



February 11, 2022

File: GE-00240

VIA EMAIL

Municipality of Middlesex Centre
10227 Ilderton Road
Ilderton ON N0M 2A0

Attention: Rob Cascaden, P.Eng.
Director, Public Works and Engineering

**Reference: Stormwater Management for Proposed Development
MN 22447 Komoka Road
Komoka, Ontario**

LDS Consultants Inc. has been retained by Mr. T. Powell, on behalf of 1571145 Ontario Limited to provide engineering consulting services for the property located at MN 22447 Komoka Road, in the community of Komoka. As you are aware, approximately two thirds of the site is occupied by a pond created from former aggregate extraction operations, with the remaining third being subject to an application for possible residential development. At this time, the owner is seeking to obtain planning approvals to be able to proceed with next steps in preparing detailed development plans and project drawings, which can be circulated back to the municipality for Site Plan review.

It is our understanding that during the Middlesex Centre Council Meeting held on January 12, 2022, that a presentation from the neighbouring land owner (Mr. J. Graham) rendered erroneous information about the magnitude of water levels observed in the onsite pond (i.e., rising 6 to 10 ft above current levels) which occurred as a result of Mr. Graham constructing a dam on Mr. Powell's property. Although there was an increase in the water level of Mr. Powell's pond, the magnitude of change in the water level was acutely overstated. Mr. Graham also neglected to inform members of Council that the construction of the dam was completed without Mr. Powell's consent, and contrary to Mr. Powell's riparian water rights. Mr. Graham, by his actions, intentionally impeded the natural flow of surface water between the ponds located at Mr. Powell's property and his own property. Although he stated in the meeting that he graciously removed the dam at the request of the municipality, it is important to note that the construction of the dam in the first place was executed without any consultation and with a complete disregard for any approvals required from the Ministry of the Environment, Upper Thames River Conservation Authority, or the Municipality.

Mr. Graham conflated those inaccurate statements with additional rhetoric suggesting that any development within the property at MN 22447 Komoka Road would contribute to extreme flooding, which would not only have detrimental impacts on his lands, but would also create flooding events which would impact Komoka Road and Glendon Drive. Those bold and inflammatory statements are completely unfounded; however, they were sufficient to cause municipal council to defer the planning matters to a later time, until a stormwater management strategy could be prepared and submitted to the municipality for review and consideration.

As part of the consulting team supporting the proposed development at MN 22447 Komoka Road, LDS has been actively engaged in providing geotechnical and hydrogeological services to ensure that any development plans which have been contemplated at the site can be carried forward using reasonable and sound engineering design. In our continued efforts to assist Mr. Powell, LDS has prepared a Conceptual Stormwater Management Brief, which is appended for reference. This demonstrates that development plans could proceed within the subject lands which would provide sufficient water quantity controls to attenuate post-development run-off levels to pre-development levels for all storm events up to and including a 250-year event.

The strategy utilizes opportunities to control and infiltrate clean stormwater runoff, without significantly impacting the capacity of the onsite pond. This approach has the added benefit of being able to work in conjunction with possible future plans by the municipality to utilize the existing pond, as part of the community stormwater management strategy.

To help further alleviate the concerns of Council, LDS is also providing additional information in this document, to demonstrate the long-term stability of groundwater levels within the site, to help ensure that there is a clear understanding that the use of infiltration measures and LID features within the Conceptual Stormwater Management Brief are both practical and feasible.

Stabilized Groundwater Levels have been measured on a monthly basis within a monitoring well which was installed by LDS at the site, for the period of March 2021 through to January 2022. The following table shows the depth to the water table over that period, and demonstrates that under seasonal fluctuations, that the groundwater level (which corresponds closely to the surface water level in the pond), varies less than 13 cm.

ID	Ground Surface Elev. (m)	Depth to Groundwater (m bgs) / Groundwater Elevation (m asl)									
		Mar 2, 2021	Apr 5, 2021	May 18, 2021	Jun 22, 2021	Jul 29, 2021	Aug 9, 2021	Sept 1, 2021	Oct 12, 2021	Nov 4, 2021	Jan 11, 2022
BH1	236.48	1.72	1.70	1.71	1.75	1.77	1.78	1.74	1.69	1.70	1.62
		234.76	234.78	234.77	234.73	234.71	234.70	234.74	234.79	234.78	234.86

The presence of the pond has a moderating effect on the seasonal variation in the shallow groundwater level in the area. The general stability of the water level within the pond can also be seen through the review of historical and aerial photographs, which show very little change in the footprint of the pond on a year over year basis. A collection of photos is appended for reference.

Further, it is understood from previous meetings involving municipal staff and technical staff from the Ministry of Environment, Conservation and Parks (MECP), that there is a potential concern regarding the persistent nature of chlorides in stormwater run-off, and that any plans which involve utilizing the pond as part of the municipal stormwater system on a broader scale, will require assessment of the chloride levels, since the current pond directly connects with the shallow groundwater. There is a long-standing history of the municipality outletting stormwater run-off from a portion of the village into the pond. As well, the stormwater run-off generated from the commercial development to the north of the site, and from Bella Lago subdivision to the west also outlet through the site, into the Powell pond.

Although Mr. Powell is not responsible for undertaking this study and analysis, LDS collected water samples on January 24, 2022, to assess current chloride levels within the pond and the shallow groundwater at our monitoring well location, which is upgradient of the pond. A site plan is provided showing the sample locations the testing results of which are summarized below.

Sample Location	Chloride Concentration (mg/L)
Pond sample 1, northeast corner of pond (considered background level away from inlet and outlet influences)	174
Pond sample 2, at the outlet (immediately upstream of neighbor's dam)	191
Bella Lago & commercial development storm outlet	2190
Groundwater sample from monitoring well installed at the site (upgradient of the pond).	124

The elevated reading at the storm outlet for Bella Lago and the commercial development to the north is not unexpected, given the winter sampling event, and the limited amount of dilution which occurs under freezing conditions. However, within the other sampling locations within the pond, and for the shallow groundwater level, the chloride levels fall within the allowable limits specified in O.Reg. 153/04 Table 8 for Groundwater (790 mg/L).

Although the chloride concentrations indicate that stormwater run-off which is both infiltrated into the natural granular soils in the area, and surface water run-off which has been directed into the existing pond has resulted in chlorides being present, this does not preclude development from occurring within the property or future considerations by the municipality to incorporate the pond into their community stormwater management strategy. It does however, suggest that consideration be given to help mitigate chloride concentrations.

Therefore, in addition to the Conceptual Stormwater Management Brief, the owner has been forward thinking, and has engaged LDS in discussions regarding the feasibility of utilizing geothermal means of providing snow and ice melt for the hard surface landscaping features (such as walkways and site pavements), which would further limit potential environmental impacts with salting associated with winter snow / ice management.

In closing, Mr. Powell has expended considerable time and resources to ensure that any future development of his lands can be done in a responsible and sound manner, and has gone well beyond what is typically required for obtaining planning approvals. After planning approvals are granted, there are prescribed processes in place to review and approve the ultimate Site Plan, and to ensure that adequate engineering design and controls are implemented in any future development. Mr. Powell has demonstrated his ongoing commitment to work with the municipality to bring forward a development plan which will ultimately benefits the municipality and the community.

We trust the above is satisfactory for your present requirements.

Respectfully,

LDS CONSULTANTS INC.



Rebecca A Walker, P. Eng., QPESA

Principal, Geotechnical Services

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Attachments:

