted pump test, however, based on minimal drawdown and a quick static recovery, it is anticipated that the well has the capacity to provide sufficient water supply to meet the building demands.

As this well also supplies the existing scalehouse with a 2" water service, a 1 ½" water service to the maintenance building is proposed to be installed from the existing 2" water supply. A 1 ½" pipe at 40 psi provides maximum flow of 110 GPM which exceeds the anticipated demand and will provide sufficient capacity.

4.3 Septic System

The existing septic system servicing the existing shop was assessed to determine if sufficient capacity was available to accommodate the maintenance building addition. It was determined that both the existing tank and bed were not sufficient to accommodate the additional loading. As such, a new septic system is proposed to service the maintenance building sanitary loading.

An Eljen septic system has been proposed to minimize the septic footprint as the space on the site is limited with the required setbacks related to the septic system installation. The septic design parameters are as follows:

Septic Design		
Daily Design Sanitary Flow Rate (DDSF)		
Office Area (75L/9.2m ²)	186.3 m ²	1,502.4 L/day
Tank Sizing		
Commercial	Q (DDSF) x 3	4,507 L
	Tank Size:	4,730 L
Septic Design Cont'd		
Eljen Module Bed Sizing		
T (Percolation Rate)	20 min/cm	Native Soil
Q (DDSF)	1,502.4 L/day	
Eljen Modules: Q/95	16	
Number of Modules Proposed	18	
Filter Bed Area (QT/400)	75.2 m ²	
Filter Bed Area Proposed	80 m ²	

4.4 Stormwater

There is a large stormwater management facility located on the site that was designed to accommodate the landfill expansion. This facility has sufficient capacity to receive the additional run-off generated by the proposed maintenance building development. A summary letter from WSP, the stormwater management facility design engineers, indicating that there is sufficient capacity is attached for reference.

The building run-off will be conveyed through header pipes to an existing storm water manhole, or overland conveyance to the stormwater management facility described above.

5. Conclusions

The following summarizes the findings of this report as it relates to the construction of the proposed maintenance facility at the WM West Carleton Environmental Centre.

- 5.1 The water for fire protection requirement is 78,000 L which will be provided by 2 – 40,000 L precast tanks to be installed below grade with a dry hydrant.

Through consultation with the Fire Prevention officer, this hydrant is proposed to be located in the front yard, beyond the 90m distance to the building required by the Ontario Building Code. It is proposed to be installed in this location as it is better positioned to provide fire protection to the 2 existing buildings already on-site in addition to the proposed maintenance building.

- 5.2 The domestic water requirement for the building is 13 GPM which will be supplied by the existing well with a 1 1/2" domestic water supply line.
- 5.3 The sanitary loads for the building will be managed by an Eljen septic system based on a daily design sanitary flow rate of 1,502.4 L/day.
- 5.4 The stormwater run-off generated by the proposed maintenance building will be conveyed to existing stormwater management facilities for quantity and quality control.

Respectfully submitted,



Hilary Murphy, P.Eng.
Taskforce Engineering Inc.



Functional Servicing Brief
WM West Carleton Environmental Maintenance Facility
TF Project No.: 2511

Appendix 1

Existing Well Records



Water management in Ontario

1. PRINT ONLY IN SPACES PROVIDED

2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11

1511894

MUNICIP

MUNICIP.
15005

CON

CON. *Edw*

K 3

COUNTY OR DISTRICT

TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE

10	14	1
CON., BLOCK, TRACT, SURVEY, ETC.		

	22	23	24
LOT	25-27		

ADDRESS

DATE COMPLETED	
----------------	--

4A-53

DAY 26 MO. 05 YR. 72

NORTHING

RC

ELEVATION

BACIN CODE

744

TR

1 2 1511894 18

424034

5015334

4

300

•

24

JAN 12, 1975

—

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

CONTRACTOR	NAME OF WELL CONTRACTOR <i>Capital Water Supply Ltd</i>		LICENCE NUMBER <i>1558</i>	
	ADDRESS <i>Box 490, Stittsville, Ont.</i>			
	NAME OF DRILLER OR BORER <i>Boyd Cameron</i>		LICENCE NUMBER	
	SIGNATURE OF CONTRACTOR <i>Holtkamp</i>		SUBMISSION DATE DAY <i>26</i> MO <i>5</i> YR <i>72</i>	
	OFFICE USE ONLY			

DATA SOURCE <i>1</i>	58 CONTRACTOR <i>1558</i>	9-62 DATE RECEIVED <i>041072</i>	63-68 80
DATE OF INSPECTION		INSPECTOR <i>1K</i>	
REMARKS:			P R WI

OWRC COPY

UTM 18 424590 E

9 R 5025225 N

Elev. 9 R 0300

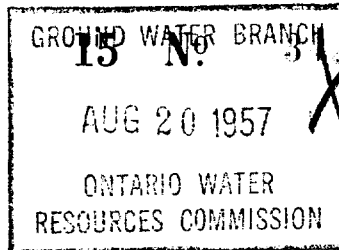
Basin 25 IV

10 + 16



ONTARIO

The Water-well Drillers Act, 1954
Department of Mines



Water-Well Record

County or Territorial District Carleton Township, Village, Town or City March
Address Dunrobin
(day) (month) (year)

Pipe and Casing Record

Pumping Test

Casing diameter(s) 4 in Static level 11 ft
Length(s) 5 ft Pumping rate 20 gpm
Type of screen - Pumping level 20 ft
Length of screen - Duration of test 20 min

Well Log

Water Record

Overburden and Bedrock Record

From ft.

To ft.

Depth (s) at which water (s) found

No. of feet water rises

Kind of water (fresh, salty, or sulphur)

limestone shale
hard sandstone

0

1

32

21

fresh

1

40

38

27

fresh

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

household

Is water clear or cloudy? clear

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

Drilling firm H. Sparks

Address South March

Name of Driller H. Sparks

Address South March

Licence Number 490

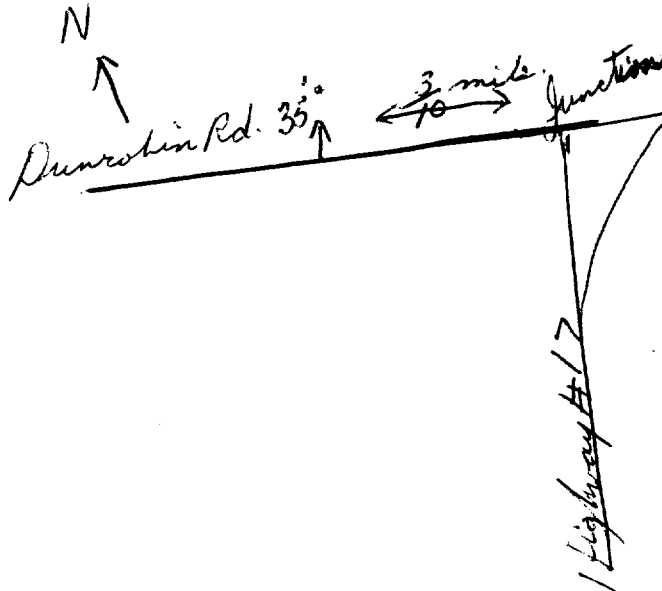
I certify that the foregoing statements of fact are true.

Date Aug 17/57

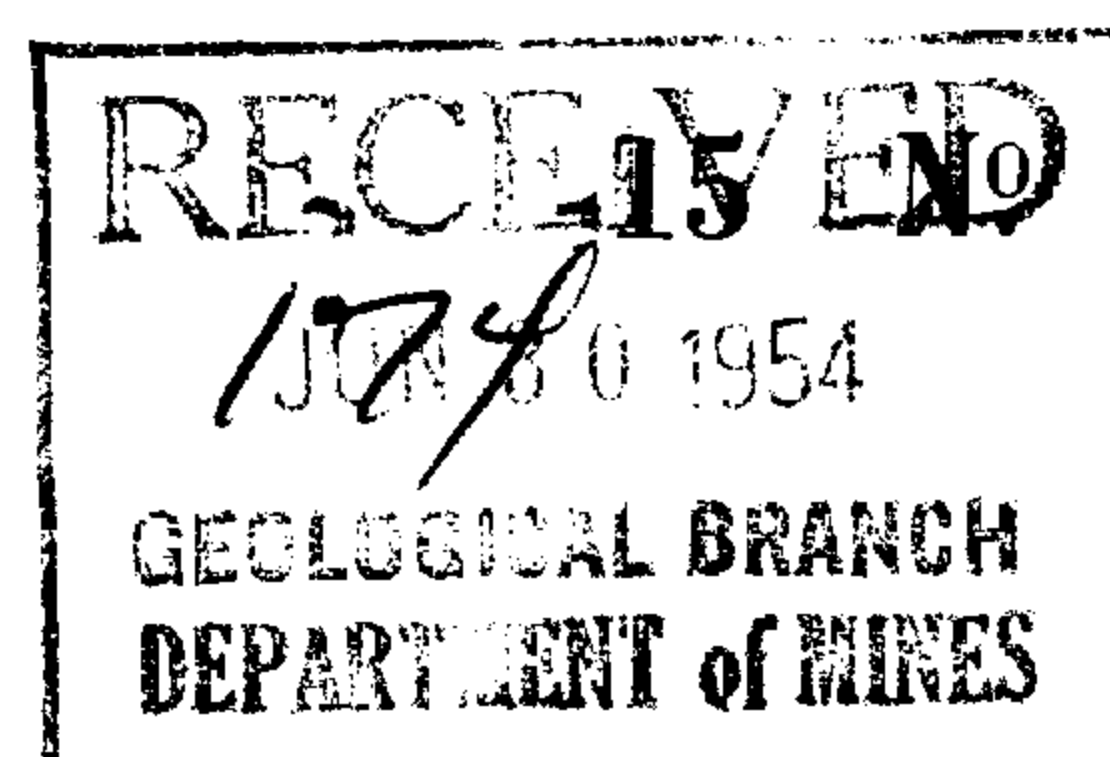
Signature of Licensee

Location of Well

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



Basin C02/55



3412

Department of Mines, Province of Ontario

County or Territorial District.....*Carleton*.....Township, Village, Town or City.....*Sundley*
Con..*3*.....Lot..*B-5*.....Street and Number (if in Village, Town or City).....
Owner.....[REDACTED].....Address.....
Date Completed..*3*.....*June*..*54*.....Cost of Well (excluding pump).....
(day) (month) (year)

Pumping Test

Casing diameter(s) .. 4"	Date... 3 June 54
Length(s) of casing(s) 50'	Static level... 40
Type of screen.....	Pumping level... 45
Length of screen.....	Pumping rate... 300 GPM
Distance from top of screen to ground level.....	Duration of test... 25 min
Is well a gravel-wall type?.....	Distance from cylinder or bowls to ground level.....

Kind (fresh or mineral) *fresh*

Quality (hard, soft, contains iron, sulphur, etc.) *hard*

Appearance (clear, cloudy, coloured) *clear*

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

.....

How far is well from possible source of contamination?

What is the source of contamination?

Enclose a copy of any mineral analysis that has been made of water.

Depth(s) to Water Horizon(s)	Kind of Water	No. of Feet Water Rises
60-75'	to	40'

To

hard pan & gravel
limestone rock

0 ft.

H.Ot.

40

251

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

• 1500' 3rd line of the

Richardson Sidel Rd

Situation: Is well on upland, in valley, or on hillside? *hillside*

Drilling Firm.....

Address.....

Name of Driller..... Address.....

Date *4 June 1954*..... Licence Number *429*.....

FORM 5

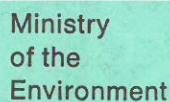
Signature of Licensee

CSS.58

Functional Servicing Brief
WM West Carleton Environmental Maintenance Facility
TF Project No.: 2511

Appendix 2

Existing Septic Records



APPLICATION NO.
77(5-III)16

INSPECTION DETAILS	TIME 1435	DATE May 5/83	WEATHER
REPRESENTING:	THE OWNER John Laurysen		THE INSTALLER W.R. Bousnel

a) Septic tank/holding tank of working capacity of 1000 Imp. Gals. constructed of steel ☐ concrete ☒ fibreglass ☐
on site ☐ or prefabricated ☒ to serve 20 (no. of bedrooms or units). 2000

MAKE AND MODEL,
IF PREFABRICATED TANK

b) Leaching bed of total 20 linear feet of 3 inch diameter distribution pipe of _____
(type and product description e.g. Canron CSA Approved PVC), laid in 4 runs and fed by _____
(gravity, siphon, pump).

c) Proprietary Aerobic System: (Manufacturer) _____ (Model) _____

d) Other details _____

a) System components installed as shown on application supporting Certificate of Approval ☒

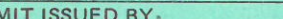
b) If located other than in (a) use space below for sketch and dimensions from permanent points of reference sufficient to facilitate future location of tank and leaching bed including orientation of pipe runs.

A large grid of graph paper, consisting of 20 columns and 10 rows of squares, intended for drawing a picture.

☐ Backfill System and Complete ☐ Finish Grading to Shed Run-off and Divert Water Around Leaching Bed

☐ Stabilize All Sloped Surfaces ☐ Other

Under Section 59a of The Environmental Protection Act 1971 and subject to the provisions of The Act and Regulations a Permit is hereby issued to (Owner) John Laurysen for the use and operation of the Class 4 sewage system constructed/installed/enlarged/extended/alterd pursuant to the Certificate of Approval issued under the above application number in accordance with the application and Certificate of Approval with any changes indicated above and located on Lot 5 Concession 3 Ward/Township/Municipality Huntley Region/District/County RNOC Plan No. _____ Sub-Lot No. _____

INSPECTED AND RECOMMENDED BY 	PERMIT ISSUED BY  DIRECTOR	DATE ISSUED 10 May 83
---	--	--------------------------

Note: Section 57(a) of The Act provides that no change can be made to any building(s) or structure(s) in connection with which this sewage system is used, if the operation or effectiveness of the sewage system will or is likely to be affected by the change, unless a new Certificate of Approval is obtained.

Section 78 of The Act provides that an applicant for a permit may appeal a decision to refuse to issue a permit. Written notice of appeal must be forwarded to the Director (who refused to issue the permit) and to the Environmental Appeal Board, 1 St. Clair Avenue West, Toronto, Ontario, M4V 1K7 within 15 days of receipt of a permit.

APPLICATION FORM AND CERTIFICATE OF APPROVAL FOR A CLASS 2-6 SEWAGE SYSTEM

(Please Print Clearly)

Application No. 77(5-III) 16
 Fee Receipt No. 51563
 Date Received 6 April 83

1. Name of Owner <u>John Laurysen</u>		Tel. No. <u>836 5353</u>		2. Installer's Name <u>RK Rowne</u>		Tel. No. <u>7494251</u>	
Address <u>Road 562</u> (No., Street, City, Town, etc.) <u>Stittsville Ont</u> <u>KOA-380</u>				Address <u>70 Queen Mary</u> (No., Street, City, Town, etc.) <u>Ottawa</u>			
3. Propose to <u>Re Locate</u> a Class <u>4</u> sewage system to serve <u>Shop</u> (Construct/Install/Alter/Extend/Enlarge) (Facility: e.g. Single Family Dwelling, Motel, etc.)							
4. Location — Region, County, District <u>Huntley</u>				Ward, Township, Town <u>West Earl</u>	Lot No. <u>5</u>	Conc. No. <u>3</u>	Sub.Lot. No.
5. State No. of	Bedrooms or Motel Units	People	Flush Toilets	Urinals	Washbasins	Showers and Bathtubs	6. Water Supply
	<u>—</u>	<u>20</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>—</u>	Dug or Bored Well ☐ Drilled Well ☒ Municipal ☐ Other ☐ Proposed ☐ or Existing ☐

7. Attach completed sketch on Page 2 — List other attachments:

8. Relationship to Severance if applicable

- ☐ Lot Approval Pending
☐ Lot Approved
 Under Severance Application
 No.

9. Directions to Lot:— Highway No. Secondary Roads, Signs to Follow, etc.

1 1/2 mile north of
Queen's Hwy. Con 3

10. I certify that the above information is complete and correct and that, if approved, the work will conform with Provincial requirements for sewage systems and local Municipal By-Laws. (Attach fee for Class 4, 5 or 6 systems)

Name of Agent

Tel. No.

Signature of Owner or Agent

Address

(No., Street, City, Town, etc.)

Date

11. INSPECTOR'S REPORT

Inspection Time

and Date 1315 AM April 11 19 83

Sub-Surface Conditions Encountered

Weather

Representing Owner

Leaching Bed Design Criteria

Depth to Rock

Design H.W.T.

5' +

5' +

Ft.

Ft.

REQUIREMENTS

Lineal Feet of

Distribution

Pipe

60m

Working Capacity of

Septic/Holding Tank

Imp. Gallons

1000ml

Rock & G.W.T.

Elevation

Soil Type

0
1
2
3
4
5

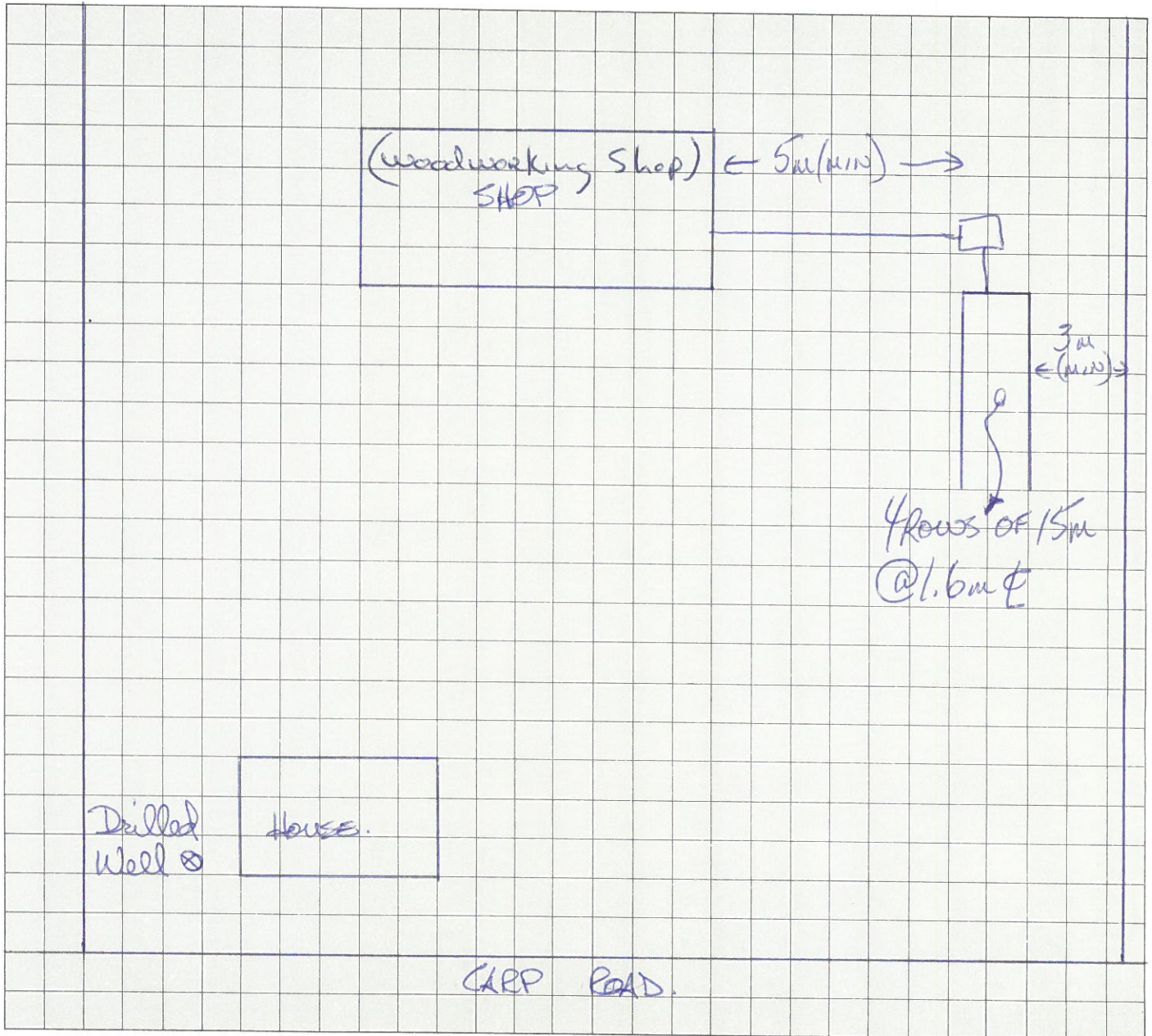
sand & gravel

Conditions of Approval and Reasons (e.g. fill, grading, drainage improvements, design sewage flows) ☐

OR

Reasons where Proposal not Acceptable (add additional pages if required) ☐

12. LOT DIAGRAM AND SEWAGE SYSTEM PLAN: — Draw to scale indicating north point and showing:
- Location of sewage system components (e.g. tanks, leaching bed). Locate and show horizontal distances from system to adjacent existing or proposed buildings, water supplies (including neighbours), existing on-site sewage systems, driveways, property lines, lakes, rivers, water courses, swimming pools.
 - Lot dimensions, topographic features (e.g. swamps, steep slopes) near system.
 - If any part of proposal conforms to a specific standard drawing, give reference number(s).



13. A Certificate of Approval for this application is refused for the reasons given in Section 11 Page 1

INSPECTED AND RECOMMENDED BY

REFUSED

DATE

DIRECTOR

CERTIFICATE OF APPROVAL

Application approved and this Certificate of Approval under Section 65 of the Environmental Protection Act is hereby issued for the proposal outlined on Pages 1 and 2 of the application and its attachments as amended by the requirements and conditions of Section 11 provided that the sewage system shall be completed and a Use Permit issued within 12 months of the issue hereof or such extended period as the Director on application allows. DO NOT OPERATE THE SYSTEM UNTIL A USE PERMIT IS ISSUED.

INSPECTED AND RECOMMENDED BY

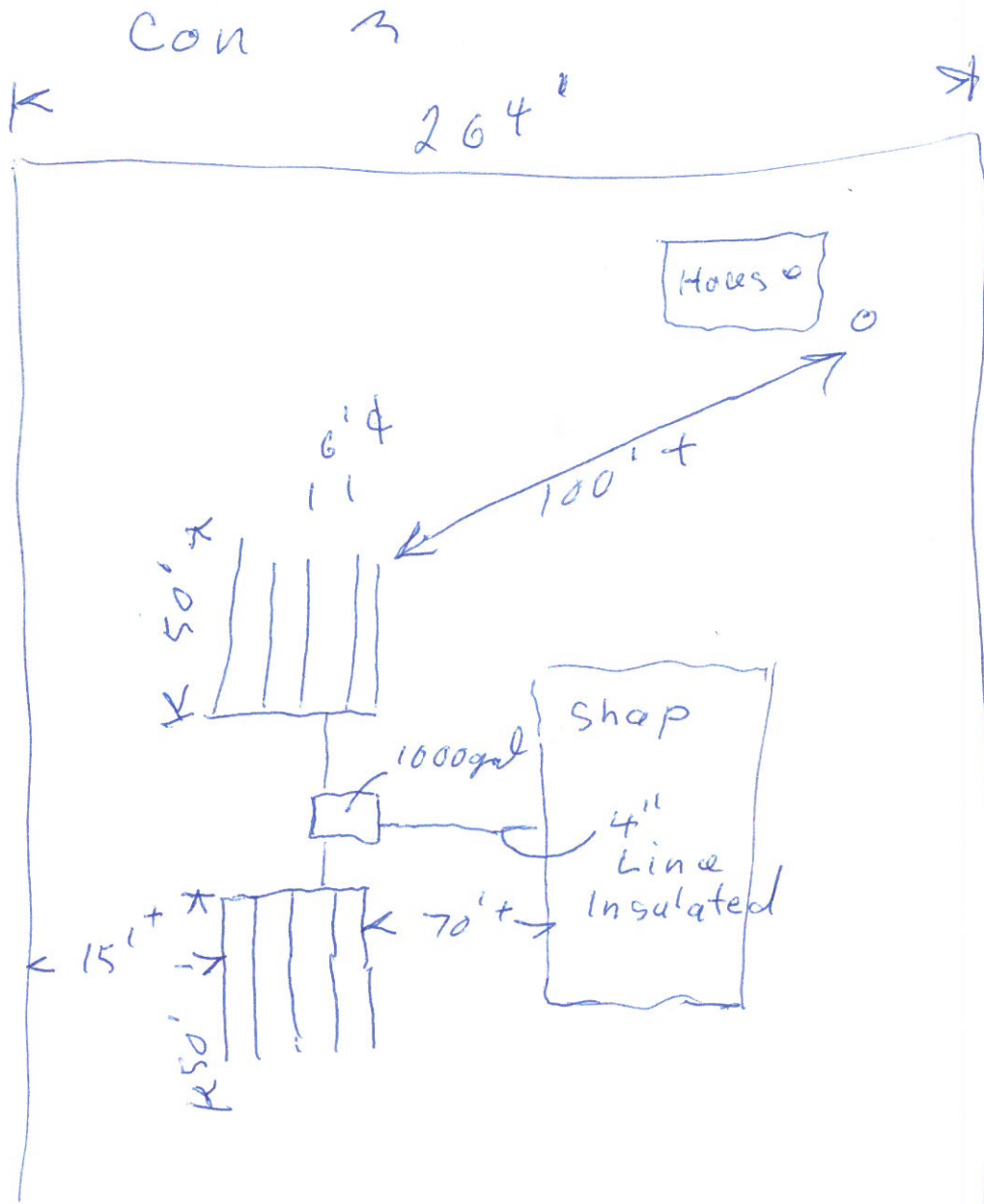
ISSUED

DATE

DIRECTOR

Under Section 121 of the Environmental Protection Act, an applicant may appeal a decision by writing to the Director and to the Environmental Appeal Board, 1 St. Clair Avenue West, Toronto, Ont., M4V 1K7 within 15 days of receipt of the decision.

3. LOT DIAGRAM: -- Attach survey plan or complete a sketch here.
The following information MUST be provided:
Outline and give dimensions of Lot(s); north arrow; location of existing or proposed buildings, disposal systems, and water supply; distinctive topographical characteristics of lot; location of lake, river and all watercoursed; location of NEIGHBOURING water supplies and disposal systems within 300 ft. of your lot line.



4. PLEASE NOTIFY THIS OFFICE WHEN THE BELOW REQUIREMENTS HAVE BEEN MET:

- 1) A test pit, in the area of the proposed tile field, is to be dug to a depth of 5 feet, or to bedrock, or to the watertable, whichever is lesser. (The minimum diameter of 6 inches is required for the test pit.)
- 2) Lot corners must be clearly marked in the field.
- 3) At the entrance from the road prominently display your name and lot number.



Ottawa Septic System Office Bureau des systèmes
septiques d'Ottawa

Application for a Permit to Construct or Demolish

This form is authorized under the Building Code Sentence 2.4.1.1A.(2).

For use by Principal Authority	
Application number:	Permit number (if different): 05-493
Date received: July 27 2005	Roll number:

Application submitted to: Ottawa Septic System Office (R.V.C.A.)
(Name of municipality, upper-tier municipality, board of health or conservation authority)

A. Project information				
Building number, street name 2415 Carp Road			Unit number	Lot/con. 5/3
Municipality Ottawa (west Carleton)	Postal code K0A 1L0	Plan number/other description SR-11322		
Project value est. \$ 17,000.00		Area of work (m ²)		
B. Applicant				
Applicant is: ☐ Owner or ☒ Authorized agent of owner				
Last name		First name		Corporation or partnership Latimer Excavating Ltd.
Street address P.O. Box 649			Unit number	Lot/con.
Municipality Stittsville	Postal code K2S 1A7	Province Ontario	E-mail	
Telephone number (613) 836-4106		Fax (613) 836-4117		Cell number ()
C. Owner (if different from applicant)				
Last name		First name		Corporation or partnership Laurysen Investments Inc.
Street address 2415 Carp Road			Unit number	Lot/con.
Municipality Carp	Postal code K0A 1L0	Province Ontario	E-mail	
Telephone number (613) 836-5353		Fax (613) 836-7511		Cell number ()
D. Builder (optional)				
Last name		First name		Corporation or partnership (if applicable)
Street address			Unit number	Lot/con.
Municipality	Postal code	Province	E-mail	
Telephone number ()		Fax ()		Cell number ()
E. Purpose of application				
☒ New construction ☐ Addition to an existing building ☐ Alteration/repair ☐ Demolition ☐ Conditional Permit				
Proposed use of building		Current use of building Commercial Office Building		
Description of proposed work Replace existing Septic System				
F. Tarion Warranty Corporation (Ontario New Home Warranty Program)				
i. Is proposed construction for a new home as defined in the Ontario New Home Warranties Plan Act? If no, go to section G.		☐ Yes	☒ No	
ii. Is registration required under the Ontario New Home Warranties Plan Act?		☐ Yes	☒ No	
iii. If yes to (ii) provide registration number(s): _____				

G. Attachments

- i. Attach documents establishing compliance with applicable law as set out in Article 1.1.3.3.
- ii. Attach Schedule 1 for each individual who reviews and takes responsibility for design activities.
- iii. Attach Schedule 2 where application is to construct on-site, install or repair a sewage system.
- iv. Attach types and quantities of plans and specifications for the proposed construction or demolition that are prescribed by the by-law, resolution, or regulation of the municipality, upper-tier municipality, board of health or conservation authority to which this application is made.

H. Declaration of applicant

I Latimer Excavating Ltd. _____ certify that:
 (print name)

1. The information contained in this application, attached schedules, attached plans and specifications, and other attached documentation is true to the best of my knowledge.
2. I have authority to bind the corporation or partnership (if applicable).

July 26-05

Date

Lat

Signature of applicant

Personal information contained in this form and schedules is collected under the authority of subsection 8(1.1) of the *Building Code Act, 1992*, and will be used in the administration and enforcement of the *Building Code Act, 1992*. Questions about the collection of personal information may be addressed to: a) the Chief Building Official of the municipality or upper-tier municipality to which this application is being made, or, b) the inspector having the powers and duties of a chief building official in relation to sewage systems or plumbing for an upper-tier municipality, board of health or conservation authority to whom this application is made, or, c) Director, Building and Development Branch, Ministry of Municipal Affairs and Housing 777 Bay St., 2nd Floor, Toronto, M5G 2E5 (416) 585-6666.

Schedule 1: Designer Information

Use one form for each individual who reviews and takes responsibility for design activities with respect to the project.

A. Project Information			
Building number, street name <u>2415 Carp Road</u>		Unit no.	Lot/con.
Municipality <u>Ottawa (west Carleton)</u>	Postal code <u>K0A 1L0</u>	Plan number/ other description <u>SR-11322</u>	
B. Individual who reviews and takes responsibility for design activities			
Name <u>Terilyn Latimer</u>		Firm <u>Latimer Excavating Ltd.</u>	
Street address <u>P.O. Box 649</u>		Unit no.	Lot/con.
Municipality <u>Stittsville</u>	Postal code <u>K2S 1A7</u>	Province <u>Ontario</u>	E-mail
Telephone number <u>(613) 836-4106</u>	Fax number <u>(613) 836-4117</u>	Cell number ()	
C. Design activities undertaken by individual identified in Section B. [Building Code Table 2.20.2.1]			
☐ House ☐ Small Buildings ☐ Large Buildings ☐ Complex Buildings		☐ HVAC – House ☐ Building Services ☐ Detection, Lighting and Power ☐ Fire Protection	
		☐ Building Structural ☐ Plumbing – House ☐ Plumbing – All Buildings ☒ On-site Sewage Systems	
Description of designer's work <u>Design Septic System - Class 4-Trench.</u>			
D. Declaration of Designer			
I <u>Terilyn Latimer</u> declare that (choose one as appropriate): (print name)			
☒ I review and take responsibility for the design work on behalf of a firm registered under subsection 2.17.4. of the Building Code. I am qualified, and the firm is registered, in the appropriate classes/categories. Individual BCIN: <u>13518</u> Firm BCIN: <u>16516</u>			
☐ I review and take responsibility for the design work and am qualified in the appropriate category as an "other designer" under subsection 2.17.5. of the Building Code. Individual BCIN: _____ Basis for exemption from registration: _____			
☐ The design work is exempt from the registration and qualification requirements of the Building Code. Basis for exemption from registration and qualification: _____			
I certify that:			
1. The information contained in this schedule is true to the best of my knowledge.			
2. I have authority to bind the corporation or partnership (if applicable).			
<u>July 26-05</u> Date		<u>[Signature]</u> Signature of Designer	

*For the purposes of this form, "individual" means the "person" referred to in Clause 2.17.4.7.(1)(d), Article 2.17.5.1. and all other persons who are exempt from qualification under Subsections 2.17.4. and 2.17.5.

NOTE:

1. Firm and Individual BCIN numbers are not required for building permit applications submitted prior to January 1, 2006
2. Schedule 1 does not need to be completed by architects, or holders of a Certificate of Practice or a Temporary License under the *Architects Act*.

