GREER GALLOWAY
CONSULTING ENGINEERS

2285 Battersea Road
Stormwater Management Report

October 2018

Prepared for:

BPE Development
141 Hickson Avenue
Kingston, Ontario
K7K 2N7

Submitted by:

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Project No.: 18-5-6085

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1.0 Introduction

The Greer Galloway Group was retained by BPE Development to prepare a stormwater management report for a proposed site development. The development is located at 2285 Battersea Road in Kingston, ON, as shown in Figure 1. The proposed development includes the construction of a several new commercial buildings including: rental cabins, event venue, spa, boutique hotel and a bar/lounge area, two new entrances to Unity Road and Battersea Road respectively, and two new parking lots on the east side of the property. There are several existing buildings on site that will remain as part of the new development. The proposed site plan in included in Appendix A.

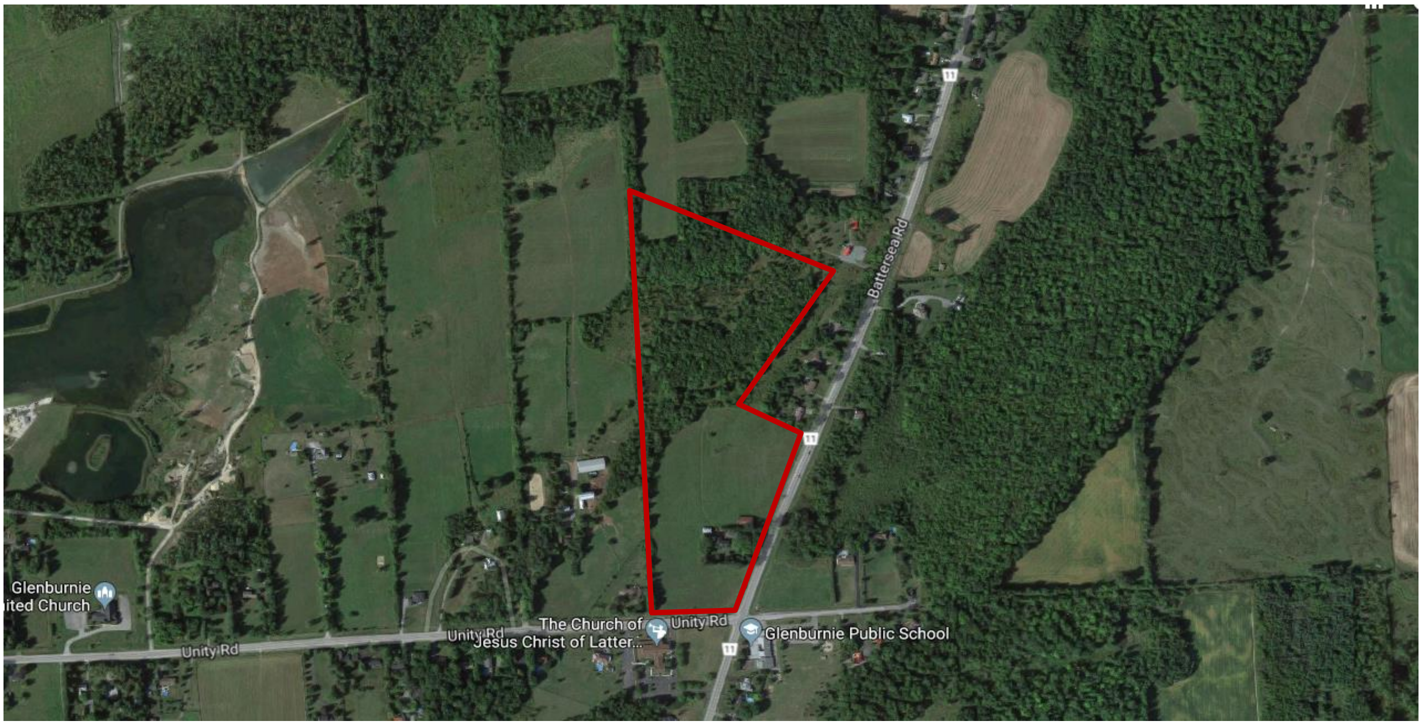


Figure 1: Site Location

1.1 Scope of Report

This Stormwater Management Report is intended to examine the effects of the proposed redevelopment on stormwater runoff conditions on the site. The report has considered existing and post construction conditions and has presented a stormwater management design that will maintain "pre-development" conditions on site after development.

1.2 Background Data

Background data pertaining to the site was provided by BPE Development and the City of Kingston. This information was used to complete the detailed stormwater management design. The background data is summarized below.

1.2.1 Survey/Site Layout

A detailed topographic survey was completed by Greer Galloway and used to interpret the watershed boundaries and complete the site grading plan. The site plan is included in Appendix A.

1.2.2 Geotechnical Information

A test pit investigation was performed by ASC Environmental. This information was used to confirm soil type. The test pit logs are included in Appendix C.

1.3 Standards and Guidelines

The following standards and guidelines were consulted:

- Stormwater Management Practices Planning and Design Manual - Ministry of the Environment, 2003;
- MTO Drainage Management Manual – Ministry of Transportation, 1997;
- Site Plan Control Guidelines – The City of Kingston, 2009;
- Urban Hydrology for Small Watershed TR-55 Manual – United States Department of Agriculture, 1986

1.4 Design Criteria

The design criteria for the stormwater management design are based on the requirements of Cataraqui Region Conservation Authority (CRCA), the Ministry of the Environment (MOE) and the City of Kingston. The key design criteria are summarized below:

- The development has been identified as requiring Level 2 (Normal) treatment as per the CRCA and the City of Kingston.
- The stormwater management system shall be designed to ensure that the post-development flows are equivalent to or less than the pre-development peak flows.
- Sediment transference and erosion is to be mitigated during and after construction of the proposed site development.

2.0 Existing Conditions

The subject site is located at 2285 Battersea Road, Kingston, Ontario. The site has approximately 295m of road frontage on Battersea Road, and approximately 155m of road frontage on Unity Road. The site consists of two properties, the south lot has an approximate size of 7.0ha and contains existing single-family dwelling and barn. These existing building will be incorporated into the new development. The remainder of this lot is primarily grassed open field. The north lot has an approximate size of 6.8ha and consists mainly of wooded area. The development site is shown in Figure 1 below.

2.1 Existing Drainage Patterns

The properties surrounding the site consist primarily of either open fields or single family- residential properties. There is no contributing flow from northwest of the site, as the property borders the watershed that drains to Collins Lake. The site, and the properties directly north of the site, are part of the watershed area for an unnamed tributary of River Styx. Drainage is facilitated primarily via roadside ditches, there is no stormwater infrastructure in this area. There is a cross culvert located south of Unity road that facilitates flow from the properties west of Battersea Road. The analysis of the proposed development has been limited to the development site itself, as it is assumed the adjacent properties do not contribute any significant stormwater runoff.

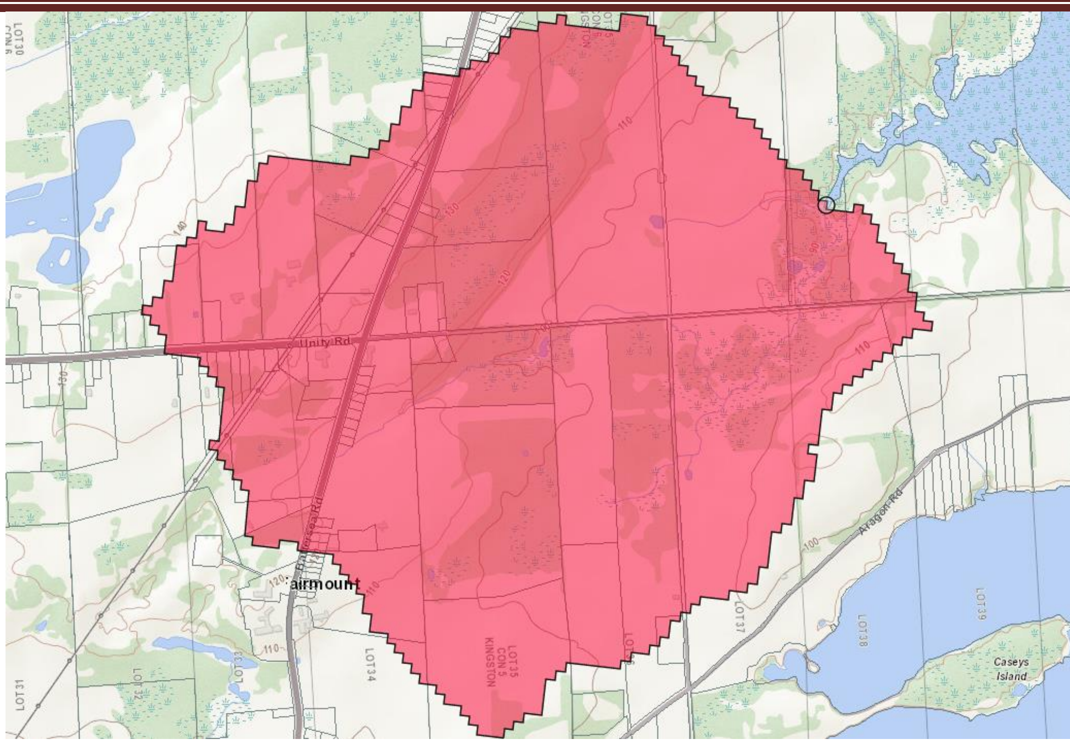


Figure 2: Watershed for unnamed tributary to River Styx

Under existing conditions, the entirety of the site sheet drains to a roadside ditch along Battersea Road. The ditch drains via cross culvert beneath Unity Road, and outlets to another cross culvert approximately 400m south of the site. Pre-Development drawings are included in Appendix A.

2.2 Existing Soil Conditions

According to the test pit investigation completed by ASC Environmental, the development site consists of mostly sandy silt, which falls in hydrologic soil group B. The depth to bedrock ranges from 1.5m to 0.5m across the site. The test pit log is included in Appendix C.

2.3 Summary of Existing Catchments

The individual catchment properties are listed in Table 1.

Table 1: Summary of Post-Development Catchment Properties

Catchment	Area (ha)	CN	% Impervious
101	7.00	65	2

The Soil / land use curve numbers (CN) have been taken from the Ministry of Transportation Drainage Management Manual – Design Chart 1.08: Hydraulic Soil Groups and Design Chart 1.09: Soil/Land Use Curve Numbers and the Urban Hydrology for Small Watersheds TR-55 Manual Table 2-2a: Runoff Curve Numbers for Urban Areas.

3.0 Proposed Development

The proposed development includes the construction of several buildings including: an addition to the existing house and a new building for the hotel, outdoor washroom facilities, an event building, a vineyard building and 39 rental cabins. Also included in the design plans are the addition of gravel roads and parking lots. The remaining footprint will consist of cultivated vineyard and landscaped/grass areas. Post Development Drawings are included in Appendix A.

The proposed development is to be constructed in two Phases. Phase 1 encompasses the development of the south lot. The proposed construction plan for Phase 1 includes the construction of the proposed event buildings, parking lot, 15 cabins, and the proposed roadway. Phase 2 stormwater management will be discussed in a sperate document.

The construction of the new development will alter the existing land cover composition of the property. There will be an overall increase in the impervious surfaces.

3.1 Post-Development Drainage Patterns

The proposed site and grading plan will divide Phase 1 into four (4) catchment areas. All catchment areas will ultimately drain into the roadside ditch along Battersea Road. Post-Development drawings are included in Appendix A.

The south lot, which consists of the majority of the buildings and parking lots, will drain to the roadside ditch via an outlet at the corner of Battersea Road and Unity Road. Runoff will be conveyed to this outlet through sheet flow, swale and a catch basin system. A wet pond will be constructed in the southeast corner of the site for stormwater storage. An outlet control will be implemented at the outlet of the pond to control flow quantities.

Area 201 is comprised of the northern part of Phase 1. The 3.32 ha site includes a portion of the vineyard area, several cabins and a portion of the proposed roadway. This area will drain south to the catch basin system, via grassed conveyance swale and overland sheet flow and outlet to the wet pond.

Area 202 is comprised of the central portion of the site. This 1.12 ha area consists of the several of the proposed event buildings, cabins, and gravel roadway. Runoff will drain to the catch basin system via grassed conveyance swales and overland sheet flow and outlet to the proposed wet pond.

Area 203 consists of 0.51 ha area that includes the gravel parking area, and the existing driveway, which will drain via overland sheet flow to the catch basin system and outlet to the wet pond.

Area 204 comprises 2.05 ha of the southern portion of the site. This area consists primarily of vineyard area, the existing house and several proposed event buildings. Also included in this area is a portion of the proposed road and several cabins. Runoff will drain via overland sheet flow to the wet pond.

Phase 1 shall be graded such that all of the site runoff is directed towards the wet pond area, before it exits the site to the existing roadside ditch at the southeast corner of the property.

3.2 Summary of Post-Development catchments

The individual catchment properties are listed in Table 2.

Table 2: Summary of Post-Development Catchment Properties			
Catchment	**Area (ha)**	**CN**	**% Impervious**
201	3.32	71	15
202	1.12	77	31
203	0.51	92	82
204	2.05	73	18
205	6.79	65	16

4.0 Hydrologic Modelling

Hydraulic modelling was completed using HEC-HMS to simulate the storage requirements for the property. The modelling was completed using HEC-HMS, created by the US Army Corps of Engineers. This software simulates the precipitation and runoff processes of watersheds.

4.1 Design Storms

The SCS Type II storm was chosen as the design storm for this model. This storm provides a peak intensity that is suitable for sizing conveyance methods in urban settings and provides rainfall volumes that are suitable for sizing storage elements. This design storm has a distribution with extremely large peak intensities and produces a large amount of runoff in a short duration. The SCS Type II distribution was applied to intensity-duration-frequency (IDF) data provided by the MTO. The IDF data is included in Appendix B. The resulting rainfall hyetographs were used as storm files in the HEC-HMS hydrological models. All design storms were synthesized using a ten-minute time step as per standard practice.

Table 3: Summary of SCS Type II Design Storm

Design Storm	Total Rainfall (mm)
2 Year	52.8
5 Year	72.0
10 Year	84.0
25 Year	98.4
50 Year	108.0
100 Year	120.0

4.2 Model Inputs

Runoff coefficients were taken from the City of Kingston Guidelines and the DMM as noted below:

- Asphalt, concrete, roof areas 0.90
- Grassed area, parkland 0.25
- Wooded 0.25
- Gravel 0.90

Gravel was treated as asphalt to account for the potential for paving these areas in the future when considering required runoff storage volumes.

The composite runoff coefficients were used to calculated Time of Concentration for each of the post-development catchment areas. Time of Concentration (T_c) values; have been calculated using the Airport, Bransby-Williams and Kirpich Formulas to provide a range of values. From these, an appropriate time has been determined based on the site conditions. Time to Peak values have been estimated as 2/3 the calculated Time of Concentration.

4.3 Pre-Development Runoff

The peak runoff flows from the pre-development catchment area as determined using HEC-HMS are summarized in Table 4. The HEC-HMS model output is included in Appendix B.

Table 4: Summary of Pre-Development Peak Flows						
Design Storm SCS Type II	Peak Flow (m^3/s)					
	2 Year 24 Hr	5 Year 24 Hr	10 Year 24 Hr	25 Year 24 Hr	50 Year 24 Hr	100 Year 24 Hr
Catchment #101	0.0277	0.1033	0.1913	0.2665	0.3380	0.4339

4.4 Post-Development Runoff

The peak runoff flows from the post-development catchment areas as determined using HEC-HMS are summarized in Table 5. The HEC-HMS model output is included in Appendix B.