Aerial Photographs

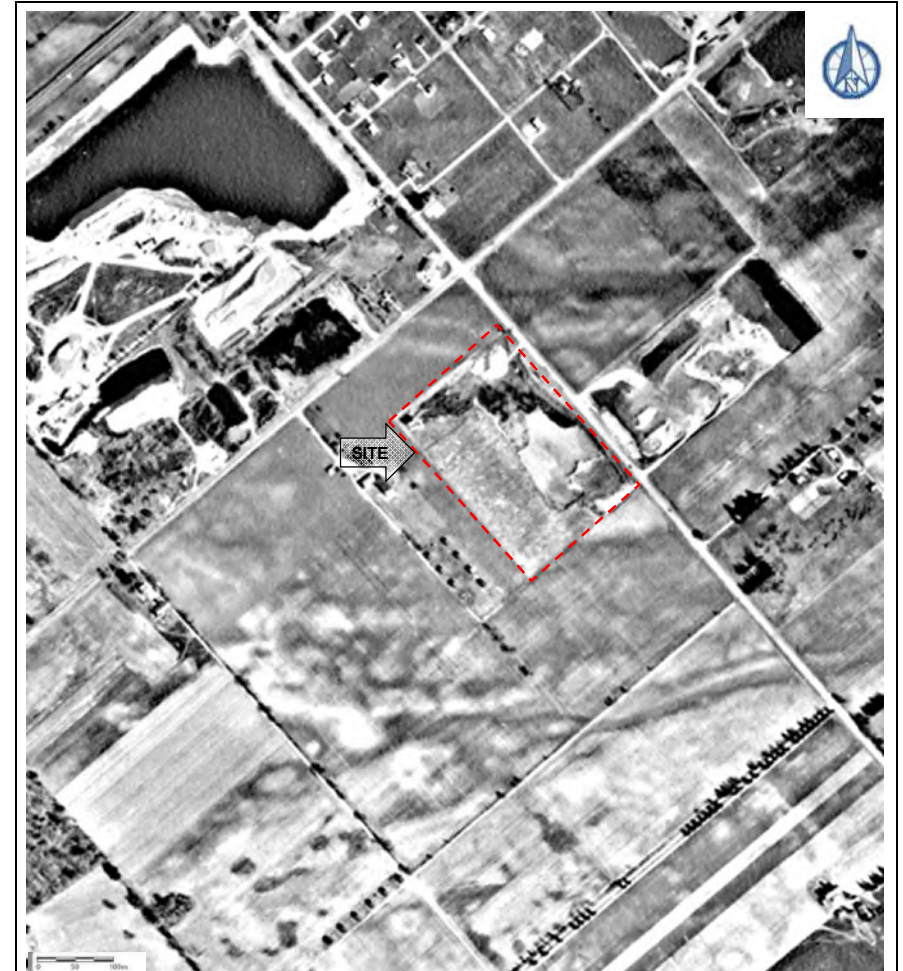
Water Sample Location Plan

Conceptual Stormwater Management Brief



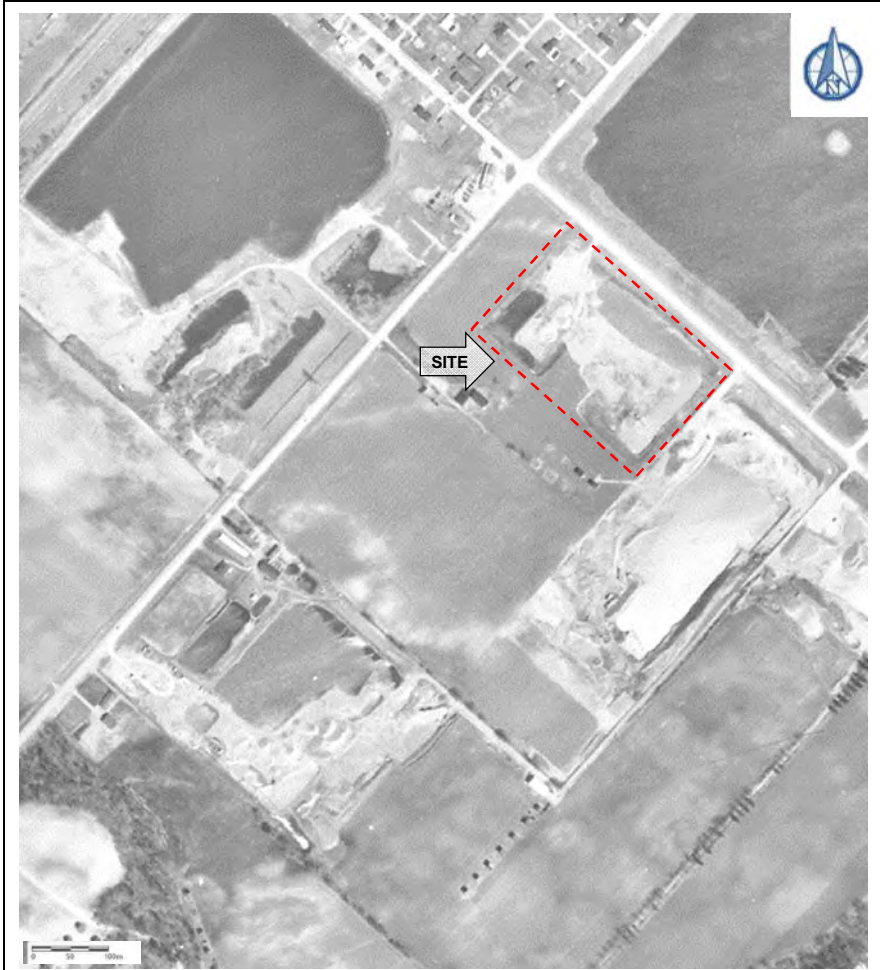
Source
Aerial photograph from University of Toronto, Map and Data Centre, Imagery © 1954.

LDS	PROJECT LOCATION	SCALE	PROJECT NO.
	22447 Komoka Road, Komoka, Ontario	NTS	GE-00240
DRAWING NAME		DATE	DRAWING NO.
1954 Aerial Photograph		January 2022	A1



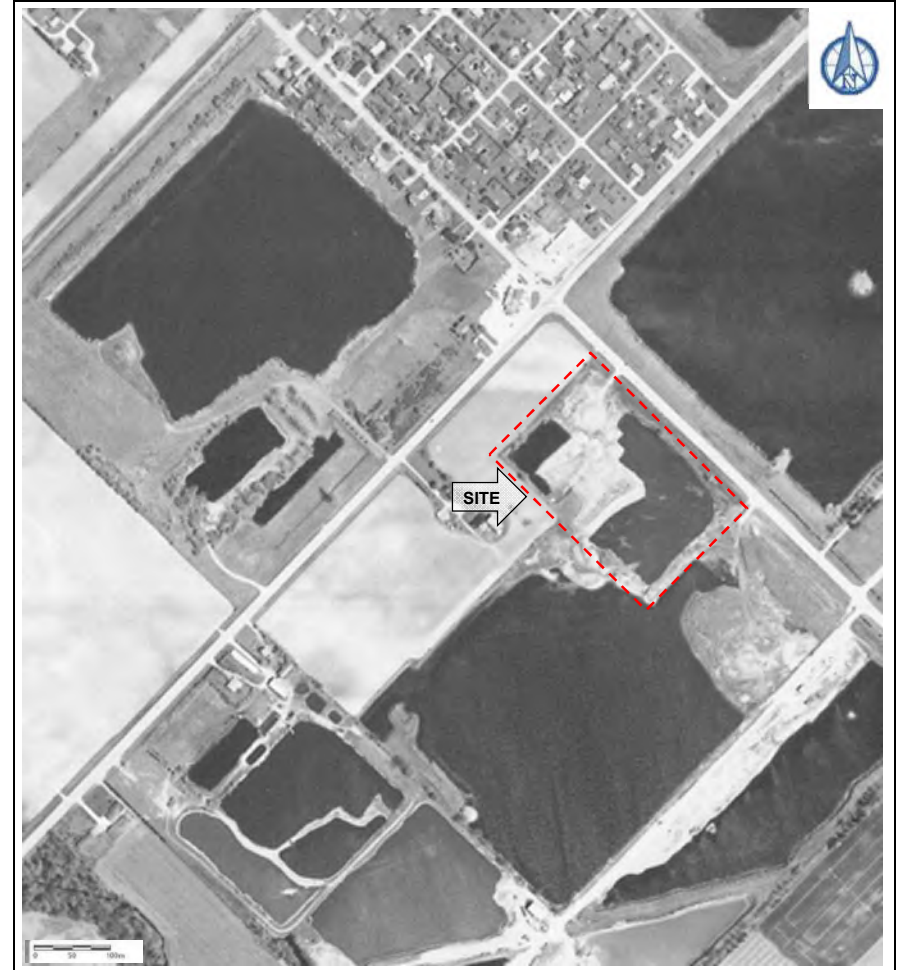
Source
Aerial photograph from Upper Thames River Conservation Authority, Imagery © 1963.

LDS	PROJECT LOCATION	SCALE	PROJECT NO.
	22447 Komoka Road, Komoka, Ontario	As Shown	GE-00240
DRAWING NAME		DATE	DRAWING NO.
1963 Aerial Photograph		January 2022	A2



Source
Aerial photograph from Upper Thames River Conservation Authority, Imagery © 1978.

LDS	PROJECT LOCATION	SCALE	PROJECT NO.
	22447 Komoka Road, Komoka, Ontario	As Shown	GE-00240
DRAWING NAME		DATE	DRAWING NO.
1978 Aerial Photograph		January 2022	A3



Source
Aerial photograph from Upper Thames River Conservation Authority, Imagery © 1989.

LDS	PROJECT LOCATION	SCALE	PROJECT NO.
	22447 Komoka Road, Komoka, Ontario	As Shown	GE-00240
DRAWING NAME		DATE	DRAWING NO.
1989 Aerial Photograph		January 2022	A4



Source
Aerial photograph from County of Middlesex GIS site, Imagery © 1999-2001.

LDS	PROJECT LOCATION	SCALE	PROJECT NO.
	22447 Komoka Road, Komoka, Ontario	As Shown	GE-00240
DRAWING NAME		DATE	DRAWING NO.
1999-2001 Aerial Photograph		January 2022	A5



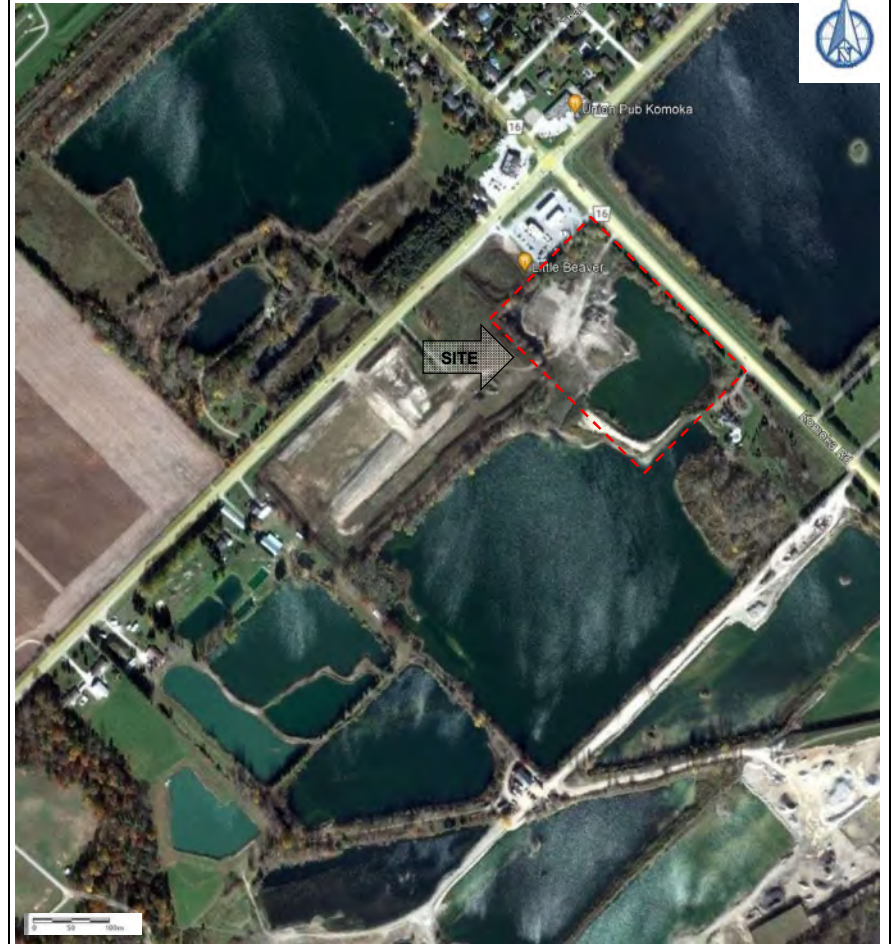
Source
Aerial photograph from County of Middlesex GIS site, Imagery © 2006.

