HOK ARCHITECTS CORPORATION

ATHLETICS AND RECREATION CENTRE (ARC) ALGONQUIN COLLEGE, OTTAWA, ON

SERVICING REPORT

SEPTEMBER 24, 2019
REVISION 1

ATHLETICS AND RECREATION CENTRE (ARC) ALGONQUIN COLLEGE, OTTAWA, ON

SERVICING REPORT

HOK ARCHITECTS CORPORATION

SITE PLAN APPLICATION
REVISION 1

PROJECT NO.: 191-01517-00
DATE: SEPTEMBER 2019

WSP
2611 QUEESVIEW DRIVE, SUITE 300
OTTAWA, ON, CANADA, K2B 8K2

TEL.: +1 613-829-2800

WSP.COM

WSP Canada Group Ltd.

September 24, 2019

Algonquin Students' Association,

Via:

HOK Architects Corporation
205 Catherine Street, Suite 101
Ottawa, ON, K2P 1C3

Attention: Angelo Montenegrino, Principal

Dear Sir:

Subject: Athletics and Recreation Centre, Algonquin College - Servicing Report

Please find attached our revised servicing report, including civil engineering design drawings, prepared for your review prior to resubmission.

Yours sincerely,

Ding Bang (Winston) Yang, P.Eng.
Project Engineer

WSP ref.: 191-01517-00

2611 Queensview Drive, Suite 300
Ottawa, ON, Canada K2B 8K2

Tel.: +1 613-829-2800

wsp.com

QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3
Remarks	Issued for Site Plan Application	Response to SPA comments		
Date	June 24, 2019	September 24, 2019		
Prepared by	Ding Bang (Winston) Yang	Ding Bang (Winston) Yang		
Signature				
Checked by	James (Jim) Johnston	James (Jim) Johnston		
Signature				
Project number	191-01517-00	191-01517-00		

SIGNATURES

PREPARED BY

Ding Bang (Winston) Yang, P.Eng
Project Engineer

REVIEWED BY

James (Jim) Johnston, P.Eng., MBA, M.Sc., LEED AP BD+C
Senior Project Manager

This report was prepared by WSP Canada Group Ltd. for the account of HOK Architects Corporation, in accordance with the professional services agreement. The disclosure of any information contained in this report is the sole responsibility of the intended recipient. The material in it reflects WSP Canada Group Ltd.'s best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. WSP Canada Group Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This limitations statement is considered part of this report.

The original of the technology-based document sent herewith has been authenticated and will be retained by WSP for a minimum of ten years. Since the file transmitted is now out of WSP's control and its integrity can no longer be ensured, no guarantee may be given with regards to any modifications made to this document.

TABLE OF CONTENTS

1 GENERAL 1

1.1 ExEcutive summary 1

1.2 Date and Revision Number 2

1.3 Location Map and Plan 3

1.4 Adherence to zoning and related requirements 3

1.5 Pre-Consultation meetings 3

1.6 Higher level studies 3

1.7 Statement of objectives and servicing criteria 4

1.8 Available existing and proposed infrastructure 4

1.9 Environmentally significant areas, watercourses and municiIpal drains 4

1.10 Concept level master grading plan 4

1.11 Impacts on private services 5

1.12 Development phasing 5

1.13 Geotechnical sutdy 5

1.14 Drawing requirement 5

2 WATER DISTRIBUTION 6

2.1 Consistency with master servicing study and availability of publIc infrastructure 6

2.2 System constraints and boundary conditions 6

2.3 Confirmation of adequate domestic supply and pressure6

2.4 Confirmation of adequate fire flow protection 7

2.5 Check of high pressure 8

2.6 Phasing constraints 8

2.7 Reliability requirements 8

2.8 Need for pressure zone bounday modification 8

2.9 Capability of major infrastructure to supply sufficient water 8
2.10 Description of proposed water distribution network 8
2.11 Off-site requirements 8
2.12 Calculation of water demands 9
2.13 Model Schematic 9

3 WASTEWATER DISPOSAL 10
3.1 Design Criteria 10
3.2 Consistency with master servicing study 10
3.3 Review of Soil conditions 10
3.4 Description of existing sanitary sewer 10
3.5 Verification of available capacity in downstream sewer 11
3.6 Calculations for New sanitary sewEr 11
3.7 Description of proposed sewer network 11
3.8 Environmental constraints 11
3.9 Pumping requirements 11
3.10 Force-mains 11
3.11 Emergency overflows from sanitary pumping stations ..11
3.12 Special considerations 12

4 SITE STORM SERVICING 13
4.1 Existing condition 13
4.2 Analysis of availabLe capacity in public infrastructure .13
4.3 Drainage drawing 13
4.4 Water quantity control objective 13
4.5 Water quality control objective 13
4.6 Design criteria 14

4.7 Proposed minor system....14
4.8 Stormwater management 14
4.9 Inlet Controls 14
4.10 On-site detention 14
4.11 Watercourses 14
4.12 Pre and Post development peak flow rates 15
4.13 Diversion of drainage catchment areas 15
4.14 Downstream capacity where quanTity control is not proposed....15
4.15 Impacts to receiving watercourses....15
4.16 Municipal drains and related approvals 15
4.17 Means of conveyance and storage capacity 15
4.18 Hydraulic analysis 15
4.19 Identification of floodplains....15
4.20 Fill constraints 15

5 SEDIMENT AND EROSION CONTROL.... 16
5.1 General 16

6 APPROVAL AND PERMIT REQUIREMENTS 17
6.1 General 17

7 CONCLUSION CHECKLIST 18
7.1 Conclusions and recommendations....18
7.2 Comments received from review agencies....18

TABLES

TABLE 2-1: BOUNDARY CONDITIONS 6

FIGURES

FIGURE 1-1 SITE LOCATION 3

APPENDICES

A

- PRE-CONSULTATION MEETING NOTES
- TOPOGRAPHIC SURVEY PLAN
- GEOTECHNICAL REPORT BY PATERSON GROUP
- GEOTECHNICAL REVIEW COMMENTS BY PATERSON GROUP
- ALGONQUIN COLLEGE OTTAWA CAMPUS STORMWATER MANAGEMENT POND
- RESPONSE TO CITY ENGINEERING COMMENTS

B

- WATERMAIN BOUNDARY CONDITIONS FROM CITY OF OTTAWA
- EMAILS FROM CITY OF OTTAWA
- FIRE UNDERWRITERS SURVEY – FIRE FLOW CALCULATION
- WATER DEMAND CALCULATION

C

- STORMWATER MANAGEMENT REPORT BY WSP
- STORM SEWER DESIGN SHEET
- POST-DEVELOPMENT STORM DRAINAGE AREA PLAN C05
- PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN FIGURE 2

- GRADING PLAN C03
- SERVICING PLAN C04
- STORMTECH CHAMBERS MC-3500
- STORMCEPTOR STC-4000

D

- EROSION AND SEDIMENTATION CONTROL PLAN C06

E

- SUBMISSION CHECK LIST

1 GENERAL

1.1 EXECUTIVE SUMMARY

WSP was retained by HOK Architects Corporation to provide servicing, grading and stormwater management design services for the proposed new athletics and recreation building, including food service, gymnasium and leisure facilities, located at Algonquin College, east of Student Commons Building and south of North Access Road. This report outlines findings and calculations pertaining to the servicing of the proposed building with a gross building area of 11,658 square metres.

Currently the land proposed for the building has been used for paved parking. The total study area was considered to be 1.549 ha in size. The site is bounded by institutional development to the north and west, and paved parking area to the east and south. It is part of lot 34 & 35 concession (Rideau Front), Geographic Township of City of Ottawa (refer to Appendix A for the Topographical Survey Plan by Stantec Geomatics Ltd, May 2019). Based on the topographic survey, the overall topography of the site is draining from east to west with a slope towards the existing catchbasins located along the current parking area and the access road east of the Student Commons Building. On-site detention facilities have not been constructed in the existing asphalt parking areas. The existing piped stormwater system conveys drainage to Pinecrest Creek.

As per the Algonquin College Ottawa Campus Stormwater Management Brief by Morrison Hershfield for the campus east of Woodroffe Avenue, the stormwater management approach has been fairly conventional. Stormwater flows mainly uncontrolled from hardened surfaces or is controlled to pre-development conditions with roof drains and inlet control catch basins as per City of Ottawa guidelines. An exception is the Student Commons Building (IBI Group, 2011), which is controlled to the 2012 Pinecrest Creek Stormwater Management Criteria using roof drains, roof storage, landscaping, and on-site sand infiltration basins.

The City of Ottawa required that the design of a drainage and stormwater management system in this development must be prepared in accordance with the following documents:

- Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area, J.F. Sabourin and Associates Inc., June 2012;
- Sewer Design Guidelines, City of Ottawa, October 2012;
- Stormwater Management Planning and Design Manual, Ministry of the Environment, March 2003; and
- Stormwater Management Facility Design Guidelines, City of Ottawa, April 2012

The City of Ottawa requires any new development or redevelopment projects within the Pinecrest Creek watershed must implement stormwater management measures that meet the criteria outlined in the "Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area" (J.F. Sabourin and Associates Inc., June 2012). Since the new development is within the Pinecrest Creek watershed, these stormwater management guidelines apply to the development.
A copy of the Stormwater Management Report by WSP Canada Inc. is attached in Appendix C of this report.

The proposed development will not increase the overall runoff coefficient of the site since the existing developed land consists primarily of asphalt parking. The required stormwater quantity control will result in a reduction in both runoff rate and quantity. The controlled areas do not receive any drainage contribution from adjacent lands.

This report was prepared utilizing servicing design criteria obtained from available sources, and outlines the design for water, sanitary wastewater, and stormwater facilities.

The format of this report matches that of the servicing study checklist found in Section 4 of the City of Ottawa's Servicing Study Guidelines for Development Applications, November 2009.

The following municipal services are available within North Access Road and access road adjacent to the development as recorded from the following as-built drawings received from Stantec:

North Access Road:

- 600 mm storm sewer, 250mm sanitary sewer and 203mm watermain.

Access Road (East of Student Commons Building):

- 375mm and 450mm storm sewers.

It is proposed that:

- On-site stormwater management systems, employing surface storage and an underground storm chamber will be provided to attenuate flow rates leaving the new parking lot and new building roof. Existing drainage patterns, previously established controlled flow rates and storm sewers will be maintained. Refer to the stormwater management report for details.

1.2 DATE AND REVISION NUMBER

This version of the report is the first revision, dated September 24, 2019.

1.3 LOCATION MAP AND PLAN

The proposed institutional development is located at Algonquin College, in the City of Ottawa at the location shown in Figure 1-1 below.

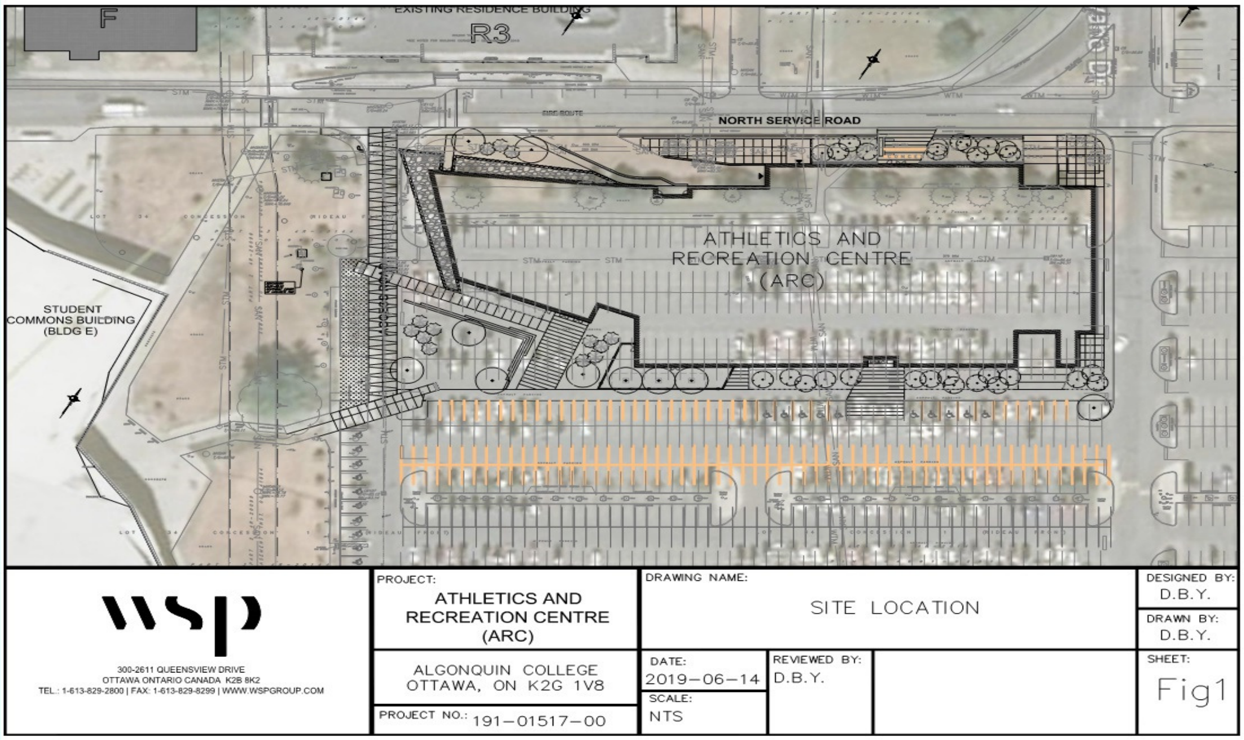


Figure 1-1 Site Location

1.4 ADHERENCE TO ZONING AND RELATED REQUIREMENTS

The proposed property use will be in conformance with zoning and related requirements prior to approval and construction, and is understood to be in conformance with current zoning.

1.5 PRE-CONSULTATION MEETINGS

A pre-consultation meeting was held with the City of Ottawa on March 6, 2019. Notes from this meeting are provided in Appendix A.

1.6 HIGHER LEVEL STUDIES

The review for servicing has been undertaken in conformance with, and utilizing information from, the following documents:

- Ottawa Sewer Design Guidelines, Second Edition, Document SDG002, October 2012, City of Ottawa including:
    - Technical Bulletin ISDTB-2012-4 (20 June 2012)

- Technical Bulletin ISDTB-2014-01 (05 February 2014)
- Technical Bulletin PIEDTB-2016-01 (September 6, 2018)
- Technical Bulletin ISDTB-2018-01 (21 March 2018)
- Technical Bulletin ISDTB-2018-04 (27 June 2018)

- Ottawa Design Guidelines – Water Distribution, July 2010 (WDG001), including:
  - Technical Bulletin ISDTB-2014-02 (May 27, 2014)
  - Technical Bulletin ISTB-2018-02 (21 March 2018)
- Stormwater Management Planning and Design Manual, Ontario Ministry of the Environment and Climate Change, March 2003 (SMPDM).
- "Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area" (J.F. Sabourin and Associates Inc., June 2012)
- Design Guidelines for Drinking-Water Systems, Ontario Ministry of the Environment and Climate Change, 2008 (GDWS).
- Fire Underwriters Survey, Water Supply for Public Fire Protection (FUS), 1999.

1.7 STATEMENT OF OBJECTIVES AND SERVICING CRITERIA

The objective of the site servicing is to meet the requirements for the proposed modification of the site while adhering to the stipulations of the applicable higher-level studies and City of Ottawa servicing design guidelines.

1.8 AVAILABLE EXISTING AND PROPOSED INFRASTRUCTURE

A municipal sanitary sewer and a watermain are located within the North Access Road right of way. A new sanitary service and a new water service will extend from North Access Road to the proposed building. The existing on-site storm sewer network running from west to east and discharging to the existing sewer along the Access Road east of Student Commons Building will be modified in one segment, as it is presently undersized. Quantity control is required to restrict the discharge leaving the development area, as noted in the Stormwater Management Report provided in Appendix C. The existing boundary roads at the site will remain open.

1.9 ENVIRONMENTALLY SIGNIFICANT AREAS, WATERCOURSES AND MUNICIPAL DRAINS

The proposed development site is bordered by institutional land uses to the north and west, and by paved parking areas to the east and south. The College is within the Pinecrest Creek Watershed. Runoff from the development site is directed to a 2100mm diameter trunk storm sewer which runs south to north and ultimately outlets to Pinecrest Creek, north of Baseline Road. The total allowable flow to the existing storm sewer from the ARC site will be limited to 36 l/s/ha in accordance with the Pinecrest Creek design criteria.

1.10 CONCEPT LEVEL MASTER GRADING PLAN

A detailed grading plan for the site has been developed, matching the existing overland flow pattern of directing overflow drainage to the Access Road to the west and then directed to the North Access Road at the north-west corner. The site topographic survey, included in Appendix A, provides evidence of direction of overland flow of the site from east to west.

Due to the existing grade difference west of the building, it will be necessary to construct a retaining wall along the west building footprint. The height of the wall will be in the range of 1.40 to 1.50 meter.
Grading will employ smooth transitions from the new work areas to existing grades with less than 4.0% slope. No changes will be made to grades at the development perimeter.

1.11 IMPACTS ON PRIVATE SERVICES

The 150 mm dia. watermain and the 250 mm dia. sanitary sewer running south-north across the development area have been verified as active, and will be rerouted to the west and north via the Access Road west of the proposed building. They will be connected to the mains along North Access Road, as at present, but at locations further west. Temporary shut down for both existing sanitary and water services will be required for making the final connection. Buildings P and S, located to the south, will be out of service when making the final connection. The rerouting has to be completed prior to the excavation of the remaining portion of the existing watermain and sanitary services running under the proposed building.

1.12 DEVELOPMENT PHASING

No development phasing is expected for the current proposal.

1.13 GEOTECHNICAL SUTDY

A geotechnical investigation report has been prepared by the Paterson Group (Report PG4624-1, June 3, 2019), and its recommendations has been taken into account in developing the engineering specifications. A copy of the report can be found in Appendix A. Paterson Group has also prepared a follow up commentary based on a geotechnical review of test pits excavated at the subject site to assess subsurface conditions. Based on this recent investigation, the long-term ground water level is anticipated at a 4 to 5 m depth. The ground water level has been taken into account in designing the underground Stormtech storage and infiltration chambers. A copy of the geotechnical memorandum can be found in the stormwater management report in Appendix C.

1.14 DRAWING REQUIREMENT

The engineering plans submitted for site plan approval are in compliance with City requirements.

2 WATER DISTRIBUTION

2.1 CONSISTENCY WITH MASTER SERVICING STUDY AND AVAILABILITY OF PUBLIC INFRASTRUCTURE

There is an existing 203mm diameter private watermain on North Access Road providing water to adjacent institutional and College owned residential properties. The new Athletics and Recreation Centre will be protected with a supervised automatic fire protection sprinkler system, and will require a 203mm diameter water service. An existing private fire hydrant will be relocated along North Access Road within 45m of the Siamese connection. No changes are required to the existing City water distribution system to allow servicing for this property.

There is an existing 150mm diameter water service running north-south across the development area. This existing water service is serves Buildings P and S, and also supplies nearby fire hydrants. Rerouting the existing 150mm diameter water service must be done prior to the construction of the building foundation. The new 150mm water service will connect to the existing 203mm diameter municipal watermain on North Access Road with a new 200x150 tee connection at the intersection of the Access Road west of the proposed building and North Access Road. The new 150mm diameter water service will be extended south close to the existing parking median through Access Road, then extended east toward the existing 150mm diameter water service. No changes are required to the existing City water distribution system for this relocation.

2.2 SYSTEM CONSTRAINTS AND BOUNDARY CONDITIONS

Boundary conditions have been provided by the City of Ottawa at the 203 mm diameter watermain on Navaho Drive for the development, and are included in Appendix B. A fire flow of 133 l/s (8,000 l/min) was used for the development which was calculated in Section 2.4. The boundary conditions were supplied by the City of Ottawa, based on fire flows and domestic demands estimated by WSP for the proposed Athletics and Recreation Centre.

Table 2-1: Boundary Conditions

BOUNDARY CONDITIONS	
SCENARIO	HGL (m)
Maximum HGL	134.8
Minimum HGL (Peak Hour)	127.0
Max Day + Fire Flow	120.0

2.3 CONFIRMATION OF ADEQUATE DOMESTIC SUPPLY AND PRESSURE

Water demands are based on Table 4.2 of the Ottawa Design Guidelines – Water Distribution. As previously noted, the development is considered as institutional development, consisting of an Athletics and Recreation Centre providing food service, gymnasium and leisure facilities. A water demand calculation sheet is included in Appendix B, and the total water demands are summarized as follows:

Average Day	0.72 l/s
Maximum Day	1.09 l/s
Peak Hour	1.96 l/s

The 2010 City of Ottawa Water Distribution Guidelines stated that the preferred practice for design of a new distribution system is to have normal operating pressures range between 345 kPa (50 psi) and 552 kPa (80 psi) under maximum daily flow conditions. Other pressure criteria identified in the guidelines are as follows:

Minimum Pressure	Minimum system pressure under peak hour demand conditions shall not be less than 276 kPa (40 psi)
Fire Flow	During the period of maximum day demand, the system pressure shall not be less than 140 kPa (20 psi) during a fire flow event.
Maximum Pressure	Maximum pressure at any point the distribution system shall not exceed 689 kPa (100 psi). In accordance with the Ontario Building/Plumbing Code, the maximum pressure should not exceed 552 kPa (80 psi). Pressure reduction controls may be required for buildings where it is not possible/feasible to maintain the system pressure below 552 kPa.

Water pressure at municipal connection check:

Min. HGL – Pavement elevation = 127.0m – 85.98m = 41.02m = 402.17 kPa

Water pressure at building connection (at average day) check:

Max. HGL – Finished floor elevation = 134.8m – 87.00 = 47.8m = 468.64 kPa

Water pressure at building connection (at max. hour demand) check:

Min. HGL – Finished floor elevation = 127.0m-87.0m = 33.0m = 392.17 kPa

Water pressure at building connection (at max. day + fire demand):

(Max Day + Fire) HGL- Finished floor elevation = 120.0m-87.0m = 323.54 kPa

The minimum water pressure inside the building at the connection is determined with the minimum HGL condition, resulting in a pressure of 392.17 kPa which exceeds the minimum requirement of 276 kPa per the guidelines.

2.4 CONFIRMATION OF ADEQUATE FIRE FLOW PROTECTION

The fire flow rate has been calculated using the Fire Underwriters Survey (FUS) method. The method takes into account the type of building construction, the building occupancy, the use of sprinklers and the exposures to adjacent structures. Assuming fire resistive construction and a fully supervised sprinkler system, a fire flow demand of 8,000 l/min has been calculated. A copy of the calculation is included in Appendix B.

The demand of 8,000 l/min can be delivered through two existing private fire hydrants. The existing hydrant located north of Building G is within 150 m of the building, and is rated at 3800 l/min. The second hydrant located at the south side of the Building G is within 35 m of the building, and is rated at 5700 l/min. The two existing hydrants have a combined total of 9500 l/min.

The proposed building on site will be serviced by a single 203 mm service off the 203 mm private watermain. The service will run into the water entry room. The proposed building will be fully sprinklered and fire protection will be provided with the fire department Siamese connection within 45 m of the existing private fire hydrant at the entrance from North Access Road. The Siamese connection is located on the north side of the building.

The boundary condition for Maximum Day and Fire Flow results in a pressure of 323.54 kPa at the ground floor level. In the guidelines, a minimum residual pressure of 140 kPa must be maintained in the distribution system for a fire flow and maximum day event. As a pressure of 323.54 kPa is achieved, the fire flow requirement is exceeded.

2.5 CHECK OF HIGH PRESSURE

High pressure is not a concern. The maximum water pressure inside the building at the connection is determined with the maximum HGL condition, resulting in a pressure of 468.64 kPa which is less than the 552 kPa threshold in the guideline in which pressure control is required. Based on this result, pressure control is not required for this building.

2.6 PHASING CONSTRAINTS

No phasing constraints exist.

2.7 RELIABILITY REQUIREMENTS

A shut off valve will be provided for the building water service at the study boundary from North Access Road. Water can be supplied to the service stub from both the North Access Road from the east and west, and can be isolated.

2.8 NEED FOR PRESSURE ZONE BOUNDAY MODIFICATION

There is no need for a pressure zone boundary modification.

2.9 CAPABILITY OF MAJOR INFRASTRUCTURE TO SUPPLY SUFFICIENT WATER

The current infrastructure is capable of meeting the domestic demand based on City requirements and fire demand as determined by FUS requirements for the proposed building.

2.10 DESCRIPTION OF PROPOSED WATER DISTRIBUTION NETWORK

A 203 mm water service is proposed to be provided into the proposed Athletics and Recreation Centre. A relocated existing private hydrant is located within 45 metres of the fire department connection on the north side of the building as per OBC requirements.

2.11 OFF-SITE REQUIREMENTS

No off-site improvements to watermains, feedermains, pumping stations, or other water infrastructure are required to maintain existing conditions and service the adjacent buildings, other than the connection of the new private watermain to the City watermain in the south frontage of the site.

2.12 CALCULATION OF WATER DEMANDS

Water demands were calculated by as described in Sections 2.3 and 2.4 above.

2.13 MODEL SCHEMATIC

The water works consist only a single building service, a model schematic is not required for this development.

3 WASTEWATER DISPOSAL

3.1 DESIGN CRITERIA

In accordance with the City of Ottawa's Sewer Design Guidelines, the following design criteria have been utilized in order to predict wastewater flows generated by the subject site and complete the sewer design;

- Minimum Velocity 0.6 m/s
- Maximum Velocity 3.0 m/s
- Manning Roughness Coefficient 0.013
- Total est. hectares institutional use 1.549
- Average sanitary flow for institutional use 28,000 L/Ha/day
- Commercial/Institutional Peaking Factor 1.5
- Infiltration Allowance (Total) 0.33 L/s/Ha
- Minimum Sewer Slopes – 200 mm diameter 0.32%

The area of 1.12 ha represents the area of the new building and immediate surrounding area to the sides of the new building. This is the sanitary collection area that is being considered to contribute to the new 200mm sanitary service extending from the existing 250mm sanitary service along North Access Road to the new building.

3.2 CONSISTENCY WITH MASTER SERVICING STUDY

The outlet for the sanitary service from the proposed building is the 250 mm diameter municipal sewer on North Access Road. The Ottawa Sewer Design Guidelines provide estimates of sewage flows based on institutional development.

The typical operation hours for Athletics and Recreation Centre will be 16 hours/day. Average daily demand for the Athletics and Recreation Centre will be increased by a factor of 16/8.
The criteria to determine anticipated actual peak flow based on site used as described in Ottawa Sewer Design Guidelines Appendix 4-A are as follows;

- Institutional (16 hours/day) 56000 L/ha/day = 0.648 L/s/ha
- Peak flow =(0.648 L/s/ha x 1.549 ha x 1.5 peaking factor) + 0.33 l/s/ha x 1.549 ha = 2.02 L/s

The on-site sanitary sewer network has been designed in accordance with 2.02 L/s as described above.

3.3 REVIEW OF SOIL CONDITIONS

There are no specific local subsurface conditions that suggest the need for a higher extraneous flow allowance.

3.4 DESCRIPTION OF EXISTING SANITARY SEWER

The outlet sanitary sewer is the existing 250 mm diameter sewer on North Access Road. This local sewer will outlet to a sanitary trunk sewer along the Woodroffe corridor, then discharge to municipal wastewater treatment facility.

There is an existing 250mm diameter sanitary sewer running north-south across the subjected developing area has been found active. This existing 250mm diameter sanitary sewer is carrying the waste water from Buildings P, S and V. Rerouting the existing 250mm diameter sanitary sewer must be completed prior to the construction of the foundation. The new 250mm sanitary sewer will be connected downstream at the existing 250mm diameter sanitary sewer on the south boulevard of North Access Road with a new sanitary manhole 4 at the south intersection of Access Road and North Access Road. Then the new 250mm diameter sanitary sewer will be extended south via Access Road, with a new sanitary manhole 3 to provide 90 degrees turning, then extended east toward the existing 250mm diameter sanitary sewer with a new sanitary manhole 2 for connection. The contributing flows and outlet sewer are unchanged from existing conditions.

3.5 VERIFICATION OF AVAILABLE CAPACITY IN DOWNSTREAM SEWER

The capacity of the downstream 250 mm diameter sewer at 0.77% slope is 52.24 L/s, which is adequate for the flow assumptions from the proposed site as noted above. This existing sewer also services approximately 6 ha of College property on the north side of the North Access Road. Assuming this existing area generates a proportional flow to that estimated above for the 1.549 ha ARC building, then the combined existing and anticipated flow estimate is 9.80 L/s.

3.6 CALCULATIONS FOR NEW SANITARY SEWER

The 200 mm diameter sanitary service from the sanitary monitoring manhole at loading area to the building will have a slope of 1.0 %, and a capacity of 32.80 L/s, with a velocity of 1.04 m/s. the 200 mm diameter sanitary service from the sanitary monitoring manhole to the existing sanitary manhole MHSAN46 will have a slope of 0.50 %, and a capacity of The capacity of 23.19 L/s, with a velocity of 0.74 m/s. The servicing pipe capacity exceeds the estimated peak sanitary flow rate of 2.02 L/s for the proposed development site.

3.7 DESCRIPTION OF PROPOSED SEWER NETWORK

The proposed sanitary sewer network on site will consist of a 200 mm diameter building service, a new 1200 mm diameter monitoring manhole at the loading area, and the 250mm sewer rerouting described in Section 3.4.

3.8 ENVIRONMENTAL CONSTRAINTS

There are no previously identified environmental constraints that impact the sanitary servicing design in order to preserve the physical condition of watercourses, vegetation, or soil cover, or to manage water quantity or quality.

3.9 PUMPING REQUIREMENTS

The proposed development will have no impact on existing pumping stations and will not require new pumping facilities.

3.10 FORCE-MAINS

No force-mains are required specifically for this development.

3.11 EMERGENCY OVERFLOWS FROM SANITARY PUMPING STATIONS

No pumping stations are required for this site, except as required internally for the plumbing design to service the lower area of the building.

3.12 SPECIAL CONSIDERATIONS

There is no known need for special considerations for sanitary sewer design related to existing site conditions.

4 SITE STORM SERVICING

4.1 EXISTING CONDITION

The site currently is dominated by an asphalt parking lot holding about 350 spaces. The campus is serviced with a series of storm sewers which collect runoff from the various buildings and significant parking lots. Most runoff from the Campus is ultimately directed to a 2100 mm diameter trunk storm sewer which runs south to north and is located along the east side of the Student Commons Building. The 2100 mm diameter storm sewer ultimately outlets to the Pinecrest Creek, north of Baseline Road. There are a series of smaller sewers adjacent to the site including a 600 mm diameter storm sewer in North Access Road and 375 mm and 450 mm diameter storm sewers in Access Road east of Student Commons Building. Drainage in excess of the minor system capacity currently flows overland to the North Access Road.

4.2 ANALYSIS OF AVAILABLE CAPACITY IN PUBLIC INFRASTRUCTURE

The 2018 Morrison Hershfield Stormwater Management Brief – Stormwater Management Pond indicates that the present contributing area to the 600mm diameter storm sewer on the North Access Road is 5.44 ha, comprised of 1.83 ha impervious area, and 3.61 ha of imperious area. Using the Rational Method, with coefficient of 0.25 for pervious areas and 0.9 for impervious areas, and a 10 minute time of concentration, results in an estimated 2 year flow of 794 L/s from this area. Using utility records from the College, the slope of the existing storm sewer immediately north of the building is 2.6%, which equates to a capacity in excess of 900 L/s. As the proposed stormwater management works for the ARC will significantly reduce runoff rates, capacity in the minor system is not a concern.

4.3 DRAINAGE DRAWING

Drawing C04 shows the receiving storm sewer and site storm sewer network. Drawing C03 provides proposed grading and drainage, and includes existing grading information. Drawing C05 provides a post-construction drainage sub-area plan, including both site and roof information. Figure 2 provides a pre-development drainage sub-area plan for the existing parking area. Site sub-area information is also provided on the storm sewer design sheet attached in Appendix C.

4.4 WATER QUANTITY CONTROL OBJECTIVE

Refer to the Stormwater Management Report in Appendix C for the water quantity objective for the site.

4.5 WATER QUALITY CONTROL OBJECTIVE

As the proposed modification in use of the site will result in fewer parked vehicles, and drainage from within the proposed building will be directed to the sanitary sewer, a conceptual net improvement in stormwater water quality is anticipated. As noted from the pre-consultation with City of Ottawa, the designated water quality control objective is to achieve 80% TSS removal. This objective will be achieved through the use of an oil and grit separator for the runoff generated from the site, achieving the TSS removal requirements as well as oil capture. As noted in the Stormwater Management Report, the high degree of initial runoff capture and infiltration will also provide a significant contribution to quality treatment.

4.6 DESIGN CRITERIA

The stormwater system was designed following the principles of dual drainage, making accommodation for both major and minor flow.

Some of the key criteria include the following:

• Design Storm (minor system)	1:2 year return (Ottawa)
• Rational Method Sewer Sizing	
• Initial Time of Concentration	10 minutes
• Runoff Coefficients	
Landscaped Areas	C = 0.25
Asphalt/Concrete	C = 0.90
Traditional Roof	C = 0.90
• Pipe Velocities	0.80 m/s to 6.0 m/s
• Minimum Pipe Size	250 mm diameter (200 mm CB Leads and service pipes)

4.7 PROPOSED MINOR SYSTEM

The detailed design for this site will maintain the existing storm sewer network to Access Road west of the development site, with the exception of replacement of one section of 375mm sewer with one of 450mm near the northwest corner of the site. This modification is required to achieve a 2 year discharge rate, without accounting for the flow reduction being implemented for quantity and quality control. Temporary pumping of storm water will be required during replacement of the existing storm sewer downstream of existing CB107 with a 450mm diameter storm sewer.

A limited amount of uncontrolled surface flow will also enter the existing storm sewer network to the north along the North Access Road, consistent with existing conditions. There were no feasible methods of controlling these small areas.

Using the above noted criteria, the existing on-site storm sewers were sized accordingly. A detailed storm sewer design sheet and the associated pre and post development storm sewer drainage area plan and figure are included in Appendix C.

4.8 STORMWATER MANAGEMENT

Refer to Stormwater Management report in Appendix C for details.

4.9 INLET CONTROLS

Refer to Stormwater Management report in Appendix C for details.

4.10 ON-SITE DETENTION

Refer to Stormwater Management report in Appendix C for details.

4.11 WATERCOURSES

The minor flow will be ultimately directed to the Pinecrest Creek, north of Baseline Road.

4.12 PRE AND POST DEVELOPMENT PEAK FLOW RATES

Pre and post development peak flow rates for the impacted areas of the site have been noted in storm sewer design sheet.

4.13 DIVERSION OF DRAINAGE CATCHMENT AREAS

There will be no diversion of existing drainage catchment areas arising from the proposed work described in this report.

4.14 DOWNSTREAM CAPACITY WHERE QUANTITY CONTROL IS NOT PROPOSED

This checklist item is not applicable to this development as quantity control is provided.

4.15 IMPACTS TO RECEIVING WATERCOURSES

No significant negative impact is anticipated to downstream receiving watercourses due to proposed quantity and quality control measures, the separation of the site from the eventual receiving watercourse as a result of discharge through City owned sewers, and the planned stormwater management pond on the north side of Baseline Road.

4.16 MUNICIPAL DRAINS AND RELATED APPROVALS

There are no municipal drains on the site or associated with the drainage from the site.

4.17 MEANS OF CONVEYANCE AND STORAGE CAPACITY

The means of flow conveyance and storage capacity are described in the Stormwater Management Report.

4.18 HYDRAULIC ANALYSIS

Hydraulic calculations for the site storm sewers are provided in the storm sewer design sheet and the Stormwater Management Report.

4.19 IDENTIFICATION OF FLOODPLAINS

There are no designated floodplains on the site of this development.

4.20 FILL CONSTRAINTS

There are no known fill constraints applicable to this site related to any floodplain. The site is generally being raised higher relative to existing conditions. No fill constraints related to soil conditions are anticipated, as confirmed in the geotechnical report.

5 SEDIMENT AND EROSION CONTROL

5.1 GENERAL

During construction, existing storm sewer system can be exposed to sediment loadings. A number of construction techniques designed to reduce unnecessary construction sediment loadings will be used including;

- Filter cloths will remain on open surface structures such as manholes and catchbasins until these structures are commissioned and put into use;
- Installation of silt fence, where applicable, around the perimeter of the proposed work area.

During construction of the services, any trench dewatering using pumps will be fitted with a “filter sock.” Thus, any pumped groundwater will be filtered prior to release to the existing surface runoff. The contractor will inspect and maintain the filter sock as needed including sediment removal and disposal.

All catchbasins, and to a lesser degree, manholes, convey surface water to sewers. Consequently, until the surrounding surface has been completed, these structures will be covered to prevent sediment from entering the minor storm sewer system. These measures will stay in place and be maintained during construction and build-out until it is appropriate to remove them.

During construction of any development both imported and native soils are placed in stockpiles. Mitigative measures and proper management to prevent these materials entering the sewer system are needed.

During construction of the deeper watermains and sewers, imported granular bedding materials are temporarily stockpiled on site. These materials are however quickly used up and generally placed before any catchbasins are installed.

Refer to the Erosion and Sedimentation Control Plan C06 provided in Appendix D.

6 APPROVAL AND PERMIT REQUIREMENTS

6.1 GENERAL

The proposed development is subject to site plan approval and building permit approval.

No approvals related to municipal drains are required.

No permits or approvals are anticipated to be required from the Ontario Ministry of Transportation, National Capital Commission, Parks Canada, Public Works and Government Services Canada, or any other provincial or federal regulatory agency.

7 CONCLUSION CHECKLIST

7.1 CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the proposed development can meet all provided servicing constraints and associated requirements. It is recommended that this report be submitted to the City of Ottawa in support of the application for site plan approval.

7.2 COMMENTS RECEIVED FROM REVIEW AGENCIES

Comments received from the City of Ottawa are provided in Appendix A.