Table 5: Summary of Post Development Peak Flows - Uncontrolled						
Design Storm SCS Type II	Peak Flow (m^3/s)					
	2 Year 24 Hr	5 Year 24 Hr	10 Year 24 Hr	25 Year 24 Hr	50 Year 24 Hr	100 Year 24 Hr
Catchment #201	0.0799	0.1573	0.2138	0.2869	0.3381	0.4043
Catchment #202	0.0369	0.0698	0.0930	0.1227	0.1435	0.1701
Catchment #203	0.0459	0.0659	0.0786	0.0940	0.1043	0.1171
Catchment #204	0.0665	0.1232	0.1630	0.2141	0.2496	0.2952

The table below summarizes the difference in pre-development and uncontrolled post-development peak flows for Phase 1. As illustrated in the table, post-development flows increase due to the increase in impervious area.

Table 6: Phase 1 Change in Peak Flow – Pre vs. Post (Uncontrolled)						
Design Storm SCS Type II	Net Change in Peak Flow (m^3/s)					
	2 Year 24 Hr	5 Year 24 Hr	10 Year 24 Hr	25 Year 24 Hr	50 Year 24 Hr	100 Year 24 Hr
Pre-Development	0.0277	0.1033	0.1939	0.2665	0.3380	0.4339
Post-Development	0.2292	0.4162	0.5484	0.7177	0.8355	0.9866
Change	+ 0.2015	+ 0.3129	+ 0.3545	+ 0.4512	+ 0.4975	+ 0.5527

5.0 Stormwater Quantity Control and Quality Treatment

There is an overall increase in runoff between pre-and post-development conditions due to an increase in impervious surfaces. The increase in peak runoff must be controlled such that the post development peak flows are equal to or less than pre-development peak runoff flows. In addition, Normal Treatment Level for stormwater runoff is required.

5.1 Stormwater Quantity Treatment

As per the recommendation of the CRCA in the Pre-Application report, storage will be facilitated via surface stormwater management facilities in order to maintain the hydrologic cycle and provide opportunity for groundwater recharge. Stormwater design calculations are included in Appendix B of this report.

The storage discharge relationship for the active storage in the proposed wet pond is summarized in the table below. The pond will have a permanent pool elevation of 124.75m, a max extended detention water level of 126.60m and a 0.3m freeboard (126.90m). The proposed pond will provide an approximate maximum storage of 2789m^3 and a corresponding peak flow of 0.370m^3/s at an elevation of 126.60m. The 100-year event produces a maximum storage requirement of 2042m^3 which corresponds to an approximate elevation of 126.30m and a peak flow rate of 0.317m^3/s. The pond will have a 75mm quality orifice outlet and a 400mm quantity control orifice. Details regarding the construction of the outlet structure are included in Appendix B.

Table 7: Proposed Wet Pond Storage Discharge Properties		
Elevation (m)	Discharge (m^3/s)	Extended Storage (m^3)
124.75	0.000	0
124.80	0.001	105
124.90	0.003	162
125.00	0.005	276
125.10	0.006	394
125.20	0.007	517
125.30	0.008	645
125.40	0.014	778
125.50	0.036	915
125.60	0.082	1058
125.70	0.158	1206
125.80	0.197	1359
125.90	0.226	1518
126.00	0.252	1682
126.10	0.275	1851
126.20	0.296	2027
126.30	0.317	2208
126.40	0.335	2396
126.50	0.353	2589
126.60	0.370	2789

Tables 8 and 9 summarize the controlled post development flows and net change in pre-development and post-development controlled peak flows.

Table 8: Summary of Post Development Peak Flows - Controlled						
Design Storm SCS Type II	Design Storm SCS Type II Peak Flow (m^3/s)					
	2 Year 24 Hr	5 Year 24 Hr	10 Year 24 Hr	25 Year 24 Hr	50 Year 24 Hr	100 Year 24 Hr
Catchment #201	0.0799	0.1573	0.2138	0.2869	0.3381	0.4043
Catchment #202	0.0564	0.0923	0.1165	0.1466	0.1672	0.1934
Catchment #203	0.0531	0.0735	0.0862	0.1015	0.1117	0.1244
Catchment #204	0.0665	0.1232	0.1630	0.2141	0.2496	0.2953
Pond	0.0207	0.0985	0.1721	0.2295	0.2616	0.2977

Table 9: Change in Peak Flow – Pre vs. Post (Controlled)						
Design Storm SCS Type II	**Peak Flow (m^3/s)**					
	2 Year 24 Hr	**5 Year 24 Hr**	**10 Year 24 Hr**	**25 Year 24 Hr**	**50 Year 24 Hr**	**100 Year 24 Hr**
Pre-Development	0.0277	0.1033	0.1913	0.2665	0.3380	0.4339
Post-Development	0.0207	0.0985	0.1721	0.2295	0.2616	0.2977
Change	-0.0070	-0.0048	-0.0192	-0.0370	-0.0764	-0.1362

Table 10 summarizes the required extended detention to provide quantity control for the 2-year through 100-year storm event.

Table 10: Required Extended Detention	
Design Storm	**Storage (m^3)**
2 Year	820
5 Year	1090
10 Year	1261
25 Year	1539
50 Year	1753
100 Year	2042

5.2 Stormwater Quality Treatment

MOECC wet pond quality volume requirements and proposed pond volumes are listed in Table 11. MOECC requirements are base on the extrapolation of the values provided in Table 3.2 of the MOE Stormwater Planning and Design Manual. Protection volumes were calculated based on an impervious level of 23% and a development area of 7.0 ha.

Table 11: MOE Wet Pond Volume Requirements and Proposed Wet Pond Volumes				
Volume Requirements	**MOE Requirement Enhanced (m^3)**	**MOE Requirement Normal (m^3)**	**Provided (m^3)**	**Comment**
Total Storage	749	514	3608*	MOE requirements exceeded
Permanent Pool Storage	469	234	819	MOE requirements exceeded
Extended Storage	280	280	2789*	MOE requirements exceeded

The pond exceeds the required Level 2 (Normal) Level of treatment and achieves Level 1 (Enhanced) quality treatment. A drawdown time of 12 hours was used as the 24-hour drawdown time resulted in a conflict with the minimum orifice size. The proposed permanent pool storage for the pond exceeds the required storage for quality control. Should the developer choose to deepen the permanent pool area of the pond, it will have no effect on the stormwater management capabilities.

5.3 Major and Overland Flows

Stormwater quantity control shall be provided by storage in a stormwater management pond. Enhanced swales which convey stormwater to the catch basin system in the parking lot have been sized for the 100-year event. The stormwater pipes have been sized to convey the 10-year storm flows. Therefore, major flow routes will be over the entryway for Catchments 201-203. Catchment 204 conveyance route will remain overland sheet flow.

6.0 Maintenance

As per the MOE Stormwater Management Planning and Design Manual For the first two years of operation, the stormwater management system shall be inspected after every significant storm to ensure proper functionality (approximately four times per year). Subsequently the system should be inspected annually in order to identify potential maintenance issues. The landowner shall be responsible for all future on-site inspection and maintenance requirements. Potential maintenance and inspection activities for the stormwater management system include:

- **Vegetation Conditio**n – Annual weed control, including the removal of invasive species. Vegetation in a swale should be trimmed yearly to prevent takeover by woody species. Weed removal should be done by hand, without the use of herbicides. Grass should be maintained and kept at a height of approximately 150mm.
- **Obstruction Removal –** Obstructions and garbage should be cleaned from all swales, detention area and the outlet structure.
- **Swales –** Swales would be inspected regularly for signs of erosion. Any areas where erosion has occurred should be infilled and vegetated immediately.
- **Outlet Structure –** outlet structure should be inspected for blockages, concrete cracks and outlet erosion. All blockages, cracks and outlet erosion should be repaired immediately to ensure proper function of the outlet structure.
- **Pond embankments –** The pond embankments should be inspected annually to confirm no groundwater seeps or slope failure.

It is expected that the need for major sediment removal will be very infrequent. Based on Figure 6.1 of the MOE Stormwater Planning and Management Design Manual, at 35% impervious sediment removal frequency is approximately every 45 years.

7.0 Erosion Control

During construction, a combination of light duty filter cloth, straw bale check dams, and other common measures will be applied to contain construction related suspended solids and other materials within the disturbed areas. All disturbed areas are to be bordered by light duty filter cloth, and straw bales or rip rap check dams are to be used where flows are concentrated. Only areas strictly required to proceed with construction will be stripped. Vegetated surfaces will be established as rapidly as possible, and the physical barriers noted above will be continuously maintained until the vegetative cover is suitably established. Filter fabric will be placed under the grate of the catch basin structures until natural surfaces are restored. The proposed stormwater management measures will be established prior to any other construction to provide runoff treatment and detention.

8.0 Conclusions and Recommendations

Based on the stormwater analysis described in this report, The Greer Galloway Group Inc. draws the following conclusions and recommendations regarding the impact of the proposed development at 2285 Battersea Road:

- Uncontrolled post-development flow will be greater than pre-development flows due to changes in surface cover.
- The proposed stormwater management design provides the required storage and outlet control to maintain post-development flows at pre-development flow rates for all storm events up to a 100-year storm.
- The proposed stormwater storage pond has the capacity to store runoff from Phase 1 for up to a 100-year storm event with a maximum water elevation of 126.30.

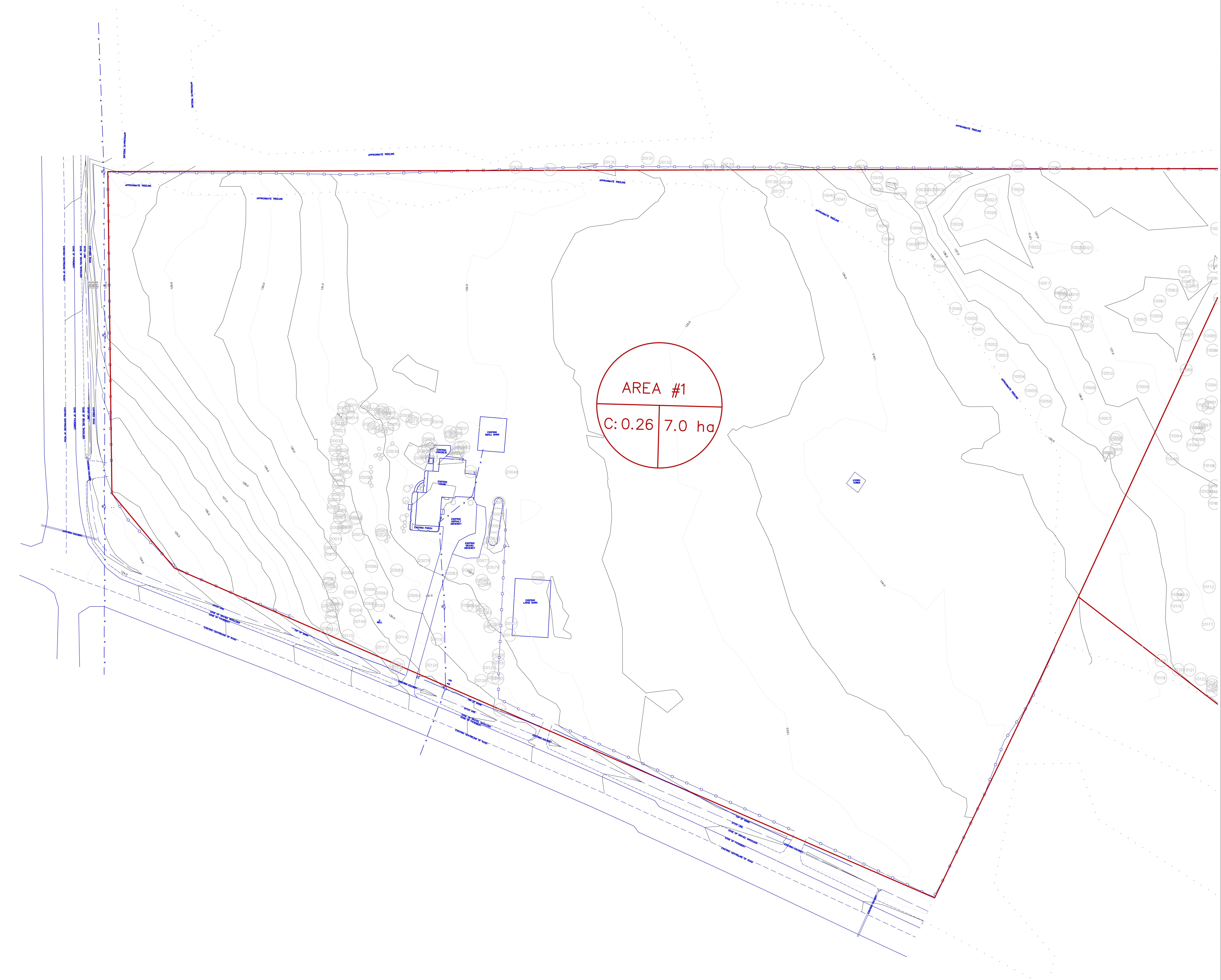
- Permanent water quality protection (enhanced level) will be provided by the proposed wet pond to all stormwater runoff.

Respectfully Submitted,

Leah Wells, E.I.T.
THE GREER GALLOWAY GROUP INC.
ENGINEERS AND PLANNERS

Kevin Hawley, P.Eng.
THE GREER GALLOWAY GROUP INC.
ENGINEERS AND PLANNER

Appendix A
Drawings



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NOTES:

1. ALL WORK SHALL BE IN ACCORDANCE WITH RELEVANT CODES AND GUIDELINES.
2. ALL DRAWINGS AND ADDENDA ARE TO BE READ AS, AND IN CONJUNCTION WITH THE SPECIFICATIONS.
3. ALL EQUIPMENT SHALL BE INSTALLED AS SPECIFIED OR APPROVED EQUIVALENT.
4. CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS BEFORE PROCEEDING WITH WORK AND BE RESPONSIBLE FOR SAME.
5. CONTRACTOR MUST REPORT ANY DISCREPANCIES TO ENGINEER FOR RESOLUTION BEFORE COMMENCING THE WORK.
6. ANY CHANGES MUST BE APPROVED BY THE ENGINEER.