LDS	PROJECT LOCATION	SCALE	PROJECT NO.
	22447 Komoka Road, Komoka, Ontario	As Shown	GE-00240
DRAWING NAME		DATE	DRAWING NO.
2006 Aerial Photograph		January 2022	A6



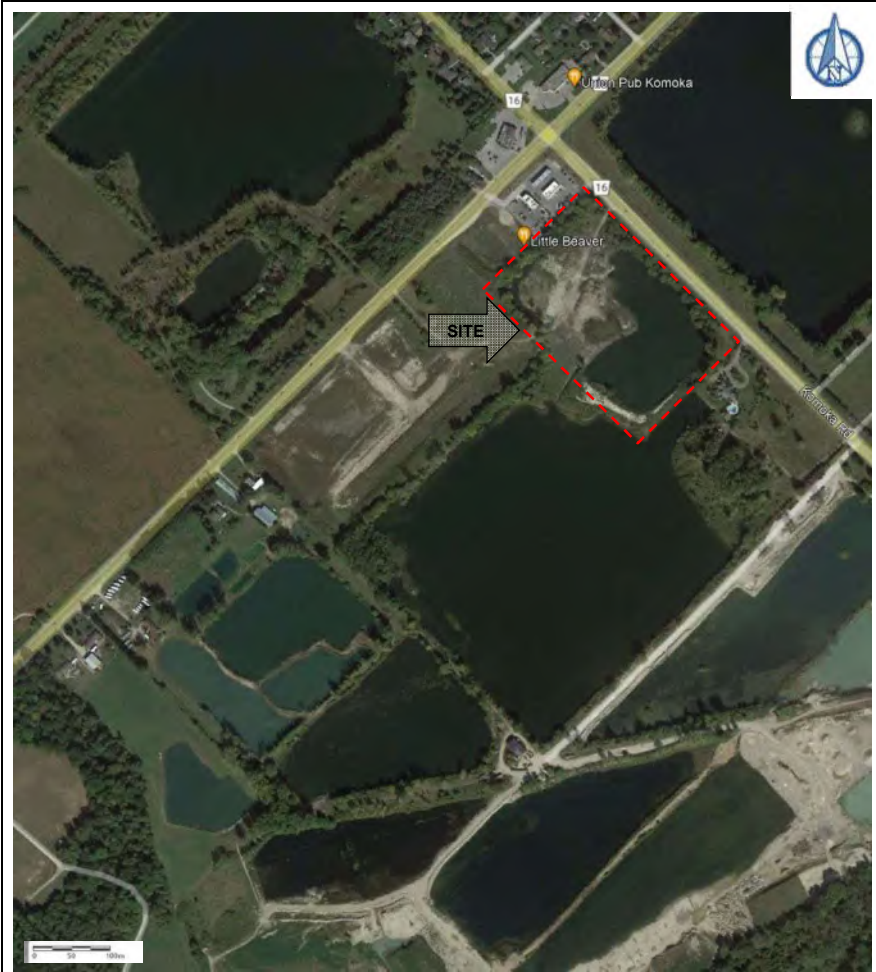
Source
Aerial photograph from County of Middlesex GIS, Imagery © 2010.

LDS	PROJECT LOCATION	SCALE	PROJECT NO.
	22447 Komoka Road, Komoka, Ontario	As Shown	GE-00240
DRAWING NAME	DATE	DRAWING NO.	
2010 Aerial Photograph	January 2022	A7	



Source
Aerial photograph from Google Earth, Imagery © October 2012.

LDS	PROJECT LOCATION	SCALE	PROJECT NO.
	22447 Komoka Road, Komoka, Ontario	As Shown	GE-00240
DRAWING NAME	DATE	DRAWING NO.	
2012 Aerial Photograph	January 2022	A8	



Source
Aerial photograph from Google Earth, Imagery © September 2013.

LDS	PROJECT LOCATION	SCALE	PROJECT NO.
	22447 Komoka Road, Komoka, Ontario	As Shown	GE-00240
DRAWING NAME		DATE	DRAWING NO.
2013 Aerial Photograph		January 2022	A9



Source
Aerial photograph from Google Earth, Imagery © September 2015.

LDS	PROJECT LOCATION	SCALE	PROJECT NO.
	22447 Komoka Road, Komoka, Ontario	As Shown	GE-00240
DRAWING NAME		DATE	DRAWING NO.
2015 Aerial Photograph		January 2022	A10



Source
Aerial photograph from Google Earth, Imagery © October 2016.

LDS	PROJECT NAME AND LOCATION	SCALE	PROJECT NO.
	22447 Komoka Road, Komoka, Ontario	As Shown	GE-00240
DRAWING NAME		DATE	DRAWING NO.
2016 Aerial Photograph		January 2022	A11




Source
Aerial photograph from Google Earth, Imagery © 2018.

LDS	PROJECT NAME AND LOCATION	SCALE	PROJECT NO.
	22447 Komoka Road, Komoka, Ontario	As Shown	GE-00240
DRAWING NAME		DATE	DRAWING NO.
2018 Aerial Photograph		January 2022	A12



Source

Aerial photograph from Google Earth, Imagery © 2018.

	<p>PROJECT LOCATION</p> <p>22447 Komoka Road, Komoka, Ontario</p>	<p>SCALE</p> <p>As Shown</p>	<p>PROJECT NO.</p> <p>GE-00240</p>
	<p>DRAWING NAME</p> <p>Water Sampling Location Plan - January 24, 2022</p>	<p>DATE</p> <p>February</p>	<p>DRAWING NO.</p> <p>A101</p>



CONCEPTUAL STORMWATER MANAGEMENT STRATEGY

**PROPOSED SENIOR'S APARTMENT DEVELOPMENT
MN 22447 KOMOKA ROAD**

LDS PROJECT NO. LD-00206

Submitted to:

MUNICIPALITY OF MIDDLESEX CENTRE

DISTRIBUTION (VIA EMAIL):
MUNICIPALITY OF MIDDLESEX CENTRE
1571145 ONTARIO LIMITED

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FIGURES

- Figure 1 – Location Plan
- Figure 2 – Pre-Development Conditions
- Figure 3 – Post-Development Conditions

APPENDICES

- Appendix A – Quantity Control
- Appendix B – Quality Control

1.0 Introduction

The proposed senior's development is located at MN 22447 Komoka Road, in the Municipality of Middlesex Centre. The existing 2.6-hectare parcel of land is located on the south side of Komoka Road east of the Glendon Drive and Komoka Road intersection (see **Figure 1**). The subject site is currently vacant and was previously utilized for aggregate extraction activities. The property is bounded by an existing commercial development to the west, open space lands and a single-family residential dwelling to the east, a mixed-use residential development to the south and Komoka Road to the north.

1571145 Ontario Limited has retained LDS Consultants Inc. (LDS) to prepare this stormwater management (SWM) report for the proposed senior's apartment development.

1.1 Background Information

The servicing strategy presented herein was developed using the following information;

- Geotechnical Investigation, prepared by LDS Consultants Inc., dated March 19th, 2021;
- Stormwater Management Planning and Design Manual, prepared by the Ministry of the Environment, dated March 2003;
- Middlesex Centre Infrastructure Design Standards, dated January 2018; and
- Stormwater Management Policy Manual, prepared by Stantec for the Municipality of Middlesex Centre, dated June 2011.

1.2 Stormwater Management Control Criteria

The subject property is located in the Municipality of Middlesex Centre in the Thames River watershed. Stormwater Management design reviews and approvals for sites located within the municipality are completed by the Upper Thames River Conservation Authority (UTRCA). LDS has developed the following stormwater management design criteria for the subject site based on site conditions and previous experience on local projects.

1.2.1 Water Quality Control

The water quality control criterion was selected using the guidance presented in the Stormwater Management Planning and Design Manual (MOE, 2003) based on existing aquatic habitats located downstream of the proposed development. The MOE's "Normal" protection level was selected as the water quality standard for the site for the following reasons:

- The receiving water body is an abandoned gravel pit and does not provide habitat sensitive to sediment or siltation, and
- The former gravel pit is located approximately 570 m west of the Thames River and discharges via exfiltration. Thus, any suspended sediment remaining in the stormwater that enters the pond will not be conveyed to the ultimate receiving watercourse.

1.2.2 Water Quantity Control

The UTRCA requires that post-development peak flows are controlled to pre-development levels for all storm events up to and including the 250-year storm.

1.2.3 Erosion Control

Erosion control storage is required on some sites to attenuate stormwater discharges to magnitudes that do not cause streambed or streambank erosion in the downstream receiving watercourse. However, since the proposed site does not include an outlet to a channel, no erosion control storage is recommended.