APPENDIX

A

- PRE-CONSULTATION MEETING NOTES
- TOPOGRAPHIC SURVEY PLAN
- GEOTECHNICAL REPORT BY PATERSON GROUP
- GEOTECHNICAL REVIEW COMMENTS BY PATERSON GROUP
- ALGONQUIN COLLEGE OTTAWA CAMPUS STORMWATER MANAGEMENT POND
- RESPONSE TO CITY ENGINEERING COMMENTS

1385 Woodroffe Avenue
Pre-Consultation Meeting Minutes

Location: Room 4102E, City Hall
Date: March 6, 3pm to 4pm

Attendee	Role	Organization
Stream Shen	Planner	City of Ottawa
Mark Fraser	Project Manager (Engineer)	
Mark Young	Urban Designer	
Rosanna Baggs	Project Manager (Transportation)	
Bess Nakashima	Planning Assistant	
Lucas Smith	Project Manager	Colliers Project Leaders
Philip Belanger	Project Manager	
John Dalziel	Project Advisor	Algonquin Student Association
Angelo Montenegrino	Architect	HOK Architects
David Rosetti	Construction Manager	PCL Constructors
James Johnston	Engineer	WSP

Comments from Applicant

1. The applicant is proposing a 3-storey, 100,000 sq ft Athletic Recreational Centre (ARC) east of the student's commons in the current parking lot.
2. The ARC will consolidate existing uses on campus and will not be servicing anyone outside of the school's student population. There are longer-term plans for the campus that may utilize the existing buildings.
3. The ARC will be connected to the student commons through an elevated skywalk.
4. 250 parking spaces will be permanent removed, with 250 additional spaces being unavailable during construction. Parking pass will not be issued next season for those spaces. There may be some temporary parking spaces (50 spaces) constructed elsewhere on campus to offset some parking pressures.
5. The building will be applying for LEED Gold standard.
6. Looking to maintain existing access points within the parking lot.
7. The building will be heated and cooled from the central system.

8. Existing servicing connections are available close by. Further investigation is required.

9. The applicant is anticipating construction in spring 2019.

Planning and Urban Design Comments

1. This is a pre-consultation for a Site Plan Control application, Manager Approval, subject to Public Consultation. Application form, timeline and fees can be found here. https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/development-application-forms

2. Please note that there are proposed changes coming to the site plan by-law and fee schedule. It is available for viewing under the February 14 Planning Committee agenda.
http://app05.ottawa.ca/SIREPub/agendaminutes/index_en.aspx

3. The site is located in the Mixed Use Centre designation within the City's Official Plan is subject to the Urban Design Review Panel process. A pre-consultation is not required, but can be accommodated if the applicant choose to do so.
https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/urban-design-review-panel

4. Staff has confirmed with legal that the proposal is subject to both the site plan control application and building permit application. However, development charges is not applicable to this project.

5. This site is located within the Baseline and Woodroffe Secondary Plan. One of the requirement identified within the secondary plan is that each submission shall be supported by an up to date master concept plan showing the entire college property. It would also be helpful to understand any future proposed buildings in the immediate vicinity so that that the public realm planning can be better coordinated.
https://www.google.com/search?q=baseline+and+woodrofe+secondary+plan&sourceid=ie7&rls=com.microsoft:en-US:IE-Address&ie=&oe=&gws_rd=ssl

6. Please consider how the pedestrian will interact with the site. Consider improvements to the public realm surrounding the building, its ground level connection to the student commons and the placement of building entrances and lobbies.

7. One suggestion is to remove the parking lot entrance adjacent to the proposed building and create a pedestrian only environment. If this is not feasible, consider

modifying the surface treatment so that pedestrian use is being prioritized over vehicle access. This can be done through the use of different surface material (e.g. pavers) or through a raised pedestrian crossing.

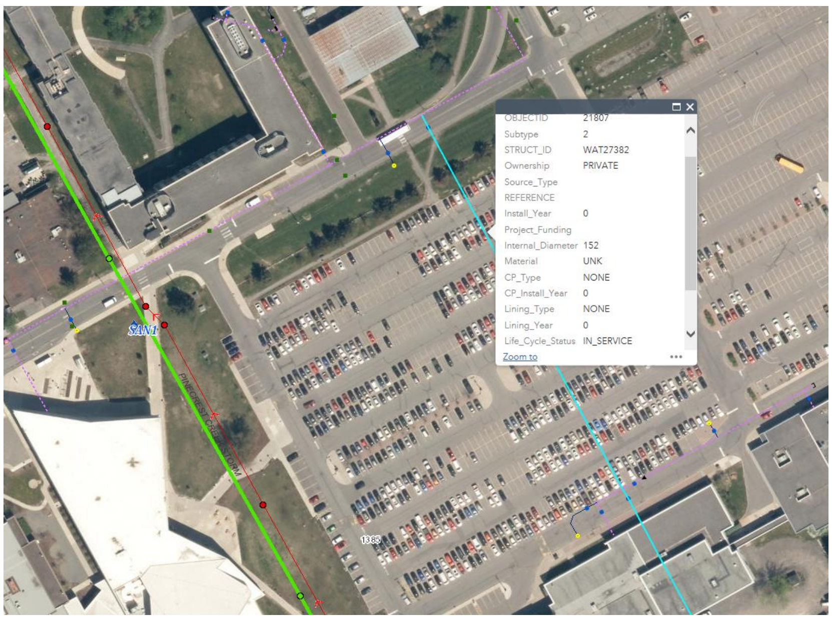
8. Please provide direct pedestrian paths to avoid cow path.
9. Please consider the implementation of way finding signage as part of this proposal.
10. Please consult with the Ward Councillor prior to submission.

Engineering Comments

General:

- Algonquin College shall move forward with finalizing Site Plan Control proposal **D07-12-18-0036.** Site Plan Approval shall be obtained and Algonquin College shall enter into a Site Plan Agreement with the City before any future works are to commence. These works have no approval status and the City has not authorized these works to commence to date.
- As per the attached correspondence the Ministry of the Environment, Conservation and Parks dated 2018-10-22 does not consider the College Campus to be industrial lands therefore an ECA is not anticipated to be required for the subject works.
- Local Conservation Authority (RVCA) clearance is required.
- Any easements on the subject site shall be identified and respected by any development proposal and shall adhere to the conditions identified in the easement agreement. All easements shall be shown on the engineering plans. Any proposed encroachments such as a covered walkway are subject to review and may not be supported. Sufficient details shall be provided to demonstrate the walkway will not be an obstruction that prevents the City from performing maintenance on the underground sewers. Previous approvals do not set a precedent for future applications and are reviewed on a case by case basis. A copy of the easement agreement shall be provided as part of the Site Plan Control application package.
- Please provide an **Existing Conditions/Removals Plan** as part of the engineering drawing set. **A Topographic Survey** of the impacted drainage area is required.
- The location of the mechanical room within the building shall take into consideration the location of available services.
- Please note that servicing and site works shall be in accordance with the following documents:
    - Ottawa Sewer Design Guidelines (October 2012)
    - Ottawa Design Guidelines-Water Distribution (July 2010)

- Stormwater Management Planning and Design Manual, Ministry of the Environment, March 2003
- Technical Bulletin PIEDTB-2016-01
- Technical Bulletins ISTB-2018-01, ISTB-2018-02 and ISTB-2018-03.
- Ottawa Design Guidelines – Water Distribution (2010)
- Geotechnical Investigation and Reporting Guidelines for Development Applications in the City of Ottawa (2007)
- City of Ottawa Accessibility Design Standards (2012)
- Ottawa Standard Tender Documents (latest version)
- Ontario Provincial Standards for Roads & Public Works (2013)



Disclaimer:

The City of Ottawa does not guarantee the accuracy or completeness of the data and information contained on the above image(s) and does not assume any responsibility or liability with respect to any damage or loss arising from the use or interpretation of the image(s) provided. This image is for schematic purposes only.

Stormwater Management Criteria:

- Algonquin College is located with the Pinecrest Creek watershed. Any new development or redevelopment projects within the Pinecrest Creek Watershed are required to implement stormwater management measure that meet the criteria outlined in the *Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area, JFSA, dated June 2012.* No future projects are permitted to proceed without adhering to these guidelines.

- The drainage and stormwater management system shall be in accordance with the attached ***Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area, JFSA, dated June 2012*** as the College is located with the Pinecrest Creek Watershed. These guidelines provide direction for the implementation of stormwater management measures (water quality, peak flow and volume control criteria) for redevelopment within the Pinecrest Creek/Westboro Area. Excerpts from this report are anticipated to be provided as supporting documentation.
- On site removal of 80% of TSS is required to be achieved and lot level /source control measures are required to be implemented in accordance with *Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area, JFSA, dated June 2012.*
- Algonquin College and Morrison Hershfield Limited are in the process of finalizing a long term stormwater management plan for the campus. The subject proposal is located outside of the SWM Pond catchment area however the stormwater management plan provides direction for future development. Please refer to *Algonquin College Ottawa Campus Stormwater Management Brief, Stormwater Management Pond, prepared by Morrison Hershfield dated February 4, 2019* **[Please note that this document does not have any approval status to date as it is still subject to review] DROPBOX Link:** https://www.dropbox.com/sh/tx22htgqinkm799/AACATTxElJglFu6FTCvuLJ23a?dl=0
- It is recommended that the Stormwater Management Servicing Report for the Student Commons Building prepared by IBI Group to establish a level of detail expected.
- The control area is the existing catchment area.
- As per *Technical Bulletin PIEDTB-2016-01 section 8.3.11.1 (p.12 of 14)* **there shall be no surface ponding on private parking areas during the 2-year storm rainfall event**. Depending on the SWM strategy proposed underground or additional underground storage may be required to satisfy this requirement.
- When using the modified rational method to calculate the storage requirements for the site any underground storage (pipe storage etc.) should not be included in the overall available storage. The modified rational method assumes that the restricted flow rate is constant throughout the storm which underestimates the storage requirement prior to the 1:100 year head elevation being reached. Please note that if you wish to utilize any underground storage as available storage, the $Q_{(release)}$ must be modified to compensate for the lack of head on the orifice. An assumed average release rate equal to 50% of the peak allowable rate shall be applied. Otherwise, disregard the underground storage as available storage or provide modeling to support SWM strategy.
- Please note that the minimum orifice dia. for a plug style ICD is 83mm and the minimum flow rate from a vortex ICD is 6 L/s in order to reduce the likelihood of plugging.

- Emergency overland flow shall be directed to the North Service Road.
- Post-development site grading shall match existing grades.
- Please provide a **Pre-Development Drainage Area Plan** as part of the engineering drawing set to define the pre-development drainage area(s)/patterns.
- A stress-test (100-year plus 20%) of the stormwater management system shall be preformed as per Section 8.3.12 of the City's sewer design guidelines. Drainage systems shall be stress tested using design storms calculated on the basis of a 20% increase in the City's IDF curves rainfall values.
- A stormwater summary table shall be provided in the report.

Storm Sewer:

- A new connection to the 2100mm dia. Pinecrest Creek Storm Sewer is not permitted. The existing storm connection shall be used as an outlet.

Sanitary:

- A direct connection to the 525mm dia. trunk sewer will only be permitted if no other options are available as a new connection is not desirable. A connection to the private sanitary sewer within the North Service Road is the preferred connection. Any proposed connection to a trunk sewer is subject to a case-by-case review. Any offline maintenance hole is to be located outside of the City 10m wide easement if it is determine that a connection is acceptable.
- Analysis and demonstration that there is sufficient/adequate residual capacity to accommodate any increase in wastewater flows in the receiving (private) and downstream (public) wastewater systems are required to be provided.
- Please review the wastewater design flow parameters *in Technical Bulletin PIEDTB-2018-01.*

Water:

- An existing private 152mm dia. watermain will be required to be relocated and blanked at the main within the North Service Road. This watermain shall be relocated through the east access to the parking lot with a W3 chamber installed within the access.
- The maximum fire flow capacity of a fire hydrant shall be reviewed and documented to ensure a sufficient number of fire hydrants are available to service the proposed development. Please review Technical Bulletin ISTB-2018-0. A **fire hydrant coverage plan** shall be provided.
- The subject site is located within the 2W Pressure Zone.
- Please provide the following information to the City of Ottawa via email to request water distribution network boundary conditions for the subject site. Please note that once this information has been provided to the City of Ottawa it takes approximately 5-10 business days to receive boundary conditions.
    - Type of Development

- Site Address
- A plan showing the proposed water service connection location(s).
- **Average Daily Demand** (L/s)
- **Maximum Daily Demand** (L/s)
- **Peak Hour Demand** (L/s)
- **Fire Flow** (L/min)

  [*Fire flow demand requirements shall be based on Fire Underwriters Survey (FUS) Water Supply for Public Fire Protection 1999*]

- **FUS Fire Flow Calculations**

Exterior Site Lighting:

- Please note that any proposed light fixtures (both pole-mounted and wall mounted) must be part of the approved Site Plan. All external light fixtures must meet the criteria for Full Cut-off Classification as recognized by the Illuminating Engineering Society of North America (IESNA or IES), and must result in minimal light spillage. Please provide the City with a **Site Lighting Plan and Photometric Plan.**

Snow Storage:

- Any portion of the subject property which is intended to be used of permanent or temporary snow storage shall be as shown on the approved site plan and grading plan. Snow storage shall not interfere with approved grading and drainage patters or servicing. Snow storage areas shall be setback from the property lines, foundations, fencing or landscaping a minimum of 1.5m. Snow storage areas shall not occupy driveways, aisles, required parking spaces or any portion of a road allowance. If snow is to be removed from the site please indicate this on the plan(s).

Phase One Environmental Site Assessment:

- A Phase 1 ESA is required to be completed in accordance with Ontario Regulation 153/04 in support this development proposal to determine the potential for site contamination.

Geotechnical Investigation:

- A Geotechnical Study shall be prepared in support of this development proposal.
- Soil infiltration rates are to be provided to support proposed SWM infiltration measures.

Please note that these comments are considered preliminary based on the conceptual information provided to date and therefore maybe amended as additional details become available and presented to the City.

Transportation Comments

- Follow Traffic Impact Assessment Guidelines
  - Traffic Impact Assessment will be required.
  - Start this process asap.
  - Applicant advised that their application will not be deemed complete until the submission of the draft step 1-4, including the functional draft RMA package (if applicable) and/or monitoring report (if applicable).
- Noise Impact Studies required for the following:
  - Stationary (if there will be any exposed mechanical equipment due to the proximity to neighbouring noise sensitive land uses)
- Show how the surrounding area will tie into the landscaping for the new building, ie sidewalks, new parking configuration, pedestrian crossings to the residents, etc.
- On site plan:
  - Show all details of the roads abutting the site up to and including the opposite curb; include such items as pavement markings, accesses and/or sidewalks.
  - Turning templates will be required for all accesses showing the largest vehicle to access the site; required for internal movements and at all access (entering and exiting and going in both directions).
  - Show all curb radii measurements; ensure that all curb radii are reduced as much as possible
  - Show lane/aisle widths.
  - Grey out any area that will not be impacted by this application.

Please refer to the links to "Guide to preparing studies and plans" and fees for general information. Additional information is available related to building permits, development charges, and the Accessibility Design Standards. Be aware that other fees and permits may be required, outside of the development review process. You may obtain background drawings by contacting informationcentre@ottawa.ca.

These pre-con comments are valid for one year. If you submit a development application(s) after this time, you may be required to meet for another pre-consultation meeting and/or the submission requirements may change. You are as well encouraged to contact us for a follow-up meeting if the plan/concept will be further refined.

Please contact me at stream.shen@ottawa.ca or at 613-580-2424 extension 24488 if you have any questions.

Sincerely,

Stream Shen MCIP RPP
Planner II
Development Review - West

APPLICANT'S STUDY AND PLAN IDENTIFICATION LIST

Legend: **S** indicates that the study or plan is required with application submission.
A indicates that the study or plan may be required to satisfy a condition of approval/draft approval.

For information and guidance on preparing required studies and plans refer to:

http://ottawa.ca/en/development-application-review-process-0/guide-preparing-studies-and-plans

All paper plans should be prepared and submitted in **folded full size A1** sheets.

A digital copy of all submission material should also be provided along with the hard copies.

S/A	Number of copies	ENGINEERING		S/A	Number of copies
S	4	1. Site Servicing Plan	2. Site Servicing Study	S	4
S	4	3. Grade Control and Drainage Plan	4. Geotechnical Study	S	4
S	4	5. Composite Utility Plan	6. Groundwater Impact Study		3
	3	7. Servicing Options Report	8. Wellhead Protection Study		3
S	4	9. Transportation Impact Assessment	10.Erosion and Sediment Control Plan / Brief	S	4
S	4	11.Storm water Management Report	12.Hydro geological and Terrain Analysis		3
S	4	13.Hydraulic Water main Analysis	14.Noise Study (if there is exposed mechanical)	S	2
	PDF only	15.Roadway Modification Functional Design	16.Confederation Line Proximity Study		3

S/A	Number of copies	PLANNING / DESIGN / SURVEY		S/A	Number of copies
	15	17.Draft Plan of Subdivision	18.Plan Showing Layout of Parking Garage		2
	15	19.Draft Plan of Condominium	20.Planning Rationale	S	2
S	5	21.Site Plan	22.Minimum Distance Separation (MDS)		3
	15	23.Concept Plan Showing Proposed Land Uses and Landscaping	24.Agrology and Soil Capability Study		3
	3	25.Concept Plan Showing Ultimate Use of Land	26.Cultural Heritage Impact Statement		3
S	3	27.Landscape Plan	28.Archaeological Resource Assessment Requirements: **S** (site plan) **A** (subdivision, condo)		3
S	2	29.Survey Plan	30.Shadow Analysis		3
S	1	31.Architectural Building Elevation Drawings (dimensioned)	32.Design Brief (includes the Design Review Panel Submission Requirements)	S	Available online
S	5	33.Campus Master Plan	34.Site Lighting Plan	S	2

S/A	Number of copies	ENVIRONMENTAL		S/A	Number of copies
S	2	35.Phase 1 Environmental Site Assessment	36.Impact Assessment of Adjacent Waste Disposal/Former Landfill Site		3
A	2	37.Phase 2 Environmental Site Assessment (depends on the outcome of Phase 1)	38.Assessment of Landform Features		3
	3	39.Record of Site Condition	40.Mineral Resource Impact Assessment		3
	3	41.Tree Conservation Report	42.Environmental Impact Statement / Impact Assessment of Endangered Species		3
	3	43.Mine Hazard Study / Abandoned Pit or Quarry Study	44.Integrated Environmental Review (Draft, as part of Planning Rationale)		3

Meeting Date: February 6, 2019

Application Type: *Site Plan Control, Manager Approval, Public*

File Lead (Assigned Planner): Stream Shen

Infrastructure Approvals Project Manager: Mark Fraser

Site Address (Municipal Address): 1385 Woodroffe

*Preliminary Assessment: 1☒ 2☐ 3☐ 4☐ 5

*One (1) indicates that considerable major revisions are required before a planning application is submitted, while five (5) suggests that proposal appears to meet the City's key land use policies and guidelines. **This assessment is purely advisory and does not consider technical aspects of the proposal or in any way guarantee application approval.**

It is important to note that the need for additional studies and plans may result during application review. If following the submission of your application, it is determined that material that is not identified in this checklist is required to achieve complete application status, in accordance with the Planning Act and Official Plan requirements, the **Planning, Infrastructure and Economic Development Department** ***will notify you of outstanding material required within the required 30 day period. Mandatory pre-application consultation will not shorten the City's standard processing timelines, or guarantee that an application will be approved. It is intended to help educate and inform the applicant about submission requirements as well as municipal processes, policies, and key issues in advance of submitting a formal development application. This list is valid for one year following the meeting date. If the application is not submitted within this timeframe the applicant must again pre-consult with the Planning, Infrastructure and Economic Development Department.***

James Fookes

From: Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Sent: Monday 22 October 2018 3:29 PM
To: James Fookes
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Hi James,

If the parcels were consolidated into one, an ECA would not be required. The MOE does not consider the college to be industrial lands.

Hope this helps clarify things.

Regards,

Emily Diamond
Environmental Officer
Ministry of the Environment, Conservation and Parks
Ottawa District Office
2430 Don Reid Drive
Ottawa, Ontario, K1H 1E1
Tel: 613-521-3450 ext 238
Fax: 613-521-5437
e-mail: emily.diamond@ontario.ca

From: James Fookes [mailto:JFookes@morrisonhershfield.com]
Sent: October 22, 2018 3:27 PM
To: Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Hi Emily,

Just following up on my message below. Our view is that the Algonquin College Woodroffe campus does not meet the definition of "Industrial Lands", but the City is requiring that we clarify this with you. Please let me know.

Thanks,
James

From: James Fookes
Sent: Wednesday 03 October 2018 11:58 AM
To: Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Hi Emily,

Thank you for this information. The College has advised that there is no particular reason why the site is split into two parcels, and they are looking into consolidating it into a single parcel, which is preferable to them for a number of reasons.

In the event that the College does complete the consolidation of the parcels, can you advise whether an ECA would still be required? The City's Development Review Project Manager (Mark Fraser) mentioned that the MOECP may consider the College campus to be "Industrial Lands" as defined under O.Reg. 525/98, and requested that we ask you to clarify this.

Thanks and regards,
James

James Fookes, P.Eng.
Senior Water and Wastewater Engineer
jfookes@morrisonhershfield.com

MORRISON HERSHFIELD
People • Culture • Capabilities
2440 Don Reid Drive | Ottawa, ON K1H 1E1 Canada
Dir: 613 739 2910 x1022225 | Cell: 613 869 9592 | Fax: 613 739 4926
morrisonhershfield.com

From: Diamond, Emily (MECP) [mailto:Emily.Diamond@ontario.ca]
Sent: Tuesday 25 September 2018 9:25 AM
To: James Fookes <JFookes@morrisonhershfield.com>
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Good Morning James,

Based on the information provided, an ECA would be required for the proposed stormwater pond servicing Algonquin College. Regardless of who owns the two parcels, the Ministry considers the parcels to be separate. The exemption set out under Ontario Regulation 525/98 would only apply if the stormwater pond was servicing one parcel with a single PIN.

Regards,

Emily Diamond
Environmental Officer
Ministry of the Environment, Conservation and Parks
Ottawa District Office
2430 Don Reid Drive
Ottawa, Ontario, K1H 1E1
Tel: 613-521-3450 ext 238
Fax: 613-521-5437
e-mail: emily.diamond@ontario.ca

From: James Fookes [mailto:JFookes@morrisonhershfield.com]
Sent: September 24, 2018 11:44 AM
To: Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Cc: Des Rochers, Christina (MECP) <Christina.Desrochers@ontario.ca>
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Hi Emily,

I would appreciate if we could get some feedback regarding the Stormwater Management Pond at Algonquin. Let me know if you need more details from me, or would like to set up a pre-consultation meeting.

Regards,
James

James Fookes, P.Eng.
Senior Water and Wastewater Engineer
jfookes@morrisonhershfield.com

MORRISON HERSHFIELD
People • Culture • Capabilities
2440 Don Reid Drive | Ottawa, ON K1H 1E1 Canada
Dir: 613 739 2910 x1022225 | Cell: 613 869 9592 | Fax: 613 739 4926
morrisonhershfield.com

From: James Fookes
Sent: Tuesday 11 September 2018 9:11 AM
To: Des Rochers, Christina (MECP) <Christina.Desrochers@ontario.ca>; Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Thanks Christina. I look forward to hearing from Emily. We have a meeting with the City at 11am tomorrow, so any feedback that can be provided in advance of that would be very much appreciated.

Regards,
James

From: Des Rochers, Christina (MECP) [mailto:Christina.Desrochers@ontario.ca]
Sent: Monday 10 September 2018 5:17 PM
To: James Fookes <JFookes@morrisonhershfield.com>; Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Hi James,

I forwarded your original email to Emily Diamond after we spoke last week and actually touched base with her this morning. I will forward this new information along to her and she will hopefully get back to you soon.

Thanks.

Christina

Christina Des Rochers
Water Inspector | Inspectrice de l'eau
Safe Drinking Water Branch | Direction du contrôle de la qualité de l'eau potable
Ministry of the Environment, Conservation and Parks | Ministère de l'Environnement, de la Protection de la nature et des Parcs
Tel. 613-521-3450 ex. 231
Fax. 613-521-5437
Spills Action Centre | Centre d'intervention en cas de déversement 1-800-268-6060

From: James Fookes [mailto:JFookes@morrisonhershfield.com]
Sent: September-10-18 5:02 PM

To: Des Rochers, Christina (MECP)
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Hi Christina,

I'm just following up regarding my email below. Do you know if your colleague has had a chance to look into this?

Also we have some new information about the separate parcel of land issue. Our planning colleagues at Fotenn have confirmed the 'Algonquin College of Applied Arts and Technology' owns both parcels and (according to the Planning Act) they should be considered one parcel of land. The parcel abstracts for the two different PINS are attached.

Thanks and regards,
James

James Fookes, P.Eng.
Senior Water and Wastewater Engineer
jfookes@morrisonhershfield.com

MORRISON HERSHFIELD
People • Culture • Capabilities
2440 Don Reid Drive | Ottawa, ON K1H 1E1 Canada
Dir: 613 739 2910 x1022225 | Cell: 613 869 9592 | Fax: 613 739 4926
morrisonhershfield.com

From: James Fookes
Sent: Wednesday 05 September 2018 11:32 AM
To: Des Rochers, Christina (MOECC) <Christina.Desrochers@ontario.ca>
Subject: SWM Pond at Algonquin College - ECA Requirements

Hi Christina,

Firstly, I'm not sure whether you are the appropriate person to contact about this – if not I would appreciate if you could forward this email appropriately.

We are involved in the design of a stormwater management pond at Algonquin College (1385 Woodroffe Avenue, Ottawa). We had previously been of the opinion that the pond did not require an ECA, since it only services the College property (i.e. institutional land use), and discharges to a sewer that is not a combined sewer. However, through the Site Plan Control process, the City of Ottawa has commented that:

1. Part of the catchment appears to be a separate parcel of land (130 Lotta Ave), and although also owned by the College, this would trigger an ECA; and,
2. In the City's opinion the site could be considered Industrial Land as defined under O. Reg. 525/98.

The City has requested that the contact the MOECP District Office to determine whether an ECA is required.

We would appreciate a pre-consultation to discuss this, if possible today or first thing tomorrow, to clarify this before a meeting that the college has scheduled with us tomorrow. We are available to meet whenever suits you – just email or call and we will come downstairs.

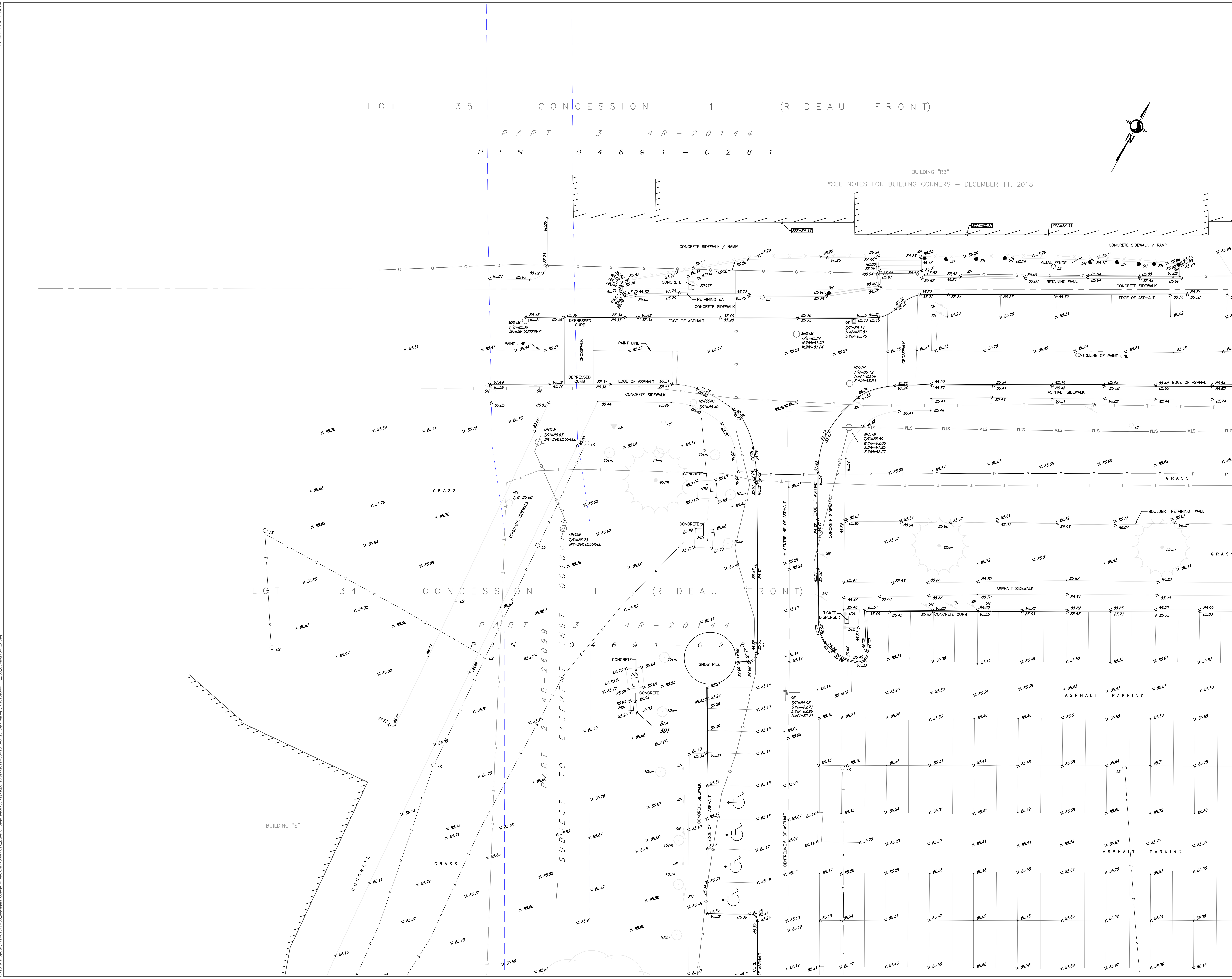
Thanks and regards,
James

James Fookes, P.Eng.

Senior Water and Wastewater Engineer
jfookes@morrisonhershfield.com

MORRISON HERSHFIELD
People • Culture • Capabilities

2440 Don Reid Drive | Ottawa, ON K1H 1E1 Canada
Dir: 613 739 2910 x1022225 | Cell: 613 869 9592 | Fax: 613 739 4926
morrisonhershfield.com



Stantec

Stantec Geomatics Ltd.
400 - 1331 Clyde Avenue
Ottawa ON
Tel. 613.722.4420
www.stantec.com

TOPOGRAPHIC SKETCH of

PART OF LOTS 34 & 35 CONCESSION 1 (RIDEAU FRONT)

(GEOGRAPHIC TOWNSHIP OF NEPEAN)

CITY OF OTTAWA

Scale 1:200

5 0 5 10 METRES

METRIC CONVERSION

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

BEARING NOTE

BEARINGS ARE ASTRONOMIC AND ARE REFERRED TO THE * LIMIT OF *, AS SHOWN ON PLAN *, HAVING A BEARING OF XX°XX'XX".

VERTICAL DATUM NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO A BENCHMARK SHOWN ON WEBSTER & SIMMONDS 1999 SURVEY, HAVING AN ELEVATION OF 85.35.

HORIZONTAL DATUM NOTE

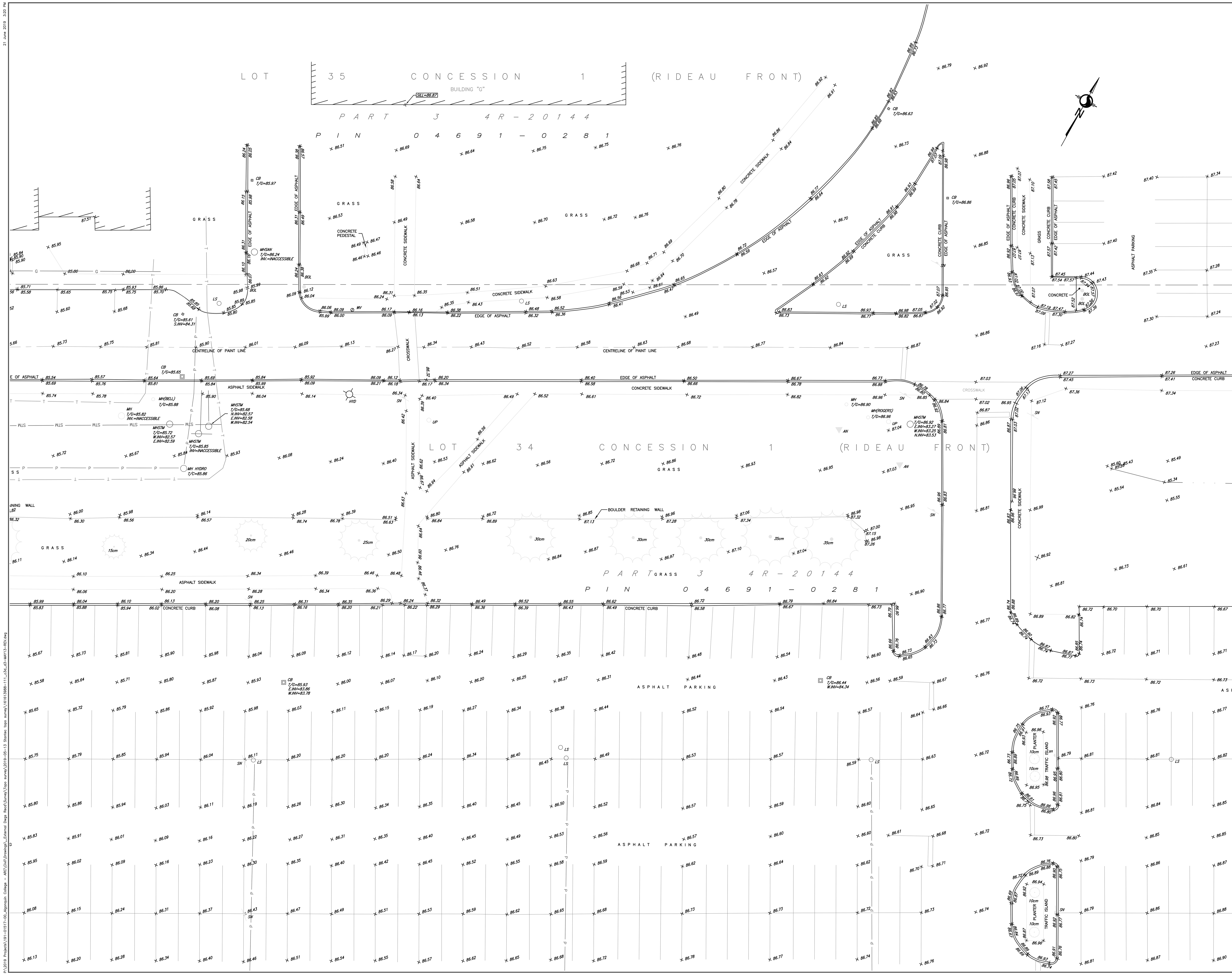
PROJECTION: UNIVERSAL TRANSVERSE MERCATOR (MTM, ZONE 9, CM76°30'W)
DATUM: NAD 83 (ORIGINAL)

DUE TO SNOW COVER CONDITIONS SOME LOW LYING FEATURES MAY NOT BE IDENTIFIED.

LEGEND

■	DENOTES	FOUND MONUMENTS
□	"	SET MONUMENTS
IB	"	IRON BAR
IBø	"	ROUND IRON BAR
SIB	"	STANDARD IRON BAR
SSIB	"	SHORT STANDARD IRON BAR
CC	"	CUT CROSS
CP	"	CONCRETE PIN
WIT	"	WITNESS
PIN	"	PROPERTY IDENTIFICATION NUMBER
MEAS	"	MEASURED
PROP	"	PROPORTIONED
OU	"	ORIGIN UNKNOWN
SG	"	STANTEC GEOMATICS LTD.
ORP	"	OBSERVED REFERENCE POINT
P	"	PLANTER
*	"	*
*	"	*
*	"	*
ACU	"	AIR CONDITIONING UNIT
AN	"	ANCHOR
ANT	"	ANTENNA
BH	"	BOREHOLE
BKR	"	BIKE RACK
BENCH	"	BENCH
BOL	"	BOLLARD
BOUL	"	BOULDER
CB	"	CATCH BASIN
DCB	"	DOUBLE CB
DICB	"	SWALE CB
CBMH	"	CB MANHOLE
DCBMH	"	DOUBLE CB MANHOLE
CBSI	"	SIDE INLET CB
CSV	"	VALVE CURB STOP
DRN	"	DRAIN
EPOST	"	ELECTRICAL OUTLET
FP	"	FLAG POLE
FL	"	FLOOD LIGHT
FTF	"	FUEL TANK FILLER CAP
GC	"	GARBAGE CAN
GFL	"	PIPE FLANGE (GAS)
GFP	"	GAS FUEL PUMP
GP	"	POLE GUYWIRE
GSR	"	GAS SERVICE REGULATOR
GV	"	GAS VALVE
HLS	"	LIGHT STANDARD HYDRO
HM	"	HYDRO METER
HTN	"	HYDRO TRANSFORMER
HW	"	HAND WELL
HYD	"	FIRE HYDRANT
JBX	"	JUNCTION BOX
MB	"	MAILBOX
MP	"	MONITORING PIN
MH	"	MAINTENANCE HOLE UNIDENTIFIED
MHBELL	"	MAINTENANCE HOLE BELL
MHF	"	MAINTENANCE HOLE FIBRE OPTIC
MHH	"	MAINTENANCE HOLE HYDRO
MHI	"	MAINTENANCE HOLE INVERT
MHSAN	"	MAINTENANCE HOLE SANITARY
MHSTM	"	MAINTENANCE HOLE STORM
MHT	"	MAINTENANCE HOLE TRAFFIC
MW	"	MONITORING WELL
NPB	"	NEWS PAPER BOX
OLP	"	LIGHT STANDARD ORNAMENTAL
OW	"	OBSERVATION WELL
PKM	"	PARKING METER
PLQ	"	PLAQUE
PLR	"	PILLAR
RLC	"	RED LIGHT CAMERA
SAT	"	SATELLITE DISH
SCLP	"	SCULPTURE
SCP	"	SUMP/CATCH PIT
SCV	"	SPRINKLER CONTROL VALVE
SH	"	SPRINKLER HEAD
SIA	"	SIAMESE CONNECTION
SN	"	SIGN
SPAN	"	SOLAR PANEL
SPT	"	SEPTIC TANK LID
TBL	"	TABLE
TB BELL	"	TERMINAL BOX - BELL
TB CATV	"	TERMINAL BOX - CABLE
TCB	"	TRAFFIC CONTROL BOX
TPIT	"	TEST PIT
TSL	"	TRAFFIC SIGNAL LIGHT
UMB	"	MARKER BELL UNDERGROUND
UMC	"	MARKER CABLE UNDERGROUND
UMG	"	MARKER GAS UNDERGROUND
UMO	"	MARKER OIL UNDERGROUND
UP	"	UTILITY POLE
VB	"	VALVE BOX
VC	"	VALVE CHAMBER
WV	"	WATER VALVE
	"	TREE STUMP
	"	TREE CONIFEROUS
	"	TREE DECIDUOUS

DRAWN: DM/NJ CHECKED: BW PM: BW FIELD: ES PROJECT No.: 161613988-111



Stantec

Stantec Geomatics Ltd.
400 - 1331 Clyde Avenue
Ottawa ON
Tel. 613.722.4420
www.stantec.com

TOPOGRAPHIC SKETCH of PART OF LOTS 34 & 35 CONCESSION 1 (RIDEAU FRONT)

(GEOGRAPHIC TOWNSHIP OF NEPEAN)

CITY OF OTTAWA

Scale 1:200

5 0 5 10 METRES

METRIC CONVERSION

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

BEARING NOTE

BEARINGS ARE ASTRONOMIC AND ARE REFERRED TO THE * LIMIT OF *, AS SHOWN ON PLAN *, HAVING A BEARING OF XX°XX'XX".