A DETAIL NO.
B DRAWING NO. – WHERE DETAILED

LEGEND

NORTH

STAMP

PROJECT
UNITY INN & SPA
2885 BATTERSEA ROAD
KINGSTON, ONTARIO

DRAWING TITLE
PRE DEVELOPMENT
STORMWATER

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04		
03		
02		
01	ISSUED FOR REVIEW	06/20/18
REVISION		DATE

DESIGNED BY

DRAWN BY

REVIEWED BY

APPROVED BY

PROJECT DATE
01/06/18
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PROJECT #
18-5-6085

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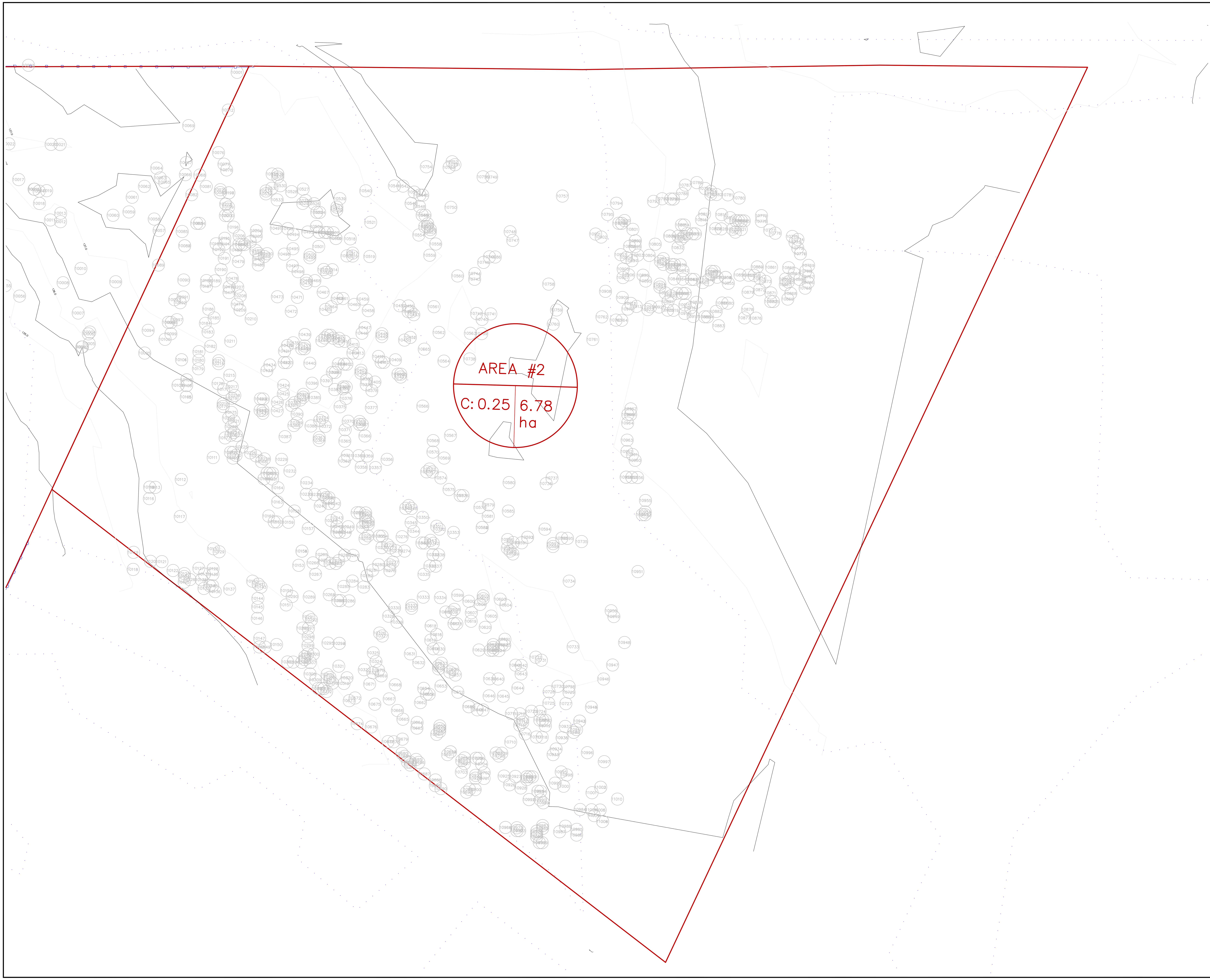

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DESIGNED BY

DRAWN BY

REVIEWED BY

APPROVED BY

PROJECT DATE
01/06/18 (DD/MM/YYYY)

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18-5-6085

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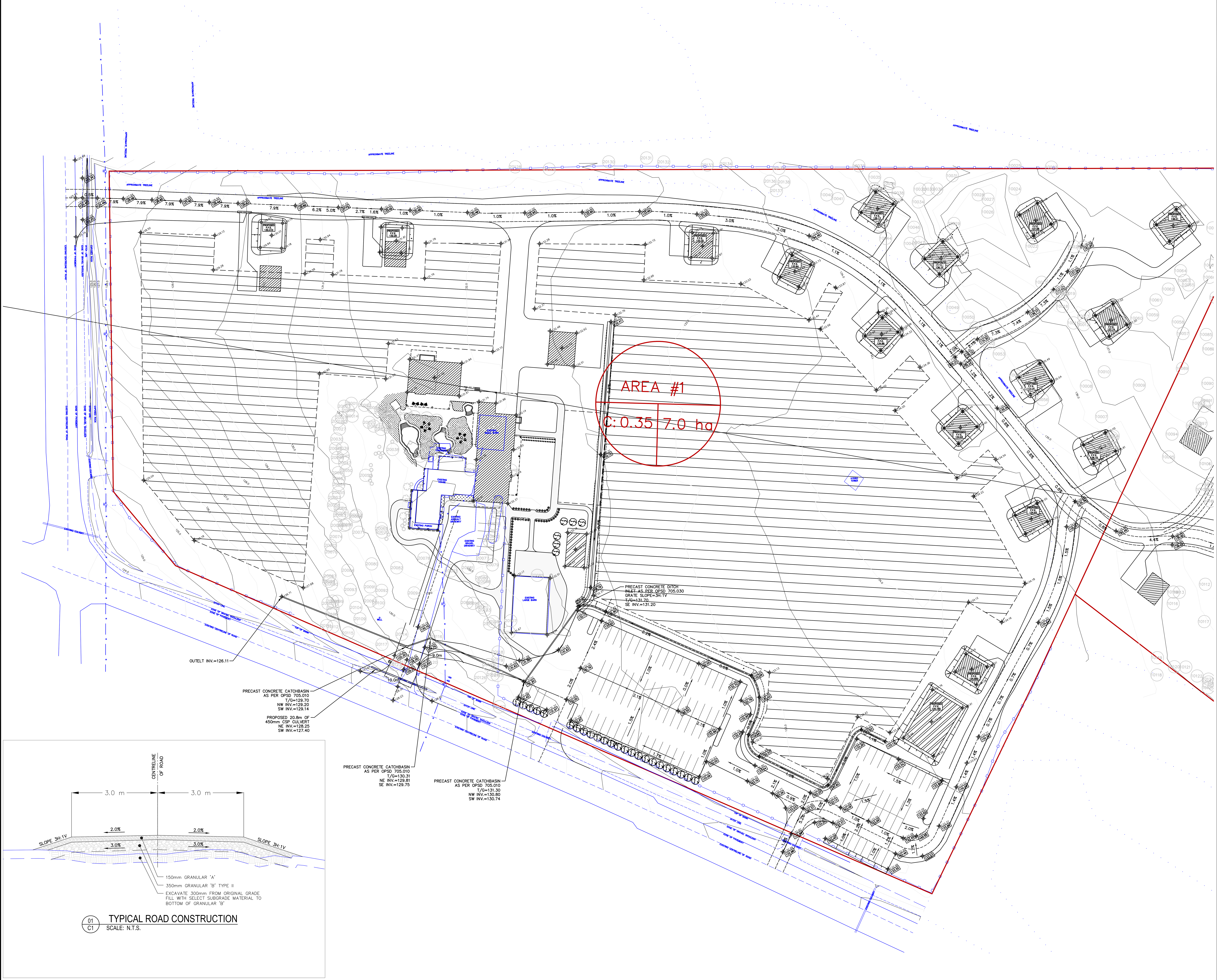

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B — B DRAWING NO. – WHERE DETAILED

LEGEND

- 100.91 EXISTING ELEVATION
- 100.95 PROPOSED ELEVATION
- GRASS
- ASPHALT
- GRAVEL
- STORMWATER POND
- PROPOSED STORM SEWER
- PROPOSED SWALE

NORTH

STAMP

PROJECT
UNITY INN & SPA
2885 BATTERSEA ROAD
KINGSTON, ONTARIO

DRAWING TITLE
GRADING PLAN

REVISION		DATE
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01	ISSUED FOR REVIEW	

DESIGNED BY: B. LEE

DRAWN BY: B. LEE

REVIEWED BY:

APPROVED BY:

PROJECT DATE: 01/06/18 (DD/MM/YYYY)

PROJECT #: 18-5-6085

SCALE: HOR: 1:600 VER: N/A

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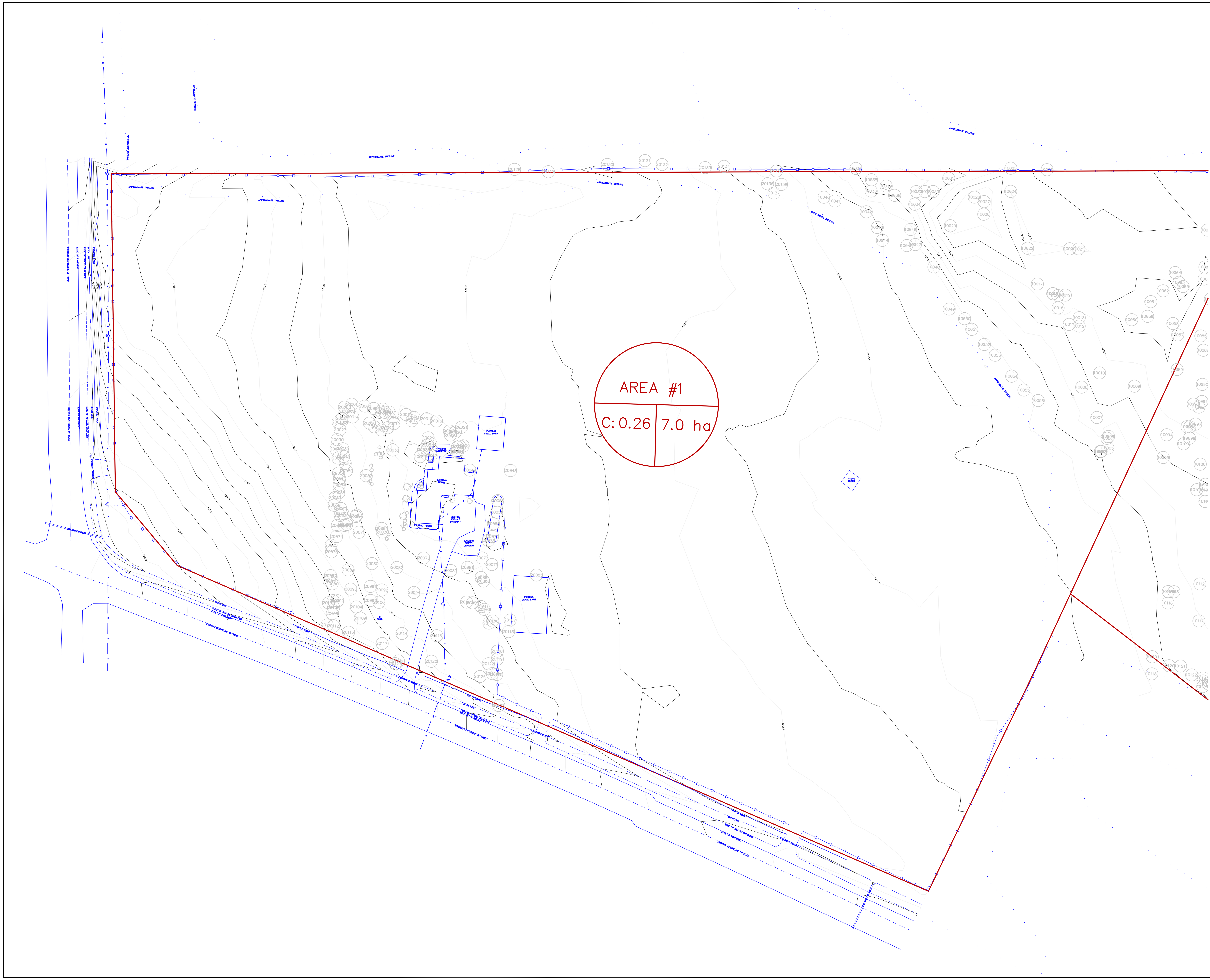

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01	ISSUED FOR REVIEW	06/20/18

DESIGNED BY

DRAWN BY

REVIEWED BY

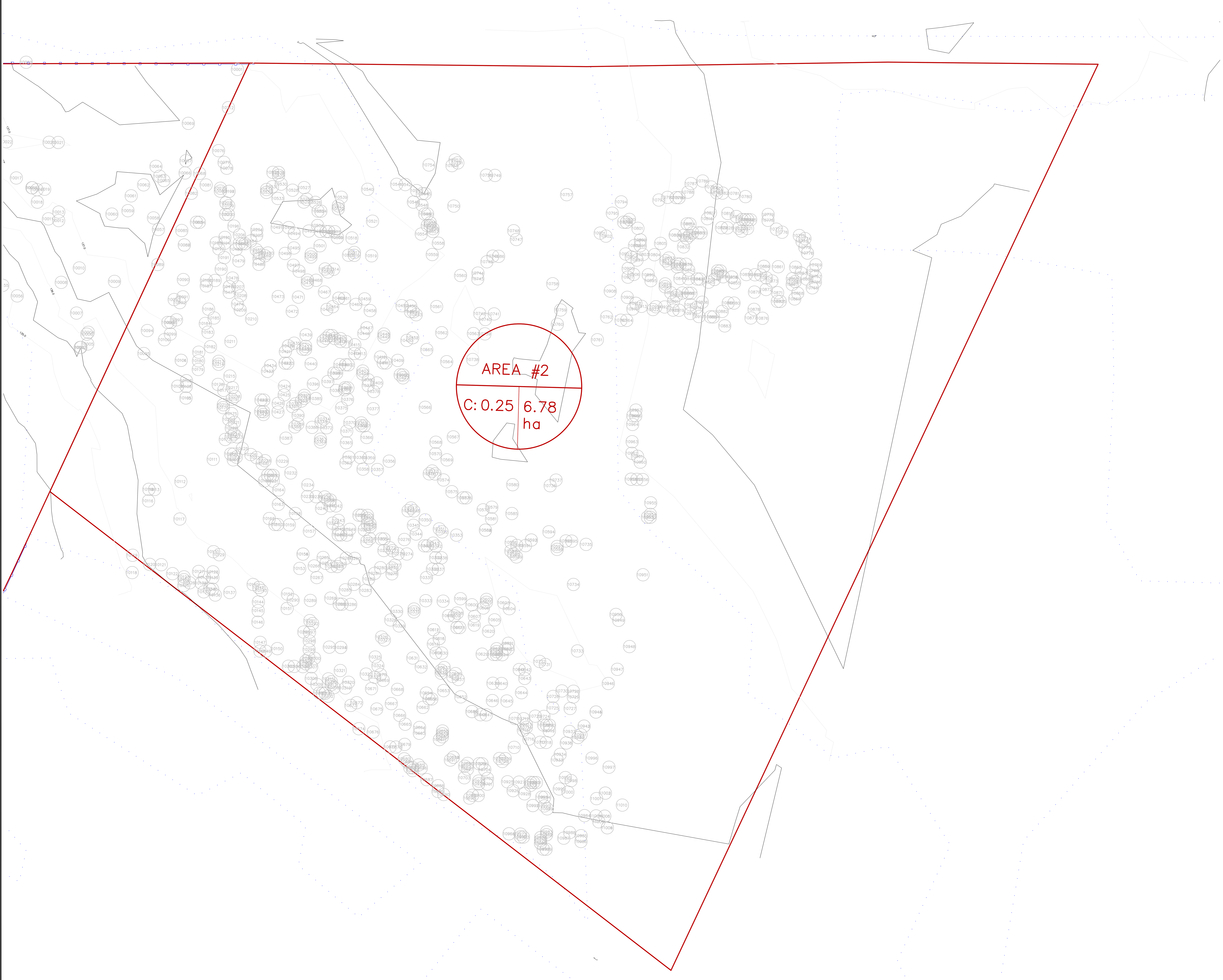
APPROVED BY

PROJECT DATE
01/06/18
(DD/MM/YYYY)

PROJECT #
18-5-6085

SCALE
HOR: 1:600
VER: N/A

DRAWING #
T1



THE GREER GALLOWAY GROUP INC.
CONSULTING ENGINEERS
PETERBOROUGH
BELLEVILLE
KINGSTON
1620 WALLBRIDGE LOYALIST ROAD
BELLEVILLE, ONTARIO, K8N 4Z5
PHONE: 613-966-3068
FAX: 613-966-3087

NOTES:

1. ALL WORK SHALL BE IN ACCORDANCE WITH RELEVANT CODES AND GUIDELINES.
2. ALL DRAWINGS AND ADDENDA ARE TO BE READ AS, AND IN CONJUNCTION WITH THE SPECIFICATIONS.
3. ALL EQUIPMENT SHALL BE INSTALLED AS SPECIFIED OR APPROVED EQUIVALENT.
4. CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS BEFORE PROCEEDING WITH WORK AND BE RESPONSIBLE FOR SAME.
5. CONTRACTOR MUST REPORT ANY DISCREPANCIES TO ENGINEER FOR RESOLUTION BEFORE COMMENCING THE WORK.
6. ANY CHANGES MUST BE APPROVED BY THE ENGINEER.