2.0 Existing Conditions

The subject site is a former aggregate extraction area based on Google Earth's spring 2018 aerial photography. Topographic mapping and hydrogeological conditions suggest that surface and groundwater from the site travel easterly through the Powell and Graham ponds on route to the Thames River. The catchment boundary of the subject site is illustrated in **Figure 2**.

2.1 Site Soils

Based on information presented in the site geotechnical report, site soils are comprised of coarse sand and gravel. Thus, soils are assumed to be highly permeable.

2.2 Pre-Development Hydrologic Modeling

A hydrologic model was developed to calculate the subject property's existing condition design peak discharges and volumes. Calculations were performed using the SWMHYMO hydrologic model and design storms developed from the City of London IDF curve for a 3-hour storm distribution. The following table summarizes the input parameters for the existing site.

Table 6 – City of London IDF Parameters

Parameter	25 mm	2-year	5-year	10-year	25-year	50-year	100-year	250-year
A	538.85	754.36	1183.74	1574.382	2019.372	2270.665	1619.363	3048.22
B	6.331	6.011	7.641	9.025	9.824	9.984	10.5	10.03
C	0.809	0.810	0.838	0.860	0.875	0.876	0.884	0.888

Table 7 – Pre-Development Conditions Hydrologic Parameters

Catchment ID	Drainage Area ¹ . (ha)	HSG ² .	C ³ .	T _c ⁴ . (min)	T _p ⁵ . (hours)
101	2.6	A	68	29	0.3

Notes:

1. Drainage area measured from available topographic mapping.
2. Hydrologic soil group selected based on information presented in the Middlesex County Soil Survey and the site geotechnical report.
3. CN estimated based on guidance presented in the Urban Hydrology for Small Watersheds (NRCS, 1986).
4. Time of Concentration calculated using the FAA equation.
5. Time to peak calculated and based on the time of concentration.
6. Initial abstraction based on values presented in Middlesex Centre Stormwater Management Policy Manual.

The following table summarizes the calculated runoff peak discharges and the corresponding model documentation in **Appendix A**.

Table 8 – Pre-Development Runoff Peak Flows

Design Event	Rainfall Depth (mm)	Runoff Depth (mm)	Peak Discharge (m ³ /s)
25 mm	23.54	2.49	0.02
2-year	32.8	5.26	0.03
5-year	44.3	9.72	0.07
10-year	52.2	13.33	0.09
25-year	61.6	18.18	0.13
50-year	68.8	22.22	0.16
100-year	76.0	26.43	0.19
250-year	86.8	33.2	0.25

3.0 Proposed Condition

A post-development drainage strategy for the proposed senior’s apartment development is illustrated in **Figure 3**. Drainage catchments are described below:

Catchment 201 – This catchment area comprises the proposed senior’s apartment development site. Minor flows from impervious areas are proposed to be collected and conveyed by a combination of low-impact development (LID) measures to perimeter infiltration galleries in landscaped areas. Similarly, major flows are conveyed as shallow surface flow towards perimeter infiltration galleries. Water quality treatment is proposed to be provided via a network of grassed waterways and shallow swales.

3.1 Post-Development Hydrologic Modeling

A hydrologic model was developed to calculate the post-development condition design peak discharges from the drainage area. Calculations were performed using the SWMHYMO hydrologic model and design storms developed from the City of London IDF curve for a 3-hour storm distribution. The post-development condition input parameters are summarized in the following table, and the corresponding supporting documentation is presented in **Appendix A**.

Table 9 – Post-Development Conditions Hydrologic Parameters

Catchment ID	Drainage Area ^{1.} (ha)	HSG ^{2.}	CN ^{3.}	TIMP ^{4.} (%)	XIMP ^{5.} (%)	I _a PER ^{6.} (mm)	I _a IMP ^{6.} (mm)
201	2.6	A	82	43	33	5	2
Notes:							
1. Drainage area measured from available topographic mapping.							
2. Hydrologic soil group selected based on information presented in the Middlesex County Soil Survey and the site geotechnical report.							
3. CN estimated based on guidance presented in the Urban Hydrology for Small Watersheds (NRCS, 1986).							
4. Total percent impervious measured from available site plan information.							
5. Directly connected percent impervious measured from available site plan information.							
6. Initial abstraction based on values presented in Middlesex Centre Stormwater Management Policy Manual.							

The following table summarizes the results of the calculations.

Table 10 – Post-Development Runoff Peak Flows

Design Event	Rainfall Depth (mm)	Runoff Depth (mm)	Peak Discharge (m ³ /s)	Storage Requirement (m ³)
25mm	23.5	10.85	0.17	202
2-year	32.8	17.34	0.26	280
5-year	44.3	26.20	0.39	383
10-year	52.2	32.67	0.47	459
25-year	61.6	40.69	0.60	532
50-year	68.8	47.01	0.70	592
100-year	76.0	53.32	0.84	651
250-year	86.8	66.06	1.072	798

3.2 Stormwater Quantity Control

3.2.1 Infiltration LID’s

Quantity control is proposed to be achieved using a combination of Best Management Practices (BMP’s) and LID technologies. Stormwater from impervious areas will be directed to perimeter infiltration galleries located within landscaped areas of the site where runoff will be infiltrated into the underlying coarse sand and gravel soils. Under static conditions, infiltration of the 250-year event is expected to cause the water level in the adjacent ponds to rise by

less than one millimetre. Details of the stormwater management strategy will be provided in conjunction with the detailed design of the site grading plan.

3.2.2 Rerouting of Existing Drains

Existing drainage channels serving lands upstream of the subject property are proposed to be realigned as open channels incorporated into the landscape design to provide adequate clearance from proposed buildings. Alternatively, channels may be rerouted via the extension of the existing pipe systems through the site to achieve the same objective.

3.4 Stormwater Quality Control

Water quality of site runoff will be improved via combination of Best Management Practices (BMP's) and LID technologies. Stormwater from impervious areas will be directed to perimeter grassed waterways and shallow swales where stormwater will be infiltrated into the underlying coarse sand and gravel soils. A water quality control calculation sheet is included in **Appendix B**.

3.5 Water Balance

Based on the information presented in the site geotechnical assessment, the groundwater table on the existing site is directly linked to the water levels in the existing abandoned gravel pit located to the south. The measured groundwater elevations suggest that under existing conditions, groundwater travels southward, into the existing gravel pit. Given the pervious nature of the local soils, this likely happens relatively rapidly.

The proposed site development involves the construction of approximately 50% impervious surface. While this will reduce the average annual infiltration volumes within the site limits, the local infiltration rates will be unaffected, since the additional surface runoff discharges to the abandoned gravel pit and infiltration LID's, which will remain hydraulically connected to the surrounding soils. Consequently, no water balance mitigation measures are proposed.

4.0 Conclusions and Recommendations

The analysis completed by LDS yields the following conclusions:

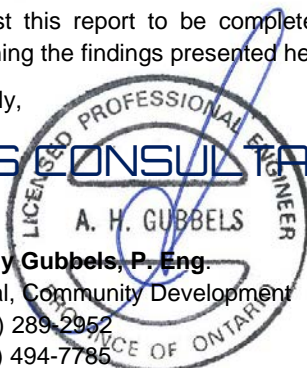
- Quantity control is provided via infiltration methods to attenuate post-development runoff to pre-development levels for all storm events up to and including the 250-year event; and
- Quality control to the normal level of protection is provided by the proposed stormwater management strategy, which includes a treatment train approach using grassed waterways and shallow swales to treat runoff from all impervious areas.

We trust this report to be complete and meet with your acceptance. However, should you have any questions concerning the findings presented herein, please do not hesitate to contact the undersigned.

Sincerely,

LDS CONSULTANTS INC.

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Luke Jesson, EIT.
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E: luke.jesson@LDSConsultants.ca

Z:\1614-00206 - 22447 KOMOKA ROAD, SENIOR'S APARTMENTS\PRELIMINARY DESIGN\ACAD\SWM DWG\LD-00206 LOCATION PLAN.DWG
2022-01-28 9:32:11 AM by: MATHEW.RUSSELL



22447 KOMOKA ROAD, KOMOKA
1571145 ONTARIO LIMITED

LOCATION PLAN

PROJECT: LD-00206

SCALE: N.T.S.

FIGURE 1

23-114-0006 - PRE-DEVELOPMENT CONDITIONS REPORT FOR 22447 KOMOKA ROAD, KOMOKA, ONTARIO
 2023-10-27 11:00 AM BY: [REDACTED]



LEGEND:

- - - PRE-DEVELOPMENT/EXISTING CATCHMENT AREA
- EXISTING OVERLAND FLOW ROUTE

STORM DRAINAGE AREA DATA:

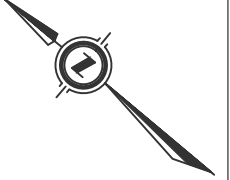
	C101	CATCHMENT ID
AREA (ha)	1.46	82
		IMPERVIOUS %

22447 KOMOKA ROAD, KOMOKA
1571145 ONTARIO LIMITED

PRE-DEVELOPMENT CONDITIONS

PROJECT: LD-00206 SCALE: 1:1500 **FIGURE 2**

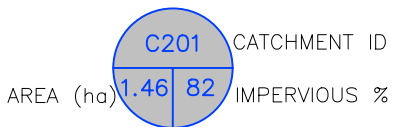
21/16/4-0006 - 22447 KOMOKA ROAD, SENNE'S APARTMENTS/RELIANT DESIGN/AD/03M DW/15-0008 PRE-POST CATCHMENTS REPORT FIGURE 3
202-22-91-27 2:26:53 PM BY: MATHIAS/SS/LL



LEGEND:

- - - - - POST-DEVELOPMENT CATCHMENT AREA
- EXISTING OVERLAND FLOW ROUTE
- PROPOSED OVERLAND FLOW ROUTE
- ULTIMATE OVERLAND FLOW ROUTE