VERTICAL DATUM NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO A BENCHMARK SHOWN ON WEBSTER & SIMMONDS 1999 SURVEY, HAVING AN ELEVATION OF 85.35.

HORIZONTAL DATUM NOTE

PROJECTION: UNIVERSAL TRANSVERSE MERCATOR (MTM, ZONE 9, CM76°30'W)

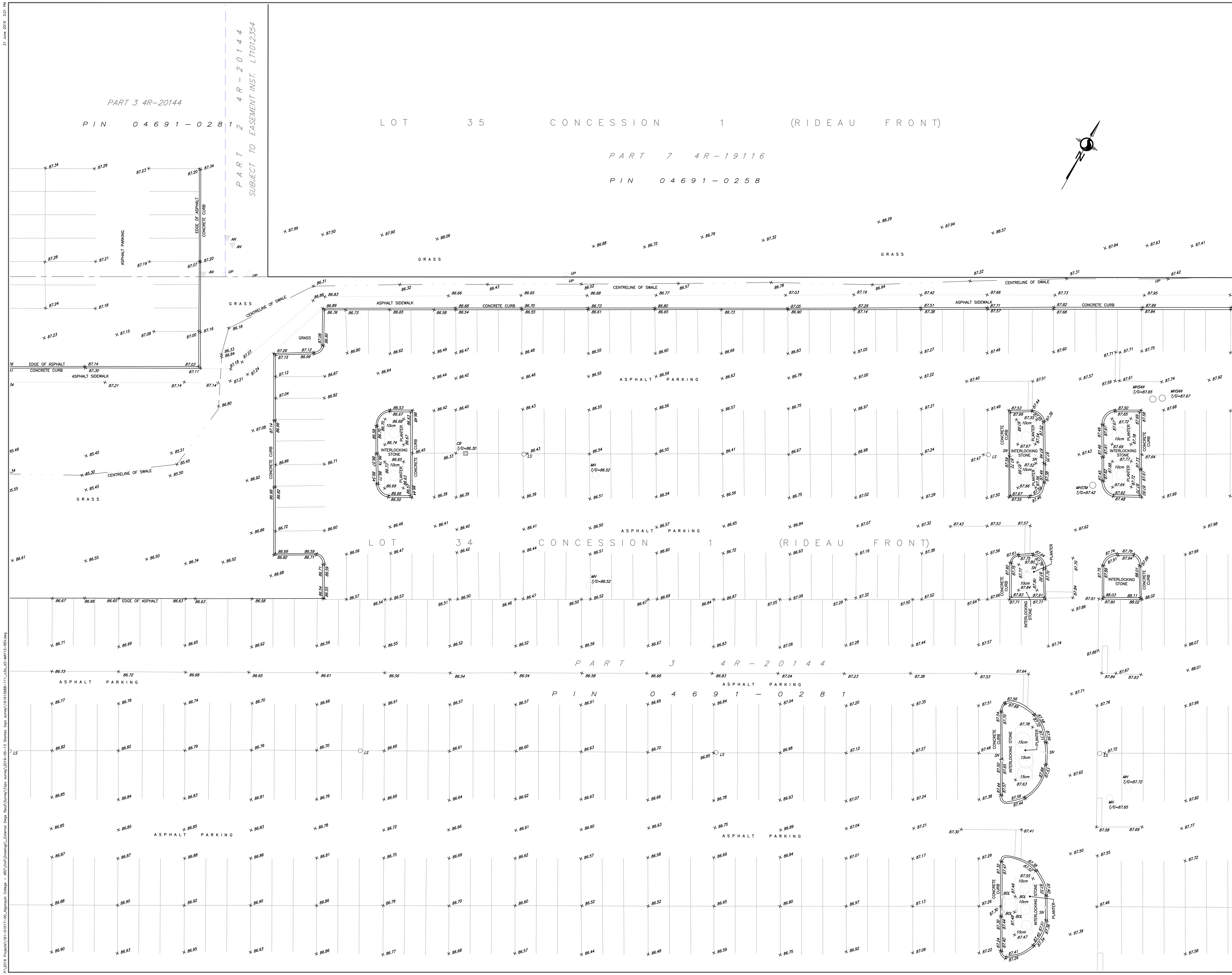
DATUM: NAD 83 (ORIGINAL)

DUE TO SNOW COVER CONDITIONS SOME LOW LYING FEATURES MAY NOT BE IDENTIFIED.

LEGEND

■	DENOTES	FOUND MONUMENTS
□	"	SET MONUMENTS
IB	"	IRON BAR
IBø	"	ROUND IRON BAR
SIB	"	STANDARD IRON BAR
SSIB	"	SHORT STANDARD IRON BAR
CC	"	CUT CROSS
CP	"	CONCRETE PIN
WIT	"	WITNESS
PIN	"	PROPERTY IDENTIFICATION NUMBER
MEAS	"	MEASURED
PROP	"	PROPORTIONED
OU	"	ORIGIN UNKNOWN
SG	"	STANTEC GEOMATICS LTD.
ORP	"	OBSERVED REFERENCE POINT
P	"	PLANTER
*	"	*
*	"	*
*	"	*
ACU	"	AIR CONDITIONING UNIT
AN	"	ANCHOR
ANT	"	ANTENNA
BH	"	BOREHOLE
BKR	"	BIKE RACK
BENCH	"	BENCH
BOL	"	BOLLARD
BOUL	"	BOULDER
CB	"	CATCH BASIN
DCB	"	DOUBLE CB
DICB	"	SWALE CB
CBMH	"	CB MANHOLE
DCBMH	"	DOUBLE CB MANHOLE
CBSI	"	SIDE INLET CB
CSV	"	VALVE CURB STOP
DRN	"	DRAIN
EPOST	"	ELECTRICAL OUTLET
FP	"	FLAG POLE
FL	"	FLOOD LIGHT
FTF	"	FUEL TANK FILLER CAP
GC	"	GARBAGE CAN
GFL	"	PIPE FLANGE (GAS)
GFP	"	GAS FUEL PUMP
GP	"	POLE GUYWIRE
GSR	"	GAS SERVICE REGULATOR
GV	"	GAS VALVE
HLS	"	LIGHT STANDARD HYDRO
HM	"	HYDRO METER
HTN	"	HYDRO TRANSFORMER
HW	"	HAND WELL
HYD	"	FIRE HYDRANT
JBX	"	JUNCTION BOX
MB	"	MAILBOX
MP	"	MONITORING PIN
MH	"	MAINTENANCE HOLE UNIDENTIFIED
MHBELL	"	MAINTENANCE HOLE BELL
MHF	"	MAINTENANCE HOLE FIBRE OPTIC
MHH	"	MAINTENANCE HOLE HYDRO
MHI	"	MAINTENANCE HOLE INVERT
MHSAN	"	MAINTENANCE HOLE SANITARY
MHSTM	"	MAINTENANCE HOLE STORM
MHT	"	MAINTENANCE HOLE TRAFFIC
MW	"	MONITORING WELL
NPB	"	NEWS PAPER BOX
OLP	"	LIGHT STANDARD ORNAMENTAL
OW	"	OBSERVATION WELL
PKM	"	PARKING METER
PLQ	"	PLAQUE
PLR	"	PILLAR
RLC	"	RED LIGHT CAMERA
SAT	"	SATELLITE DISH
SCLP	"	SCULPTURE
SCP	"	SUMP/CATCH PIT
SCV	"	SPRINKLER CONTROL VALVE
SH	"	SPRINKLER HEAD
SIA	"	SIAMESE CONNECTION
SN	"	SIGN
SPAN	"	SOLAR PANEL
SPT	"	SEPTIC TANK LID
TBL	"	TABLE
TB BELL	"	TERMINAL BOX - BELL
TB CATV	"	TERMINAL BOX - CABLE
TCB	"	TRAFFIC CONTROL BOX
TPIT	"	TEST PIT
TSL	"	TRAFFIC SIGNAL LIGHT
UMB	"	MARKER BELL UNDERGROUND
UMC	"	MARKER CABLE UNDERGROUND
UMG	"	MARKER GAS UNDERGROUND
UMO	"	MARKER OIL UNDERGROUND
UP	"	UTILITY POLE
VB	"	VALVE BOX
VC	"	VALVE CHAMBER
WV	"	WATER VALVE
	"	TREE STUMP
	"	TREE CONIFEROUS
	"	TREE DECIDUOUS

DRAWN: DM/NJ CHECKED: BW PM: BW FIELD: ES PROJECT No.: 161613988-111



Stantec

Stantec Geomatics Ltd.
400 - 1331 Clyde Avenue
Ottawa ON
Tel. 613.722.4420
www.stantec.com

TOPOGRAPHIC SKETCH of
PART OF LOTS 34 & 35 CONCESSION 1 (RIDEAU FRONT)
(GEOGRAPHIC TOWNSHIP OF NEPEAN)
CITY OF OTTAWA

Scale 1:200

5 0 5 10 METRES

METRIC CONVERSION
DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

BEARING NOTE
BEARINGS ARE ASTRONOMIC AND ARE REFERRED TO THE * LIMIT OF *, AS SHOWN ON PLAN *, HAVING A BEARING OF XX°XX'XX".

VERTICAL DATUM NOTE
ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO A BENCHMARK SHOWN ON WEBSTER & SIMMONDS 1999 SURVEY, HAVING AN ELEVATION OF 85.35.

HORIZONTAL DATUM NOTE
PROJECTION: UNIVERSAL TRANSVERSE MERCATOR (MTM, ZONE 9, CM76°30'W)
DATUM: NAD 83 (ORIGINAL)

DUE TO SNOW COVER CONDITIONS SOME LOW LYING FEATURES MAY NOT BE IDENTIFIED.

LEGEND

■	DENOTES	FOUND MONUMENTS
□	"	SET MONUMENTS
IB	"	IRON BAR
IBø	"	ROUND IRON BAR
SIB	"	STANDARD IRON BAR
SSIB	"	SHORT STANDARD IRON BAR
CC	"	CUT CROSS
CP	"	CONCRETE PIN
WIT	"	WITNESS
PIN	"	PROPERTY IDENTIFICATION NUMBER
MEAS	"	MEASURED
PROP	"	PROPORTIONED
OU	"	ORIGIN UNKNOWN
SG	"	STANTEC GEOMATICS LTD.
ORP	"	OBSERVED REFERENCE POINT
P	"	PLANTER
*	"	*
*	"	*
*	"	*
ACU	"	AIR CONDITIONING UNIT
AN	"	ANCHOR
ANT	"	ANTENNA
BH	"	BOREHOLE
BKR	"	BIKE RACK
BENCH	"	BENCH
BOL	"	BOLLARD
BOUL	"	BOULDER
CB	"	CATCH BASIN
DCB	"	DOUBLE CB
DICB	"	SWALE CB
CBMH	"	CB MANHOLE
DCBMH	"	DOUBLE CB MANHOLE
CBSI	"	SIDE INLET CB
CSV	"	VALVE CURB STOP
DRN	"	DRAIN
EPOST	"	ELECTRICAL OUTLET
FP	"	FLAG POLE
FL	"	FLOOD LIGHT
FTF	"	FUEL TANK FILLER CAP
GC	"	GARBAGE CAN
GFL	"	PIPE FLANGE (GAS)
GFP	"	GAS FUEL PUMP
GP	"	POLE GUYWIRE
GSR	"	GAS SERVICE REGULATOR
GV	"	GAS VALVE
HLS	"	LIGHT STANDARD HYDRO
HM	"	HYDRO METER
HTN	"	HYDRO TRANSFORMER
HW	"	HAND WELL
HYD	"	FIRE HYDRANT
JBX	"	JUNCTION BOX
MB	"	MAILBOX
MP	"	MONITORING PIN
MH	"	MAINTENANCE HOLE UNIDENTIFIED
MHBELL	"	MAINTENANCE HOLE BELL
MHF	"	MAINTENANCE HOLE FIBRE OPTIC
MHH	"	MAINTENANCE HOLE HYDRO
MHI	"	MAINTENANCE HOLE INVERT
MHSAN	"	MAINTENANCE HOLE SANITARY
MHSTM	"	MAINTENANCE HOLE STORM
MHT	"	MAINTENANCE HOLE TRAFFIC
MW	"	MONITORING WELL
NPB	"	NEWS PAPER BOX
OLP	"	LIGHT STANDARD ORNAMENTAL
OW	"	OBSERVATION WELL
PKM	"	PARKING METER
PLQ	"	PLAQUE
PLR	"	PILLAR
RLC	"	RED LIGHT CAMERA
SAT	"	SATELLITE DISH
SCLP	"	SCULPTURE
SCP	"	SUMP/CATCH PIT
SCV	"	SPRINKLER CONTROL VALVE
SH	"	SPRINKLER HEAD
SIA	"	SIAMESE CONNECTION
SN	"	SIGN
SPAN	"	SOLAR PANEL
SPT	"	SEPTIC TANK LID
TBL	"	TABLE
TB BELL	"	TERMINAL BOX - BELL
TB CATV	"	TERMINAL BOX - CABLE
TCB	"	TRAFFIC CONTROL BOX
TPIT	"	TEST PIT
TSL	"	TRAFFIC SIGNAL LIGHT
UMB	"	MARKER BELL UNDERGROUND
UMC	"	MARKER CABLE UNDERGROUND
UMG	"	MARKER GAS UNDERGROUND
UMO	"	MARKER OIL UNDERGROUND
UP	"	UTILITY POLE
VB	"	VALVE BOX
VC	"	VALVE CHAMBER
WV	"	WATER VALVE
	"	TREE STUMP
	"	TREE CONIFEROUS
	"	TREE DECIDUOUS

DRAWN: DM/NJ CHECKED: BW PM: BW FIELD: ES PROJECT No.: 161613988-111

Stantec Geomatics Ltd.
400 - 1331 Clyde Avenue
Ottawa ON
Tel. 613.722.4420
www.stantec.com

TOPOGRAPHIC SKETCH of

PART OF LOTS 34 & 35 CONCESSION 1 (RIDEAU FRONT)

(GEOGRAPHIC TOWNSHIP OF NEPEAN)

CITY OF OTTAWA

Scale 1:200

5 0 5 10 METRES

METRIC CONVERSION

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

BEARING NOTE

BEARINGS ARE ASTRONOMIC AND ARE REFERRED TO THE * LIMIT OF *, AS SHOWN ON PLAN *, HAVING A BEARING OF XX°XX'XX".

VERTICAL DATUM NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO A BENCHMARK SHOWN ON WEBSTER & SIMMONDS 1999 SURVEY, HAVING AN ELEVATION OF 85.35.

HORIZONTAL DATUM NOTE

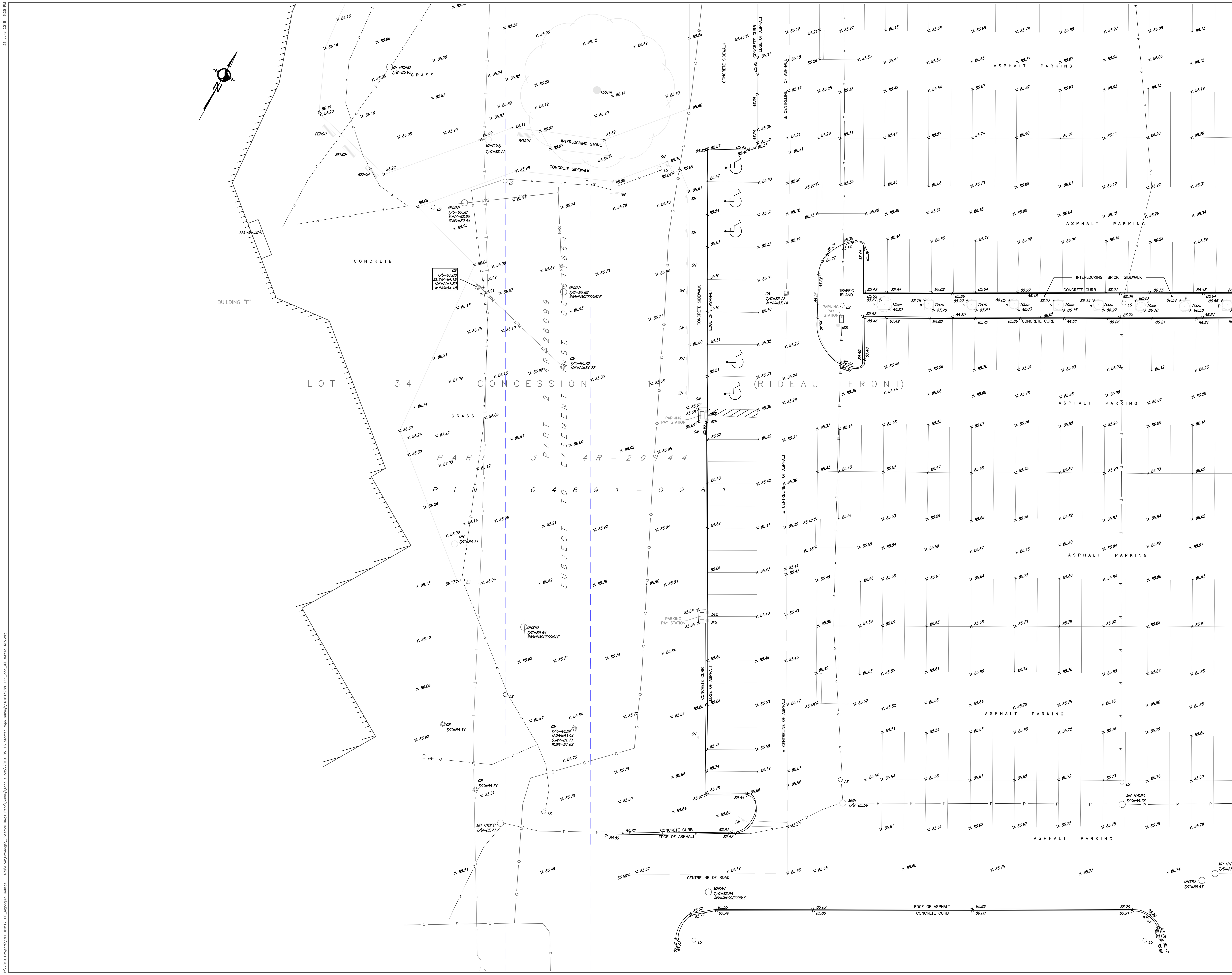
PROJECTION: UNIVERSAL TRANSVERSE MERCATOR (MTM, ZONE 9, CM76°30'W)
DATUM: NAD 83 (ORIGINAL)

DUE TO SNOW COVER CONDITIONS SOME LOW LYING FEATURES MAY NOT BE IDENTIFIED.

LEGEND

■	DENOTES	FOUND MONUMENTS
□	"	SET MONUMENTS
IB	"	IRON BAR
IBø	"	ROUND IRON BAR
SIB	"	STANDARD IRON BAR
SSIB	"	SHORT STANDARD IRON BAR
CC	"	CUT CROSS
CP	"	CONCRETE PIN
WIT	"	WITNESS
PIN	"	PROPERTY IDENTIFICATION NUMBER
MEAS	"	MEASURED
PROP	"	PROPORTIONED
OU	"	ORIGIN UNKNOWN
SG	"	STANTEC GEOMATICS LTD.
ORP	"	OBSERVED REFERENCE POINT
P	"	PLANTER
*	"	*
*	"	*
*	"	*
ACU	"	AIR CONDITIONING UNIT
AN	"	ANCHOR
ANT	"	ANTENNA
BH	"	BOREHOLE
BKR	"	BIKE RACK
BENCH	"	BENCH
BOL	"	BOLLARD
BOUL	"	BOULDER
CB	"	CATCH BASIN
DCB	"	DOUBLE CB
DICB	"	SWALE CB
CBMH	"	CB MANHOLE
DCBMH	"	DOUBLE CB MANHOLE
CBSI	"	SIDE INLET CB
CSV	"	VALVE CURB STOP
DRN	"	DRAIN
EPOST	"	ELECTRICAL OUTLET
FP	"	FLAG POLE
FL	"	FLOOD LIGHT
FTF	"	FUEL TANK FILLER CAP
GC	"	GARBAGE CAN
GFL	"	PIPE FLANGE (GAS)
GFP	"	GAS FUEL PUMP
GP	"	POLE GUYWIRE
GSR	"	GAS SERVICE REGULATOR
GV	"	GAS VALVE
HLS	"	LIGHT STANDARD HYDRO
HM	"	HYDRO METER
HTN	"	HYDRO TRANSFORMER
HW	"	HAND WELL
HYD	"	FIRE HYDRANT
JBX	"	JUNCTION BOX
MB	"	MAILBOX
MP	"	MONITORING PIN
MH	"	MAINTENANCE HOLE UNIDENTIFIED
MHBELL	"	MAINTENANCE HOLE BELL
MHF	"	MAINTENANCE HOLE FIBRE OPTIC
MHH	"	MAINTENANCE HOLE HYDRO
MHI	"	MAINTENANCE HOLE INVERT
MHSAN	"	MAINTENANCE HOLE SANITARY
MHSTM	"	MAINTENANCE HOLE STORM
MHT	"	MAINTENANCE HOLE TRAFFIC
MW	"	MONITORING WELL
NPB	"	NEWS PAPER BOX
OLP	"	LIGHT STANDARD ORNAMENTAL
OW	"	OBSERVATION WELL
PKM	"	PARKING METER
PLQ	"	PLAQUE
PLR	"	PILLAR
RLC	"	RED LIGHT CAMERA
SAT	"	SATELLITE DISH
SCLP	"	SCULPTURE
SCP	"	SUMP/CATCH PIT
SCV	"	SPRINKLER CONTROL VALVE
SH	"	SPRINKLER HEAD
SIA	"	SIAMESE CONNECTION
SN	"	SIGN
SPAN	"	SOLAR PANEL
SPT	"	SEPTIC TANK LID
TBL	"	TABLE
TB BELL	"	TERMINAL BOX - BELL
TB CATV	"	TERMINAL BOX - CABLE
TCB	"	TRAFFIC CONTROL BOX
TPIT	"	TEST PIT
TSL	"	TRAFFIC SIGNAL LIGHT
UMB	"	MARKER BELL UNDERGROUND
UMC	"	MARKER CABLE UNDERGROUND
UMG	"	MARKER GAS UNDERGROUND
UMO	"	MARKER OIL UNDERGROUND
UP	"	UTILITY POLE
VB	"	VALVE BOX
VC	"	VALVE CHAMBER
WV	"	WATER VALVE
	"	TREE STUMP
	"	TREE CONIFEROUS
	"	TREE DECIDUOUS

DRAWN: DM/NJ CHECKED: BW PM: BW FIELD: ES PROJECT No.: 161613988-111



Stantec

Stantec Geomatics Ltd.
400 - 1331 Clyde Avenue
Ottawa ON
Tel. 613.722.4420
www.stantec.com

TOPOGRAPHIC SKETCH of PART OF LOTS 34 & 35 CONCESSION 1 (RIDEAU FRONT)

(GEOGRAPHIC TOWNSHIP OF NEPEAN)

CITY OF OTTAWA

Scale 1:200

5 0 5 10 METRES

METRIC CONVERSION

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

BEARING NOTE

BEARINGS ARE ASTRONOMIC AND ARE REFERRED TO THE * LIMIT OF *, AS SHOWN ON PLAN *, HAVING A BEARING OF XX°XX'XX".

VERTICAL DATUM NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO A BENCHMARK SHOWN ON WEBSTER & SIMMONDS 1999 SURVEY, HAVING AN ELEVATION OF 85.35.

HORIZONTAL DATUM NOTE

PROJECTION: UNIVERSAL TRANSVERSE MERCATOR (MTM, ZONE 9, CM76°30'W)

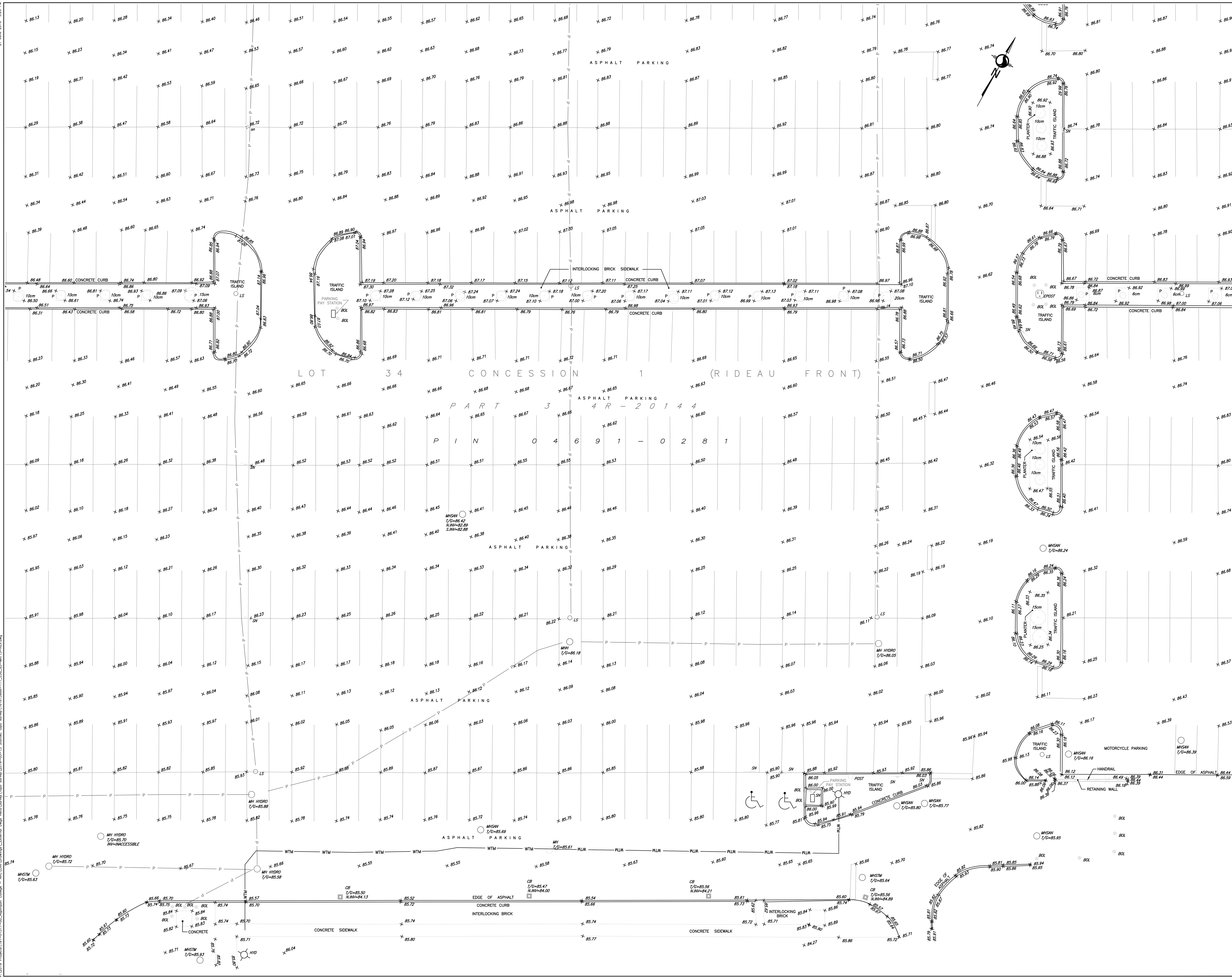
DATUM: NAD 83 (ORIGINAL)

DUE TO SNOW COVER CONDITIONS SOME LOW LYING FEATURES MAY NOT BE IDENTIFIED.

LEGEND

■	DENOTES	FOUND MONUMENTS
□	"	SET MONUMENTS
IB	"	IRON BAR
IBø	"	ROUND IRON BAR
SIB	"	STANDARD IRON BAR
SSIB	"	SHORT STANDARD IRON BAR
CC	"	CUT CROSS
CP	"	CONCRETE PIN
WIT	"	WITNESS
PIN	"	PROPERTY IDENTIFICATION NUMBER
MEAS	"	MEASURED
PROP	"	PROPORTIONED
OU	"	ORIGIN UNKNOWN
SG	"	STANTEC GEOMATICS LTD.
ORP	"	OBSERVED REFERENCE POINT
P	"	PLANTER
*	"	*
*	"	*
*	"	*
ACU	"	AIR CONDITIONING UNIT
AN	"	ANCHOR
ANT	"	ANTENNA
BH	"	BOREHOLE
BKR	"	BIKE RACK
BENCH	"	BENCH
BOL	"	BOLLARD
BOUL	"	BOULDER
CB	"	CATCH BASIN
DCB	"	DOUBLE CB
DICB	"	SWALE CB
CBMH	"	CB MANHOLE
DCBMH	"	DOUBLE CB MANHOLE
CBSI	"	SIDE INLET CB
CSV	"	VALVE CURB STOP
DRN	"	DRAIN
EPOST	"	ELECTRICAL OUTLET
FP	"	FLAG POLE
FL	"	FLOOD LIGHT
FTF	"	FUEL TANK FILLER CAP
GC	"	GARBAGE CAN
GFL	"	PIPE FLANGE (GAS)
GFP	"	GAS FUEL PUMP
GP	"	POLE GUYWIRE
GSR	"	GAS SERVICE REGULATOR
GV	"	GAS VALVE
HLS	"	LIGHT STANDARD HYDRO
HM	"	HYDRO METER
HTN	"	HYDRO TRANSFORMER
HW	"	HAND WELL
HYD	"	FIRE HYDRANT
JBX	"	JUNCTION BOX
MB	"	MAILBOX
MP	"	MONITORING PIN
MH	"	MAINTENANCE HOLE UNIDENTIFIED
MHBELL	"	MAINTENANCE HOLE BELL
MHF	"	MAINTENANCE HOLE FIBRE OPTIC
MHH	"	MAINTENANCE HOLE HYDRO
MHI	"	MAINTENANCE HOLE INVERT
MHSAN	"	MAINTENANCE HOLE SANITARY
MHSTM	"	MAINTENANCE HOLE STORM
MHT	"	MAINTENANCE HOLE TRAFFIC
MW	"	MONITORING WELL
NPB	"	NEWS PAPER BOX
OLP	"	LIGHT STANDARD ORNAMENTAL
OW	"	OBSERVATION WELL
PKM	"	PARKING METER
PLQ	"	PLAQUE
PLR	"	PILLAR
RLC	"	RED LIGHT CAMERA
SAT	"	SATELLITE DISH
SCLP	"	SCULPTURE
SCP	"	SUMP/CATCH PIT
SCV	"	SPRINKLER CONTROL VALVE
SH	"	SPRINKLER HEAD
SIA	"	SIAMESE CONNECTION
SN	"	SIGN
SPAN	"	SOLAR PANEL
SPT	"	SEPTIC TANK LID
TBL	"	TABLE
TB BELL	"	TERMINAL BOX - BELL
TB CATV	"	TERMINAL BOX - CABLE
TCB	"	TRAFFIC CONTROL BOX
TPIT	"	TEST PIT
TSL	"	TRAFFIC SIGNAL LIGHT
UMB	"	MARKER BELL UNDERGROUND
UMC	"	MARKER CABLE UNDERGROUND
UMG	"	MARKER GAS UNDERGROUND
UMO	"	MARKER OIL UNDERGROUND
UP	"	UTILITY POLE
VB	"	VALVE BOX
VC	"	VALVE CHAMBER
WV	"	WATER VALVE
	"	TREE STUMP
	"	TREE CONIFEROUS
	"	TREE DECIDUOUS

DRAWN: DM/NJ CHECKED: BW PM: BW FIELD: ES PROJECT No.: 161613988-111



Stantec

Stantec Geomatics Ltd.
400 - 1331 Clyde Avenue
Ottawa ON
Tel. 613.722.4420
www.stantec.com

TOPOGRAPHIC SKETCH of
PART OF LOTS 34 & 35 CONCESSION 1 (RIDEAU FRONT)
(GEOGRAPHIC TOWNSHIP OF NEPEAN)
CITY OF OTTAWA

Scale 1:200

5 0 5 10 METRES

METRIC CONVERSION
DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

BEARING NOTE
BEARINGS ARE ASTRONOMIC AND ARE REFERRED TO THE * LIMIT OF *, AS SHOWN ON PLAN *, HAVING A BEARING OF XX°XX'XX".

VERTICAL DATUM NOTE
ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO A BENCHMARK SHOWN ON WEBSTER & SIMMONDS 1999 SURVEY, HAVING AN ELEVATION OF 85.35.

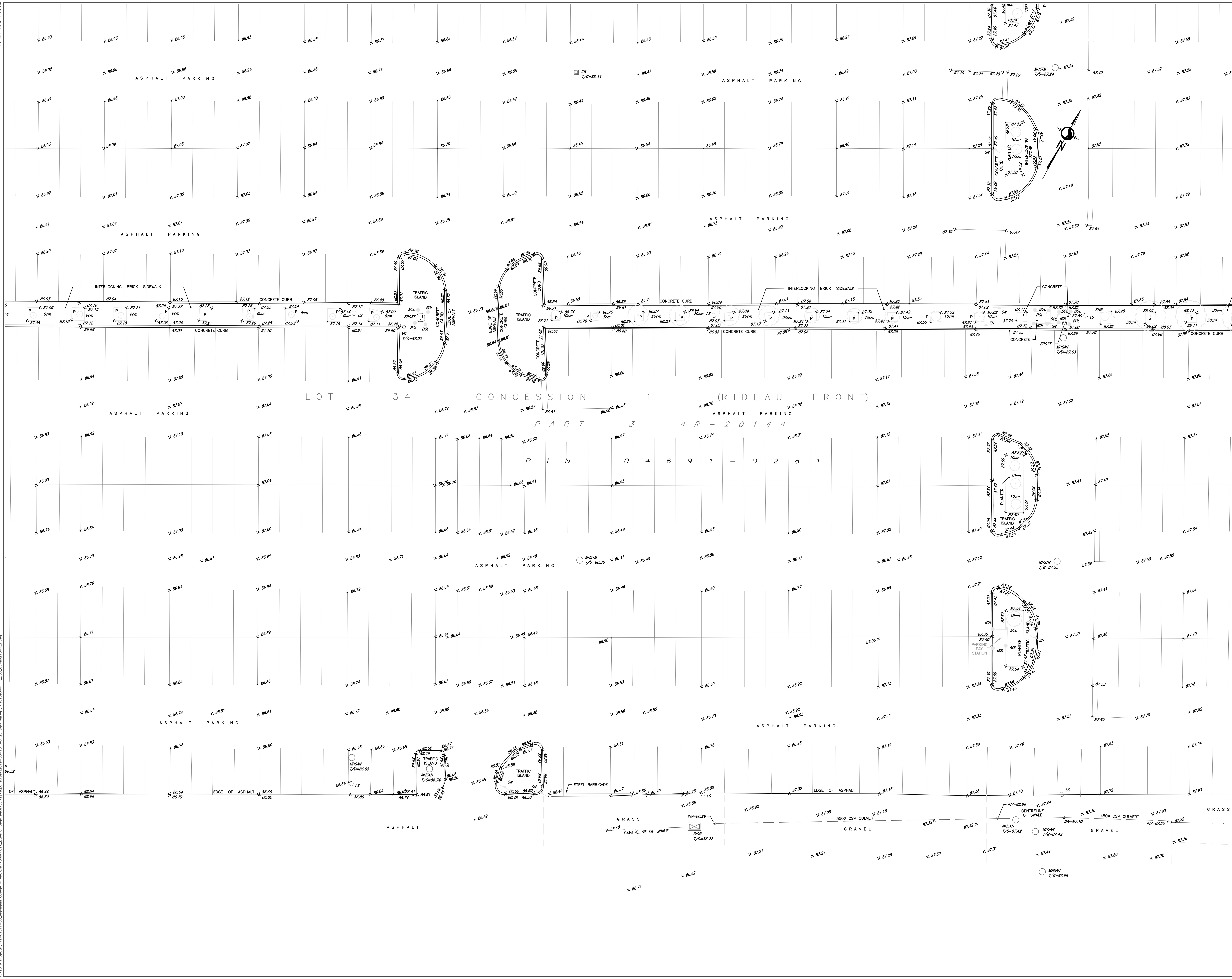
HORIZONTAL DATUM NOTE
PROJECTION: UNIVERSAL TRANSVERSE MERCATOR (MTM, ZONE 9, CM76°30'W)
DATUM: NAD 83 (ORIGINAL)

DUE TO SNOW COVER CONDITIONS SOME LOW LYING FEATURES MAY NOT BE IDENTIFIED.