A DETAIL NO.
B DRAWING NO. – WHERE DETAILED

LEGEND

NORTH

STAMP

PROJECT
UNITY INN & SPA
2885 BATTERSEA ROAD

KINGSTON, ONTARIO

DRAWING TITLE

PRE DEVELOPMENT
STORMWATER

05		
04		
03		
02		
01	ISSUED FOR REVIEW	06/20/18
REVISION		DATE

DESIGNED BY

DRAWN BY

REVIEWED BY

APPROVED BY

PROJECT DATE
01/06/18 (DD/MM/YYYY)

PROJECT #
18-5-6085

SCALE
HOR: 1:600
VER: N/A

DRAWING #
T2

Appendix B
Calculations

18-5-6085 Unity Inn & Spa

Pre Development

Time of Concentration

Tc: $0.0195L^{0.77}S^{-0.385}$ (Kirpich)
Tc: $1.44(0.20L)^{0.467}S^{-0.235}$ (Kerby)
Tc: $3.26*(1.1-C)*L^{0.5}/S_w^{0.33}$ (Airport)
Tc: $0.057*L/(S_w^{0.2}xA^{0.1})$ (Bransby Williams)

AREA 101

Drainage Area: 7.00 ha

Kingston Site Plan control — Coefficient Range

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.06	0.90	0.05	98	6	
Roofs	0.06	0.90	0.05	98	6	
Wooded	0.73	0.25	0.18	58	42	
Grass	6.15	0.25	1.54	65	400	(Soil Group B)
Blank	0.00	0.00	0.00		0	
Blank	0.00	0.00	0.00		0	
Total	7.00		1.83		454	

Composite CN Value: 65
Composite Runoff Coefficient: 0.26 Percent Impervious: 2%

Watershed Length: 280 m
Elevation - Top: 137.14
Elevation - Bottom: 133.17
Watershed Slope: 1.4 %

Time of Concentration
Tc: ~~8~~ (Kirpich, channel flow)
Tc: ~~26~~ (Kerby, overland flow)
Tc: 41 (Airport, c < 0.40)
Tc: ~~12~~ (Bransby Williams, c > 0.40)

Time of Concentration: 41 minutes
Lag Time 0r Time to Peak (Tp): 27 minutes

AREA 102

Drainage Area: 0.12 ha

(MTO Design Chart 1.07) — Coefficient Range

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.00	0.95	0.00	98	0	
Roofs	0.00	0.95	0.00	98	0	
Gravel	0.00	0.60	0.00		0	
Grass	0.31	0.25	0.08	65	20	(Soil Group B)
Wooded	6.48	0.25	1.62	58	376	
Blank	0.00	0.00	0.00		0	
Total	6.79		1.70		396	

Composite CN Value: 58
Composite Runoff Coefficient: 0.25 Percent Impervious: 0%

Watershed Length: 350 m
Elevation - Top: 137.96
Elevation - Bottom: 136.51
Watershed Slope: 0.4 %

Time of Concentration
Tc: ~~15~~ (Kirpich, channel flow)
Tc: ~~38~~ (Kerby, overland flow)
Tc: 69 (Airport, c < 0.40)
Tc: ~~29~~ (Bransby Williams, c > 0.40)

Time of Concentration: 69 minutes
Lag Time 0r Time to Peak (Tp): 46 minutes

Proposed Development

Time of Concentration
- Tc: $0.0195L^{0.77}S^{-0.385}$ (Kirpich)
- Tc: $1.44(0.20L)^{0.467}S^{-0.235}$ (Kerby)
- Tc: $3.26*(1.1-C)*L^{0.5}/S_w^{0.33}$ (Airport)
- Tc: $0.057*L/(S_w^{0.2}xA^{0.1})$ (Bransby Williams)

AREA 201

Drainage Area: 3.32 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.44	0.90	0.40	98	43	
Roofs	0.06	0.90	0.05	98	6	
Vineyard	0.85	0.25	0.21	70	60	(Soil Group B)
Grass	1.96	0.25	0.49	65	127	(Soil Group B)
Blank	0.00	0.00	0.00			
Blank	0.00	0.00	0.00			
Total	3.32		1.16		236	

Composite CN Value: 71
Composite Runoff Coefficient: 0.35 Percent Impervious: 15%

Overland Flow

Watershed Length: 261 m
Elevation - Top: 137.3
Elevation - Bottom: 131.5
Watershed Slope: 2.2 %

Time of Concentration
- Tc: ~~6~~ (Kirpich, channel flow)
- Tc: 22 (Kerby, overland flow)
- Tc: ~~30~~ (Airport, c < 0.40)
- Tc: ~~11~~ (Bransby Williams, c > 0.40)

Time of Concentration: 22 minutes
Lag Time or Time to Peak (Tp): 15 minutes

AREA 202

Drainage Area: 1.12 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.32	0.90	0.28	98	31	
Roofs	0.03	0.90	0.02	98	3	
Vineyard	0.51	0.25	0.13	70	36	(Soil Group B)
Grass	0.27	0.25	0.07	65	18	(Soil Group B)
Blank	0.00	0.00	0.00			
Blank	0.00	0.00	0.00			
Total	1.12		0.50		87	

Composite CN Value: 77
Composite Runoff Coefficient: 0.45 Percent Impervious: 31%

Watershed Length: 217 m
Elevation - Top: 137
Elevation - Bottom: 131.5
Watershed Slope: 2.5 %

Time of Concentration
- Tc: ~~5~~ (Kirpich, channel flow)
- Tc: 20 (Kerby, overland flow)
- Tc: 23 (Airport, c < 0.40)
- Tc: ~~10~~ (Bransby Williams, c > 0.40)

Time of Concentration: 20 minutes
Lag Time or Time to Peak (Tp): 13 minutes

AREA 203

Drainage Area: 0.51 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.39	0.90	0.35	98	38	
Roofs	0.02	0.90	0.02	98	2	
Gravel	0.00	0.60	0.00		0	
Grass	0.09	0.25	0.02	65	6	(Soil Group B)
Blank	0.00	0.00	0.00			
Blank	0.00	0.00	0.00			
Total	0.51		0.40		47	

Composite CN Value: 92
Composite Runoff Coefficient: 0.78 Percent Impervious: 82%

Watershed Length: 65 m

18-5-6085 Unity Inn & Spa

Proposed Development

Time of Concentration		Tc: $0.0195L^{0.77}S^{-0.385}$	(Kirpich)
		Tc: $1.44(0.20L)^{0.467}S^{-0.235}$	(Kerby)
		Tc: $3.26*(1.1-C)*L^{0.5}/S_w^{0.33}$	(Airport)
		Tc: $0.057*L/(S_w^{0.2}xA^{0.1})$	(Bransby Williams)
Watershed Slope:	1.5	%	

Time of Concentration	Tc:	~~2~~	(Kirpich, channel flow)
	Tc:	13	(Kerby, overland flow)
	Tc:	7	(Airport, c < 0.40)
	Tc:	~~4~~	(Bransby Williams, c > 0.40)

Time of Concentration: 7 minutes
Lag Time or Time to Peak (Tp): 5 minutes

AREA 204

Drainage Area: 2.05 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.20	0.90	0.18	98	19	
Roof	0.18	0.95	0.17	98	18	
Vineyard	0.78	0.25	0.19	70	55	(Soil Group B)
Grass	0.89	0.25	0.22	65	58	(Soil Group B)
Blank	0.00	0.00	0.00			
Blank	0.00	0.00	0.00			
Total	2.05		0.77		149	

Composite CN Value: 73
Composite Runoff Coefficient: 0.37 Percent Impervious: 18%

Watershed Length: 160 m
Elevation - Top: 132.1
Elevation - Bottom: 127
Watershed Slope: 3.2 %

Time of Concentration	Tc:	~~4~~	(Kirpich, channel flow)
	Tc:	16	(Kerby, overland flow)
	Tc:	20	(Airport, c < 0.40)
	Tc:	~~7~~	(Bransby Williams, c > 0.40)

Time of Concentration: 20 minutes
Lag Time or Time to Peak (Tp): 13 minutes

AREA 205

Drainage Area: 6.79 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.90	0.90	0.81	98	88	
Roofs (cabins)	0.18	0.90	0.16	98	18	
Wooded	5.10	0.25	1.28	58	296	(Soil Group B)
Grass	0.61	0.25	0.15	65	40	(Soil Group B)
Blank	0.00	0.00	0.00			
Blank	0.00	0.00	0.00			
Total	6.79		2.40		441	

Composite CN Value: 65
Composite Runoff Coefficient: 0.35 Percent Impervious: 16%

Watershed Length: 350 m
Elevation - Top: 137.96
Elevation - Bottom: 136.51
Watershed Slope: 0.4 %

Time of Concentration	Tc:	~~15~~	(Kirpich, channel flow)
	Tc:	~~38~~	(Kerby, overland flow)
	Tc:	61	(Airport, c < 0.40)
	Tc:	~~20~~	(Bransby Williams, c > 0.40)

Time of Concentration: 61 minutes
Lag Time or Time to Peak (Tp): 41 minutes

HEC-HMS PRE DEVLOPMENT STORMWATER

SCS Type II 24 Hour – 2 Year Storm

Project: 2285 Battersea - Wet Pond   Simulation Run: Pre-Dev 2 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Predevelopment
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 2 Yr
Compute Time: 30Jul2018, 14:57:36   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catchment 101	0.0700	0.0277	01Jan2000, 12:28	0.3409
Catchment 102	0.0679	0.0026	01Jan2000, 14:28	0.0812
Roadside Ditch	0.1379	0.0277	01Jan2000, 12:28	0.4221

SCS Type II 24 Hour – 5 Year Storm

Project: 2285 Battersea - Wet Pond   Simulation Run: Pre-Dev 5 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Predevelopment
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Ttpe II - 5 Yr
Compute Time: 30Jul2018, 14:55:50   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catchment 101	0.0700	0.1033	01Jan2000, 12:23	0.8409
Catchment 102	0.0679	0.0231	01Jan2000, 13:03	0.3686
Roadside Ditch	0.1379	0.1128	01Jan2000, 12:26	1.2095

SCS Type II 24 Hour – 10 Year Storm

Project: 2285 Battersea - Wet Pond   Simulation Run: Pre-Dev 10 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Predevelopment
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 10 Yr
Compute Time: 01Aug2018, 12:09:57   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Hydrologic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catchment 101	0.07	0.1913	01Jan2000, 12:21	1.3783
Catchment 102	0.0679	0.0492	01Jan2000, 12:56	0.6321
Roadside Ditch	0.1379	0.2153	01Jan2000, 12:23	2.0105

SCS Type II 24 Hour – 25 Year Storm

Project: 2285 Battersea - Wet Pond   Simulation Run: Pre-Dev 25 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Predevelopment
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 25 Yr
Compute Time: 30Jul2018, 14:51:55   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catchment 101	0.0700	0.2665	01Jan2000, 12:20	1.7797
Catchment 102	0.0679	0.0921	01Jan2000, 12:50	1.0179
Roadside Ditch	0.1379	0.3206	01Jan2000, 12:24	2.7976

SCS Type II 24 Hour – 50 Year Storm

Project: 2285 Battersea - Wet Pond   Simulation Run: Pre-Dev 50 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Predevelopment
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 50 Yr
Compute Time: 30Jul2018, 14:49:36   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catchment 101	0.0700	0.3380	01Jan2000, 12:20	2.1749
Catchment 102	0.0679	0.1269	01Jan2000, 12:48	1.3113
Roadside Ditch	0.1379	0.4163	01Jan2000, 12:23	3.4863

SCS Type II 24 Hour – 100 Year Storm

Project: 2285 Battersea - Wet Pond   Simulation Run: Pre- Dev 100 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Predevelopment
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 100 Yr
Compute Time: 30Jul2018, 14:46:28   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catchment 101	0.0700	0.4339	01Jan2000, 12:19	2.7010
Catchment 102	0.0679	0.1763	01Jan2000, 12:46	1.7134
Roadside Ditch	0.1379	0.5479	01Jan2000, 12:23	4.4144

HEC-HMS POST DEVLOPMENT UNCONTROLLED STORMWATER

SCS Type II 24 Hour – 2 Year Storm

Project: Revised Stormwater   Simulation Run: Post Uncontrolled 2 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Post Dev without detention
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 2 Yr
Compute Time: 03Oct2018, 15:08:12   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.0799	01Jan2000, 12:08	0.4564
Basin 202	0.0120	0.0369	01Jan2000, 12:06	0.1915
Basin 203	0.0051	0.0459	01Jan2000, 12:02	0.2127
Basin 204	0.0205	0.0665	01Jan2000, 12:06	0.3451
Basin 205	0.0679	0.0782	01Jan2000, 12:32	0.7874
CB #1	0.0491	0.1457	01Jan2000, 12:09	0.8595
Roadside Ditch	0.1375	0.2601	01Jan2000, 12:09	1.9920
Swale 1	0.0320	0.0799	01Jan2000, 12:14	0.4555
Swale 2	0.0120	0.0369	01Jan2000, 12:09	0.1913

SCS Type II 24 Hour – 5 Year Storm

Project: Revised Stormwater   Simulation Run: Post Uncontrolled 5 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Post Dev without detention
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Ttpe II - 5 Yr
Compute Time: 03Oct2018, 15:08:44   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.1573	01Jan2000, 12:08	0.8019
Basin 202	0.0120	0.0698	01Jan2000, 12:06	0.3306
Basin 203	0.0051	0.0659	01Jan2000, 12:02	0.3035
Basin 204	0.0205	0.1232	01Jan2000, 12:06	0.5863
Basin 205	0.0679	0.1470	01Jan2000, 12:34	1.3843
CB #1	0.0491	0.2681	01Jan2000, 12:09	1.4342
Roadside Ditch	0.1375	0.4685	01Jan2000, 12:09	3.4048
Swale 1	0.0320	0.1573	01Jan2000, 12:14	0.8004
Swale 2	0.0120	0.0698	01Jan2000, 12:09	0.3303

SCS Type II 24 Hour – 10 Year Storm

Project: Revised Stormwater   Simulation Run: Post Uncontrolled 10 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Post Dev without detention
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 10 Yr
Compute Time: 03Oct2018, 15:09:11   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.2138	01Jan2000, 12:07	1.0489
Basin 202	0.0120	0.0930	01Jan2000, 12:06	0.4286
Basin 203	0.0051	0.0786	01Jan2000, 12:02	0.3614
Basin 204	0.0205	0.1630	01Jan2000, 12:05	0.7556
Basin 205	0.0679	0.2035	01Jan2000, 12:34	1.8270
CB #1	0.0491	0.3561	01Jan2000, 12:09	1.8366
Roadside Ditch	0.1375	0.6235	01Jan2000, 12:09	4.4192
Swale 1	0.0320	0.2138	01Jan2000, 12:13	1.0470
Swale 2	0.0120	0.0930	01Jan2000, 12:09	0.4282