STORM DRAINAGE AREA DATA:



22447 KOMOKA ROAD, KOMOKA
1571145 ONTARIO LIMITED

POST-DEVELOPMENT CONDITIONS

PROJECT: LD-00206 SCALE: 1:1000 FIGURE 3

APPENDIX A
QUANTITY CONTROL

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00001> =====
00002>
00003> SSSSS W W M M H H Y Y M M O O 999 999 =====
00004> S W W M M M H H Y Y M M O O 9 9 9 9
00005> SSSSS W W M M M H H H H Y Y M M O O ## 9 9 9 9 Ver 4.05
00006> S W W M M H H H Y Y M M O O 9999 9999 Sept 2011
00007> SSSSS W W M M H H Y Y M M O O 9 9 9 9 =====
00008> 9 9 9 9 # 4058874
00009> StormWater Management Hydrologic Model 999 999 =====
00010>
00011> *****
00012> ***** SWMMHYMO Ver/4.05 *****
00013> ***** A single event and continuous hydrologic simulation model *****
00014> ***** based on the principles of HYMO and its successors *****
00015> ***** OTHYMO-83 and OTHYMO-89. *****
00016> *****
00017> ***** Distributed by: J. F. Sabourin and Associates Inc. *****
00018> ***** Ottawa, Ontario: (613) 836-3884 *****
00019> ***** Gatineau, Quebec: (819) 243-6858 *****
00020> ***** E-Mail: swmhymo@jfesa.Com *****
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00022>
00023> *****
00024> ***** Licensed user: Land Development Solutions *****
00025> ***** London SERIAL#:4058874 *****
00026> *****
00027> *****
00028> *****
00029> ***** PROGRAM ARRAY DIMENSIONS *****
00030> ***** Maximum value for ID numbers : 30 *****
00031> ***** Max. number of rainfall points: 105408 *****
00032> ***** Max. number of flow points : 105408 *****
00033> *****
00034> *****
00035> *****
00036> ***** D E T A I L E D O U T P U T *****
00037> *****
00038> * DATE: 2022-01-26 TIME: 13:31:04 RUN COUNTER: 000680 *
00039> *****
00040> * Input filename: C:\SWMHYMO\projects\00206\Existing.dat *
00041> * Output filename: C:\SWMHYMO\projects\00206\Existing.out *
00042> * Summary filename: C:\SWMHYMO\projects\00206\Existing.sum *
00043> * User comments: *
00044> * 1: *
00045> * 2: *
00046> * 3: *
00047> *****
00048>
00049>
00050> 001:0001-----
00051> *****
00052> *# Project Name: [22447 Komoka Rd] Project Number: [LD-00206]
00053> *# Date : 26-01-2022
00054> *# Modeller : [AS]
00055> *# Company : Land Development Solutions Inc.
00056> *# License # : 4058874
00057> *****
00058>
00059> | START | Project dir.: C:\SWMHYMO\projects\00206\
00060> |-----| Rainfall dir.: C:\SWMHYMO\projects\00206\
00061> | TZERO = .00 hrs on 0
00062> | METOUT= 2 (output = METRIC)
00063> | NRUN = 001
00064> | NSTORM= 0
00065> |-----|
00066> 001:0002-----
00067> *****
00068> *****
00069> *# =====
00070> *# 22447 Komoka Rd
00071> *#
00072> *#
00073> *#
00074> *#
00075> *#
00076> *#
00077> *# 25mm Event
00078> *# =====
00079> *#
00080> *****
00081> *****
00082> | CHICAGO STORM | IDF curve parameters: A= 538.850
00083> | Ptotal= 23.54 mm | B= 6.331
00084> | C= 809
00085> |-----| used in: INTENSITY = A / (t + B)^C
00086>
00087> Duration of storm = 3.00 hrs
00088> Storm time step = 5.00 min
00089> Time to peak ratio = .33
00090>
00091> TIME RAIN TIME RAIN TIME RAIN TIME RAIN
00092> hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr
00093> .08 1.881 .83 10.955 1.58 5.429 2.33 2.467
00094> .17 2.056 .92 25.749 1.67 4.765 2.42 2.332
00095> .25 2.270 1.00 75.607 1.75 4.251 2.50 2.213
00096> .33 2.539 1.08 33.150 1.83 3.841 2.58 2.106
00097> .42 2.889 1.17 18.381 1.92 3.506 2.67 2.010
00098> .50 3.363 1.25 12.506 2.00 3.228 2.75 1.923
00099> .58 4.040 1.33 9.432 2.08 2.994 2.83 1.844
00100> .67 5.090 1.42 7.564 2.17 2.793 2.92 1.772
00101> .75 6.931 1.50 6.317 2.25 2.619 3.00 1.705
00102>
00103>
00104> 001:0003-----
00105> *****
00106> | CALIB NASHYD | Area (ha)= 2.60 Curve Number (CN)=68.00
00107> | 01:c101 DT= 1.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
00108> |-----| U.H. Tp(hrs)= .300
00109>
00110> Unit Hyd Qpeak (cms)= .331
00111>
00112> PEAK FLOW (cms)= .015 (i)
00113> TIME TO PEAK (hrs)= 1.467
00114> RUNOFF VOLUME (mm)= 2.490
00115> TOTAL RAINFALL (mm)= 23.543
00116> RUNOFF COEFFICIENT = .106
00117>
00118> (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00119>
00120>
00121> 001:0004-----
00122> *****
00123> | CALIB STANDHYD | Area (ha)= 2.60
00124> | 02:201 DT= 1.00 | Total Imp(%)= 43.00 Dir. Conn.(%)= 33.00
00125> |-----|
00126> IMPERVIOUS PERVIOUS (i)
00127> Surface Area (ha)= 1.12 1.48

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00128> Dep. Storage (mm)= 2.00 5.00
00129> Average Slope (%)= .50 2.00
00130> Length (m)= 45.00 20.00
00131> Mannings n = .013 .250
00132>
00133> Max.eff.Inten.(mm/hr)= 75.61 11.76
00134> over (min) 2.00 13.00
00135> Storage Coeff. (min)= 2.18 (ii) 13.14 (ii)
00136> Unit Hyd. Tpeak (min)= 2.00 13.00
00137> Unit Hyd. peak (cms)= .53 .09
00138>
00139> PEAK FLOW (cms)= .16 .03 *TOTALS*
00140> TIME TO PEAK (hrs)= 1.00 1.28 1.000
00141> RUNOFF VOLUME (mm)= 21.54 5.58 10.845
00142> TOTAL RAINFALL (mm)= 23.54 23.54 23.543
00143> RUNOFF COEFFICIENT = .92 .24 .461
00144>
00145> (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00146> CN* = 82.0 Ia = Dep. Storage (Above)
00147> (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00148> THAN THE STORAGE COEFFICIENT.
00149> (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00150>
00151>
00152> 001:0005-----
00153> *****
00154> COMPUTE VOLUME | DISCHARGE TIME
00155> ID:02 (201 ) | (cms) (hrs)
00156> START CONTROLLING AT .000 .650
00157> INFLOW HYD. PEAKS AT .167 1.000
00159> STOP CONTROLLING AT .015 2.192
00160>
00161> REQUIRED STORAGE VOLUME (ha.m.)= .0202
00162> TOTAL HYDROGRAPH VOLUME (ha.m.)= .0282
00163> % OF HYDROGRAPH TO STORE = 71.4634
00164>
00165> NOTE: Storage was computed to reduce the inflow
00166> peak to .015 (cms).
00167>
00168>
00169> 001:0006-----
00170> *****
00171> *****
00172> *# 2-year
00173> *# =====
00174> *#
00175> *#
00176>
00177> | CHICAGO STORM | IDF curve parameters: A= 754.360
00178> | Ptotal= 32.83 mm | B= 6.011
00179> | C= .810
00180> |-----| used in: INTENSITY = A / (t + B)^C
00181>
00182> Duration of storm = 3.00 hrs
00183> Storm time step = 5.00 min
00184> Time to peak ratio = .33
00185>
00186> TIME RAIN TIME RAIN TIME RAIN TIME RAIN
00187> hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr
00188> .08 2.595 .83 15.086 1.58 7.470 2.33 3.400
00189> .17 2.835 .92 35.781 1.67 6.558 2.42 3.216
00190> .25 3.130 1.00 108.068 1.75 5.852 2.50 3.052
00191> .33 3.500 1.08 46.214 1.83 5.289 2.58 2.905
00192> .42 3.981 1.17 25.395 1.92 4.829 2.67 2.773
00193> .50 4.632 1.25 17.229 2.00 4.447 2.75 2.653
00194> .58 5.563 1.33 12.980 2.08 4.125 2.83 2.544
00195> .67 7.005 1.42 10.407 2.17 3.849 2.92 2.444
00196> .75 9.536 1.50 8.691 2.25 3.610 3.00 2.353
00197>
00198>
00199> 001:0007-----
02000>
02001> | CALIB NASHYD | Area (ha)= 2.60 Curve Number (CN)=68.00
02002> | 01:c101 DT= 1.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
02003> |-----| U.H. Tp(hrs)= .300
02004>
02005> Unit Hyd Qpeak (cms)= .331
02006>
02007> PEAK FLOW (cms)= .034 (i)
02008> TIME TO PEAK (hrs)= 1.433
02009> RUNOFF VOLUME (mm)= 5.257
02010> TOTAL RAINFALL (mm)= 32.833
02011> RUNOFF COEFFICIENT = .160
02012>
02013> (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02014>
02015>
02016> 001:0008-----
02017> *****
02018> | CALIB STANDHYD | Area (ha)= 2.60
02019> | 02:201 DT= 1.00 | Total Imp(%)= 43.00 Dir. Conn.(%)= 33.00
02020> |-----|
02021> IMPERVIOUS PERVIOUS (i)
02022> Surface Area (ha)= 1.12 1.48
02023> Dep. Storage (mm)= 2.00 5.00
02024> Average Slope (%)= .50 2.00
02025> Length (m)= 45.00 20.00
02026> Mannings n = .013 .250
02027>
02028> Max.eff.Inten.(mm/hr)= 108.07 27.99
02029> over (min) 2.00 10.00
02030> Storage Coeff. (min)= 1.89 (ii) 9.64 (ii)
02031> Unit Hyd. Tpeak (min)= 2.00 10.00
02032> Unit Hyd. peak (cms)= .58 .12
02033>
02034> PEAK FLOW (cms)= .24 .07 *TOTALS*
02035> TIME TO PEAK (hrs)= 1.00 1.18 1.000
02036> RUNOFF VOLUME (mm)= 30.83 10.74 17.374
02037> TOTAL RAINFALL (mm)= 32.83 32.83 32.833
02038> RUNOFF COEFFICIENT = .94 .33 .529
02039>
02040> (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
02041> CN* = 82.0 Ia = Dep. Storage (Above)
02042> (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
02043> THAN THE STORAGE COEFFICIENT.
02044> (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02045>
02046>
02047> 001:0009-----
02048> *****
02049> COMPUTE VOLUME | DISCHARGE TIME
02050> ID:02 (201 ) | (cms) (hrs)
02051> START CONTROLLING AT .000 .552
02052> INFLOW HYD. PEAKS AT .256 1.000
02053> STOP CONTROLLING AT .034 1.811
02054>