Schedule 2: Sewage System Installer Information

A. Project Information			
Building number, street name <u>2415 Carp Road</u>		Unit number	Lot/con.
Municipality <u>Ottawa (West Carleton)</u>	Postal code <u>K0A 1L0</u>	Plan number/ other description <u>5R-11322</u>	
B. Sewage system installer			
Is the installer of the sewage system engaged in the business of constructing on-site, installing, repairing, servicing, cleaning or emptying sewage systems, in accordance with Building Code Article 2.18.1.1?			
☒ Yes (Continue to Section C) ☐ No (Continue to Section E) ☐ Installer unknown at time of application (Continue to Section E)			
C. Registered installer information (where answer to B is "Yes")			
Name <u>Latimer Excavating Ltd.</u>		BCIN <u>16516</u>	
Street address <u>P.O. Box 649</u>		Unit number	Lot/con.
Municipality <u>Stittsville</u>	Postal code <u>K2S 1A7</u>	Province <u>Ontario</u>	E-mail
Telephone number <u>(613) 836-4106</u>	Fax <u>(613) 836-4117</u>	Cell number ()	
D. Qualified supervisor information (where answer to section B is "Yes")			
Name of qualified supervisor(s) <u>Temilyn Latimer</u>		Building Code Identification Number (BCIN) <u>13518</u>	
E. Declaration of Applicant:			
I <u>Latimer Excavating Ltd.</u> declare that: (print name)			
☒ I am the applicant for the permit to construct the sewage system. If the installer is unknown at time of application, I shall submit a new Schedule 2 prior to construction when the installer is known;			
OR			
☐ I am the holder of the permit to construct the sewage system, and am submitting a new Schedule 2 now that the installer is known.			
I certify that:			
1. The information contained in this schedule is true to the best of my knowledge.			
2. I have authority to bind the corporation or partnership (if applicable).			
<u>July 26-05</u> Date		<u>[Signature]</u> Signature of applicant	



Schedule 4 Proposed Services

Do Not Complete
Permit No 05-493
Revision No _____
Date _____

1. Engineered

☐ Yes

☒ No

2. Water supply

☐ Proposed

☒ Existing

3. Type of work proposed

☐ New Installation

☒ Replacement

☐ Alteration

4. Type of Well

☐ Dug/bored/Sandpoint well

☒ Drilled well

☐ Municipal

☐ Other

5. Residential Sewage Design Flow Info.

Bedrooms _____

House (floor area) _____ m²

People _____

Total Fixture Units _____ (Schedule 7)

Residential Flow _____ L/day

6. Sewage Design Flow for Other Occupancies

Design Flow 2.595 L/day

Detailed sewage flow calculations:

Store $279\text{m}^2 \div 1.0\text{m}^2 = 279 \times 5 = 1395$

Office $139.5\text{m}^2 \div 9.3\text{m}^2 = 15 \times 75 = 1125 = 15 \text{ employees} \times 75$

Other Storage $46\text{m}^2 \div 46\text{m}^2 = 1 \times 75 = 75$

7. Type of System

☐ Treatment Unit _____

☐ Class 2 – Leaching Pit

☐ Class 3 – Cesspool

☐ Class 4 – Shallow Buried Trench

☒ Class 4 – Trench

☐ Fully raised

☐ Partially raised

☒ In-ground

☐ Class 4 – Filter Media

☐ Fully raised

☐ Partially raised

☐ In-ground

☐ Class 4 – Area Bed

☐ Fully raised

☐ Partially raised

☐ In-ground

☐ Class 4 – Aerobic with Trench

☐ Fully raised

☐ Partially raised

☐ In-ground

☐ Class 4 – Aerobic with Filter Media

☐ Fully raised

☐ Partially raised

☐ In-ground

☐ Class 5 – Holding Tank



Schedule 5 Sewage System Details

Type of System Class 4 - Trench (Schedule 4)

Septic/Holding 9500 L

Septic Tank Effluent Filter Orencia

Site to be Scarified (If in Clay) YES / NO

Clay Seal Required (If in bedrock) YES / NO

Trench Bed - Length of Distribution Pipe 108 m

Proposed diameter of Tile (mm/in) 3

Filter Bed - Stone _____ m

Sand _____ m

Pipe _____ m

Amount of Filter Media _____ Kg required

Pump(s) required _____

Specify discharge rate required _____ L/15min

Note: Alarm required for all pumping systems

SBT - Length of Distribution Pipe _____ m

Area Bed - Stone _____ m

Sand _____ m

Pipe _____ m

Refer to Typical Drawing _____

Mantle Information

Native or imported 15m in 1(S) direction(s)

Slope subgrade 1 % slope

(S) direction(s)

Loading rate 324.38 m required

Construction Notes: _____



Schedule 6
Soil and Water Table Information
(Minimum depth of test pit: 2 metres)

Name of Applicant/Agent: <u>Latimer Excavating</u> Date: <u>July 11-05</u> Time: <u>P.M.</u> Applicant/Agent Signature: <u>[Signature]</u>			Inspector: <u>ACD</u> Date: <u>Aug. 2/05</u> Time: <u>2:15</u> Inspector Signature: <u>[Signature]</u>		
EG (<u>98.26</u>)	Soil Description	T	EG (<u>98.391</u>)	Soil Description	T
<u>0.15</u>	<u>Topsoil</u>		<u>0.13</u>	<u>Topsoil</u>	
.5m	<u>Pit Run</u> <u>Gravel</u> <u>Sand</u> <u>mix</u>		.5m	<u>compact silty</u> <u>till</u>	
1.0 m			1.0 m		
1.5m	<u>Bottom</u> <u>of Test</u> <u>Pit.</u>		<u>1.17</u> <u>dry</u>		
2.0 m			1.5m		
			2.0 m		
EG (<u>95.74</u>)	Soil Description	T	EG (<u>95.788</u>)	Soil Description	T
<u>0.150</u>	<u>Topsoil</u>		<u>0.1</u>	<u>Topsoil</u>	
.5m	<u>Pit run</u> <u>Gravel</u> <u>Sand mix</u>		<u>0.37</u>	<u>compact silty till</u>	
1.0 m			1.0 m	<u>compact sandy</u> <u>silt w pebbles</u> <u>& cobbles</u>	
1.5m	<u>Bottom of</u> <u>Test pit</u>		<u>1.07</u> <u>dry</u>		
2.0 m			1.5m		
			2.0 m		
LEGEND BR = Bedrock HGWT = High ground water table EG = Existing grade GWT = Ground water table M = metres T = percolation rate					



Scale: ~~1 Block~~ = 1:500

Schedule 7 Layout Section

N

See Attached
Drawing

 Dug Well Drilled Well Neighbouring Homes Benchmark Tile Drainage Property Line

Elevations (metric only)

B.M. 100.0 m

B.M. Description Top of Foundation

Exact Location Top of Foundation under Door

Min. of 5 elevations in proposed system area
(in X pattern)

X ₁ <u>98.60</u>	X ₂ <u>97.40</u>
X ₃ <u>95.30</u>	X ₄ <u>95.74</u>
X ₅ <u>98.26</u>	X _{6 (toe)} <u>95.68</u>
X ₇	X ₈



Schedule 8 Fixture unit count

Fixtures	# Existing	+ # Proposed	X	unit count	=	Fixture Count
Bathroom						
Bathroom group (toilet, sink and tub or shower) with flush tank		+	X	6	=	
Bathtub with/without overhead shower		+	X	1.5	=	
Shower stall		+	X	1.5	=	
Wash basin (1 inch trap)		+	X	1.5	=	
Watercloset (toilet) tank operated		+	X	4	=	
Bidet		+	X	1	=	
Kitchen						
Dishwasher		+	X	0.5	=	
Sink with/without garbage grinder(s), domestic and other small type single, double or 2 single with a common trap		+	X	1.5	=	
Other						
Domestic washing machine		+	X	1.5	=	
Combination sink and laundry tray single or double (Installed on 1 trap)		+	X	1.5	=	

Total:

Insert the TOTAL in section 5 of Schedule 4 (0.Reb.403/97 Table 7.4.9.3)

1. Sump pumps and floor drains are not to be connected to the sewage system. Connection of such fixtures to a sewage system may lead to a hydraulic failure of the said system. The above mentioned fixtures should be discharged separately to an approved Class 2 (leaching pit) sewage system.
2. Where laundry waste is not more than 20% of the total daily design sanitary sewage flow, it may discharge to a sewage system (Part 8, OBC, 8.1.3.1(2)).

Agent/Owner signature

Date



BURIED OR RAISED TILE BED - ABSORPTION TRENCH METHOD

Date _____

Applicant _____

Scarification required ☒ Yes ☐ No

DATE 3/05 Wm. J. Dwyer
MANAGER, O.S.S.O.

Is mantle required:

Yes ☒

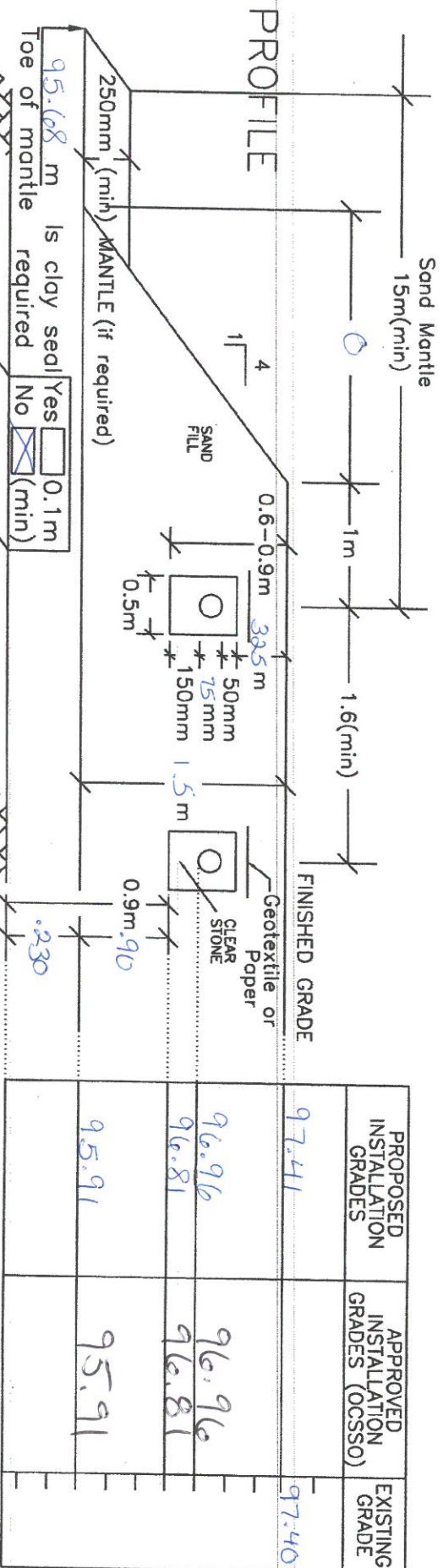
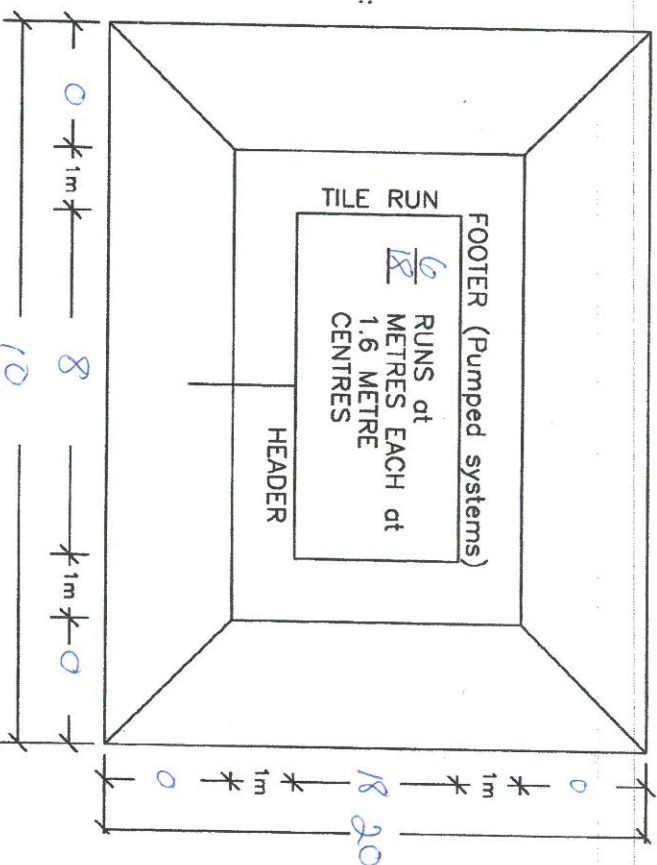
No ☐

If Yes, in what direction 1(S)

PLAN

Yes ☒ No ☐

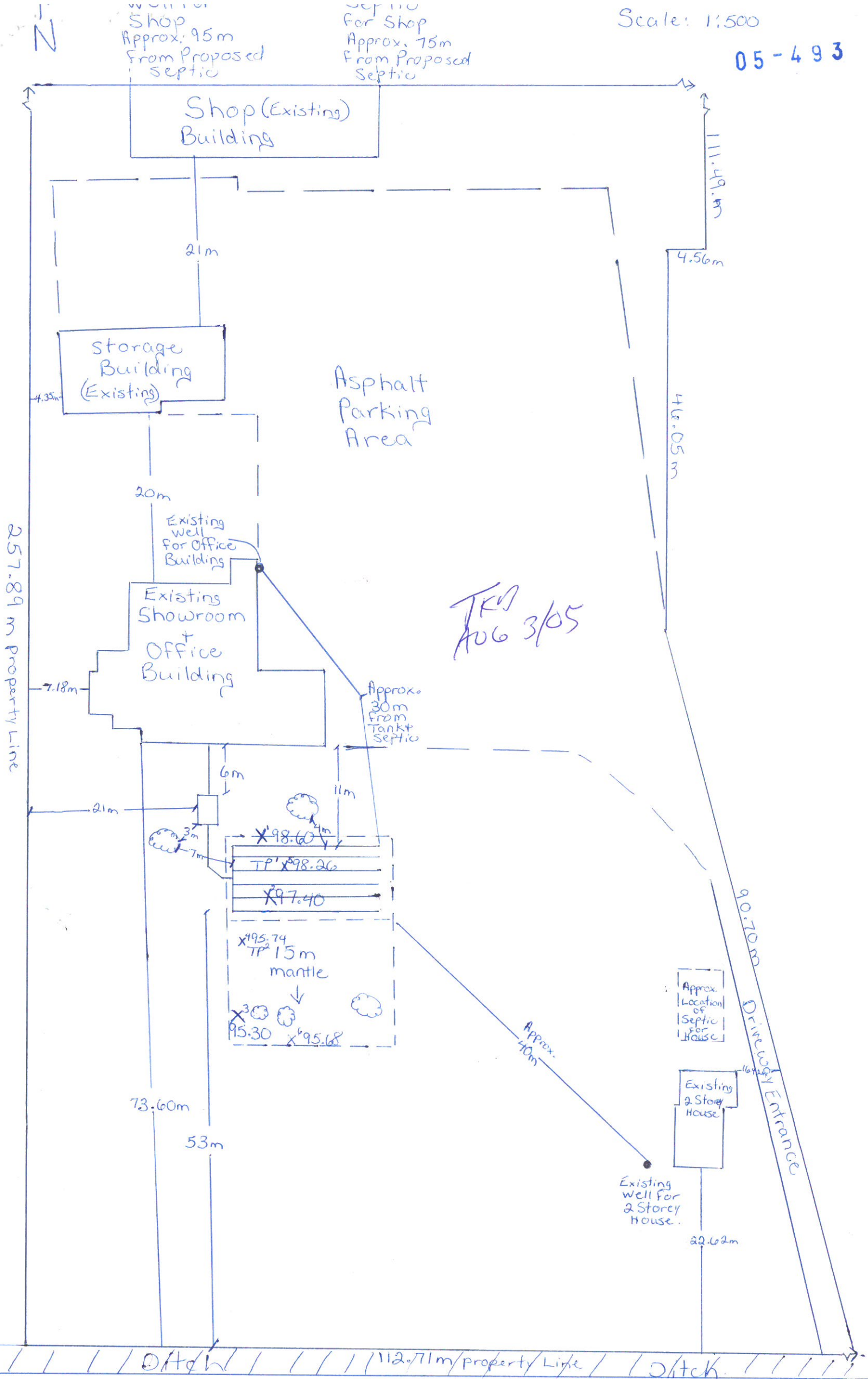
If Yes, in what direction 1 (S)



All rights reserved. No part of this work covered by the copyright herein may be reproduced or used in any form or by any means – graphic, electronic, or mechanical, including photocopying, recording, taping, or information retrieval systems – without the prior written permission of the Conservation Authority.

Scale: 1:500

05-493



257.89 m Property Line

112.71m/property Line / Ditch

2415 Carp Road.



Permit

Do Not Complete
Permit No 05-493
Revision No _____
Date _____

FOR OFFICE USE ONLY

Inspected and Recommended by ACD

Inspection Date (dd/mm/yyyy) and time: 02/08/05 Weather: sun ~30°C

Representing Owner _____

Design T 8.3 min/cm Design HGWT 1 m

Percolation test required Yes/No No Grain size analysis required Yes/No No

Site to be Scarified Yes/No No Clay Seal Inspection Yes/No No

Mantle Yes/No No

Septic/Holding Tank 9500 L

Leaching Bed Design Criteria – Depth to rock/impervious soil _____ m

Requirements – Length of Distribution Pipe 108 m

Area Bed – Stone _____ m², Sand _____ m², Pipe _____ m

Shallow Buried Trench – Length of Pipe _____ m

Septic Tank Effluent Filter strongly recommended Amount of Filter Media 1 Kg required

Treatment Unit – Make and Model _____ Number of Units _____

Manager, Septic System Approvals: Jenny Davidson

Permit Issued Date: AUGUST 3, 2005

Permit Revision

Revision Description

- ① OSSO to inspect subgrade suitability prior to placing sand fill
- ② Septic system to be installed according to OBC.
- ③ Toe of mantle is to be free draining.

Manager, Septic System Approvals: T

Revision Issued Date: _____



Installation Report • Rapport d'installation

Applicant: <u>Laurysen Investments Inc.</u>	Legal Description: Lot: _____ Conc.: _____ S.Lot: _____ R.Plan: _____
File #: <u>105-493</u>	Present on site: _____ Inspector: <u>Adam Dillon</u>
Date: <u>Aug 16/05</u>	Time: <u>10:30</u> Weather: <u>sun ~30°C</u>
Civic Address: <u>2415 Carp Rd.</u>	

Scarification Inspection and/or Clay Seal	Time: _____ Date: _____ Approved: ☐ yes ☐ no Weather: _____ On-site: _____ Inspector: _____ Length: _____ Width: _____ Elevations: _____ Bed Area: _____ Comments: _____ Mantle: _____
Section A Tank	Septic tank/holding tank size: <u>9400</u> (L) Filter make and model: <u>OSI Brofube</u> Make and model: <u>Boyd Bros.</u> Inlet: <u>sealed w glue</u> Outlet: <u>sealed</u> ☐ plastic ☒ concrete ☐ fiberglass ☐ on-site Lids: <u>recessed to concrete</u> Baffles: <u>pvc 'Ty'</u> ☒ prefabricated
Section B Treatment Unit	Make: _____ Connections: _____ Model: _____ Electrical: _____
Section C Leaching Bed	Location: <u>Front yard</u> Distances: _____ Type: <u>class 4 trench</u> Structure(s): <u>office House: 14 m</u> Height: <u>70.9 m unsaturated sand</u> Lot Lines: <u>75.0 m</u> Wells*: 1) <u>718 m</u> Header: ☒ level End Pipe: ☒ level Watercourses: _____ 2) _____ Runs: <u>6</u> Length: <u>18 m</u> Tree(s): <u>maple, spruce, pine, poplar</u> Gravel Size: <u>3/4"</u> Thickness: <u>OK</u> Between Trenches: <u>1.6 m</u> Fall on Runs: ☒ yes ☐ no Mantles: <u>13.2 to 14.8</u> metres in <u>1</u> direction(s) Ends capped: ☒ yes ☐ no Interconnect ☐ thickness: <u>70.25 m</u> Geotextile: ☐ yes ☒ no Paper: ☐ yes ☐ no Other: _____ Pipes: Diameter ☒ 3 in. ☐ 4 in. ☐ chamber syst. Elevations: (if required) Make: _____ Header: _____ Ends: _____ Extended base: _____ Paperwork for F.M.: ☐ grain size and C.U. ☐ Weigh Bills Shallow Buried Trench: Runs: _____ Length: _____ Pipe: ☐ 1" ☐ 1.5" Chamber: _____ Area Bed: _____ Stone: Length: _____ Width: _____ Sand: Length: _____ Width: _____
Section D Pump Chamber	☐ pump chamber ☐ pump present ☐ forced main: ☐ check valve ☐ floats installed ☐ electrical wiring ☐ frost protection installed ☐ alarm: ☐ inside ☐ outside ☐ other: _____ ☐ joints sealed properly
Section E Distribution Box	☐ sealed joints ☐ baffle or other ☐ Diagram: _____ ☐ level ☐ compacted base ☐ frost protection number of outlets: _____

*affected neighbouring wells

- ☒ Picture(s) taken
☐ Approved in Full
☒ Preliminary On-Site Approval (additional paperwork required, etc.)

☐ Not approved, for re-inspection, call 692-0160 or 1-800-459-5975. Please ensure that ALL noted deficiencies have been rectified prior to calling for a re-inspection.

Remarks:

- ① Geotextile to be placed over stone prior to backfilling.
② existing septic tank to be broken down / decommissioned.
③ 15 m mantle required, check @ 3rd inspection



Ottawa Septic System Office Bureau des systèmes septiques d'Ottawa

SEPTIC SYSTEM PERMIT #

05-493

REQUIRED FOR ALL INQUIRIES

AS-BUILT DRAWING

(required prior to installation inspection)

Elevations of installed system must be supplied with this report (in reference to the TBM).

Exact size and location of all structures, well(s) and system(s) and its components must be shown (including neighbouring lots).

Septic/Holding Tank: 9400 L

Manufacturer: Boyd Bros.

☒ concrete ☐ polyethylene ☐ other

Filter: ☐ no ☒ yes Orencia make

Treatment: Make _____

Unit: Model _____

Diameter of pipes: 3 mm/inches

Make of pipes: Iplex

Ends: ☒ capped ☐ interconnected

Number of runs: 6 Runs m

Length of runs: 18 m

Filter media:

Amount Purchased: _____ kg

Date Purchased: _____

Supplier: _____

Grain/size analysis by: _____

Analysis dated: _____

Name of owner: Lauryser Investments Inc.

Installer: Latimer Excavating Ltd.

Installer Signature: [Signature]

License Number: 16516

Date of Installation: August 11, 2005

Civic Address or Legal Description of Property:

2415 Carp Rd.

Township West Carleton (Huntley)

Pump Systems:

Volume discharge rates: _____/15min

Alarm location: _____

Dimension of Pump Chamber: _____

Height of Float Switch: _____

Grease Interceptor:

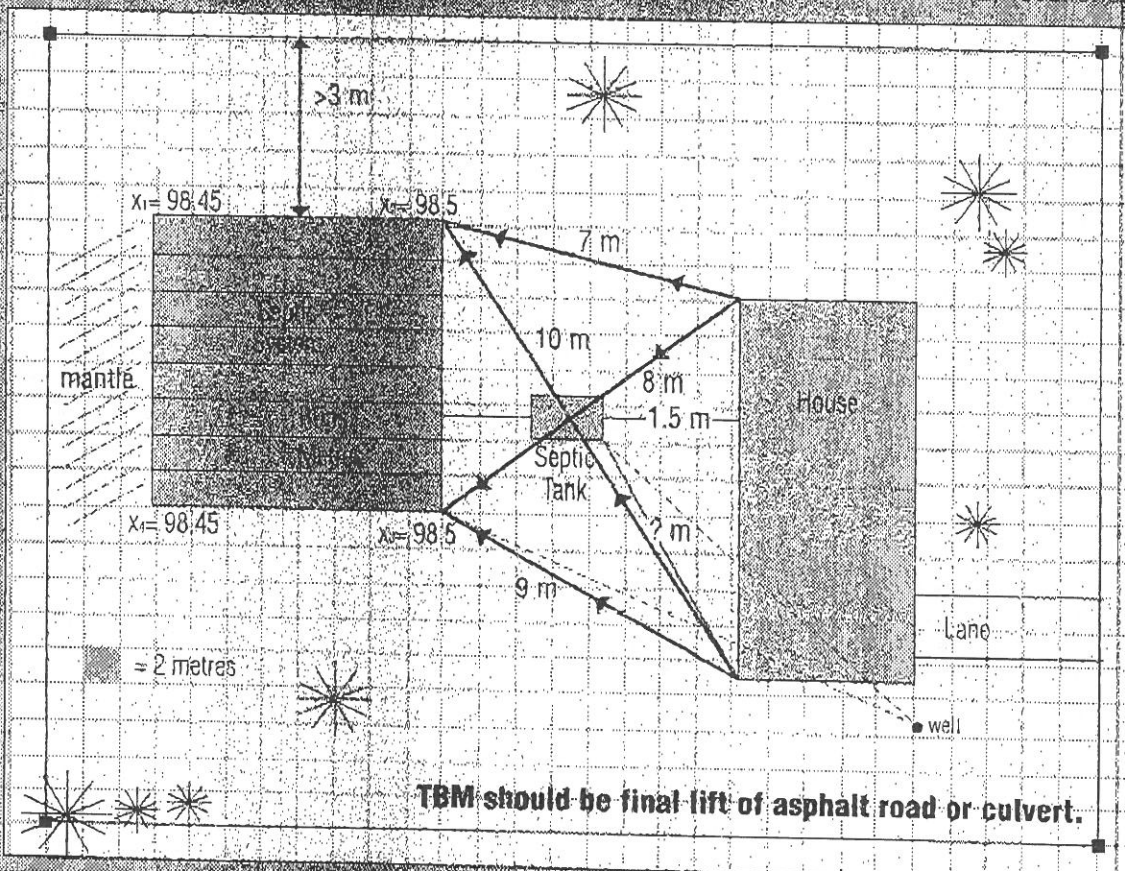
☐ no ☐ yes Size: _____

Location: _____

***Grain Size Analysis and weight bills must be supplied with this report.**

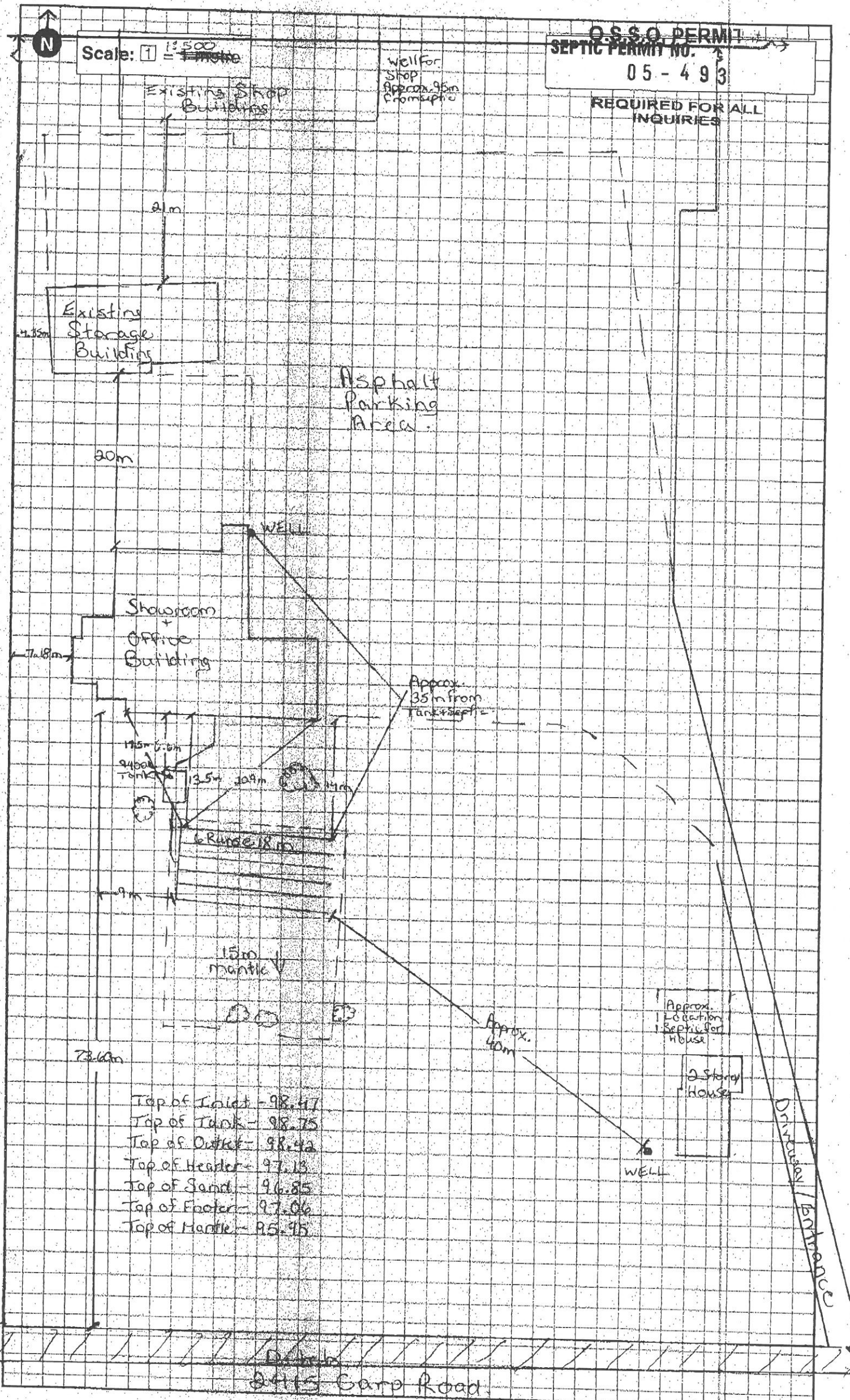
All rights reserved. No part of this work may be reproduced or used in any form without the prior written permission of the copyright holder.

NOTE: All as-built drawings must be cross-referenced to the house in two (2) locations.



NOTE:

- Drilled well: 15 metres to 20 metres
- Dug well: 15 metres septic tank, 30-33 metres to distribution pipes





Final Grading Inspection

File #: 05-493 Lot Ident: _____ Applicant: harryson Investments Inc.
 Lot Identification: _____ Date: Sept. 1/05 Time: 2:20 Weather: sun
 Present on Site: Julie Lyons Inspector: Adam Dillon / TKD
 Civic Address: 2415 Carp Rd.

- 1) Depth of cover material measured from the top of the crushed stone layer to surface.

$X_1 = \frac{0.82}{0.58} \text{ m}$ $X_2 = \frac{0.78}{0.70} \text{ m}$ $X_3 = \frac{0.65}{0.48} \text{ m}$ $X_4 = \frac{0.65}{0.48} \text{ m}$ $X_5 = \frac{0.65}{0.42} \text{ m}$

- 2) Description of cover material: ☒ sand ☒ topsoil ☐ seed/sod

- 3) Is the top of the bed shaped to shed water? ☒ yes ☐ no

- 4) Is the side slope stable? ☒ yes ☐ no

- 5) Is all drainage directed away from the tile bed? ☒ yes ☐ no

- 6) Thickness of Mantle: _____

$L_1 = \text{_____ m}$ $L_2 = \text{_____ m}$ $L_3 = \text{_____ m}$ $L_4 = \text{_____ m}$

- 7) Depth of mantle _____ (metres) ☐ yes ☐ no

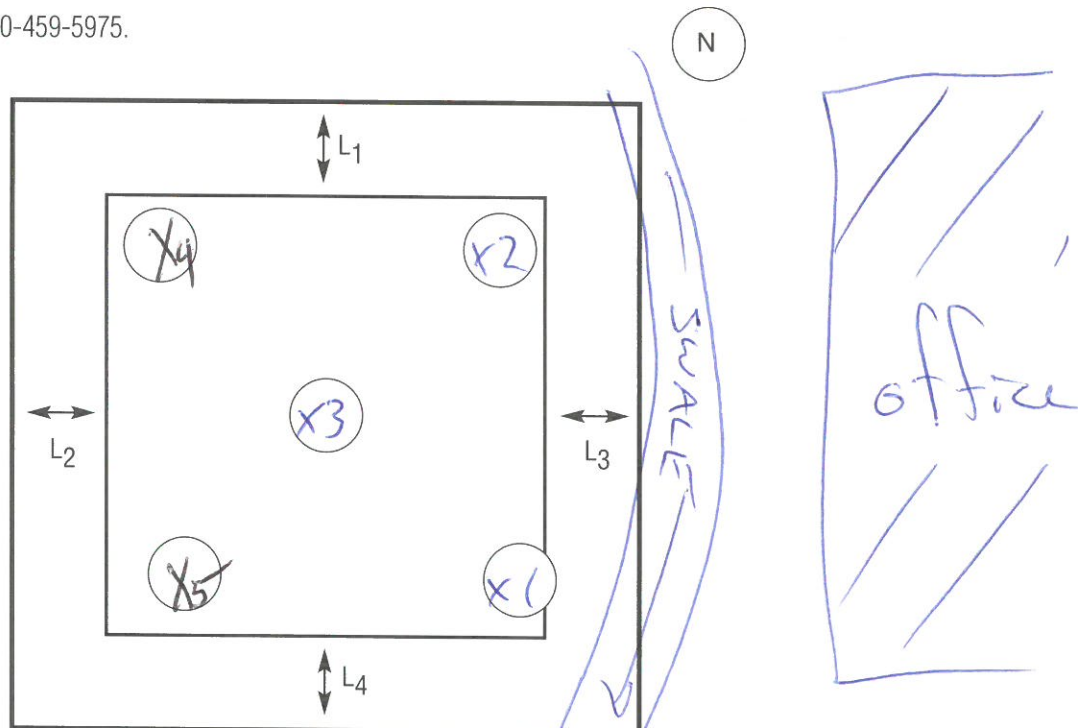
- 8) Description of mantle material: _____

- 9) Was a photograph of the complete system taken? ☐ yes ☒ no

- 10) Inspection: ☒ approved in full ☐ conditional approval (see comments:)

☒ not approved (see comments:)

For re-inspection, call 692-0160 or 1 800-459-5975.



- 11) Comments:

Remove soil cover & construct swale to direct surface water away from septic bed. $\Rightarrow$ OK Sept 14/05 GPA

* 0.70m final cover in area of X_2 exceeds maximum of 0.60m, but will be overlooked since drainage swale is in place to direct surface runoff away from bed.



JIM GONCH

Ottawa Septic Bureau des systèmes
System Office septiques d'Ottawa

Certificate of Completion

For the use and operation of an on-site sewage disposal system in accordance with the **Sewage System Permit**.

This certifies that the on-site sewage system conforms to the *Ontario Building Code* and *Ontario Regulation 403/97* as amended by *Ontario Regulation 22/98*

Sewage System Permit Number	05-493	Issued to	Lauryser Investments Inc
Legal Description	Lot 5	Concession	3
		Sub. Lot	
		Registered/Reference Plan	5R-11322

Municipal Address: 2415 Carp Rd
In the former Township/City of Huntley

Within the City of Ottawa

Details Pertaining to System

☐ new installation ☒ replacement ☐ alteration

- a) Type of System: Class 4 sewage system ☒ trench ☐ filter media ☐ SBT ☐ area bed ☐ other
- b) ☒ New ☐ Existing septic tank/holding tank with a working capacity of 9400 litres constructed of ☒ concrete ☐ fibreglass ☐ plastic
- c) ☒ Trench ☐ Filter Media Leaching bed of total 108 metres of [76 (mm) diameter pipe, or chambers] laid in 6 runs at 18 metres and fed by ☒ gravity ☐ siphon ☐ pump
- d) Shallow Buried Trench metres of millimetre diameter distribution pipe laid in runs at metres
- e) Area Bed: Stone m² Sand m² Pipe metres fed by ☐ gravity ☐ pump
- f) Effluent Filter: Manufacturer ORENCO Model OSI Biotube
- g) Sewage Treatment Unit(s): Manufacturer Model
- h) Other

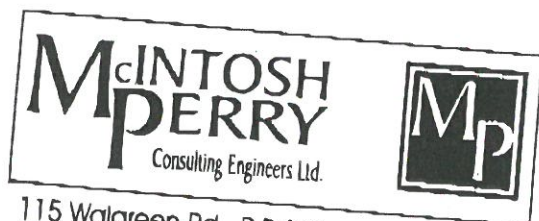
Certificate Issued By:

Director of Regulations
Ottawa Septic System Office

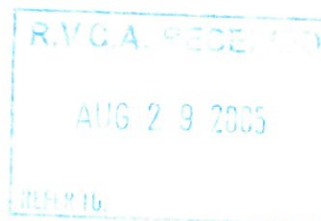
Janet Davidson

Date Issued

SEPTEMBER 19, 2005



115 Walgreen Rd., R.R.3 Carp, ON K0A 1L0
Tel.: (613) 836-2184 Fax: (613) 836-3742



August 29, 2005

VIA FACSIMILE
(613) 692-0831

Ottawa Septic Systems Office
1127 Mill Street
P.O. Box 599
Manotick, Ontario
K4M 1A5

Attention: Terry Davidson, Director of Regulations

RE: Laurysen Investments Inc.
Permit No. 05-493

During a site inspection on August 26, 2005, it was confirmed that the depth of cover over the top of the crushed stone layer was in excess of 0.6m for one of the tile runs. Thus, it was recommended that some of the cover material be removed. A second site inspection was completed on August 29, 2005 and it was confirmed that the depth of cover had been reduced to approximately 0.6m over the septic bed tile runs.

Furthermore, additional test pits were dug at the end of the 14.3m mantle to determine the content of the existing soil. The test pits revealed a sandy soil, which would be adequate mantle material. It is McIntosh Perry Consulting Engineers Ltd. recommendation that the mantle consist of both native and imported material. Therefore, the 15m mantle would extend into the native material to a depth of 0.25m.

If you have any questions, please do not hesitate to contact the undersigned.

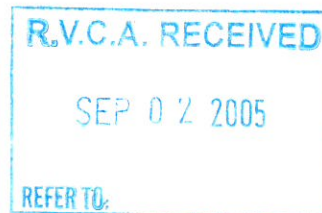
Yours truly,

Lisa Marshall, B.Eng.
Ext. 24

C.C. Adam Dillion, Inspector
Ivan Latimer, Latimer Excavating (Fax 836-4117)



115 Walgreen Road Carp, ON K0A1L0
Tel.: (613) 836-2184 Fax: (613) 836-3742



September 1, 2005

The Ottawa Septic System Office
1127 Mill Street
Manotick, Ontario
K4M 1A5
Fax: (613) 692-0831

VIA FACSIMILE

Attention: Terry Davidson
Director of Regulations

**FILE NO. 05-493 – LAURYSSEN INVESTMENTS INC.
ONSITE SEWAGE DISPOSAL SYSTEM
RESCIND BED INSTALLATION COMMENT**

This letter is written after a site meeting with the Ottawa Septic System Office on September 1, 2005, and the subsequent inspection at the above noted location. It was found after further inspection, conducted by both representatives from McIntosh Perry and the Septic Office, Julie Lyons and Adam Dillon respectively, that the cover material was in excess of Ontario Building Code requirements. Please rescind the letter received from our office dated September 1, 2005, titled 'Bed Installation Comment', and stamped by Julie Lyons, P.Eng. It is agreed that additional material needs to be removed from the top of the tile bed area to meet OBC requirements.

If you have any questions or comments regarding the above, please contact Lisa Marshall at ext. 24, or the undersigned.

Yours truly,

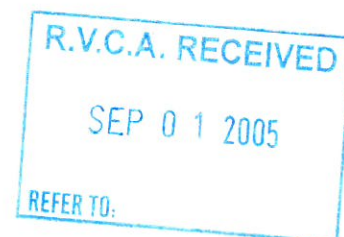
A handwritten signature in cursive script that reads 'Julie Lyons'.