SCS Type II 24 Hour – 25 Year Storm

Project: Revised Stormwater Simulation Run: Post Uncontrolled 25 Yr

Start of Run: 01Jan2000, 00:00 Basin Model: Post Dev without detention
End of Run: 02Jan2000, 00:00 Meteorologic Model: SCS Type II - 25 Yr
Compute Time:03Oct2018, 15:09:51 Control Specifications:Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.2869	01Jan2000, 12:07	1.3690
Basin 202	0.0120	0.1227	01Jan2000, 12:05	0.5545
Basin 203	0.0051	0.0940	01Jan2000, 12:02	0.4317
Basin 204	0.0205	0.2141	01Jan2000, 12:05	0.9726
Basin 205	0.0679	0.2815	01Jan2000, 12:34	2.4134
CB #1	0.0491	0.4691	01Jan2000, 12:09	2.3524
Roadside Ditch	0.1375	0.8285	01Jan2000, 12:09	5.7384
Swale 1	0.0320	0.2869	01Jan2000, 12:13	1.3666
Swale 2	0.0120	0.1227	01Jan2000, 12:08	0.5541

SCS Type II 24 Hour – 50 Year Storm

Project: Revised Stormwater Simulation Run: Post Uncontrolled 50 Yr

Start of Run: 01Jan2000, 00:00 Basin Model: Post Dev without detention
End of Run: 02Jan2000, 00:00 Meteorologic Model: SCS Type II - 50 Yr
Compute Time:03Oct2018, 15:10:18 Control Specifications:Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.3381	01Jan2000, 12:07	1.5940
Basin 202	0.0120	0.1435	01Jan2000, 12:05	0.6425
Basin 203	0.0051	0.1043	01Jan2000, 12:02	0.4789
Basin 204	0.0205	0.2496	01Jan2000, 12:05	1.1240
Basin 205	0.0679	0.3387	01Jan2000, 12:33	2.8323
CB #1	0.0491	0.5480	01Jan2000, 12:09	2.7122
Roadside Ditch	0.1375	0.9745	01Jan2000, 12:09	6.6685
Swale 1	0.0320	0.3381	01Jan2000, 12:13	1.5913
Swale 2	0.0120	0.1435	01Jan2000, 12:08	0.6420

SCS Type II 24 Hour – 100 Year Storm

Project: Revised Stormwater Simulation Run: Post Uncontrolled 100 Yr

Start of Run: 01Jan2000, 00:00 Basin Model: Post Dev without detention
End of Run: 02Jan2000, 00:00 Meteorologic Model: SCS Type II - 100 Yr
Compute Time:03Oct2018, 15:10:46 Control Specifications:Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.4043	01Jan2000, 12:07	1.8861
Basin 202	0.0120	0.1701	01Jan2000, 12:05	0.7562
Basin 203	0.0051	0.1171	01Jan2000, 12:01	0.5381
Basin 204	0.0205	0.2952	01Jan2000, 12:05	1.3195
Basin 205	0.0679	0.4145	01Jan2000, 12:33	3.3825
CB #1	0.0491	0.6496	01Jan2000, 12:09	3.1767
Roadside Ditch	0.1375	1.1655	01Jan2000, 12:09	7.8788
Swale 1	0.0320	0.4043	01Jan2000, 12:13	1.8830
Swale 2	0.0120	0.1701	01Jan2000, 12:08	0.7556

HEC-HMS POST DEVLOPMENT STORMWATER

SCS Type II 24 Hour – 2 Year Storm

Project: Revised Stormwater   Simulation Run: Controlled 2 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Post Development Controlled
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 2 Yr
Compute Time: 03Oct2018, 14:44:16   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.0799	01Jan2000, 12:08	0.4564
Basin 202	0.0112	0.0564	01Jan2000, 12:05	0.2785
Basin 203	0.0051	0.0531	01Jan2000, 12:01	0.2507
Basin 204	0.0205	0.0665	01Jan2000, 12:06	0.3451
CB #1	0.0483	0.1707	01Jan2000, 12:08	0.9846
Phase 2	0.0679	0.0782	01Jan2000, 12:32	0.7874
Pond	0.0688	0.0207	01Jan2000, 14:15	0.6433
Roadside Ditch	0.1367	0.0880	01Jan2000, 12:34	1.4307
Swale 1	0.0320	0.0799	01Jan2000, 12:14	0.4555
Swale 2	0.0112	0.0564	01Jan2000, 12:08	0.2783

Project: Revised Stormwater   Simulation Run: Controlled 2 Yr
Reservoir: Pond

Start of Run: 01Jan2000, 00:00   Basin Model: Post Development Controlled
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 2 Yr
Compute Time: 03Oct2018, 14:44:16   Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow: 0.2368 (M3/S)   Date/Time of Peak Inflow: 01Jan2000, 12:07
Peak Discharge: 0.0207 (M3/S)   Date/Time of Peak Discharge: 01Jan2000, 14:15
Inflow Volume: 1.3296 (1000 M3)   Peak Storage: 0.8197 (1000 M3)
Discharge Volume: 0.6433 (1000 M3)

SCS Type II 24 Hour – 5 Year Storm

Project: Revised Stormwater   Simulation Run: Controlled 5 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Post Development Controlled
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Ttpe II - 5 Yr
Compute Time: 03Oct2018, 14:46:35   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.1573	01Jan2000, 12:08	0.8019
Basin 202	0.0112	0.0923	01Jan2000, 12:05	0.4363
Basin 203	0.0051	0.0735	01Jan2000, 12:01	0.3471
Basin 204	0.0205	0.1232	01Jan2000, 12:06	0.5863
CB #1	0.0483	0.2955	01Jan2000, 12:08	1.5834
Phase 2	0.0679	0.1470	01Jan2000, 12:34	1.3843
Pond	0.0688	0.0985	01Jan2000, 12:48	1.4144
Roadside Ditch	0.1367	0.2387	01Jan2000, 12:40	2.7987
Swale 1	0.0320	0.1573	01Jan2000, 12:14	0.8004
Swale 2	0.0112	0.0923	01Jan2000, 12:08	0.4360

Project: Revised Stormwater Simulation Run: Controlled 5 Yr
Reservoir: Pond

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 03Oct2018, 14:46:35

Basin Model: Post Development Controlled
Meteorologic Model: SCS Ttpe II - 5 Yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow: 0.4165 (M3/S)
Peak Discharge: 0.0985 (M3/S)
Inflow Volume: 2.1697 (1000 M3)
Discharge Volume: 1.4144 (1000 M3)

Date/Time of Peak Inflow: 01Jan2000, 12:07
Date/Time of Peak Discharge: 01Jan2000, 12:48
Peak Storage: 1.0901 (1000 M3)

SCS Type II 24 Hour – 10 Year Storm

Project: Revised Stormwater Simulation Run: Controlled 10 yr

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 03Oct2018, 14:52:07

Basin Model: Post Development Controlled
Meteorologic Model: SCS Type II - 10 Yr
Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.2138	01Jan2000, 12:07	1.0489
Basin 202	0.0112	0.1165	01Jan2000, 12:05	0.5425
Basin 203	0.0051	0.0862	01Jan2000, 12:01	0.4075
Basin 204	0.0205	0.1630	01Jan2000, 12:05	0.7556
CB #1	0.0483	0.3842	01Jan2000, 12:08	1.9966
Phase 2	0.0679	0.2035	01Jan2000, 12:34	1.8270
Pond	0.0688	0.1721	01Jan2000, 12:38	1.9714
Roadside Ditch	0.1367	0.3751	01Jan2000, 12:35	3.7983
Swale 1	0.0320	0.2138	01Jan2000, 12:13	1.0470
Swale 2	0.0112	0.1165	01Jan2000, 12:08	0.5421

Project: Revised Stormwater Simulation Run: Controlled 10 yr
Reservoir: Pond

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 03Oct2018, 14:52:07

Basin Model: Post Development Controlled
Meteorologic Model: SCS Type II - 10 Yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow: 0.5439 (M3/S)
Peak Discharge: 0.1721 (M3/S)
Inflow Volume: 2.7522 (1000 M3)
Discharge Volume: 1.9714 (1000 M3)

Date/Time of Peak Inflow: 01Jan2000, 12:07
Date/Time of Peak Discharge: 01Jan2000, 12:38
Peak Storage: 1.2611 (1000 M3)

SCS Type II 24 Hour – 25 Year Storm

Project: Revised Stormwater   Simulation Run: Controlled 25 Yr

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 03Oct2018, 14:53:57

Basin Model: Post Development Controlled
Meteorologic Model: SCS Type II - 25 Yr
Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.2869	01Jan2000, 12:07	1.3690
Basin 202	0.0112	0.1466	01Jan2000, 12:05	0.6755
Basin 203	0.0051	0.1015	01Jan2000, 12:01	0.4803
Basin 204	0.0205	0.2141	01Jan2000, 12:05	0.9726
CB #1	0.0483	0.4973	01Jan2000, 12:08	2.5219
Phase 2	0.0679	0.2815	01Jan2000, 12:34	2.4134
Pond	0.0688	0.2295	01Jan2000, 12:36	2.6921
Roadside Ditch	0.1367	0.5109	01Jan2000, 12:34	5.1054
Swale 1	0.0320	0.2869	01Jan2000, 12:13	1.3666
Swale 2	0.0112	0.1466	01Jan2000, 12:08	0.6750

Project: Revised Stormwater   Simulation Run: Controlled 25 Yr
Reservoir: Pond

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 03Oct2018, 14:53:57

Basin Model: Post Development Controlled
Meteorologic Model: SCS Type II - 25 Yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow: 0.7066 (M3/S)
Peak Discharge: 0.2295 (M3/S)
Inflow Volume: 3.4945 (1000 M3)
Discharge Volume: 2.6921 (1000 M3)

Date/Time of Peak Inflow: 01Jan2000, 12:07
Date/Time of Peak Discharge: 01Jan2000, 12:36
Peak Storage: 1.5394 (1000 M3)

SCS Type II 24 Hour – 50 Year Storm

Project: Revised Stormwater   Simulation Run: Controlled 50 Yr

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 03Oct2018, 14:56:06

Basin Model: Post Development Controlled
Meteorologic Model: SCS Type II - 50 Yr
Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.3381	01Jan2000, 12:07	1.5940
Basin 202	0.0112	0.1672	01Jan2000, 12:04	0.7667
Basin 203	0.0051	0.1117	01Jan2000, 12:01	0.5288
Basin 204	0.0205	0.2496	01Jan2000, 12:05	1.1240
CB #1	0.0483	0.5759	01Jan2000, 12:08	2.8864
Phase 2	0.0679	0.3387	01Jan2000, 12:33	2.8323
Pond	0.0688	0.2616	01Jan2000, 12:36	3.1935
Roadside Ditch	0.1367	0.6001	01Jan2000, 12:34	6.0259
Swale 1	0.0320	0.3381	01Jan2000, 12:13	1.5913
Swale 2	0.0112	0.1672	01Jan2000, 12:07	0.7662

Project: Revised Stormwater   Simulation Run: Controlled 50 Yr
Reservoir: Pond

Start of Run: 01Jan2000, 00:00   Basin Model: Post Development Controlled
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 50 Yr
Compute Time: 03Oct2018, 14:56:06   Control Specifications: Control 1

Volume Units: (•) MM ( ) 1000 M3

Computed Results

Peak Inflow: 0.8195 (M3/S)   Date/Time of Peak Inflow: 01Jan2000, 12:07
Peak Discharge: 0.2616 (M3/S)   Date/Time of Peak Discharge: 01Jan2000, 12:36
Inflow Volume: 58.29058 (MM)   Peak Storage: 1.7525 (1000 M3)
Discharge Volume: 46.41783 (MM)

SCS Type II 24 Hour – 100 Year Storm

Project: Revised Stormwater   Simulation Run: Controlled 100 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Post Development Controlled
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 100 Yr
Compute Time: 03Oct2018, 14:58:04   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: ( ) MM (•) 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.4043	01Jan2000, 12:07	1.8861
Basin 202	0.0112	0.1934	01Jan2000, 12:04	0.8832
Basin 203	0.0051	0.1244	01Jan2000, 12:01	0.5896
Basin 204	0.0205	0.2952	01Jan2000, 12:05	1.3195
CB #1	0.0483	0.6770	01Jan2000, 12:08	3.3552
Phase 2	0.0679	0.4145	01Jan2000, 12:33	3.3825
Pond	0.0688	0.2977	01Jan2000, 12:37	3.8399
Roadside Ditch	0.1367	0.7116	01Jan2000, 12:33	7.2225
Swale 1	0.0320	0.4043	01Jan2000, 12:13	1.8830
Swale 2	0.0112	0.1934	01Jan2000, 12:07	0.8826

Project: Revised Stormwater   Simulation Run: Controlled 100 Yr
Reservoir: Pond

Start of Run: 01Jan2000, 00:00   Basin Model: Post Development Controlled
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 100 Yr
Compute Time: 03Oct2018, 14:58:04   Control Specifications: Control 1

Volume Units: ( ) MM (•) 1000 M3

Computed Results

Peak Inflow: 0.9647 (M3/S)   Date/Time of Peak Inflow: 01Jan2000, 12:07
Peak Discharge: 0.2977 (M3/S)   Date/Time of Peak Discharge: 01Jan2000, 12:37
Inflow Volume: 4.6747 (1000 M3)   Peak Storage: 2.0417 (1000 M3)
Discharge Volume: 3.8399 (1000 M3)

Quality - MOE SWM Planning & Design Manual

Wet Pond			Development Area:	7.00	ha
Level 1 Enhanced Protection	(80% S.S. Removal)				
Impervious:	23%				
			Total Impervious:	1.64	ha
Values at 35% Impervious (from Table 3.2)			Percent Impervious:	23%	
Storage Volume:	140	m^3/ha			
Extended Detention Portion:	40	m^3/ha			
Permanent Pool Portion:	100	m^3/ha			
Values at Actual Impervious (through extrapolation)					
Extended Detention:	40	m^3/ha			
Permanent Pool:	67	m^3/ha			
Extended Detention:	280	m^3			
Permanent Pool:	469	m^3			

Quality - MOE SWM Planning & Design Manual

Wet Pond			Development Area:	7.00	ha
Level 2 Normal Protection	(70% S.S. Removal)				
Impervious:	23%				
			Total Impervious:	1.64	ha
Values at 35% Impervious (from Table 3.2)			Percent Impervious:	23%	
Storage Volume:	90	m^3/ha			
Extended Detention Portion:	40	m^3/ha			
Permanent Pool Portion:	50	m^3/ha			
Values at Actual Impervious (through extrapolation)					
Extended Detention:	40	m^3/ha			
Permanent Pool:	33	m^3/ha			
Extended Detention:	280	m^3			
Permanent Pool:	234	m^3			

Stage Storage/Stage Discharge (2285 Battersea Road)

ORIFICE CALCULATIONS **Q = C_o*A*√2gh**

PIPE #1-QUALITY ORIFICE

Orifice Diameter=	0.0760	m
Orifice Area=	0.0045	m2
Orifice Coeficient=	0.6	
g=	9.8066	m/s^2

PIPE #2-100 YEAR ORIFICE

Orifice Diameter=	0.4021	m
Orifice Area=	0.1271	m2
Orifice Coeficient=	0.6	
g=	9.8066	m/s^2

V NOTCH WEIR CALCLATIONS **Q = Cd * (8/15)*(2g)$^{0.5}$*tan(Deg/2)*h$^{2.5}$**

ORIFICE

Where:

Cd =	0.600	* MTO Drainage Manual Chart 2.45
g=	9.8066	m/s^2
h=	Varies	m
Deg=	90 Degree	V Notch

Water Surface Elevation (m)	Surface Area (m2)	Volume (m3)	Cumulative Volume (m3)*		Water Surface Elevation (m)	Head (m) Quality Outlet **	Qualiity Discharge Rate (m3/s)	Discharge Time (hr)	Head (m) Quantity Outlet **	Quantity Discharge Rate (m3/s)	Total Discharge Rate (m3/s)	Type of Flow
123.80	675.00	0.00	0.00	**Pond Bottom**	123.80							
123.90	711.36	69.32	69.32		123.90							
124.00	748.44	72.99	142.34		124.00							
124.10	786.24	76.73	219.19		124.10							
124.20	824.76	80.55	299.95		124.20							
124.30	864.00	84.44	384.75		124.30							
124.40	903.96	88.40	473.69		124.40							
124.50	944.64	92.43	566.87		124.50							
124.60	986.04	96.53	664.42		124.60							
124.70	1028.16	100.71	766.42		124.70							
124.75	1049.49	249.27	819.13	**Perm Pool Surface**	124.75	0.00	0.0000	0.0			0.000	
124.80	1071.00	104.96	105	**Perm. Storage Required (m3)=**	124.80	0.26	0.0509	4.5			0.051	V Notch Flow
124.90	1114.56	109.28	162	**397**	124.90	0.36	0.0073	4.2			0.007	
125.00	1158.84	113.67	276		125.00	0.46	0.0082	3.8			0.008	
125.10	1203.84	118.13	394		125.10	0.56	0.0091	3.6			0.009	
125.20	1249.56	122.67	517	**Required First Flush (m3)=**	125.20	0.66	0.0098	8.0			0.010	
125.30	1296.00	127.28	645	**350**	125.30	0.76	0.0105	11.3	0.00	0.0000	0.011	V Notch Flow
125.40	1343.16	131.96	778		125.40	0.86	0.0112	14.6	0.10	0.0046	0.016	V Notch Flow
125.50	1391.04	136.71	915		125.50	0.96	0.0118	17.8	0.20	0.0259	0.038	V Notch Flow
125.60	1439.64	141.53	1058		125.60	1.06	0.0124	20.9	0.30	0.0715	0.084	V Notch Flow
125.70	1488.96	146.43	1206		125.70	1.16	0.0130	24.1	0.40	0.1467	0.160	V Notch Flow
125.80	1539.00	151.40	1359		125.80	1.26	0.0136	27.2	0.30	0.1847	0.198	
125.90	1589.76	156.44	1518		125.90	1.36	0.0141	30.3	0.40	0.2133	0.227	
126.00	1641.24	161.55	1682		126.00	1.46	0.0146	33.3	0.50	0.2386	0.253	
126.10	1693.44	166.73	1851		126.10	1.56	0.0151	36.4	0.60	0.2614	0.276	
126.20	1746.36	171.99	2027		126.20	1.66	0.0156	39.5	0.70	0.2824	0.298	
126.30	1800.00	177.32	2208	**100 Year Storm Event**	126.30	1.76	0.0160	42.5	0.80	0.3019	0.318	
126.40	1854.36	182.72	2396		126.40	1.86	0.0165	45.6	0.90	0.3202	0.337	
126.50	1909.44	188.19	2589		126.50	1.96	0.0169	48.7	1.00	0.3376	0.355	
126.60	1965.24	193.73	2789	**Available Extended Detention**	126.60	2.06	0.0173	51.8	1.10	0.3541	0.371	

* - does not account for lose due to the barrier

** - Effective head for each orifice measured from the water surface to the mid point of the orifice except where flow conditions are calculated assuming V Notch flow

Pre Development

Time of Concentration

Tc: $0.0195L^{0.77}S^{-0.385}$ (Kirpich)
Tc: $1.44(0.20L)^{0.467}S^{-0.235}$ (Kerby)
Tc: $3.26*(1.1-C)*L^{0.5}/S_w^{0.33}$ (Airport)
Tc: $0.057*L/(S_w^{0.2}xA^{0.1})$ (Bransby Williams)

AREA 101

Drainage Area: 7.00 ha

Kingston Site Plan control — Coefficient Range

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.06	0.90	0.05	98	6	
Roofs	0.06	0.90	0.05	98	6	
Wooded	0.73	0.25	0.18	58	42	
Grass	6.15	0.25	1.54	65	400	(Soil Group B)
Blank	0.00	0.00	0.00		0	
Blank	0.00	0.00	0.00		0	
Total	7.00		1.83		454	

Composite CN Value: 65
Composite Runoff Coefficient: 0.26 Percent Impervious: 2%

Watershed Length: 280 m
Elevation - Top: 137.14
Elevation - Bottom: 133.17
Watershed Slope: 1.4 %

Time of Concentration
Tc: ~~8~~ (Kirpich, channel flow)
Tc: ~~26~~ (Kerby, overland flow)
Tc: 41 (Airport, c < 0.40)
Tc: ~~12~~ (Bransby Williams, c > 0.40)

Time of Concentration: 41 minutes
Lag Time 0r Time to Peak (Tp): 27 minutes

AREA 102

Drainage Area: 0.12 ha

(MTO Design Chart 1.07) — Coefficient Range

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.00	0.95	0.00	98	0	
Roofs	0.00	0.95	0.00	98	0	
Gravel	0.00	0.60	0.00		0	
Grass	0.31	0.25	0.08	65	20	(Soil Group B)
Wooded	6.48	0.25	1.62	58	376	
Blank	0.00	0.00	0.00		0	
Total	6.79		1.70		396	

Composite CN Value: 58
Composite Runoff Coefficient: 0.25 Percent Impervious: 0%

Watershed Length: 350 m
Elevation - Top: 137.96
Elevation - Bottom: 136.51
Watershed Slope: 0.4 %

Time of Concentration
Tc: ~~15~~ (Kirpich, channel flow)
Tc: ~~38~~ (Kerby, overland flow)
Tc: 69 (Airport, c < 0.40)
Tc: ~~29~~ (Bransby Williams, c > 0.40)

Time of Concentration: 69 minutes
Lag Time 0r Time to Peak (Tp): 46 minutes

HEC-HMS PRE DEVLOPMENT STORMWATER

SCS Type II 24 Hour – 2 Year Storm

Project: 2285 Battersea - Wet Pond   Simulation Run: Pre-Dev 2 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Predevelopment
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 2 Yr
Compute Time: 30Jul2018, 14:57:36   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catchment 101	0.0700	0.0277	01Jan2000, 12:28	0.3409
Catchment 102	0.0679	0.0026	01Jan2000, 14:28	0.0812
Roadside Ditch	0.1379	0.0277	01Jan2000, 12:28	0.4221

SCS Type II 24 Hour – 5 Year Storm

Project: 2285 Battersea - Wet Pond   Simulation Run: Pre-Dev 5 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Predevelopment
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Ttpe II - 5 Yr
Compute Time: 30Jul2018, 14:55:50   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catchment 101	0.0700	0.1033	01Jan2000, 12:23	0.8409
Catchment 102	0.0679	0.0231	01Jan2000, 13:03	0.3686
Roadside Ditch	0.1379	0.1128	01Jan2000, 12:26	1.2095

SCS Type II 24 Hour – 10 Year Storm

Project: 2285 Battersea - Wet Pond   Simulation Run: Pre-Dev 10 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Predevelopment
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 10 Yr
Compute Time: 01Aug2018, 12:09:57   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Hydrologic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catchment 101	0.07	0.1913	01Jan2000, 12:21	1.3783
Catchment 102	0.0679	0.0492	01Jan2000, 12:56	0.6321
Roadside Ditch	0.1379	0.2153	01Jan2000, 12:23	2.0105

SCS Type II 24 Hour – 25 Year Storm

Project: 2285 Battersea - Wet Pond   Simulation Run: Pre-Dev 25 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Predevelopment
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 25 Yr
Compute Time: 30Jul2018, 14:51:55   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catchment 101	0.0700	0.2665	01Jan2000, 12:20	1.7797
Catchment 102	0.0679	0.0921	01Jan2000, 12:50	1.0179
Roadside Ditch	0.1379	0.3206	01Jan2000, 12:24	2.7976

SCS Type II 24 Hour – 50 Year Storm

Project: 2285 Battersea - Wet Pond   Simulation Run: Pre-Dev 50 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Predevelopment
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 50 Yr
Compute Time: 30Jul2018, 14:49:36   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catchment 101	0.0700	0.3380	01Jan2000, 12:20	2.1749
Catchment 102	0.0679	0.1269	01Jan2000, 12:48	1.3113
Roadside Ditch	0.1379	0.4163	01Jan2000, 12:23	3.4863

SCS Type II 24 Hour – 100 Year Storm

Project: 2285 Battersea - Wet Pond   Simulation Run: Pre- Dev 100 Yr

Start of Run: 01Jan2000, 00:00   Basin Model: Predevelopment
End of Run: 02Jan2000, 00:00   Meteorologic Model: SCS Type II - 100 Yr
Compute Time: 30Jul2018, 14:46:28   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catchment 101	0.0700	0.4339	01Jan2000, 12:19	2.7010
Catchment 102	0.0679	0.1763	01Jan2000, 12:46	1.7134
Roadside Ditch	0.1379	0.5479	01Jan2000, 12:23	4.4144

18-5-6085 Unity Inn & Spa

Proposed Development

Time of Concentration	Tc: $0.0195L^{0.77}S^{-0.385}$	(Kirpich)
	Tc: $1.44(0.20L)^{0.467}S^{-0.235}$	(Kerby)
	Tc: $3.26*(1.1-C)*L^{0.5}/S_w^{0.33}$	(Airport)
	Tc: $0.057*L/(S_w^{0.2}xA^{0.1})$	(Bransby Williams)

AREA 201

Drainage Area: 3.32 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.44	0.90	0.40	98	43	
Roofs	0.06	0.90	0.05	98	6	
Vineyard	0.85	0.25	0.21	70	60	(Soil Group B)
Grass	1.96	0.25	0.49	65	127	(Soil Group B)
Blank	0.00	0.00	0.00			
Blank	0.00	0.00	0.00			
Total	3.32		1.16		236	

Composite CN Value: 71

Composite Runoff Coefficient: 0.35 Percent Impervious: 15%

Overland Flow

Watershed Length:	261	m
Elevation - Top:	137.3	
Elevation - Bottom:	131.5	
Watershed Slope:	2.2	%

Time of Concentration	Tc:	~~6~~	(Kirpich, channel flow)
	Tc:	22	(Kerby, overland flow)
	Tc:	~~30~~	(Airport, c < 0.40)
	Tc:	~~11~~	(Bransby Williams, c > 0.40)

Time of Concentration: 22 minutes

Lag Time or Time to Peak (Tp): 15 minutes

AREA 202

Drainage Area: 1.12 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.32	0.90	0.28	98	31	
Roofs	0.03	0.90	0.02	98	3	
Vineyard	0.51	0.25	0.13	70	36	(Soil Group B)
Grass	0.27	0.25	0.07	65	18	(Soil Group B)
Blank	0.00	0.00	0.00			
Blank	0.00	0.00	0.00			
Total	1.12		0.50		87	

Composite CN Value: 77

Composite Runoff Coefficient: 0.45 Percent Impervious: 31%

Watershed Length:	217	m
Elevation - Top:	137	
Elevation - Bottom:	131.5	
Watershed Slope:	2.5	%

Time of Concentration	Tc:	~~5~~	(Kirpich, channel flow)
	Tc:	20	(Kerby, overland flow)
	Tc:	23	(Airport, c < 0.40)
	Tc:	~~10~~	(Bransby Williams, c > 0.40)

Time of Concentration: 20 minutes

Lag Time or Time to Peak (Tp): 13 minutes

AREA 203

Drainage Area: 0.51 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.39	0.90	0.35	98	38	
Roofs	0.02	0.90	0.02	98	2	
Gravel	0.00	0.60	0.00		0	
Grass	0.09	0.25	0.02	65	6	(Soil Group B)
Blank	0.00	0.00	0.00			
Blank	0.00	0.00	0.00			
Total	0.51		0.40		47	

Composite CN Value: 92

Composite Runoff Coefficient: 0.78 Percent Impervious: 82%

Watershed Length: 65 m

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Proposed Development

Time of Concentration
Tc: $0.0195L^{0.77}S^{-0.385}$ (Kirpich)
Tc: $1.44(0.20L)^{0.467}S^{-0.235}$ (Kerby)
Tc: $3.26*(1.1-C)*L^{0.5}/S_w^{0.33}$ (Airport)
Tc: $0.057*L/(S_w^{0.2}xA^{0.1})$ (Bransby Williams)

Watershed Slope: 1.5 %

Time of Concentration
Tc: ~~2~~ (Kirpich, channel flow)
Tc: 13 (Kerby, overland flow)
Tc: 7 (Airport, c < 0.40)
Tc: ~~4~~ (Bransby Williams, c > 0.40)

Time of Concentration: 7 minutes
Lag Time or Time to Peak (Tp): 5 minutes

AREA 204

Drainage Area: 2.05 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.20	0.90	0.18	98	19	
Roof	0.18	0.95	0.17	98	18	
Vineyard	0.78	0.25	0.19	70	55	(Soil Group B)
Grass	0.89	0.25	0.22	65	58	(Soil Group B)
Blank	0.00	0.00	0.00			
Blank	0.00	0.00	0.00			
Total	2.05		0.77		149	

Composite CN Value: 73
Composite Runoff Coefficient: 0.37 Percent Impervious: 18%

Watershed Length: 160 m
Elevation - Top: 132.1
Elevation - Bottom: 127
Watershed Slope: 3.2 %

Time of Concentration
Tc: ~~4~~ (Kirpich, channel flow)
Tc: 16 (Kerby, overland flow)
Tc: 20 (Airport, c < 0.40)
Tc: ~~7~~ (Bransby Williams, c > 0.40)

Time of Concentration: 20 minutes
Lag Time or Time to Peak (Tp): 13 minutes

AREA 205

Drainage Area: 6.79 ha

(MTO Design Chart 1.07)

Land Use	Area (Ha)	Runoff Coefficient	C x A	CN Value	CN x A	
Pavement	0.90	0.90	0.81	98	88	
Roofs (cabins)	0.18	0.90	0.16	98	18	
Wooded	5.10	0.25	1.28	58	296	(Soil Group B)
Grass	0.61	0.25	0.15	65	40	(Soil Group B)
Blank	0.00	0.00	0.00			
Blank	0.00	0.00	0.00			
Total	6.79		2.40		441	

Composite CN Value: 65
Composite Runoff Coefficient: 0.35 Percent Impervious: 16%

Watershed Length: 350 m
Elevation - Top: 137.96
Elevation - Bottom: 136.51
Watershed Slope: 0.4 %

Time of Concentration
Tc: ~~15~~ (Kirpich, channel flow)
Tc: ~~38~~ (Kerby, overland flow)
Tc: 61 (Airport, c < 0.40)
Tc: ~~20~~ (Bransby Williams, c > 0.40)