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00255> REQUIRED STORAGE VOLUME (ha.m.)= .0280
00256> TOTAL HYDROGRAPH VOLUME (ha.m.)= .0452
00258> % OF HYDROGRAPH TO STORE = 62.0831
00259>
00260> NOTE: Storage was computed to reduce the Inflow
00261> peak to .034 (cms).
00262>
00263>-----
00264> 001:0010-----
00265> *#*****
00266> *#
00267> *# 5-year
00268> *# =====
00269> *#
00270> *#*****
00271>-----
00272> CHICAGO STORM IDF curve parameters: A=1183.740
00273> Ptotal= 44.28 mm B= 7.641
00274> C= .838
00275> used in: INTENSITY = A / (t + B)^C
00276>
00277> Duration of storm = 3.00 hrs
00278> Storm time step = 4.80 min
00279> Time to peak ratio = .33
00280>
00281> TIME RAIN TIME RAIN TIME RAIN TIME RAIN
00282> hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr
00283> .08 3.322 .88 52.462 1.68 8.043 2.48 3.754
00284> .16 3.656 .96 143.142 1.76 7.205 2.56 3.569
00285> .24 4.071 1.04 67.299 1.84 6.527 2.64 3.402
00286> .32 4.598 1.12 37.692 1.92 5.967 2.72 3.251
00287> .40 5.290 1.20 25.406 2.00 5.497 2.80 3.113
00288> .48 6.238 1.28 18.906 2.08 5.098 2.88 2.988
00289> .56 7.613 1.36 14.959 2.16 4.754 2.96 2.872
00290> .64 9.776 1.44 12.336 2.24 4.455 3.04 2.766
00291> .72 13.628 1.52 10.479 2.32 4.193
00292> .80 22.128 1.60 9.102 2.40 3.961
00293>
00294>-----
00295> 001:0011-----
00296>
00297> CALIB NASHYD Area (ha)= 2.60 Curve Number (CN)=68.00
00298> 01:c101 DT= 1.00 Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
00299> U.H. Tp(hrs)= .300
00300>
00301> Unit Hyd Qpeak (cms)= .331
00302>
00303> PEAK FLOW (cms)= .065 (i)
00304> TIME TO PEAK (hrs)= 1.380
00305> RUNOFF VOLUME (mm)= 9.716
00306> TOTAL RAINFALL (mm)= 44.282
00307> RUNOFF COEFFICIENT = .219
00308>
00309> (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00310>
00311>-----
00312> 001:0012-----
00313>
00314> CALIB STANDHYD Area (ha)= 2.60
00315> 02:201 DT= 1.00 Total Imp(%)= 43.00 Dir. Conn.(%)= 33.00
00316>
00317> IMPERVIOUS PERVIOUS (i)
00318> Surface Area (ha)= 2.00 5.00
00319> Dep. Storage (mm)= 2.00 5.00
00320> Average Slope (%)= .50 2.00
00321> Length (m)= 45.00 20.00
00322> Mannings n = .013 .250
00323>
00324> Max.eff.Inten.(mm/hr)= 143.14 53.27
00325> over (min)= 1.20 7.20
00326> Storage Coeff. (min)= 1.69 (ii) 7.68 (ii)
00327> Unit Hyd. Tpeak (min)= 1.20 7.20
00328> Unit Hyd. peak (cms)= .72 .15
00329>
00330> PEAK FLOW (cms)= .33 .14 .385 (iii)
00331> TIME TO PEAK (hrs)= 1.12 1.10 .960
00332> RUNOFF VOLUME (mm)= 42.28 18.32 26.227
00333> TOTAL RAINFALL (mm)= 44.28 44.28 44.282
00334> RUNOFF COEFFICIENT = .95 .41 .592
00335>
00336> (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00337> CN* = 82.0 Ia = Dep. Storage (Above)
00338> (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00339> THAN THE STORAGE COEFFICIENT.
00340> (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00341>
00342>-----
00343> 001:0013-----
00344>
00345> COMPUTE VOLUME
00346> ID:02 (201) DISCHARGE TIME
00347> (cms) (hrs)
00348> START CONTROLLING AT .000 .440
00349> INFLOW HYD. PEAKS AT .385 .960
00350> STOP CONTROLLING AT .065 1.579
00351>
00352> REQUIRED STORAGE VOLUME (ha.m.)= .0383
00353> TOTAL HYDROGRAPH VOLUME (ha.m.)= .0682
00354> % OF HYDROGRAPH TO STORE = 56.2283
00355>
00356> NOTE: Storage was computed to reduce the Inflow
00357> peak to .065 (cms).
00358>
00359>-----
00360> 001:0014-----
00361> *#*****
00362> *#
00363> *# 10-year
00364> *# =====
00365> *#
00366> *#*****
00367>-----
00368> CHICAGO STORM IDF curve parameters: A=1574.382
00369> Ptotal= 52.15 mm B= 9.025
00370> C= .860
00371> used in: INTENSITY = A / (t + B)^C
00372>
00373> Duration of storm = 3.00 hrs
00374> Storm time step = 4.80 min
00375> Time to peak ratio = .33
00376>
00377> TIME RAIN TIME RAIN TIME RAIN TIME RAIN
00378> hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr
00379> .08 3.646 .88 63.858 1.68 9.367 2.48 4.155
00380> .16 4.040 .96 164.489 1.76 8.333 2.56 3.937
00381> .24 4.531 1.04 81.516 1.84 7.500 2.64 3.740