LEGEND

■	DENOTES	FOUND MONUMENTS
□	"	SET MONUMENTS
IB	"	IRON BAR
IBø	"	ROUND IRON BAR
SIB	"	STANDARD IRON BAR
SSIB	"	SHORT STANDARD IRON BAR
CC	"	CUT CROSS
CP	"	CONCRETE PIN
WIT	"	WITNESS
PIN	"	PROPERTY IDENTIFICATION NUMBER
MEAS	"	MEASURED
PROP	"	PROPORTIONED
OU	"	ORIGIN UNKNOWN
SG	"	STANTEC GEOMATICS LTD.
ORP	"	OBSERVED REFERENCE POINT
P	"	PLANTER
*	"	*
*	"	*
*	"	*
ACU	"	AIR CONDITIONING UNIT
AN	"	ANCHOR
ANT	"	ANTENNA
BH	"	BOREHOLE
BKR	"	BIKE RACK
BENCH	"	BENCH
BOL	"	BOLLARD
BOUL	"	BOULDER
CB	"	CATCH BASIN
DCB	"	DOUBLE CB
DICB	"	SWALE CB
CBMH	"	CB MANHOLE
DCBMH	"	DOUBLE CB MANHOLE
CBSI	"	SIDE INLET CB
CSV	"	VALVE CURB STOP
DRN	"	DRAIN
EPOST	"	ELECTRICAL OUTLET
FP	"	FLAG POLE
FL	"	FLOOD LIGHT
FTF	"	FUEL TANK FILLER CAP
GC	"	GARBAGE CAN
GFL	"	PIPE FLANGE (GAS)
GFP	"	GAS FUEL PUMP
GP	"	POLE GUYWIRE
GSR	"	GAS SERVICE REGULATOR
GV	"	GAS VALVE
HLS	"	LIGHT STANDARD HYDRO
HM	"	HYDRO METER
HTN	"	HYDRO TRANSFORMER
HW	"	HAND WELL
HYD	"	FIRE HYDRANT
JBX	"	JUNCTION BOX
MB	"	MAILBOX
MP	"	MONITORING PIN
MH	"	MAINTENANCE HOLE UNIDENTIFIED
MHBELL	"	MAINTENANCE HOLE BELL
MHF	"	MAINTENANCE HOLE FIBRE OPTIC
MHH	"	MAINTENANCE HOLE HYDRO
MHI	"	MAINTENANCE HOLE INVERT
MHSAN	"	MAINTENANCE HOLE SANITARY
MHSTM	"	MAINTENANCE HOLE STORM
MHT	"	MAINTENANCE HOLE TRAFFIC
MW	"	MONITORING WELL
NPB	"	NEWS PAPER BOX
OLP	"	LIGHT STANDARD ORNAMENTAL
OW	"	OBSERVATION WELL
PKM	"	PARKING METER
PLQ	"	PLAQUE
PLR	"	PILLAR
RLC	"	RED LIGHT CAMERA
SAT	"	SATELLITE DISH
SCLP	"	SCULPTURE
SCP	"	SUMP/CATCH PIT
SCV	"	SPRINKLER CONTROL VALVE
SH	"	SPRINKLER HEAD
SIA	"	SIAMESE CONNECTION
SN	"	SIGN
SPAN	"	SOLAR PANEL
SPT	"	SEPTIC TANK LID
TBL	"	TABLE
TB BELL	"	TERMINAL BOX - BELL
TB CATV	"	TERMINAL BOX - CABLE
TCB	"	TRAFFIC CONTROL BOX
TPIT	"	TEST PIT
TSL	"	TRAFFIC SIGNAL LIGHT
UMB	"	MARKER BELL UNDERGROUND
UMC	"	MARKER CABLE UNDERGROUND
UMG	"	MARKER GAS UNDERGROUND
UMO	"	MARKER OIL UNDERGROUND
UP	"	UTILITY POLE
VB	"	VALVE BOX
VC	"	VALVE CHAMBER
WV	"	WATER VALVE
	"	TREE STUMP
	"	TREE CONIFEROUS
	"	TREE DECIDUOUS

DRAWN: DM/NJ CHECKED: BW PM: BW FIELD: ES PROJECT No.: 161613988-111



Stantec

Stantec Geomatics Ltd.
400 - 1331 Clyde Avenue
Ottawa ON
Tel. 613.722.4420
www.stantec.com

TOPOGRAPHIC SKETCH of

PART OF LOTS 34 & 35 CONCESSION 1 (RIDEAU FRONT)

(GEOGRAPHIC TOWNSHIP OF NEPEAN)

CITY OF OTTAWA

Scale 1:200

5 0 5 10 METRES

METRIC CONVERSION

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

BEARING NOTE

BEARINGS ARE ASTRONOMIC AND ARE REFERRED TO THE * LIMIT OF *, AS SHOWN ON PLAN *, HAVING A BEARING OF XX°XX'XX".

VERTICAL DATUM NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO A BENCHMARK SHOWN ON WEBSTER & SIMMONDS 1999 SURVEY, HAVING AN ELEVATION OF 85.35.

HORIZONTAL DATUM NOTE

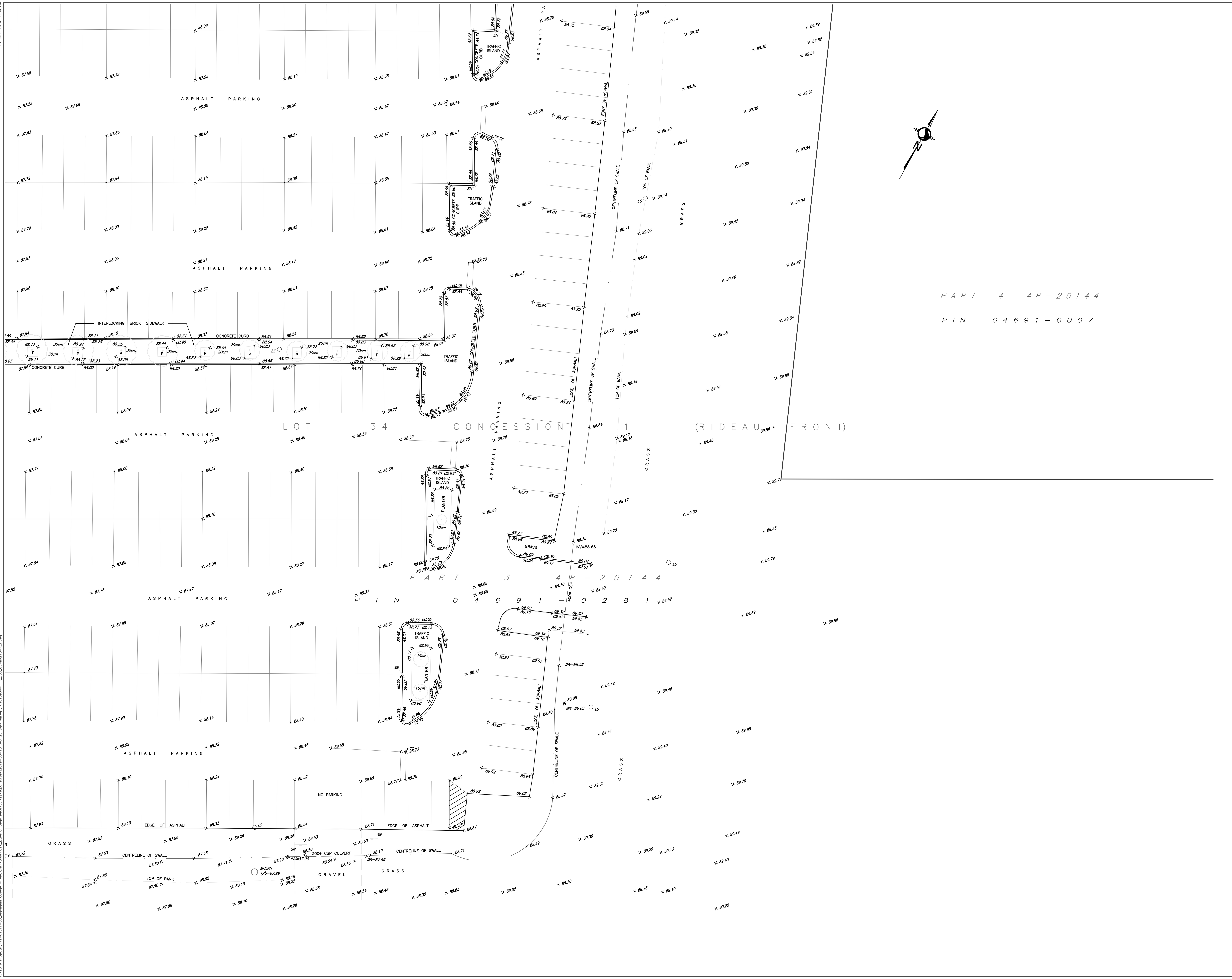
PROJECTION: UNIVERSAL TRANSVERSE MERCATOR
(MTM, ZONE 9, CM76°30'W)
DATUM: NAD 83 (ORIGINAL)

DUE TO SNOW COVER CONDITIONS SOME LOW LYING FEATURES MAY NOT BE IDENTIFIED.

LEGEND

■	DENOTES	FOUND MONUMENTS
□	"	SET MONUMENTS
IB	"	IRON BAR
IBø	"	ROUND IRON BAR
SIB	"	STANDARD IRON BAR
SSIB	"	SHORT STANDARD IRON BAR
CC	"	CUT CROSS
CP	"	CONCRETE PIN
WIT	"	WITNESS
PIN	"	PROPERTY IDENTIFICATION NUMBER
MEAS	"	MEASURED
PROP	"	PROPORTIONED
OU	"	ORIGIN UNKNOWN
SG	"	STANTEC GEOMATICS LTD.
ORP	"	OBSERVED REFERENCE POINT
P	"	PLANTER
*	"	*
*	"	*
*	"	*
ACU	"	AIR CONDITIONING UNIT
AN	"	ANCHOR
ANT	"	ANTENNA
BH	"	BOREHOLE
BKR	"	BIKE RACK
BENCH	"	BENCH
BOL	"	BOLLARD
BOUL	"	BOULDER
CB	"	CATCH BASIN
DCB	"	DOUBLE CB
DICB	"	SWALE CB
CBMH	"	CB MANHOLE
DCBMH	"	DOUBLE CB MANHOLE
CBSI	"	SIDE INLET CB
CSV	"	VALVE CURB STOP
DRN	"	DRAIN
EPOST	"	ELECTRICAL OUTLET
FP	"	FLAG POLE
FL	"	FLOOD LIGHT
FTF	"	FUEL TANK FILLER CAP
GC	"	GARBAGE CAN
GFL	"	PIPE FLANGE (GAS)
GFP	"	GAS FUEL PUMP
GP	"	POLE GUYWIRE
GSR	"	GAS SERVICE REGULATOR
GV	"	GAS VALVE
HLS	"	LIGHT STANDARD HYDRO
HM	"	HYDRO METER
HTN	"	HYDRO TRANSFORMER
HW	"	HAND WELL
HYD	"	FIRE HYDRANT
JBX	"	JUNCTION BOX
MB	"	MAILBOX
MP	"	MONITORING PIN
MH	"	MAINTENANCE HOLE UNIDENTIFIED
MHBELL	"	MAINTENANCE HOLE BELL
MHF	"	MAINTENANCE HOLE FIBRE OPTIC
MHH	"	MAINTENANCE HOLE HYDRO
MHI	"	MAINTENANCE HOLE INVERT
MHSAN	"	MAINTENANCE HOLE SANITARY
MHSTM	"	MAINTENANCE HOLE STORM
MHT	"	MAINTENANCE HOLE TRAFFIC
MW	"	MONITORING WELL
NPB	"	NEWS PAPER BOX
OLP	"	LIGHT STANDARD ORNAMENTAL
OW	"	OBSERVATION WELL
PKM	"	PARKING METER
PLQ	"	PLAQUE
PLR	"	PILLAR
RLC	"	RED LIGHT CAMERA
SAT	"	SATELLITE DISH
SCLP	"	SCULPTURE
SCP	"	SUMP/CATCH PIT
SCV	"	SPRINKLER CONTROL VALVE
SH	"	SPRINKLER HEAD
SIA	"	SIAMESE CONNECTION
SN	"	SIGN
SPAN	"	SOLAR PANEL
SPT	"	SEPTIC TANK LID
TBL	"	TABLE
TB BELL	"	TERMINAL BOX - BELL
TB CATV	"	TERMINAL BOX - CABLE
TCB	"	TRAFFIC CONTROL BOX
TPIT	"	TEST PIT
TSL	"	TRAFFIC SIGNAL LIGHT
UMB	"	MARKER BELL UNDERGROUND
UMC	"	MARKER CABLE UNDERGROUND
UMG	"	MARKER GAS UNDERGROUND
UMO	"	MARKER OIL UNDERGROUND
UP	"	UTILITY POLE
VB	"	VALVE BOX
VC	"	VALVE CHAMBER
WV	"	WATER VALVE
	"	TREE STUMP
	"	TREE CONIFEROUS
	"	TREE DECIDUOUS

DRAWN: DM/NJ CHECKED: BW PM: BW FIELD: ES PROJECT No.: 161613988-111



Stantec Geomatics Ltd.
400 - 1331 Clyde Avenue
Ottawa ON
Tel. 613.722.4420
www.stantec.com

TOPOGRAPHIC SKETCH of PART OF LOTS 34 & 35 CONCESSION 1 (RIDEAU FRONT)

(GEOGRAPHIC TOWNSHIP OF NEPEAN)

CITY OF OTTAWA

Scale 1:200

5 0 5 10 METRES

METRIC CONVERSION

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

BEARING NOTE

BEARINGS ARE ASTRONOMIC AND ARE REFERRED TO THE * LIMIT OF *, AS SHOWN ON PLAN *, HAVING A BEARING OF XX°XX'XX".

VERTICAL DATUM NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE REFERRED TO A BENCHMARK SHOWN ON WEBSTER & SIMMONDS 1999 SURVEY, HAVING AN ELEVATION OF 85.35.

HORIZONTAL DATUM NOTE

PROJECTION: UNIVERSAL TRANSVERSE MERCATOR (MTM, ZONE 9, CM76°30'W)

DATUM: NAD 83 (ORIGINAL)

DUE TO SNOW COVER CONDITIONS SOME LOW LYING FEATURES MAY NOT BE IDENTIFIED.

LEGEND

■	DENOTES	FOUND MONUMENTS
□	"	SET MONUMENTS
IB	"	IRON BAR
IBø	"	ROUND IRON BAR
SIB	"	STANDARD IRON BAR
SSIB	"	SHORT STANDARD IRON BAR
CC	"	CUT CROSS
CP	"	CONCRETE PIN
WIT	"	WITNESS
PIN	"	PROPERTY IDENTIFICATION NUMBER
MEAS	"	MEASURED
PROP	"	PROPORTIONED
OU	"	ORIGIN UNKNOWN
SG	"	STANTEC GEOMATICS LTD.
ORP	"	OBSERVED REFERENCE POINT
P	"	PLANTER
*	"	*
*	"	*
*	"	*
ACU	"	AIR CONDITIONING UNIT
AN	"	ANCHOR
ANT	"	ANTENNA
BH	"	BOREHOLE
BKR	"	BIKE RACK
BENCH	"	BENCH
BOL	"	BOLLARD
BOUL	"	BOULDER
CB	"	CATCH BASIN
DCB	"	DOUBLE CB
DICB	"	SWALE CB
CBMH	"	CB MANHOLE
DCBMH	"	DOUBLE CB MANHOLE
CBSI	"	SIDE INLET CB
CSV	"	VALVE CURB STOP
DRN	"	DRAIN
EPOST	"	ELECTRICAL OUTLET
FP	"	FLAG POLE
FL	"	FLOOD LIGHT
FTF	"	FUEL TANK FILLER CAP
GC	"	GARBAGE CAN
GFL	"	PIPE FLANGE (GAS)
GFP	"	GAS FUEL PUMP
GP	"	POLE GUYWIRE
GSR	"	GAS SERVICE REGULATOR
GV	"	GAS VALVE
HLS	"	LIGHT STANDARD HYDRO
HM	"	HYDRO METER
HTN	"	HYDRO TRANSFORMER
HW	"	HAND WELL
HYD	"	FIRE HYDRANT
JBX	"	JUNCTION BOX
MB	"	MAILBOX
MP	"	MONITORING PIN
MH	"	MAINTENANCE HOLE UNIDENTIFIED
MHBELL	"	MAINTENANCE HOLE BELL
MHF	"	MAINTENANCE HOLE FIBRE OPTIC
MHH	"	MAINTENANCE HOLE HYDRO
MHI	"	MAINTENANCE HOLE INVERT
MHSAN	"	MAINTENANCE HOLE SANITARY
MHSTM	"	MAINTENANCE HOLE STORM
MHT	"	MAINTENANCE HOLE TRAFFIC
MW	"	MONITORING WELL
NPB	"	NEWS PAPER BOX
OLP	"	LIGHT STANDARD ORNAMENTAL
OW	"	OBSERVATION WELL
PKM	"	PARKING METER
PLQ	"	PLAQUE
PLR	"	PILLAR
RLC	"	RED LIGHT CAMERA
SAT	"	SATELLITE DISH
SCLP	"	SCULPTURE
SCP	"	SUMP/CATCH PIT
SCV	"	SPRINKLER CONTROL VALVE
SH	"	SPRINKLER HEAD
SIA	"	SIAMESE CONNECTION
SN	"	SIGN
SPAN	"	SOLAR PANEL
SPT	"	SEPTIC TANK LID
TBL	"	TABLE
TB BELL	"	TERMINAL BOX - BELL
TB CATV	"	TERMINAL BOX - CABLE
TCB	"	TRAFFIC CONTROL BOX
TPIT	"	TEST PIT
TSL	"	TRAFFIC SIGNAL LIGHT
UMB	"	MARKER BELL UNDERGROUND
UMC	"	MARKER CABLE UNDERGROUND
UMG	"	MARKER GAS UNDERGROUND
UMO	"	MARKER OIL UNDERGROUND
UP	"	UTILITY POLE
VB	"	VALVE BOX
VC	"	VALVE CHAMBER
WV	"	WATER VALVE
	"	TREE STUMP
	"	TREE CONIFEROUS
	"	TREE DECIDUOUS

DRAWN: DM/NJ CHECKED: BW PM: BW FIELD: ES PROJECT No.: 161613988-111

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

patersongroup

Geotechnical Investigation

Proposed Athletic Recreation Complex (ARC)
Algonquin College
Woodroffe Campus - Ottawa

Prepared For

Algonquin College
c/o Colliers Project Leaders

June 3, 2019

Report: PG4624-1 Revision 1

Paterson Group Inc.
Consulting Engineers
154 Colonnade Road South
Ottawa (Nepean), Ontario
Canada K2E 7J5

Tel: (613) 226-7381
Fax: (613) 226-6344
www.patersongroup.ca

Table of Contents

Page

1.0 Introduction 1

2.0 Proposed Development 1

3.0 Method of Investigation
3.1 Field Investigation 2
3.2 Field Survey 3
3.3 Laboratory Testing 3
3.4 Analytical Testing 4

4.0 Observations
4.1 Surface Conditions 5
4.2 Subsurface Profile 5
4.3 Groundwater 6

5.0 Discussion
5.1 Geotechnical Assessment 7
5.2 Site Grading and Preparation 7
5.3 Foundation Design 8
5.4 Design of Earthquakes 10
5.5 Slab-on-Grade / Basement Slab Construction 11
5.6 Basement Wall 11
5.7 Pavement Structure 12

6.0 Design and Construction Precautions
6.1 Foundation Drainage and Backfill 15
6.2 Protection Against Frost Action 16
6.3 Excavation Side Slopes 17
6.4 Pipe Bedding and Backfill 17
6.5 Groundwater Control 18
6.6 Winter Construction 18
6.7 Corrosion Potential and Sulphate 19

7.0 Recommendations 20

8.0 Statement of Limitations 21

Appendices

Appendix 1 Soil Profile and Test Data Sheets
Symbols and Terms
Analytical Test Results

Appendix 2 Figure 1 - Key Plan
Figure 2 - Aerial Photograph - 1965
Figure 3 - Aerial Photograph - 1991
Figure 4 - Aerial Photograph - 2017
Figure 5 - Water Suppression System Detail
Drawing PG4624-1 - Test Hole Location Plan

1.0 Introduction

Paterson Group (Paterson) was commissioned by Colliers Project Leaders on behalf of Algonquin College to conduct a geotechnical investigation for the proposed Athletic Recreation Complex (ARC) to be constructed at the Algonquin College Woodroffe Campus in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2).

The objective of the geotechnical investigation was to:

- determine the subsurface soil and groundwater conditions by means of boreholes.

- provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect its design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. The report contains the geotechnical findings and includes recommendations pertaining to the design and construction of the subject development as understood at the time of writing this report.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of this present investigation.

2.0 Proposed Development

For the proposed Athletic Recreation Complex (ARC), it's our understanding that the proposed development will consist of a one-storey slab-on-grade building with a partial basement to be used as gymnasium and other facilities. The proposed development will occupy the majority of the existing parking area. It is also expected that the proposed building will be fully municipally serviced and will be integrated with the existing surrounding hard surfaces.

Furthermore, it's our understanding that an underground storm water storage system will be installed south of the proposed building footprint. A hydrogeological review of the infiltration potential will be presented in a separate report.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the geotechnical investigation was carried out on August 16, 2018. At that time, a total of 9 boreholes were drilled to a maximum depth of 6.7 m below existing ground surface. The test hole locations were determined in the field by Paterson personnel and distributed in a manner to provided general coverage of the proposed project known at the time of the field portion of the geotechnical investigation while taking into consideration of site features and underground utilities. The test hole locations are presented on Drawing PG4624-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were put down using a truck-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer from our geotechnical department. The test hole procedures consisted of augering to the required depths at the selected locations and sampling the overburden.

Sampling and In Situ Testing

Soil samples from the boreholes were recovered from the auger flights or a 50 mm diameter split-spoon sampler. All soil samples were classified on site, placed in sealed plastic bags and transported to the laboratory for further review. The depths at which the auger and split spoon samples were recovered from the test holes are presented as, AU and SS, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

Standard Penetration Testing (SPT) was conducted and recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sample 300 mm into the soil after a 150 mm initial penetration with a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength testing was conducted at regular intervals in cohesive soils and completed using a MTO field vane apparatus.

Overburden thickness was evaluated by a dynamic cone penetration test (DCPT) at BH 2, BH 3 and BH 4. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip and a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded every 300 mm.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1 of this report.

Groundwater

Flexible standpipes were installed in the boreholes during the field investigation to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Sample Storage

All samples from the investigation will be stored in the laboratory for a period of one month after issuance of this report. The samples will then be discarded unless directed otherwise.

3.2 Field Survey

The test holes completed during the field investigation were selected in the field and surveyed by Paterson. The ground surface elevations at the test hole locations were referenced to a geodetic benchmark, consisting of the top of spindle of the fire hydrant located to the south of the subject section of the site. An geodetic elevation of 86.84 m was assigned to this benchmark.

The location of the TBM, test hole locations and ground surface elevation at each test hole location are presented on Drawing PG4624-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the subject site were visually examined in our laboratory to review the results of the field logging.

3.4 Analytical Testing

One soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The majority of the subject site is currently occupied by an at-grade, asphalt covered car parking and access lanes. A landscaped area with mature trees was also noted along the north boundary of the site. The subject site is relatively flat with a slight downslope towards the northwest portion.

Based on historical aerial photographs of the site, a former drainage ditch bisected the west portion of the subject site at the approximate location of the proposed Athletic Recreation Complex (ARC). The former drainage ditch ran in a north-south direction across the west portion of the subject section of the site. The aerial photograph from 1965 illustrated in Figure 2 in Appendix 2 identifies the approximate alignment of the former drainage ditch. The approximate location of the former drainage ditch has been further presented in an aerial photograph of 1991 and 2017 in Figure 3 and Figure 4, respectively.

The site is bordered to the north by a 3 storey Algonquin Commons Theater, to the east and south by an at-grade asphalt covered parking area.

4.2 Subsurface Profile

Generally, the subsurface profile encountered at the test hole locations consists a pavement structure overlying a hard to stiff brown silty clay crust followed by a very stiff to stiff grey silty clay deposit. Glacial till was encountered at BH 4 consisting of grey silty clay with sand and gravel. It should be noted that a fill layer consisting of brown silty sand with crushed stone and/or brown silty clay with sand and gravel was encountered within BH 1, BH 2 and BH 4 where the former drainage ditch ran along the west portion of the site. In addition, a layer of topsoil and organics was encountered directly below the fill material at BH 1 and BH 2.

Practical refusal to DCPT was encountered at a depth of 9.9, 8.5 and 9.1m at BH 2, BH 3 and BH 4, respectively.

Refer to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

4.3 Groundwater

The measured groundwater levels are summarized below in Table 1 and presented on the Soil Profile and Test Data sheets in Appendix 1. It should be noted that surface water can become perched with a backfilled borehole, which can lead to higher than normal groundwater level readings. The long-term groundwater level can also be estimated based on the recovered soil samples' moisture levels, colouring and consistency. Based on these observations, the long-term groundwater level is anticipated at a **4 to 5 m depth**. Groundwater levels are subject to seasonal fluctuations and could vary at the time of construction.

Table 1 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Depth (m)	Groundwater Elevation (m)	Date
BH 1	85.84	3.08	82.76	August 21, 2018
BH 2	86.07	3.07	83.00	August 21, 2018
BH 3	86.55	2.82	83.73	August 21, 2018
BH 4	85.58	2.96	82.62	August 21, 2018
BH 5	86.24	2.84	83.40	August 21, 2018
BH 6	86.92	Blocked	-	August 21, 2018
BH 7	86.82	Blocked	-	August 21, 2018
BH 8	86.67	2.04	84.63	August 21, 2018
BH 9	87.08	2.72	84.36	August 21, 2018

Note: The ground surface at the test hole locations was referenced to a geodetic benchmark consisting of the top of spindle of the fire hydrant located to the south of the subject section of the site. A elevation of 86.84 was assigned to the benchmark.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is satisfactory for the proposed development. It's expected that the proposed building will be founded on conventional spread footings placed on an undisturbed, stiff silty clay bearing surface.

Where the existing fill is encountered at design underside of footing elevation, it's expected that the footings will be either extended to reach an undisturbed, silty clay bearing surface, placed on an approved engineered fill or placed on lean concrete in-filled trench that extends to an undisturbed, silty clay bearing surface.

Consideration could be given to leaving the existing fill under the proposed slab-on-grade. It is recommended to sub-excavate an additional 300 mm below the proposed subgrade where existing fill is currently present. The fill subgrade should be proof rolled, under dry conditions, making several passes and approved by the geotechnical consultant at the time of construction. The sub-excavated area should then be in-filled with OPSS Granular B Type II and compacted to a minimum 98% of the material's SPMDD up to the underside of footing elevation.

Due to the presence of the silty clay layer, grading in close proximity to any settlement sensitive structures will be subjected to a permissible grade raise restriction.

To ensure that the proposed basement area remains dry and prone to less moisture intrusion, a water suppression system is recommended to manage and reduce the volume of water infiltration over the long term at post-construction.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and fill, such as those containing organic or deleterious materials, should be stripped from under any buildings and other settlement sensitive structures. It's expected that the existing fill, free of deleterious material and significant amounts of organics, can be left in place below the proposed building footprint, outside of lateral support zones for the footings, and below the proposed parking area and access lane. However, it is recommended that the existing fill layer be proof-rolled several times and approved by the geotechnical consultant at the time of construction.

Any poor performing areas noted during the proof-rolling operation should be removed and replaced with an approved fill. Existing foundation walls and/or other construction debris, where present, should be entirely removed from within the building perimeter.

Fill Placement

Fill placed for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in maximum 300 mm thick lifts and compacted to 98% of the material's standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be placed as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts compacted by the tracks of the spreading equipment to minimize voids. If the material is to be placed to increase the subgrade level for areas to be paved, the fill should be compacted in maximum 300 mm lifts and compacted to 95% of the material's SPMDD. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

5.3 Foundation Design

Bearing Resistance Values (Slab-on-Grade Portion)

Pad footings, up to 6 m wide, and strip footings, up to 3 m wide, founded on an undisturbed, stiff silty clay bearing surface or over an approved engineered fill extending to an undisturbed, silty clay bearing surface can be designed using the bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **250 kPa**. Alternatively, footings founded over a lean concrete in-filled trench as detailed below can be designed using the abovenoted SLS and ULS values.

A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, under dry conditions, prior to the placement of concrete for footings.

Bearing Resistance Values (Basement)

For the basement portion of the building within the western portion, it's expected that the depth of the foundation will be approximately 3 m below the existing grade. Minimal to no sub-excavation of fill will be required to be removed below the proposed underside of footings due to the depth of the founding level.

To protect the soil bearing surface during construction and to create a horizontal hydraulic barrier at depth, it's recommended that a concrete mud slab be placed immediately after exposure of the bearing surface. The bearing surface should be inspected by the geotechnical engineer prior to concrete placement. The concrete mud slab should consist of a 150 mm thick layer with a minimum 25 MPa compressive strength concrete.

Footings placed on 25 MPa concrete mud slab overlying an undisturbed, stiff silty clay bearing surface or over an approved engineered fill extending to an undisturbed, silty clay bearing surface can be designed using the bearing resistance value at serviceability limit states (SLS) of **175 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **300 kPa**.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, wether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

The above noted bearing resistance value at SLS will be subjected to total and differential settlements of 25 and 20 mm, respectively.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a stiff silty clay or engineered fill above the groundwater table when a plane extending horizontally and vertically from the underside of the footing at a minimum of 1.5H:1V passing through in situ soil of the same or higher bearing capacity as the bearing medium soil.

Permissible Grade Raise

A permissible grade raise restriction of **2 m** above existing ground surface is recommended for the proposed building.

5.4 Design for Earthquakes

The subject site can be taken as seismic site response **Class C** as defined in the Ontario Building Code 2012 (OBC 2012; Table 4.1.8.4.A) for foundations considered at this site. The soils underlying the site are not susceptible to liquefaction.

5.5 Slab on Grade/Basement Slab Construction

With the removal of all topsoil and deleterious fill, such as those containing significant amounts of organic matter, within the footprint of the proposed building, undisturbed native soil surface or existing fill, approved by the geotechnical consultant at the time of construction, will be considered acceptable subgrade on which to commence backfilling for floor slab construction. It's recommended that the existing fill layer, free of deleterious and organic materials, be proof-rolled (if possible due to moisture content) and approved by the geotechnical consultant at the time of construction. Any soft areas should be removed and backfilled with suitable dryer backfill material. It's recommended that the upper 200 mm of sub-slab fill of a slab-on-grade construction to consist of an OPSS Granular A crushed stone.

For the basement slab, it's our understanding that the floor will be heated and will have an insulation layer. Furthermore, since a concrete mud slab will be used to create a hydraulic barrier, the material to backfill above the concrete mud slab will consist of a free draining material such as an OPSS Granular A and/or possibly a layer of 19 mm clear crushed stone. Subfloor drainage will be incorporated in this design which will permit the subfloor material to remain dry.

5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the subject structure. However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a dry unit weight of 20 kN/m^3. The applicable effective unit weight of the retained soil can be estimated as 13 kN/m^3, where applicable.

A hydrostatic pressure should be added to the total static earth pressure when calculating the effective unit weight.

Lateral Earth Pressures

The static horizontal earth pressure (P_o) can be calculated by a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil, 0.5
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure having a magnitude equal to $K_o \cdot q$ and acting on the entire wall height should be incorporated to the diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be calculated with the seismic loading case.

Actual earth pressures could be higher than the "at-rest" case if care is not exercised during the compaction of the backfill materials to stay at least 0.3 m away from the walls with the compaction equipment.

Seismic Earth Pressures

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}).

The seismic earth force (ΔP_{AE}) could be calculated using $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

a_c = $(1.45 - a_{max}/g)a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.32g according to OBC 2012. The vertical seismic coefficient is assumed to be zero.

The earth force component (P_o) under seismic conditions could be calculated using $P_o = 0.5\, K_o \gamma\, H^2$, where $K_o = 0.5$ for the soil conditions presented above.

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:

$$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6 \cdot H)\}/P_{AE}$$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2012.

5.7 Pavement Structure

For design purposes, the following pavement structures presented below could be used for the design of car parking areas, bus lanes and access lanes. It is anticipated that both pavement structures provided would be adequate for use as a fire route.

Table 2 - Recommended Pavement Structure - Car Only Parking Areas

Thickness (mm)	Material Description
50	**Wear Course** - HL 3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 3 - Recommended Pavement Structure
Bus Turning Areas and Access Lanes

Thickness (mm)	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil	

Minimum Performance Graded (PG) 64-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is dependent on the moisture condition of the contact zone between the subgrade material and granular base. Failure to provide adequate drainage under conditions of heavy wheel loading could result in the subgrade fines being pumped into the stone subbase voids, thereby reducing the load bearing capacity.

Due to the impervious nature of the subgrade materials consideration should be provided to installing subdrains during the pavement construction. The subdrains should extend in four orthogonal directions and longitudinally when placed along a curb. The clear crushed stone surrounding the drainage lines or the pipe, should be wrapped with suitable filter cloth. The subdrain inverts should be approximately 300 mm below subgrade level and placed in accordance with City of Ottawa standard drawings. The subgrade surface should be shaped to promote water flow to the drainage lines.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Water Suppression System and Foundation Drainage

To manage and control groundwater water infiltration over the long term, the following water suppression system is recommended to be installed for the exterior foundation walls and underfloor drainage (refer to Figure 5 - Water Suppression System in Appendix 2 for an illustration of this system cross-section):

- ❑ The concrete mud slab will create a horizontal hydraulic barrier to lessen the water infiltration at the base of the excavation and will consist of a 150 mm thick layer of 25 MPa compressive strength concrete. The 150 mm minimum thickness is required to enable the support of construction traffic until the footings are poured and the area is backfilled and minimize long term cracking.

- ❑ A composite drainage layer will be placed from finished grade to the bottom of the foundation wall. It is recommended that the composite drainage system (such as Delta Drain 6000 or equivalent) extend down to the bottom of the foundation wall. It's expected that 150 mm diameter sleeves placed at 3 m centres be cast in the foundation wall at the footing interface to allow the infiltration of water to flow to an interior perimeter drainage pipe. The perimeter drainage pipe should direct water to the sump pit(s) within the lower basement area.

- ❑ A waterproofing membrane will be required to lessen the effect of water infiltration for the basement level starting at 1.5 m below finished grade. The waterproofing membrane will consist of bentonite panels fastened to the composite drainage layer. The bentonite membrane should extend to the bottom of the excavation at the founding level of the proposed footings over the concrete mud slab.

- ❑ A sump pit should be designed to manage any groundwater infiltration which would be discharged to the sewer system. The sump pump should be designed to handle a maximum water volume of 200,000 L/day. However, once steady state is achieved, it's expected that water infiltration volumes will be less than 5,000 L/day.

Underfloor Drainage

Underfloor drainage may be required to control water infiltration below the basement slab that breaches the horizontal hydraulic barrier (minimum 150 mm thick concrete mud slab). For design purposes, it's recommended that a 150 mm diameter perforated pipe be placed in each bay. The final spacing of the underfloor drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

Water Infiltration Volumes

During the construction phase, it's expected that water infiltration should have a steady state volume between 10,000 and 25,000 L/day plus any surface water infiltration following a precipitation event. The initial influx will be greater once the excavation extends below the long term groundwater level. The zone of influence associated with the temporary dewatering during construction excavation for 1 basement level will be approximately 5 m.

Based on the proposed water suppression system, it's expected that long term groundwater infiltration will be significantly reduced during post-construction. With a properly implemented water suppression system, it's expected that post-construction volumes will be less than 5,000 L/day.

6.2 Protection Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effects of frost action. A minimum 1.5 m thick soil cover (or equivalent) should be provided.

Exterior unheated footings, such as those for isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure proper and require additional protection. The recommended minimum thickness of soil cover is 2.1 m (or equivalent).

6.3 Excavation Side Slopes

The excavations for the proposed development will be through a native silty clay material. The subsurface soil is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects. Above the groundwater level, for excavations to depths of approximately 3 m, the excavation side slopes should be stable in the short term at 1H:1V. Shallower slopes should be provided for deeper excavations or for excavation below the groundwater level. Where such side slopes are not permissible or practical, temporary shoring should be installed.

The slope cross-sections recommended above are for temporary slopes. Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be maintain safe working distance from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

A trench box is recommended to be installed at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by "cut and cover" methods and excavations should not remain open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with City of Ottawa standards and specifications.

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A material. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD. The bedding material should extend at a minimum to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A crushed stone, should extend from the spring line of the pipe to a minimum of 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD.

Generally, the dry brown silty clay could be place above the cover material if the excavation and backfilling operations are completed in dry weather conditions. The wet silty clay materials could be difficult to place and compact, due to the high water content.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should consist of the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the SPMDD.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

A temporary Ministry of the Environment, Conservation and Parks (MECP) Category 3 permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum of 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

Precautions should be provided if winter construction is considered for this project. The subsurface soil conditions mostly consist of frost susceptible materials. In presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the installation of straw, propane heaters and tarpaulins or other suitable means. The base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

The trench excavations should be constructed to avoid the introduction of frozen materials, snow or ice into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving during construction. Also, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure.

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of an aggressive to very aggressive corrosive environment.

7.0 Recommendations

The following is recommended to be completed once the site plan and development are determined:

- ❏ Review detailed grading plan(s) from a geotechnical perspective.
- ❏ Observation and inspection of the water suppression system installation.
- ❏ Observation of all bearing surfaces prior to the placement of concrete.
- ❏ Observation of all subgrades prior to backfilling.
- ❏ Field density tests to ensure that the specified level of compaction has been achieved.
- ❏ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ❏ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming the construction has been completed in general accordance with the recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The report recommendations are in accordance with the present understanding of the project. Paterson requests permission to review the grading plan, once available, and recommendations when the drawings and specifications are complete.

The recommendations are based on information gathered at the specific test locations and could only be extrapolated to an undefined limited area around the test locations. The extent of the limited area depends on the soil, bedrock and groundwater conditions, as well the history of the site reflecting natural, construction, and other activities.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Algonquin College, Colliers Project Leaders or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Faisal I. Abou-Seido, P.Eng.

Carlos P. Da Silva, P.Eng., ing., QP_{ESA}.

Report Distribution

- ❏ Colliers Project Leaders (3 copies)
- ❏ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Athletics Recreation Complex (ARC)
Algonquin College - Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located to the south of the subject section of site. Geodetic elevation = 86.84m.