Time of Concentration: 61 minutes
Lag Time or Time to Peak (Tp): 41 minutes

HEC-HMS POST DEVLOPMENT STORMWATER

SCS Type II 24 Hour – 2 Year Storm

Project: Revised Stormwater Simulation Run: Controlled 2 Yr

Start of Run: 01Jan2000, 00:00 Basin Model: Post Development Controlled
End of Run: 02Jan2000, 00:00 Meteorologic Model: SCS Type II - 2 Yr
Compute Time:03Oct2018, 14:44:16 Control Specifications:Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.0799	01Jan2000, 12:08	0.4564
Basin 202	0.0112	0.0564	01Jan2000, 12:05	0.2785
Basin 203	0.0051	0.0531	01Jan2000, 12:01	0.2507
Basin 204	0.0205	0.0665	01Jan2000, 12:06	0.3451
CB #1	0.0483	0.1707	01Jan2000, 12:08	0.9846
Phase 2	0.0679	0.0782	01Jan2000, 12:32	0.7874
Pond	0.0688	0.0207	01Jan2000, 14:15	0.6433
Roadside Ditch	0.1367	0.0880	01Jan2000, 12:34	1.4307
Swale 1	0.0320	0.0799	01Jan2000, 12:14	0.4555
Swale 2	0.0112	0.0564	01Jan2000, 12:08	0.2783

Project: Revised Stormwater Simulation Run: Controlled 2 Yr
Reservoir: Pond

Start of Run: 01Jan2000, 00:00 Basin Model: Post Development Controlled
End of Run: 02Jan2000, 00:00 Meteorologic Model: SCS Type II - 2 Yr
Compute Time:03Oct2018, 14:44:16 Control Specifications:Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow: 0.2368 (M3/S) Date/Time of Peak Inflow: 01Jan2000, 12:07
Peak Discharge: 0.0207 (M3/S) Date/Time of Peak Discharge:01Jan2000, 14:15
Inflow Volume: 1.3296 (1000 M3) Peak Storage: 0.8197 (1000 M3)
Discharge Volume:0.6433 (1000 M3)

SCS Type II 24 Hour – 5 Year Storm

Project: Revised Stormwater Simulation Run: Controlled 5 Yr

Start of Run: 01Jan2000, 00:00 Basin Model: Post Development Controlled
End of Run: 02Jan2000, 00:00 Meteorologic Model: SCS Ttpe II - 5 Yr
Compute Time:03Oct2018, 14:46:35 Control Specifications:Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.1573	01Jan2000, 12:08	0.8019
Basin 202	0.0112	0.0923	01Jan2000, 12:05	0.4363
Basin 203	0.0051	0.0735	01Jan2000, 12:01	0.3471
Basin 204	0.0205	0.1232	01Jan2000, 12:06	0.5863
CB #1	0.0483	0.2955	01Jan2000, 12:08	1.5834
Phase 2	0.0679	0.1470	01Jan2000, 12:34	1.3843
Pond	0.0688	0.0985	01Jan2000, 12:48	1.4144
Roadside Ditch	0.1367	0.2387	01Jan2000, 12:40	2.7987
Swale 1	0.0320	0.1573	01Jan2000, 12:14	0.8004
Swale 2	0.0112	0.0923	01Jan2000, 12:08	0.4360

Project: Revised Stormwater   Simulation Run: Controlled 5 Yr
Reservoir: Pond

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 03Oct2018, 14:46:35

Basin Model: Post Development Controlled
Meteorologic Model: SCS Ttpe II - 5 Yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow: 0.4165 (M3/S)
Peak Discharge: 0.0985 (M3/S)
Inflow Volume: 2.1697 (1000 M3)
Discharge Volume: 1.4144 (1000 M3)

Date/Time of Peak Inflow: 01Jan2000, 12:07
Date/Time of Peak Discharge: 01Jan2000, 12:48
Peak Storage: 1.0901 (1000 M3)

SCS Type II 24 Hour – 10 Year Storm

Project: Revised Stormwater   Simulation Run: Controlled 10 yr

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 03Oct2018, 14:52:07

Basin Model: Post Development Controlled
Meteorologic Model: SCS Type II - 10 Yr
Control Specifications: Control 1

Show Elements: All Elements   Volume Units: MM 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.2138	01Jan2000, 12:07	1.0489
Basin 202	0.0112	0.1165	01Jan2000, 12:05	0.5425
Basin 203	0.0051	0.0862	01Jan2000, 12:01	0.4075
Basin 204	0.0205	0.1630	01Jan2000, 12:05	0.7556
CB #1	0.0483	0.3842	01Jan2000, 12:08	1.9966
Phase 2	0.0679	0.2035	01Jan2000, 12:34	1.8270
Pond	0.0688	0.1721	01Jan2000, 12:38	1.9714
Roadside Ditch	0.1367	0.3751	01Jan2000, 12:35	3.7983
Swale 1	0.0320	0.2138	01Jan2000, 12:13	1.0470
Swale 2	0.0112	0.1165	01Jan2000, 12:08	0.5421

Project: Revised Stormwater   Simulation Run: Controlled 10 yr
Reservoir: Pond

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 03Oct2018, 14:52:07

Basin Model: Post Development Controlled
Meteorologic Model: SCS Type II - 10 Yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow: 0.5439 (M3/S)
Peak Discharge: 0.1721 (M3/S)
Inflow Volume: 2.7522 (1000 M3)
Discharge Volume: 1.9714 (1000 M3)

Date/Time of Peak Inflow: 01Jan2000, 12:07
Date/Time of Peak Discharge: 01Jan2000, 12:38
Peak Storage: 1.2611 (1000 M3)

SCS Type II 24 Hour – 25 Year Storm

Project: Revised Stormwater Simulation Run: Controlled 25 Yr

Start of Run: 01Jan2000, 00:00 Basin Model: Post Development Controlled
End of Run: 02Jan2000, 00:00 Meteorologic Model: SCS Type II - 25 Yr
Compute Time: 03Oct2018, 14:53:57 Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.2869	01Jan2000, 12:07	1.3690
Basin 202	0.0112	0.1466	01Jan2000, 12:05	0.6755
Basin 203	0.0051	0.1015	01Jan2000, 12:01	0.4803
Basin 204	0.0205	0.2141	01Jan2000, 12:05	0.9726
CB #1	0.0483	0.4973	01Jan2000, 12:08	2.5219
Phase 2	0.0679	0.2815	01Jan2000, 12:34	2.4134
Pond	0.0688	0.2295	01Jan2000, 12:36	2.6921
Roadside Ditch	0.1367	0.5109	01Jan2000, 12:34	5.1054
Swale 1	0.0320	0.2869	01Jan2000, 12:13	1.3666
Swale 2	0.0112	0.1466	01Jan2000, 12:08	0.6750

Project: Revised Stormwater Simulation Run: Controlled 25 Yr
Reservoir: Pond

Start of Run: 01Jan2000, 00:00 Basin Model: Post Development Controlled
End of Run: 02Jan2000, 00:00 Meteorologic Model: SCS Type II - 25 Yr
Compute Time: 03Oct2018, 14:53:57 Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow: 0.7066 (M3/S) Date/Time of Peak Inflow: 01Jan2000, 12:07
Peak Discharge: 0.2295 (M3/S) Date/Time of Peak Discharge: 01Jan2000, 12:36
Inflow Volume: 3.4945 (1000 M3) Peak Storage: 1.5394 (1000 M3)
Discharge Volume: 2.6921 (1000 M3)

SCS Type II 24 Hour – 50 Year Storm

Project: Revised Stormwater Simulation Run: Controlled 50 Yr

Start of Run: 01Jan2000, 00:00 Basin Model: Post Development Controlled
End of Run: 02Jan2000, 00:00 Meteorologic Model: SCS Type II - 50 Yr
Compute Time: 03Oct2018, 14:56:06 Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.3381	01Jan2000, 12:07	1.5940
Basin 202	0.0112	0.1672	01Jan2000, 12:04	0.7667
Basin 203	0.0051	0.1117	01Jan2000, 12:01	0.5288
Basin 204	0.0205	0.2496	01Jan2000, 12:05	1.1240
CB #1	0.0483	0.5759	01Jan2000, 12:08	2.8864
Phase 2	0.0679	0.3387	01Jan2000, 12:33	2.8323
Pond	0.0688	0.2616	01Jan2000, 12:36	3.1935
Roadside Ditch	0.1367	0.6001	01Jan2000, 12:34	6.0259
Swale 1	0.0320	0.3381	01Jan2000, 12:13	1.5913
Swale 2	0.0112	0.1672	01Jan2000, 12:07	0.7662

Project: Revised Stormwater   Simulation Run: Controlled 50 Yr
Reservoir: Pond

Start of Run:	01Jan2000, 00:00	Basin Model:	Post Development Controlled
End of Run:	02Jan2000, 00:00	Meteorologic Model:	SCS Type II - 50 Yr
Compute Time:	03Oct2018, 14:56:06	Control Specifications:	Control 1

Volume Units: (•) MM ( ) 1000 M3

Computed Results

Peak Inflow:	0.8195 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:07
Peak Discharge:	0.2616 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:36
Inflow Volume:	58.29058 (MM)	Peak Storage:	1.7525 (1000 M3)
Discharge Volume:	46.41783 (MM)		

SCS Type II 24 Hour – 100 Year Storm

Project: Revised Stormwater   Simulation Run: Controlled 100 Yr

Start of Run:	01Jan2000, 00:00	Basin Model:	Post Development Controlled
End of Run:	02Jan2000, 00:00	Meteorologic Model:	SCS Type II - 100 Yr
Compute Time:	03Oct2018, 14:58:04	Control Specifications:	Control 1

Show Elements: All Elements   Volume Units: ( ) MM (•) 1000 M3   Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.4043	01Jan2000, 12:07	1.8861
Basin 202	0.0112	0.1934	01Jan2000, 12:04	0.8832
Basin 203	0.0051	0.1244	01Jan2000, 12:01	0.5896
Basin 204	0.0205	0.2952	01Jan2000, 12:05	1.3195
CB #1	0.0483	0.6770	01Jan2000, 12:08	3.3552
Phase 2	0.0679	0.4145	01Jan2000, 12:33	3.3825
Pond	0.0688	0.2977	01Jan2000, 12:37	3.8399
Roadside Ditch	0.1367	0.7116	01Jan2000, 12:33	7.2225
Swale 1	0.0320	0.4043	01Jan2000, 12:13	1.8830
Swale 2	0.0112	0.1934	01Jan2000, 12:07	0.8826

Project: Revised Stormwater   Simulation Run: Controlled 100 Yr
Reservoir: Pond

Start of Run:	01Jan2000, 00:00	Basin Model:	Post Development Controlled
End of Run:	02Jan2000, 00:00	Meteorologic Model:	SCS Type II - 100 Yr
Compute Time:	03Oct2018, 14:58:04	Control Specifications:	Control 1

Volume Units: ( ) MM (•) 1000 M3

Computed Results

Peak Inflow:	0.9647 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:07
Peak Discharge:	0.2977 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:37
Inflow Volume:	4.6747 (1000 M3)	Peak Storage:	2.0417 (1000 M3)
Discharge Volume:	3.8399 (1000 M3)		

HEC-HMS POST DEVLOPMENT UNCONTROLLED STORMWATER

SCS Type II 24 Hour – 2 Year Storm

Project: Revised Stormwater Simulation Run: Post Uncontrolled 2 Yr

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 03Oct2018, 15:08:12

Basin Model: Post Dev without detention
Meteorologic Model: SCS Type II - 2 Yr
Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.0799	01Jan2000, 12:08	0.4564
Basin 202	0.0120	0.0369	01Jan2000, 12:06	0.1915
Basin 203	0.0051	0.0459	01Jan2000, 12:02	0.2127
Basin 204	0.0205	0.0665	01Jan2000, 12:06	0.3451
Basin 205	0.0679	0.0782	01Jan2000, 12:32	0.7874
CB #1	0.0491	0.1457	01Jan2000, 12:09	0.8595
Roadside Ditch	0.1375	0.2601	01Jan2000, 12:09	1.9920
Swale 1	0.0320	0.0799	01Jan2000, 12:14	0.4555
Swale 2	0.0120	0.0369	01Jan2000, 12:09	0.1913

SCS Type II 24 Hour – 5 Year Storm

Project: Revised Stormwater Simulation Run: Post Uncontrolled 5 Yr

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 03Oct2018, 15:08:44

Basin Model: Post Dev without detention
Meteorologic Model: SCS Ttpe II - 5 Yr
Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.1573	01Jan2000, 12:08	0.8019
Basin 202	0.0120	0.0698	01Jan2000, 12:06	0.3306
Basin 203	0.0051	0.0659	01Jan2000, 12:02	0.3035
Basin 204	0.0205	0.1232	01Jan2000, 12:06	0.5863
Basin 205	0.0679	0.1470	01Jan2000, 12:34	1.3843
CB #1	0.0491	0.2681	01Jan2000, 12:09	1.4342
Roadside Ditch	0.1375	0.4685	01Jan2000, 12:09	3.4048
Swale 1	0.0320	0.1573	01Jan2000, 12:14	0.8004
Swale 2	0.0120	0.0698	01Jan2000, 12:09	0.3303

SCS Type II 24 Hour – 10 Year Storm

Project: Revised Stormwater Simulation Run: Post Uncontrolled 10 Yr

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 03Oct2018, 15:09:11

Basin Model: Post Dev without detention
Meteorologic Model: SCS Type II - 10 Yr
Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.2138	01Jan2000, 12:07	1.0489
Basin 202	0.0120	0.0930	01Jan2000, 12:06	0.4286
Basin 203	0.0051	0.0786	01Jan2000, 12:02	0.3614
Basin 204	0.0205	0.1630	01Jan2000, 12:05	0.7556
Basin 205	0.0679	0.2035	01Jan2000, 12:34	1.8270
CB #1	0.0491	0.3561	01Jan2000, 12:09	1.8366
Roadside Ditch	0.1375	0.6235	01Jan2000, 12:09	4.4192
Swale 1	0.0320	0.2138	01Jan2000, 12:13	1.0470
Swale 2	0.0120	0.0930	01Jan2000, 12:09	0.4282

SCS Type II 24 Hour – 25 Year Storm

Project: Revised Stormwater Simulation Run: Post Uncontrolled 25 Yr

Start of Run: 01Jan2000, 00:00 Basin Model: Post Dev without detention
End of Run: 02Jan2000, 00:00 Meteorologic Model: SCS Type II - 25 Yr
Compute Time: 03Oct2018, 15:09:51 Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.2869	01Jan2000, 12:07	1.3690
Basin 202	0.0120	0.1227	01Jan2000, 12:05	0.5545
Basin 203	0.0051	0.0940	01Jan2000, 12:02	0.4317
Basin 204	0.0205	0.2141	01Jan2000, 12:05	0.9726
Basin 205	0.0679	0.2815	01Jan2000, 12:34	2.4134
CB #1	0.0491	0.4691	01Jan2000, 12:09	2.3524
Roadside Ditch	0.1375	0.8285	01Jan2000, 12:09	5.7384
Swale 1	0.0320	0.2869	01Jan2000, 12:13	1.3666
Swale 2	0.0120	0.1227	01Jan2000, 12:08	0.5541

SCS Type II 24 Hour – 50 Year Storm

Project: Revised Stormwater Simulation Run: Post Uncontrolled 50 Yr

Start of Run: 01Jan2000, 00:00 Basin Model: Post Dev without detention
End of Run: 02Jan2000, 00:00 Meteorologic Model: SCS Type II - 50 Yr
Compute Time: 03Oct2018, 15:10:18 Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.3381	01Jan2000, 12:07	1.5940
Basin 202	0.0120	0.1435	01Jan2000, 12:05	0.6425
Basin 203	0.0051	0.1043	01Jan2000, 12:02	0.4789
Basin 204	0.0205	0.2496	01Jan2000, 12:05	1.1240
Basin 205	0.0679	0.3387	01Jan2000, 12:33	2.8323
CB #1	0.0491	0.5480	01Jan2000, 12:09	2.7122
Roadside Ditch	0.1375	0.9745	01Jan2000, 12:09	6.6685
Swale 1	0.0320	0.3381	01Jan2000, 12:13	1.5913
Swale 2	0.0120	0.1435	01Jan2000, 12:08	0.6420