00382> .32 5.160 1.12 46.280 1.92 6.816 2.72 3.563
00383> .40 5.994 1.20 31.103 2.00 6.245 2.80 3.402
00384> .48 7.147 1.28 22.969 2.08 5.761 2.88 3.256
00385> .56 8.836 1.36 18.011 2.16 5.347 2.96 3.122
00386> .64 11.520 1.44 14.719 2.24 4.989 3.04 2.999
00387> .72 16.341 1.52 12.396 2.32 4.676
00388> .80 27.001 1.60 10.680 2.40 4.400
00389>
00390>-----
00391> 001:0015-----
00392>
00393> CALIB NASHYD Area (ha)= 2.60 Curve Number (CN)=68.00
00394> 01:c101 DT= 1.00 Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
00395> U.H. Tp(hrs)= .300
00396>
00397> Unit Hyd Qpeak (cms)= .331
00398>
00399> PEAK FLOW (cms)= .092 (i)
00400> TIME TO PEAK (hrs)= 1.380
00401> RUNOFF VOLUME (mm)= 13.337
00402> TOTAL RAINFALL (mm)= 52.148
00403> RUNOFF COEFFICIENT = .256
00404>
00405> (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00406>
00407>-----
00408> 001:0016-----
00409>
00410> CALIB STANDHYD Area (ha)= 2.60
00411> 02:201 DT= 1.00 Total Imp(%)= 43.00 Dir. Conn.(%)= 33.00
00412>
00413> IMPERVIOUS PERVIOUS (i)
00414> Surface Area (ha)= 1.12 1.48
00415> Dep. Storage (mm)= 2.00 5.00
00416> Average Slope (%)= .50 2.00
00417> Length (m)= 45.00 20.00
00418> Mannings n = .013 .250
00419>
00420> Max.eff.Inten.(mm/hr)= 164.49 71.11
00421> over (min)= 1.20 7.20
00422> Storage Coeff. (min)= 1.60 (ii) 6.93 (ii)
00423> Unit Hyd. Tpeak (min)= 1.20 7.20
00424> Unit Hyd. peak (cms)= .75 .16
00425>
00426> PEAK FLOW (cms)= .38 .20 .466 (iii)
00427> TIME TO PEAK (hrs)= .96 1.08 .960
00428> RUNOFF VOLUME (mm)= 50.15 24.06 32.671
00429> TOTAL RAINFALL (mm)= 52.15 52.15 52.148
00430> RUNOFF COEFFICIENT = .96 .46 .627
00431>
00432> (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00433> CN* = 82.0 Ia = Dep. Storage (Above)
00434> (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00435> THAN THE STORAGE COEFFICIENT.
00436> (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00437>
00438>-----
00439> 001:0017-----
00440>
00441> COMPUTE VOLUME
00442> ID:02 (201) DISCHARGE TIME
00443> (cms) (hrs)
00444> START CONTROLLING AT .001 .420
00445> INFLOW HYD. PEAKS AT .466 .960
00446> STOP CONTROLLING AT .090 1.527
00447>
00448> REQUIRED STORAGE VOLUME (ha.m.)= .0459
00449> TOTAL HYDROGRAPH VOLUME (ha.m.)= .0849
00450> % OF HYDROGRAPH TO STORE = 54.0333
00451>
00452> NOTE: Storage was computed to reduce the Inflow
00453> peak to .090 (cms).
00454>
00455>-----
00456> 001:0018-----
00457> *#*****
00458> *#
00459> *# 25-year
00460> *# =====
00461> *#
00462> *#*****
00463>-----
00464> CHICAGO STORM IDF curve parameters: A=2019.372
00465> Ptotal= 61.59 mm B= 9.824
00466> C= .875
00467> used in: INTENSITY = A / (t + B)^C
00468>
00469> Duration of storm = 3.00 hrs
00470> Storm time step = 4.80 min
00471> Time to peak ratio = .33
00472>
00473> TIME RAIN TIME RAIN TIME RAIN TIME RAIN
00474> hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr
00475> .08 4.079 .88 76.933 1.68 10.925 2.48 4.676
00476> .16 4.540 .96 193.101 1.76 9.673 2.56 4.419
00477> .24 5.119 1.04 98.004 1.84 8.667 2.64 4.189
00478> .32 5.865 1.12 55.960 1.92 7.844 2.72 3.981
00479> .40 6.859 1.20 37.510 2.00 7.159 2.80 3.794
00480> .48 8.242 1.28 27.558 2.08 6.581 2.88 3.623
00481> .56 10.282 1.36 21.482 2.16 6.087 2.96 3.467
00482> .64 13.545 1.44 17.451 2.24 5.661 3.04 3.325
00483> .72 19.436 1.52 14.612 2.32 5.290
00484> .80 32.490 1.60 12.521 2.40 4.964
00485>
00486>-----
00487> 001:0019-----
00488>
00489> CALIB NASHYD Area (ha)= 2.60 Curve Number (CN)=68.00
00490> 01:c101 DT= 1.00 Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
00491> U.H. Tp(hrs)= .300
00492>
00493> Unit Hyd Qpeak (cms)= .331
00494>
00495> PEAK FLOW (cms)= .129 (i)
00496> TIME TO PEAK (hrs)= 1.380
00497> RUNOFF VOLUME (mm)= 18.185
00498> TOTAL RAINFALL (mm)= 61.593
00499> RUNOFF COEFFICIENT = .295
00500>
00501> (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00502>
00503>-----
00504> 001:0020-----
00505>
00506> CALIB STANDHYD Area (ha)= 2.60
00507> 02:201 DT= 1.00 Total Imp(%)= 43.00 Dir. Conn.(%)= 33.00
00508>

00509> IMPERVIOUS PERVIOUS (i)
00510> Surface Area (ha)= 1.12 1.48
00511> Dep. Storage (mm)= 2.00 5.00
00512> Average Slope (%)= .50 2.00
00513> Length (m)= 45.00 20.00
00514> Mannings n = .013 .250
00515>
00516> Max.eff.Inten.(mm/hr)= 193.10 99.90
00517> over (min) 1.20 6.00
00518> Storage Coeff. (min)= 1.50 (ii) 6.16 (ii)
00519> Unit Hyd. Tpeak (min)= 1.20 6.00
00520> Unit Hyd. peak (cms)= .78 .19
00521>
00522> *TOTALS*
00523> PEAK FLOW (cms)= .45 .28 .601 (iii)
00524> TIME TO PEAK (hrs)= .96 1.04 .960
00525> RUNOFF VOLUME (mm)= 59.59 31.38 40.690
00526> TOTAL RAINFALL (mm)= 61.59 61.59 61.593
00527> RUNOFF COEFFICIENT = .97 .51 .661
00528> (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00529> CN* = 82.0 Ia = Dep. Storage (Above)
00530> (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00531> THAN THE STORAGE COEFFICIENT.
00532> (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00533>
00534>
00535> 001:0021-----
00536>
00537> COMPUTE VOLUME DISCHARGE TIME
00538> ID:02 (201) (cms) (hrs)
00539>
00540> START CONTROLLING AT .000 .380
00541> INFLOW HYD. PEAKS AT .601 .960
00542> STOP CONTROLLING AT .130 1.448
00543>
00544> REQUIRED STORAGE VOLUME (ha.m.)= .0532
00545> TOTAL HYDROGRAPH VOLUME (ha.m.)= 1.0558
00546> % OF HYDROGRAPH TO STORE = 50.2931
00547>
00548> NOTE: Storage was computed to reduce the Inflow
00549> peak to .130 (cms).
00550>
00551>
00552> 001:0022-----
00553> *****
00554> # 50-year
00555> # *****
00556> # *****
00557> # *****
00558> # *****
00559> *****
00560> CHICAGO STORM IDF curve parameters: A=2270.665
00561> Ptotal= 68.84 mm B= 9.984
00562> C= .876
00563> used in: INTENSITY = A / (t + B)^C
00564>
00565> Duration of storm = 3.00 hrs
00566> Storm time step = 4.80 min
00567> Time to peak ratio = .33
00568>
00569>
00570> TIME RAIN TIME RAIN TIME RAIN TIME RAIN
00571> hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr
00572> .08 4.555 .88 86.091 1.68 12.247 2.48 5.225
00573> .16 5.073 .96 214.494 1.76 10.839 2.56 4.937
00574> .24 5.722 1.04 109.551 1.84 9.709 2.64 4.679
00575> .32 6.560 1.12 62.739 1.92 8.783 2.72 4.446
00576> .40 7.676 1.20 42.096 2.00 8.014 2.80 4.236
00577> .48 9.231 1.28 30.935 2.08 7.364 2.88 4.045
00578> .56 11.524 1.36 24.112 2.16 6.810 2.96 3.870
00579> .64 15.192 1.44 19.583 2.24 6.331 3.04 3.710
00580> .72 20.814 1.52 16.392 2.32 5.915
00581> .80 36.467 1.60 14.041 2.40 5.549
00582>
00583> 001:0023-----
00584>
00585> CALIB NASHYD Area (ha)= 2.60 Curve Number (CN)=68.00
00586> 01:c101 DT= 1.00 Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
00587> U.H. Tp(hrs)= .300
00588>
00589> Unit Hyd Qpeak (cms)= .331
00590>
00591> PEAK FLOW (cms)= .159 (i)
00592> TIME TO PEAK (hrs)= 1.360
00593> RUNOFF VOLUME (mm)= 22.228
00594> TOTAL RAINFALL (mm)= 68.844
00595> RUNOFF COEFFICIENT = .323
00596>
00597> (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00598>
00599>
00600> 001:0024-----
00601>
00602> CALIB STANDHYD Area (ha)= 2.60
00603> 02:201 DT= 1.00 Total Imp(%)= 43.00 Dir. Conn.(%)= 33.00
00604>
00605>
00606> IMPERVIOUS PERVIOUS (i)
00607> Surface Area (ha)= 1.12 1.48
00608> Dep. Storage (mm)= 2.00 5.00
00609> Average Slope (%)= .50 2.00
00610> Length (m)= 45.00 20.00
00611> Mannings n = .013 .250
00612>
00613> Max.eff.Inten.(mm/hr)= 214.49 119.88
00614> over (min) 1.20 6.00
00615> Storage Coeff. (min)= 1.44 (ii) 5.77 (ii)
00616> Unit Hyd. Tpeak (min)= 1.20 6.00
00617> Unit Hyd. peak (cms)= .80 .19
00618>
00619> *TOTALS*
00620> PEAK FLOW (cms)= .50 .35 .960 (iii)
00621> TIME TO PEAK (hrs)= .96 1.04 .960
00622> RUNOFF VOLUME (mm)= 66.84 37.24 47.010
00623> TOTAL RAINFALL (mm)= 68.84 68.84 68.844
00624> RUNOFF COEFFICIENT = .97 .54 .683
00625>
00626> (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00627> CN* = 82.0 Ia = Dep. Storage (Above)
00628> (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00629> THAN THE STORAGE COEFFICIENT.
00630> (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00631>
00632>
00633> 001:0025-----
00634>
00635> COMPUTE VOLUME DISCHARGE TIME
00636> ID:02 (201) (cms) (hrs)