Julie Lyons, P.Eng.
Ext. 25

P05-154 Lauryssen Septic Comment.Aug31.2005.doc
cc: Ivan Latimer, Latimer Excavating
Adam Dillon, Inspector



115 Walgreen Road Carp, ON K0A1L0
Tel.: (613) 836-2184 Fax: (613) 836-3742



September 1, 2005

The Ottawa Septic System Office
1127 Mill Street
Manotick, Ontario
K4M 1A5
Fax: (613) 692-0831

VIA FACSIMILE

Attention: Terry Davidson
Director of Regulations

**FILE NO. 05-493 – LAURYSSEN INVESTMENTS INC.
ONSITE SEWAGE DISPOSAL SYSTEM
BED INSTALLATION COMMENT**

This letter is written to comment on the suitability of the septic system installation at the above noted property. In a previous letter from McIntosh Perry Consulting Engineers (MPCE), dated August 29, 2005, it was stated that the depth of cover over the tile bed area had been reduced to approximately 0.6m. The letter also stated that a 15m mantle, with a depth of 0.25m, was in place.

The Ottawa Septic System Office (OSSO) conducted an additional inspection after receipt of our letter. McIntosh Perry then conducted a third site inspection. The following observations were noted in response to the inspection report dated August 30, 2005.

1. Depth of cover at locations x1 and x2 were 0.7m and 0.56m respectively. It should be noted that the cover material in place consists of sand and topsoil, thus it should not increase. Settlement of the cover material will also take place with time, further reducing the depth of cover. The 0.075m additional cover (75mm tile) at x1 should not affect evapo-transpiration and root uptake and the proper functioning of the tile bed.
2. As noted in the OSSO inspection report dated August 30, 2005, depth of cover at locations x3 and x4 are less than at locations x1 and x2, thus the top of the bed is sloped to shed surface water towards the mantle area. McIntosh Perry inspected the bed Wednesday, August 31, 2005 after a heavy rainfall and no surface ponding was evident. Thus it would seem the swale indicated on the OSSO inspection

Functional Servicing Brief
WM West Carleton Environmental Maintenance Facility
TF Project No.: 2511

Appendix 3

Stormwater Report

**Stormwater Design Brief
West Carleton Environmental Centre**

August 2015



**Prepared for:
Waste Management of Canada Corporation
2301 Carp Road
Carp, Ontario K0A 1L0**



**Prepared by:
WSP Canada Inc.
1450 1st Avenue West, Suite 101
Owen Sound, Ontario N4K 6W2**

Project No. 131-19416-00

Table of Contents

1.	INTRODUCTION AND BACKGROUND	1-1
1.1	Location	1-1
2.	STORMWATER MANAGEMENT.....	2-1
2.1	Existing Topography and Drainage	2-1
2.2	Objectives	2-3
2.3	Detailed Stormwater System Assessment.....	2-4
2.3.1	Pre-Development Conditions	2-4
2.3.1.1	Drainage Areas With No Off-Site Discharge	2-6
2.3.1.2	Drainage Areas Discharging Off-Site	2-7
2.3.2	Post-Development Conditions.....	2-8
2.3.2.1	Drainage Areas With No Off-Site Discharge	2-9
2.3.2.2	Drainage Areas Discharging Off-Site	2-11
2.3.3	Hydrologic Modelling	2-12
2.3.4	Stormwater System Infrastructure.....	2-13
2.3.4.1	Ditching	2-13
2.3.4.2	Storm Sewers and Culverts.....	2-13
2.3.4.3	Stormwater Ponds	2-14
2.3.4.4	Infiltration Basins	2-16
2.3.4.5	Operational Controls.....	2-18

List of Figures

Figure 1-1	Site Plan - Surrounding Area
Figure 8-1	Pre-Development Drainage Areas
Figure 8-2	Post-Development Drainage Areas
Figure 8-3	Stormwater Pond Schematic

List of Tables

Table 8-1	Drainage Area Characteristics, Pre-Development Conditions
Table 8-2	Drainage Area Characteristics, Post-Development Conditions
Table 8-3	Hydrologic Modelling Results – Stormwater Ponds (24-HR SCS II Storm)
Table 8-4	Hydrologic Modelling Results – Infiltration Basins (24-HR SCS II Storm)

List of Drawings

Drawing 4	Proposed Final Landfill Contours
Drawing 9	Sections
Drawing 10	Sections

Appendices

Appendix A	Summary of Modelling Procedure
Appendix B	Pondpack Printouts – Drainage Areas A & B Post Development
Appendix C	Stormwater Management Performance Assessment

1. Introduction and Background

This report has been prepared in support of the Waste Management of Canada Corporation (WM) Site Plan Control application for a site expansion at the West Carleton Environmental Centre (WCEC). The Site Plan Control approval is required by the City of Ottawa before the proposed site development, in addition to the Environmental Compliance Approval (ECA) by Ontario Ministry of the Environment and Climate Change (MOECC). WM applied for an ECA approval in September 2014 and their application is under review.

Details of the proposed landfill expansion are outlined in the Development and Operations Report dated July 2014, by WSP Canada Inc.

1.1 Location

The WCEC is located adjacent to Carp Road and Highway 417, locally known as 2301 Carp Road, at the westerly end of Ottawa. The landfill site expansion is an extension of the existing Waste Management Facility, owned and operated by WM.

The WCEC is located on Parts of Lots 2, 3 and 4, Concession 2 and parts of Lots 3, 4 and 5, Concession 3, in the former Township of Huntley, formerly in the Township of West Carleton, now the City of Ottawa, near Carp Road and Highway 417. The existing landfill footprint occupies approximately 34 hectares (ha), bordered by the City of Ottawa Road 5 (Carp Road) on the east, Highway 417 on the south, William Mooney Road to the west and private lands south of Richardson Sideroad. Those lands between Richardson Sideroad and 300 m southerly, between William Mooney Road and Carp Road, are owned by WM, but are not designated as part of the site. The Contaminant Attenuation Zone (CAZ) part of the site consists of two (2) land parcels, one large parcel north of Highway 417 and the second small parcel south of Highway 417. **Figure 1-1** shows these lands and various facilities within the existing and proposed landfill site.

2. Stormwater Management

The stormwater management features of the landfill expansion are shown on **Drawing 4**. Sections through the stormwater ponds and infiltration basins are shown on **Drawings 9 and 10**. **Figure 8-1** shows the drainage areas before development of the landfill expansion. **Figure 8-2** shows how drainage and subdrainage areas are broken down and controlled after the development of the new landfill footprint. **Figure 8-3** provides details related to water storage facilities.

2.1 Existing Topography and Drainage

The natural topography on the area of WCEC property, which has been modified by aggregate extraction and waste disposal activities, ranges from an elevation of approximately 131 metres above sea level (masl) southwest of the landfill site to less than 110 masl on the Huntley Quarry property, east of Carp Road. The present landfill extends to an elevation of approximately 174 masl, and the Huntley Quarry has been mined to a floor elevation of less than 75 masl. Refer to **Figure 1-1** for the area conditions.

From within the boundaries of the existing landfill property, there is no direct off-site discharge of surface water that is in contact with waste that has been landfilled; internal surface water drainage is contained within the landfill property and is directed to on-site ponds, which are engineered, natural, or depressions remaining from aggregate extraction. The exceptions to this are the external slopes of the vegetated site perimeter berms along the east and south boundaries of the landfill property; this amount of surface water is very minor and is not in contact with activities at the landfill. Runoff from the vegetated berms flow into Carp Road and Highway 417 drainage systems. There is a small area of drainage from the extreme western end of the site, in the area of the existing service entrance which flows into the ditch along William Mooney Road and northward into the tributary of Huntley Creek.

The above noted tributary of Huntley Creek originates from the wetland west of William Mooney Road and west of the WCEC property. The wetland feeds a drainage course that collects surface water from the agricultural and residential properties along William Mooney Road, west of the WCEC property. Flowing from west to east under William Mooney Road the drainage course bends to the north and flows towards Richardson Sideroad. Along the south side of Richardson Sideroad, the creek is aligned as a roadside drainage ditch, flowing eastward to a point approximately 450 m east of William Mooney Road. Surface water from the agricultural land east of William Mooney Road and south of the Richardson Sideroad is controlled by drainage ditches and flows northward to the roadside ditch along Richardson Sideroad.

The Huntley Creek tributary then flows northward through a culvert under Richardson Sideroad. Here the creek collects drainage from the area north of Richardson Sideroad, including several residential and commercial/industrial properties. Approximately 250 m west of Carp Road, Huntley Creek flows in a southeasterly direction under Richardson Sideroad and bends towards the northeast, where it passes under Carp Road. From there, the creek flows eastward, parallel to Richardson Sideroad, then northward through a culvert under the road, eventually discharging to the Carp River, some 3.8 km northeast of the landfill property. Ditches along both sides of Carp Road between the landfill property and Richardson Sideroad also drain into this tributary.

Drainage south of the existing landfill is contained within a large wet forested area on the westerly end. The south central and southeasterly lands largely drain through a series of on-site stormwater ditching to a sedimentation pond and infiltration pond designated Stormwater Pond #2, which in turn discharges to the low lying area of Depression #1. The southerly part of the existing landfill at the easterly end drains to Depression #2 and recharges into the water table.

The stormwater flow pattern on the lands for the new landfill footprint can be divided into two (2) zones. On the south central and easterly part, surface flow is controlled by a series of ditches and Stormwater Pond #1, which recharges the water into the water table. Surface flow is generally from southwest to northeast. Because the east end of the property was used for aggregate extraction, the ground surface is lower than the surrounding area, and consequently there is no direct off-site surface water runoff from this area. A previous residential property is located beyond the eastern limit of the former extraction area, west of Carp Road. Surface water flow is northeast, following the slope of the land surface. On the north half of the property for the new landfill footprint, and the complete westerly part, is partially wooded and partially agricultural land. The southeast corner was a manufacturing facility (Laurysen Kitchens Limited). The western and north central part is flat lying, and surface drainage follows land contours and agricultural ditches in a northerly to northeasterly orientation toward Richardson Sideroad and into the tributary of Huntley Creek described previously. The eastern portion of the new lands for the landfill slopes, and has a northeasterly orientation along the edge of a post-glacial beach ridge. Surface drainage follows the land slope into ditches along Carp Road. These ditches drain northerly into the Huntley Creek tributary. West of the previous residential properties, a large depression from aggregate extraction remains, and designated as Depression #5 on **Figure 1-1**. Where the land surface in former extraction areas are depressed, surface water collects in localized ponds. The water level in the depressions reflects low flow groundwater table elevation.

There are no flood hazard zones located within the proposed landfill area. Elevated topography and high recharge potential on beach ridge deposits along Carp Road negate the potential for surface flooding.

2.2 Objectives

The general objectives of the stormwater management plan are as follows:

- control surface water draining on-site;
- control quality and rate of runoff discharging directly from the site to protect water quality and wildlife habitat and to prevent flooding within the South Huntley Creek watershed. Off-site discharge of surface water will be limited to the site perimeter and no offsite discharge from the existing and proposed waste fill areas will occur; and
- control sediment discharge and erosion during site operation and development.

Runoff from the landfill expansion area will drain into landfill perimeter ditching and pass through lined Stormwater Pond #2, where it will be settled before being discharged into Infiltration Basin #2. Runoff from the existing landfill footprint will be contained on-site in one of several depressions including new Infiltration Basin #1. These natural and manmade water storage facilities serve as groundwater recharge areas. Clean runoff from non-operating areas along the site perimeter will continue to drain off-site bypassing the above noted groundwater recharge areas.

The stormwater management plan complies with the MOE Landfill Standards. The design criteria for the site's stormwater facilities are as follows:

Internal Ditches and Stormwater Structures

- 1:25 year storm
- Provide overland flow route to carry peak flow from a 1:100 year storm.

Surface Water Quality Control

- Stormwater ponds sized to store/treat runoff generated from a 4-hour, 25-mm storm event.

Surface Water Quantity Control

- Control post-development peak flows from all storm events up to 1:100 year at or below pre-development levels. This applies only to the areas with direct off-site discharge along the site

boundary. There will be no off-site discharge from the central part of the site containing all waste disposal areas.

Infiltration Basins

The proposed infiltration basins are sized for 1:100 year storm event and in accordance with design criteria outlined in the MOE “Stormwater Management Planning and Design Manual” as follows:

- Depth to bedrock and water table – at least 1 m
- Water storage depth – no more than 0.6 m

The 1:100 year storm is the regulatory flood for Eastern Ontario (Zone 2), which includes the WCEC Facility.

2.3 Detailed Stormwater System Assessment

2.3.1 Pre-Development Conditions

Refer to **Figure 8-1** for the outline of the pre-development drainage areas. General hydrologic information concerning each drainage area is presented in **Table 8-1**.

The site is situated within the South Huntley Creek watershed which drains in an easterly direction north of the site. The South Huntley Creek is a tributary of Huntley Creek which in turn empties into the Carp River northeast of the site. South Huntley Creek is a permanent warm water system that has been significantly impacted historically by surrounding agricultural land use and roadways which have bisected its length into smaller reaches, separated generally by culverts. The South Huntley Creek watershed extends to the south of Highway 417 west of the site. The drainage divide runs near the south limit of the WM property just north of Highway 417. The lands draining south to Highway 417 belong to the Feedmill Creek watershed. Feedmill Creek is also a Carp River tributary. The active quarry on the east side of Carp Road locally influences drainage patterns.

The site is relatively flat with the exception of the existing landfill mound which rises approximately 40 – 45 m above the adjacent ground. Generally, the land slopes northeasterly and local drainage patterns are influenced by wetlands and manmade depressions (ponds, pits). These no outlet features serve as groundwater recharge areas and contribute to South Huntley Creek base flow. A portion of the groundwater flow is also drawn by the quarry east of the site.

As shown on **Figure 8-1**, the existing landfill footprint belongs to three (3) separate, no outlet Drainage Areas B, C and D. The existing Waste Transfer & Processing Facility (WTPF) in the southwest part of the site is located within Drainage Area E. The old aggregate extraction pit (Depression #5) forms another no outlet Drainage Area A. In total, on site, no outlet areas occupy 127.5 ha out of 188.3 ha under pre-development conditions. The remaining drainage areas (SH1 and SH2) discharge off-site to the South Huntley Creek and Drainage Area FD to the Highway 417 drainage system and ultimately to Feedmill Creek. A small portion of the site near the existing landfill entrance (Drainage Area F) drains into the quarry on the east side of Carp Road. Generally, drainage areas discharging off-site are located along the site perimeter and do not encroach waste fill or waste processing areas.

The site soil textures according to the Ontario Soil Map are classified as follows:

- | | |
|--------------------------------|---------------|
| ▪ Kg – Kars Gravely Sandy Loam | Soil Group B |
| ▪ Rs – Rubicon Sand | Soil Group AB |
| ▪ Li – Lyons Loam | Soil Group B |

These soils provide good drainage and are relatively permeable.

The Rational Method was used to determine peak flows using Ottawa rainfall intensity duration frequency (IDF) data. The design rainfall intensity was calculated in accordance with the formula:

$$i = A \times T_c^B$$

where i = rainfall intensity (mm/hr)

T_c = time of concentration (hr)

A, B = rainfall equation coefficients dependent on storm return frequency and meteorological station location.

The following runoff coefficients were used to calculate a cumulative runoff coefficient “C” for each drainage area:

- | | | |
|-------------------------------------|---|------|
| ▪ pavement/buildings | - | 0.9 |
| ▪ gravel areas | - | 0.55 |
| ▪ existing capped landfill – soil C | - | 0.45 |
| ▪ woods-soil B | - | 0.19 |
| ▪ pasture-soil B | - | 0.24 |
| ▪ pond, wetland | - | 0.05 |

▪ proposed landfill 5% slope – soil C/D	-	0.42
▪ proposed landfill steep slope – soil C/D	-	0.50
▪ lined stormwater pond	-	0.5
▪ infiltration basin	-	0.16

The time of concentration required to determine rainfall intensity in the Rational Method was calculated using the Kirpich Method. This method gives conservative, relatively short travel times as shown in **Table 8-1**.

In the Rational Method, peak flows for storms having a return period of more than ten (10) years were increased as follows:

- 1:25 year - 10%;
- 1:50 year - 20%; and
- 1:100 year - 25%.

2.3.1.1 Drainage Areas With No Off-Site Discharge

a) Drainage Area A

Drainage Area A, located in the northeast corner of the site, occupies approximately 10.08 ha. Surface water drains overland into Depression #5 which is an old, presently unused aggregate extraction pit. The west part of the existing Laurysen manufacturing facility and gravel yard west of the building belong to this catchment. Surface water flow is not channelized. The bottom of Depression #5 is at approximately 117.5 masl.

b) Drainage Area B

Drainage Area B is subdivided into two (2) subcatchments, B1 and B2. Catchment B1 collects stormwater from the north slope of the existing landfill. The landfill perimeter ditch directs stormwater to the existing Stormwater Pond #1 which overflows into the elongated natural wetland (Depression #3). Under high flow conditions Depression #3 may overflow into the rehabilitated old Dibbley Pit (Depression #4) which has a bottom elevation at approximately 122.0 masl. Sub-Area B2 drains directly into Depression #4.

Drainage Area B has a very large water storage capacity particularly within Depression #4 where the water level would have to rise more than 3 m before overflowing in a northerly direction. Drainage Area B encompasses 39.47 ha.

c) **Drainage Area C**

Drainage Area C is also subdivided into two (2) subcatchments, C1 and C2. Area C1 includes a large portion of the south slope of the existing landfill and lands to the south of the existing landfill. Sub-basin C2 collects runoff from the majority of the Closed South Cell including the poplar plantation and lands surrounding the Gas to Energy Facility. Area C1 drains via manmade ditch into existing Stormwater Pond #2. Under high flow conditions, this pond may overflow into adjacent Depression #1 which services sub-basin C2. Depression #1 also has substantial storage capacity and the water level may rise up to 124.5 masl (approximately 2 m) without overflowing. Drainage Area C encompasses 45.19 ha.

d) **Drainage Area D**

Drainage Area D includes the most easterly part of the existing landfill and the north section of the Closed South Cell. Stormwater drains into Depression #2 which lies south of the lined part of the existing landfill. Ground elevations range from 121.5 (bottom of Depression #2) to 170 masl at the top of the existing landfill mound. The area occupies 21.34 ha.

e) **Drainage Area E**

This 11.50 ha catchment in the southwest part of the site is very flat and mostly tree covered. Stormwater drains into the wetland inside the wooded area north of Highway 417. The existing waste transfer station is located within the slightly elevated west part of this area.

2.3.1.2 **Drainage Areas Discharging Off-Site**

a) **Drainage Area F**

This relatively small drainage area of 5.8 ha, on the west side of Carp Road near the existing landfill entrance, drains northerly along the roadside ditch which crosses Carp Road south of the existing Laurysen building entrance. Further downstream this channel enters Huntley Quarry. The 1:100 year peak flow at the Carp Road crossing is estimated at 0.99 m³/s. This area has a higher level of imperviousness due to paved road surfaces within the Carp Road allowance and near the existing landfill entrance.

b) **Drainage Area SH1**

This large catchment of 41.35 ha occupies the northwest part of the site. Generally, it drains northerly towards South Huntley Creek through several channels. A large part of this area drains overland towards

Richardson Sideroad along an undefined flow path. Ditching north of the WTPF directs stormwater westerly across William Mooney Road where it joins the tributary of South Huntley Creek. In summary, stormwater outletting from this basin follows multiple pathways instead of a single concentrated channel.

The area is relatively flat with ground elevations varying from 127 masl in the south beside the existing landfill to 121.5 masl in the north near the property boundary. This basin includes a large woodlot and open field which is used for agricultural purposes.

c) Drainage Area SH2

Runoff from this area of 5.77 ha, located in the northeast corner of the site, drains northerly via roadside ditch along Carp Road into South Huntley Creek. This area includes the commercial/industrial strip on the west side of Carp Road including a large part of the Lauryzen manufacturing facility. Generally land in this part of the site slopes easterly towards Carp Road. The Rational Method 1:100 year peak flow at the outlet of this area was calculated as 0.75 m³/s.

d) Drainage Area FD

This small drainage area of 7.79 ha is situated along the southern property boundary and drains into the Highway 417 ditching system which ultimately discharges into the Carp River through Feedmill Creek east of the site. There is minimal direct off-site discharge from this catchment, generally limited to the external slopes of perimeter berms along the south and east boundaries of the landfill property.

2.3.2 Post-Development Conditions

Refer to **Figure 8-2** for the outline of the post-development drainage areas. Hydrologic parameters characterizing each catchment are shown in **Table 8-2**.

Post-development conditions are characterized by higher runoff coefficients and shorter travel times (time of concentration) due to steep landfill grades and flow channelization. These factors tend to increase peak flows but because the site design is based on no off-site discharge, peak flow attenuation is not an issue for the landfill development area. Runoff from the proposed landfiling area will be contained on-site in Infiltration Basin #2.

The existing Stormwater Pond #1 and small wetland (Depression #3) located within the landfill expansion area will be eliminated and replaced with new clay lined Stormwater Pond #1 and Infiltration Basin #1 within Depression #4. Similarly, Stormwater Pond #2 and Infiltration Basin #2 are proposed in the area designated

as Depression #5. Infiltration Basin #2 will service the entire landfill expansion area while Infiltration Basin #1 almost the entire north half of the existing landfill. The landfill expansion will shift drainage boundaries within Drainage Areas A and B, and in catchments located along the site perimeter (SH1, SH2 and F). Drainage patterns within the remaining part of the property will be hardly affected and generally will remain the same as under pre-development conditions. There will be a significant increase in the size of on-site no outlet areas to 151.76 ha from 127.48 ha under pre-development conditions. As a result, more stormwater will be contained on-site and recharged into groundwater and less discharged off-site as surface flow from lands located along the site perimeter.

Drainage Areas A and B were subdivided into small subcatchments for the purpose of hydrologic modelling which was used for sizing of the proposed stormwater storage facilities. Cumulative runoff coefficients and times of concentration were established in a similar fashion as those for the pre-development conditions. Runoff coefficient for the entire study area will increase to 0.35 from 0.29 before the development.

The following soil/land use CN curve numbers were used to establish cumulative CN value for each subcatchment within Drainage Areas A and B, which were subject to hydrologic modelling:

▪ pavement/buildings	-	98
▪ gravel areas	-	90
▪ existing capped landfill – soil C	-	81
▪ pasture – native or imported soil B	-	73
▪ lined stormwater pond	-	85
▪ proposed landfill 5% slope – soil C/D	-	81
▪ proposed landfill steep slope – soil C/D	-	83
▪ infiltration basin	-	70

All above values are for the average antecedent moisture conditions (AMC II).

2.3.2.1 Drainage Areas With No Off-Site Discharge

a) Drainage Area A

This drainage area was subdivided into nine (9) smaller sub-areas to facilitate hydrologic modelling. The overall size of the catchment will expand to 51.66 ha. The cumulative runoff coefficient was calculated as 0.432 in comparison to 0.29 prior to landfill expansion. The Rational Method 1:100 year peak flow at Pond #2 was calculated as 5.31 m³/s.

Stormwater Pond #2 will control stormwater flows by providing temporary storage and treatment before releasing water into Infiltration Basin #2. All runoff originating from the landfill expansion area will be handled within this catchment. The proposed landfill will be graded such that all runoff from the mound will drain toward the landfill perimeter and be intercepted by the perimeter ditching. The ditching system will direct stormwater into Stormwater Pond #2. A large part of the on-site road network, including the main access road and scale house area, will be also routed through Stormwater Pond #2. Stormwater accumulating over the landfill base during base preparation as well as stormwater pools west of the lined area will be pumped to the perimeter ditching system, on an as required basis.

b) Drainage Area B

This watershed was also subdivided into multiple sub-areas to facilitate hydrologic modelling. Drainage Area B will be smaller, 22.58 ha down from 39.47 ha originally as a result of the proposed development. The northwest part of the catchment will be shifted into Drainage Area A and comprise part of the landfill footprint. The cumulative runoff coefficient increases to 0.398 from 0.32 prior to development. The overall CN number was estimated at 79.1 and the Rational Method 1:100 year flow at Pond #1 was calculated as 2.13 m³/s.

Stormwater Pond #1 and Infiltration Basin #1 will function in the same fashion as stormwater storage facilities within Drainage Area A. New ditching will be provided on the west and south side of the existing landfill to intercept runoff coming from side slopes and direct it towards new Stormwater Pond #1. The south half of the main access road between two (2) mounds and the entire Mini-Transfer Area (MTA) are included within this drainage basin.

c) Remaining Drainage Areas

The size of Drainage Areas C, D and E will not change as a result of the landfill expansion as there is no major development planned for the south half of the WM property. Construction activities will be limited to the leachate treatment plant, contingency poplar plantation, road improvement (paving), extension of underground utilities and minor building improvements (blower building). These activities will have a negligible effect on the existing drainage patterns, and stormwater flows will remain the same as under pre-development conditions.

2.3.2.2 Drainage Areas Discharging Off-Site

a) Drainage Area F

The catchment boundary will be slightly realigned as a result of the landfill expansion with a minor reduction in size to 5.24 ha from 5.8 ha. The imperviousness level will increase with construction of the new access road off Carp Road and the Carp Road widening near the new entrance. This part of the site will also be subject to landscaping activities such as tree and bush planting, etc. The runoff coefficient for this area will increase by approximately 10% to 0.38. The 1:100 year peak flow will remain at the pre-development level of 0.99 m³/s. This area will continue to discharge into the quarry east of the site.

b) Drainage Area SH1

The post-development size of this area will decrease to 18.44 ha down from 41.35 ha. For this reason there will be no increase in flows leaving the site. A decrease in size of this basin is a result of the proposed development; a portion of this area would become part of the landfill footprint.

Generally, this area extends near the limit of the development area and as such will not see major construction activities. Clearing and earthwork will be limited to the south and east catchment boundary. Landscaping and reforestation activities will take place within the westerly and northerly buffer area.

c) Drainage Area SH2

This area will not be heavily affected by the proposed development and its boundary will be slightly realigned because of interference with Infiltration Basin #2 and Stormwater Pond #2. Other project related activities will be limited to the Carp Road widening and minor landscaping work along the site boundary. Post-development size of this catchment will shrink to 5.06 ha down from 5.77 ha originally. The runoff coefficient remains unchanged at 0.36 after development. The 1:100 year flow was estimated as 0.66 m³/s at the catchment outlet and is lower than under pre-development conditions.

d) Drainage Area FD

There will be no change in hydrologic characteristics of this area as there is no new development proposed within this part of the site.

2.3.3 Hydrologic Modelling

The Bentley Pondpack Version 8i computer program utilizing the SCS Unit Hydrograph Method was used for hydrologic modelling. A summary of the modelling procedure is outlined in **Appendix A**. Pondpack printouts for post-development conditions within Drainage Areas A and B are provided in **Appendix B**. The reader is referred to the same appendix for schematic of both catchments. **Tables 8-3 and 8-4** provide a comprehensive summary of the hydrologic modelling results. These results include rainfall data, flows, runoff volumes and coefficients, water levels, storage capacities and draining times.

The synthetic SCS Type II rainfall distribution for the 24-hour storm for the Ottawa meteorological station was used for hydrograph development with the following input parameters:

- size of drainage area;
- time of concentration;
- calibrated CN curve number; and
- constant infiltration rate of 12 mm/hr for both infiltration basins as recommended by the geotechnical investigation and hydrogeologist.

Default equations for time to peak and peak discharge of the hydrograph were used.

Hydrograph routing and addition in accordance with the drainage area schematic was carried out by the computer model. Stormwater ponds and infiltration basins were sized through an iterative process until they complied with the established design criteria. The Modified Puls Method was used for reach routing to account for hydrograph translation through the on-site ditching network.

It is interpreted that modelling results are conservative because simulated low frequency peak flows exceed those calculated manually with the Rational Method. For example, simulated 1:100 year flow at Pond #2 is 7.71 m³/s, and is 45% higher than the same flow determined with the Rational Method. Similarly, runoff coefficients shown in **Table 8-3**, Column (7) for low frequency events are generally higher than the corresponding coefficients shown in **Table 8-2** even when accounting for the Rational Method peak flow increase factor for infrequent storms. For example, the simulated 1:100 year runoff coefficient for Catchment B is 0.533 and higher than the adjusted corresponding Rational Method coefficient of 0.498 (0.398 x 1.25) shown in **Table 8-2**. This indicates that the ponds are not undersized and that their storage capacities are adequate and conservative.

2.3.4 Stormwater System Infrastructure

2.3.4.1 Ditching

The overall layout of the proposed ditching system including invert elevations is shown on **Drawing 4**.

Ditching will be trapezoidal in the section with bottom width ranging from zero (triangular section) to 2 m depending on estimated flow. Schedule of ditch bottom widths is provided on **Drawing 4**. The highest flows will be in the landfill perimeter ditch draining into Stormwater Pond #2. The design 1:25 year flow for the south and north branches of the landfill perimeter ditch near Pond #2 inlet was calculated at approximately 1.8 m³/s. Water depth under such flow in trapezoidal channel having a bottom width of 2 m and a slope of 0.5% would be 0.5 m which is less than the minimum ditch depth of approximately 1.1 m.

The landfill perimeter ditch will have an outer slope of 3H:1V (minimum) and an inner (landfill side) slope of 4H:1V (minimum) which is the same as the landfill side slopes. All other ditches will have side slopes not steeper than 3H:1V. Generally, the proposed ditches are relatively flat at grades around 0.5%. Flow velocity under such conditions for the 1:25 year storm event will be low at less than 1.0 m/s. Such velocities are suitable for grass lining which will assist in sediment filtering and erosion control.

Locally, ditching will be steeper and all ditches sloping at more than 3 to 4% will be rip rap lined with appropriately sized stone over geotextile. This includes ditching along the high access road having a grade of up to 8%. The rip rap lining will also be provided at all culvert ends, ditch inlets and at ditch alignment changes exceeding 45 degrees. Rip rap grouting may be used to further reduce erosion potential and washouts. Rock check dams will be installed along the long, steep ditch sections to reduce flow velocity.

Erosion control mats and sod may be used wherever establishment of vegetation cover is critical.

2.3.4.2 Storm Sewers and Culverts

Two (2) sections of storm sewers are part of the proposed drainage system. The first is 300 mm diameter overflow line for Infiltration Basin #1 discharging into Infiltration Basin #2. This line is provided in compliance with design guidelines which require overflow protection for infiltration basins. The line will not transmit any stormwater under normal conditions.

The second short section of storm sewer will service the mini-transfer drop-off area. This sewer line will be equipped with an isolation valve and Stormceptor unit to provide continuous treatment of total suspended solids as well as oil separation in case of an accidental spill upstream within the drop-off area. The above

noted system components will prevent pollution from reaching Stormwater Pond #1 and ultimately Infiltration Basin #1.

Corrugated steel pipe (circular and arch) will be used for culvert installation. Corrugated steel pipe arch (CSPA) is proposed under roads where increased depth of cover is required to withstand loadings from vehicular traffic. Concrete culverts are proposed at critical locations where heavy truck traffic is anticipated and where lighter pipe integrity could be in question.

All culverts were sized for the 1:25 year flow with sufficient spare capacity to allow for the 1:100 year flow to pass without overtopping ditch embankments.

2.3.4.3 Stormwater Ponds

Two (2) new stormwater ponds are proposed for surface water quality control in accordance with the MOE Landfill Design Standards. The ponds will attenuate peak flows but this function is not important since pre-treated stormwater discharges into the infiltration basin where it is recharged into the shallow groundwater system. The ponds outflow rates are controlled by recharge capacity of the shallow groundwater regime in the vicinity of the downstream infiltration facilities.

Stormwater pond dimensions and outlet pipe details are outlined on **Figure 8-3**. Hydrologic modelling results related to stormwater ponds are shown in **Table 8-3**. This table shows pond flows, volumes, water levels and drainage times. The ponds internal side slopes will be 4H:1V (minimum) and external side slopes 3H:1V (minimum). Each pond will consist of the following storage zones:

- permanent water pool, which includes sediment storage – between pond bottom and invert of the outlet pipe; and
- settlement zone – above invert of the outlet pipe.

The outlet pipe will be a relatively small diameter culvert (HDPE pipe) equipped with an isolation valve. A typical section for Pond #1 and Pond #2 are shown on **Drawing 9**. All ponds will be lined with a 600 mm clay liner. The pond base and side slopes up to 0.3 m above the normal water level will be covered with at least 150 mm of drainage gravel which will be placed over geotextile separator. The gravel layer will protect the underlying clay liner and serve as an indicator during sediment removal operations. In addition, drainage gravel will protect pond side slopes against wave action. The remaining portion of the internal side slopes will be topsoiled and vegetated. Fill placed within containment berms will consist of well compacted fine grained soils. In order to increase the infiltration contact area with native soils, fill material underlying the clay liner below the pond base will be composed of well compacted permeable granular

material (sand). All surficial, in-place loose fill will be removed down to native soil before any fill placement. A large quantity of such unsuitable material has been identified through the geotechnical investigation within Dibbley Pit (Depression #4). All of the above noted requirements are illustrated on Sections C, D and E, **Drawing 9**. The stability of pond side slopes has been assessed by the geotechnical engineer and found to be satisfactory under various operational scenarios.

The proponent may change the lining of the stormwater ponds and use geomembrane supported geosynthetic clay liner (GCL) instead of a conventional clay liner. This option would be decided based on economics and subject to a geotechnical slope stability assessment.

Each pond will be capable of settling particles larger than 40 microns even during major storm events. It was determined that both ponds will be capable of settling particles as small as 7 microns. A high sediment capture efficiency is caused by relatively low outflow rates. Refer to **Appendix A** for the theoretical size of settled particle calculations.

Both ponds have sufficient capacity to store/treat all runoff generated from the 25 mm storm event. This volume, as determined through hydrologic modelling, is 436 m³ and 1,296 m³ for Ponds #1 and #2 respectively and they are substantially lower than the corresponding permanent water pool volumes of 2,600 m³ and 4,200 m³ as is shown in **Table 8-3**.

Both ponds were sized with a relatively high length to width ratio exceeding 4:1.

A plunge pool (forebay) will be provided near each pond inlet to capture coarser suspended particles. The forebay will be 0.5 m deeper than pond bottom design elevation, providing additional sediment storage capacity. The forebay area will also be covered with drainage gravel and geotextile. Each pond inlet will be reinforced with rip rap. Accumulated sediment will be removed in accordance with criteria outlined in the Erosion and Sediment Control Plan, West Carleton Environmental Centre, WSP, March 2015. Removed sediment will be used as daily cover within the active disposal area.

A rip rap baffle across the pond width downstream of the inlet(s) is proposed to improve flow distribution, minimize short circuiting and to separate forebay from the more quiescent settling zone. Each pond will be equipped with a rip rap lined overflow spillway sized for the 1:100 year flow rate discharging into the downstream infiltration basin. Pond draining time will not exceed 48 hours.

2.3.4.4 Infiltration Basins

Infiltration facilities are designed to capture and retain runoff and allow it to infiltrate rather than discharge to surface water. This system has several benefits such as reducing surface runoff volume and pollutant discharge as well as augmenting low flow stream conditions and thus supporting wildlife habitat during low flow periods.

Subsurface exploration consisting of several borings was carried out to determine in-situ soil and groundwater conditions within the designated groundwater recharge areas. This work is summarized in the Supplemental Geotechnical Investigation by Alston Associates Inc. Refer to “Geotechnical Studies, West Carleton Environmental Centre” assembled in March 2015 by WSP. The permeability of soil from numerous samples collected within the footprint of infiltration facilities was estimated with the Hazen formula and ranged from 5×10^{-2} cm/s to 1.6×10^{-5} cm/s.

The constant rate infiltration rate of 12 mm/hr was selected for design in consultation with the hydrogeologist based on the observed local subsurface conditions. This rate was used as an input in hydrologic modelling and was used for sizing of both basins.

Groundwater recharge at infiltration facilities will result in the long term localized mounding of the shallow groundwater table. The maximum long term elevation of the shallow groundwater was determined by the hydrogeologist using “Modflow” groundwater flow computer model as follows:

- Infiltration Basin #1 – 120.81 masl
- Infiltration Basin #2 – 120.86 masl

Infiltration basin base elevations were selected to provide at least 1 m separation from the maximum predicted groundwater level.

Suspended solids loading in stormwater draining into each basin will be largely reduced by sedimentation taking place in both of the new stormwater ponds. This will control/reduce blinding and plugging of the basin base surface.