REMARKS

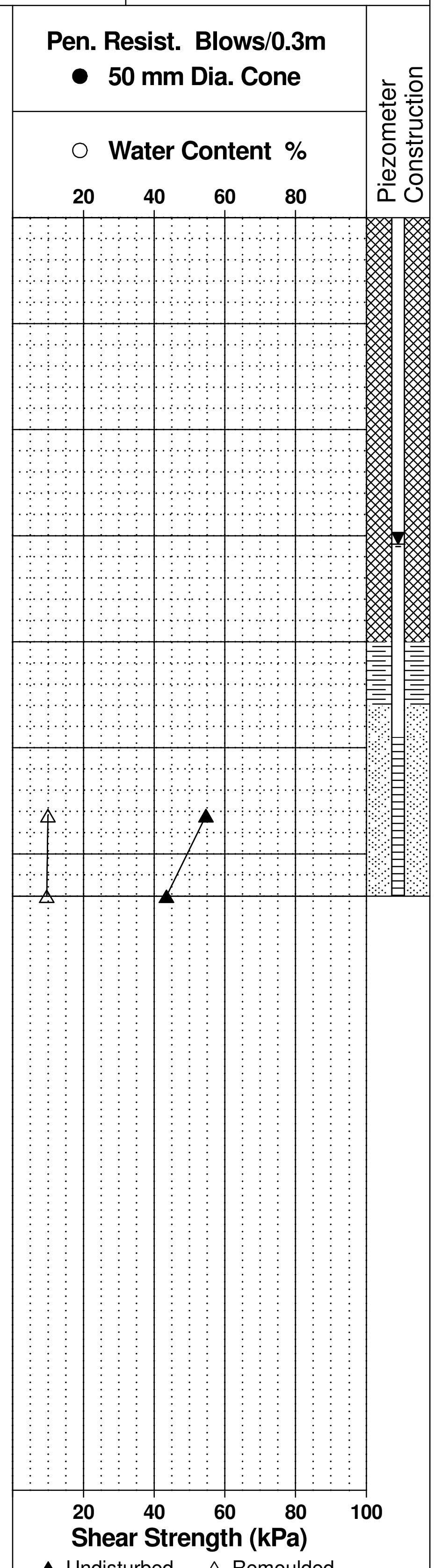
BORINGS BY CME 55 Power Auger

DATE 2018 August 16

FILE NO. PG4624

HOLE NO. BH 1

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	85.84
Asphaltic concrete	0.05	AU	1				
FILL: Brown silty sand with crushed stone and gravel	1.52	SS	2	67	6	1	84.84
FILL: Brown silty clay, some sand, trace gravel	3.73	SS	3	33	4	2	83.84
		SS	4	58	8	3	82.84
		SS	5	58	4		
TOPSOIL and organics with silty clay	4.01	SS	6	75	8	4	81.84
Very stiff to stiff, brown **SILTY CLAY**	6.40	SS	7	100	0	5	80.84
						6	79.84
End of Borehole							
(GWL @ 3.08m - August 21, 2018)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Athletics Recreation Complex (ARC)
Algonquin College - Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located to the south of the subject section of site. Geodetic elevation = 86.84m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2018 August 16

FILE NO. PG4624

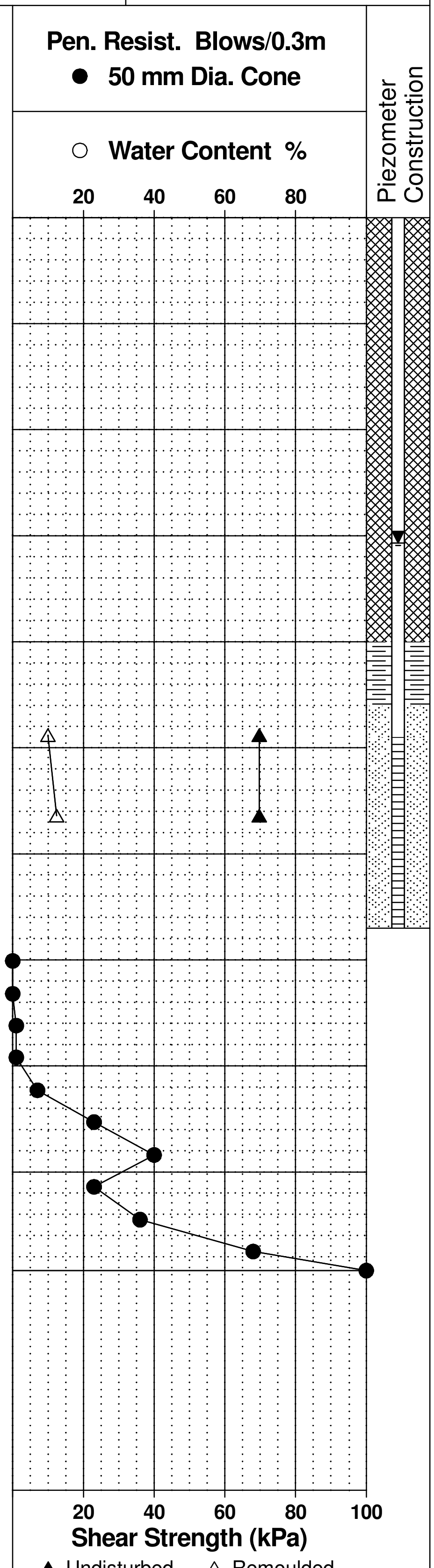
HOLE NO. BH 2

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.05	AU	1		
FILL: Brown silty sand with crushed stone and gravel	0.56				
FILL: Brown silty clay, some sand, trace gravel	3.66	SS	2	63	8
		SS	3	79	5
		SS	4	58	6
		SS	5	67	3
TOPSOIL and organics	4.01	SS	6	54	4
Stiff, brown **SILTY CLAY**	5.33				
Stiff, grey **SILTY CLAY,** trace sand	6.71	SS	7	100	0
Dynamic Cone Penetration Test commenced at 6.71 m depth	9.93				
End of Borehole					

Practical refusal to DCPT @ 9.93 m depth

(GWL @ 3.07m - August 21, 2018)

DEPTH (m)	ELEV. (m)
0	86.07
1	85.07
2	84.07
3	83.07
4	82.07
5	81.07
6	80.07
7	79.07
8	78.07
9	77.07



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Athletics Recreation Complex (ARC)
Algonquin College - Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located to the south of the subject section of site. Geodetic elevation = 86.84m.

REMARKS

BORINGS BY CME 55 Power Auger

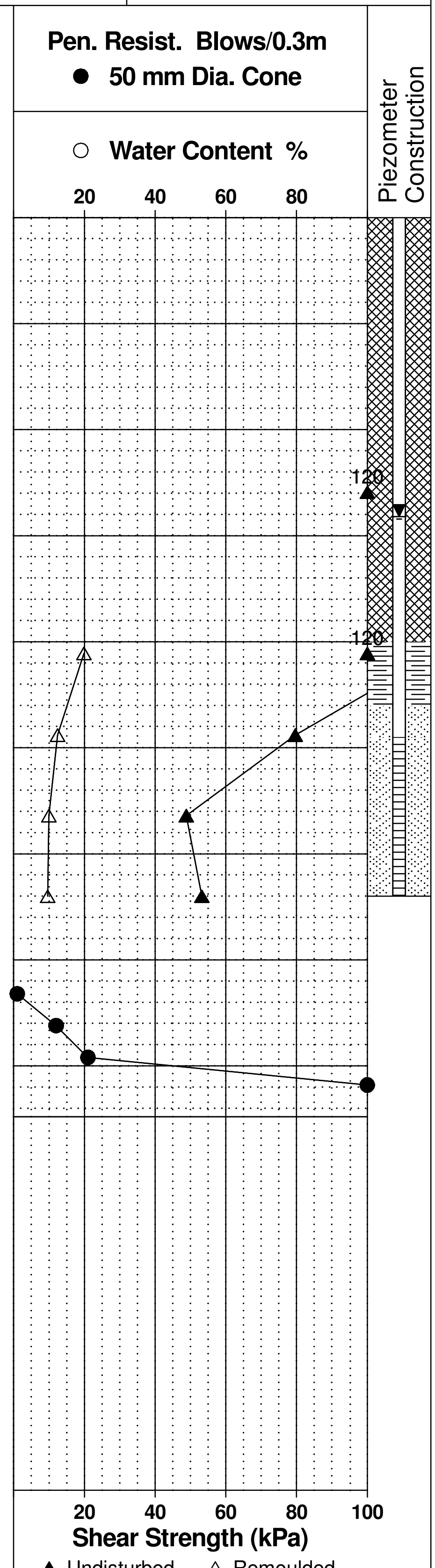
DATE 2018 August 16

FILE NO. PG4624

HOLE NO. BH 3

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.05				
FILL: Crushed stone with brown silty sand, some gravel	0.53	AU	1		
FILL: Compact, brown silty sand	1.52	SS	2	58	10
Very stiff to stiff, brown **SILTY CLAY**	5.33	SS	3	100	6
		SS	4	100	5
Very stiff to stiff, brown **SILTY CLAY**, trace gravel -trace sand and gravel by 6.1 m depth	6.40				
Dynamic Cone Penetration Test commenced at 6.40 m depth	8.48				
End of Borehole Practical refusal to DCPT @ 8.48 m depth (GWL @ 2.82m - August 21, 2018)					

DEPTH (m)	ELEV. (m)
0	86.55
1	85.55
2	84.55
3	83.55
4	82.55
5	81.55
6	80.55
7	79.55
8	78.55



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Athletics Recreation Complex (ARC)
Algonquin College - Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located to the south of the subject section of site. Geodetic elevation = 86.84m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2018 August 16

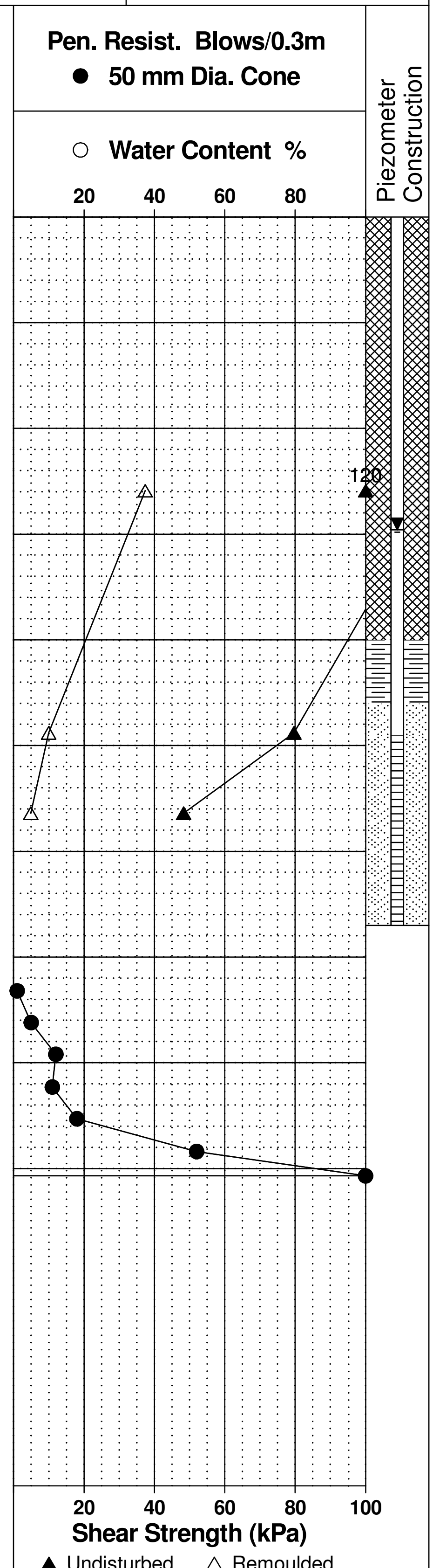
FILE NO. PG4624

HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	85.58
Asphaltic concrete (to 0.08)		AU	1				
FILL: Brown silty sand with crushed stone and gravel (0.08 to 0.53)							
FILL: Brown silty clay with sand, some gravel (0.53 to 3.05)		SS	2	50	6	1	84.58
		SS	3	67	4	2	83.58
Very stiff to stiff, brown **SILTY CLAY** (3.05 to 6.10)		SS	4	88	6	3	82.58
		SS	5	100	5	4	81.58
- grey by 5.3 m depth						5	80.58
GLACIAL TILL: Stiff, grey silty clay with sand, some gravel (6.10 to 6.71)		SS	6	100	3	6	79.58
Dynamic Cone Penetration Test commenced at 6.71m depth. (6.71 to 9.07)						7	78.58
						8	77.58
End of Borehole (9.07)						9	76.58

Practical refusal to DCPT @ 9.07 m depth

(GWL @ 2.96m - August 21, 2018)



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Athletics Recreation Complex (ARC)
Algonquin College - Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located to the south of the subject section of site. Geodetic elevation = 86.84m.

REMARKS

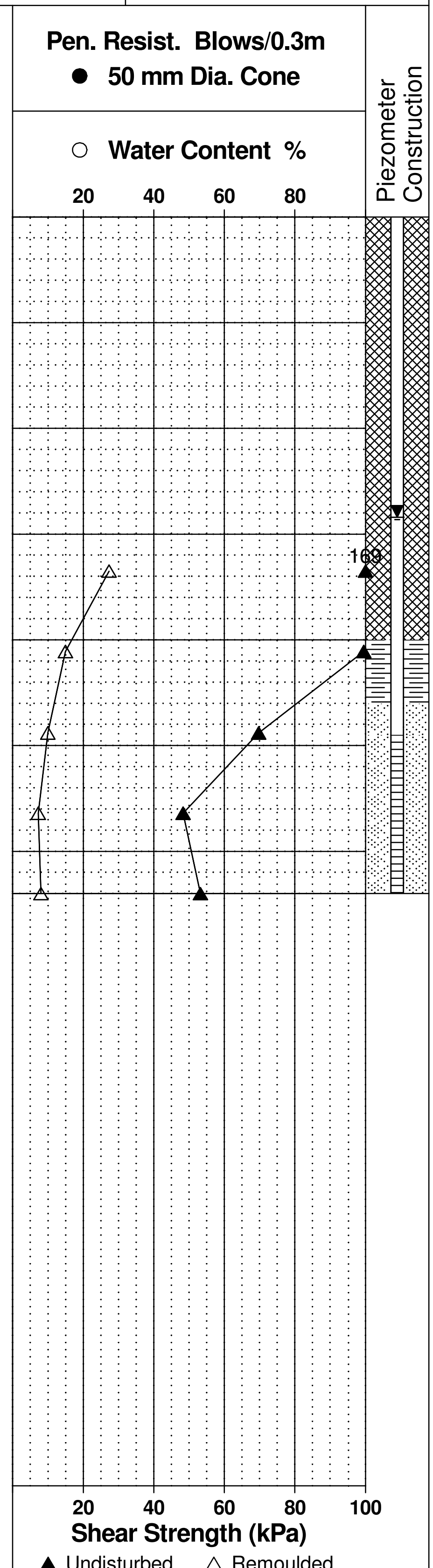
BORINGS BY CME 55 Power Auger

DATE 2018 August 16

FILE NO. PG4624

HOLE NO. BH 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.24
Asphaltic concrete 0.04							
FILL: Brown silty sand with crushed stone and gravel 0.51		AU	1				
Very stiff to stiff, brown **SILTY CLAY**		SS	2	92	8	1	85.24
		SS	3	100	9	2	84.24
		SS	4	100	6	3	83.24
						4	82.24
						5	81.24
- grey by 5.3 m depth						6	80.24
6.40 End of Borehole							
(GWL @ 2.84m - August 21, 2018)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Athletics Recreation Complex (ARC)
Algonquin College - Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located to the south of the subject section of site. Geodetic elevation = 86.84m.

REMARKS

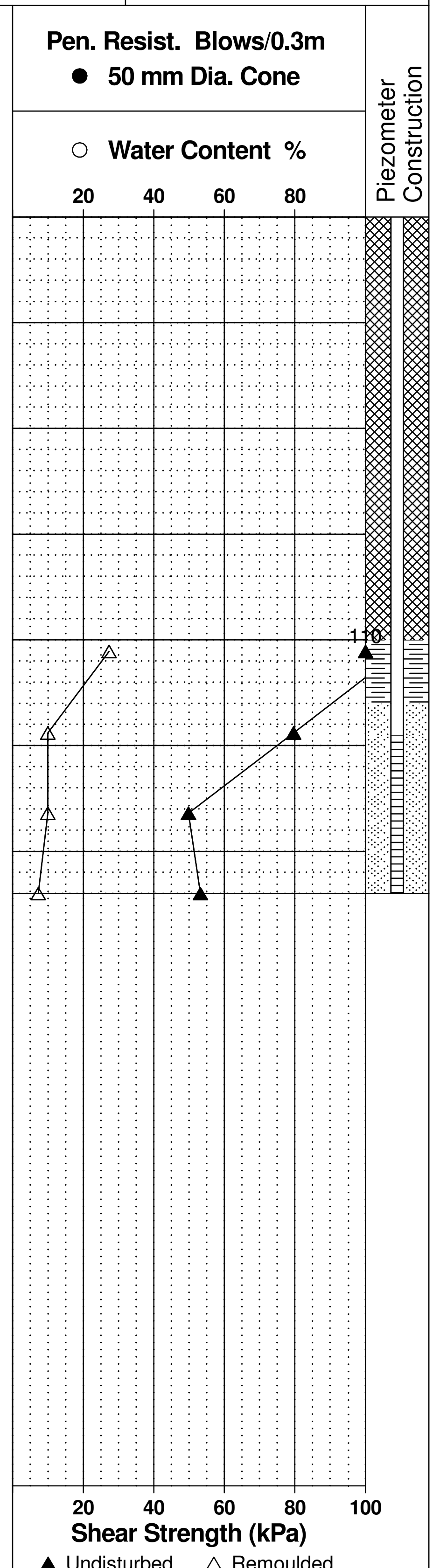
BORINGS BY CME 55 Power Auger

DATE 2018 August 16

FILE NO. PG4624

HOLE NO. BH 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Asphaltic concrete 0.06		AU	1			0	86.92
FILL: Brown silty sand with crushed stone and gravel 0.56							
Hard to stiff, brown **SILTY CLAY**		SS	2	79	17	1	85.92
		SS	3	100	8	2	84.92
		SS	4	100	9	3	83.92
		SS	5	100	6	4	82.92
						5	81.92
- grey by 5.3 m depth						6	80.92
6.40 End of Borehole							
(Piezometer blocked at 3.05m depth - August 21, 2018)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Athletics Recreation Complex (ARC)
Algonquin College - Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located to the south of the subject section of site. Geodetic elevation = 86.84m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2018 August 16

FILE NO. PG4624

HOLE NO. BH 7

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.82
Asphaltic concrete 0.05							
FILL: Crushed stone, some sand, trace silty clay 0.53		AU	1				
Very stiff to stiff, brown **SILTY CLAY**		SS	2	79	6	1	85.82
						2	84.82
		SS	3	100	8		
3.35		SS	4	100	5	3	83.82
End of Borehole							
(Piezometer blocked @ 2.81m depth - August 21, 2018)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %
20 40 60 80

120

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Athletics Recreation Complex (ARC)
Algonquin College - Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located to the south of the subject section of site. Geodetic elevation = 86.84m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2018 August 16

FILE NO. PG4624

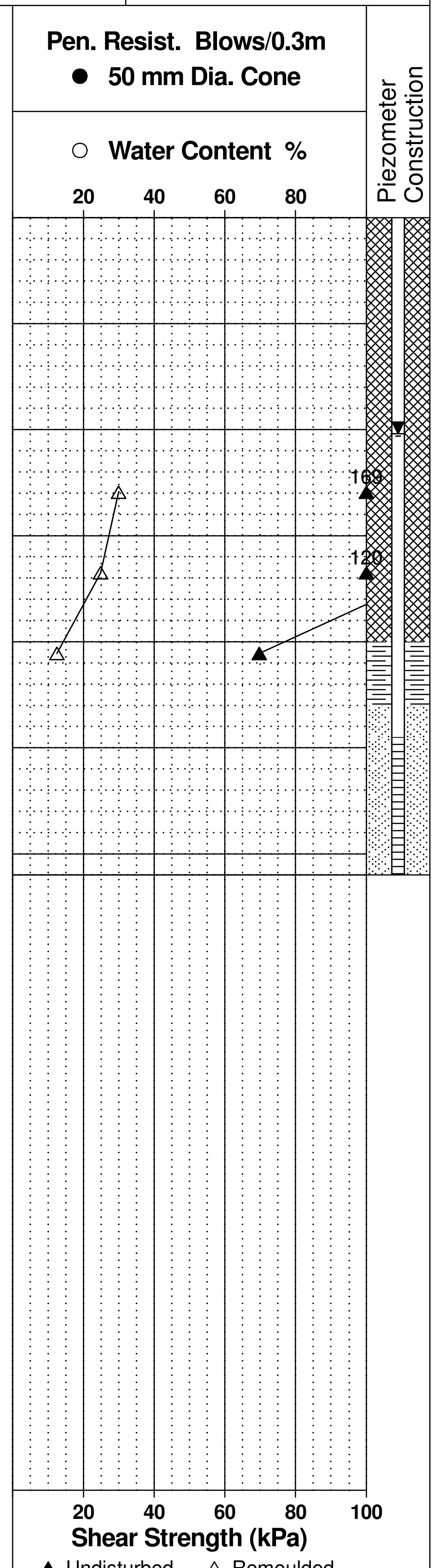
HOLE NO. BH 8

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.67
Asphaltic concrete 0.05							
FILL: Brown silty sand with crushed stone and gravel 0.53		AU	1				
Very stiff to stiff, brown **SILTY CLAY**		SS	2	100	9	1	85.67
		SS	3	100	6	2	84.67
4.57						3	83.67
						4	82.67
GLACIAL TILL: Hard to stiff, grey silty clay, some sand, gravel, cobbles and boulders 5.33		SS	4	100	50+	5	81.67
GLACIAL TILL: Dense, grey silty sand with gravel, occasional cobbles and boulders, some clay 6.20		SS	5	63	44	6	80.67
		SS	6	100	50+		

End of Borehole

Practical refusal to augering at 6.20m depth

(GWL @ 2.04m - August 21, 2018)



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Athletics Recreation Complex (ARC)
Algonquin College - Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located to the south of the subject section of site. Geodetic elevation = 86.84m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2018 August 16

FILE NO. PG4624

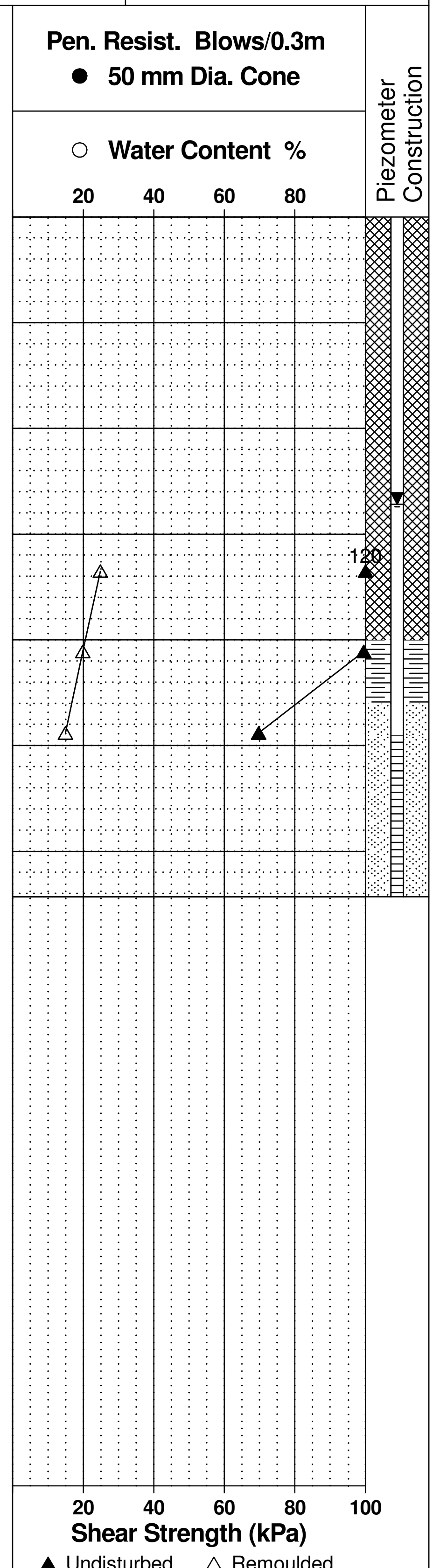
HOLE NO. BH 9

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.06	AU	1		
FILL: Brown silty sand with crushed stone and gravel	1.52	SS	2	54	28
Very stiff to stiff, brown **SILTY CLAY**	5.33	SS	3	75	8
		SS	4	100	7
GLACIAL TILL: Hard, brown silty clay, trace sand and gravel, occasional cobbles and boulders	6.43	SS	5	100	50+
		SS	6	100	50+
End of Borehole					

DEPTH (m)	ELEV. (m)
0	87.08
1	86.08
2	85.08
3	84.08
4	83.08
5	82.08
6	81.08

Practical refusal to augering at 6.43m depth

(GWL @ 2.72m - August 21, 2018)



SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) ‘N’ value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of “P” denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	‘N’ Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

Consistency	Undrained Shear Strength (kPa)	‘N’ Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic Limit, % (water content above which soil behaves plastically)
PI	-	Plasticity Index, % (difference between LL and PL)
Dxx	-	Grain size at which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2 / (D10 \times D60)$
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

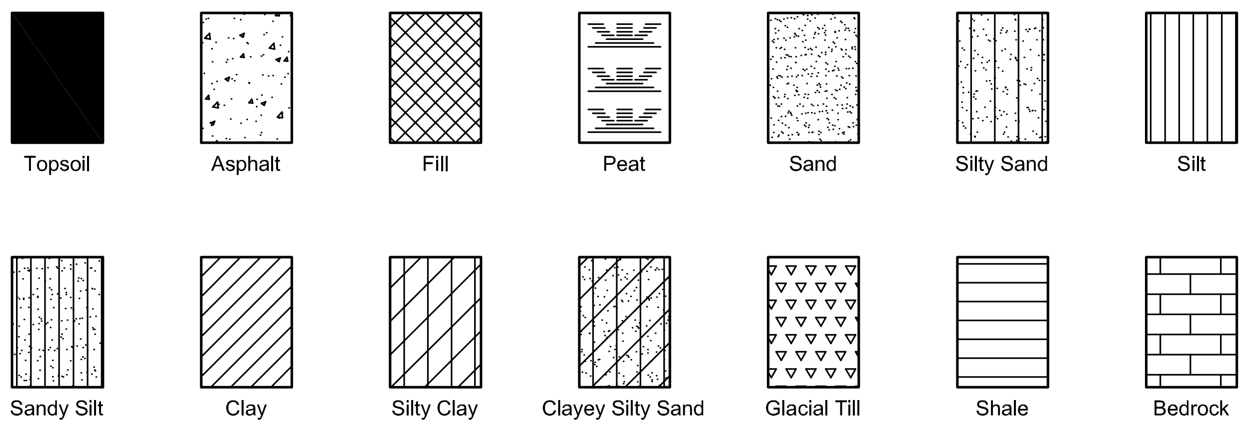
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

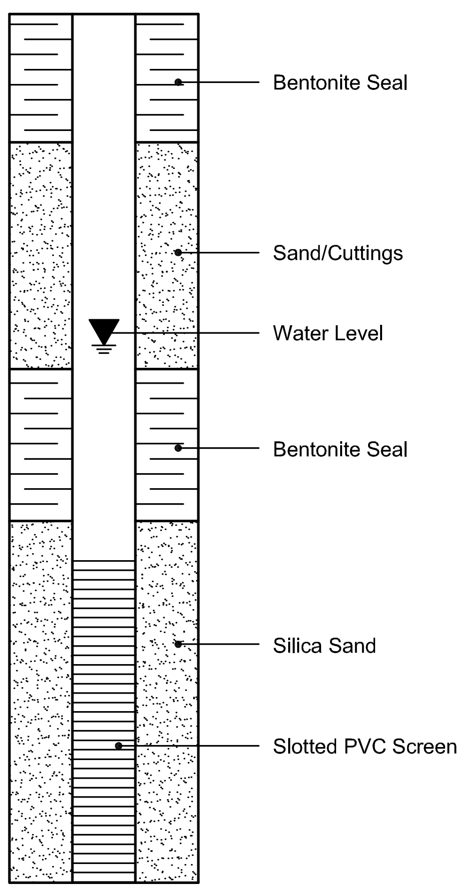
SYMBOLS AND TERMS (continued)

STRATA PLOT

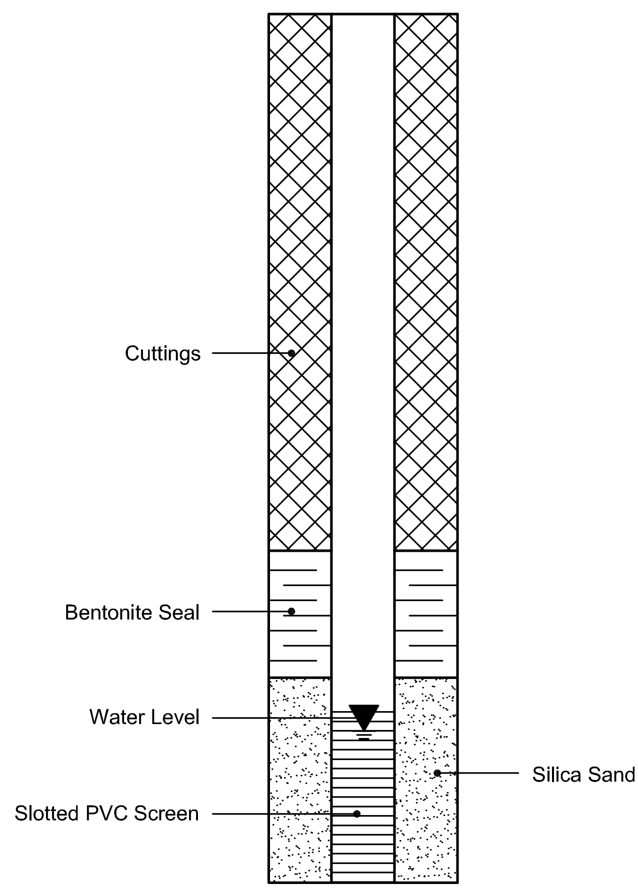


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 2491

Report Date: 27-Aug-2018
Order Date: 21-Aug-2018
Project Description: PG4624

	Client ID:	BH3-SS3	-	-	-
	Sample Date:	08/16/2018 15:30	-	-	-
	Sample ID:	1834311-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	73.9	-	-	-
General Inorganics					
pH	0.05 pH Units	7.60	-	-	-
Resistivity	0.10 Ohm.m	2.19	-	-	-
Anions					
Chloride	5 ug/g dry	3180	-	-	-
Sulphate	5 ug/g dry	344	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2 - AERIAL PHOTOGRAPH - 1965