00636> START CONTROLLING AT .037 .641
00637> INFLOW HYD. PEAKS AT .695 .960
00638> STOP CONTROLLING AT .160 1.417
00639>
00640> REQUIRED STORAGE VOLUME (ha.m.)= .0592
00641> TOTAL HYDROGRAPH VOLUME (ha.m.)= 1.222
00642> % OF HYDROGRAPH TO STORE = 48.4594
00643>
00644> NOTE: Storage was computed to reduce the Inflow
00645> peak to .160 (cms).
00646>
00647>
00648> 001:0026-----
00649> *****
00650> # 100-year
00651> # *****
00652> # *****
00653> # *****
00654> # *****
00655> *****
00656> CHICAGO STORM IDF curve parameters: A=2619.363
00657> Ptotal= 75.96 mm B= 10.500
00658> C= .884
00659> used in: INTENSITY = A / (t + B)^C
00660>
00661> Duration of storm = 3.00 hrs
00662> Storm time step = 4.80 min
00663> Time to peak ratio = .33
00664>
00665> TIME RAIN TIME RAIN TIME RAIN TIME RAIN
00666> hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr
00667> .08 4.890 .88 95.920 1.68 13.465 2.48 5.629
00668> .16 5.460 .96 234.925 1.76 11.886 2.56 5.310
00669> .24 6.179 1.04 121.830 1.84 10.620 2.64 5.026
00670> .32 7.108 1.12 70.130 1.92 9.586 2.72 4.770
00671> .40 8.350 1.20 47.047 2.00 8.726 2.80 4.538
00672> .48 10.086 1.28 34.503 2.08 8.003 2.88 4.328
00673> .56 12.655 1.36 26.820 2.16 7.386 2.96 4.136
00674> .64 16.775 1.44 21.718 2.24 6.854 3.04 3.961
00675> .72 24.231 1.52 18.125 2.32 6.392
00676> .80 40.720 1.60 15.480 2.40 5.987
00677>
00678>
00679> 001:0027-----
00680>
00681> CALIB NASHYD Area (ha)= 2.60 Curve Number (CN)=68.00
00682> 01:c101 DT= 1.00 Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
00683> U.H. Tp(hrs)= .300
00684>
00685> Unit Hyd Qpeak (cms)= .331
00686>
00687> PEAK FLOW (cms)= .191 (i)
00688> TIME TO PEAK (hrs)= 1.360
00689> RUNOFF VOLUME (mm)= 26.436
00690> TOTAL RAINFALL (mm)= 75.964
00691> RUNOFF COEFFICIENT = .348
00692>
00693> (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00694>
00695>
00696> 001:0028-----
00697>
00698> CALIB STANDHYD Area (ha)= 2.60
00699> 02:201 DT= 1.00 Total Imp(%)= 43.00 Dir. Conn.(%)= 33.00
00700>
00701>
00702> IMPERVIOUS PERVIOUS (i)
00703> Surface Area (ha)= 1.12 1.48
00704> Dep. Storage (mm)= 2.00 5.00
00705> Average Slope (%)= .50 2.00
00706> Length (m)= 45.00 20.00
00707> Mannings n = .013 .250
00708>
00709> Max.eff.Inten.(mm/hr)= 234.92 151.29
00710> over (min) 1.20 6.00
00711> Storage Coeff. (min)= 1.38 (ii) 5.33 (ii)
00712> Unit Hyd. Tpeak (min)= 1.20 6.00
00713> Unit Hyd. peak (cms)= .82 .22
00714>
00715> *TOTALS*
00716> PEAK FLOW (cms)= .55 .42 .941 (iii)
00717> TIME TO PEAK (hrs)= .96 1.02 .960
00718> RUNOFF VOLUME (mm)= 73.96 43.16 53.326
00719> TOTAL RAINFALL (mm)= 75.96 75.96 75.964
00720> RUNOFF COEFFICIENT = .97 .57 .702
00721>
00722> (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00723> CN* = 82.0 Ia = Dep. Storage (Above)
00724> (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00725> THAN THE STORAGE COEFFICIENT.
00726> (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00727>
00728>
00729> 001:0029-----
00730>
00731> COMPUTE VOLUME DISCHARGE TIME
00732> ID:02 (201) (cms) (hrs)
00733> START CONTROLLING AT .042 .643
00734> INFLOW HYD. PEAKS AT .841 .960
00735> STOP CONTROLLING AT .200 1.371
00736>
00737> REQUIRED STORAGE VOLUME (ha.m.)= .0651
00738> TOTAL HYDROGRAPH VOLUME (ha.m.)= 1.1386
00739> % OF HYDROGRAPH TO STORE = 46.9787
00740>
00741> NOTE: Storage was computed to reduce the Inflow
00742> peak to .200 (cms).
00743>
00744> 001:0030-----
00745> *****
00746> # 250-year
00747> # *****
00748> # *****
00749> # *****
00750> # *****
00751> *****
00752> CHICAGO STORM IDF curve parameters: A=3048.220
00753> Ptotal= 86.75 mm B= 10.030
00754> C= .888
00755> used in: INTENSITY = A / (t + B)^C
00756>
00757> Duration of storm = 3.00 hrs
00758> Storm time step = 4.80 min
00759> Time to peak ratio = .33
00760>
00761> TIME RAIN TIME RAIN TIME RAIN TIME RAIN
00762> hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr

00763>	.08	5.390	.88	110.202	1.68	14.951	2.48	6.210
00764>	.16	6.023	.96	278.018	1.76	13.183	2.56	5.857
00765>	.24	6.821	1.04	140.735	1.84	11.768	2.64	5.541
00766>	.32	7.854	1.12	79.810	1.92	10.614	2.72	5.257
00767>	.40	9.237	1.20	53.104	2.00	9.655	2.80	5.001
00768>	.48	11.172	1.28	38.743	2.08	8.849	2.88	4.768
00769>	.56	14.044	1.36	30.008	2.16	8.162	2.96	4.556
00770>	.64	18.667	1.44	24.234	2.24	7.571	3.04	4.362
00771>	.72	27.078	1.52	20.184	2.32	7.058		
00772>	.80	45.861	1.60	17.211	2.40	6.607		

00773>-----

00775> 001:0031-----

00776>-----

00777> | CALIB NASHYD | Area (ha)= 2.60 Curve Number (CN)=68.00

00778> | 01:c101 DT= 1.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00

00779>-----

00780> U.H. Tp(hrs)= .300

00781> Unit Hyd Opeak (cms)= .331

00782>-----

00783> PEAK FLOW (cms)= .247 (i)

00784> TIME TO PEAK (hrs)= 1.360

00785> RUNOFF VOLUME (mm)= 33.203

00786> TOTAL RAINFALL (mm)= 86.750

00787> RUNOFF COEFFICIENT = .383

00788>-----

00789> (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

00790>-----

00791> 001:0032-----

00792>-----

00794> | CALIB STANDHYD | Area (ha)= 2.66

00795> | 02:201 DT= 1.00 | Total Imp(%)= 43.00 Dir. Conn.(%)= 33.00

00796>-----

00797> IMPERVIOUS PERVIOUS (i)

00798> Surface Area (ha)= 1.14 1.52

00799> Dep. Storage (mm)= 2.00 5.00

00800> Average Slope (%)= .50 2.00

00801> Length (m)= 45.00 20.00

00802> Mannings n = .013 .250

00803>-----

00804> Max.eff. Inten.(mm/hr)= 278.02 194.18

00805> Storage Coeff. (min)= 1.20 4.80

00806> Unit Hyd. Tpeak (min)= 1.29 (ii) 4.86 (ii)

00807> Unit Hyd. Tpeak (min)= 1.20 4.80

00808> Unit Hyd. peak (cms)= .86 .23

00809>-----

00810> *TOTALS*

00811> PEAK FLOW (cms)= .67 .56 1.072 (iii)

00812> TIME TO PEAK (hrs)= .96 1.02 .960

00813> RUNOFF VOLUME (mm)= 84.75 52.38 63.061

00814> TOTAL RAINFALL (mm)= 86.75 86.75 86.750

00815> RUNOFF COEFFICIENT = .98 .60 .727

00816>-----

00817> (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

00818> CN* = 82.0 Ia = Dep. Storage (Above)

00819> (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL

00820> THAN THE STORAGE COEFFICIENT.

00821> (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

00822>-----

00823> 001:0033-----

00824>-----

00825> | COMPUTE VOLUME |

00826> | ID:02 (201) | DISCHARGE TIME

00827>-----

00828> START CONTROLLING AT .047 .640

00829> INFLOW HYD. PEAKS AT 1.072 .960

00830> STOP CONTROLLING AT .250 1.350

00831>-----

00832> REQUIRED STORAGE VOLUME (ha.m.)= .0798

00833> TOTAL HYDROGRAPH VOLUME (ha.m.)= .1677

00834> % OF HYDROGRAPH TO STORE = 47.5732

00835>-----

00836> NOTE: Storage was computed to reduce the Inflow

00837> peak to .250 (cms).

00838>-----

00839>-----

00840> 001:0034-----

00841> FINISH

00842>-----

00843>*****

00844> WARNINGS / ERRORS / NOTES

00845>-----

00846> Simulation ended on 2022-01-26 at 13:31:05

00847>-----

00848>-----

00849>-----

Conceptual Infiltration LIDs		
Design Storm Runoff Volume	798	m ³
Contact Area for Infiltration of Runoff Volume (L x W)	754	m ²
Height of One Infiltration Basin	0.3	m
Void Ratio of Basin	0.35	
Potential Bottom Area of Infiltration LID's	2800	m ²
Percolation Rate (refer to notes)	63	mm/hr
Number of Galleries Proposed in Block	4	
Total Available Storage Volume	1554	m ³
Drawdown Time (refer to notes)	48	hr
<p>Notes:</p> <ol style="list-style-type: none"> 1. Infiltration rate determined using site specific geotechnical investigation. 2. Drawdown time recommended by the MOE Stormwater Planning and Design Manual (MOE, 2003). 3. Bottom area of infiltration LID footprint measured in AutoCAD. 		

APPENDIX B
QUALITY CONTROL

Table 3.2 Water Quality Storage Requirements Base On Receiving Waters (from MOE Stormwater Management Planning and Design Manual, March 2003)					
Protection Level	SWMP Level	Storage Volume (m ³ /ha) for Impervious Level			
		35%	55%	70%	85%
<i>Enhanced</i> 80% long-term S.S removal	Infiltration	25	30	35	40
	Wetlands	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
<i>Normal</i> 70% long-term S.S removal	Infiltration	20	20	25	30
	Wetlands	60	70	80	9
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
<i>Basic</i> 60% long-term S.S removal	Infiltration	20	20	20	20
	Wetlands	60	60	60	60
	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

Level of Water Quality Control

Enhanced 70% long-term S.S. removal

Unit Storage Volume Requirement (m³/ha)

20

Type of Facility
Storage Volume Requirement (m³)

53.0

Catchment Area (ha)

2.65

Imperviousness (%)

51