The following dimensions were established for the base of each infiltration basin:

- Infiltration Basin #1 – 116 x 158 m
- Infiltration Basin #2 – 118 x 217 m

Hydrologic modelling results including basin volumes, water levels and draining times are presented in **Table 8-4**. Maximum water storage under the 1:100 year design storm was calculated as 5,669 m³ for Basin #1 and 15,530 m³ for Basin #2. Each basin will have substantial additional capacity above the design water level which was calculated as follows:

- Infiltration Basin #1 – 19,573 m³
- Infiltration Basin #2 – 28,062 m³

This additional storage will provide a safety cushion in case of an extreme storm, heavier than the 1:100 year design event.

Sections of the infiltration basin are shown on **Drawings 9 and 10**. Imported, permeable fill will be required for construction of each basin. Permeable fill (sand having permeability ranging from 0.01 – 0.001 cm/s) will be placed loose over the scarified native soil following removal of all unsuitable loose fill material which was identified mainly within Infiltration Basin #1 area. Interior and exterior side slopes of infiltration basins will be 3H:1V. Fill placed within containment berms will consist of fine grained soil with the uppermost 600 mm consisting of the clay liner. Permeable material placed below the containment berms will be compacted to 98% SPMDD. Impermeable containment berms are required to ensure integrity and stability of fills when exposed to hydraulic gradients resulting from a sudden rise of water level. This requirement applies to the east and northeast berm in Infiltration Basin #2. The remaining banks of the basins constructed as fill or cut will not require the same treatment as exterior containment berms and engineered fill may be used at these locations. The reader is also referred to Sections C and D, **Drawing 9**, showing construction requirements along the boundary between infiltration basin and stormwater pond. All interior and exterior side slopes of infiltration basins will be topsoiled and vegetated, with the base remaining bare so it can be raked and scarified when needed. Permeable sand on the bottom of an infiltration basin will intercept silt, sediment and debris that could otherwise clog the base of the basin. The upper 50 – 100 mm of this sand layer can be readily restored following removal operations. Sand replacement material shall be of the same quality as originally installed material (hydraulic conductivity 1×10^{-4} to 1×10^{-5} m/s).

Rip rap lining for energy dissipation will be provided at all inlets into the basin for erosion control. All basins will also be equipped with an access ramp for maintenance access. Overflow spillways are provided in accordance with design guidelines to protect infiltration facilities against catastrophic failure from excessive rise in water level but due to the significant additional capacity within the basins are never anticipated to be used.

2.3.4.5 Operational Controls

Under normal conditions, isolation valves on the outlet piping from stormwater ponds will be open allowing water to drain by gravity into infiltration basins. These valves will be closed if contamination is suspected including the valve controlling drainage from the mini-transfer drop-off area.

Stormwater will flow into the ponds, deposit the coarse fraction of sediment in the forebay and settle smaller particles in the aft-bay section of the stormwater ponds before water is released into the infiltration basin.

In day-to-day operation, staff will visually monitor all stormwater ponds. Should contamination be suspected, testing of the stormwater pond's contents will be carried out by hand-held, on-site instrumentation to measure conductivity, pH and visual aesthetic conditions. Conditions present on site that might indicate the necessity to monitor the pond's contents could include the following:

- visible leachate seep to surface water flowing to one of the surface water ponds;
- evidence of dark stained water;
- oil or any other substance in amounts sufficient to create a visible film, sheen or foam on the receiving waters; or,
- accumulation of floating or settleable solids.

Refer to **Appendix C** for decision-making criteria related to regular and emergency operation of stormwater ponds. Stormwater quality criteria for field and laboratory sampling are also outlined in the same appendix.

The isolation valve on the outlet piping would be closed and remain closed when the pond's water quality is in question. A sample taken for further analysis would be placed in a "rush" category for reporting by an independent laboratory. If the stormwater does not satisfy the trigger concentrations then the stormwater contingency plan will be initiated. Refer to **Appendix C** for a list of contingency corrective actions.

The isolation valve controlling the mini-transfer area shall be closed immediately after spill detection and remain closed until satisfactory clean-up is completed and the area suitable for normal operations.

Depending on the type and severity of contamination, it may be desirable to remove accumulated sediment from the forebay and/or aft bay of the stormwater pond.

These procedures will allow control of surface water discharging into infiltration basins. Under normal conditions, surface water draining into infiltration facilities shall be deemed suitable for groundwater recharge.

Prepared by:

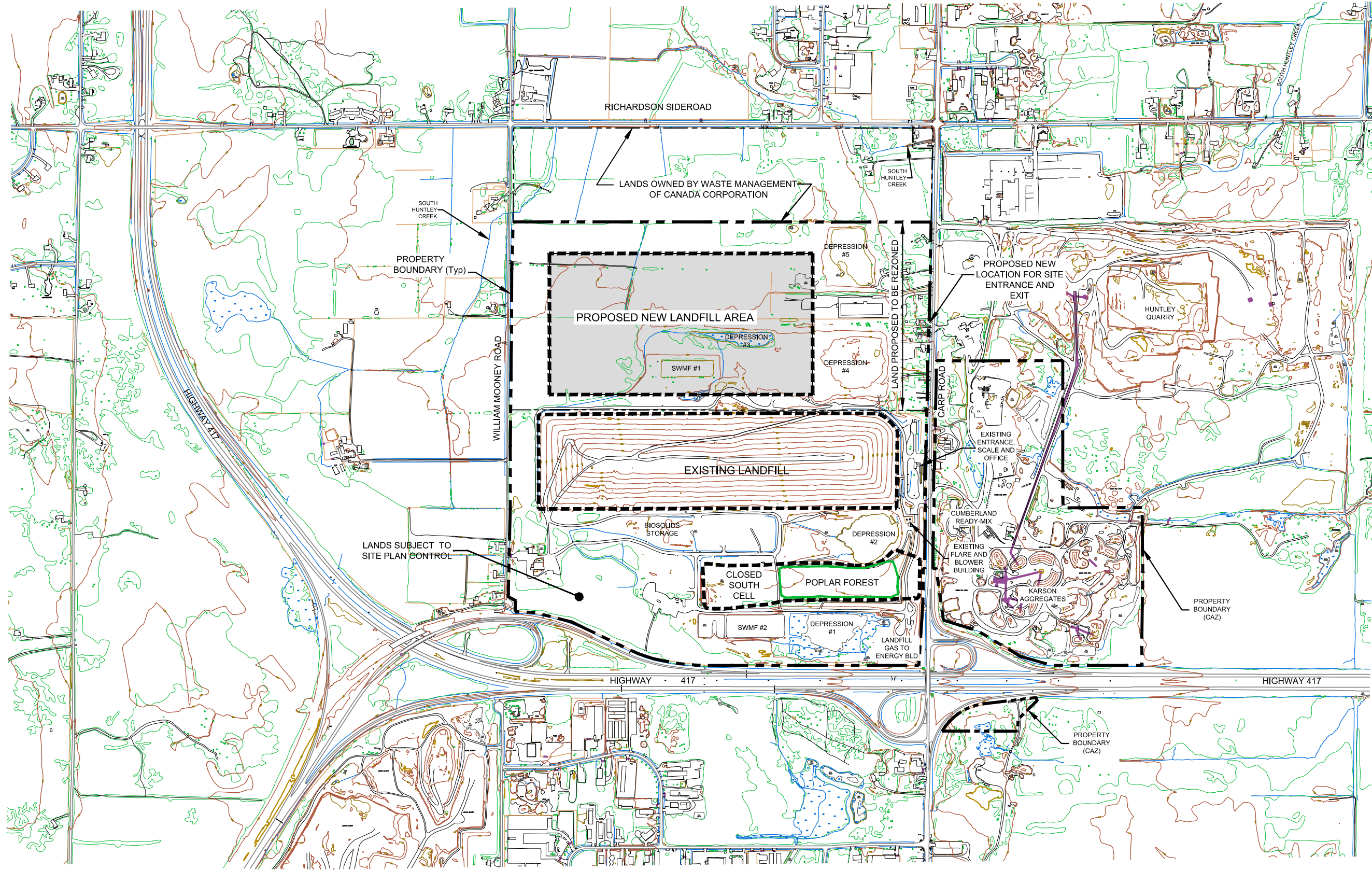
WSP Canada Inc.

P. Brodzikowski

Peter S. Brodzikowski, P. Eng.
Designated Consulting Engineer
Senior Environmental Engineer
PSB/dlw



Figures



NOTE :

1. TOPOGRAPHIC FEATURES SHOWN ON THIS PLAN ARE BASED ON AERIAL PHOTOGRAPHY BY BASE MAPPING LIMITED FROM JULY 2007

SCALE : 1 : 12500
0 100 200 300 400 500m

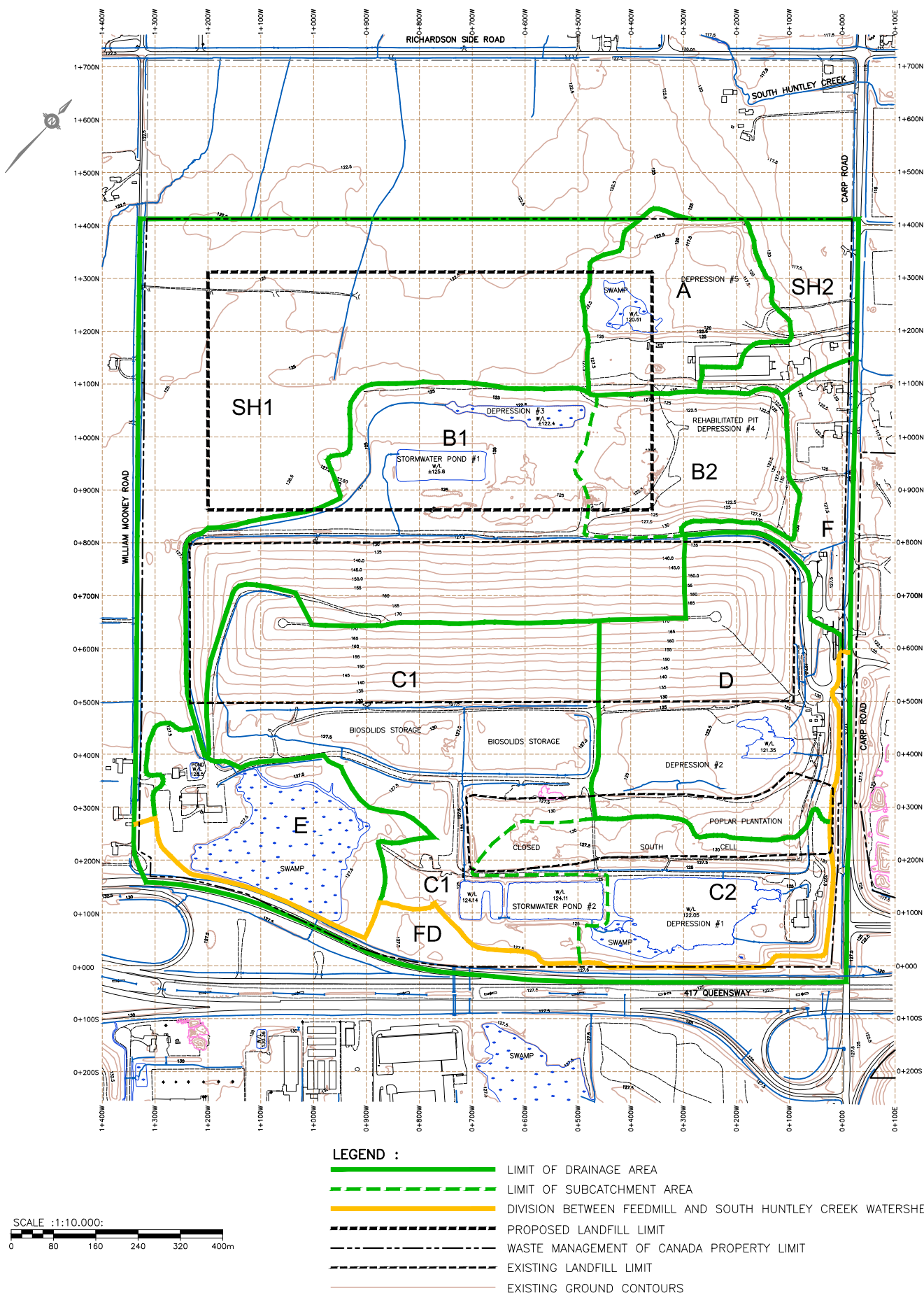


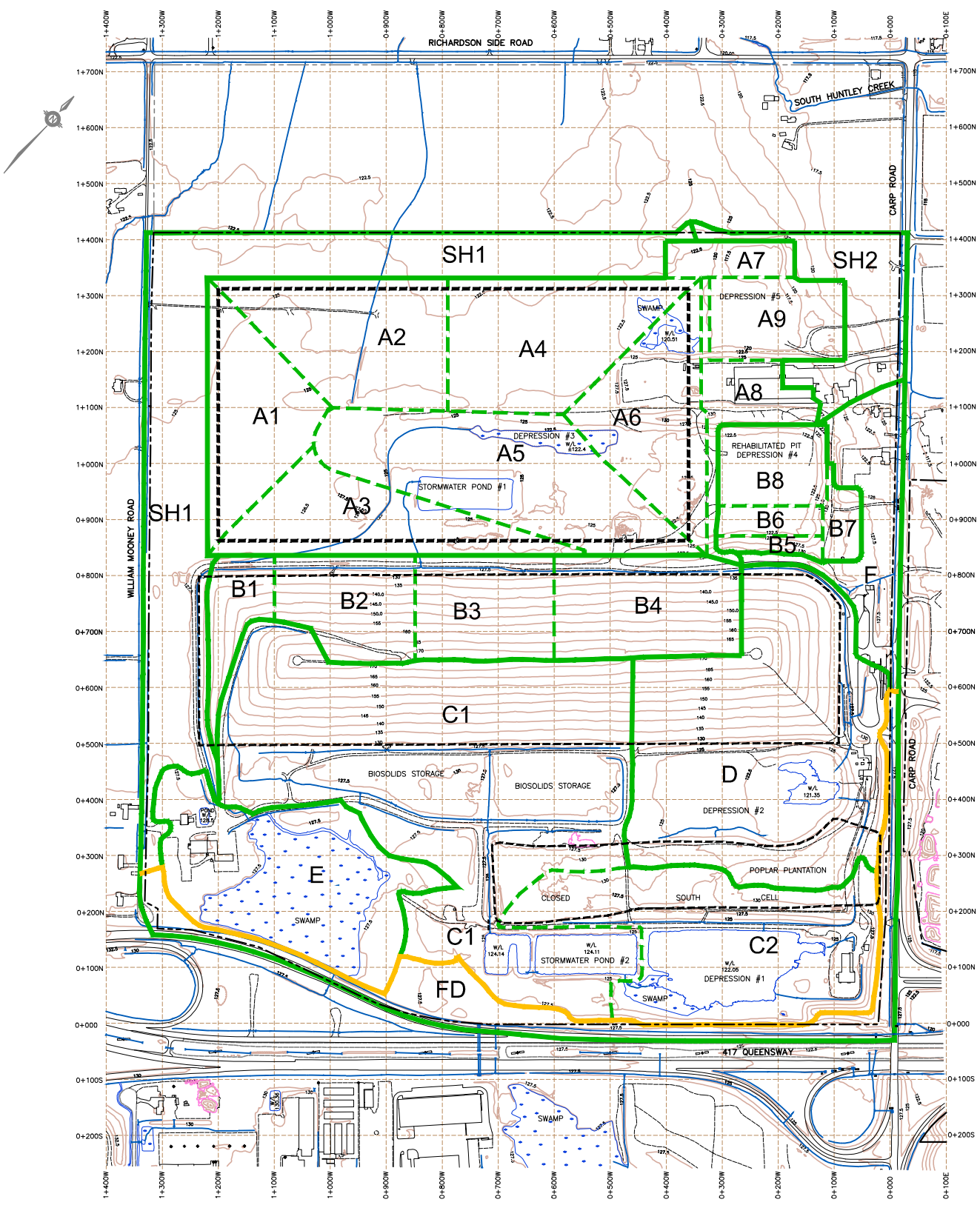
FIGURE 8-1

DWN BY: T C G
CHK BY: P S B
DATE: JULY 2014
SCALE: SEE BAR SCALE
WASTE MANAGEMENT OF CANADA CORP.
DRAWING NO. 131-19416-00 - 8-1

PRE-DEVELOPMENT
DRAINAGE AREAS
WEST CARLETON
ENVIRONMENTAL CENTRE



WSP
101-1450 1st AVENUE W
OWEN SOUND (ONTARIO) CANADA N4K 6W2
TEL: 519-376-7812 | FAX: 519-376-8088 | WWW.WSPGROUP.COM



LEGEND :

- LIMIT OF DRAINAGE AREA
- - - - - LIMIT OF SUBCATCHMENT AREA
- DIVISION BETWEEN FEEDMILL AND SOUTH HUNTLEY CREEK WATERSHEDS
- - - - - PROPOSED LANDFILL LIMIT
- - - - - WASTE MANAGEMENT OF CANADA PROPERTY LIMIT
- - - - - EXISTING LANDFILL LIMIT
- EXISTING GROUND CONTOURS

SCALE : 1:10,000:
 0 80 160 240 320 400m

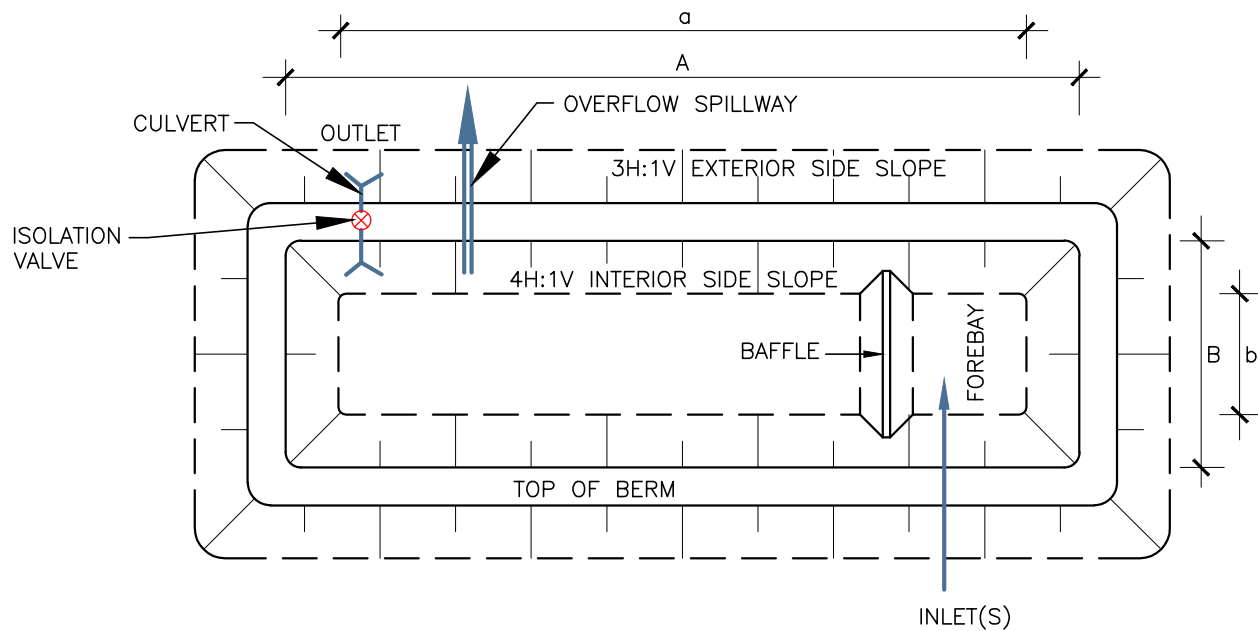
© 2013/2013-2014 - Owen Sound Expressway/Highway 131 - 19416-00 - 8-2 July 06, 2014 - 1048mm

FIGURE 8-2

DWN BY: T C C
 CHK BY: P S B
 DATE: JULY 2014
 SCALE: SEE BAR SCALE
WASTE MANAGEMENT OF CANADA CORP.
 DRAWING NO. 131-19416-00 - 8-2

POST-DEVELOPMENT DRAINAGE AREAS
WEST CARLETON ENVIRONMENTAL CENTRE





STORMWATER POND SCHEMATIC

SCALE: NTS

POND #	1	2
BOTTOM ELEVATION (m)	124.00	122.80
TOP OF BERM ELEVATION (m)	VARIES 126.75 – 129.00	VARIES 126.30 – 126.80
OUTLET PIPE NOMINAL ϕ (mm)	300	350
OUTLET INVERT UPSTREAM (m)	124.60	123.40
OUTLET INVERT DOWNSTREAM (m)	124.50	123.30
OVERFLOW SPILLWAY ELEVATION (m)	125.85	125.40
OVERFLOW SPILLWAY BOTTOM WIDTH (m)	3.0	6.0
a (m)	150	200
A (m)	184	228
b (m)	26	32
B (m)	51	62

NOTE :

ACTUAL INLET/OUTLET CONFIGURATION MAY VARY FROM THIS SHOWN HEREIN.

C:\2015\05\13-401 - Environmental\131-19416-00 - Ottawa Landfill Expansion\Drawings For DMS\131-19416-00-8-3.dwg Jul 09, 2014 - 10:00am

FIGURE
8-3

DWN BY: T C G
CHK BY: P S B
DATE: JULY 2014
SCALE: NTS
WASTE MANAGEMENT OF CANADA CORP.
DRAWING NO. 131-19416-00 - 8-3

STORMWATER POND
SCHEMATIC
WEST CARLETON
ENVIRONMENTAL CENTRE

WM.
WASTE MANAGEMENT

WSP
101-1450 1st AVENUE W.
OWEN SOUND (ONTARIO) CANADA N4K 0W2
TEL.: 519-376-7812 | FAX: 519-376-8081 | WWW.WSPGROUP.COM

Tables

TABLE 8-1
DRAINAGE AREA CHARACTERISTICS, PRE-DEVELOPMENT CONDITIONS
WM - WEST CARLETON ENVIRONMENTAL CENTRE

Drainage Area		Size [ha]		Time of Concentration (Tc) ⁽¹⁾ [min]	Runoff Coefficient C		Rational Method Peak Flow Q ₁₀₀ [m ³ /s]	Remarks
A		10.08		19	0.29		1.01	No outlet.
B	B1	39.47	29.41	35	0.32	0.34	2.30	No outlet.
	B2		10.06	10		0.25	1.34	No outlet.
C	C1	45.19	31.69	25	0.29	0.32	2.92	No outlet.
	C2		13.50	12		0.22	1.40	No outlet.
D		21.34		16	0.34		2.82	No outlet.
E		11.50		29	0.25		0.83	No outlet.
F		5.80		11	0.34		0.99	No outlet. Drains off-site to Huntley Quarry
SH	SH1	47.12	41.35	-	0.25	0.23	-	Multiple outlets to South Huntley Creek
	SH2		5.77	18		0.36	0.75	
FD		7.79		38	0.31		0.52	Drains to Feedmill Creek
TOTAL		188.29		-	0.29		-	

Notes:

(1) Tc established using Kirpich Method

**TABLE 8-2
DRAINAGE AREA CHARACTERISTICS, POST-DEVELOPMENT CONDITIONS
WM - WEST CARLETON ENVIRONMENTAL CENTRE**

Drainage Area		Size [ha]		Time of Concentration (Tc) ⁽³⁾ [min]		Runoff Coefficient C		Soil/Land Use Curve Number CN (AMC II)		Rational Method Peak Flow Q ₁₀₀ [m³/s]		Remarks	
A	A1	51.66	5.75	32 ⁽¹⁾	15	0.432	0.433	80.9	5.31 ⁽¹⁾	1.01	No outlet		
	A2		7.59		15		0.435			81.2		1.34	
	A3		6.3		19		0.459			82.1		1.00	
	A4		7.74		19		0.435			81.1		1.17	
	A5		10.27		17		0.44			81.6		1.69	
	A6		6.25		15		0.45			81.4		1.14	
	A7		1.5		-		0.5			85		-	No concentrated flow
	A8		2.8		18		0.561			85.7		0.57	
	A9		3.46		-		0.16			70		-	No concentrated flow
B	B1	22.58	2.11	31 ⁽²⁾	11	0.398	0.412	79.1	2.13 ⁽²⁾	0.44	No outlet		
	B2		4.28		12		0.418			79.7		0.84	
	B3		4.67		14		0.42			79.9		0.84	
	B4		6.1		15		0.439			80.5		1.09	
	B5		0.64		6		0.24			72		0.12	
	B6		1.03		-		0.5			85		-	No concentrated flow
	B7		0.94		6		0.606			86.2		0.43	
	B8		2.81		-		0.16			70		-	No concentrated flow
C	C1	45.19	31.69	25	0.29	0.32	-	2.91	No outlet. No change.				
	C2		13.5	12		0.22	-	1.40	No outlet. No change.				
D		20.83		16		0.34		-		2.75	No outlet. No change.		
E		11.50		29		0.25		-		0.83	No outlet. No change.		
F		5.24		11		0.38		-		0.99	No outlet. No flow increase.		
SH	SH1	23.50	18.44	-	0.27	0.25	-	-	Multiple outlets. Drainage area reduced by 55%. Flow lower than under pre-development conditions.				
	SH2		5.06	18		0.36	-	0.66	Flow lower than under pre-development conditions.				
FD		7.79		38		0.31		-		0.52	No change.		
TOTAL		188.29		-		0.35		-		-			

Notes:

- (1) Tc and Q₁₀₀ at Pond 2
- (2) Tc and Q₁₀₀ at Pond 1
- (3) Tc established using Kirpich Method

TABLE 8-3
HYDROLOGIC MODELLING RESULTS - STORMWATER PONDS (24-HR SCS II STORM)
WM - WEST CARLETON ENVIRONMENTAL CENTRE

Storm	Rainfall Depth [mm]	Post Development Conditions									
		Rainfall Volume [m ³]	Pond Peak Inflow [m ³ /s]	Rational Method Pond Peak Inflow [m ³ /s]	Runoff Volume [m ³]	Calculated Runoff Coefficient (6) / (3)	Peak Pond Outflow [m ³ /s]	Maximum Water Level [mASL]	Maximum Water Storage excluding PWPV [m ³]	Total Pond Water Storage [m ³]	Draining Time After Storm [hr]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Drainage Area A (Pond #2) - 48.2 ha, Normal Water Level - 123.4 m, Permanent Water Pool Volume (PWPV) - 4,200 m³											
1:2 yr	48.2	23,232	1.50	2.06	7,024	0.302	0.10	123.87	3,845	8,045	23
1:5 yr	63.8	30,752	2.94	2.65	12,177	0.396	0.15	124.25	7,247	11,447	31
1:10 yr	74.2	35,764	4.01	3.04	15,954	0.446	0.18	124.53	9,917	14,117	35
1:25 yr	87.3	41,206	5.46	3.88	20,988	0.509	0.22	124.88	13,609	17,809	40
1:50 yr	97.0	46,754	6.57	4.66	24,866	0.532	0.24	125.15	16,534	20,734	44
1:100 yr	106.6	51,381	7.71	5.31	28,805	0.561	0.26	125.40	19,543	23,743	48
Drainage Area B - (Pond #1) - 19.77 ha, Normal Water Level - 124.60 m, Permanent Water Pool Volume (PWPV) - 2,598 m³											
1:2 yr	48.2	9,529	0.51	0.83	2,606	0.273	0.04	124.88	1,369	3,967	11
1:5 yr	63.8	12,613	1.07	1.06	4,617	0.366	0.08	125.08	2,444	5,042	14
1:10 yr	74.2	14,669	1.49	1.22	6,106	0.416	0.10	125.25	3,391	5,989	17
1:25 yr	87.3	17,259	2.08	1.55	8,104	0.469	0.12	125.47	4,720	7,318	20
1:50 yr	97.0	19,177	2.54	1.87	9,651	0.503	0.13	125.64	5,784	8,382	23
1:100 yr	106.6	21,075	3.00	2.13	11,226	0.533	0.15	125.81	6,890	9,488	25

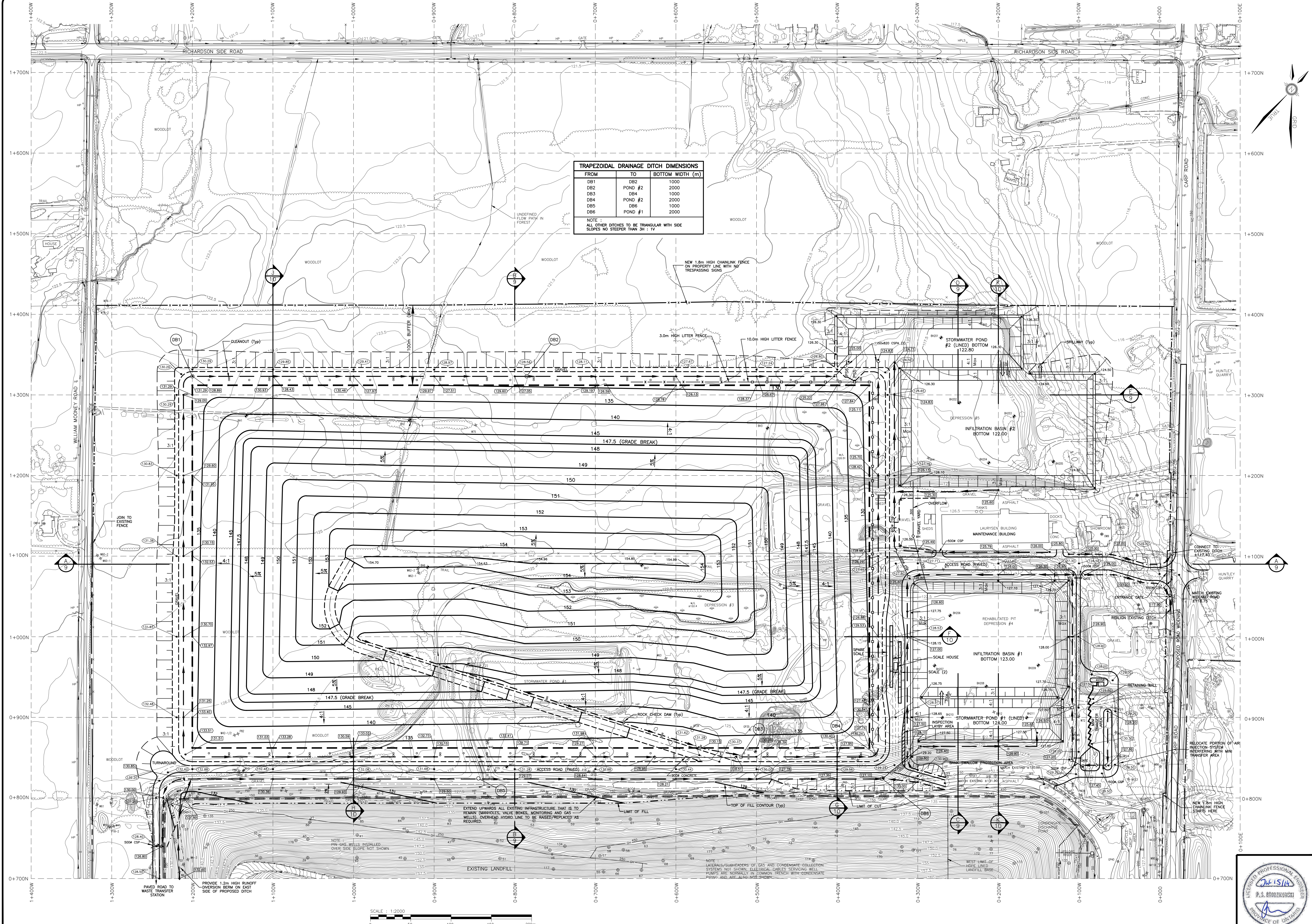
TABLE 8-4
HYDROLOGIC MODELLING RESULTS - INFILTRATION BASINS (24-HR SCS II STORM)
WM - WEST CARLETON ENVIRONMENTAL CENTRE

Storm	Post-Development Conditions				
	Runoff Volume [m ³]	Maximum Water Level [mASL]	Maximum Water Storage [m ³]	Draining Time After Upstream Pond Empties [hr]	Capacity Up to Emergency Overflow Level [m ³]
(1)	(2)	(3)	(4)	(5)	(6)
Drainage Area A - Infiltration Basin 2 - Bottom 122.00, Overflow Spillway Level - 123.60 mASL					
1:2 yr	7,084	122.05	1,348	5	43,592
1:5 yr	12,448	122.16	3,997	7	
1:10 yr	16,399	122.25	6,381	13	
1:25 yr	21,680	122.38	9,827	24	
1:50 yr	25,760	122.48	12,612	32	
1:100 yr	29,909	122.59	15,530	40	
Drainage Area B - Infiltration Basin 1 - Bottom 123.00 - Overflow Storm Sewer Invert - 124.30 mASL					
1:2 yr	2,728	123.03	525	8	25,242
1:5 yr	4,921	123.06	1,165	9	
1:10 yr	6,558	123.11	2,040	10	
1:25 yr	8,767	123.18	3,370	15	
1:50 yr	10,484	123.24	4,484	18	
1:100 yr	12,238	123.31	5,669	23	

Note: Constant infiltration rate 12 mm/hr

Drawings

G:\2013\05\13-401 - Environment\131-19416-00 - Ottawa Landfill Expansion Drawings for D&S\STAMPED DRAWINGS TO MINISTRY JULY 2014\131-19416-4.dwg Aug 07, 2014 - 8:56am