FIGURE 3 - AERIAL PHOTOGRAPH - 1991

FIGURE 4 - AERIAL PHOTOGRAPH - 2017

FIGURE 5 - WATER SUPPRESSION SYSTEM DETAIL

DRAWING PG4624-1 - TEST HOLE LOCATION PLAN

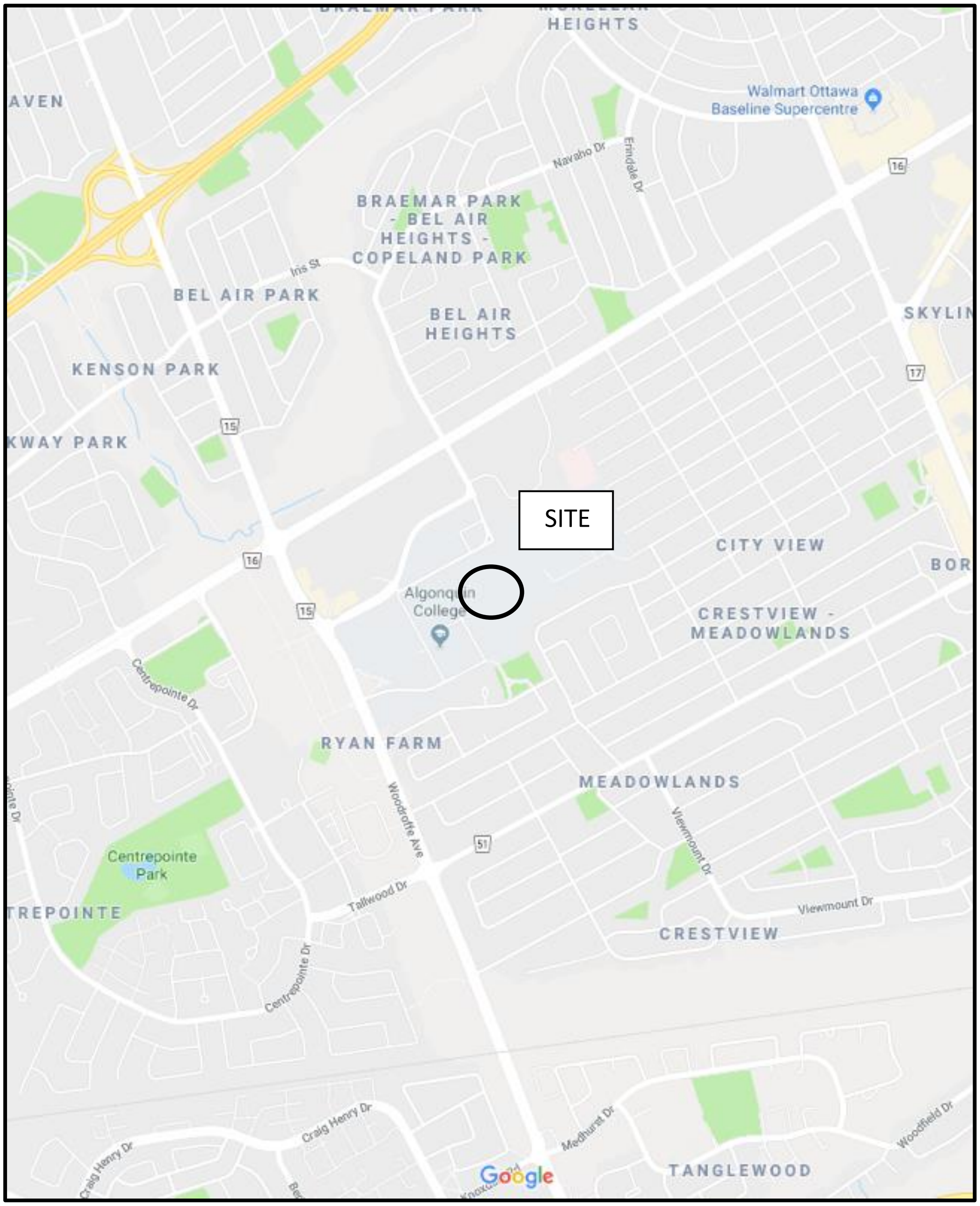


Figure 1

Key Plan

patersongroup

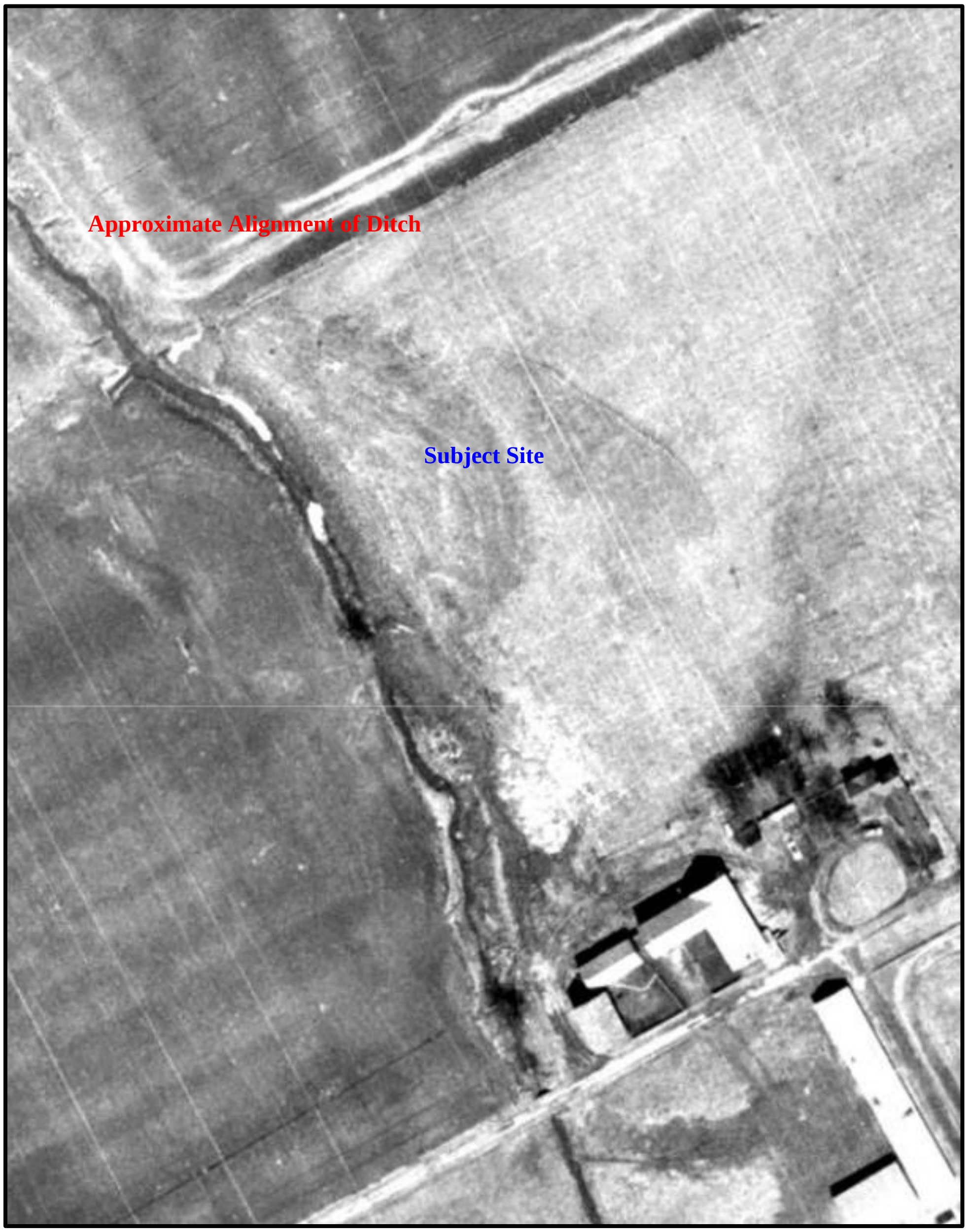


Figure 2

Aerial Photograph - 1965

Figure 3

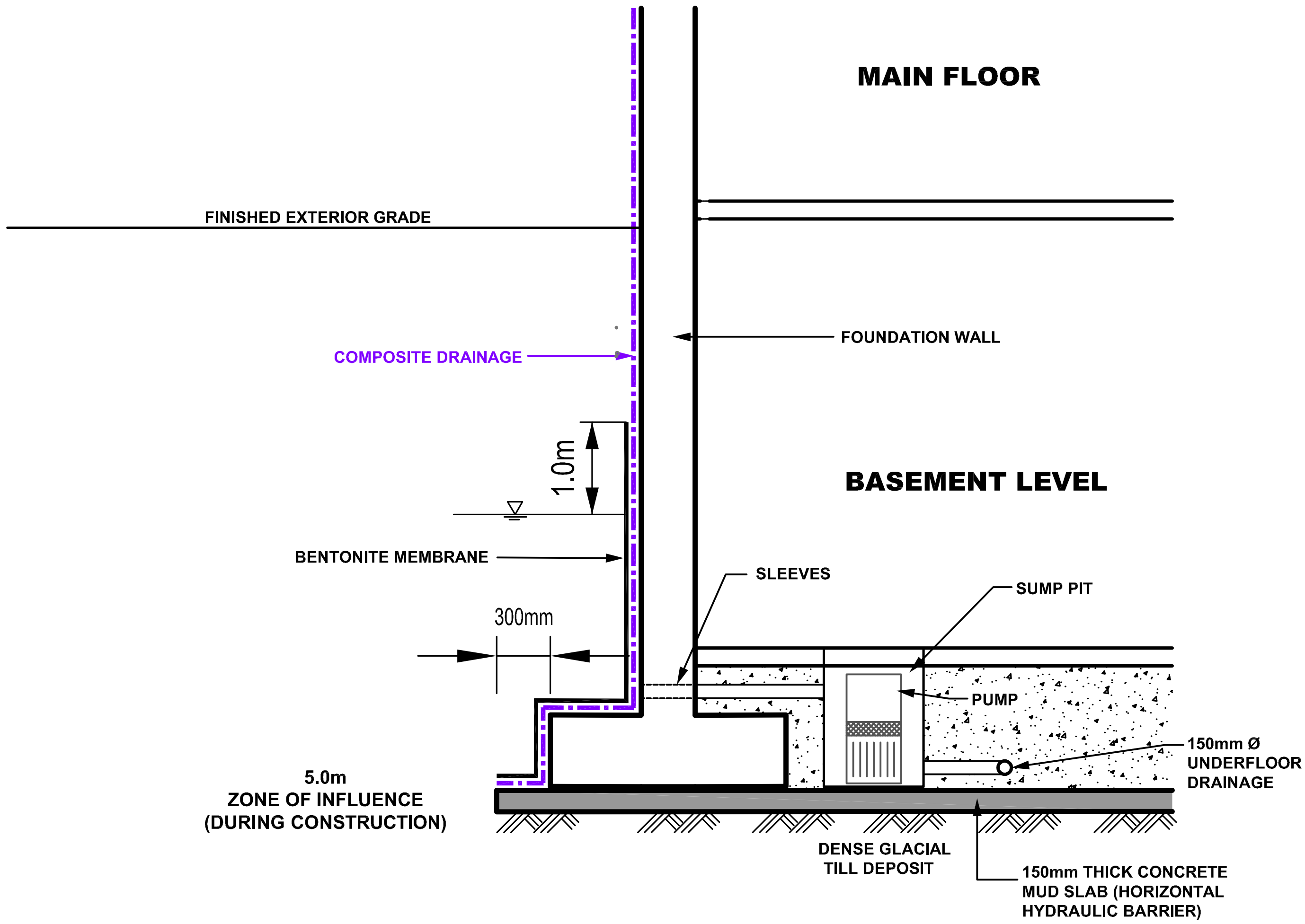
Aerial Photograph - 1991

patersongroup

Figure 4

Aerial Photograph - 2017

patersongroup



patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344
www.patersongroup.ca

ALGONQUIN COLLEGE

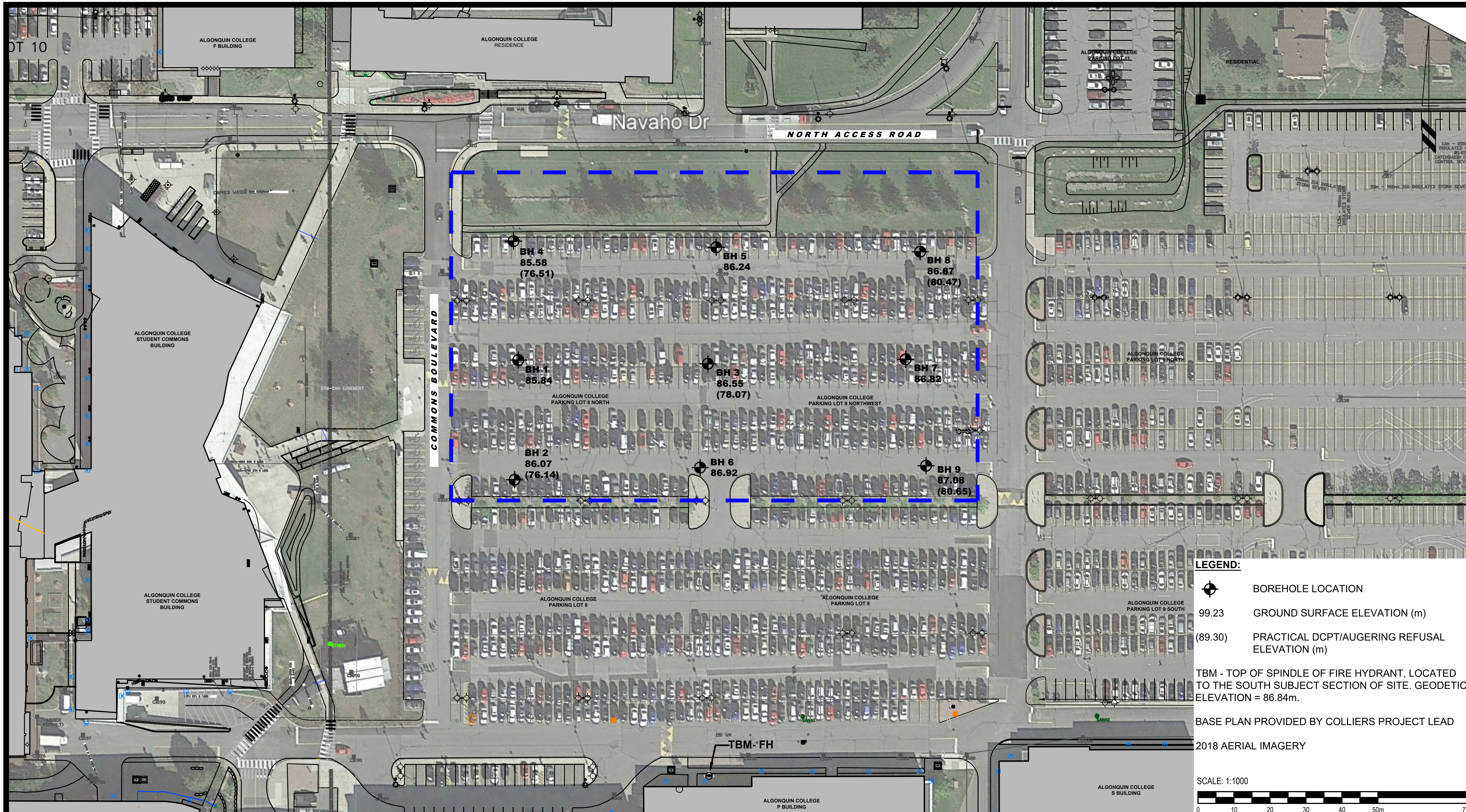
PROP. ATHLETIC RECREATION COMPLEX
WOODROFFE CAMPUS, WOODROOFE AVE.
OTTAWA, ONTARIO

Title:

WATER SUPPRESSION SYSTEM

Date: 05/2019		Report No.: PG4624
Scale: N.T.S.		Drawing No.: FIGURE 5
Drawn by: RCG	Checked by: CDS	

p:\autocad drawings\geotechnical\pg46xx\pg4624\pg4624 water suppression system.dwg



LEGEND:

⌖	BOREHOLE LOCATION
99.23	GROUND SURFACE ELEVATION (m)
(89.30)	PRACTICAL DCPT/AUGERING REFUSAL ELEVATION (m)

TBM - TOP OF SPINDLE OF FIRE HYDRANT, LOCATED TO THE SOUTH SUBJECT SECTION OF SITE. GEODETIC ELEVATION = 86.84m.

BASE PLAN PROVIDED BY COLLIERS PROJECT LEAD

2018 AERIAL IMAGERY

SCALE: 1:1000

0 10 20 30 40 50m 75m

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
1	GROUND SURFACE ELEVATIONS CONVERTED TO GEODETIC	05/31/2019	FA

COLLIERS PROJECT LEADERS

GEOTECHNICAL INVESTIGATION - PROPOSED ATHLETIC RECREATION COMPLEX (ARC)
ALGONQUIN COLLEGE - WOODROFFE AVENUE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1000	Date: 09/2018
Drawn by: RCG	Report No.: PG4624-1
Checked by: RG	Dwg. No.: PG4624-1
Approved by: DJG	Revision No.: 1

p:\autocad drawings\geotechnical\pg46xx\pg4624\pg4624-1 rev1 thlp.dwg

patersongroup memorandum

consulting engineers

re: **Geotechnical Review Comments**
Proposed Athletic Recreation Complex
Algonquin College - Woodroffe Campus - Ottawa

to: Colliers Project Leaders - **Mr. Philip Belanger** - philip.belanger@colliersprojectleaders.com

date: September 16, 2019

file: PG4624-MEMO.02

Further to your request and authorization, Paterson Group (Paterson) prepared a follow up commentary based on a geotechnical review of test pits excavated at the subject site to assess subsurface conditions.

Groundwater

In the geotechnical report, Paterson stated the following:

"Based on these observations, the long-term groundwater level is anticipated at a **4 to 5 m depth**."

Based on the observations on September 11, 2019, the above long term groundwater levels were confirmed. Glacial till was encountered at a depth of approximately 4.5 m at this location. Therefore, a water suppression system will not be required. Paterson suggests the following:

❏ During the excavation program, groundwater can be easily managed with conventional pumping.

❏ Footings can be poured directly on the native soil which is directly or indirectly on the glacial till deposit.

❏ A perimeter drainage system can handle water infiltration adjacent to foundation walls. Therefore, one or two inlet points along the footing will suffice to direct infiltration water to the sump pit in the basement area or to a storm sewer outlet based on gravity flow.

❏ An underfloor drainage system will be required below the basement floor to manage groundwater. It's expected that a spacing of 9 m will be acceptable.

❏ A composite drainage layer will be required for the exterior vertical face of the foundation walls for the partial basement area.

Fill Areas Below the Proposed Founding Elevation

For the western portion of the site, there is an existing fill layer that extends to depths up to 3.5 to 4 m below the existing grade. The fill consists of a silty clay material most likely from site sources from previous developments. The fill material is relatively compact and behaved similar to the native silty clay at depth. The following options are available for constructing in the fill areas:

Option A – Extend Footings to the Native Soil

Extending the footings to the native soil is a significant undertaking. Although this is an option, it's considered unfeasible and will most likely not be undertaken.

Option B – Lean Concrete Filled Trenches

Option B consists of excavating for foundations using a conventional approach. If native soil is not encountered, deepen the excavation trench vertically for strip and pad footings (approximately the same dimensions of the footings) and fill the open trench with lean concrete. Please footing on the concrete filled trench at the proposed founding elevation. Although this is a viable option, there will be a cost associated with filling with lean concrete. The advantage is that most of the existing fill can remain in place and settlements will be similar to placing footings on native material.

Option C – Remove 600 mm of Fill below the Proposed Footings and Fill with OPSS Granular B Type II

Similar to Option B, the fill material, when encountered, will be subexcavated to a depth of at least 600 mm below the proposed founding elevation and approximately 600 mm beyond the exterior sides of the footings. The subexcavated area can be backfilled with OPSS Granular B Type II, placed in 300 mm lifts and compacted to 98% of the material's standard Proctor maximum dry density. This should be the least costly option. However, due to the fill layer remaining below the engineered fill, the area may be subjects to slightly increased settlements (estimated 35 mm total and 25 mm differential).

Bearing Resistance Values (Basement)

For the basement portion of the building within the eastern portion of the development, it's expected that the depth of the foundation will be approximately 5.3 m below the existing grade. The proposed foundation will encounter the dense glacial till deposit at depths ranging from 4.5 to 6 m below the existing grade. Footings can be founded directly or indirectly (lean concrete filled trenches extending to the glacial till deposit) using the following design criteria:

- ❑ Footings placed on the glacial till deposit or concrete filled trenches extending to the dense glacial till depopsit can be designed using the bearing resistance value at serviceability limit states (SLS) of **250 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **400 kPa**.

- ❑ An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, wether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

- ❑ The above noted bearing resistance value at SLS will be subjected to total and differential settlements of 25 and 20 mm, respectively.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

Carlos P. Da Silva, P.Eng., ing., QP_{ESA}

LICENSED PROFESSIONAL ENGINEER
C. P. DA SILVA
PROVINCE OF ONTARIO

Paterson Group

Head Office and Laboratory
154 Colonnade Road South
Ottawa - Ontario - K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

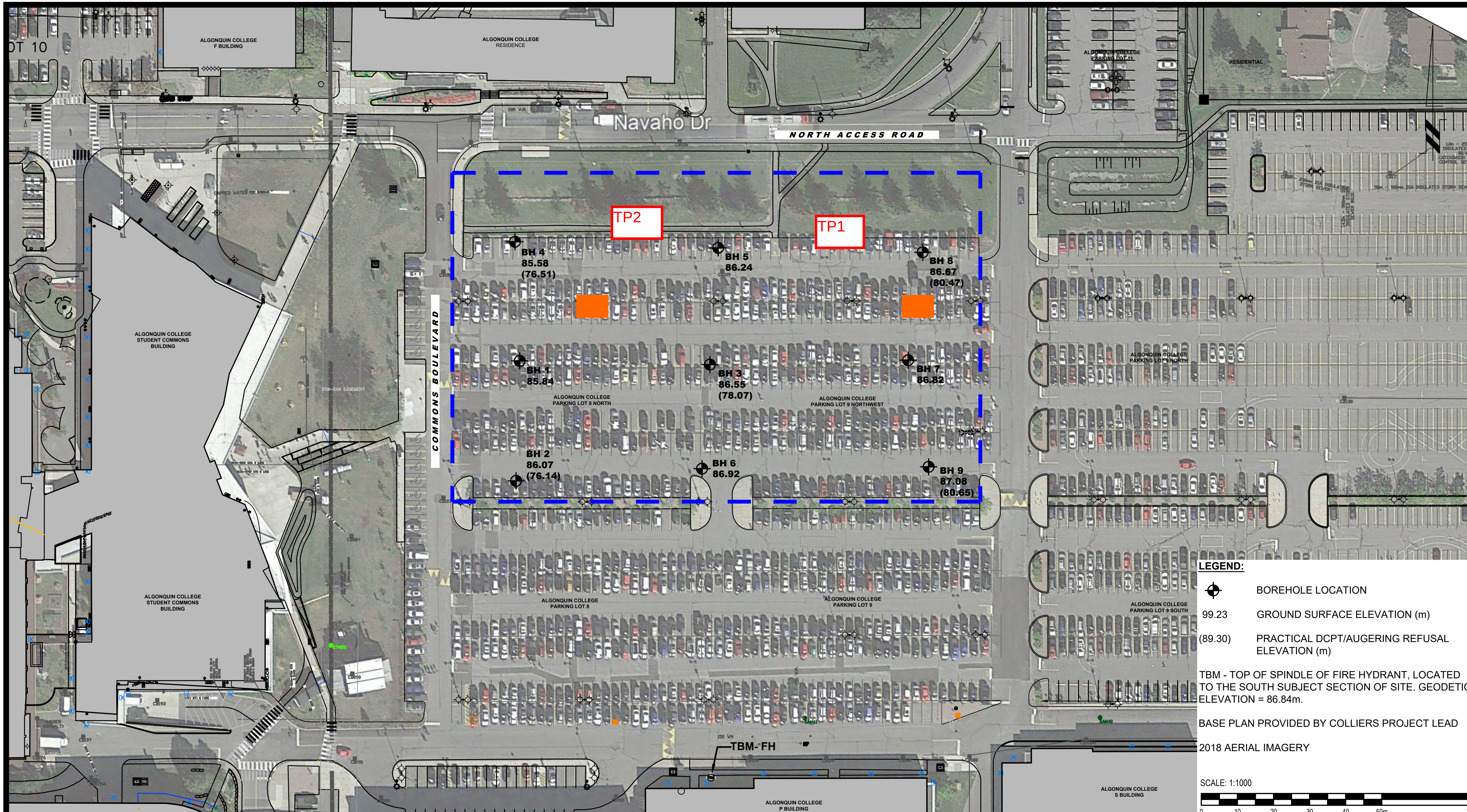
Northern Office and Laboratory
63 Gibson Street
North Bay - Ontario - P1B 8Z4
Tel: (705) 472-5331 Fax: (705) 472-2334

St. Lawrence Office
993 Princess Street
Kingston - Ontario - K7L 1H3
Tel: (613) 542-7381

TP1 - Excavated to approximately 5 m below the existing grade. Minor water infiltration during the excavation program.

Groundwater observed after 30 minutes in TP1 at a depth of approximately 4.2 m.

TP-2 - Silty clay fill is relatively compact and similar to native soil. Native silty clay deposit encountered at approximately 3.2 m depth.



LEGEND:

⌖	BOREHOLE LOCATION
99.23	GROUND SURFACE ELEVATION (m)
(89.30)	PRACTICAL DCPT/AUGERING REFUSAL ELEVATION (m)

TBM - TOP OF SPINDLE OF FIRE HYDRANT, LOCATED TO THE SOUTH SUBJECT SECTION OF SITE. GEODETIC ELEVATION = 86.84m.

BASE PLAN PROVIDED BY COLLIERS PROJECT LEAD

2018 AERIAL IMAGERY

SCALE: 1:1000

0 10 20 30 40 50m 75m

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
1	GROUND SURFACE ELEVATIONS CONVERTED TO GEODETIC	05/31/2019	FA

COLLIERS PROJECT LEADERS

GEOTECHNICAL INVESTIGATION - PROPOSED ATHLETIC RECREATION COMPLEX (ARC)
ALGONQUIN COLLEGE - WOODROFFE AVENUE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1000	Date: 09/2018
Drawn by: RCG	Report No.: PG4624-1
Checked by: RG	Dwg. No.: **PG4624-1**
Approved by: DJG	Revision No.: 1

p:\autocad drawings\geotechnical\pg46xx\pg4624\pg4624-1 rev1 thlp.dwg

REPORT

Algonquin College Ottawa Campus Stormwater Management Brief

Stormwater Management Pond

File Number: D07-12-18-0036

Ottawa, Ontario

Presented to:

City of Ottawa

Planning, Infrastructure and Economic Development Department

Development Review Services

110 Laurier Avenue West
Ottawa, Ontario
K1P 1J1

Project No. 2085345.47 February 4, 2018

TABLE OF CONTENTS

Page

1.	INTRODUCTION			1
	1.1	Study Area		1
2.	DESIGN CRITERIA			6
	2.1	Stormwater Management Guidelines for Pinecrest Creek		6
	2.2	City of Ottawa Design Guidelines		7
	2.3	Provincial Stormwater Requirements		8
3.	STORMWATER MODEL – EXISTING CONDITIONS			9
	3.1	Catchment Areas and Hydrologic Parameters		9
	3.2	Existing Controls		9
	3.3	Peak Flows – Existing Conditions		11
4.	STORMWATER PLAN FOR EXISTING SHORTFALL			12
	4.1	Background for Existing Shortfall Projects		12
		4.1.1	NE Parking Lot (File No. D07-12-13-0025)	12
		4.1.2	Building C Addition (File No. D07-12-16-0137)	14
		4.1.3	Building S Addition	14
	4.2	Stormwater Requirements for Existing Shortfall Projects		15
	4.3	Proposed Pond Solution		15
	4.4	Pond Design Requirements		16
		4.4.1	Water Quality – Total Suspended Solids Removal	16
		4.4.2	Runoff Volume Reduction	18
		4.4.3	Water Quantity – Erosion Control	18
		4.4.4	Water Quantity – Flood Management	18
	4.5	Total Provided Pond Volume		19
	4.6	Reserve Pond Capacity		19
	4.7	SWMHYMO Model Short Term Development - Peak Flows with Pond		20
	4.8	Baseline Storm Sewer Trunk		22
5.	FACILITY COMPONENTS			24
	5.1	Design Drawings		24
	5.2	Site Layout and Grading		24
	5.3	Pond Inlet		25
	5.4	Pond Outlet		26
	5.5	Forebay & Main Pond Cell		27
	5.6	Access Road/Pathway		28
	5.7	Safety		28
	5.8	Pond Hydraulic Profile		28
6.	LANDSCAPING			30
	6.1	Existing Conditions		30
	6.2	General Design Principles		30
	6.3	Landscape Elements		30
		6.3.1	Protection of Existing Landscape Features	30
		6.3.2	Grading and General Layout	31
		6.3.3	Multi-use Pathways and Connectivity	31
		6.3.4	Planting Design	31
		6.3.5	Retaining Walls	31
		6.3.6	Fencing	31

TABLE OF CONTENTS

Page

6.3.7 Signage 31
6.3.8 Lighting 31
7. PERMITS AND APPROVALS 32
7.1 City of Ottawa 32
7.2 Conservation Authorities 32
7.3 Province of Ontario 32
7.3.1 Ontario Ministry of the Environment, Parks and Conservation (MOECP) 32
7.3.2 Ontario Ministry of Natural Resources 33
7.3.3 Ontario Ministry of Transportation 33
7.4 Federal Approvals 33
7.4.1 Department of Fisheries and Oceans 33
7.4.2 National Capital Commission 33
7.5 Other Approvals 33
7.5.1 Utilities 33
7.5.2 Private Property 34
7.5.3 Tree Permit 34
7.5.4 Migratory Bird Convention Act 34
8. EROSION & SEDIMENT CONTROL 35
9. GEOTECHNICAL INVESTIGATION 36
10. OPERATION & MAINTENANCE ACTIVITIES 37
10.1 Inspection 37
10.2 Weed Control 37
10.3 Debris/Trash Removal 37
10.4 Draw Down for Maintenance and Sediment Removal 38
10.5 Sediment Removal 38
10.6 Planting 38
10.7 Bank Erosion & Rip Rap 38
11. MONITORING 39
12. STORMWATER PLAN FOR FUTURE DEVELOPMENT 40
13. LOW IMPACT DEVELOPMENT (LID) PILoT PROJECT 43
14. CONCLUSIONS AND RECOMMENDATIONS 45
15. AUTHORIZATION 46
16. CLOSURE 47
REFERENCES 48

TABLE OF CONTENTS

Page

LIST OF TABLES

Table 1: Pinecrest Creek Stormwater Management Criteria for Ottawa Campus 7

Table 2: Water Quality Storage Requirements 8

Table 3: Existing Peak Flows from Campus (East of Woodroffe) 11

Table 4: Pinecrest Creek Stormwater Management Requirements for Shortfall Projects 15

Table 5: Reserve Pond Capacity 19

Table 6: Short Term Development (Pond and Shortfall Projects) Peak Flows from Campus (East of Woodroffe) 20

Table 7: Comparison of Peak Flows from Campus (East of Woodroffe) 22

LIST OF FIGURES

Figure 1: Algonquin College - Ottawa Campus within Pinecrest Creek Watershed 4

Figure 2: Algonquin College - Existing Conditions & Controls 5

Figure 3: Algonquin College – Pre-Development Subcatchment Areas 10

Figure 4: Algonquin College – Shortfall Project Locations 13

Figure 5: Algonquin College – Post Development Subcatchment Areas & Overall Pond Catchment Area 17

Figure 6: Algonquin College – Major and Minor Drainage Areas to Pond 21

Figure 7: Algonquin College – Pond Hydraulic Profile 29

Figure 8: Algonquin College – Future Stormwater Plan 41

TABLE OF CONTENTS

Page

LIST OF APPENDICES

Appendix A - Background Information

- A-I: Stormwater Management Report - Student Commons Building (IBI Group, 2011)
- A-II: Stormwater Management Report - Phase III Residence (Novatech, 2003)
- A-III: Stormwater Management Report - Police/Justice Building (TSH, 1999)
- A-IV: Stormwater Management Report - Sports Field (JLR, 2005)
- A-V: Stormwater Management Report - ACCE Building (Morrison Hershfield (MH), 2008)
- A-VI: Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area (JFSA, June 2012)
- A-VII: Stormwater Management Report – NE Parking Lot (MH, 2011)
- A-VIII: NE Parking Lot – Site Plan Approval Supporting Documents
- A-IX: Stormwater Management Report – IELCIIE Building (Building C) (MH, 2017)
- A-X: IELCIIE Building (Building C) – Site Plan Approval Supporting Documents
- A-XI: Stormwater Management Report – Building S (MH, 2017)

Appendix B – Stormwater Calculations

- B-I: Existing Subcatchment Areas and Hydrologic Parameters
- B-II: Existing Building Roof Characteristics
- B-III: SWMHYMO Model – Existing Schematic
- B-III: SWMHYMO Model – Existing Conditions
- B-IV: Pinecrest Creek Criteria – Existing Shortfall Projects
- B-IV: Short Term Development 100 Year Storage Volume Requirement
- B-V: Pond Design Requirements
- B-V: Pond Forebay Design Calculations
- B-V: Pond Reserve Capacity Calculations
- B-V: Pond Volume Required to Address Shortfall
- B-V: Pond Stage Storage Discharge (Orifice & Weir)
- B-V: Pond Drawdown Time Calculations
- B-VI: Short Term Development Subcatchment Areas and Hydrologic Parameters
- B-VI: Short Term Development Building Roof Characteristics
- B-VII: SWMHYMO Model – Short Term Development (Pond & Shortfall Projects) Schematic
- B-VII: SWMHYMO Model – Short Term Development (Pond & Shortfall Projects)
- B-VIII: Storm Sewer Design Sheet

Appendix C Pond Design Drawings

Appendix D Site Survey

Appendix E Tree Conservation Report

Appendix F Landscape Drawings

Appendix G Nest Visit & Clearance

Appendix H Erosion & Sediment Control Plan

Appendix I Geotechnical Investigation

Appendix J Stakeholder Correspondence

1. INTRODUCTION

In January 2016, Morrison Hershfield Limited (MH) was retained by Algonquin College to provide professional engineering services associated with the development of an Integrated Rainwater/Stormwater Management Plan for long-term development for the Ottawa Campus, located at 1385 Woodroffe Avenue in Ottawa, Ontario.

The scope of the project includes:

- Review background information;
- Delineate stormwater drainage catchment areas and construct a stormwater management model for the entire campus (both sides of Woodroffe Avenue);
- Develop a preferred stormwater management option that adheres to all required design criteria to address the current stormwater shortfall; and
- Develop cost estimates for the works associated with the stormwater management option; and
- Prepare a summary report that documents the analyses completed and the results obtained.

In September 2017, Morrison Hershfield Limited (MH) was retained by Algonquin College to provide professional engineering services associated with the engineering design and contract documents of a stormwater management pond.

1.1 Study Area

Algonquin College Ottawa Campus is located at 1385 Woodroffe Avenue, Ottawa ON K2G 1V8. Zoning on this property is I2 (Major Institutional Zone) and it is within City Ward 8 – College.

Algonquin College Ottawa Campus is situated within the heart of the Pinecrest Creek watershed. **Figure 1** shows the location of the Ottawa Campus within the Pinecrest Creek watershed. Through urban development, the creek has been altered severely in sections. Many portions are now buried (enclosed in storm sewers and culverts). Few natural sections remain. The Ottawa Campus is located just upstream of the remaining natural stream portion. The creek remains buried under the Campus.

The Ottawa Campus on the west side of Woodroffe Avenue covers an area of approximately 2ha that includes an academic building, asphalt parking lots, and landscaped areas. Drainage is by means of a series of an on-site storm sewer that outlet at a controlled rate to the 2400mm diameter trunk storm sewer on Woodroffe Avenue.

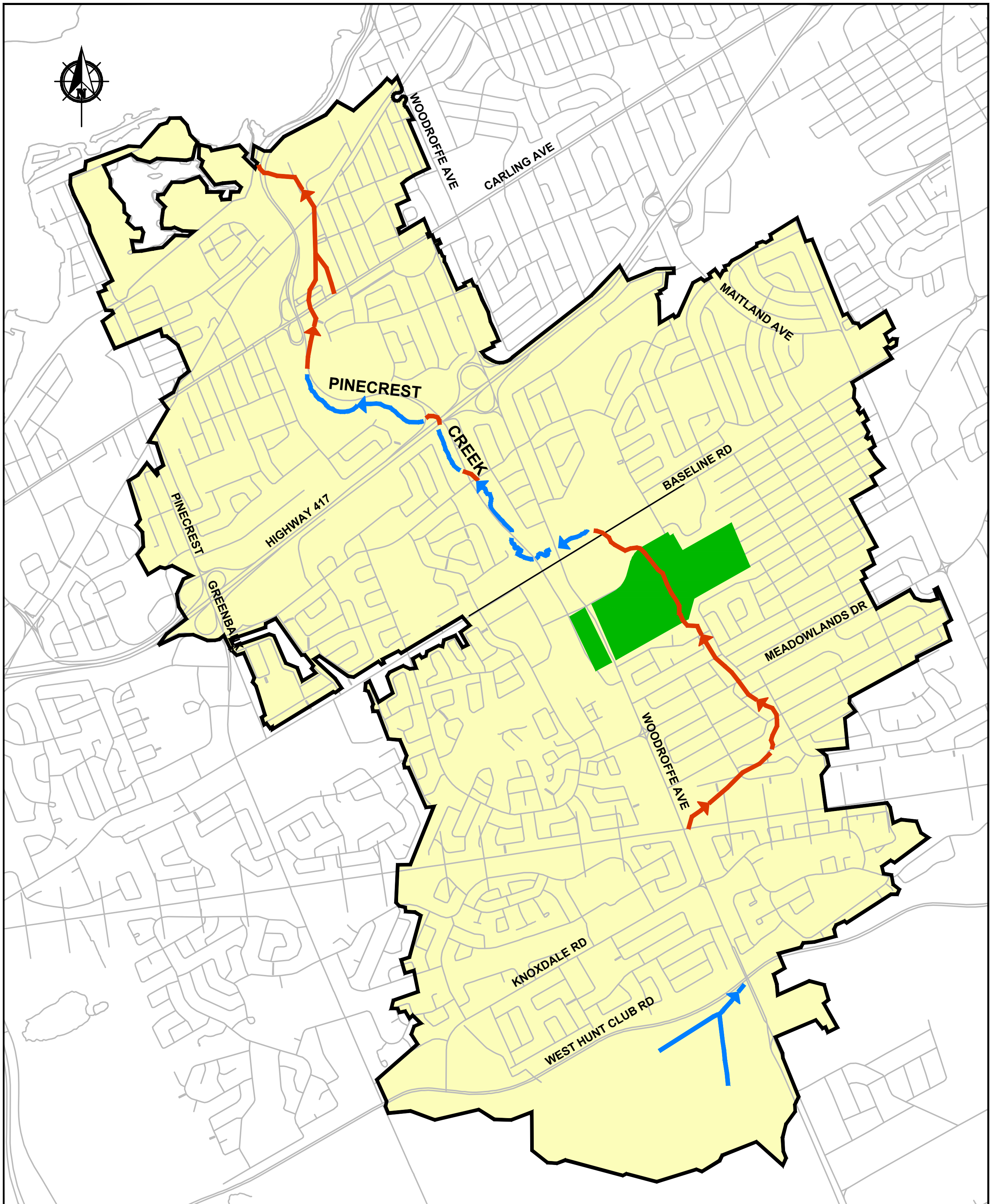
The Ottawa Campus on the east side of Woodroffe Avenue covers an area of approximately 35ha that includes academic buildings, a sports complex, asphalt parking lots, administrative and utility buildings, and landscaped areas. Drainage is by means of a series of on-site storm sewers that outlet to a 2100mm diameter trunk storm sewer that bisects the Campus from south to north (directly east of Buildings E, F, N, and T) and discharges to Pinecrest Creek, north of Baseline Road. The trunk sewer also conveys storm runoff from the residential area to the south of the Ottawa Campus (Ryan Farm).

Figure 2 shows lands from the Algonquin College Ottawa Campus flowing to the major City of Ottawa trunk storm sewers including the existing 2100mm diameter (“Baseline Trunk”) and the existing 2400mm diameter (“Woodroffe Trunk”). It also shows the existing known controls that are described below.

East of Woodroffe Avenue, the stormwater management approach has been fairly conventional. Stormwater flows mainly uncontrolled from hardened surfaces or is controlled to pre-development conditions with roof drains and inlet control catch basins as per City of Ottawa guidelines. With exception is the Student Commons Building (IBI Group, 2011), which is controlled to the previous 2009 Pinecrest Creek Stormwater Management Criteria using roof drains, roof storage, landscaping, and on-site sand infiltration basins. The Student Residence (Phase III) and Courtyard is controlled to 5-year pre-development conditions with roof drains, roof storage, and landscaping (Novatech, 2003). The Sports Field Complex development (J.L. Richards, 2005) did not require stormwater management as the pre-development condition was concluded to be equivalent to the post-development condition. The same conclusion was reached for the Police/Justice Building (TSH, February 1999) and BMPs were not required to maintain post development flows to pre development conditions nor to provide any specific water quality control.

West of Woodroffe Avenue, rainwater and stormwater management is relatively more advanced. To help achieve LEED criteria, post-development flows from ACCE (Algonquin College – Centre for Construction Trades and Buildings Sciences) building and adjacent landscape area are controlled to 25% less than pre-development flows (Morrison Hershfield, December 2008). Runoff is attenuated on site in the parking lot, on the green/asphalt roof, and in an underground cistern before draining to existing 2400 diameter storm sewer on Woodroffe Avenue. The ponding areas were designed to store the runoff excess from the 100 year design storm as per the *City of Ottawa Sewer Design Guidelines*.

The stormwater management reports described above are included in **Appendix A-I, A-II, A-III, A-IV and A-V** for reference purposes.

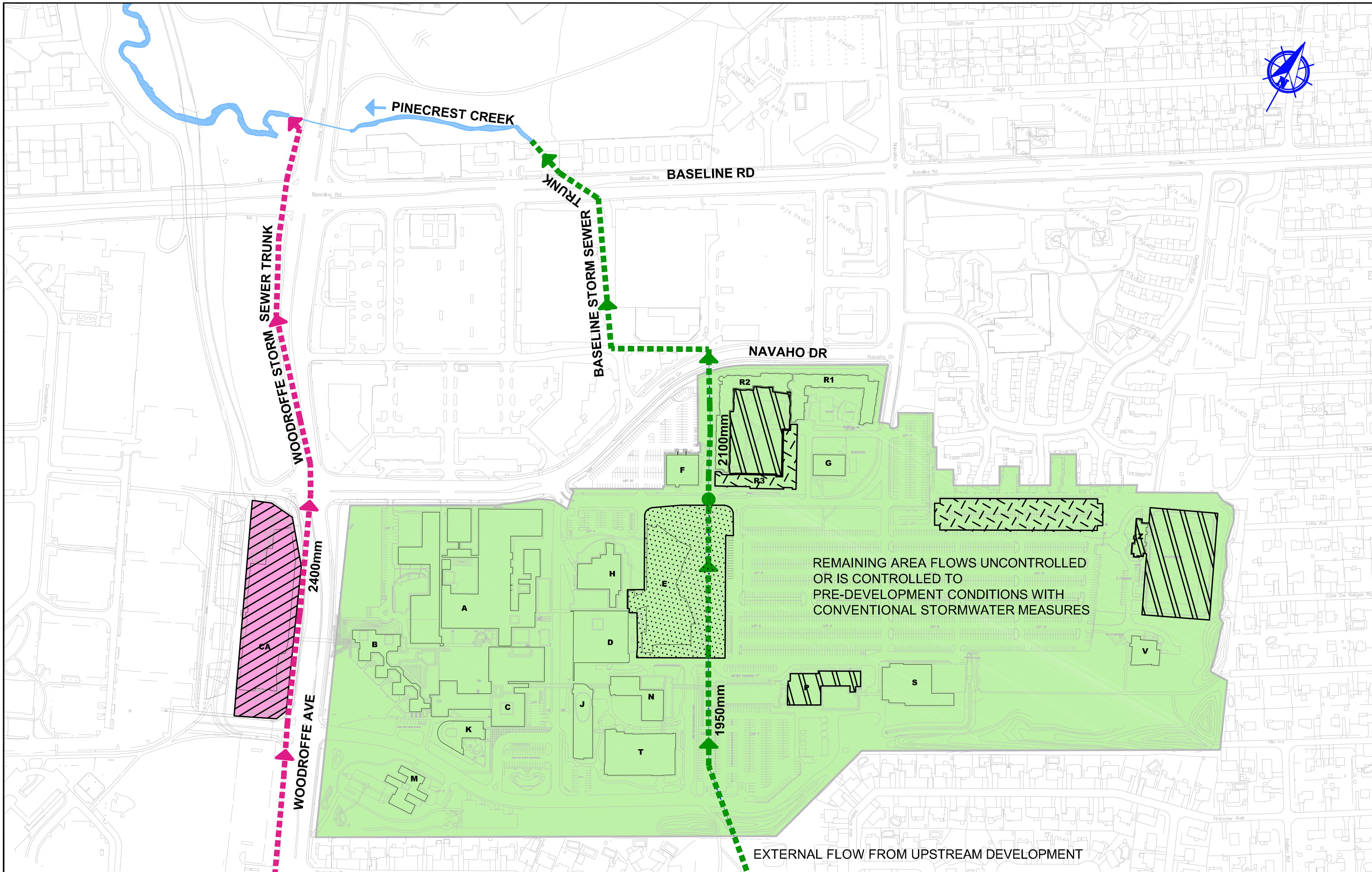


REFERENCE: PINECREST CREEK / WESTBORO STORMWATER MANAGEMENT RETROFIT STUDY (2011)

LEGEND

- STUDY AREA
- PINECREST CREEK WATERSHED BOUNDARY
- BURIED STREAMS
- REMAINING STREAMS

MORRISON HERSHFIELD	ALGONQUIN COLLEGE
ALGONQUIN COLLEGE OTTAWA CAMPUS WITHIN PINECREST CREEK WATERSHED	SCALE: N.T.S.
	Figure No.: 1



LEGEND

- CAMPUS LAND DRAINING TO WOODROFFE TRUNK
- CAMPUS LAND DRAINING TO BASELINE TRUNK
- MEETS PINECREST CRITERIA (2009)
- MEETS LEED
- MEETS PRE-DEVELOPMENT UNCONTROLLED
- MEETS PRE-DEVELOPMENT CONTROLLED

MORRISON HERSHFIELD

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE EXISTING CONDITIONS & CONTROLS

SCALE: N.T.S.

Figure No.: 2

2. DESIGN CRITERIA

The design of a drainage and stormwater management system in this study area must be prepared in accordance with the following documents:

- *Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area*, J.F. Sabourin and Associates Inc., June 2012;
- *Sewer Design Guidelines*, City of Ottawa, October 2012;
- *Stormwater Management Planning and Design Manual*, Ministry of the Environment, March 2003; and
- *Stormwater Management Facility Design Guidelines,* City of Ottawa, April 2012

The document version dates referenced above are the most recent upon finalization of this report. These documents should be checked before designing a drainage and stormwater management system and the most recent document should be referenced.

2.1 Stormwater Management Guidelines for Pinecrest Creek

Any new development or redevelopment projects within the Pinecrest Creek watershed must implement stormwater management measures that meet the criteria outlined in the “Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area” (J.F. Sabourin and Associates Inc., June 2012). Since the Algonquin College Ottawa Campus is within the Pinecrest Creek watershed, these stormwater management guidelines apply to the Ottawa Campus.