SCS Type II 24 Hour – 100 Year Storm

Project: Revised Stormwater Simulation Run: Post Uncontrolled 100 Yr

Start of Run: 01Jan2000, 00:00 Basin Model: Post Dev without detention
End of Run: 02Jan2000, 00:00 Meteorologic Model: SCS Type II - 100 Yr
Compute Time: 03Oct2018, 15:10:46 Control Specifications: Control 1

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Basin 201	0.0320	0.4043	01Jan2000, 12:07	1.8861
Basin 202	0.0120	0.1701	01Jan2000, 12:05	0.7562
Basin 203	0.0051	0.1171	01Jan2000, 12:01	0.5381
Basin 204	0.0205	0.2952	01Jan2000, 12:05	1.3195
Basin 205	0.0679	0.4145	01Jan2000, 12:33	3.3825
CB #1	0.0491	0.6496	01Jan2000, 12:09	3.1767
Roadside Ditch	0.1375	1.1655	01Jan2000, 12:09	7.8788
Swale 1	0.0320	0.4043	01Jan2000, 12:13	1.8830
Swale 2	0.0120	0.1701	01Jan2000, 12:08	0.7556

Quality - MOE SWM Planning & Design Manual

Wet Pond			Development Area:	7.00	ha
Level 1 Enhanced Protection	(80% S.S. Removal)				
Impervious:	23%				
			Total Impervious:	1.64	ha
Values at 35% Impervious (from Table 3.2)			Percent Impervious:	23%	
Storage Volume:	140	m^3/ha			
Extended Detention Portion:	40	m^3/ha			
Permanent Pool Portion:	100	m^3/ha			
Values at Actual Impervious (through extrapolation)					
Extended Detention:	40	m^3/ha			
Permanent Pool:	67	m^3/ha			
Extended Detention:	280	m^3			
Permanent Pool:	469	m^3			

Quality - MOE SWM Planning & Design Manual

Wet Pond			Development Area:	7.00	ha
Level 2 Normal Protection	(70% S.S. Removal)				
Impervious:	23%				
			Total Impervious:	1.64	ha
Values at 35% Impervious (from Table 3.2)			Percent Impervious:	23%	
Storage Volume:	90	m^3/ha			
Extended Detention Portion:	40	m^3/ha			
Permanent Pool Portion:	50	m^3/ha			
Values at Actual Impervious (through extrapolation)					
Extended Detention:	40	m^3/ha			
Permanent Pool:	33	m^3/ha			
Extended Detention:	280	m^3			
Permanent Pool:	234	m^3			

Stage Storage/Stage Discharge (2285 Battersea Road)

ORIFICE CALCULATIONS $Q = C_o*A*\sqrt{2gh}$

PIPE #1-QUALITY ORIFICE

Orifice Diameter=	0.0760	m
Orifice Area=	0.0045	m2
Orifice Coeficient=	0.6	
g=	9.8066	m/s^2

PIPE #2-100 YEAR ORIFICE

Orifice Diameter=	0.4021	m
Orifice Area=	0.1271	m2
Orifice Coeficient=	0.6	
g=	9.8066	m/s^2

V NOTCH WEIR CALCLATIONS $Q = Cd * (8/15)*(2g)^{0.5}*\tan(Deg/2)*h^{2.5}$

ORIFICE

Where:

Cd =	0.600	* MTO Drainage Manual Chart 2.45
g=	9.8066	m/s^2
h=	Varies	m
Deg=	90 Degree	V Notch

Water Surface Elevation (m)	Surface Area (m2)	Volume (m3)	Cumulative Volume (m3)*		Water Surface Elevation (m)	Head (m) Quality Outlet **	Qualiity Discharge Rate (m3/s)	Discharge Time (hr)	Head (m) Quantity Outlet **	Quantity Discharge Rate (m3/s)	Total Discharge Rate (m3/s)	Type of Flow
123.80	675.00	0.00	0.00	**Pond Bottom**	123.80							
123.90	711.36	69.32	69.32		123.90							
124.00	748.44	72.99	142.34		124.00							
124.10	786.24	76.73	219.19		124.10							
124.20	824.76	80.55	299.95		124.20							
124.30	864.00	84.44	384.75		124.30							
124.40	903.96	88.40	473.69		124.40							
124.50	944.64	92.43	566.87		124.50							
124.60	986.04	96.53	664.42		124.60							
124.70	1028.16	100.71	766.42		124.70							
124.75	1049.49	249.27	819.13	**Perm Pool Surface**	124.75	0.00	0.0000	0.0			0.000	
124.80	1071.00	104.96	105	**Perm. Storage Required (m3)=**	124.80	0.26	0.0509	4.5			0.051	V Notch Flow
124.90	1114.56	109.28	162	**397**	124.90	0.36	0.0073	4.2			0.007	
125.00	1158.84	113.67	276		125.00	0.46	0.0082	3.8			0.008	
125.10	1203.84	118.13	394		125.10	0.56	0.0091	3.6			0.009	
125.20	1249.56	122.67	517	**Required First Flush (m3)=**	125.20	0.66	0.0098	8.0			0.010	
125.30	1296.00	127.28	645	**350**	125.30	0.76	0.0105	11.3	0.00	0.0000	0.011	V Notch Flow
125.40	1343.16	131.96	778		125.40	0.86	0.0112	14.6	0.10	0.0046	0.016	V Notch Flow
125.50	1391.04	136.71	915		125.50	0.96	0.0118	17.8	0.20	0.0259	0.038	V Notch Flow
125.60	1439.64	141.53	1058		125.60	1.06	0.0124	20.9	0.30	0.0715	0.084	V Notch Flow
125.70	1488.96	146.43	1206		125.70	1.16	0.0130	24.1	0.40	0.1467	0.160	V Notch Flow
125.80	1539.00	151.40	1359		125.80	1.26	0.0136	27.2	0.30	0.1847	0.198	
125.90	1589.76	156.44	1518		125.90	1.36	0.0141	30.3	0.40	0.2133	0.227	
126.00	1641.24	161.55	1682		126.00	1.46	0.0146	33.3	0.50	0.2386	0.253	
126.10	1693.44	166.73	1851		126.10	1.56	0.0151	36.4	0.60	0.2614	0.276	
126.20	1746.36	171.99	2027		126.20	1.66	0.0156	39.5	0.70	0.2824	0.298	
126.30	1800.00	177.32	2208	**100 Year Storm Event**	126.30	1.76	0.0160	42.5	0.80	0.3019	0.318	
126.40	1854.36	182.72	2396		126.40	1.86	0.0165	45.6	0.90	0.3202	0.337	
126.50	1909.44	188.19	2589		126.50	1.96	0.0169	48.7	1.00	0.3376	0.355	
126.60	1965.24	193.73	2789	**Available Extended Detention**	126.60	2.06	0.0173	51.8	1.10	0.3541	0.371	

* - does not account for lose due to the barrier

** - Effective head for each orifice measured from the water surface to the mid point of the orifice except where flow conditions are calculated assuming V Notch flow

Appendix C
Geotechnical Information

File: ASC-438
BPE Development
Test Pit Investigation
2885 Battersea Rd, Kingston

ASC ENVIRONMENTAL

Test Pit Log

Project No.:	ASC-438
Project:	Test Pit Investigation
Client:	BPE Development
Date:	May 3rd, 2018
Location:	2285 Battersea Rd., Kingston, ON

TP I.D.	Depth(m)	Moisture	Colour	Soil Type	Sample Number	Rock Depth (m)
TP1	0.0 - 0.2	Dry	Brown	Top Soil	-	
	0.2 - 0.55	Dry	Brown	Sandy Silt	SA-1	
	0.55-1.6	Dry	Light Brown	Clayey Sand Some Limestone and Granite Cobbles	SA-2	1.60
	End of Test Pit at target depth of 1.6 metres on inferred Limestone Bedrock					
TP2	0.0 - 0.25	Dry	Brown	Top Soil	-	
	0.25 - 0.45	Dry	Brown	Sandy Silt	-	
	0.45 - 0.9	Dry	Light Brown	Gravely Sand Some Limeston and Granite Cobbles	-	0.90
	End of Test Pit at target depth of 0.9m on inferred Bedrock					
TP3	0.0 - 0.65	Dry	Brown	Top Soil	SA-1	0.65
	End of Test Pit at target depth of 0.65 metres on inferred Bedrock					
TP4	0.0 - 0.3	Dry	Brown	Top Soil	-	
	0.3 - 0.65	Dry	Brown	Sandy Silt	-	0.65
	End of Test Pit at target depth of 0.65 metres on inferred Bedrock					
TP5	0.0 - 0.25	Dry	Brown	Top Soil	-	
	0.25 - 0.95	Dry	Brown	Sandy Silt some Limestone and Granite Gravel and Cobbles	-	0.95
	End of Test Pit at target depth of 0.95 metres on inferred Bedrock					
TP6	0.0 - 0.25	Dry	Brown	Top Soil	SA-1	
	0.25 - 0.45	Dry	Brown	Sandy Silt	-	
	0.45 - 1.7	Damp to Wet	Light Brown	Gravely Sand Some Limeston and Granite Cobbles	SA-2	1.70
	End of Test Pit at target depth of 1.7 metres on inferred Bedrock					
TP7	0.0 - 0.25	Dry	Brown	Top Soil	-	
	0.25 - 0.50	Dry	Brown	Gravely Sand Some Limeston and Granite Cobbles	-	0.50
	End of Test Pit at target depth of 0.50m on inferred Bedrock					
TP8	0.0 - 0.25	Dry	Brown	Top Soil	-	
	0.25 - 0.50	Dry	Brown	Sandy Silt	-	
	0.50 - 1.2	Dry	Brown	Sand some Gravel and Limestone and Granite Cobbles	SA-1	1.20
	End of Test Pit at target depth of 1.2m on inferred Bedrock					
TP9	0.0 - 0.30	Dry	Brown	Top Soil	SA-1	
	0.30 - 0.7	Dry	Brown	Sandy Silt	-	
	0.7 - 1.55	Dry	Brown	Sand and Gravel some Limestone and Granite Cobbles	SA-2	1.55
	End of Test Pit at target depth of 1.55m on inferred Bedrock					
TP10	0.0 - 0.20	Dry	Brown	Top Soil	-	
	0.20 - 0.70	Dry	Brown	Sandy Silt and Gravel some Limestone and Granite Cobble	-	0.70
	End of Test Pit at target depth of 0.70m on inferred Bedrock					
TP11	0.0 - 0.25	Dry	Brown	Top Soil	-	
	0.30 - 0.45	Dry	Light Brown	Sandy Silt and Gravel some Limestone and Granite Cobble	SA-1	
	0.45 - 0.65	Dry	Light Brown	Shale	-	0.65
	End of Test Pit at target depth of 0.65m on infered Bedrock					
TP12	0.0 - 0.30	Dry	Brown	Top Soil	SA-1	0.30
	End of Test Pit at target depth of 0.30m on inferred Bedrock					
TP13	0.0 - 0.40	Dry	Brown	Top Soil trace Limestone and Granite Cobbles	SA-1	0.40
	End of Test Pit at target depth of 0.40m on inferred Bedrock					
TP14	0.0 - 0.30	Dry	Brown	Top Soil	-	
	0.30 - 0.40	Dry	Brown	Sandy Silt	-	0.40
	End of Test Pit at target depth of 0.40m on inferred Bedrock					

Notes
" - " Denotes no soil sample taken from the test pit for range of depth indicated in table

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TP I.D.	Depth(m)	Moisture	Colour	Soil Type	Sample Number	Rock Depth (m)
TP1	0.0 - 0.2	Dry	Brown	Top Soil	-	
	0.2 - 0.55	Dry	Brown	Sandy Silt	SA-1	
	0.55-1.6	Dry	Light Brown	Clayey Sand Some Limestone and Granite Cobbles	SA-2	1.60
	End of Test Pit at target depth of 1.6 metres on inferred Limestone Bedrock					
TP2	0.0 - 0.25	Dry	Brown	Top Soil	-	
	0.25 - 0.45	Dry	Brown	Sandy Silt	-	
	0.45 - 0.9	Dry	Light Brown	Gravely Sand Some Limeston and Granite Cobbles	-	0.90
	End of Test Pit at target depth of 0.9m on inferred Bedrock					
TP3	0.0 - 0.65	Dry	Brown	Top Soil	SA-1	0.65
	End of Test Pit at target depth of 0.65 metres on inferred Bedrock					
TP4	0.0 - 0.3	Dry	Brown	Top Soil	-	
	0.3 - 0.65	Dry	Brown	Sandy Silt	-	0.65
	End of Test Pit at target depth of 0.65 metres on inferred Bedrock					
TP5	0.0 - 0.25	Dry	Brown	Top Soil	-	
	0.25 - 0.95	Dry	Brown	Sandy Silt some Limestone and Granite Gravel and Cobbles	-	0.95
	End of Test Pit at target depth of 0.95 metres on inferred Bedrock					
TP6	0.0 - 0.25	Dry	Brown	Top Soil	SA-1	
	0.25 - 0.45	Dry	Brown	Sandy Silt	-	
	0.45 - 1.7	Damp to Wet	Light Brown	Gravely Sand Some Limeston and Granite Cobbles	SA-2	1.70
	End of Test Pit at target depth of 1.7 metres on inferred Bedrock					
TP7	0.0 - 0.25	Dry	Brown	Top Soil	-	
	0.25 - 0.50	Dry	Brown	Gravely Sand Some Limeston and Granite Cobbles	-	0.50
	End of Test Pit at target depth of 0.50m on inferred Bedrock					
TP8	0.0 - 0.25	Dry	Brown	Top Soil	-	
	0.25 - 0.50	Dry	Brown	Sandy Silt	-	
	0.50 - 1.2	Dry	Brown	Sand some Gravel and Limestone and Granite Cobbles	SA-1	1.20
	End of Test Pit at target depth of 1.2m on inferred Bedrock					
TP9	0.0 - 0.30	Dry	Brown	Top Soil	SA-1	
	0.30 - 0.7	Dry	Brown	Sandy Silt	-	
	0.7 - 1.55	Dry	Brown	Sand and Gravel some Limestone and Granite Cobbles	SA-2	1.55
	End of Test Pit at target depth of 1.55m on inferred Bedrock					
TP10	0.0 - 0.20	Dry	Brown	Top Soil	-	
	0.20 - 0.70	Dry	Brown	Sandy Silt and Gravel some Limestone and Granite Cobble	-	0.70
	End of Test Pit at target depth of 0.70m on inferred Bedrock					
TP11	0.0 - 0.25	Dry	Brown	Top Soil	-	
	0.30 - 0.45	Dry	Light Brown	Sandy Silt and Gravel some Limestone and Granite Cobble	SA-1	
	0.45 - 0.65	Dry	Light Brown	Shale	-	0.65
	End of Test Pit at target depth of 0.65m on infered Bedrock					
TP12	0.0 - 0.30	Dry	Brown	Top Soil	SA-1	0.30
	End of Test Pit at target depth of 0.30m on inferred Bedrock					
TP13	0.0 - 0.40	Dry	Brown	Top Soil trace Limestone and Granite Cobbles	SA-1	0.40
	End of Test Pit at target depth of 0.40m on inferred Bedrock					
TP14	0.0 - 0.30	Dry	Brown	Top Soil	-	
	0.30 - 0.40	Dry	Brown	Sandy Silt	-	0.40
	End of Test Pit at target depth of 0.40m on inferred Bedrock					

Notes
" - " Denotes no soil sample taken from the test pit for range of depth indicated in table