101-150 1st AVENUE W
OWEN SOUND (ONTARIO) CANADA N4K 6V2
TEL: 519-376-7612 FAX: 519-376-8081 WWW.WSPGROUP.COM

WASTE MANAGEMENT

PROPOSED FINAL LANDFILL
CONTOURS

WEST CARLETON ENVIRONMENTAL CENTRE

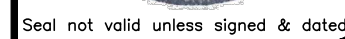
WASTE MANAGEMENT OF CANADA CORPORATION

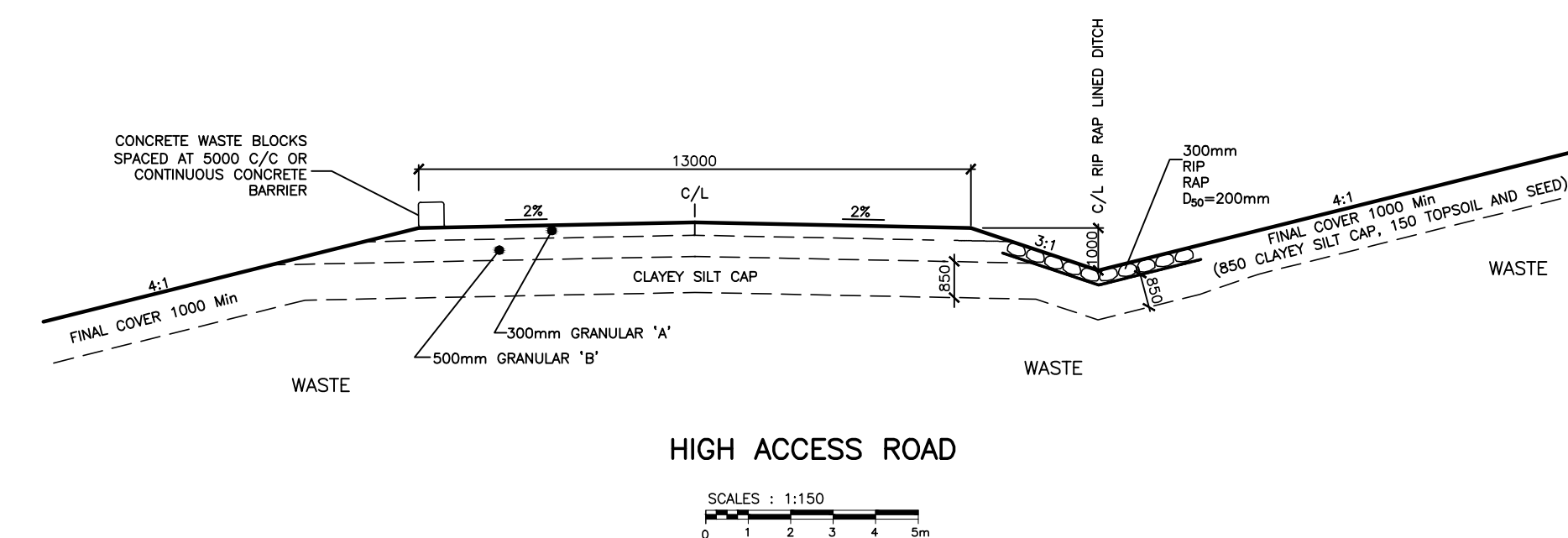
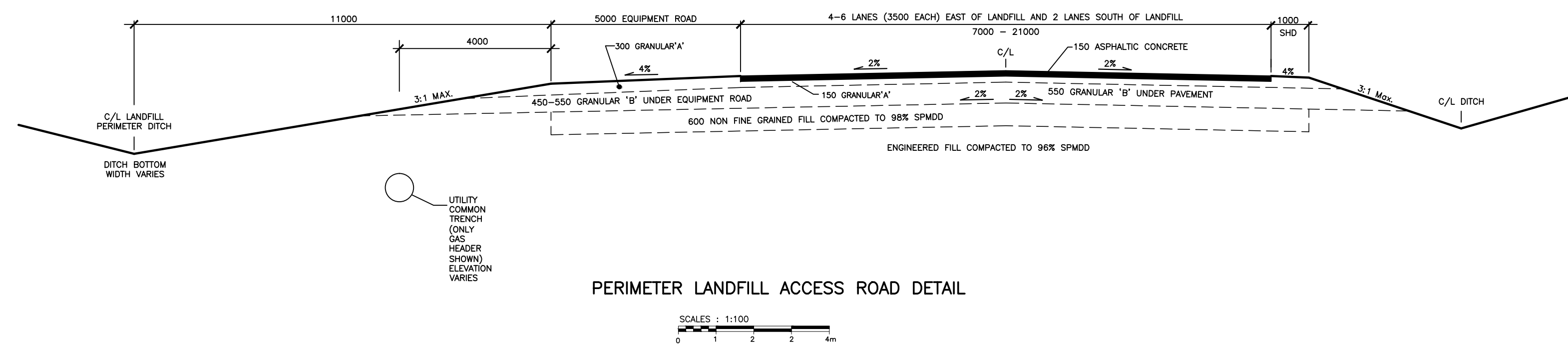
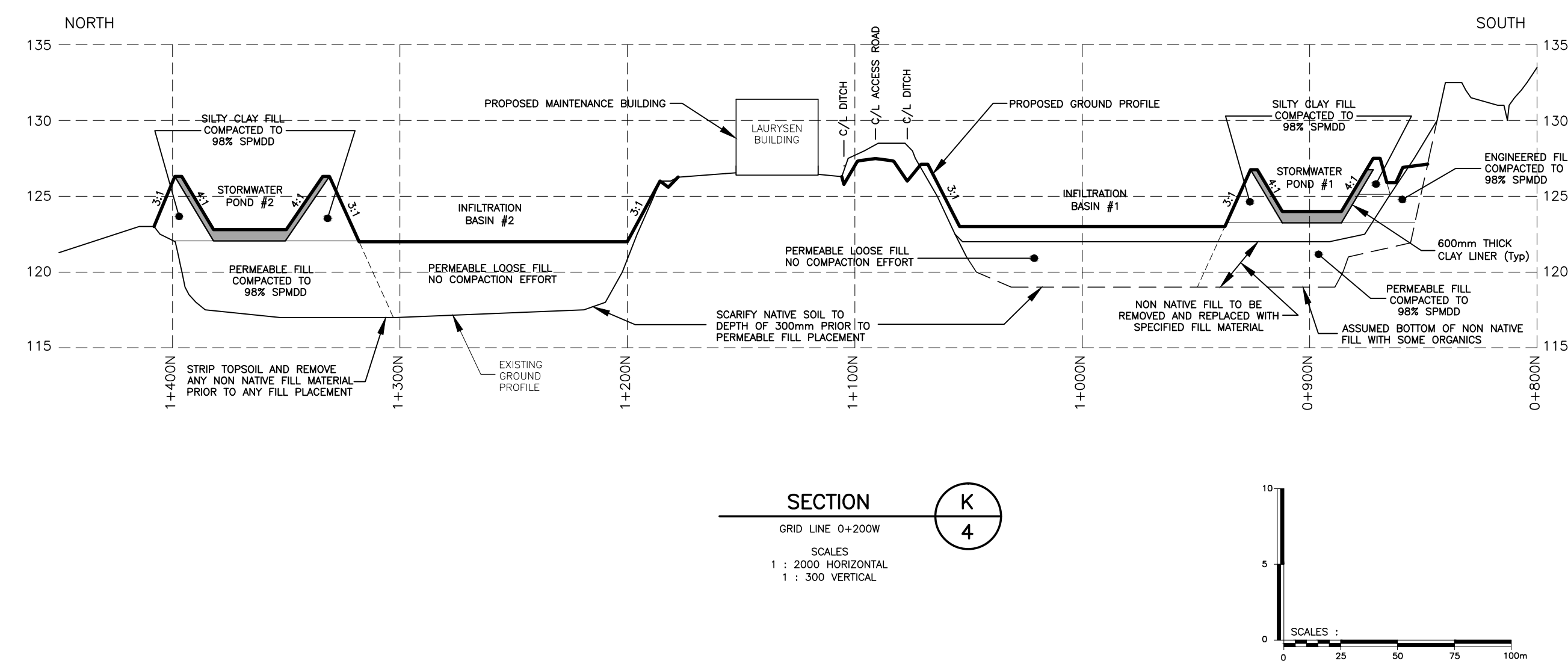
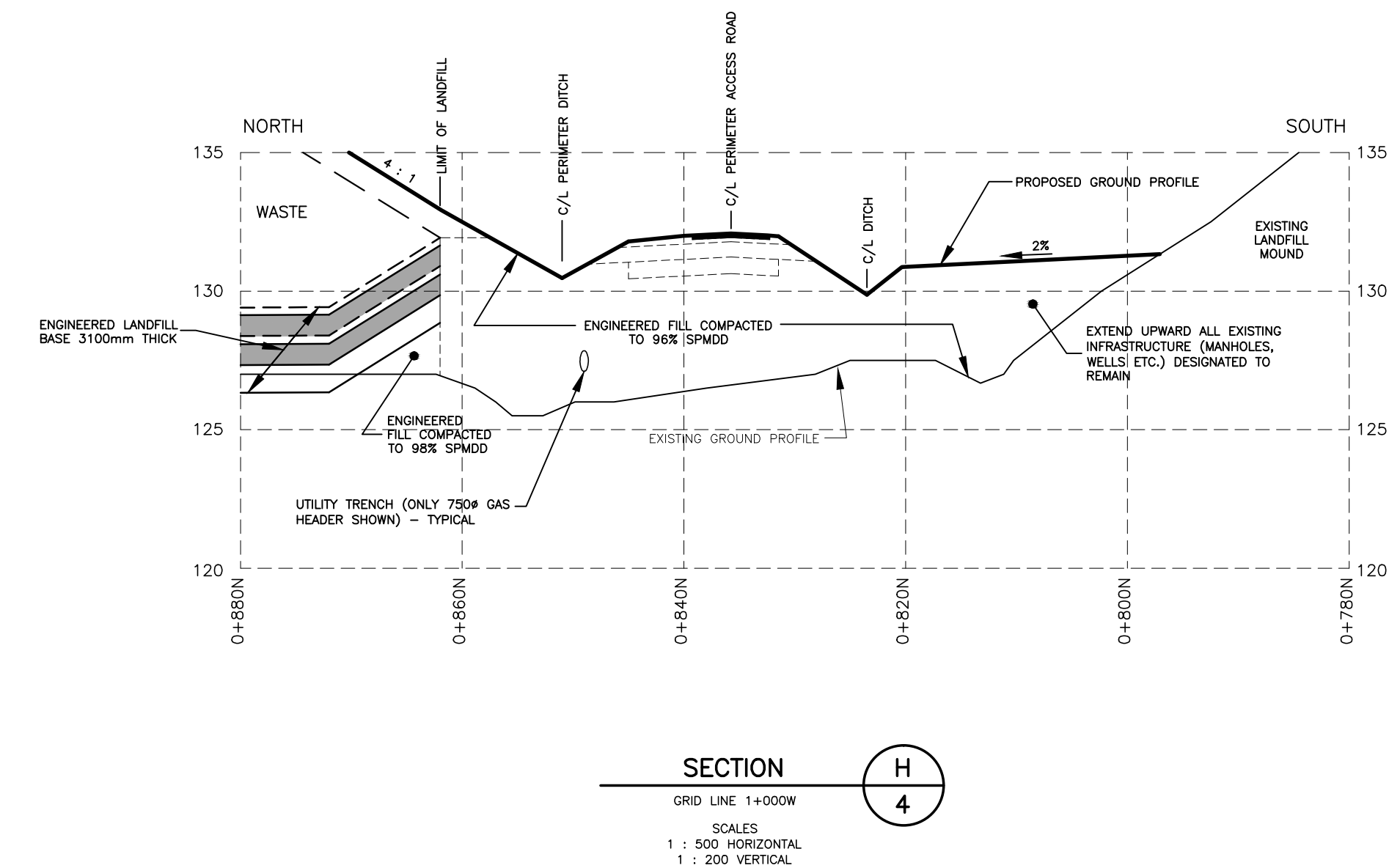
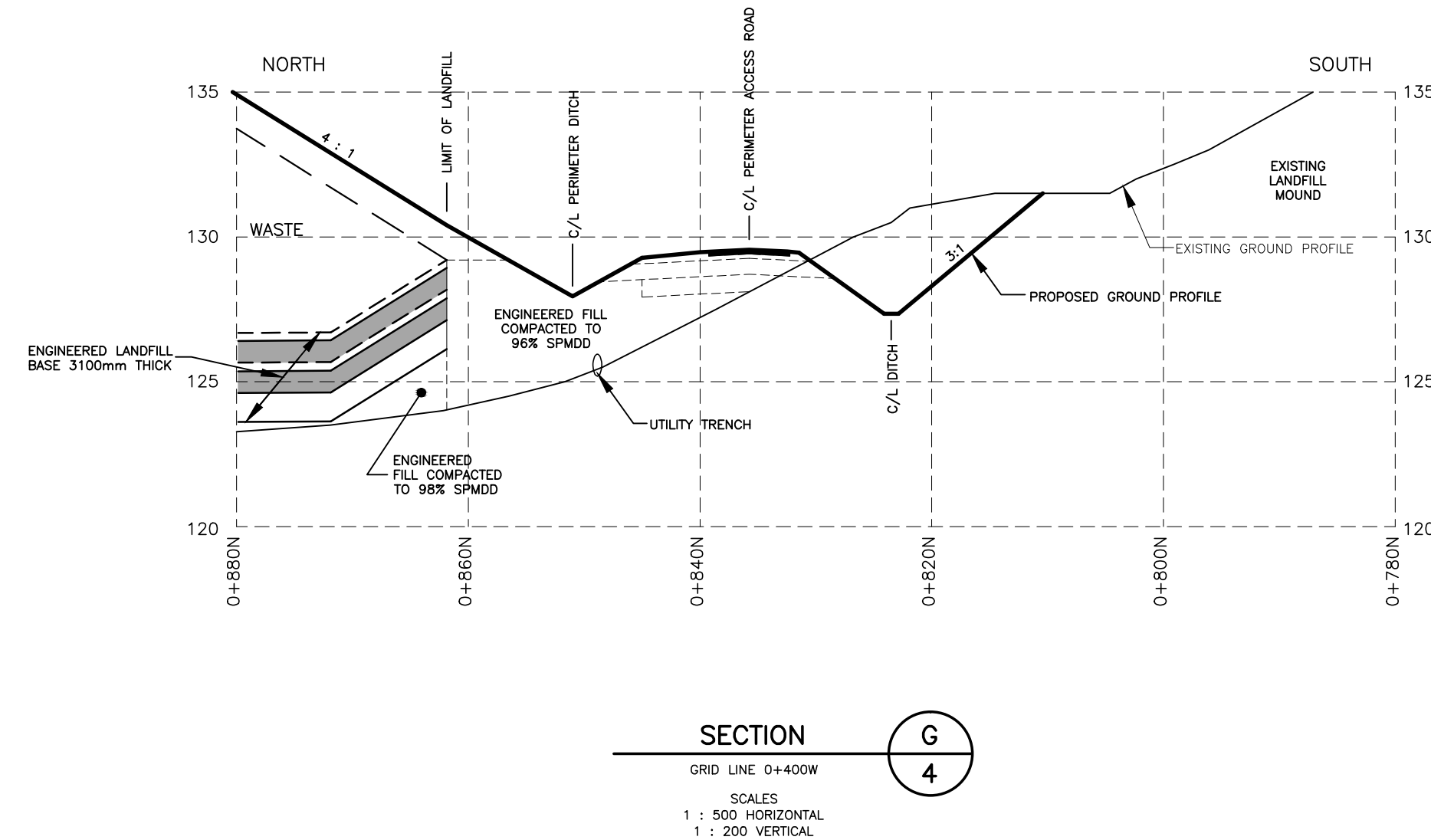
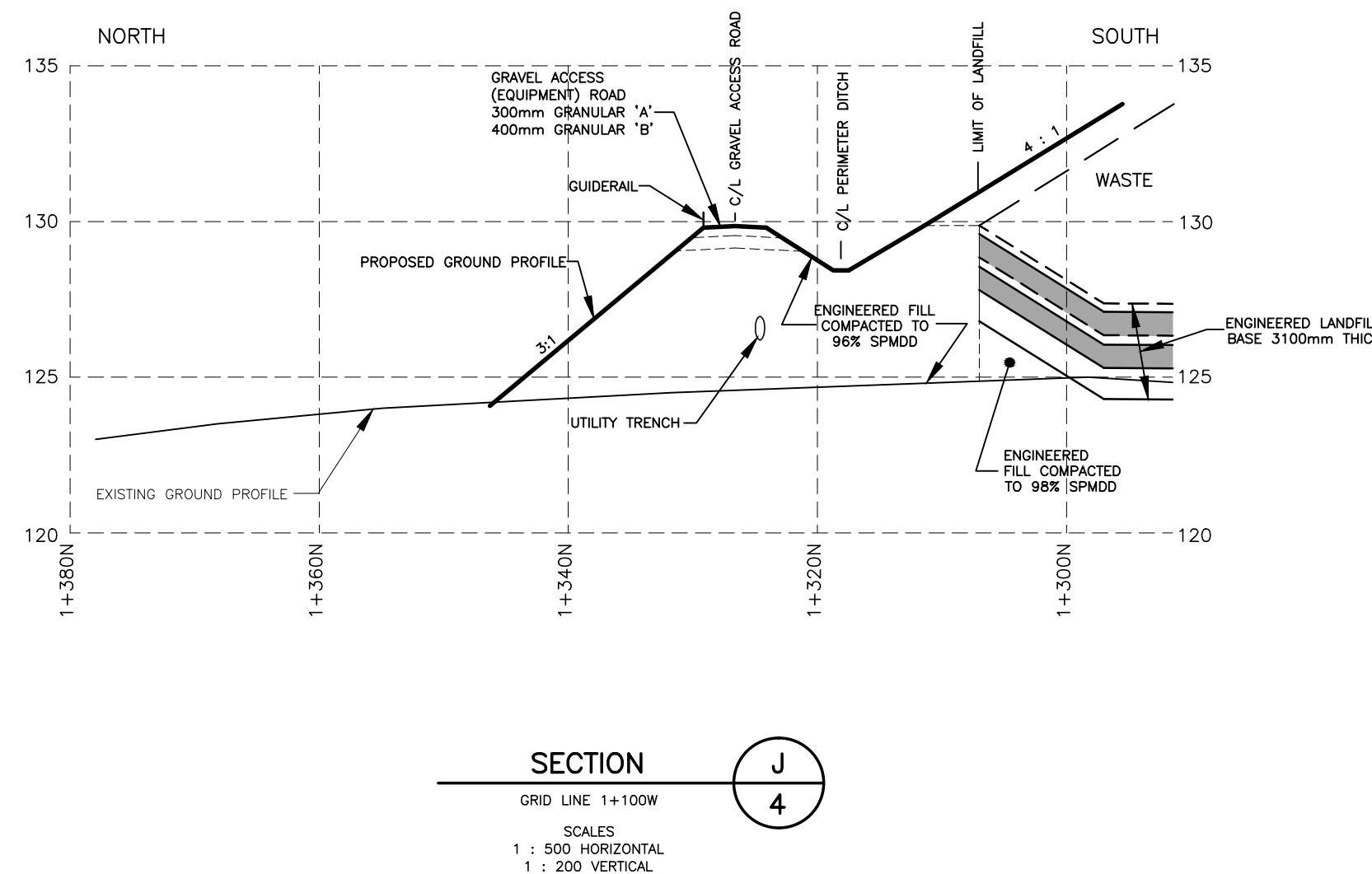
DRAWING NO. 131-19416-00 - 4

DWN BY: T C G
CHK BY: P S B
DATE: JULY 2014
SCALE: SEE BAR SCALE

DRAWING

4





DATE	DESCRIPTION
	REVISION / ISSUE



Appendices

Appendix A

Summary of Modelling Procedure

Appendix A

Stormwater Modelling Procedure Summary

Hydrologic modelling of the stormwater management system is limited to the post development conditions because there will be no off-site discharge from lands encompassing waste disposal area. All runoff originating from landfilling areas will be diverted to infiltration basins and recharged into subsurface groundwater regime.

Post Development Conditions

1. Establish drainage network schematic for each infiltration basin watershed.
2. Define input parameters for SCS Unit Hydrograph Method used by Bentley PondPack model. These include the following parameters:
 - a) Subwatershed area.
 - b) Time of concentration for each subwatershed which is established within PondPack model using Kirpich equation. This method is conservative and provides relatively short times.
 - c) CN curve number for each watershed. Cumulative CN value was established for each subwatershed from conservatively selected CN values corresponding to various applicable land cover features.
3. Enter geometric information for drainage channels as required for hydrograph routing by Modified Puls Method.
4. Establish stormwater pond and infiltration basin dimensions. Use constant infiltration rate of 12 mm/hour recommended by a hydrogeologist for sizing of both infiltration basins.
5. Size outlet structures including emergency overflows for all water storage facilities.
6. Run PondPack model for 24 hour SCS storm (2 to 100 year return period). Verify peak flows and check water levels at each water storage location to ensure compliance with design criteria.
7. Optimize size of water storage facilities and fit them into the overall site design.

In addition to PondPack Modelling, the Rational Method was used to calculate peak flows for all subwatersheds using the following input parameters:

- a) subwatershed area;
- b) runoff coefficient C;
- c) time of concentration (Kirpich Method)
- d) rainfall intensity i calculated from Ottawa Intensity Duration Frequency (IDF) data.

The peak flow increase factor was applied to all storms having a return period of more than 10 years. Rational Method peak flows were used for sizing of all proposed culverts.

Settling Velocities for Lined Ponds

Formula to calculate settling velocity is:

$$V_s = \frac{1.2 Q}{A}$$

Q - is 1:100 year peak pond outflow

A - is water surface area in pond at top of settlement zone i.e. invert of culvert outlet

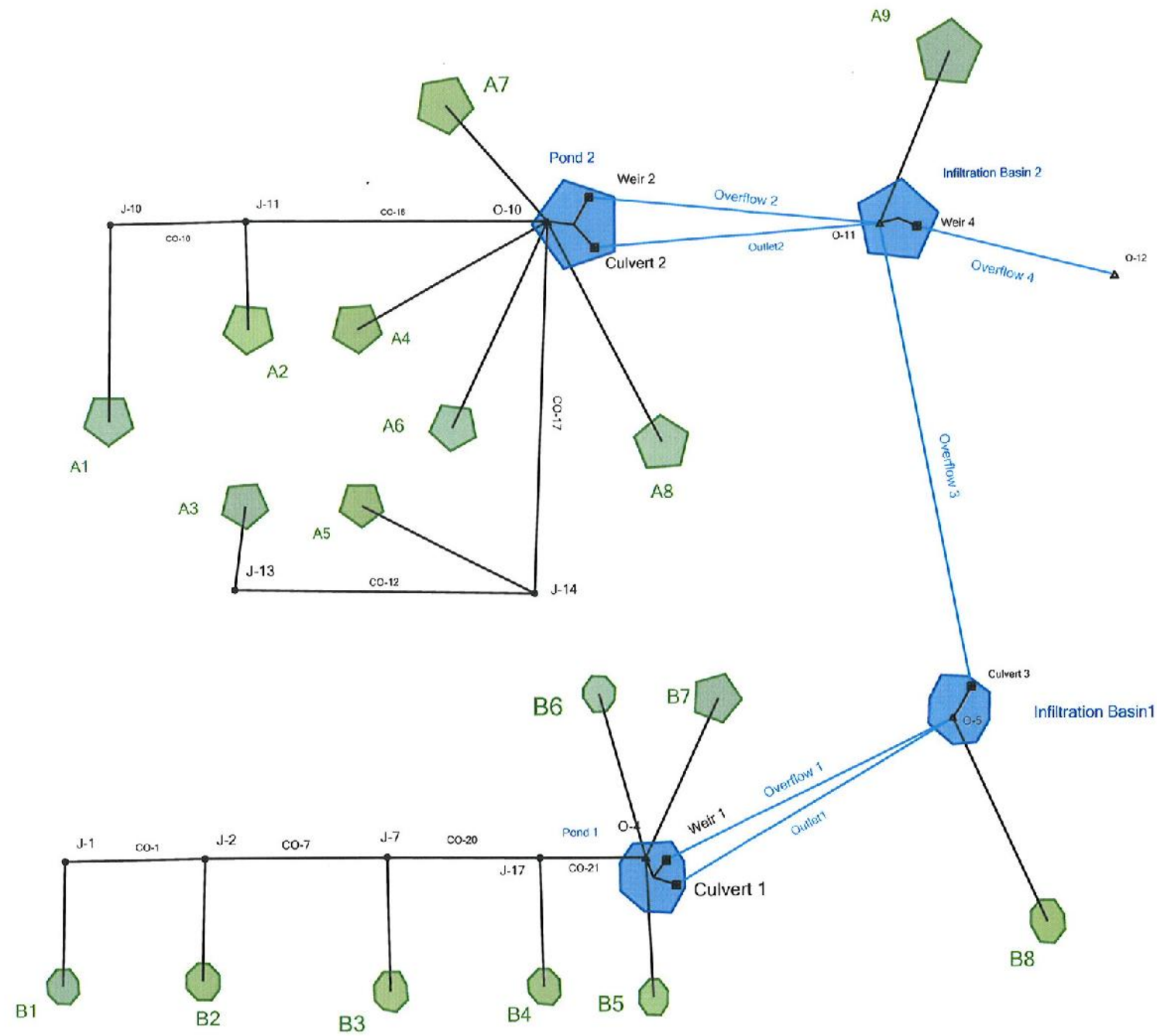
The table below shows calculation results including size of settled particles corresponding to settling velocity V_s

Pond #	Settled Particle Size [Microns]	Q [m ³ /s]	A [m ²]	Top of Settlement Zone Elevation [masL]	Calculated V_s [m/s]
1	7	0.15	4,768	124.6	3.78×10^{-5}
2	7	0.26	7,537	123.4	4.14×10^{-5}

Appendix B

Pondpack Printouts – Drainage Areas A & B Post Development

Scenario: Post-Development 1



Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m ³)	Time to Peak (hours)	Peak Flow (m ³ /s)
B1	Post-Development 1	1	39.304	4.000	0.01
B1	Post-Development 2	2	260.430	12.050	0.09
B1	Post-Development 5	5	469.578	12.000	0.17
B1	Post-Development 10	10	625.463	12.000	0.23
B1	Post-Development 25	25	835.319	12.000	0.30
B1	Post-Development 50	50	998.254	12.000	0.36
B1	Post-Development 100	100	1,164.530	12.000	0.42
B2	Post-Development 1	1	81.099	4.000	0.02
B2	Post-Development 2	2	532.187	12.050	0.18
B2	Post-Development 5	5	957.761	12.050	0.33
B2	Post-Development 10	10	1,274.768	12.000	0.44
B2	Post-Development 25	25	1,701.333	12.000	0.60
B2	Post-Development 50	50	2,032.357	12.000	0.72
B2	Post-Development 100	100	2,370.120	12.000	0.84
B3	Post-Development 1	1	91.633	4.000	0.02
B3	Post-Development 2	2	589.981	12.050	0.19
B3	Post-Development 5	5	1,057.917	12.050	0.35
B3	Post-Development 10	10	1,405.903	12.050	0.48
B3	Post-Development 25	25	1,873.697	12.050	0.64
B3	Post-Development 50	50	2,236.521	12.050	0.76
B3	Post-Development 100	100	2,606.481	12.050	0.89
B4	Post-Development 1	1	132.466	4.000	0.03
B4	Post-Development 2	2	806.832	12.050	0.25
B4	Post-Development 5	5	1,431.332	12.050	0.47
B4	Post-Development 10	10	1,893.604	12.050	0.63
B4	Post-Development 25	25	2,513.233	12.050	0.84
B4	Post-Development 50	50	2,992.779	12.050	1.00
B4	Post-Development 100	100	3,481.132	12.050	1.16
B6	Post-Development 1	1	43.523	4.000	0.01
B6	Post-Development 2	2	188.590	11.950	0.08
B6	Post-Development 5	5	310.749	11.950	0.13
B6	Post-Development 10	10	398.220	11.950	0.16
B6	Post-Development 25	25	513.158	11.950	0.21
B6	Post-Development 50	50	600.799	11.950	0.25
B6	Post-Development 100	100	689.175	11.950	0.28
B5	Post-Development 1	1	1.699	4.000	0.00
B5	Post-Development 2	2	40.691	12.000	0.01
B5	Post-Development 5	5	86.904	12.000	0.03
B5	Post-Development 10	10	123.801	11.950	0.05
B5	Post-Development 25	25	175.536	11.950	0.07
B5	Post-Development 50	50	216.907	11.950	0.09
B5	Post-Development 100	100	260.005	11.950	0.11
B8	Post-Development 1	1	2.605	4.000	0.00
B8	Post-Development 2	2	145.039	12.000	0.04
B8	Post-Development 5	5	328.872	12.000	0.12

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m ³)	Time to Peak (hours)	Peak Flow (m ³ /s)
B8	Post-Development 10	10	478.810	12.000	0.18
B8	Post-Development 25	25	691.781	11.950	0.27
B8	Post-Development 50	50	863.720	11.950	0.35
B8	Post-Development 100	100	1,043.816	11.950	0.42
A3	Post-Development 1	1	176.301	4.000	0.04
A3	Post-Development 2	2	939.128	12.100	0.26
A3	Post-Development 5	5	1,620.856	12.100	0.47
A3	Post-Development 10	10	2,119.459	12.100	0.63
A3	Post-Development 25	25	2,782.781	12.100	0.82
A3	Post-Development 50	50	3,293.334	12.100	0.98
A3	Post-Development 100	100	3,811.363	12.100	1.13
A5	Post-Development 1	1	266.065	4.000	0.06
A5	Post-Development 2	2	1,474.826	12.100	0.43
A5	Post-Development 5	5	2,566.979	12.050	0.78
A5	Post-Development 10	10	3,368.714	12.050	1.04
A5	Post-Development 25	25	4,437.816	12.050	1.39
A5	Post-Development 50	50	5,262.091	12.050	1.65
A5	Post-Development 100	100	6,099.392	12.050	1.91
A6	Post-Development 1	1	156.932	4.000	0.03
A6	Post-Development 2	2	884.477	12.050	0.28
A6	Post-Development 5	5	1,544.741	12.050	0.50
A6	Post-Development 10	10	2,030.176	12.050	0.67
A6	Post-Development 25	25	2,678.094	12.050	0.89
A6	Post-Development 50	50	3,177.971	12.050	1.05
A6	Post-Development 100	100	3,686.004	12.050	1.22
A1	Post-Development 1	1	133.316	4.000	0.03
A1	Post-Development 2	2	783.839	12.050	0.25
A1	Post-Development 5	5	1,380.814	12.050	0.45
A1	Post-Development 10	10	1,821.396	12.050	0.61
A1	Post-Development 25	25	2,410.811	12.050	0.81
A1	Post-Development 50	50	2,866.316	12.050	0.96
A1	Post-Development 100	100	3,329.778	12.050	1.11
A2	Post-Development 1	1	184.626	4.000	0.04
A2	Post-Development 2	2	1,058.116	12.050	0.33
A2	Post-Development 5	5	1,854.329	12.050	0.61
A2	Post-Development 10	10	2,440.572	12.050	0.81
A2	Post-Development 25	25	3,223.760	12.050	1.07
A2	Post-Development 50	50	3,828.438	12.050	1.27
A2	Post-Development 100	100	4,443.225	12.050	1.48
A4	Post-Development 1	1	185.334	4.000	0.04
A4	Post-Development 2	2	1,070.547	12.100	0.30
A4	Post-Development 5	5	1,879.389	12.100	0.55
A4	Post-Development 10	10	2,475.374	12.100	0.73
A4	Post-Development 25	25	3,271.983	12.100	0.97
A4	Post-Development 50	50	3,887.223	12.100	1.15

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m ³)	Time to Peak (hours)	Peak Flow (m ³ /s)
A4	Post-Development 100	100	4,512.912	12.100	1.33
A7	Post-Development 1	1	63.373	4.000	0.01
A7	Post-Development 2	2	274.673	11.950	0.11
A7	Post-Development 5	5	452.532	11.950	0.19
A7	Post-Development 10	10	579.957	11.950	0.24
A7	Post-Development 25	25	747.310	11.950	0.31
A7	Post-Development 50	50	874.962	11.950	0.36
A7	Post-Development 100	100	1,003.662	11.950	0.41
A9	Post-Development 1	1	3.228	4.000	0.00
A9	Post-Development 2	2	178.594	12.000	0.05
A9	Post-Development 5	5	404.959	12.000	0.15
A9	Post-Development 10	10	589.557	12.000	0.22
A9	Post-Development 25	25	851.827	11.950	0.33
A9	Post-Development 50	50	1,063.524	11.950	0.43
A9	Post-Development 100	100	1,285.273	11.950	0.52
B7	Post-Development 1	1	46.468	4.000	0.01
B7	Post-Development 2	2	186.891	11.950	0.08
B7	Post-Development 5	5	302.339	11.950	0.13
B7	Post-Development 10	10	384.373	11.950	0.16
B7	Post-Development 25	25	491.580	11.950	0.20
B7	Post-Development 50	50	573.048	11.950	0.23
B7	Post-Development 100	100	655.025	11.950	0.27
A8	Post-Development 1	1	129.776	4.000	0.02
A8	Post-Development 2	2	538.133	12.100	0.16
A8	Post-Development 5	5	877.114	12.050	0.27
A8	Post-Development 10	10	1,118.799	12.050	0.34
A8	Post-Development 25	25	1,435.324	12.050	0.44
A8	Post-Development 50	50	1,676.159	12.050	0.51
A8	Post-Development 100	100	1,918.721	12.050	0.58

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m ³)	Time to Peak (hours)	Peak Flow (m ³ /s)
J-1	Post-Development 1	1	39.304	4.000	0.01
J-1	Post-Development 2	2	260.430	12.050	0.09
J-1	Post-Development 5	5	469.578	12.000	0.17
J-1	Post-Development 10	10	625.463	12.000	0.23
J-1	Post-Development 25	25	835.319	12.000	0.30
J-1	Post-Development 50	50	998.254	12.000	0.36
J-1	Post-Development 100	100	1,164.530	12.000	0.42
J-2	Post-Development 1	1	120.403	4.000	0.03
J-2	Post-Development 2	2	792.617	12.050	0.23
J-2	Post-Development 5	5	1,427.339	12.050	0.46

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m ³)	Time to Peak (hours)	Peak Flow (m ³ /s)
J-2	Post-Development 10	10	1,900.230	12.050	0.62
J-2	Post-Development 25	25	2,536.651	12.050	0.84
J-2	Post-Development 50	50	3,030.610	12.050	1.01
J-2	Post-Development 100	100	3,534.650	12.050	1.18
J-7	Post-Development 1	1	212.037	4.050	0.05
J-7	Post-Development 2	2	1,382.598	12.100	0.36
J-7	Post-Development 5	5	2,485.256	12.100	0.72
J-7	Post-Development 10	10	3,306.162	12.050	0.99
J-7	Post-Development 25	25	4,410.349	12.050	1.36
J-7	Post-Development 50	50	5,267.132	12.050	1.65
J-7	Post-Development 100	100	6,141.131	12.050	1.95
J-10	Post-Development 1	1	133.316	4.000	0.03
J-10	Post-Development 2	2	783.839	12.050	0.25
J-10	Post-Development 5	5	1,380.814	12.050	0.45
J-10	Post-Development 10	10	1,821.396	12.050	0.61
J-10	Post-Development 25	25	2,410.811	12.050	0.81
J-10	Post-Development 50	50	2,866.316	12.050	0.96
J-10	Post-Development 100	100	3,329.778	12.050	1.11
J-11	Post-Development 1	1	317.942	4.000	0.07
J-11	Post-Development 2	2	1,841.954	12.100	0.53
J-11	Post-Development 5	5	3,235.143	12.050	0.98
J-11	Post-Development 10	10	4,261.969	12.050	1.33
J-11	Post-Development 25	25	5,634.571	12.050	1.78
J-11	Post-Development 50	50	6,694.754	12.050	2.13
J-11	Post-Development 100	100	7,773.003	12.050	2.49
J-13	Post-Development 1	1	176.301	4.000	0.04
J-13	Post-Development 2	2	939.128	12.100	0.26
J-13	Post-Development 5	5	1,620.856	12.100	0.47
J-13	Post-Development 10	10	2,119.459	12.100	0.63
J-13	Post-Development 25	25	2,782.781	12.100	0.82
J-13	Post-Development 50	50	3,293.334	12.100	0.98
J-13	Post-Development 100	100	3,811.363	12.100	1.13
J-14	Post-Development 1	1	442.337	4.000	0.09
J-14	Post-Development 2	2	2,413.955	12.100	0.64
J-14	Post-Development 5	5	4,187.835	12.100	1.18
J-14	Post-Development 10	10	5,488.173	12.100	1.58
J-14	Post-Development 25	25	7,220.569	12.100	2.11
J-14	Post-Development 50	50	8,555.425	12.100	2.50
J-14	Post-Development 100	100	9,910.783	12.100	2.91
O-12	Post-Development 1	1	0.000	0.000	0.00
O-12	Post-Development 2	2	0.000	0.000	0.00
O-12	Post-Development 5	5	0.000	0.000	0.00
O-12	Post-Development 10	10	0.000	0.000	0.00
O-12	Post-Development 25	25	0.000	0.000	0.00
O-12	Post-Development 50	50	0.000	0.000	0.00

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m ³)	Time to Peak (hours)	Peak Flow (m ³ /s)
O-12	Post-Development 100	100	0.000	0.000	0.00
J-17	Post-Development 1	1	344.474	4.050	0.08
J-17	Post-Development 2	2	2,189.430	12.100	0.49
J-17	Post-Development 5	5	3,916.588	12.100	1.04
J-17	Post-Development 10	10	5,199.766	12.100	1.45
J-17	Post-Development 25	25	6,923.582	12.100	2.00
J-17	Post-Development 50	50	8,259.911	12.100	2.42
J-17	Post-Development 100	100	9,622.263	12.100	2.85

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m ³)	Time to Peak (hours)	Peak Flow (m ³ /s)	Maximum Water Surface Elevation (m)	Maximum Pond Storage (m ³)
Pond 1 (IN)	Post-Development 1	1	436.164	4.000	0.09	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 1	1	426.876	5.350	0.00	124.68	2,992.977
Pond 1 (IN)	Post-Development 2	2	2,605.631	12.150	0.51	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 2	2	2,582.949	15.400	0.04	124.88	3,967.417
Pond 1 (IN)	Post-Development 5	5	4,616.580	12.150	1.07	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 5	5	4,591.860	14.450	0.08	125.08	5,042.154
Pond 1 (IN)	Post-Development 10	10	6,106.160	12.100	1.49	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 10	10	6,079.712	14.600	0.10	125.25	5,989.070
Pond 1 (IN)	Post-Development 25	25	8,103.885	12.100	2.08	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 25	25	8,074.945	14.800	0.12	125.47	7,317.894
Pond 1 (IN)	Post-Development 50	50	9,650.664	12.100	2.54	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 50	50	9,619.856	15.000	0.13	125.64	8,382.155