The guidelines specific to Pinecrest Creek/Westboro impose special conditions for water quality, peak flow and volume control. Implementation of these additional criteria is intended to ensure that the impact of infill and redevelopment upon Pinecrest Creek are mitigated as follows:

- Water quality is not adversely affected;
- Flood risk along Pinecrest Creek is not increased; and
- The cumulative impacts of any new developments, infill projects, or redevelopments will not have an adverse effect on the overall health of Pinecrest Creek.

These criteria are in addition to those outlined in the City of Ottawa Sewer Design Guidelines (October 2012) and Ministry of the Environment and Climate Change (MOECC) Stormwater Management Planning and Design Manual (March 2003), with the most stringent requirements governing.

The criteria have been tailored to specific constraints in Pinecrest Creek and the type (residential, institutional/commercial/industrial (ICI), etc.) and scale (single lot vs. sit plan control, etc.) of development. The stormwater management criteria for institutional/commercial/industrial developments that discharge to Pinecrest Creek are summarized in **Table 1**.

Table 1: Pinecrest Creek Stormwater Management Criteria for Ottawa Campus

Development Type	Water Quantity			Water Quality
	Runoff Volume Reduction	Flood Management	Erosion Control	
Sites with soil infiltration rates ≥ 1mm/hour	Minimum on-site retention of the 10mm rainfall.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5L/s/ha. ii) City of Ottawa Sewer Design Guidelines (Section 8.3.7.3).	Control (detain) the runoff from the 25mm rainfall such that the peak outflow from the site does not exceed 5.8 L/s/ha.	On site removal of 80% of total suspended solids
Sites with soil infiltration rates < 1mm/hour	If the entire property is underlain by native soils with infiltration rates < 1mm/hour, no infiltrating stormwater management measures may be used. A minimum depth of 300mm of amended soil shall be provided below all from yard landscaped areas. A green roof and/or rain harvesting measures could be implements to provide further volume reduction.			
Source: "Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area" dated June 2012, prepared by J.F. Sabourin and Associates Inc. for the City of Ottawa				

The Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area, prepared by JFSA (June 2012) is included in **Appendix A-VI**.

The above criteria are in addition to those outlined in the City of Ottawa Sewer Design Guidelines and the Ministry of the Environment Stormwater Management Planning and Design Manual, with the most stringent requirements governing.

2.2 City of Ottawa Design Guidelines

Any existing separated sewer area within the City of Ottawa must implement stormwater management measures that meet the criteria outlined in the "City of Ottawa Sewer Design Guidelines" (City of Ottawa, October 2012). Since the Algonquin College Ottawa Campus is located within an existing separated sewer area, the following stormwater management guidelines apply to the Campus:

- Control runoff to the 5-year pre-development flow;

- Flows to the storm sewer in excess of the 5-year storm release rate, up to and including the 100-year storm event, must be detained on site;
- Grassed infill areas: maximum equivalent post development runoff coefficient to equal pre-development runoff coefficient;
- Hard surface infill area: post development runoff coefficient to equal 0.5;
- On site detentions techniques shall be required to limit run-off from the subject site to a maximum equivalent runoff coefficient; and
- Increase runoff coefficient by 25%, to a limit of 1.0, for the 100 year storm event.

2.3 Provincial Stormwater Requirements

The Ministry of Environment's (now Ministry of the Environment and Climate Change) *"Stormwater Management Planning & Design Manual"* (March 2003) offers a variety of lot level conveyance, and end-of-pipe stormwater management practices including bioswales, buffer strips, and enhanced grassed swales. The manual suggests that these be used as part of a multi-component approach that also includes end-of-pipe treatment.

In addition to these sources and conveyance stormwater management practices, the Ministry of Environment Manual offers a number of end-of-pipe solutions. The storage requirements for 'enhanced' protection (80% total suspended solid removal) for different impervious levels and stormwater management practice types are outlined in **Table 2**.

Table 2: Water Quality Storage Requirements

Protection Level	Stormwater Management Practice Type	Required Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	80%
Enhanced 80% Long-Term Suspended Solid 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

Source: "Stormwater Management Planning & Design Manual" (Ministry of Environment, 2003)

The minimum design criteria for the different stormwater management practice types above (infiltration, wetland, hybrid wet pond/wetland, and wet ponds) are outlined in the MOE Manual.

3. STORMWATER MODEL – EXISTING CONDITIONS

A stormwater model has been developed for the Algonquin College Ottawa Campus lands east of Woodroffe Ave. The model is a baseline tool that can be used to compare stormwater runoff flow rates and volumes under existing conditions to future conditions with changes in development. The model can be used to test the effect of proposed rainwater and stormwater management measures on Campus. Model results can be submitted to the City of Ottawa to support site plan applications. The model should be updated in the future with changes in land use and drainage. Long term flow monitoring data (when available) should be obtained to validate and calibrate the model.

3.1 Catchment Areas and Hydrologic Parameters

The modelling tool “SWMHYMO” was used to simulate stormwater runoff under existing conditions. The model input includes design rainfall and a series of parameters that characterize subcatchment areas. Key catchment area and hydrological parameters are included in **Appendix B-I**.

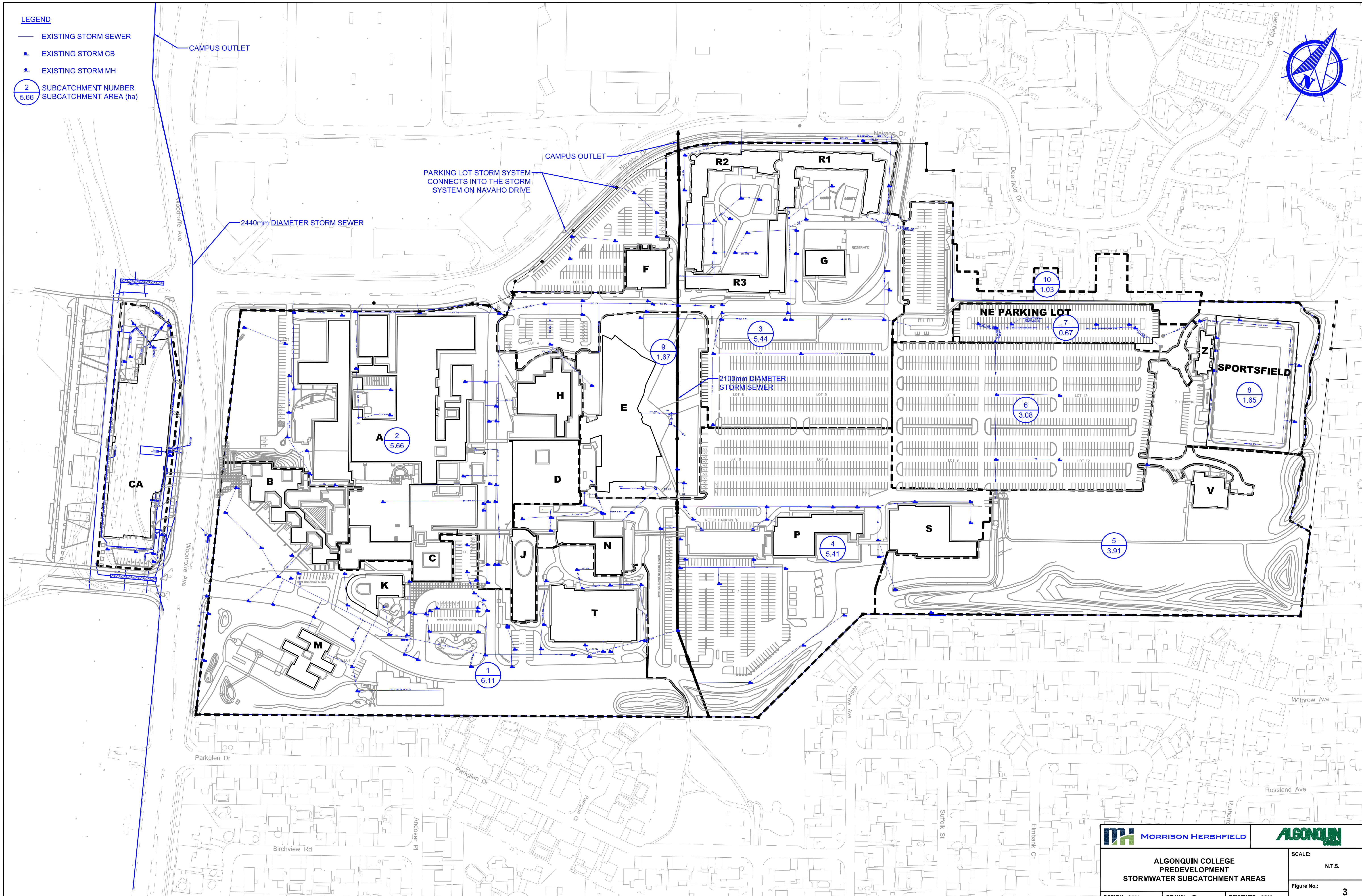
Figure 3 shows the pre-development subcatchment areas for the Algonquin College Ottawa Campus.

3.2 Existing Controls

The release rate and storage volume of the building roofs were estimated based on roof plan drawings prepared for the Preventative Roof Maintenance Project (July 2013). The estimated release rates and storage volumes for the roofs are included in **Appendix B-II**.

Release rates for Student Commons Building (Building E), NE Parking Lot and Student Residence – Phase III (Building R3) were obtained from stormwater management reports:

- The Student Commons Building (Building E) is located in the middle of the Campus, north of Building N, east of Parking Lot 8, west of Buildings H and D, and south of Building F. A stormwater management system for the Student Commons Building was designed to meet the *Pinecrest Creek Stormwater Management Criteria (Version 2009)*. The proposed constructed solution included roof storage, swales, depressed pervious areas and sand infiltration basins. Water quality requirements (80% TSS removal) were met through runoff volume control. These design values were incorporated into the existing condition model. The Stormwater Management Servicing Report for the Student Commons Building (May 2011) is included in **Appendix A-I**.



MORRISON HERSHFIELD

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE
PREDEVELOPMENT
STORMWATER SUBCATCHMENT AREAS

SCALE: N.T.S.

Figure No.: 3

DESIGN: SDM | DRAWN: JB | REVIEWED: SDM

\\mh.local\data\Offices\Ottawa\proj\2085345\2085345.43 Woodroffe Campus SWM Plan\300 - Engineering\08 Stormwater\RW SW Integrated Plan\Figures\NEW_Figure_3_Pre Development_06272018.dwg
LAST SAVED: Thursday, June 28, 2018

- The displaced parking lot (NE Parking Lot) for the Student Commons Building is located in the northeastern corner of the Campus, north of Parking Lot 12 and west of Building Z. A stormwater management system was designed in accordance with *Sewer Design Guidelines* (City of Ottawa, November 2004). Design values were incorporated into the existing condition stormwater model. The Stormwater Management Report for the Student Commons Displaced Parking Lot (November 2011) is included in **Appendix A-VII**.

- The Student Residence – Phase III Building (Building R3) is located in the north portion of the Campus, north of Parking Lot 8, east of Building F, south of Building B2 and the residence courtyard and west of Building G. A stormwater management system was designed in accordance with the criteria outlined in the Stormwater Management Report for the building. Design values were incorporated into the existing condition stormwater model. The Stormwater Management Report for the Student Residence – Phase III Building (January 2003) is included in **Appendix A-III**.

3.3 Peak Flows – Existing Conditions

Peak flows associated with the 3, 6, 12, and 24 hour Chicago design storms are summarized in **Table 3**. It should be noted that the peak flows presented below only represent the peak flows generated from the Ottawa Campus on the east side of Woodroffe Avenue and do not include upstream flows from the Ryan Farm residential development that contribute to the existing 2100mm diameter trunk storm sewer that bisects the Campus from south to north.

Table 3: Existing Peak Flows from Campus (East of Woodroffe)

Return Period	3 Hour Chicago	6 Hour Chicago	12 Hour Chicago	24 Hour Chicago
	Peak Flow (m^3/s)			
5 Year	3.8	3.9	4.0	4.1
100 Year	7.7	7.9	8.0	8.2

The model input and output files for existing conditions are included in **Appendix B-III**.

4. STORMWATER PLAN FOR EXISTING SHORTFALL

The City of Ottawa approved the following projects to proceed without adhering to the Stormwater Management Guidelines for Pinecrest Creek:

- **NE Parking Lot (File No. D07-12-13-0025)** - Reinstatement of Parking Displaced by Student Commons Building
- **Building C Addition (File No. D07-12-16-0137)** - Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE)
- **Building S Addition** - Automotive Welding Shop Addition (Phase 1)

The City of Ottawa has indicated that these projects could proceed without adhering to the Pinecrest Creek Stormwater Management Guidelines (2012) but the shortfalls as a result of the above three (3) projects must be addressed in the Integrated Rainwater/Stormwater Plan for the Ottawa Campus. The City of Ottawa Sewer Design Guidelines for infill developments within the urban core were/will be applied to these sites. **Figure 4** shows the location of the shortfall projects.

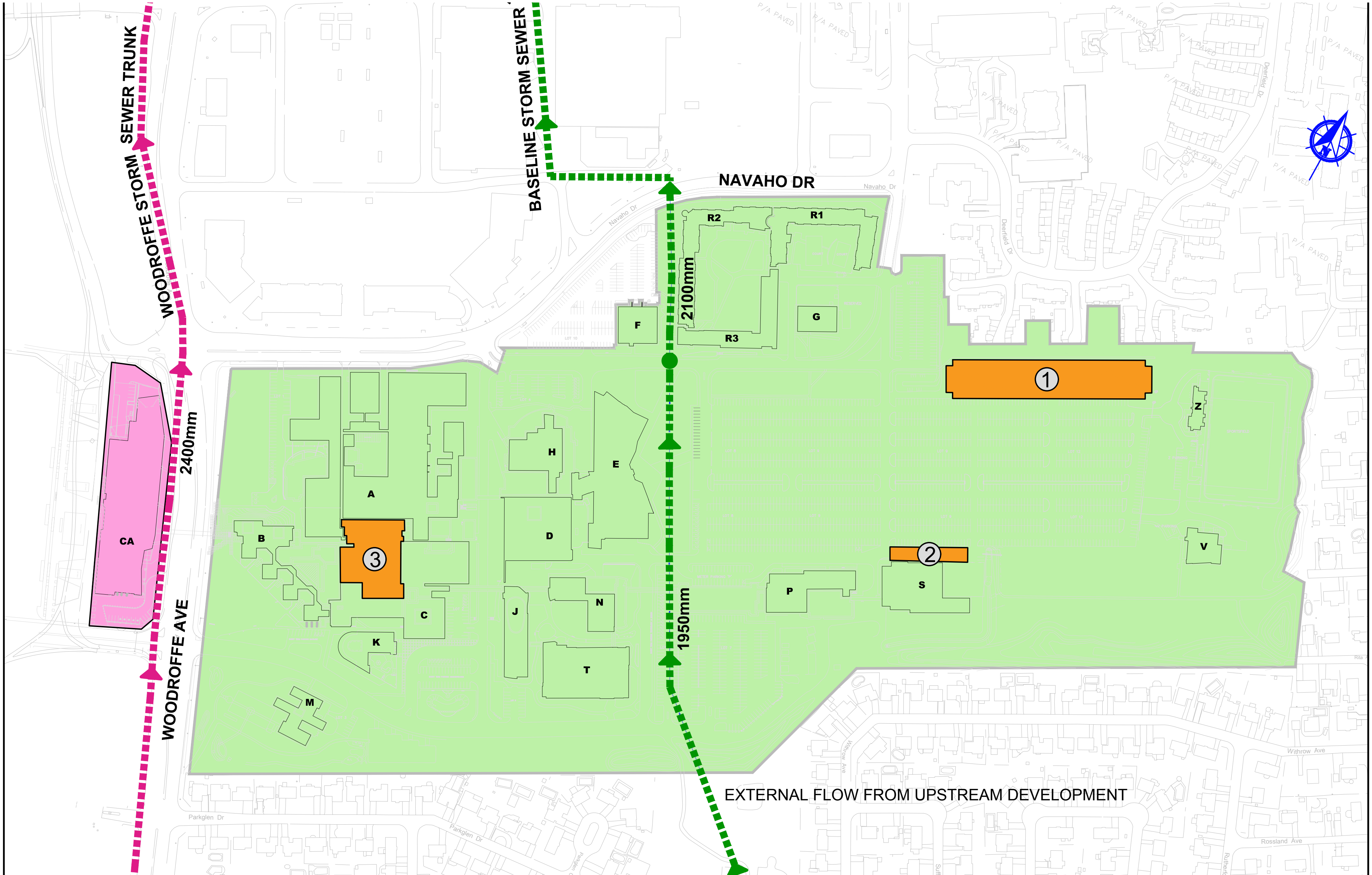
4.1 Background for Existing Shortfall Projects

4.1.1 NE Parking Lot (File No. D07-12-13-0025)

Algonquin College obtained site plan approval to construct a 244 space parking area in order to replace 251 parking spaces lost as a result of construction of a new Student Commons Building. The new parking area is located in the northeast corner of the Campus with existing parking to the south and west. Adjacent land uses include a row-house development to the north and a sports dome to the east. The area measures approximately 6000m^2 and was originally a grassed area.

Site works would be designed to accommodate pre to post on-site while, conditions above this basic requirement (i.e. Pinecrest Creek Stormwater Guidelines) would be dealt with through the pending implementation of a stormwater management pond.

Previous site plan approval addressed increased runoff by requiring the College to improve an existing ditch to provided improved quality and quantity control of stormwater. Since then, the College has undertaken a commitment to develop an overall master plan for the Woodroffe Campus including a transportation plan and a water strategy. In this way the College will avoid



LEGEND

CAMPUS LAND DRAINING TO WOODROFFE TRUNK

CAMPUS LAND DRAINING TO BASELINE TRUNK

SHORTFALL PROJECTS
1. NE PARKING LOT
2. BUILDING S ADDITION
3. BUILDING C COURTYARD

MORRISON HERSHFIELD

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE SHORTFALL PROJECT LOCATIONS

SCALE: N.T.S.

Figure No.: 4

constructing improvements that may not be consistent with the future water strategy.

The revised approval (dated October 18, 2013) amends the previous approval by removing the need to improve the ditch. In the interim there are quantity controls that have been installed in the new parking area. The ditch is vegetated and thereby offering some quality control. This approval extends the previous approval for another year to allow the College to complete the amending agreement and works.

All relevant correspondence with the City of Ottawa regarding the site plan approval of this site is included in **Appendix A-VIII**.

4.1.2 Building C Addition (File No. D07-12-16-0137)

Algonquin College obtained site plan approval to construct additions and renovations to the existing Building C on the Woodroffe Campus to establish the Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE).

Building ‘C’ specifically faces Co-Generation Plant to the north, existing fire route/drop-off/parking area to the south, existing court yard to the west and an existing internal college road to the east.

Building ‘C’ has an existing gross floor area of approximately 17,400m^2 and the proposed three-storey addition is approximately 3,000m^2 in size, which includes a 454 m^2 single storey addition and a vertical addition located on top of the two storey portion of the existing Building ‘C’. Renovations to the existing building will include a new curtain wall façade composed of glazing and metal panels, and a curved roof. The addition is positioned to overlook the existing green courtyard and the components of the project are being designed with the intent to obtain LEED Gold Certification.

On-site storage controls the flow to the 5-year pre-development rate with a combination of surface and subsurface storage.

The stormwater management report is included in **Appendix A-X**.

All relevant correspondence with the City of Ottawa regarding the site plan approval of this site is included in **Appendix A-X**.

4.1.3 Building S Addition

The Building S expansion is a two phase addition to the north side of Building S to accommodate:

- Phase 1: New Welding Shop
- Phase 2: Expansion to north of existing Building S and west of Phase 1

Building S faces an asphalt area consisting of access roads and parking lots. The proposed Phase 1 expansion covers an approximate area of 350m^2 and was originally an impervious area.

At the Pre-Consultation Meeting held at the City of Ottawa on November 3rd, 2016 it was suggested by MH and approved by the City that site works would be designed to accommodate pre to post on-site while, conditions above this basic requirement (i.e. Pinecrest Creek Stormwater Guidelines) would be dealt with through the pending implementation of a stormwater management pond. During this meeting, it was confirmed that the proposed works would not trigger the Site Plan Control approval process due to size. A stormwater management memo was requested by the City to document the stormwater management intentions for the site.

The stormwater management memo, dated April 18, 2017, is included in **Appendix XI**.

4.2 Stormwater Requirements for Existing Shortfall Projects

The stormwater shortfalls for the above three (3) projects are summarized below in **Table 4**. Detailed calculations are included in **Appendix B-IV** and **B-V**. The shortfall is calculated as the total stormwater management volume to meet Pinecrest Creek Criteria less the actual storage volumes provided (or planned to be provided) on site.

Table 4: Pinecrest Creek Stormwater Management Requirements for Shortfall Projects

Pinecrest Creek Criteria	Development Project			
Stormwater Management Requirements (m^3)	NE Parking Lot	Building C Addition	Building S Addition	Total
Water Quality (1)	67.5	9.2	3.4	80.1
Water Quantity - Runoff Volume Reduction (2)	51.1	5.2	2.9	59.2
Water Quantity - Flood Management (3)	273.0	43.3	15.1	331.4
Water Quantity - Erosion Control (4)	91.3	10.0	5.1	106.4
Storage Volume Provided on Site	196.0	26.0	10.4	232.4
Total Shortfall	287	42	16	345

(1) *On-site removal of 80% total suspended solids. Based on Table 3.2 - Water Quality Storage Requirements from the MOE Stormwater Management Design Manual for a wetland facility. Permanent pool volume only.*
(2) *On-site retention of the 10mm rainfall*
(3) *1:100 year discharge to not exceed 33.5L/s/ha*
(4) *Detention of the 25mm rainfall based on retaining at 5.8 L/s/ha*

4.3 Proposed Pond Solution

Based on the area available, a stormwater management facility with significant permanent depth is not technically feasible. As such, a shallow pond option will address the existing shortfall. The proposed pond will be an off-line stormwater management facility. The pond is sized according to the shallower ‘constructed wetland’ criterion from MOECC. It can be designed to meet the multiple design criteria. It is capable of providing the required water quantity control (retention/detention) while also meeting the MOECC ‘enhanced’ criterion.

While other LID options could fulfill some of the required functions, they cannot meet some of the storage requirements required for the shortfall. LIDs (or a combination thereof) can be considered on a site-by-site basis for long term future development. Preferred measures will depend on the drainage area to the site and the physical characteristics of the site. Key factors include topography, infiltration rate of the native soils, and depths to groundwater and bedrock.

Although stormwater management measures to meet the conditions of the Pinecrest Creek Stormwater Management Guidelines are required only of the NE Parking Lot, Building C Addition, and Building S Addition, that have a combined area of approximately 1.0ha, a minimum 5.0ha (in accordance with the MOE Stormwater Management Planning and Design Manual) drainage area is required for a viable SWM facility. As such, it is recommended that the 9.31ha drainage area be considered. The 9.31ha drainage area is the eastern portion of the Campus that includes Catchments 5, 6, 7, and 8, which are shown on **Figure 5.**

It should be noted that the existing shortfall projects have a combined approximate area of 1.0ha.

4.4 Pond Design Requirements

The design requirements outlined below are in accordance with the *“Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area”*, dated June 2012.

4.4.1 Water Quality – Total Suspended Solids Removal

On-site removal of 80% total suspended solids (equivalent to “Enhanced” treatment) will be required. Minimum MOECC requirements for a pond based on “constructed wetland” sizing requirements to service the 9.31ha drainage area with an average imperviousness 45% are approximately as follows:

ALGONQUIN COLLEGE POST DEVELOPMENT STORMWATER SUBCATCHMENT AREAS — Figure No. 5

- Total Water Quality Storage Volume = 861m^3
    - Extended Detention Storage Volume = 372m^3
    - Permanent Pool Volume = 489m^3

4.4.2 Runoff Volume Reduction

On-site retention of the 10mm rainfall to service the 3 shortfall projects, NE Parking Lot (Student Commons Displaced Parking Lot), Building C Addition (IELCIIE Building), and Building S Automotive Welding Shop Addition (Phase 1) must be sized as follows:

- 10mm Runoff Volume = 59m^3

This volume will be provided as permanent pool in the proposed pond. This volume is added to the 489m^3 above resulting in a total permanent pool requirement of 548 m^3.

4.4.3 Water Quantity – Erosion Control

The detention of the 25mm rainfall to service the entire 9.31ha drainage area must be sized and released as follows:

- 25mm Runoff Volume = 1029m^3
- Release Rate = 23L/s

Since the Pinecrest Creek Stormwater Management Guideline requirements control the minimum volumes for extended detention, the pond facility must be sized for an extended detention volume of 1029m^3 instead of 372m^3 (as outlined in **Section 4.4.1**).

Since the MOE Stormwater Management Planning & Design Manual requirements control the release rate for draw-down time, the 25mm rainfall will be released at 23L/s instead of 54L/s (in accordance with Pinecrest Creek Stormwater Management Guideline) to achieve a minimum 24hour draw-down Draw-down time calculations are included in **Appendix B-V.**

4.4.4 Water Quantity – Flood Management

The detention of the 100 year design storm to service the entire 9.31ha drainage area must be sized and released as follows:

- 100 Year Volume = 3,755m^3

- Release Rate = 312L/s

To allow for the possibility of consecutive storms, the total required extended/active storage volume includes 1,029m^3 (25mm event) plus 3,755m^3 (100yr event) resulting in a total required extended/active storage volume of 4,784 m^3.

4.5 Total Provided Pond Volume

The pond will meet the Pinecrest Creek criteria for the upstream drainage area of 9.31ha. Based on the final design of the pond, the total provided capacity is 5,647m^3. This includes 780m^3 of permanent pool volume and 4,867m^3 of extended/active storage volume. The provided volumes meet and/or exceed the required volumes described above. The pond design volumes are detailed in **Appendix B-V**.

4.6 Reserve Pond Capacity

Although two of the three shortfall projects outlined above are not within the pond drainage area, the pond will offset the current stormwater deficit of all three projects. The remaining pond capacity will be reserved to help offset SWM requirements from other future projects. The reserve pond capacity is calculated as follows:

RESERVE POND CAPACITY = TOTAL POND CAPACITY – CAPACITY FOR SHORTFALL PROJECTS

A summary of the reserve capacity in the pond is provided below in **Table 5**. Detailed calculations are provided in **Appendix B-V**.

Table 5: Reserve Pond Capacity

Volume Type	Design Capacity of Pond	Capacity Needed for Shortfall Projects[1]	Reserve Capacity in Pond
Permanent Pool Volume (m^3)	780	139	**641**
Extended Detention / Active Storage Volume (m^3)	4,867	205	**4,662**
Total (m^3)	5,647	345	**5,302**

(1) Includes NE Displaced Parking Lot, Building C Courtyard, Building S Welding Shop.

The three shortfall projects currently identified will require a significant portion of the permanent pool portion of the pond to address their requirements for runoff volume reduction (10mm) and water quality storage (80% TSS Removal). The remaining capacity in the permanent pool is the limiting factor compared to extended detention as it would only meet the permanent pool water quality storage requirements for an additional 4 ha of future development at 90% imperviousness.

4.7 SWMHYMO Model Short Term Development - Peak Flows with Pond

The modelling tool "SWMHYMO" was used to simulate stormwater runoff with the implementation of the pond. The model input includes design rainfall and a series of parameters that characterize subcatchment areas. Key subcatchment and hydrological parameters were updated to include short term development (shortfall projects) and are included in **Appendix B-VI**.

The peak flows were estimated with the implementation of the pond and are summarized in **Table 6**. It should be noted that the peak flows presented in **Table 6** only represent the peak flows generated from the Campus (east side of Woodroffe Avenue) and do not include upstream flows from the Ryan Farm residential development that contribute to the existing 2100mm diameter trunk storm sewer that bisects the Campus from south to north.

Table 6: Short Term Development (Pond and Shortfall Projects) Peak Flows from Campus (East of Woodroffe)

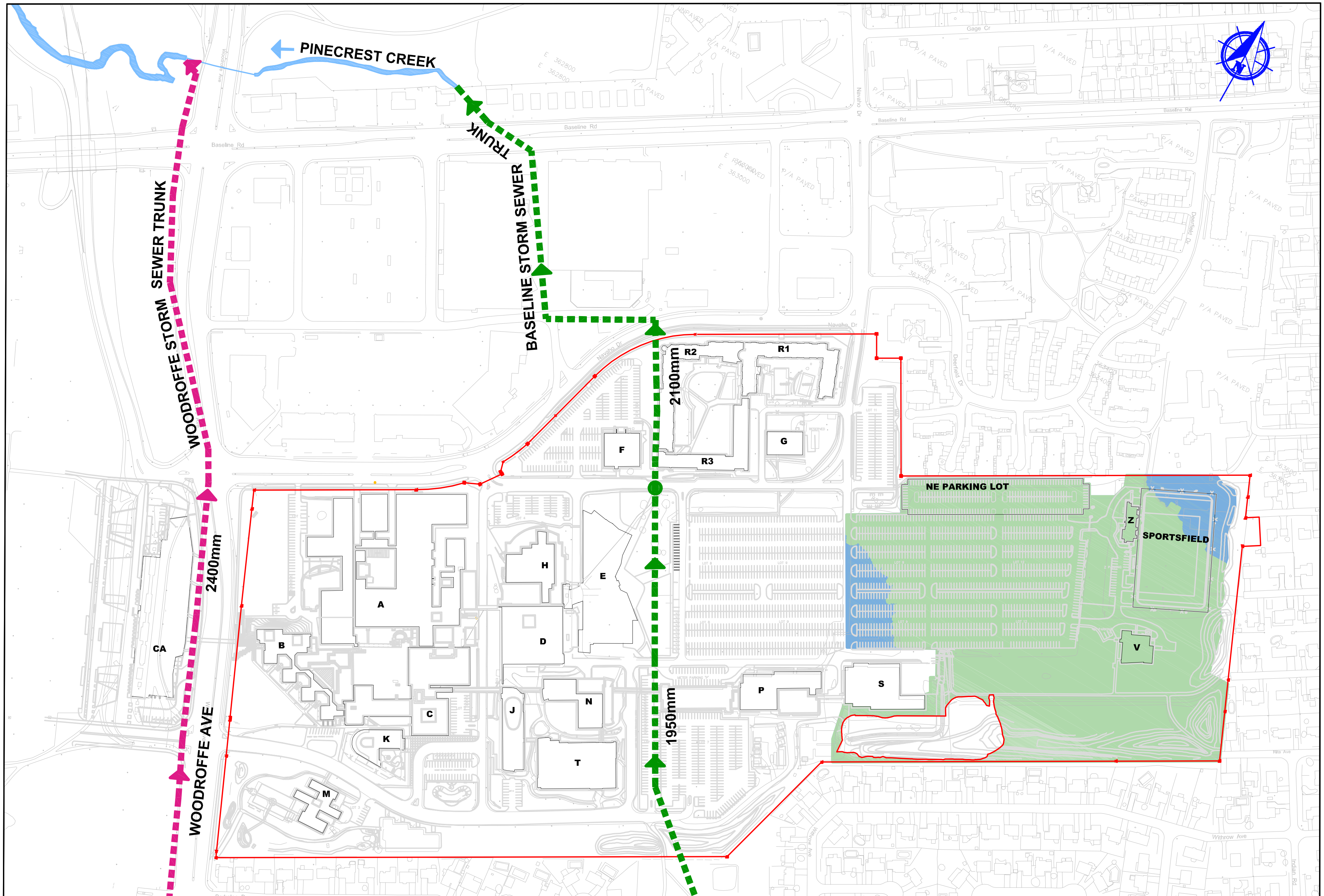
Rainfall Event Return Period	3 Hour Chicago	6 Hour Chicago	12 Hour Chicago	24 Hour Chicago
	Peak Flow (m^3/s)			
5 Year	3.0	3.1	3.2	3.3
100 Year	6.2	6.3	6.5	6.6

The SWMHYMO input and output files and detailed calculations are included in **Appendix B-VII**. As the peak flows presented in **Table 6** are estimates only, flow monitoring is recommended to verify and adjust the peak flows accordingly to match actual conditions.

Figure 5 shows the post development subcatchment areas for the Algonquin College Ottawa Campus.

Figure 6 shows the major and minor drainage areas to the pond.

A comparison of the existing peak flows and short term development (pond and shortfall projects) peak flow are summarized in **Table 7**.



LEGEND

MAJOR STORM DRAINAGE AREA

MINOR STORM DRAINAGE AREA

LOCATION OF PROPOSED POND

MORRISON HERSHFIELD

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE
MAJOR AND MINOR DRAINAGE AREAS
TO POND

SCALE: N.T.S.

Figure No.: 6

Table 7: Comparison of Peak Flows from Campus (East of Woodroffe)

Rainfall Event Return Period		3 Hour Chicago	6 Hour Chicago	12 Hour Chicago	24 Hour Chicago
		Peak Flow (m^3/s)			
5 Year	Existing	3.8	3.9	4.0	4.1
	Short Term Development	3.0	3.1	3.2	3.3
	Flow Reduction (%)	**21%**	**20%**	**20%**	**19%**
100 Year	Existing	7.7	7.9	8.0	8.2
	Short Term Development	6.2	6.3	6.5	6.6
	Flow Reduction (%)	**20%**	**20%**	**19%**	**20%**

The implementation of the SWM facility reduces the overall Campus flow by approximately 20%.

4.8 Baseline Storm Sewer Trunk

The report prepared for the design of the Pinecrest Creek SWM Facility does not provide any HGL information upstream of Baseline Road. JFSA indicated that the PCSWMM model associated with the report was not intended to be used for analysis of HGL in the trunk sewer. We have however reviewed the model results as an order-of-magnitude indication of HGL. The model indicates a 100-year HGL of 84.5m in the trunk sewer just downstream of the connection from the proposed Algonquin SWM pond. This is approximately 0.9m lower than the 100-year water level in the pond.

The pond has a similar depth to the existing “swale” located in the same location. We are not aware of any existing issues relating to HGL from the trunk sewer backing up in the swale. The pond will provide additional storage and peak flow reduction to the trunk sewer, providing an overall benefit to the system.

Since the permanent pool water level in the pond (83.9m) is well above the obvert (82.1m) of the trunk sewer, and the pond has a small and highly impervious catchment, we consider it likely that the pond water level will respond more rapidly to a major storm event than the trunk sewer. Significant backflow into the pond is not likely. A more detailed HGL assessment is not required and is beyond the scope of this project.

The invert of the college storm sewer entering the existing pond/ditch is approximately 84.9m. Since this is higher than the modelled 100-year trunk sewer HGL, no impact on the local minor system is anticipated.

5. FACILITY COMPONENTS

5.1 Design Drawings

The pond design drawings are included in **Appendix C**.

5.2 Site Layout and Grading

The pond will be located in the southeast corner of the Campus. The existing grassed land to the east of the pond will continue to be utilized for snow storage. The lands to the south contain existing residential development (Ryan Farm). The existing survey is included in **Appendix D**.

The overall layout of the pond features a peninsula between the sediment forebay and detention cell. The pond has been designed with a curvilinear shape to provide a naturalized appearance. Due to site constraints and limited space, variable side slopes could not be provided to visually enhance aesthetics. The side slope grading will be 3:1 around the entire pond.

The design adheres to the City's SWMF Design Guidelines which allow 3:1 slopes throughout, provided that a flat 3m wide aquatic bench is provided, 0.3m below the permanent pool level (refer to Figure 8.2 of the Design Guidelines). The entire base of the wetland detention cell is similar to an aquatic bench, in that it is at 0.3m depth. The forebay incorporates aquatic benches. This approach was taken because of the constraints of the narrow site, which does not provide sufficient space for shallower slopes, and because of the overall shallow depth (0.3m) of the wetland detention cell.

Existing drainage swales will be maintained and extended where necessary to ensure adequate drainage of the site. Three (3) 300mm diameter corrugated steel pipe (CSP) culverts are proposed, one (1) will outlet to the forebay and two (2) will outlet to the detention cell. These culverts will convey very low flows and are required to ensure drainage of the surrounding lands around the pond. The minimum size of 300mm is based on the City of Ottawa Park and Pathway Development Manual, March 2012, standard detail PN-01 (Walkway Culvert Plan and Section) on page 94. Note 2 on this detail indicates that the minimum acceptable culvert diameter is 300mm.

The CSP culverts which outlet to the detention cell are not intended to be used to convey flows from future development.

The layout and grading drawings are included in **Appendix C**.

5.3 Pond Inlet

The existing minor system ends with a 450mm diameter corrugated steel pipe (CSP) at 0.5% slope. The downstream invert of the existing pipe is approximately 84.65m. This will be extended at the same slope with 450mm diameter reinforced concrete pipe (RCP) to the pond inlet, via two new maintenance holes (STMH1 and CBMH1). The sewer will drop by 230mm in CBMH1. As such, the inlet to the pond will normally be free flowing as it is slightly above (84.05m) the permanent water level (83.90m). Between 84.05m and the extended detention water level (84.30m), the inlet will be partially submerged, but because of the drop in CBMH1, the sewer upstream of CBMH1 will not be affected. Above the extended detention water level, the sewer will be surcharged.

A sewer design sheet for the inlet is provided in **Appendix B-VIII**. It is noted that the minor system inlet has been designed as an extension of the existing system, rather than to provide capacity for the theoretical peak flow from the drainage area. Due to anticipated development within the catchment area, it is likely that future upgrades of the minor system would follow different alignments to the existing system. Since actual flows to the pond are constrained by the existing minor system, upsizing the pond inlet at this stage is not recommended. Rather, future development should include the construction of a new storm sewer to the pond inlet, aligned to suit the development.

The outlet of the inlet pipe (to the pond) will be equipped with safety grate to prevent public access. A hinged outwards-opening grate will be used to allow for cleaning. A safety handrail will be provided on the headwall.

A major system rip rap spill way is provided on the north embankment beside the minor system pond inlet. This conveys major system flows from the catchment into the pond. The major system inlet enters the sediment forebay, which is designed to prevent re-suspension of sediments.

Flow from the minor system inlet will enter just above the permanent pool level. Scour protection (rip rap) will be provided in the forebay bed, and will transition to the transition to the natural bed of the pond mid-way through the forebay.

Rip rap is compressed of angular stones ranging from 150mm stone to 450mm stone, with a D_{50} of 350mm.

5.4 Pond Outlet

The active storage volume provided is 4,867 m^3 and includes up to the 100 year storm event. The 100 year water level is 85.40m. A minimum freeboard of 0.3m is provided around the pond.

The outlet structure will release the attenuated water at a controlled rate into the existing storm sewer system to meet City of Ottawa Sewer Design Guidelines and Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area.