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m³)	Time to Peak (hours)	Peak Flow (m³/s)	Maximum Water Surface Elevation (m)	Maximum Pond Storage (m³)
Pond 1 (IN)	Post-Development 100	100	11,226.469	12.100	3.00	(N/A)	(N/A)
Pond 1 (OUT)	Post-Development 100	100	11,193.734	15.150	0.15	125.81	9,488.267
Infiltration Basin1 (IN)	Post-Development 1	1	429.482	5.350	0.00	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 1	1	0.000	0.000	0.00	123.00	50.829
Infiltration Basin1 (IN)	Post-Development 2	2	2,727.988	15.100	0.05	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 2	2	0.000	0.000	0.00	123.03	524.711
Infiltration Basin1 (IN)	Post-Development 5	5	4,920.732	12.000	0.13	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 5	5	0.000	0.000	0.00	123.06	1,164.700
Infiltration Basin1 (IN)	Post-Development 10	10	6,558.493	12.000	0.20	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 10	10	0.000	0.000	0.00	123.11	2,040.455
Infiltration Basin1 (IN)	Post-Development 25	25	8,766.726	12.000	0.30	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 25	25	0.000	0.000	0.00	123.18	3,370.441
Infiltration Basin1 (IN)	Post-Development 50	50	10,483.576	12.000	0.39	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 50	50	0.000	0.000	0.00	123.24	4,483.774
Infiltration Basin1 (IN)	Post-Development 100	100	12,237.550	11.950	0.48	(N/A)	(N/A)
Infiltration Basin1 (OUT)	Post-Development 100	100	0.000	0.000	0.00	123.31	5,669.231
Pond 2 (IN)	Post-Development 1	1	1,295.666	4.000	0.25	(N/A)	(N/A)

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m³)	Time to Peak (hours)	Peak Flow (m³/s)	Maximum Water Surface Elevation (m)	Maximum Pond Storage (m³)
Pond 2 (OUT)	Post-Development 1	1	1,228.215	5.200	0.02	123.55	5,377.426
Pond 2 (IN)	Post-Development 2	2	7,023.711	12.150	1.50	(N/A)	(N/A)
Pond 2 (OUT)	Post-Development 2	2	6,905.374	15.700	0.10	123.87	8,045.212
Pond 2 (IN)	Post-Development 5	5	12,176.754	12.150	2.94	(N/A)	(N/A)
Pond 2 (OUT)	Post-Development 5	5	12,042.702	15.950	0.15	124.25	11,447.227
Pond 2 (IN)	Post-Development 10	10	15,954.419	12.100	4.01	(N/A)	(N/A)
Pond 2 (OUT)	Post-Development 10	10	15,809.295	16.100	0.18	124.53	14,117.647
Pond 2 (IN)	Post-Development 25	25	20,987.852	12.100	5.46	(N/A)	(N/A)
Pond 2 (OUT)	Post-Development 25	25	20,828.485	16.400	0.22	124.88	17,809.569
Pond 2 (IN)	Post-Development 50	50	24,866.495	12.100	6.58	(N/A)	(N/A)
Pond 2 (OUT)	Post-Development 50	50	24,696.226	16.700	0.24	125.15	20,734.756
Pond 2 (IN)	Post-Development 100	100	28,805.057	12.100	7.71	(N/A)	(N/A)
Pond 2 (OUT)	Post-Development 100	100	28,623.886	16.800	0.26	125.40	23,742.911
Infiltration Basin 2 (IN)	Post-Development 1	1	1,231.415	5.200	0.02	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 1	1	0.000	0.000	0.00	122.01	156.337
Infiltration Basin 2 (IN)	Post-Development 2	2	7,083.969	15.300	0.11	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 2	2	0.000	0.000	0.00	122.05	1,347.599

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (m³)	Time to Peak (hours)	Peak Flow (m³/s)	Maximum Water Surface Elevation (m)	Maximum Pond Storage (m³)
Infiltration Basin 2 (IN)	Post-Development 5	5	12,447.661	12.000	0.16	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 5	5	0.000	0.000	0.00	122.16	3,996.583
Infiltration Basin 2 (IN)	Post-Development 10	10	16,398.852	12.000	0.26	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 10	10	0.000	0.000	0.00	122.25	6,381.230
Infiltration Basin 2 (IN)	Post-Development 25	25	21,680.284	12.000	0.41	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 25	25	0.000	0.000	0.00	122.38	9,827.333
Infiltration Basin 2 (IN)	Post-Development 50	50	25,759.750	12.000	0.52	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 50	50	0.000	0.000	0.00	122.48	12,611.927
Infiltration Basin 2 (IN)	Post-Development 100	100	29,909.159	11.950	0.63	(N/A)	(N/A)
Infiltration Basin 2 (OUT)	Post-Development 100	100	0.000	0.000	0.00	122.59	15,530.431

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.248 hours
Area (User Defined)	5.750 ha
Computational Time Increment	0.033 hours
Time to Peak (Computed)	12.032 hours
Flow (Peak, Computed)	1.12 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	1.11 m ³ /s
Drainage Area	
SCS CN (Composite)	80.900
Area (User Defined)	5.750 ha
Maximum Retention (Pervious)	60.0 mm
Maximum Retention (Pervious, 20 percent)	12.0 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	57.9 mm
Runoff Volume (Pervious)	3,329.496 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	3,329.778 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.248 hours
Computational Time Increment	0.033 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.84 m ³ /s
Unit peak time, Tp	0.165 hours
Unit receding limb, Tr	0.661 hours
Total unit time, Tb	0.826 hours

Subsection: Time of Concentration Calculations
Label: A1

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	110.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.40 m/s
Segment Time of Concentration	0.077 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	70.00 m
Slope	0.250 m/m
Tc Multiplier	2.000
Average Velocity	0.67 m/s
Segment Time of Concentration	0.029 hours
Segment #3: Kirpich (TN)	
Hydraulic Length	290.00 m
Slope	0.006 m/m
Tc Multiplier	0.750
Average Velocity	0.57 m/s
Segment Time of Concentration	0.142 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.248 hours

Modified Puls Results Summary

Length (Channel)	430.00 m
Travel Time (Channel)	0.091 hours
Number of Sections	1
Length (Section)	430.00 m
Flow (Weighted)	0.39 m ³ /s
Overflow Channel	No Overflow Data
Elevation (Overflow)	130.11 m

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Starting Water Surface)	128.91 m
Volume (Starting, per section)	0.000 m ³
Flow (Out Starting)	0.00 m ³ /s
Infiltration (Starting, per section)	0.00 m ³ /s
Flow (Total Out Starting)	0.00 m ³ /s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	1.11 m ³ /s	Time to Peak (In)	12.050 hours
Flow (Peak Out)	1.05 m ³ /s	Time to Peak (Out)	12.100 hours

Mass Balance (m³)

Volume (Initial)	0.000 m ³
Volume (Total Inflow)	3,329.776 m ³
Volume (Total Infiltration)	0.000 m ³
Volume (Total Outlet Outflow)	3,329.776 m ³
Volume (Retained)	0.000 m ³
Volume (Unrouted)	0.000 m ³
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.250 hours
Area (User Defined)	7.590 ha
Computational Time Increment	0.033 hours
Time to Peak (Computed)	12.058 hours
Flow (Peak, Computed)	1.48 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	1.48 m ³ /s
Drainage Area	
SCS CN (Composite)	81.200
Area (User Defined)	7.590 ha
Maximum Retention (Pervious)	58.8 mm
Maximum Retention (Pervious, 20 percent)	11.8 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	58.5 mm
Runoff Volume (Pervious)	4,443.191 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	4,443.225 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.250 hours
Computational Time Increment	0.033 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	2.41 m ³ /s
Unit peak time, Tp	0.167 hours
Unit receding limb, Tr	0.666 hours
Total unit time, Tb	0.833 hours

Subsection: Time of Concentration Calculations
Label: A2

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	140.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.42 m/s
Segment Time of Concentration	0.092 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	80.00 m
Slope	0.250 m/m
Tc Multiplier	2.000
Average Velocity	0.69 m/s
Segment Time of Concentration	0.032 hours
Segment #3: Kirpich (TN)	
Hydraulic Length	220.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.49 m/s
Segment Time of Concentration	0.125 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.250 hours

Modified Puls Results Summary

Length (Channel)	400.00 m
Travel Time (Channel)	0.142 hours
Number of Sections	1
Length (Section)	400.00 m
Flow (Weighted)	0.87 m ³ /s
Overflow Channel	No Overflow Data
Elevation (Overflow)	128.16 m

Infiltration

Infiltration Method (Computed)	No Infiltration
--------------------------------	-----------------

Initial Conditions

Elevation (Starting Water Surface)	126.96 m
Volume (Starting, per section)	0.000 m ³
Flow (Out Starting)	0.00 m ³ /s
Infiltration (Starting, per section)	0.00 m ³ /s
Flow (Total Out Starting)	0.00 m ³ /s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	2.49 m ³ /s	Time to Peak (In)	12.050 hours
Flow (Peak Out)	2.19 m ³ /s	Time to Peak (Out)	12.150 hours

Mass Balance (m³)

Volume (Initial)	0.000 m ³
Volume (Total Inflow)	7,773.002 m ³
Volume (Total Infiltration)	0.000 m ³
Volume (Total Outlet Outflow)	7,773.002 m ³
Volume (Retained)	0.000 m ³
Volume (Unrouted)	0.000 m ³
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.324 hours
Area (User Defined)	6.300 ha
Computational Time Increment	0.043 hours
Time to Peak (Computed)	12.094 hours
Flow (Peak, Computed)	1.14 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.100 hours
Flow (Peak Interpolated Output)	1.13 m ³ /s
Drainage Area	
SCS CN (Composite)	82.100
Area (User Defined)	6.300 ha
Maximum Retention (Pervious)	55.4 mm
Maximum Retention (Pervious, 20 percent)	11.1 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	60.5 mm
Runoff Volume (Pervious)	3,809.572 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	3,811.363 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.324 hours
Computational Time Increment	0.043 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.54 m ³ /s
Unit peak time, Tp	0.216 hours
Unit receding limb, Tr	0.864 hours
Total unit time, Tb	1.080 hours

Subsection: Time of Concentration Calculations
Label: A3

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	105.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.39 m/s
Segment Time of Concentration	0.074 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	70.00 m
Slope	0.250 m/m
Tc Multiplier	2.000
Average Velocity	0.67 m/s
Segment Time of Concentration	0.029 hours
Segment #3: Kirpich (TN)	
Hydraulic Length	460.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.58 m/s
Segment Time of Concentration	0.221 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.324 hours

Modified Puls Results Summary

Length (Channel)	215.00 m
Travel Time (Channel)	0.099 hours
Number of Sections	1
Length (Section)	215.00 m
Flow (Weighted)	0.41 m ³ /s
Overflow Channel	No Overflow Data
Elevation (Overflow)	129.88 m

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Starting Water Surface)	128.68 m
Volume (Starting, per section)	0.000 m ³
Flow (Out Starting)	0.00 m ³ /s
Infiltration (Starting, per section)	0.00 m ³ /s
Flow (Total Out Starting)	0.00 m ³ /s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	1.13 m ³ /s	Time to Peak (In)	12.100 hours
Flow (Peak Out)	1.07 m ³ /s	Time to Peak (Out)	12.150 hours

Mass Balance (m³)

Volume (Initial)	0.000 m ³
Volume (Total Inflow)	3,811.376 m ³
Volume (Total Infiltration)	0.000 m ³
Volume (Total Outlet Outflow)	3,811.376 m ³
Volume (Retained)	0.000 m ³
Volume (Unrouted)	0.000 m ³
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.320 hours
Area (User Defined)	7.740 ha
Computational Time Increment	0.043 hours
Time to Peak (Computed)	12.073 hours
Flow (Peak, Computed)	1.35 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.100 hours
Flow (Peak Interpolated Output)	1.33 m ³ /s
Drainage Area	
SCS CN (Composite)	81.100
Area (User Defined)	7.740 ha
Maximum Retention (Pervious)	59.2 mm
Maximum Retention (Pervious, 20 percent)	11.8 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	58.3 mm
Runoff Volume (Pervious)	4,514.567 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	4,512.912 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.320 hours
Computational Time Increment	0.043 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.92 m ³ /s
Unit peak time, Tp	0.213 hours
Unit receding limb, Tr	0.853 hours
Total unit time, Tb	1.066 hours

Subsection: Time of Concentration Calculations
Label: A4

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	150.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.43 m/s
Segment Time of Concentration	0.097 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	80.00 m
Slope	0.250 m/m
Tc Multiplier	2.000
Average Velocity	0.69 m/s
Segment Time of Concentration	0.032 hours
Segment #3: Kirpich (TN)	
Hydraulic Length	400.00 m
Slope	0.005 m/m
Tc Multiplier	0.750
Average Velocity	0.58 m/s
Segment Time of Concentration	0.190 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.320 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.286 hours
Area (User Defined)	10.270 ha
Computational Time Increment	0.038 hours
Time to Peak (Computed)	12.071 hours
Flow (Peak, Computed)	1.93 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	1.91 m ³ /s
Drainage Area	
SCS CN (Composite)	81.600
Area (User Defined)	10.270 ha
Maximum Retention (Pervious)	57.3 mm
Maximum Retention (Pervious, 20 percent)	11.5 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	59.4 mm
Runoff Volume (Pervious)	6,099.708 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	6,099.392 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.286 hours
Computational Time Increment	0.038 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	2.85 m ³ /s
Unit peak time, Tp	0.190 hours
Unit receding limb, Tr	0.762 hours
Total unit time, Tb	0.952 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	100.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.39 m/s
Segment Time of Concentration	0.071 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	160.00 m
Slope	0.015 m/m
Tc Multiplier	0.750
Average Velocity	0.73 m/s
Segment Time of Concentration	0.061 hours
Segment #3: Kirpich (TN)	
Hydraulic Length	290.00 m
Slope	0.080 m/m
Tc Multiplier	0.750
Average Velocity	1.59 m/s
Segment Time of Concentration	0.051 hours
Segment #4: Kirpich (TN)	
Hydraulic Length	170.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.46 m/s
Segment Time of Concentration	0.103 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.286 hours

Modified Puls Results Summary

Length (Channel)	490.00 m
Travel Time (Channel)	0.154 hours
Number of Sections	1
Length (Section)	490.00 m
Flow (Weighted)	1.04 m ³ /s
Overflow Channel	No Overflow Data
Elevation (Overflow)	128.94 m

Infiltration

Infiltration Method (Computed)	No Infiltration
--------------------------------	-----------------

Initial Conditions

Elevation (Starting Water Surface)	127.74 m
Volume (Starting, per section)	0.000 m ³
Flow (Out Starting)	0.00 m ³ /s
Infiltration (Starting, per section)	0.00 m ³ /s
Flow (Total Out Starting)	0.00 m ³ /s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	2.91 m ³ /s	Time to Peak (In)	12.100 hours
Flow (Peak Out)	2.57 m ³ /s	Time to Peak (Out)	12.150 hours

Mass Balance (m³)

Volume (Initial)	0.000 m ³
Volume (Total Inflow)	9,910.780 m ³
Volume (Total Infiltration)	0.000 m ³
Volume (Total Outlet Outflow)	9,910.780 m ³
Volume (Retained)	0.000 m ³
Volume (Unrouted)	0.000 m ³
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.255 hours
Area (User Defined)	6.250 ha
Computational Time Increment	0.034 hours
Time to Peak (Computed)	12.051 hours
Flow (Peak, Computed)	1.22 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	1.22 m ³ /s
Drainage Area	
SCS CN (Composite)	81.400
Area (User Defined)	6.250 ha
Maximum Retention (Pervious)	58.0 mm
Maximum Retention (Pervious, 20 percent)	11.6 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	59.0 mm
Runoff Volume (Pervious)	3,685.372 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	3,686.004 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.255 hours
Computational Time Increment	0.034 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.95 m ³ /s
Unit peak time, Tp	0.170 hours
Unit receding limb, Tr	0.679 hours
Total unit time, Tb	0.849 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	150.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.43 m/s
Segment Time of Concentration	0.097 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	85.00 m
Slope	0.250 m/m
Tc Multiplier	2.000
Average Velocity	0.70 m/s
Segment Time of Concentration	0.034 hours
Segment #3: Kirpich (TN)	
Hydraulic Length	250.00 m
Slope	0.006 m/m
Tc Multiplier	0.750
Average Velocity	0.56 m/s
Segment Time of Concentration	0.123 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.255 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.100 hours
Area (User Defined)	1.500 ha
Computational Time Increment	0.013 hours
Time to Peak (Computed)	11.933 hours
Flow (Peak, Computed)	0.42 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	0.41 m ³ /s
Drainage Area	
SCS CN (Composite)	85.000
Area (User Defined)	1.500 ha
Maximum Retention (Pervious)	44.8 mm
Maximum Retention (Pervious, 20 percent)	9.0 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	66.9 mm
Runoff Volume (Pervious)	1,003.741 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	1,003.662 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.100 hours
Computational Time Increment	0.013 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.19 m ³ /s
Unit peak time, Tp	0.067 hours
Unit receding limb, Tr	0.267 hours
Total unit time, Tb	0.333 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.302 hours
Area (User Defined)	2.800 ha
Computational Time Increment	0.040 hours
Time to Peak (Computed)	12.084 hours
Flow (Peak, Computed)	0.59 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	0.58 m ³ /s
Drainage Area	
SCS CN (Composite)	85.700
Area (User Defined)	2.800 ha
Maximum Retention (Pervious)	42.4 mm
Maximum Retention (Pervious, 20 percent)	8.5 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	68.5 mm
Runoff Volume (Pervious)	1,918.732 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	1,918.721 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.302 hours
Computational Time Increment	0.040 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	0.73 m ³ /s
Unit peak time, Tp	0.201 hours
Unit receding limb, Tr	0.806 hours
Total unit time, Tb	1.007 hours

Subsection: Time of Concentration Calculations
Label: A8

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	240.00 m
Slope	0.003 m/m
Tc Multiplier	0.750
Average Velocity	0.43 m/s
Segment Time of Concentration	0.155 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	250.00 m
Slope	0.005 m/m
Tc Multiplier	0.750
Average Velocity	0.53 m/s
Segment Time of Concentration	0.131 hours
Segment #3: Kirpich (TN)	
Hydraulic Length	50.00 m
Slope	0.050 m/m
Tc Multiplier	0.750
Average Velocity	0.89 m/s
Segment Time of Concentration	0.016 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.302 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144,000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.100 hours
Area (User Defined)	3.460 ha
Computational Time Increment	0.013 hours
Time to Peak (Computed)	11.947 hours
Flow (Peak, Computed)	0.52 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	0.52 m ³ /s
Drainage Area	
SCS CN (Composite)	70.000
Area (User Defined)	3.460 ha
Maximum Retention (Pervious)	108.9 mm
Maximum Retention (Pervious, 20 percent)	21.8 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	37.2 mm
Runoff Volume (Pervious)	1,285.498 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	1,285.273 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.100 hours
Computational Time Increment	0.013 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	2.74 m ³ /s
Unit peak time, Tp	0.067 hours
Unit receding limb, Tr	0.267 hours
Total unit time, Tb	0.333 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.188 hours
Area (User Defined)	2.110 ha
Computational Time Increment	0.025 hours
Time to Peak (Computed)	12.009 hours
Flow (Peak, Computed)	0.43 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	0.42 m ³ /s
Drainage Area	
SCS CN (Composite)	79.600
Area (User Defined)	2.110 ha
Maximum Retention (Pervious)	65.1 mm
Maximum Retention (Pervious, 20 percent)	13.0 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	55.2 mm
Runoff Volume (Pervious)	1,164.532 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	1,164.530 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.188 hours
Computational Time Increment	0.025 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	0.89 m ³ /s
Unit peak time, Tp	0.125 hours
Unit receding limb, Tr	0.500 hours
Total unit time, Tb	0.625 hours

Subsection: Time of Concentration Calculations
Label: B1

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	340.00 m
Slope	0.012 m/m
Tc Multiplier	0.750
Average Velocity	0.79 m/s
Segment Time of Concentration	0.119 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	100.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.40 m/s
Segment Time of Concentration	0.069 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.188 hours

Subsection: Channel Routing Summary

Label: CO-1

Return Event: 100 years

Storm Event: 100YR 24hr SCS II

Modified Puls Results Summary

Length (Channel)	250.00 m
Travel Time (Channel)	0.134 hours
Number of Sections	1
Length (Section)	250.00 m
Flow (Weighted)	0.14 m ³ /s
Overflow Channel	No Overflow Data
Elevation (Overflow)	131.36 m

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Starting Water Surface)	130.36 m
Volume (Starting, per section)	0.000 m ³
Flow (Out Starting)	0.00 m ³ /s
Infiltration (Starting, per section)	0.00 m ³ /s
Flow (Total Out Starting)	0.00 m ³ /s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	0.42 m ³ /s	Time to Peak (In)	12.000 hours
Flow (Peak Out)	0.36 m ³ /s	Time to Peak (Out)	12.100 hours

Mass Balance (m³)

Volume (Initial)	0.000 m ³
Volume (Total Inflow)	1,164.534 m ³
Volume (Total Infiltration)	0.000 m ³
Volume (Total Outlet Outflow)	1,164.534 m ³
Volume (Retained)	0.000 m ³
Volume (Unrouted)	0.000 m ³
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.203 hours
Area (User Defined)	4.280 ha
Computational Time Increment	0.027 hours
Time to Peak (Computed)	12.012 hours
Flow (Peak, Computed)	0.85 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.000 hours
Flow (Peak Interpolated Output)	0.84 m ³ /s
Drainage Area	
SCS CN (Composite)	79.700
Area (User Defined)	4.280 ha
Maximum Retention (Pervious)	64.7 mm
Maximum Retention (Pervious, 20 percent)	12.9 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	55.4 mm
Runoff Volume (Pervious)	2,371.010 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	2,370.120 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.203 hours
Computational Time Increment	0.027 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.67 m ³ /s
Unit peak time, Tp	0.136 hours
Unit receding limb, Tr	0.542 hours
Total unit time, Tb	0.678 hours

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	75.00 m
Slope	0.286 m/m
Tc Multiplier	2.000
Average Velocity	0.71 m/s
Segment Time of Concentration	0.029 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	25.00 m
Slope	0.020 m/m
Tc Multiplier	2.000
Average Velocity	0.20 m/s
Segment Time of Concentration	0.035 hours
Segment #3: Kirpich (TN)	
Hydraulic Length	250.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.50 m/s
Segment Time of Concentration	0.139 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.203 hours

Subsection: Channel Routing Summary

Label: CO-7

Return Event: 100 years

Storm Event: 100YR 24hr SCS II

Modified Puls Results Summary

Length (Channel)	250.00 m
Travel Time (Channel)	0.103 hours
Number of Sections	1
Length (Section)	250.00 m
Flow (Weighted)	0.41 m ³ /s
Overflow Channel	No Overflow Data
Elevation (Overflow)	130.28 m

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Starting Water Surface)	129.28 m
Volume (Starting, per section)	0.000 m ³
Flow (Out Starting)	0.00 m ³ /s
Infiltration (Starting, per section)	0.00 m ³ /s
Flow (Total Out Starting)	0.00 m ³ /s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	1.18 m ³ /s	Time to Peak (In)	12.050 hours
Flow (Peak Out)	1.09 m ³ /s	Time to Peak (Out)	12.100 hours

Mass Balance (m³)

Volume (Initial)	0.000 m ³
Volume (Total Inflow)	3,534.656 m ³
Volume (Total Infiltration)	0.000 m ³
Volume (Total Outlet Outflow)	3,534.656 m ³
Volume (Retained)	0.000 m ³
Volume (Unrouted)	0.000 m ³
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.234 hours
Area (User Defined)	4.670 ha
Computational Time Increment	0.031 hours
Time to Peak (Computed)	12.020 hours
Flow (Peak, Computed)	0.89 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	0.89 m ³ /s
Drainage Area	
SCS CN (Composite)	79.900
Area (User Defined)	4.670 ha
Maximum Retention (Pervious)	63.9 mm
Maximum Retention (Pervious, 20 percent)	12.8 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	55.8 mm
Runoff Volume (Pervious)	2,606.385 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	2,606.481 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.234 hours
Computational Time Increment	0.031 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.59 m ³ /s
Unit peak time, Tp	0.156 hours
Unit receding limb, Tr	0.623 hours
Total unit time, Tb	0.779 hours

Subsection: Time of Concentration Calculations
Label: B3

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	10.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.23 m/s
Segment Time of Concentration	0.012 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	140.00 m
Slope	0.285 m/m
Tc Multiplier	2.000
Average Velocity	0.82 m/s
Segment Time of Concentration	0.047 hours
Segment #3: Kirpich (TN)	
Hydraulic Length	25.00 m
Slope	0.020 m/m
Tc Multiplier	2.000
Average Velocity	0.20 m/s
Segment Time of Concentration	0.035 hours
Segment #4: Kirpich (TN)	
Hydraulic Length	250.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.50 m/s
Segment Time of Concentration	0.139 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.234 hours

Subsection: Channel Routing Summary

Label: CO-20

Return Event: 100 years

Storm Event: 100YR 24hr SCS II

Modified Puls Results Summary

Length (Channel)	310.00 m
Travel Time (Channel)	0.103 hours
Number of Sections	1
Length (Section)	310.00 m
Flow (Weighted)	0.68 m ³ /s
Overflow Channel	No Overflow Data
Elevation (Overflow)	129.21 m

Infiltration

Infiltration Method (Computed)	No Infiltration
--------------------------------	-----------------

Initial Conditions

Elevation (Starting Water Surface)	128.21 m
Volume (Starting, per section)	0.000 m ³
Flow (Out Starting)	0.00 m ³ /s
Infiltration (Starting, per section)	0.00 m ³ /s
Flow (Total Out Starting)	0.00 m ³ /s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	1.95 m ³ /s	Time to Peak (In)	12.050 hours
Flow (Peak Out)	1.79 m ³ /s	Time to Peak (Out)	12.100 hours

Mass Balance (m³)

Volume (Initial)	0.000 m ³
Volume (Total Inflow)	6,141.144 m ³
Volume (Total Infiltration)	0.000 m ³
Volume (Total Outlet Outflow)	6,141.144 m ³
Volume (Retained)	0.000 m ³
Volume (Unrouted)	0.000 m ³
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.246 hours
Area (User Defined)	6.100 ha
Computational Time Increment	0.033 hours
Time to Peak (Computed)	12.036 hours
Flow (Peak, Computed)	1.17 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.050 hours
Flow (Peak Interpolated Output)	1.16 m ³ /s
Drainage Area	
SCS CN (Composite)	80.500
Area (User Defined)	6.100 ha
Maximum Retention (Pervious)	61.5 mm
Maximum Retention (Pervious, 20 percent)	12.3 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	57.1 mm
Runoff Volume (Pervious)	3,480.797 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	3,481.132 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.246 hours
Computational Time Increment	0.033 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	1.97 m ³ /s
Unit peak time, Tp	0.164 hours
Unit receding limb, Tr	0.656 hours
Total unit time, Tb	0.820 hours

Subsection: Time of Concentration Calculations
Label: B4

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	13.00 m
Slope	0.050 m/m
Tc Multiplier	2.000
Average Velocity	0.24 m/s
Segment Time of Concentration	0.015 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	140.00 m
Slope	0.285 m/m
Tc Multiplier	2.000
Average Velocity	0.82 m/s
Segment Time of Concentration	0.047 hours
Segment #3: Kirpich (TN)	
Hydraulic Length	25.00 m
Slope	0.020 m/m
Tc Multiplier	2.000
Average Velocity	0.20 m/s
Segment Time of Concentration	0.035 hours
Segment #4: Kirpich (TN)	
Hydraulic Length	255.00 m
Slope	0.004 m/m
Tc Multiplier	0.750
Average Velocity	0.50 m/s
Segment Time of Concentration	0.141 hours
Segment #5: Kirpich (TN)	
Hydraulic Length	55.00 m
Slope	0.013 m/m
Tc Multiplier	0.200
Average Velocity	2.02 m/s
Segment Time of Concentration	0.008 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.246 hours

Modified Puls Results Summary

Length (Channel)	165.00 m
Travel Time (Channel)	0.056 hours
Number of Sections	1
Length (Section)	165.00 m
Flow (Weighted)	1.01 m ³ /s
Overflow Channel	No Overflow Data
Elevation (Overflow)	127.40 m

Infiltration

Infiltration Method (Computed)	No Infiltration
-----------------------------------	-----------------

Initial Conditions

Elevation (Starting Water Surface)	126.40 m
Volume (Starting, per section)	0.000 m ³
Flow (Out Starting)	0.00 m ³ /s
Infiltration (Starting, per section)	0.00 m ³ /s
Flow (Total Out Starting)	0.00 m ³ /s
Time Increment	0.050 hours

Inflow/Outflow Hydrograph Summary

Flow (Peak In)	2.85 m ³ /s	Time to Peak (In)	12.100 hours
Flow (Peak Out)	2.78 m ³ /s	Time to Peak (Out)	12.100 hours

Mass Balance (m³)

Volume (Initial)	0.000 m ³
Volume (Total Inflow)	9,622.263 m ³
Volume (Total Infiltration)	0.000 m ³
Volume (Total Outlet Outflow)	9,622.263 m ³
Volume (Retained)	0.000 m ³
Volume (Unrouted)	0.000 m ³
Error (Mass Balance)	0.0 %

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.106 hours
Area (User Defined)	0.640 ha
Computational Time Increment	0.014 hours
Time to Peak (Computed)	11.942 hours
Flow (Peak, Computed)	0.11 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	0.11 m ³ /s
Drainage Area	
SCS CN (Composite)	72.000
Area (User Defined)	0.640 ha
Maximum Retention (Pervious)	98.8 mm
Maximum Retention (Pervious, 20 percent)	19.8 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	40.6 mm
Runoff Volume (Pervious)	260.041 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	260.005 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.106 hours
Computational Time Increment	0.014 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	0.48 m ³ /s
Unit peak time, Tp	0.071 hours
Unit receding limb, Tr	0.283 hours
Total unit time, Tb	0.353 hours

Subsection: Time of Concentration Calculations
Label: B5

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	20.00 m
Slope	0.285 m/m
Tc Multiplier	2.000
Average Velocity	0.53 m/s
Segment Time of Concentration	0.011 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	165.00 m
Slope	0.005 m/m
Tc Multiplier	0.750
Average Velocity	0.48 m/s
Segment Time of Concentration	0.095 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.106 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.100 hours
Area (User Defined)	1.030 ha
Computational Time Increment	0.013 hours
Time to Peak (Computed)	11.933 hours
Flow (Peak, Computed)	0.29 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	0.28 m ³ /s
Drainage Area	
SCS CN (Composite)	85.000
Area (User Defined)	1.030 ha
Maximum Retention (Pervious)	44.8 mm
Maximum Retention (Pervious, 20 percent)	9.0 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	66.9 mm
Runoff Volume (Pervious)	689.236 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	689.175 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.100 hours
Computational Time Increment	0.013 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	0.82 m ³ /s
Unit peak time, Tp	0.067 hours
Unit receding limb, Tr	0.267 hours
Total unit time, Tb	0.333 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.091 hours
Area (User Defined)	0.940 ha
Computational Time Increment	0.012 hours
Time to Peak (Computed)	11.929 hours
Flow (Peak, Computed)	0.28 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	0.27 m ³ /s
Drainage Area	
SCS CN (Composite)	86.200
Area (User Defined)	0.940 ha
Maximum Retention (Pervious)	40.7 mm
Maximum Retention (Pervious, 20 percent)	8.1 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	69.7 mm
Runoff Volume (Pervious)	655.080 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	655.025 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.091 hours
Computational Time Increment	0.012 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	0.82 m ³ /s
Unit peak time, Tp	0.060 hours
Unit receding limb, Tr	0.242 hours
Total unit time, Tb	0.302 hours

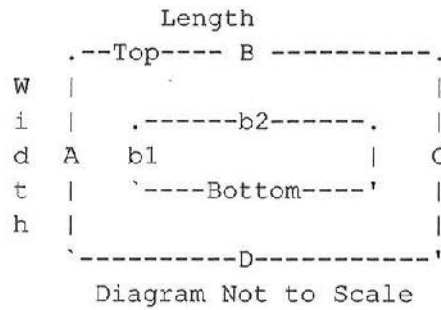
Subsection: Time of Concentration Calculations
Label: B7

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Time of Concentration Results

Segment #1: Kirpich (TN)	
Hydraulic Length	25.00 m
Slope	0.010 m/m
Tc Multiplier	0.400
Average Velocity	0.76 m/s
Segment Time of Concentration	0.009 hours
Segment #2: Kirpich (TN)	
Hydraulic Length	170.00 m
Slope	0.010 m/m
Tc Multiplier	0.750
Average Velocity	0.63 m/s
Segment Time of Concentration	0.075 hours
Segment #3: Kirpich (TN)	
Hydraulic Length	30.00 m
Slope	0.005 m/m
Tc Multiplier	0.200
Average Velocity	1.22 m/s
Segment Time of Concentration	0.007 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.091 hours

Storm Event	100YR 24hr SCS II
Return Event	100 years
Duration	144.000 hours
Depth	106.6 mm
Time of Concentration (Composite)	0.100 hours
Area (User Defined)	2.810 ha
Computational Time Increment	0.013 hours
Time to Peak (Computed)	11.947 hours
Flow (Peak, Computed)	0.43 m ³ /s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	0.42 m ³ /s
Drainage Area	
SCS CN (Composite)	70.000
Area (User Defined)	2.810 ha
Maximum Retention (Pervious)	108.9 mm
Maximum Retention (Pervious, 20 percent)	21.8 mm
Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	37.2 mm
Runoff Volume (Pervious)	1,044.003 m ³
Hydrograph Volume (Area under Hydrograph curve)	
Volume	1,043.816 m ³
SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.100 hours
Computational Time Increment	0.013 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	2.23 m ³ /s
Unit peak time, Tp	0.067 hours
Unit receding limb, Tr	0.267 hours
Total unit time, Tb	0.333 hours



Pond Volume Calculation for Trapezoidal Basin	
Trapezoid Top Elevation	126.75 m
Trapezoid Top Length (A to C) (A to C)	172.00 m
Trapezoid Top Width (B to D) (B to D)	48.00 m
Trapezoid Bottom Elevation	124.00 m
Trapezoid Bottom Length	150.00 m
Trapezoid Bottom Width	26.00 m

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

[illegible]

11.00 m

[illegible]

11.00 m

Trapezoid Vertical Increment 0.10 m

Elevation (m)	Planimeter (m ²)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m ³)	Volume (Total) (m ³)
124.00	0.0	0.390	0.000	0.000	0.000
124.10	0.0	0.404	1.191	397.059	397.059
124.20	0.0	0.418	1.234	411.246	808.304
124.30	0.0	0.433	1.277	425.602	1,233.907
124.40	0.0	0.447	1.320	440.072	1,673.979
124.50	0.0	0.462	1.364	454.655	2,128.606
124.60	0.0	0.477	1.408	469.380	2,597.986
124.70	0.0	0.492	1.453	484.218	3,082.204
124.80	0.0	0.507	1.498	499.198	3,581.401
124.90	0.0	0.522	1.543	514.291	4,095.720
125.00	0.0	0.537	1.589	529.525	4,625.245
125.10	0.0	0.553	1.635	544.901	5,170.146
125.20	0.0	0.568	1.681	560.390	5,730.509

Subsection: Trapezoidal Volume
Label: Pond 1

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Elevation (m)	Planimeter (m ²)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m ³)	Volume (Total) (m ³)
125.30	0.0	0.584	1.728	575.993	6,306.530
125.40	0.0	0.600	1.775	591.737	6,898.267
125.50	0.0	0.616	1.823	607.623	7,505.862
125.60	0.0	0.632	1.871	623.622	8,129.483
125.70	0.0	0.648	1.919	639.734	8,769.246
125.80	0.0	0.664	1.968	655.988	9,425.234
125.90	0.0	0.681	2.017	672.384	10,097.618
126.00	0.0	0.697	2.067	688.892	10,786.510
126.10	0.0	0.714	2.117	705.543	11,492.052
126.20	0.0	0.731	2.167	722.306	12,214.358
126.30	0.0	0.748	2.218	739.211	12,953.541
126.40	0.0	0.765	2.269	756.230	13,709.771
126.50	0.0	0.782	2.320	773.390	14,483.161
126.60	0.0	0.799	2.372	790.663	15,273.795
126.75	0.0	0.826	2.437	1,218.644	16,492.468

Structure ID: Culvert 1	
Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	291.0 mm
Length	20.00 m
Length (Computed Barrel)	20.00 m
Slope (Computed)	0.005 m/m
Outlet Control Data	
Manning's n	0.013
Ke	0.900
Kb	0.033
Kr	0.900
Convergence Tolerance	0.00 m
Inlet Control Data	
Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1.158
T2 ratio (HW/D)	1.304
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	124.94 m	T1 Flow	0.07 m ³ /s
T2 Elevation	124.98 m	T2 Flow	0.08 m ³ /s

Subsection: Elevation-Volume-Flow Table (Pond)

Label: Pond 1

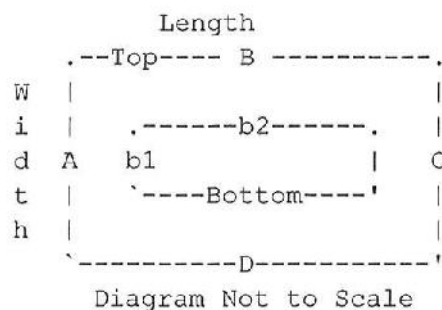
Return Event: 1 years

Storm Event: 25mm Storm 4hr

Infiltration	
Infiltration Method (Computed)	No Infiltration
Initial Conditions	
Elevation (Water Surface, Initial)	124.60 m
Volume (Initial)	2,597.986 m ³
Flow (Initial Outlet)	0.00 m ³ /s
Flow (Initial Infiltration)	0.00 m ³ /s
Flow (Initial, Total)	0.00 m ³ /s
Time Increment	0.050 hours

Elevation (m)	Outflow (m ³ /s)	Storage (m ³)	Area (ha)	Infiltration (m ³ /s)	Flow (Total) (m ³ /s)	2S/t + O (m ³ /s)
124.00	0.00	0.000	0.390	0.00	0.00	0.00
124.05	0.00	196.757	0.397	0.00	0.00	2.19
124.10	0.00	397.051	0.404	0.00	0.00	4.41
124.15	0.00	600.897	0.411	0.00	0.00	6.68
124.20	0.00	808.310	0.418	0.00	0.00	8.98
124.25	0.00	1,019.308	0.426	0.00	0.00	11.33
124.30	0.00	1,233.906	0.433	0.00	0.00	13.71
124.35	0.00	1,452.120	0.440	0.00	0.00	16.13
124.40	0.00	1,673.966	0.447	0.00	0.00	18.60
124.45	0.00	1,899.460	0.455	0.00	0.00	21.11
124.50	0.00	2,128.618	0.462	0.00	0.00	23.65
124.55	0.00	2,361.457	0.469	0.00	0.00	26.24
124.60	0.00	2,597.991	0.477	0.00	0.00	28.87
124.65	0.00	2,838.237	0.484	0.00	0.00	31.54
124.70	0.01	3,082.212	0.492	0.00	0.01	34.25
124.75	0.01	3,329.930	0.499	0.00	0.01	37.01
124.80	0.02	3,581.409	0.507	0.00	0.02	39.82
124.85	0.04	3,836.663	0.514	0.00	0.04	42.67
124.90	0.05	4,095.710	0.522	0.00	0.05	45.56
124.95	0.06	4,358.565	0.530	0.00	0.06	48.49
125.00	0.07	4,625.244	0.537	0.00	0.07	51.47
125.05	0.08	4,895.763	0.545	0.00	0.08	54.48
125.10	0.09	5,170.138	0.553	0.00	0.09	57.53
125.15	0.09	5,448.384	0.560	0.00	0.09	60.63
125.20	0.10	5,730.520	0.568	0.00	0.10	63.77
125.25	0.10	6,016.559	0.576	0.00	0.10	66.95
125.30	0.11	6,306.518	0.584	0.00	0.11	70.18
125.35	0.11	6,600.413	0.592	0.00	0.11	73.45
125.40	0.12	6,898.260	0.600	0.00	0.12	76.76
125.45	0.12	7,200.075	0.608	0.00	0.12	80.12
125.50	0.12	7,505.875	0.616	0.00	0.12	83.52
125.55	0.13	7,815.674	0.624	0.00	0.13	86.97
125.60	0.13	8,129.490	0.632	0.00	0.13	90.46
125.65	0.14	8,447.337	0.640	0.00	0.14	93.99
125.70	0.14	8,769.233	0.648	0.00	0.14	97.58
125.75	0.14	9,095.192	0.656	0.00	0.14	101.20

Elevation (m)	Outflow (m ³ /s)	Storage (m ³)	Area (ha)	Infiltration (m ³ /s)	Flow (Total) (m ³ /s)	2S/t + O (m ³ /s)
125.80	0.15	9,425.232	0.664	0.00	0.15	104.87
125.85	0.15	9,759.367	0.672	0.00	0.15	108.59
125.90	0.21	10,097.615	0.681	0.00	0.21	112.41
125.95	0.33	10,439.990	0.689	0.00	0.33	116.33
126.00	0.49	10,786.510	0.697	0.00	0.49	120.34
126.05	0.69	11,137.190	0.706	0.00	0.69	124.44
126.10	0.93	11,492.046	0.714	0.00	0.93	128.62
126.15	1.22	11,851.093	0.722	0.00	1.22	132.90
126.20	1.54	12,214.349	0.731	0.00	1.54	137.26
126.25	1.91	12,581.829	0.739	0.00	1.91	141.71
126.30	2.32	12,953.549	0.748	0.00	2.32	146.24
126.35	2.77	13,329.525	0.756	0.00	2.77	150.87
126.40	3.26	13,709.773	0.765	0.00	3.26	155.59
126.45	3.80	14,094.308	0.773	0.00	3.80	160.41
126.50	4.39	14,483.149	0.782	0.00	4.39	165.31
126.55	5.02	14,876.309	0.791	0.00	5.02	170.32
126.60	5.71	15,273.805	0.799	0.00	5.71	175.41
126.65	6.44	15,675.651	0.808	0.00	6.44	180.61
126.70	7.22	16,081.861	0.817	0.00	7.22	185.90
126.75	8.05	16,492.460	0.826	0.00	8.05	191.30



Pond Volume Calculation for Trapezoidal Basin	
Trapezoid Top Elevation	126.30 m
Trapezoid Top Length (A to C)	228.00 m
Trapezoid Top Width (B to D)	62.00 m
Trapezoid Bottom Elevation	122.80 m
Trapezoid Bottom Length	200.00 m
Trapezoid Bottom Width	32.00 m

[illegible][illegible]

Trapezoid Vertical Increment

0.10 m

Elevation (m)	Planimeter (m ²)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m ³)	Volume (Total) (m ³)
122.80	0.0	0.640	0.000	0.000	0.000
122.90	0.0	0.660	1.950	649.872	649.872
123.00	0.0	0.680	2.009	669.693	1,319.565
123.10	0.0	0.700	2.069	689.685	2,009.250
123.20	0.0	0.720	2.129	709.790	2,719.040
123.30	0.0	0.740	2.190	730.037	3,449.077
123.40	0.0	0.761	2.251	750.425	4,199.502
123.50	0.0	0.781	2.313	770.954	4,970.484
123.60	0.0	0.802	2.375	791.626	5,762.082
123.70	0.0	0.823	2.437	812.410	6,574.520
123.80	0.0	0.844	2.500	833.365	7,407.885
123.90	0.0	0.865	2.563	854.433	8,262.318
124.00	0.0	0.886	2.627	875.642	9,137.960

Subsection: Trapezoidal Volume
Label: Pond 2

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Elevation (m)	Planimeter (m ²)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m ³)	Volume (Total) (m ³)
124.10	0.0	0.908	2.691	896.993	10,034.952
124.20	0.0	0.929	2.755	918.485	10,953.438
124.30	0.0	0.951	2.820	940.091	11,893.557
124.40	0.0	0.973	2.886	961.867	12,855.423
124.50	0.0	0.995	2.951	983.756	13,839.179
124.60	0.0	1.017	3.017	1,005.786	14,844.965
124.70	0.0	1.039	3.084	1,027.958	15,872.923
124.80	0.0	1.061	3.151	1,050.272	16,923.223
124.90	0.0	1.084	3.218	1,072.727	17,995.951
125.00	0.0	1.107	3.286	1,095.296	19,091.246
125.10	0.0	1.129	3.354	1,118.034	20,209.280
125.20	0.0	1.152	3.423	1,140.886	21,350.166
125.30	0.0	1.175	3.492	1,163.879	22,514.045
125.40	0.0	1.199	3.561	1,187.014	23,701.031
125.50	0.0	1.222	3.631	1,210.290	24,911.321
125.60	0.0	1.245	3.701	1,233.680	26,145.001
125.70	0.0	1.269	3.772	1,257.240	27,402.241
125.80	0.0	1.293	3.843	1,280.913	28,683.125
125.90	0.0	1.317	3.914	1,304.727	29,987.852
126.00	0.0	1.341	3.986	1,328.683	31,316.535
126.10	0.0	1.365	4.058	1,352.781	32,669.316
126.20	0.0	1.389	4.131	1,376.992	34,046.307
126.30	0.0	1.414	4.204	1,401.372	35,447.680

Subsection: Outlet Input Data
 Label: Outlet Structure 2

Return Event: 100 years
 Storm Event: 100YR 24hr SCS II

Structure ID: Culvert 2	
Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	327.0 mm
Length	20.00 m
Length (Computed Barrel)	20.00 m
Slope (Computed)	0.005 m/m
Outlet Control Data	
Manning's n	0.013
Ke	0.900
Kb	0.028
Kr	0.900
Convergence Tolerance	0.00 m
Inlet Control Data	
Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1.158
T2 ratio (HW/D)	1.304
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
 interpolate between flows at T1 & T2...

T1 Elevation	123.78 m	T1 Flow	0.09 m ³ /s
T2 Elevation	123.83 m	T2 Flow	0.11 m ³ /s

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Pond 2

Return Event: 1 years
Storm Event: 25mm Storm 4hr

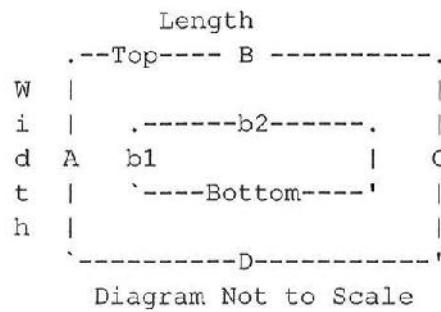
Infiltration	
Infiltration Method (Computed)	No Infiltration
Initial Conditions	
Elevation (Water Surface, Initial)	123.40 m
Volume (Initial)	4,199.502 m ³
Flow (Initial Outlet)	0.00 m ³ /s
Flow (Initial Infiltration)	0.00 m ³ /s
Flow (Initial, Total)	0.00 m ³ /s
Time Increment	0.050 hours

Elevation (m)	Outflow (m ³ /s)	Storage (m ³)	Area (ha)	Infiltration (m ³ /s)	Flow (Total) (m ³ /s)	2S/t + O (m ³ /s)
122.80	0.00	0.000	0.640	0.00	0.00	0.00
122.85	0.00	322.459	0.650	0.00	0.00	3.58
122.90	0.00	649.861	0.660	0.00	0.00	7.22
122.95	0.00	982.223	0.670	0.00	0.00	10.91
123.00	0.00	1,319.562	0.680	0.00	0.00	14.66
123.05	0.00	1,661.895	0.690	0.00	0.00	18.47
123.10	0.00	2,009.240	0.700	0.00	0.00	22.32
123.15	0.00	2,361.614	0.710	0.00	0.00	26.24
123.20	0.00	2,719.033	0.720	0.00	0.00	30.21
123.25	0.00	3,081.516	0.730	0.00	0.00	34.24
123.30	0.00	3,449.078	0.740	0.00	0.00	38.32
123.35	0.00	3,821.738	0.750	0.00	0.00	42.46
123.40	0.00	4,199.512	0.761	0.00	0.00	46.66
123.45	0.00	4,582.418	0.771	0.00	0.00	50.92
123.50	0.01	4,970.472	0.781	0.00	0.01	55.23
123.55	0.02	5,363.693	0.792	0.00	0.02	59.61
123.60	0.03	5,762.095	0.802	0.00	0.03	64.05
123.65	0.04	6,165.699	0.812	0.00	0.04	68.55
123.70	0.05	6,574.519	0.823	0.00	0.05	73.10
123.75	0.07	6,988.573	0.833	0.00	0.07	77.72
123.80	0.09	7,407.880	0.844	0.00	0.09	82.40
123.85	0.10	7,832.454	0.854	0.00	0.10	87.13
123.90	0.11	8,262.315	0.865	0.00	0.11	91.91
123.95	0.12	8,697.478	0.876	0.00	0.12	96.75
124.00	0.12	9,137.962	0.886	0.00	0.12	101.65
124.05	0.13	9,583.783	0.897	0.00	0.13	106.62
124.10	0.13	10,034.958	0.908	0.00	0.13	111.63
124.15	0.14	10,491.504	0.918	0.00	0.14	116.71
124.20	0.15	10,953.440	0.929	0.00	0.15	121.85
124.25	0.15	11,420.780	0.940	0.00	0.15	127.05
124.30	0.16	11,893.544	0.951	0.00	0.16	132.31
124.35	0.16	12,371.748	0.962	0.00	0.16	137.63
124.40	0.17	12,855.409	0.973	0.00	0.17	143.01
124.45	0.17	13,344.545	0.984	0.00	0.17	148.45
124.50	0.18	13,839.172	0.995	0.00	0.18	153.95
124.55	0.18	14,339.307	1.006	0.00	0.18	159.51

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Pond 2

Return Event: 1 years
Storm Event: 25mm Storm 4hr

Elevation (m)	Outflow (m ³ /s)	Storage (m ³)	Area (ha)	Infiltration (m ³ /s)	Flow (Total) (m ³ /s)	2S/t + O (m ³ /s)
124.60	0.19	14,844.969	1.017	0.00	0.19	165.13
124.65	0.19	15,356.173	1.028	0.00	0.19	170.82
124.70	0.20	15,872.937	1.039	0.00	0.20	176.56
124.75	0.20	16,395.278	1.050	0.00	0.20	182.37
124.80	0.21	16,923.215	1.061	0.00	0.21	188.24
124.85	0.21	17,456.761	1.073	0.00	0.21	194.18
124.90	0.22	17,995.938	1.084	0.00	0.22	200.17
124.95	0.22	18,540.759	1.095	0.00	0.22	206.23
125.00	0.22	19,091.244	1.107	0.00	0.22	212.35
125.05	0.23	19,647.408	1.118	0.00	0.23	218.53
125.10	0.23	20,209.270	1.129	0.00	0.23	224.78
125.15	0.24	20,776.846	1.141	0.00	0.24	231.09
125.20	0.24	21,350.154	1.152	0.00	0.24	237.46
125.25	0.24	21,929.210	1.164	0.00	0.24	243.90
125.30	0.25	22,514.032	1.175	0.00	0.25	250.40
125.35	0.25	23,104.636	1.187	0.00	0.25	256.97
125.40	0.26	23,701.042	1.199	0.00	0.26	263.60
125.45	0.37	24,303.263	1.210	0.00	0.37	270.41
125.50	0.59	24,911.320	1.222	0.00	0.59	277.38
125.55	0.88	25,525.227	1.234	0.00	0.88	284.50
125.60	1.24	26,145.004	1.245	0.00	1.24	291.74
125.65	1.66	26,770.666	1.257	0.00	1.66	299.11
125.70	2.14	27,402.231	1.269	0.00	2.14	306.61
125.75	2.68	28,039.716	1.281	0.00	2.68	314.23
125.80	3.27	28,683.139	1.293	0.00	3.27	321.97
125.85	3.92	29,332.515	1.305	0.00	3.92	329.84
125.90	4.63	29,987.863	1.317	0.00	4.63	337.83
125.95	5.40	30,649.199	1.329	0.00	5.40	345.94
126.00	6.22	31,316.543	1.341	0.00	6.22	354.18
126.05	7.10	31,989.907	1.353	0.00	7.10	362.55
126.10	8.04	32,669.313	1.365	0.00	8.04	371.03
126.15	9.04	33,354.775	1.377	0.00	9.04	379.65
126.20	10.10	34,046.312	1.389	0.00	10.10	388.39
126.25	11.22	34,743.940	1.401	0.00	11.22	397.26
126.30	12.40	35,447.677	1.414	0.00	12.40	406.26

[illegible]

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

[illegible]

11.25 m

[illegible]

11.25 m

Trapezoid Vertical Increment

0.10 m

Elevation (m)	Planimeter (m ²)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m ³)	Volume (Total) (m ³)
123.00	0.0	1.833	0.000	0.000	0.000
123.10	0.0	1.849	5.523	1,841.020	1,841.020
123.20	0.0	1.866	5.573	1,857.557	3,698.577
123.30	0.0	1.882	5.622	1,874.122	5,572.699
123.40	0.0	1.899	5.672	1,890.772	7,463.500
123.50	0.0	1.916	5.723	1,907.508	9,371.007
123.60	0.0	1.933	5.773	1,924.300	11,295.307
123.70	0.0	1.950	5.824	1,941.176	13,236.483
123.80	0.0	1.967	5.874	1,958.138	15,194.622
123.90	0.0	1.984	5.925	1,975.157	17,169.778
124.00	0.0	2.001	5.977	1,992.232	19,162.010
124.10	0.0	2.018	6.028	2,009.392	21,171.402
124.20	0.0	2.035	6.080	2,026.637	23,198.010

Subsection: Trapezoidal Volume
 Label: Infiltration Basin1

Return Event: 100 years
 Storm Event: 100YR 24hr SCS II

Elevation (m)	Planimeter (m ²)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m ³)	Volume (Total) (m ³)
124.30	0.0	2.053	6.132	2,043.938	25,241.948
124.40	0.0	2.070	6.184	2,061.297	27,303.245
124.50	0.0	2.088	6.236	2,078.740	29,381.985
124.60	0.0	2.105	6.289	2,096.268	31,478.281
124.70	0.0	2.123	6.342	2,113.853	33,592.133
124.80	0.0	2.140	6.395	2,131.522	35,723.656
124.90	0.0	2.158	6.448	2,149.277	37,872.933
125.00	0.0	2.176	6.501	2,167.060	40,039.992
125.10	0.0	2.194	6.555	2,184.956	42,224.949
125.20	0.0	2.212	6.609	2,202.909	44,427.858
125.30	0.0	2.230	6.663	2,220.919	46,648.776
125.40	0.0	2.248	6.717	2,239.013	48,887.818
125.50	0.0	2.266	6.772	2,257.192	51,145.010
125.60	0.0	2.285	6.826	2,275.429	53,420.439
125.70	0.0	2.303	6.881	2,293.750	55,714.160
125.80	0.0	2.321	6.936	2,312.127	58,026.287
125.90	0.0	2.340	6.992	2,330.590	60,356.877
126.00	0.0	2.358	7.047	2,349.109	62,705.986
126.10	0.0	2.377	7.103	2,367.713	65,073.699
126.20	0.0	2.396	7.159	2,386.374	67,460.101
126.30	0.0	2.415	7.215	2,405.120	69,865.221
126.40	0.0	2.433	7.272	2,423.950	72,289.171
126.50	0.0	2.452	7.328	2,442.838	74,732.009
126.60	0.0	2.471	7.385	2,461.782	77,193.790
126.75	0.0	2.500	7.457	3,728.394	80,922.185

Infiltration	
Infiltration Method (Computed)	Average Infiltration Rate
Infiltration Rate (Average)	12.0000 mm/h
Initial Conditions	
Elevation (Water Surface, Initial)	123.00 m
Volume (Initial)	0.000 m ³
Flow (Initial Outlet)	0.00 m ³ /s
Flow (Initial Infiltration)	0.00 m ³ /s
Flow (Initial, Total)	0.00 m ³ /s
Time Increment	0.050 hours

Elevation (m)	Outflow (m ³ /s)	Storage (m ³)	Area (ha)	Infiltration (m ³ /s)	Flow (Total) (m ³ /s)	2S/t + O (m ³ /s)
123.00	0.00	0.000	1.833	0.00	0.00	0.00
123.05	0.00	918.456	1.841	0.06	0.06	10.27
123.10	0.00	1,841.032	1.849	0.06	0.06	20.52
123.15	0.00	2,767.735	1.858	0.06	0.06	30.81
123.20	0.00	3,698.576	1.866	0.06	0.06	41.16
123.25	0.00	4,633.562	1.874	0.06	0.06	51.55
123.30	0.00	5,572.704	1.882	0.06	0.06	61.98
123.35	0.00	6,516.009	1.891	0.06	0.06	72.46
123.40	0.00	7,463.487	1.899	0.06	0.06	82.99
123.45	0.00	8,415.148	1.908	0.06	0.06	93.57
123.50	0.00	9,370.999	1.916	0.06	0.06	104.19
123.55	0.00	10,331.051	1.924	0.06	0.06	114.85
123.60	0.00	11,295.311	1.933	0.06	0.06	125.57
123.65	0.00	12,263.790	1.941	0.06	0.06	136.33
123.70	0.00	13,236.495	1.950	0.06	0.06	147.14
123.75	0.00	14,213.436	1.958	0.07	0.07	157.99
123.80	0.00	15,194.623	1.967	0.07	0.07	168.89
123.85	0.00	16,180.063	1.975	0.07	0.07	179.84
123.90	0.00	17,169.767	1.984	0.07	0.07	190.84
123.95	0.00	18,163.742	1.992	0.07	0.07	201.89
124.00	0.00	19,161.998	2.001	0.07	0.07	212.98
124.05	0.00	20,164.545	2.009	0.07	0.07	224.12
124.10	0.00	21,171.390	2.018	0.07	0.07	235.30
124.15	0.00	22,182.544	2.027	0.07	0.07	246.54
124.20	0.00	23,198.014	2.035	0.07	0.07	257.82
124.25	0.00	24,217.811	2.044	0.07	0.07	269.15
124.30	0.00	25,241.942	2.053	0.07	0.07	280.53
124.35	0.00	26,270.417	2.061	0.07	0.07	291.96
124.40	0.01	27,303.246	2.070	0.07	0.08	303.45
124.45	0.02	28,340.436	2.079	0.07	0.09	314.98
124.50	0.03	29,381.998	2.088	0.07	0.10	326.56
124.55	0.04	30,427.939	2.096	0.07	0.11	338.20
124.60	0.06	31,478.270	2.105	0.07	0.13	349.89
124.65	0.07	32,532.998	2.114	0.07	0.14	361.62
124.70	0.09	33,592.133	2.123	0.07	0.16	373.41

Subsection: Elevation-Volume-Flow Table (Pond)
Label: Infiltration Basin1

Return Event: 1 years
Storm Event: 25mm Storm 4hr

Elevation (m)	Outflow (m ³ /s)	Storage (m ³)	Area (ha)	Infiltration (m ³ /s)	Flow (Total) (m ³ /s)	2S/t + O (m ³ /s)
124.75	0.11	34,655.685	2.132	0.07	0.18	385.25
124.80	0.13	35,723.661	2.140	0.07	0.20	397.13
124.85	0.15	36,796.072	2.149	0.07	0.22	409.07
124.90	0.17	37,872.925	2.158	0.07	0.24	421.05
124.95	0.17	38,954.231	2.167	0.07	0.24	433.07
125.00	0.17	40,039.997	2.176	0.07	0.24	445.13
125.05	0.17	41,130.233	2.185	0.07	0.24	457.25
125.10	0.17	42,224.949	2.194	0.07	0.25	469.41
125.15	0.18	43,324.152	2.203	0.07	0.25	481.63
125.20	0.18	44,427.853	2.212	0.07	0.25	493.89
125.25	0.18	45,536.059	2.221	0.07	0.25	506.21
125.30	0.18	46,648.781	2.230	0.07	0.26	518.58
125.35	0.18	47,766.026	2.239	0.07	0.26	530.99
125.40	0.19	48,887.804	2.248	0.07	0.26	543.46
125.45	0.19	50,014.125	2.257	0.08	0.26	555.98
125.50	0.19	51,144.996	2.266	0.08	0.27	568.54
125.55	0.19	52,280.428	2.275	0.08	0.27	581.16
125.60	0.19	53,420.428	2.285	0.08	0.27	593.83
125.65	0.20	54,565.007	2.294	0.08	0.27	606.55
125.70	0.20	55,714.172	2.303	0.08	0.28	619.32
125.75	0.20	56,867.934	2.312	0.08	0.28	632.14
125.80	0.20	58,026.300	2.321	0.08	0.28	645.02
125.85	0.21	59,189.280	2.331	0.08	0.28	657.94
125.90	0.21	60,356.884	2.340	0.08	0.29	670.92
125.95	0.21	61,529.119	2.349	0.08	0.29	683.94
126.00	0.21	62,705.996	2.358	0.08	0.29	697.02
126.05	0.21	63,887.522	2.368	0.08	0.29	710.15
126.10	0.22	65,073.708	2.377	0.08	0.30	723.34
126.15	0.22	66,264.561	2.386	0.08	0.30	736.57
126.20	0.22	67,460.091	2.396	0.08	0.30	749.86
126.25	0.22	68,660.308	2.405	0.08	0.30	763.19
126.30	0.22	69,865.219	2.415	0.08	0.30	776.58
126.35	0.23	71,074.835	2.424	0.08	0.31	790.03
126.40	0.23	72,289.163	2.433	0.08	0.31	803.52
126.45	0.23	73,508.214	2.443	0.08	0.31	817.07
126.50	0.23	74,731.995	2.452	0.08	0.31	830.67
126.55	0.23	75,960.517	2.462	0.08	0.32	844.32
126.60	0.24	77,193.787	2.471	0.08	0.32	858.03
126.65	0.24	78,431.815	2.481	0.08	0.32	871.78
126.70	0.24	79,674.611	2.490	0.08	0.32	885.60
126.75	0.24	80,922.182	2.500	0.08	0.32	899.46

Diagram Not to Scale

Pond Volume Calculation for Trapezoidal Basin	
Trapezoid Top Elevation	124.50 m
Trapezoid Top Length (A to C)	232.00 m
Trapezoid Top Width (B to D)	133.00 m
Trapezoid Bottom Elevation	122.00 m
Trapezoid Bottom Length	217.00 m
Trapezoid Bottom Width	118.00 m

0.10 m

Subsection: Trapezoidal Volume
Label: Infiltration Basin 2

Return Event: 100 years
Storm Event: 100YR 24hr SCS II

Elevation (m)	Planimeter (m ²)	Area (ha)	A1+A2+sqr (A1*A2) (ha)	Volume (m ³)	Volume (Total) (m ³)
123.30	0.0	2.828	8.452	2,817.470	35,012.620
123.40	0.0	2.849	8.516	2,838.509	37,851.129
123.50	0.0	2.870	8.579	2,859.633	40,710.734
123.60	0.0	2.891	8.642	2,880.814	43,591.548
123.70	0.0	2.913	8.706	2,902.052	46,493.600
123.80	0.0	2.934	8.770	2,923.375	49,416.975
123.90	0.0	2.955	8.834	2,944.782	52,361.757
124.00	0.0	2.977	8.899	2,966.246	55,328.003
124.10	0.0	2.999	8.963	2,987.795	58,315.770
124.20	0.0	3.020	9.028	3,009.401	61,325.171
124.30	0.0	3.042	9.093	3,031.064	64,356.235
124.40	0.0	3.064	9.159	3,052.839	67,409.074
124.50	0.0	3.086	9.224	3,074.671	70,483.745

Infiltration	
Infiltration Method (Computed)	Average Infiltration Rate
Infiltration Rate (Average)	12.0000 mm/h
Initial Conditions	
Elevation (Water Surface, Initial)	122.00 m
Volume (Initial)	0.000 m ³
Flow (Initial Outlet)	0.00 m ³ /s
Flow (Initial Infiltration)	0.00 m ³ /s
Flow (Initial, Total)	0.00 m ³ /s
Time Increment	0.050 hours

Elevation (m)	Outflow (m ³ /s)	Storage (m ³)	Area (ha)	Infiltration (m ³ /s)	Flow (Total) (m ³ /s)	2S/t + O (m ³ /s)
122.00	0.00	0.000	2.561	0.00	0.00	0.00
122.05	0.00	1,282.814	2.571	0.09	0.09	14.34
122.10	0.00	2,570.661	2.581	0.09	0.09	28.65
122.15	0.00	3,863.552	2.591	0.09	0.09	43.01
122.20	0.00	5,161.495	2.601	0.09	0.09	57.44
122.25	0.00	6,464.499	2.611	0.09	0.09	71.91
122.30	0.00	7,772.572	2.621	0.09	0.09	86.45
122.35	0.00	9,085.725	2.631	0.09	0.09	101.04
122.40	0.00	10,403.966	2.642	0.09	0.09	115.69
122.45	0.00	11,727.303	2.652	0.09	0.09	130.39
122.50	0.00	13,055.747	2.662	0.09	0.09	145.15
122.55	0.00	14,389.306	2.672	0.09	0.09	159.97
122.60	0.00	15,727.989	2.682	0.09	0.09	174.84
122.65	0.00	17,071.804	2.693	0.09	0.09	189.78
122.70	0.00	18,420.762	2.703	0.09	0.09	204.77
122.75	0.00	19,774.871	2.713	0.09	0.09	219.81
122.80	0.00	21,134.139	2.724	0.09	0.09	234.91
122.85	0.00	22,498.577	2.734	0.09	0.09	250.08
122.90	0.00	23,868.193	2.744	0.09	0.09	265.29
122.95	0.00	25,242.996	2.755	0.09	0.09	280.57
123.00	0.00	26,622.994	2.765	0.09	0.09	295.90
123.05	0.00	28,008.198	2.776	0.09	0.09	311.29
123.10	0.00	29,398.616	2.786	0.09	0.09	326.74
123.15	0.00	30,794.256	2.797	0.09	0.09	342.25
123.20	0.00	32,195.129	2.807	0.09	0.09	357.82
123.25	0.00	33,601.243	2.817	0.09	0.09	373.44
123.30	0.00	35,012.607	2.828	0.09	0.09	389.12
123.35	0.00	36,429.229	2.839	0.09	0.09	404.86
123.40	0.00	37,851.120	2.849	0.09	0.09	420.66
123.45	0.00	39,278.288	2.860	0.10	0.10	436.52
123.50	0.00	40,710.742	2.870	0.10	0.10	452.44
123.55	0.00	42,148.490	2.881	0.10	0.10	468.41
123.60	0.00	43,591.543	2.891	0.10	0.10	484.45
123.65	0.08	45,039.909	2.902	0.10	0.17	500.62
123.70	0.22	46,493.596	2.913	0.10	0.32	516.92

Subsection: Elevation-Volume-Flow Table (Pond)
 Label: Infiltration Basin 2

Return Event: 1 years
 Storm Event: 25mm Storm 4hr

Elevation (m)	Outflow (m ³ /s)	Storage (m ³)	Area (ha)	Infiltration (m ³ /s)	Flow (Total) (m ³ /s)	2S/t + O (m ³ /s)
123.75	0.43	47,952.615	2.923	0.10	0.52	533.33
123.80	0.68	49,416.974	2.934	0.10	0.77	549.85
123.85	0.97	50,886.682	2.945	0.10	1.07	566.48
123.90	1.32	52,361.747	2.955	0.10	1.42	583.22
123.95	1.71	53,842.180	2.966	0.10	1.81	600.06
124.00	2.15	55,327.989	2.977	0.10	2.25	617.00
124.05	2.64	56,819.183	2.988	0.10	2.74	634.06
124.10	3.17	58,315.770	2.999	0.10	3.27	651.22
124.15	3.75	59,817.761	3.009	0.10	3.85	668.50
124.20	4.39	61,325.164	3.020	0.10	4.49	685.88
124.25	5.07	62,837.988	3.031	0.10	5.17	703.37
124.30	5.80	64,356.241	3.042	0.10	5.90	720.97
124.35	6.59	65,879.934	3.053	0.10	6.69	738.69
124.40	7.42	67,409.075	3.064	0.10	7.52	756.51
124.45	8.31	68,943.673	3.075	0.10	8.41	774.46
124.50	9.26	70,483.736	3.086	0.10	9.36	792.51

Appendix C

Stormwater Management Performance Assessment

Appendix C

Stormwater Management Performance Assessment

This appendix outlines decision making criteria related to operation of the stormwater management (SWM) system. It includes performance assessment of the SWM ponds, disposal of secondary drainage layer (SDL) water and construction water into the SWM conveyance/holding system. Decision making criteria are presented in the following flow charts. The following field and laboratory sampling information shall be read in conjunction with the flow charts.

1. Sampling Locations

- Stormwater Pond Inlet
- Stormwater Pond Content
- Stormwater Pond Outlet (only if outlet valve open).
- SDL sampling port near Pumping Station PS6.
- Construction water-variable locations.

2. Water Quality Based on Field Sampling

Level 1

- conductivity < 1,000 $\mu\text{S}/\text{cm}$

Level 2

- 1,000 $\mu\text{S}/\text{cm}$ < conductivity < 2,000 $\mu\text{S}/\text{cm}$

Level 3

- conductivity > 2,000 $\mu\text{S}/\text{cm}$
- 6.5 < pH < 9.0
- dissolved oxygen (DO) < 3 mg/L May through October
<5 mg/L November to April

3. Water Quality Based on Laboratory Sample

Elevated:

- conductivity between 1,000 and 2,000 $\mu\text{S}/\text{cm}$
- TDS between 600 and 1,200 mg/L
- chloride between 150 and 250 mg/L
- sodium between 110 and 200 mg/L

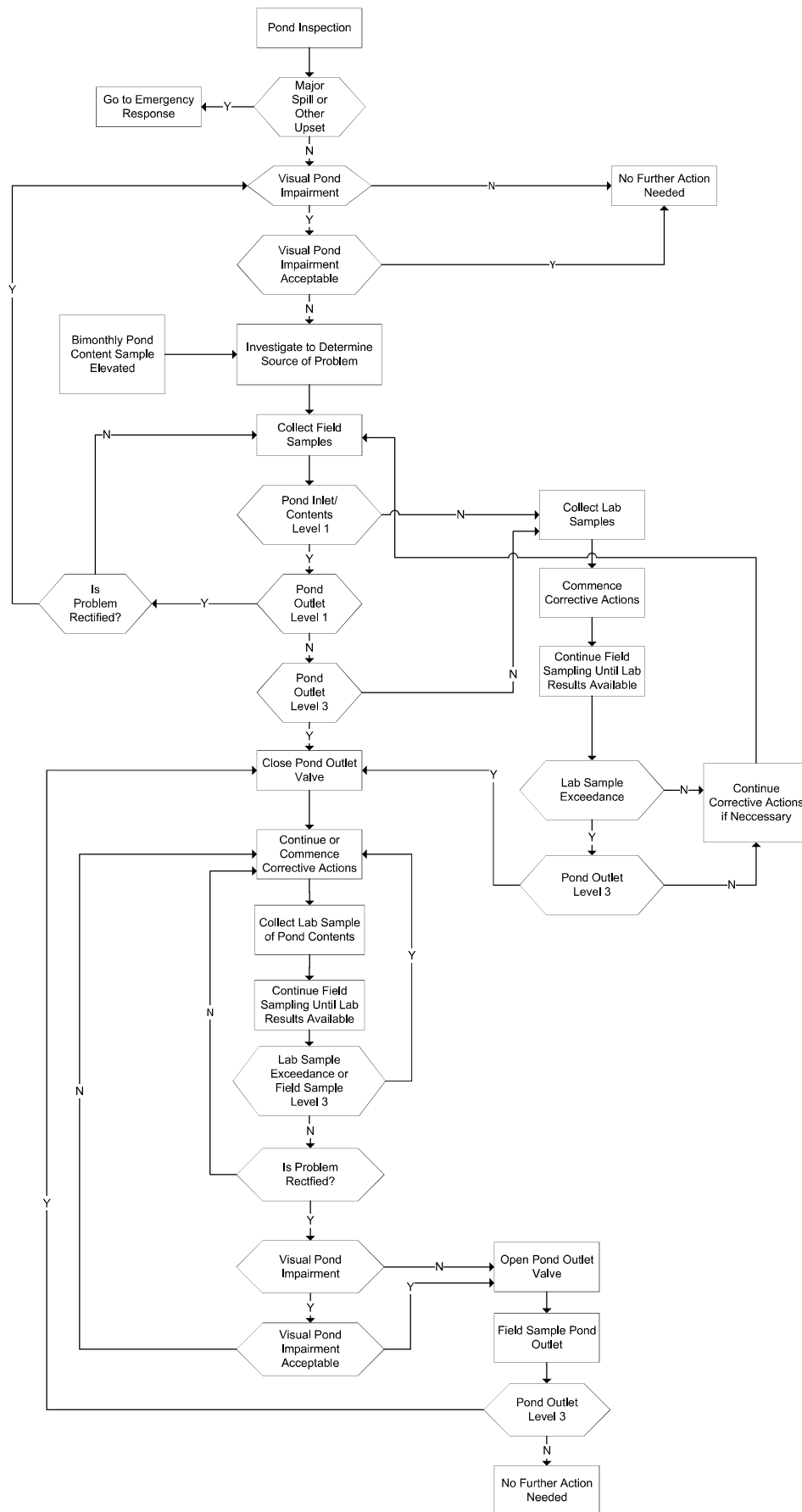
Exceedance:

- conductivity > 2,000 $\mu\text{S}/\text{cm}$
- TDS > 1,200 mg/L
- chloride > 250 mg/L
- sodium > 200 mg/L

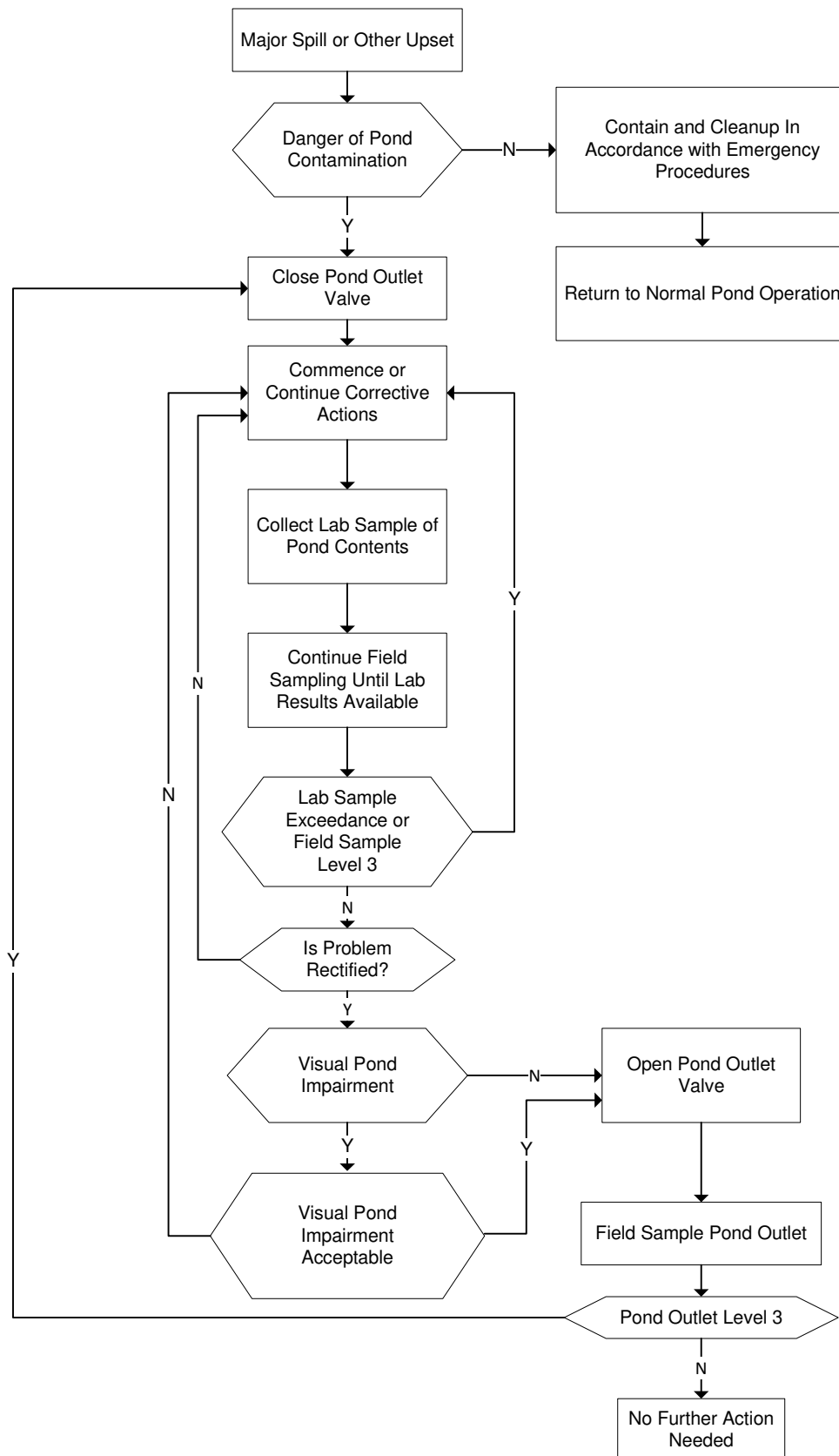
Increased turbidity shall not be considered as visual impairment of surface water. In case of a spill, indicator parameters should be revised/added based on the nature of spilled liquid.

Corrective actions will always depend on the nature of the problem. Usually it will require fixing the source of the problem such as leachate seep, exposed waste, spill, etc. If the pond contents are contaminated, corrective measures may include in-situ treatment, dilution (mixing to agitate contents, floating aerator and/or other measures to prevent stagnation), containment with booms, removal of floating material and removal of pond contents for treatment on-site or off-site.

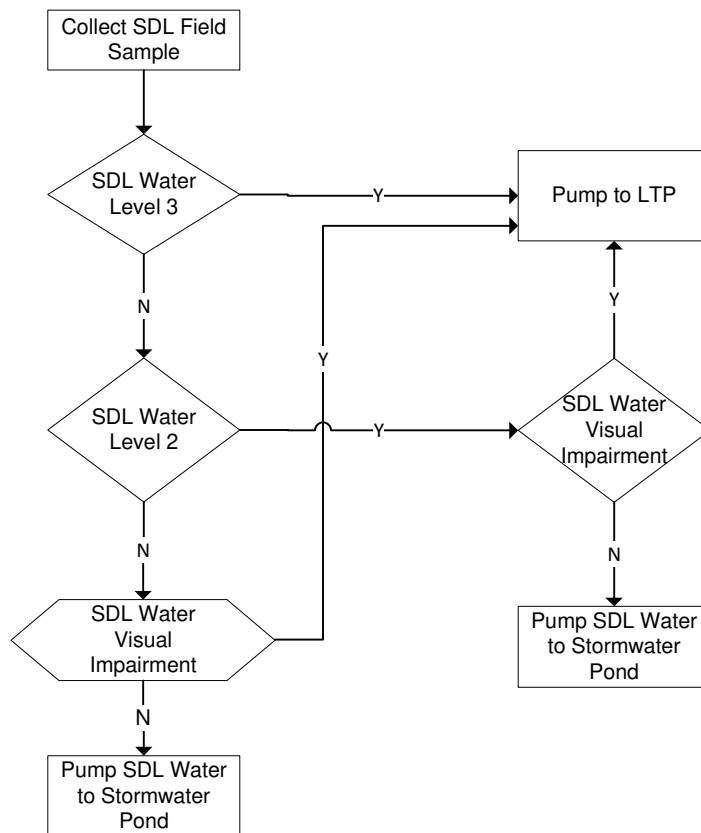
A - Regular Pond Operation



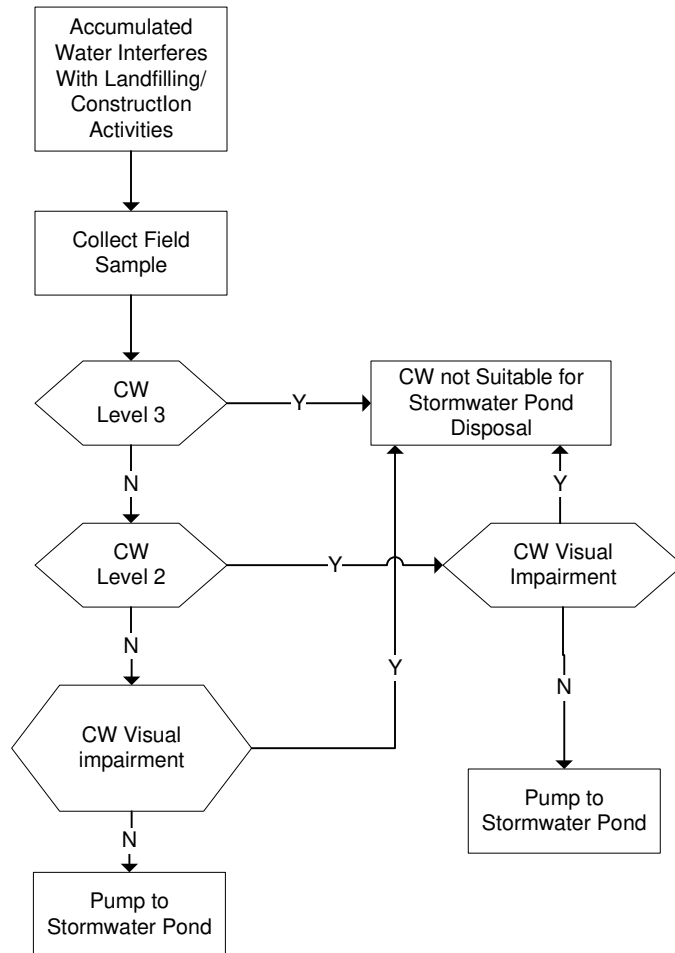
B - Stormwater Pond Emergency Response



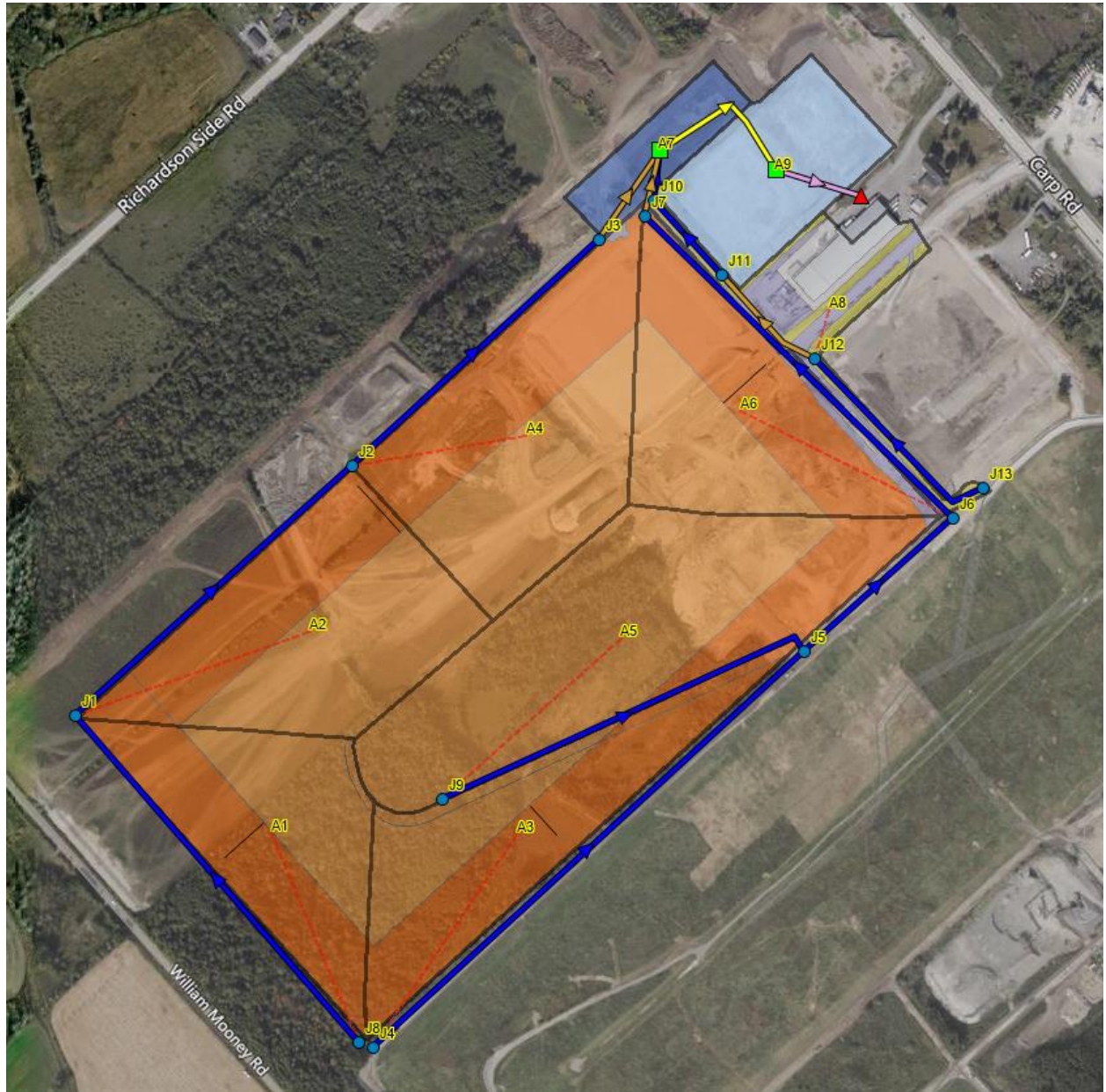
C - Handling of Secondary Drainage Layer (SDL) Water



D - Construction Dewatering (Handling of Construction Water (CW))



PCSWMM Output



EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)

Element Count

Number of rain gages 17

Number of subcatchments ... 9

Number of nodes 17

Number of links 15

Number of pollutants 0

Number of land uses 0

Raingage Summary

Name	Data Source	Data Type	Recording Interval
100yr_3hr_Chicago	100yr_3hr_Chicago	INTENSITY	10 min.
100yr_3hr_Chicago_Climate_Change	100yr_3hr_Chicago_Increase_20percent	INTENSITY	10 min.
100yr_6hr_Chicago	100yr_6hr_Chicago	INTENSITY	10 min.
100yr_6hr_Chicago_Climate_Change	100yr_6hr_Chicago_Increase_20percent	INTENSITY	10 min.
100yr-24hr-SCS_Type_II	100yr-24hr-SCS_Type_II	INTENSITY	15 min.
10yr_3hr_Chicago	10yr_3hr_Chicago	INTENSITY	10 min.
10yr_6hr_Chicago	10yr_6hr_Chicago	INTENSITY	10 min.
25mm_3hr_Chicago	25mm_3hr_Chicago	INTENSITY	10 min.
25mm_4hr_Chicago	25mm_4hr_Chicago	INTENSITY	10 min.
25yr_3hr_Chicago	25yr_3hr_Chicago	INTENSITY	10 min.
25yr_6hr_Chicago	25yr_6hr_Chicago	INTENSITY	10 min.
2yr_3hr_Chicago	2yr_3hr_Chicago	INTENSITY	10 min.
2yr_6hr_Chicago	2yr_6hr_Chicago	INTENSITY	10 min.
50yr_3hr_Chicago	50yr_3hr_Chicago	INTENSITY	10 min.
50yr_6hr_Chicago	50yr_6hr_Chicago	INTENSITY	10 min.
5yr_3hr_Chicago	5yr_3hr_Chicago	INTENSITY	10 min.
5yr_6hr_Chicago	5yr_6hr_Chicago	INTENSITY	10 min.

Subcatchment Summary

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
A1	5.77	294.14	0.00	15.0000	100yr-24hr-SCS_Type_II	J8
A2	7.43	330.04	0.00	15.0000	100yr-24hr-SCS_Type_II	J1
A3	6.11	313.17	0.00	15.0000	100yr-24hr-SCS_Type_II	J4
A4	7.95	353.19	0.00	15.0000	100yr-24hr-SCS_Type_II	J2
A5	10.33	574.07	0.00	5.0000	100yr-24hr-SCS_Type_II	J9
A6	6.43	268.04	0.00	15.0000	100yr-24hr-SCS_Type_II	J6
A7	1.51	1006.13	0.00	0.5000	100yr-24hr-SCS_Type_II	Pond#2
A8	2.80	350.29	0.00	3.5000	100yr-24hr-SCS_Type_II	J12
A9	3.53	2353.07	0.00	0.5000	100yr-24hr-SCS_Type_II	IB2

Node Summary

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	128.89	3.00	0.0	
J10	JUNCTION	124.70	3.00	0.0	
J11	JUNCTION	125.14	3.01	0.0	
J12	JUNCTION	125.60	3.00	0.0	
J13	JUNCTION	130.80	3.00	0.0	
J2	JUNCTION	127.05	3.00	0.0	
J3	JUNCTION	125.22	3.00	0.0	
J4	JUNCTION	131.51	3.00	0.0	
J5	JUNCTION	128.95	3.00	0.0	
J6	JUNCTION	127.74	3.00	0.0	
J7	JUNCTION	125.02	3.09	0.0	
J8	JUNCTION	131.51	3.00	0.0	
J9	JUNCTION	150.00	3.00	0.0	
OF1	OUTFALL	0.00	0.00	0.0	
OF2	OUTFALL	122.00	0.00	0.0	
IB2	STORAGE	122.00	2.50	0.0	
Pond#2	STORAGE	122.80	3.50	0.0	

Link Summary

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	Pond#2	IB2	CONDUIT	25.0	0.4000	0.0130
C10	J9	J5	CONDUIT	465.6	4.5257	0.0350
C11	J13	J12	CONDUIT	267.5	1.9445	0.0350
C12	J12	J11	CONDUIT	146.2	0.3146	0.0120
C13	J11	J10	CONDUIT	115.3	0.3816	0.0350
C14	J10	Pond#2	CONDUIT	5.0	41.0817	0.0350
C2	J1	J2	CONDUIT	428.6	0.4293	0.0350
C3	J2	J3	CONDUIT	385.0	0.4753	0.0350
C4	J3	Pond#2	CONDUIT	25.0	0.8800	0.0240
C5	J4	J5	CONDUIT	671.5	0.3812	0.0350
C6	J5	J6	CONDUIT	229.6	0.5269	0.0350
C7	J6	J7	CONDUIT	495.6	0.5489	0.0350
C8	J7	Pond#2	CONDUIT	24.0	0.7917	0.0240
C9	J8	J1	CONDUIT	497.1	0.5270	0.0350

OL1 IB2 OF2 OUTLET

Cross Section Summary

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	CIRCULAR	0.33	0.08	0.08	0.33	1	0.08
C10	TRIANGULAR	1.10	1.65	0.44	3.00	1	5.83
C11	TRIANGULAR	1.10	1.65	0.44	3.00	1	3.82
C12	CIRCULAR	0.60	0.28	0.15	0.60	1	0.37
C13	TRIANGULAR	1.10	1.65	0.44	3.00	1	1.69
C14	TRIANGULAR	1.10	1.65	0.44	3.00	1	17.58
C2	TRAPEZOIDAL	1.10	4.73	0.59	7.60	1	6.26
C3	TRAPEZOIDAL	1.10	5.83	0.65	8.60	1	8.63
C4	ARCH	0.82	0.74	0.25	1.15	2	1.14
C5	TRAPEZOIDAL	1.10	4.18	0.56	7.10	1	5.01
C6	TRAPEZOIDAL	1.10	5.28	0.62	8.10	1	8.00
C7	TRAPEZOIDAL	1.10	5.83	0.65	8.60	1	9.27
C8	ARCH	0.82	0.74	0.25	1.15	2	1.08
C9	TRIANGULAR	1.10	1.65	0.44	3.00	1	1.99

Analysis Options

Flow Units CMS
Process Models:
 Rainfall/Runoff YES
 RDII NO
 Snowmelt NO
 Groundwater NO
 Flow Routing YES
 Ponding Allowed YES
 Water Quality NO
Infiltration Method CURVE NUMBER
Flow Routing Method DYNWAVE
Surcharge Method EXTRAN
Starting Date 11/10/2013 00:00:00
Ending Date 11/13/2013 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:05:00
Wet Time Step 00:05:00
Dry Time Step 00:05:00
Routing Time Step 1.00 sec
Variable Time Step YES
Maximum Trials 20
Number of Threads 2
Head Tolerance 0.001500 m

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation	5.802	111.900
Evaporation Loss	0.000	0.000
Infiltration Loss	2.665	51.389
Surface Runoff	3.077	59.345
Final Storage	0.066	1.264
Continuity Error (%)	-0.089	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	3.077	30.772
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	1.922	19.216
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	4.420	4.202
Final Stored Volume	1.575	15.752
Continuity Error (%)	0.018	

Time-Step Critical Elements

None

Highest Flow Instability Indexes

Link C4 (3)
Link C12 (1)

Most Frequent Nonconverging Nodes

Convergence obtained at all time steps.

Routing Time Step Summary

Minimum Time Step : 0.50 sec
Average Time Step : 1.00 sec

Maximum Time Step : 1.00 sec
 % of Time in Steady State : 0.00
 Average Iterations per Step : 2.00
 % of Steps Not Converging : 0.00
 Time Step Frequencies :
 1.000 - 0.871 sec : 100.00 %
 0.871 - 0.758 sec : 0.00 %
 0.758 - 0.660 sec : 0.00 %
 0.660 - 0.574 sec : 0.00 %
 0.574 - 0.500 sec : 0.00 %

 Subcatchment Runoff Summary

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
A1	111.90	0.00	0.00	52.23	0.00	58.50	58.50	3.37	0.78	0.523
A2	111.90	0.00	0.00	52.33	0.00	58.39	58.39	4.34	0.93	0.522
A3	111.90	0.00	0.00	52.23	0.00	58.50	58.50	3.57	0.83	0.523
A4	111.90	0.00	0.00	52.33	0.00	58.39	58.39	4.64	1.00	0.522
A5	111.90	0.00	0.00	52.60	0.00	58.11	58.11	6.00	1.05	0.519
A6	111.90	0.00	0.00	52.39	0.00	58.34	58.34	3.75	0.77	0.521
A7	111.90	0.00	0.00	35.89	0.00	74.98	74.98	1.13	0.39	0.670
A8	111.90	0.00	0.00	34.29	0.00	76.50	76.50	2.14	0.59	0.684
A9	111.90	0.00	0.00	59.29	0.00	51.49	51.49	1.82	0.60	0.460

 Node Depth Summary

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J1	JUNCTION	0.04	0.58	129.47	0 12:07	0.57
J10	JUNCTION	0.13	0.64	125.34	0 18:25	0.64
J11	JUNCTION	0.06	0.69	125.83	0 12:06	0.69
J12	JUNCTION	0.04	0.95	126.55	0 12:06	0.95
J13	JUNCTION	0.00	0.00	130.80	0 00:00	0.00
J2	JUNCTION	0.03	0.56	127.61	0 12:08	0.56
J3	JUNCTION	0.04	0.77	125.99	0 12:16	0.77
J4	JUNCTION	0.03	0.51	132.02	0 12:04	0.51
J5	JUNCTION	0.03	0.50	129.45	0 12:11	0.50
J6	JUNCTION	0.03	0.53	128.27	0 12:12	0.52
J7	JUNCTION	0.07	0.73	125.75	0 12:22	0.73
J8	JUNCTION	0.08	0.88	132.39	0 12:03	0.87
J9	JUNCTION	0.05	0.61	150.61	0 12:01	0.61
OF1	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
OF2	OUTFALL	0.00	0.00	122.00	0 00:00	0.00
IB2	STORAGE	0.37	0.59	122.59	2 02:03	0.59
Pond#2	STORAGE	1.34	2.54	125.34	0 18:25	2.54

 Node Inflow Summary

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	0.930	1.525	0 12:01	4.34	7.72	0.029
J10	JUNCTION	0.000	0.411	0 12:07	0	2.15	0.265
J11	JUNCTION	0.000	0.411	0 12:06	0	2.14	-0.320
J12	JUNCTION	0.587	0.587	0 12:00	2.14	2.14	0.041
J13	JUNCTION	0.000	0.000	0 00:00	0	0	0.000 ltr
J2	JUNCTION	0.995	2.189	0 12:04	4.64	12.4	-0.189
J3	JUNCTION	0.000	2.121	0 12:08	0	12.4	0.310
J4	JUNCTION	0.832	0.832	0 12:00	3.57	3.57	-0.712
J5	JUNCTION	0.000	1.677	0 12:04	0	9.61	0.382
J6	JUNCTION	0.774	2.024	0 12:09	3.75	13.3	-0.328
J7	JUNCTION	0.000	1.988	0 12:12	0	13.4	0.403
J8	JUNCTION	0.783	0.783	0 12:00	3.37	3.37	-0.210
J9	JUNCTION	1.048	1.048	0 12:00	6	6	-0.168
OF1	OUTFALL	0.000	0.000	0 00:00	0	0	0.000 ltr
OF2	OUTFALL	0.000	0.089	2 02:03	0	19.2	0.000
IB2	STORAGE	0.603	0.626	0 12:00	1.82	30.2	0.004
Pond#2	STORAGE	0.394	4.183	0 12:18	1.13	33.1	-0.042

 Node Surchage Summary

No nodes were surcharged.

 Node Flooding Summary

No nodes were flooded.

 Storage Volume Summary

Storage Unit	Average Volume 1000 m³	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m³	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
IB2	9.553	13.5	0.0	0.0	15.470	21.9	2 02:03	0.089
Pond#2	10.990	31.0	0.0	0.0	22.966	64.8	0 18:25	0.242

Outfall Loading Summary

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
OF1	0.00	0.000	0.000	0.000
OF2	84.68	0.088	0.089	19.215
System	42.34	0.088	0.089	19.215

Link Flow Summary

Link	Type	Maximum Flow CMS	Time of Max Occurrence days hr:min	Maximum Veloc m/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	0.242	0 18:25	2.88	3.15	1.00
C10	CONDUIT	1.029	0 12:02	2.97	0.18	0.48
C11	CONDUIT	0.000	0 00:00	0.00	0.00	0.43
C12	CONDUIT	0.411	0 12:06	1.45	1.10	1.00
C13	CONDUIT	0.411	0 12:07	1.31	0.24	0.44
C14	CONDUIT	0.411	0 12:07	1.06	0.02	0.79
C2	CONDUIT	1.396	0 12:07	0.91	0.22	0.52
C3	CONDUIT	2.121	0 12:08	1.00	0.25	0.60
C4	CONDUIT	1.939	0 12:16	1.55	0.85	0.74
C5	CONDUIT	0.722	0 12:07	0.74	0.14	0.45
C6	CONDUIT	1.476	0 12:11	0.94	0.18	0.47
C7	CONDUIT	1.988	0 12:12	1.04	0.21	0.56
C8	CONDUIT	1.803	0 12:22	1.50	0.83	0.71
C9	CONDUIT	0.694	0 12:04	0.98	0.35	0.66
OL1	DUMMY	0.089	2 02:03			

Flow Classification Summary

Conduit	Adjusted /Actual Length	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C1	1.00	0.13	0.00	0.00	0.00	0.00	0.87	0.00	0.00
C10	1.00	0.14	0.00	0.00	0.57	0.29	0.00	0.00	0.00
C11	1.00	0.68	0.32	0.00	0.00	0.00	0.00	0.00	0.00
C12	1.00	0.12	0.55	0.00	0.32	0.00	0.00	0.00	0.85
C13	1.00	0.13	0.00	0.00	0.87	0.00	0.00	0.20	0.00
C14	1.00	0.00	0.13	0.00	0.87	0.00	0.00	0.59	0.00
C2	1.00	0.14	0.00	0.00	0.86	0.00	0.00	0.62	0.00
C3	1.00	0.14	0.00	0.00	0.86	0.00	0.00	0.76	0.00
C4	1.00	0.15	0.00	0.00	0.20	0.00	0.00	0.65	0.19
C5	1.00	0.14	0.00	0.00	0.86	0.00	0.00	0.17	0.00
C6	1.00	0.14	0.00	0.00	0.85	0.00	0.00	0.85	0.00
C7	1.00	0.14	0.00	0.00	0.86	0.00	0.00	0.83	0.00
C8	1.00	0.15	0.00	0.00	0.25	0.00	0.00	0.60	0.08
C9	1.00	0.14	0.00	0.00	0.86	0.00	0.00	0.00	0.00

Conduit Surcharge Summary

Conduit	Hours Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C1	17.43	39.58	17.43	39.90	17.43
C12	0.45	0.45	0.64	0.26	0.40
C14	0.01	0.01	35.09	0.01	0.01

Analysis begun on: Tue May 13 11:43:48 2025

Analysis ended on: Tue May 13 11:43:52 2025

Total elapsed time: 00:00:04

Functional Servicing Brief
WM West Carleton Environmental Maintenance Facility
TF Project No.: 2511

Appendix 4

Stormwater Memo

MEMO

TO: Rémi Godin, P.Eng
Senior Area Engineer
Eastern Canada Area
rgodin@wm.com

2301 Carp Road
Ottawa, ON, K0A 1L0

FROM: Kathryn Kerker, P.Eng
Eeshan Kumar, P.Eng

SUBJECT: DRAFT - West Carleton Environmental Centre – Stormwater Analysis for Proposed Maintenance Building

DATE: June 11, 2025

The Stormwater Design Brief prepared in August 2015 by WSP Canada Inc. provides an analysis of the proposed site conditions and design of the stormwater management ponds and infiltration basins on site. A new 12000 ft² maintenance building is proposed on land that was gravel-covered in the original design. The purpose of this memo is to verify that the existing stormwater infrastructure has the capacity to accept the additional flow from this new building. The original Stormwater Design Brief has been attached for reference.

DESIGN CRITERIA

The design criteria used in the original design of the stormwater management system are as follows:

- Internal ditches and stormwater structures: 1:25 year storm, with overland flow route to carry peak flow from 1:100 year storm
- Surface Water Quality Control: Stormwater ponds sized to store/treat runoff generated from a 4-hour, 25mm storm event.
- Surface Water Quantity Control: Control post-development peak flows to pre-development levels. However, as there is no off-site discharge from the central site area, this condition is automatically met.
- Infiltration Basins: At least 1m to bedrock and water table, and no more than 0.6m water storage depth.

STORMWATER MODELLING

Modelling was previously completed using Bentley PondPack. As we no longer have access to this software, modelling was replicated in PCSWMM to determine the impact of the added

impervious area on the overall stormwater management system. The PCSWMM model was calibrated to align with the PondPack results. PCSWMM model results are attached for reference.

The proposed maintenance building lies within catchment area A8, which was originally modelled with parameters as shown in Table 1. The new 12000 ft² (1115 m²) maintenance building will be placed on land that was previously gravel-covered, which leads to a slight increase in runoff coefficient and CN value.

Table 1: Catchment A8 model parameters

	WITHOUT MAINTENANCE BUILDING	WITH MAINTENANCE BUILDING
C	0.561	0.57
CN	85.7	86.0

RESULTS

INFILTRATION BASIN

The PCSWMM model was run with the 100-year 24-hour SCS Type II storm. Under existing conditions, the infiltration basin reaches a maximum depth of 0.59m, which remains unchanged under proposed conditions. This meets the design requirement of ponding less than 0.60m in the infiltration basin. Modelling results are shown in Table 2.

Table 2: PCSWMM Modelling Results

	WITHOUT MAINTENANCE BUILDING	WITH MAINTENANCE BUILDING
Maximum water depth in Infiltration Basin #2	0.590 m	0.590 m
Total runoff volume entering Pond #2	28800 m ³	28827 m ³
Peak runoff Subcatchment A8	0.582 m ³ /s	0.587 m ³ /s

WATER QUALITY

The 25mm 4-hour Chicago storm event was run in the model under proposed conditions. The total volume reaching the pond during the water quality event is 266 m³. As the pond has a permanent pool volume of 4200 m³ and an extended detention volume of 19520 m³, there is sufficient volume to store and treat runoff generated from a 4-hour, 25mm storm event.

The quality criteria outlined in the MOE SWM Planning and Design Manual were also assessed. Based on Table 3.2 of the manual and extrapolating for a 4.5% impervious contributing area, the pond also meets an enhanced 80% TSS removal protection level as shown in Table 3.

Table 3: Pond Water Quality Parameters

PARAMETER	VALUE
Contributing Area Imperviousness	4.5%
Contributing Area	52 ha
Storage Volume for Imperviousness Level	75 m ³ /ha
Required Extended Detention Volume (40 m ³ /ha)	2080 m ³
Available Extended Detention Volume	19520 m ³
Required Permanent Pool Volume (35 m ³ /ha)	1820 m ³
Available Permanent Pool Volume	4200 m ³

CONVEYANCE

The existing ditches and stormwater infrastructure were verified to ensure that they still meet the design criteria with the additional flow from the new maintenance building. Figure 1 shows that the existing triangular ditch (1.1m deep, 3:1 side slopes) and 0.6 m culvert convey the 25-year storm without surcharging and convey the 100-year storm without overtopping.



Figure 1: Hydraulic Grade Line along ditch and culvert adjacent to new maintenance building



CONCLUSIONS

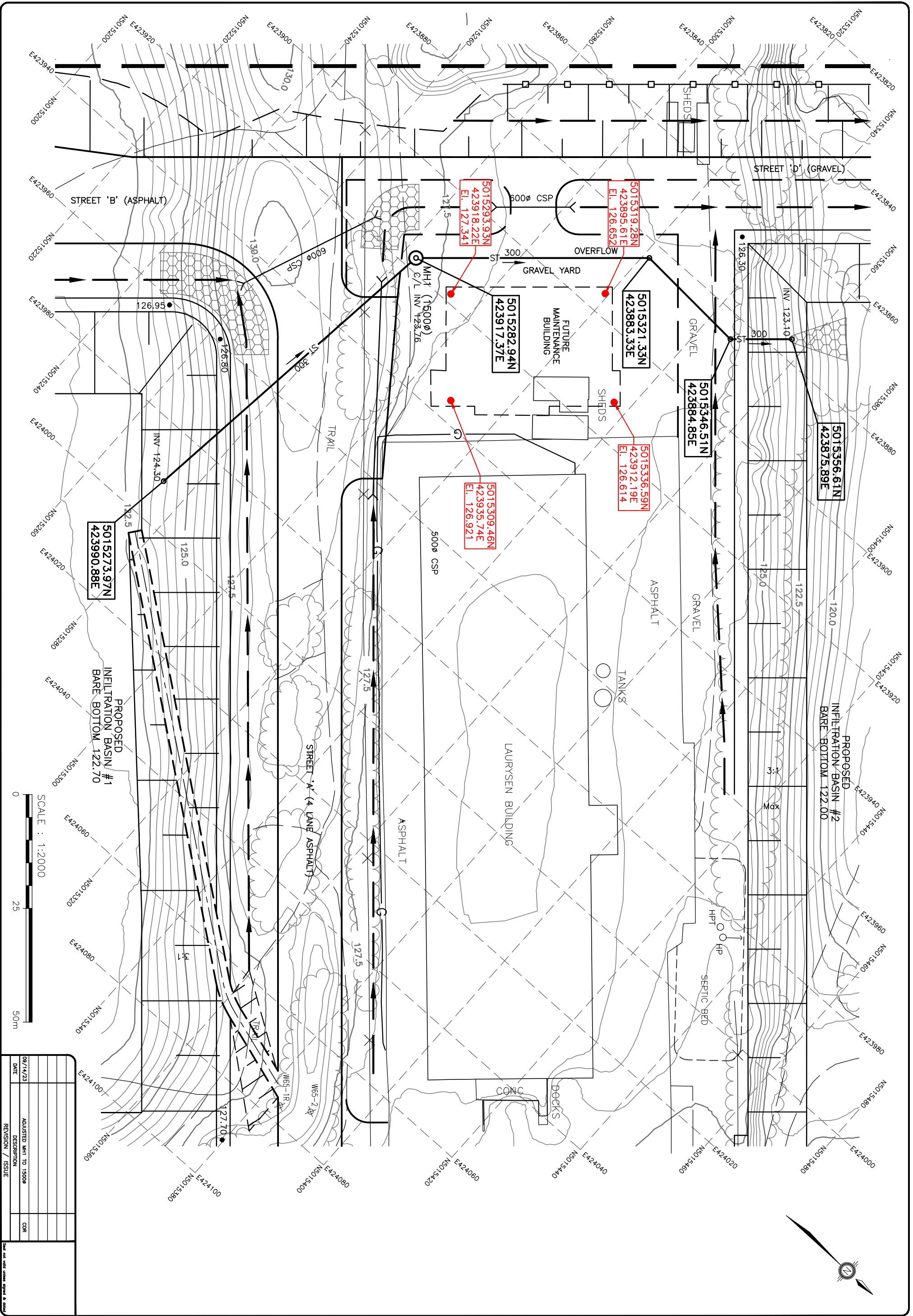
The peak depth in the infiltration basin, water quality treatment, and stormwater conveyance have all been confirmed to meet the design criteria. This memo has shown that the existing stormwater system is sufficient to support the proposed maintenance building.

Kathryn Kerker, P.Eng, Water Resources Engineer

Eeshan Kumar, P.Eng, Senior Water Resources Engineer

ATTACHMENTS

- Proposed Maintenance Building Location
- Stormwater Design Brief, August 2015
- PCSWMM Model Output



SCALE : 1:2000
0 25 50m

09/14/23	ADJUSTED MHT TO 15000	CHK
DATE	DESCRIPTION	CHK
REVISION	ISSUE	