The outlet pipe is a 450mm diameter reinforced concrete pipe (RCP) with a length of 4m and slope of approximately 1.1%. The pipe invert (83.87m) will be just below the permanent water level (83.90m). The pipe obvert (84.32m) will be just above the extended detention level (84.30m). The flows will pass through a 130mm diameter plug type orifice plate. The invert of the orifice will be at 83.90m. The orifice will control the 25mm rainfall event to a release rate of 23L/s.

The outlet pipe will connect into a 1200mm x 600mm concrete ditch inlet catchbasin (OPSD 810.010). The existing 450mm diameter reinforced concrete pipe (RCP) will also connect into the proposed ditch inlet catchbasin. The ditch inlet catchbasin grate opening will be at 85.155m. The grate opening will act as a 1200mm wide transverse weir for the major storm events and function in conjunction with the orifice plate. The weir (combined with flow through the orifice) will control the 100 year rainfall event to 312L/s.

Scour protection (rip rap) will be provided at the outlet.

Design calculations for the orifice and weir are included in **Appendix B-V.**

An emergency overflow is provided on the berm adjacent to the outlet structure. The overflow is at 85.70m elevation, which is 0.1m lower than the berm and will be lined with riprap. The overflow is 0.3m lower than the finished floor level of the adjacent Building ‘S’ (86.00m elevation) as required by the City’s SWM Facility Design Guidelines. It is further noted that the lowest contours adjacent to the residential properties which back onto the pond are all also at least 86.00m elevation, and finished floor levels are likely higher.

The emergency overland flow route is shown on **Figure 5**. Overland flow would move west from the pond and gather in a depressed area, where it would enter CB098, which discharges to the Baseline Trunk Sewer.

5.5 Forebay & Main Pond Cell

The pond has been designed in accordance with the MOE Stormwater Management Planning and Design Guidelines for enhanced protection (80% long term total suspended solids removal). The design information provided below is in accordance with Table 4.6 of the Stormwater Management Planning and Design Guidelines. In accordance with Table 3.2 of the Stormwater Management Planning and Design Guidelines, the facility requires 92.5m^3/ha of treatment volume. This is based on an impervious level of 45% and a wetland facility. The treatment volume is made up of permanent pool volume and active storage (extended detention) volume. The active storage (extended detention) volume requirement is 40m^3/ha.

The required permanent pool volume is 548m^3 (includes 489m^3 based on the MOE design criteria and 59m^3 for the 10mm event runoff for the three (3) shortfall projects based on the Pinecrest Creek design criteria). The provided permanent pool volume is 780m^3.

The forebay has been sized to ensure an average forebay velocity equal to or less than 0.15m/s.

The proposed forebay length is 25m long and 13m wide. The forebay length to width ratio of 2:1 meets the MOE design requirements.

The forebay area is 14% of the total permanent pool area and meets the MOE design requirements.

The sediment forebay will be divided from the main pond cell by a berm, constituting rip-rap protection of the slope from the forebay up to the shallower main cell. The top of the rip-rap will be submerged 0.3m below the permanent pool level, to prevent the public from walking on it.

For safety purposes, a 3m aquatic bench is provided in the forebay at a proposed elevation of 83.60m.

The pond side slopes are 3:1 to maximize the functionality of the pond.

The active storage volume provided is 4,867m^3 and active storage depth is 1.5m. The active storage detention time was calculated using Equation 4.10 and 4.11 from the MOE Stormwater Management Planning and Design Manual, which results in an approximate detention time of 25 hours to allow for suspended solids settling.

Design calculations for the forebay (including settling length) and draw-down time calculations are included in **Appendix B-V.**

5.6 Access Road/Pathway

A 4m wide gravel surfaced (150mm Granular A and 300mm Granular B) access road, complete with turnaround, will be provided along the north side of the pond.

A 3m wide stone dust multi-use pathway will be provided along the east and south sides of the pond.

The access road and multi-use pathway will provide maintenance crews sufficient access to the sediment forebay, inlet structure, and outlet structure, for general inspection and maintenance purposes.

Although runoff from the stone-dust and granular surfaces may carry increased Total Suspended Solids (TSS), this runoff will cross a vegetated slope which will remove TSS before it enters the pond.

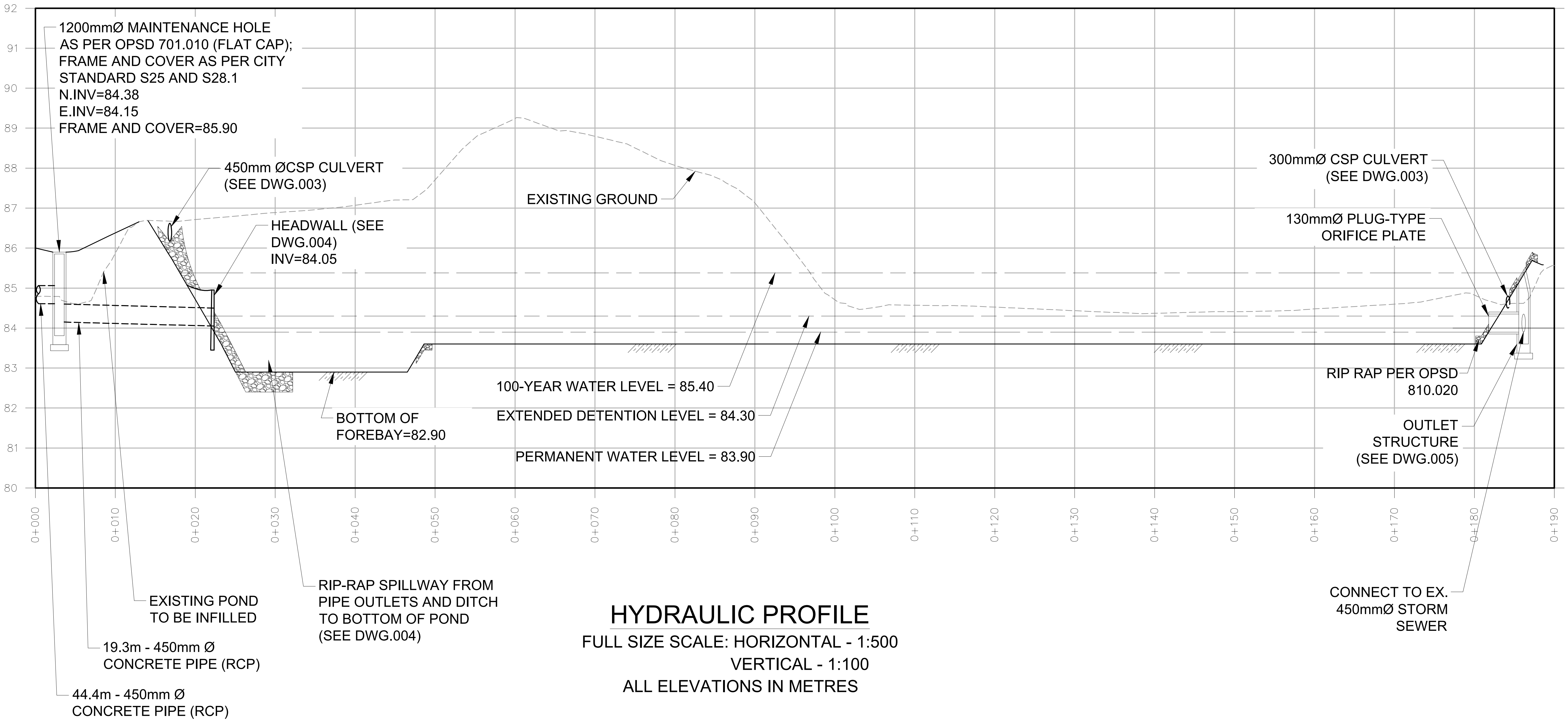
5.7 Safety

The following safety measures were incorporated into the design of the stormwater management facility:

- Railing and safety grate on the inlet headwall;
- Aquatic bench (safety bench) in the sediment forebay with a depth of 0.3m;
- Shallow pond depth of 0.3m (bottom of pond to permanent water level);
- Pond grading and features are in conformance with the recommendation and conclusions in the geotechnical report;
- Plantings throughout the pond.

5.8 Pond Hydraulic Profile

Figure 7 show the hydraulic profile of the proposed stormwater management pond.



HYDRAULIC PROFILE

FULL SIZE SCALE: HORIZONTAL - 1:500
VERTICAL - 1:100
ALL ELEVATIONS IN METRES

MORRISON HERSHFIELD	ALGONQUIN COLLEGE STORMWATER MANAGEMENT POND HYDRAULIC PROFILE	LEGEND	**FIGURE 7** DATE: 2018-07-05 SCALE: AS SHOWN

6. LANDSCAPING

6.1 Existing Conditions

The existing landscape can be characterized as open grassland with mature tree groups and a man-made ditch.

The site does provide greenspace linkages as identified in the Greenspace Master Plan near a multi-use pathway and the Ottawa River Corridor, but no natural linkages are present.

The site does not contain rare communities or other unique ecological features, or Species at Risk (SAR) and their habitat.

The topography of the site is generally flat with a gentle slope from east to west. The existing man-made ditch is approximately 1.5m lower than the surrounding land.

An inventory of the existing trees is included in the Tree Conservation Report. The Tree Conservation Report is included in **Appendix E**.

6.2 General Design Principles

The landscape strategy for the site has been developed based on the following design principles:

- Retain and protect existing vegetation and landscape features in areas not required to accommodate the new stormwater pond;
- Minimize the extent if disturbance to existing landscape habitats and features;
- Restore disturbed areas to natural vegetation; and
- Maintain community/campus access.

6.3 Landscape Elements

6.3.1 Protection of Existing Landscape Features

The proposed Landscape Plan and Tree Conservation Report identifies areas of existing trees to be retained and protected during construction. Tree protection fencing will be established prior to any tree removal of site works and will be maintained for the duration of the construction activity.

6.3.2 Grading and General Layout

The pond will be located in the southeast corner of the Campus. The existing grassed land to the east of the pond will be utilized for snow storage.

The overall layout of the pond features a peninsula between the forebay and detention cell. The pond has been designed with a curvilinear shape to provide a naturalized appearance. Due to site constraints and limited space, variable side slopes could not be provided to visually enhance aesthetics. The side slope grading will be 3:1 around the entire pond.

6.3.3 Multi-use Pathways and Connectivity

A 3m wide multi-use pathway stone dust multi-use pathway is proposed along the east and south side of the pond to provide a continuous circular route around the pond for informal recreational use by students, staff and local residents.

6.3.4 Planting Design

The proposed planting around the pond shall be in accordance with Landscape Drawing (L102). The landscape drawings are included in **Appendix F**.

6.3.5 Retaining Walls

Retaining walls are currently not party of the proposed landscape plan.

6.3.6 Fencing

Fencing is not part of the proposed landscape plan.

6.3.7 Signage

Stormwater facility cautionary signs will be placed close to the two main access points to the facility. Standard City of Ottawa signage will be used, customized to display the College's logo and contact details.

6.3.8 Lighting

Site lighting is not standard for pathways on the College campus, and is not called for by the City's SWM Facility Design Guidelines. As such, lighting is not part of the proposed landscape plan.

7. PERMITS AND APPROVALS

The permits and approvals outlined below are identified here as future commitments for the final design and construction.

7.1 City of Ottawa

Permission may be required from City related to by-laws for noise.

7.2 Conservation Authorities

The proposed pond does not outlet to a river, lake, or stream, nor will it impact existing woodlands, wetlands, or natural habitat in the watershed. Therefore, work will not be submitted to conservation authorities for review.

7.3 Province of Ontario

7.3.1 Ontario Ministry of the Environment, Parks and Conservation (MOECP)

Storm water management facilities can require Environmental Compliance Approval (ECA) under the Ontario Water Resources Act (O.Reg. 525/98). However, an exemption is made for a storm water management facility that:

(a) is designed to service one lot or parcel of land;

(b) discharges into a storm sewer that is not a combined sewer;

(c) does not service industrial land or a structure located on industrial land; and

(d) is not located on industrial land.

The pond services only the Woodroffe Campus. This is currently made up of two parcels of land (both owned by Algonquin College). The College has committed to consolidate these into a single parcel. (Confirmation from the College is provided in **Appendix J.**) The MOECP has confirmed that if consolidated, an ECA is not required. (Refer to correspondence in **Appendix J.**)

The pond discharges into a storm sewer (the Baseline Trunk).

The MOECP does not consider the campus to be industrial land. (Refer to correspondence in **Appendix J.**)

An ECA is therefore not required for the pond.

Other Provincial Approvals

Permit to Take Water – As we do not expect the inflow of water to exceed 400,000L/day, a permit to take water (PTTW) is not expected to be required. It is possible that an Environmental Activity and Sector Registry (EASR) may be required.

Municipal Drainage Act – There are no municipal drains within the site limits, therefore the Ontario Drainage Act does not need to be consulted.

Species at Risk in Ontario (SARO) – In accordance with **Appendix E**, Tree Conservation Report, the site does not contain Species at Risk, or their habitat.

7.3.2 Ontario Ministry of Natural Resources

Project does not include instream works, therefore Ontario Ministry of Natural Resources does not need to be involved.

7.3.3 Ontario Ministry of Transportation

The proposed facility does not cross a highway under provincial jurisdiction, avoiding the need for Ontario Ministry of Transportation approval.

7.4 Federal Approvals

7.4.1 Department of Fisheries and Oceans

This facility will not cause a harmful alteration, disruption, or destruction of fish habitat, since there is no fish habitat in the area.

7.4.2 National Capital Commission

The site is not within the National Capital Region and will not affect federal lands, therefore the NCC will not need to conduct an environmental assessment.

7.5 Other Approvals

7.5.1 Utilities

The contractor will be completing locates prior to construction.

7.5.2 Private Property

Consultation with the public has been completed, despite the project not having an impact on nearby residential area.

7.5.3 Tree Permit

A tree permit is required before trees 10cm or larger in diameter can be removed from the site. The tree permit was issued by the City of Ottawa on June 18, 2018 for the proposed works.

7.5.4 Migratory Bird Convention Act

In accordance with **Appendix G**, Nest Visit and Clearance Algonquin College, a pair of Song Sparrows and a pair of Red-Winged Blackbirds with a nest were found. The Song Sparrows were suspected to have a nest, but this was not confirmed. The contractor should make an attempt to fell the trees away from the ditch, near the confirmed Blackbird nest, however there are no legal restrictions related to the destruction of this nest, following the Migratory Bird Convention Act. For the Song Sparrows, care should be taken when removing trees on the west side, where a nest is suspected.

8. EROSION & SEDIMENT CONTROL

Erosion and sediment control measures are to be implemented during construction to prevent soil loss by storm water runoff and/or wind erosion, prevent sedimentation of storm sewers or receiving streams, prevent polluting the air with dust and particulate matter and minimize the amount of disturbed soil.

The following measures will be implemented prior to commencement of construction and maintained in good order until vegetation has been established:

- Silt fence will be erected along the perimeter of the clearing limits in accordance with OPSD 219.110; and

- Geotextile cloth will be installed between all catch basin covers and frames to catch sediments prior to entering the underground infrastructure.

The Erosion and Sediment Control Plan (February 2018) is included in **Appendix H**.

9. GEOTECHNICAL INVESTIGATION

A geotechnical investigation was carried out by GEMTEC Consulting Engineers and Scientists (Houle Chevrier Engineering) for the proposed stormwater management pond. The purpose of the investigation was to identify the general subsurface conditions at the site by means of a borehole investigation and, based on the factual information obtained, to provide engineering guidelines on the geotechnical design aspects of the project, including construction considerations that could influence design decisions. The geotechnical report, dated June 29, 2017, is included in **Appendix I**.

10. OPERATION & MAINTENANCE ACTIVITIES

In accordance with Table 6.1 of the MOE Stormwater Management Planning & Design Manual, there are various operation and maintenance activities for wet ponds/wetlands. The operation and maintenance activities include inspection, weed control, removal of accumulated sediments, and debris/trash removal.

10.1 Inspection

The pond outlet should be visually inspected daily to check for any clogging of the orifice plate. The orifice plate is exposed just above the water level at the pond end of the outlet pipe, so is readily visible. Any material obstructing the orifice plate should be removed.

During the first two (2) years of operation, a full inspection of wet pond/wetland should take place after every significant storm to ensure proper functioning (the average is about four (4) inspections per year). After the first two (2) years, annual inspections will be sufficient as long as the facility is operating properly.

Table 6.2 of the MOE Stormwater Management Panning & Design Manual outlines routine questions that can be used when inspecting the wet pond/wetland.

10.2 Weed Control

Weed control by-laws should be consulted for local requirements. Weed control may be required on an annual basis.

Weeding should be done to prevent the destruction of surround vegetation. The use of herbicides and insecticides should be prohibited near the stormwater management facility since they create water quality problems. The use of fertilizer should also be limited to minimize nutrient loadings to the downstream receiving waters.

10.3 Debris/Trash Removal

A spring clean-up is generally required to remove trash from all surfaces of the stormwater management facility. Trash removal should also be performed as required based on observations during regular inspections.

10.4 Draw Down for Maintenance and Sediment Removal

Draw down of the stormwater management facility for maintenance and/or sediment removal should be by pumping from the deepest area (i.e. the forebay). Water pumped from the facility should be discharged to the outlet structure. The outlet pipe should be blocked (at the pond end) using a sandbag or similar, to prevent backflow into the facility.

10.5 Sediment Removal

The sediment that accumulated in the stormwater management facility should be removed periodically to ensure long term effectiveness.

Sediment removal should not take place until the system is functioning at 75% efficiency.

All sediment removed from the stormwater facility should be tested to determine the disposal option for the site. The three (3) generalized disposal options are on-site disposal, off-site disposal, and hazardous waste disposal.

Sediment removal is expected to occur at infrequent intervals (once every 5 years).

10.6 Planting

The planting must be maintained to ensure that the vegetation remains healthy. Since plant material takes up pollutants, dead material should be removed in the fall.

Additional plantings should be added to the pond is an excess amount of algae growth is observed. Plantings provide shade to minimize water temperature increase and contribute to the maintenance of dissolved oxygen level which prevent algae growth.

10.7 Bank Erosion & Rip Rap

Bank erosion and rip rap must be repaired as soon as possible. Ongoing erosion will have a negative impact on sedimentation, clogging of the outlet, and aesthetics.

11. MONITORING

Ongoing performance monitoring is required to ensure that the SWM facility functions as intended. A monitoring program must focus on both the hydraulic and biological function of the facility. The hydraulic function can be monitored by simple observation of the water levels in the facility. Water levels should return to normal within approximately 24 hours of a rainfall of 25mm of less (unless subsequent storms occur with that period). If the detention times increase substantially, the outlet must be inspected (i.e. to check for debris blocking the outlet orifice, or an obstruction within the outlet structure). Other monitoring tasks include checking the facility for locations of scour and/or bank erosion, sediment accumulation, and debris. Biological monitoring would consist of regular observations of all plant material.

An adaptive management strategy is recommended to optimize the facility's operations and effectiveness.

12. STORMWATER PLAN FOR FUTURE DEVELOPMENT

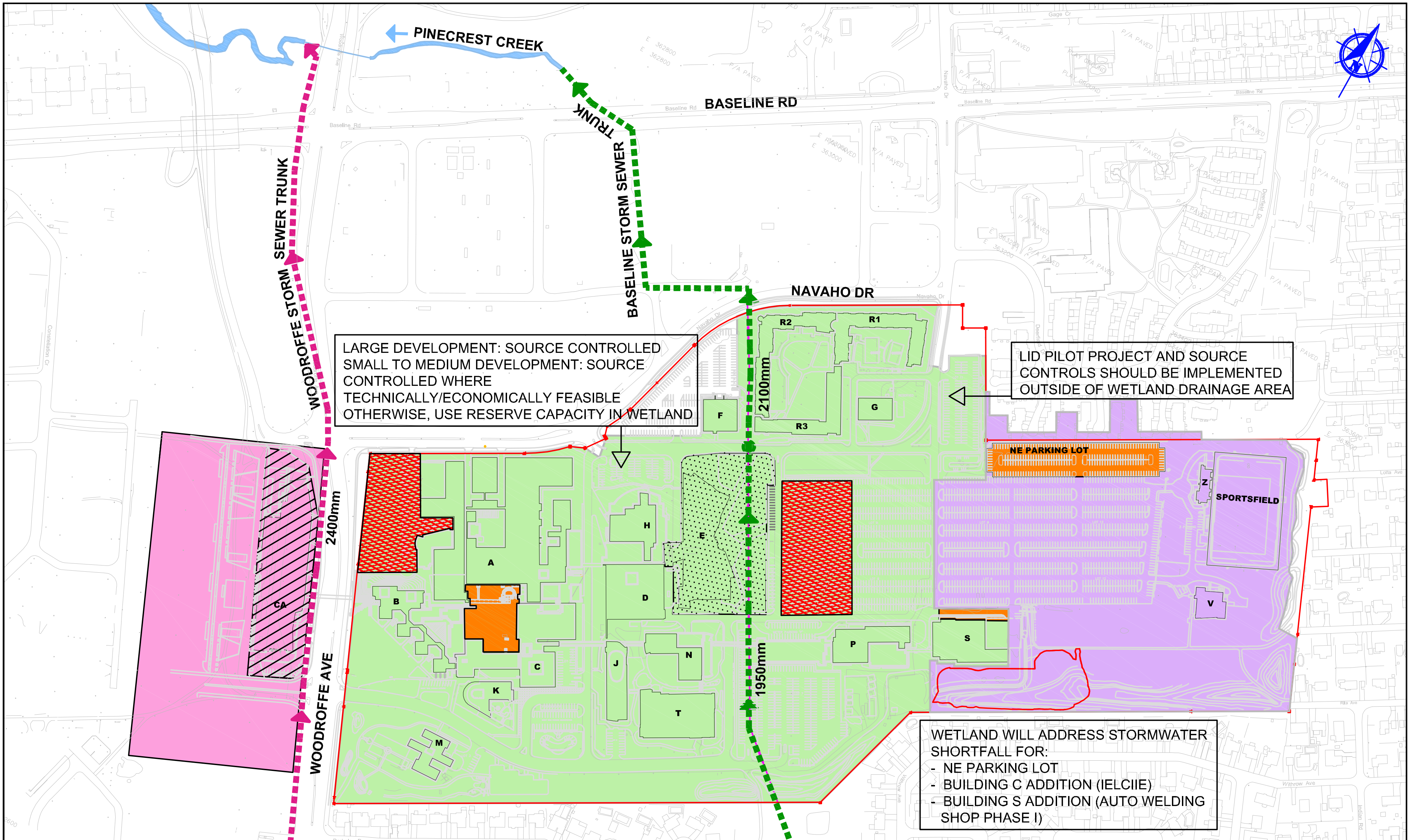
Rainwater from the existing campus west of Woodroffe is currently source controlled on site. Future development west of Woodroffe will continue to be source controlled with the use of LID (Low Impact Development) measures.

East of Woodroffe flows are uncontrolled or by mainly conventional approaches. The proposed pond will address the current shortfall for three projects (NE Parking Lot, Building C Addition, and Building S Addition). Future development projects should address SWM needs with on-site source controls and LID. Reserve capacity in the pond can be used to help offset SWM requirements when source control/LID measures are not technically/economically feasible. Priority for use of the reserve pond capacity will be given to smaller sized development projects. Future use of the reserve capacity to address SWM needs for development projects must be tracked and reported with each development. Future development outside of the pond catchment area may still have to meet only the 10mm retention criterion. The pond is an interim solution until the East implements wide-scale source control measures. **Figure 8** provides a summary of the proposed plan for future conditions.

The City of Ottawa is planning to construct a large stormwater management pond at the north-east corner of Baseline Road and Woodroffe Avenue downstream of the Baseline trunk sewer outlet. The pond will receive rainfall runoff from 435ha of existing development including the Campus east of Woodroffe. The pond will be constructed with Stage 2 Ottawa LRT sometime between 2018 and 2023. The pond will provide water quality benefits (70% to 80% TSS removal) and some erosion control and flood management on Pinecrest Creek. The City has indicated that the pond will mitigate impacts of development from the existing campus but not entirely meet criteria. Future development will still be required to adhere to the criteria.

The design of a drainage and stormwater management system for future development at the Ottawa Campus must be prepared in accordance with the following documents (latest version):

- *Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area*, J.F. Sabourin and Associates Inc., June 2012;
- *Sewer Design Guidelines*, City of Ottawa, October 2012;
- *Stormwater Management Planning and Design Manual*, Ministry of the Environment, March 2003; and
- *Draft Stormwater Management Facility Design Guidelines,* City of Ottawa, April 2012



LEGEND

- SOURCE CONTROL TO BE APPLIED
- SOURCE CONTROL, WHERE FEASIBLE
- WETLAND DRAINAGE AREA=9.3ha
- STORMWATER CRITERIA WILL BE MET BY WETLAND
- MEETS PINECREST CRITERIA (2009)
- MEETS LEED
- LOCATION OF PROPOSED POND
- FUTURE DEVELOPMENT (0 TO 5 YEARS) SOURCE CONTROLLED/LID

MORRISON HERSHFIELD

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE FUTURE STORMWATER PLAN

SCALE: N.T.S.

Figure No.: 8

- *Low Impact Development Stormwater Management Planning and Design Guide (Credit Valley Conservation, Toronto Regional Conservation, 2010)*

Each site should pursue source control methodologies to ensure that the watershed objectives, targets and functional requirements outlined in the design documents above are met. Development may be required to meet the latest version of LEED Gold criteria. This will be considered on a site-by-site basis.

Opportunities to incorporate stormwater management practices into all components of the development may include landscaped areas, parking areas, roof tops, and subsurface infrastructure. Recommended source control/LID measures include:

- Harvesting of rainwater from rooftops for non-potable uses (e.g., irrigation, toilet flushing) using rain barrels or cisterns;
- Installation of green roofs;
- Drainage of runoff from rooftops to pervious or depression storage areas;
- Integration of soakaways (e.g. infiltration trenches/chambers) below landscaped areas, parking areas, etc.;
- Incorporation of bioretention areas, rain gardens, or biofilters into the landscape design;
- Use of permeable pavement in low and medium traffic areas; and
- Incorporation of bioretention areas, vegetated filter strips, and swales to intercept and treat parking lot and roadway runoff.

Development projects may complex challenges with respect to integrating landscaped-based solutions for stormwater management for the following reasons:

- Sites are typically constrained with respect to the extent of open space available;
- Limitations with topography due to fixed grades around the site perimeter; and
- Infrastructure beneath and around the site are typically fixed in terms of location, depth, and capacity and may limit potential excavations depths and opportunities for infiltration.

13. LOW IMPACT DEVELOPMENT (LID) PILOT PROJECT

The College is interested in pursuing an LID pilot project at the Ottawa Campus in collaboration with the City of Ottawa, other watershed partners and industry/commercial partners. The intent of the pilot is to confirm effectiveness and feasibility of LID prior to large scale implementation on Campus while enhancing Campus beautification and natural greenspaces and providing a research and applied learning opportunity for the community. The pilot project could also have the added benefit of offsetting stormwater management needs for future development projects.

It is recommended that the project be completed in accordance with the following:

- *Low Impact Development Stormwater Management Planning and Design Guide (Credit Valley Conservation, Toronto Regional Conservation, 2010)*

The City of Ottawa completed two bioretention (rain garden) retrofit pilot projects on Sunnyside Avenue and Stewart Street in 2015 and 2016. Construction costs on Stewart Street were in the order of approximately $800 per metre of rain garden. Photos of each project are shown below.

LID Pilot Projects
Bioretention Cells on Sunnyside Avenue (left)
Stewart Street (right)
By the City of Ottawa with Morrison Hershfield Ltd. and Aquafor Beech Ltd.

With all the hardened surfaces and imperviousness created mainly due to the surface parking, many opportunities for LID retrofit projects exist on the Ottawa Campus. For example, the photo below shows a potential LID retrofit location within the visitor parking gateway near Building P. The existing sidewalk could be converted to permeable pavers to allow infiltration. Hardened tree islands can be converted to pervious strips such as vegetated filter strips and rain gardens to allow infiltration of rainfall and to reduce the runoff volumes. A site evaluation and selection process is recommended prior to design.

Potential LID opportunity at the Ottawa Campus

14. CONCLUSIONS AND RECOMMENDATIONS

A proposed SWM pond will provide water quality and quantity control for an approximate 9.3ha area of the existing Algonquin College Ottawa Campus located east of Woodroffe. The proposed facility will meet the criteria of the *"Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area (2012)*". The pond will address an existing stormwater management shortfall for 3 projects: NE Parking Lot, Building C Addition (IELCIIE), and Building S Addition (Automotive Welding Shop Phase 1). Since the shortfall projects require only a portion of the pond capacity, the excess capacity in the pond could be reserved to offset requirements for future development. Priority for use of reserve pond capacity will be given to smaller sized projects. Where technically and economically feasible, larger developments will be required to use source controls and LID measures. Use of reserve capacity in the pond should be tracked.

Should the stormwater management pond be considered for future campus development, adjustment of the control structure may be required. It is recommended that the overflow orifice be adjustable so that both storage and outflow can be adjusted to meet future needs.

The College is exploring the feasibility of an LID pilot project in collaboration with its external watershed partners prior to large scale implementation in the long term. The recommended next steps include a site evaluation and selection process in consultation with potential partners.

15. AUTHORIZATION

This document entitled *"Algonquin College Ottawa Campus Stormwater Management Pond Design Brief"* was prepared by Morrison Hershfield Limited for Algonquin College for the purposes stated in the document. The contents of the report represent the best judgment of Morrison Hershfield Limited based on available information at the time of preparation. Any use of this report by a third party, reliance on, or decisions made based on this report, are the responsibility of such third parties. Morrison Hershfield Limited accepts no responsibility for damages suffered by any third party as a result of decisions made or actions based on the report.

16. CLOSURE

We trust that this report meets your current requirements. Please contact us should you have any questions or comments.

Sincerely,

Morrison Hershfield Limited

Prepared By:

James Fookes, P.Eng.
Municipal Engineer

Karyn Cornfield, M.Sc.Eng., P.Eng.
Water Resources Engineer

REFERENCES

1. IBI Group, "Stormwater Management Servicing Report Student Commons Building," Ottawa, 2011.
2. TSH Engineers Architects Planners, "Police/Justice Building, Woodroffe Campus: Stormwater/Drainage Report," Ottawa, 1999.
3. Novatech Engineering Consultants LTD, "Algonquin College - Phase III Residence Stormwater Management Report," Kanata, 2003.
4. J.L. Richards & Associates LTD, "Stormwater Management Report - Algonquin College, Woodroffe Campus, Sportsfield Project, Ottawa, 2005.
5. Morrison Hershfield LTD, "Stormwater Management Report & Assessment of Adequacy of Public Services Report; Algonquin College - The Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship," Ottawa, 2017.
6. City of Ottawa, *Site Plan Control Approval Application,* Ottawa, 2013.
7. Morrison Hershfield LTD, "Stormwater Management Brief: Algonquin College – Building S Phase 1 Expansion," Ottawa, 2017.
8. Morrison Hershfield LTD, "Stormwater Management Report: Algonquin College - Centre for Construction Trades and Building Sciences Building," Ottawa, 2008.
9. JFSA Water Resources and Environmental Consultants, "Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area," Ottawa, 2012.
10. J.F. Sabourin and Associates Inc., "Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area," Ottawa, 2012.
11. City of Ottawa, "Sewer Design Guidelines," Ottawa, 2012.
12. Morrison Hershfield LTD, "Stormwater Management Report: Algonquin College - Student Commons Building Displaced Parking Lot," Ottawa, 2011.
13. Ministry of the Environment, "Stormwater Management Planning and Design Manual," Ontario, 2003.
14. Toronto and Region Conservation and Credit Valley Conservation, "Low Impact Development Planning and Design Guide," Toronto, 2010.
15. Morrison Hershfield LTD, "Algonquin College Stormwater Management Pond Design Drawings, Contract #17047," Ottawa, 2018.
16. Fairhall, Moffatt & Woodland Limited, "Topographic Land Survey of Part of Lot 34 Concession 1, (Rideau Front), Geographic Township of Nepean, Now City of Ottawa," Kanata, 2011.
17. Morrison Hershfield LTD, "Tree Conservation Report - Algonquin College Ottawa Campus," Ottawa, 2018.
18. Brook McIlroy, "Stormwater Management Pond Landscape and Planting Plan," Toronto, 2018.

19. Bowfin Environmental Consulting, *Nest Visit and Clearance at Algonquin College,* Cornwall, 2018.

20. Morrison Hershfield LTD, "Erosion and Sediment Control Plan - Algonquin College Ottawa Campus," Ottawa, 2018.

Appendix A

Background Information

Appendix A-I

CONTENTS

Stormwater Management Report – Student Commons Building 65 pages

Algonquin College

STORMWATER MANAGEMENT SERVICING REPORT STUDENT COMMONS BUILDING

29062

MAY 2011

TABLE OF CONTENTS

1. INTRODUCTION 1
1.1 Existing Conditions 1
1.2 Design Parameters 2
2. DESIGN CRITERIA 3
2.1 Water Quantity Control 3
2.1.1 First 25 mm of Rainfall 3
2.1.2 Maximum Allowable Release Rate 3
2.2 Water Quality Control 4
3. PROPOSED STORMWATER MANAGEMENT SYSTEM 4
3.1 System Concept 5
3.1.1 First 25 mm of Rainfall 5
3.1.2 Maximum 100 year flow 9
3.1.3 Water Quality Control 11
4. STORMWATER SITE MANAGEMENT 12
5. CONCLUSIONS AND RECOMMENDATIONS 13

List of Figures

Figure 1 Site plan location
Figure 2 Drainage area plan
Figure 3 Surface Ponding plan
Figure 4 Subsurface Ponding plan

List of Drawings

Drawings C04

List of Appendices

Appendix A Supporting Calculations and Parameters
Appendix B SWMHYMO Schematic and Output
Appendix C Orifice Calculations, Stage-Storage and Stage-Discharge Curves
Appendix D Extended Detention Time, Water Quality

1. INTRODUCTION

Algonquin College is constructing a 10,800 m^2 Student Commons Building on its Woodroffe Avenue campus in the City of Ottawa. The building is proposed on a portion of the site that fronts onto North Access Road, a private roadway internal to the College with access to Navaho Drive. The parking area continues to the east while existing college buildings abuts the site to the west and south. Refer to **Figure 1** for the site location plan. The proposed three-storey building will be the social hub of the campus, providing students with a place for clubs, activities, and academic services. Among other uses such as the bookstore, food services and print shop, the Student Commons will include a 700-seat auditorium intended to provide space for cinema, theatre and key note speakers. The building is intended to be the new heart of the campus.

The building will be linked via a covered walkway to existing buildings D and H located to the west, providing a continuous connection to the Woodroffe Avenue overpass and the Baseline Rapid Transit Station. A new bus stop and lay-by lane are proposed off of North Access Road providing direct access to the building via public transit. The main entry of the Student Commons is proposed on the eastern side of the building, providing direct access to the building from the parking areas. Secondary pedestrian entrances are proposed off of North Access Road and to a Commons outdoor plaza east of the building.

The planned link to existing buildings D and H will create two other areas of interest. A cafe court is planned at the southwest portion of the site adjacent to building D and the Mamidosewin Grove at the west side of the site adjacent to building H will have an informal copse of trees and a small gathering area which references First Nations Cultural Heritage and providing a backdrop for ceremonial activities.

This report presents the stormwater management design solution to service the development. The stormwater management system has been prepared in accordance with the following documents:

- City of Ottawa *Sewer Design Guidelines* (November 2004)
- Ontario Ministry of Environment *Stormwater Management Planning and Design Guidelines* (March 2003)
- *Pinecrest / Centrepointe Stormwater Management Criteria Study* (JF Sabourin and Associates Inc. and JTB Environmental Systems Inc., June 2009)[1] and referred to herewith as the 2009 Pinecrest SWM Criteria Study[1].

1.1 Existing Conditions

The site currently includes an asphalt parking lot holding about 240 spaces and is otherwise dominated by natural coniferous vegetation. The Campus is serviced with a series of storm sewers which collect runoff from the various buildings and significant parking lots. Most runoff from the Campus is ultimately directed to a 2100 mm diameter trunk storm sewer which runs south to north and is located in the east portion of the site (see **Figure 1**). The 2100 mm diameter storm sewer ultimately outlets to the Pinecrest Creek, north of Baseline Road. There are a series of smaller sewers adjacent to the site including an 825 mm diameter storm sewer in North Access Road.

1.2 Design Parameters

The following summarizes the design parameters used to evaluate and model the drainage areas for the site.

Design Storms

The following storms were used in the evaluation:

- 25 mm 4 hour Chicago storm event (consistent with Ontario Ministry of the Environment *Stormwater Management Planning and Design Manual* (March 2003));
- 100 year 3 hour Chicago Storm with a 10 minute time step (consistent with the City of Ottawa *Sewer Design Guidelines* (November 2004)).

Minor System Design

The total allowable flow to the existing storm sewer was limited to 36 l/s/ha. This restricted flowrate is consistent with the 2009 Pinecrest SWM Criteria Study[1].

Major System Design and Storage Requirements

The 2009 Pinecrest SWM Criteria Study[1] outlined the following major system and storage requirements for the site:

- Flow in excess of 36 l/s/ha is required to be stored on-site without overflow.
- First 10 mm of rainfall to be stored on-site without outflow.
- Second 15 mm of rainfall to be retained on-site and released over 48 hours.

Hydrological Parameters

Imperviousness:

Hard surface areas (asphalt, crushed brick, roof) were assumed to have 100% total imperviousness. All of the hard surface areas, which runoff to a non-grassed area, were considered directly connected. The directly connected imperviousness was assumed to be 100%.

Grassed areas were modeled using the 'Calib Nashyd' routine in SWMHYMO.

Infiltration:

CN value of 71 and the equivalent Horton's parameters of f_O (mm/hr) = 162.5, f_C (mm/hr) = 9 and k (1/hr) = 2 were used. For details regarding the determination of soil infiltration parameters refer to **Appendix A**. Due to the detailed soils information available for the site, the default values from the City of Ottawa *Sewer Design Guidelines* (November 2004) were not used.

SWMHYMO Length Parameters:

The impervious length is based on the average of the measured length of the catchment trunk and the calculated length from the SWMHYMO user's manual. This approach is consistent with City of

Ottawa *Sewer Design Guidelines Appendix 8* (November 2004). Applicable calculations are provided in **Appendix A**. The pervious length was taken as 10 m for all catchment areas.

Initial Abstraction (Depression Storage):

For those areas where the first 10 mm of rainfall could be stored within the catchment area, the initial abstraction for impervious and pervious areas is 10 mm. The roof area retains the first 11.2 mm of rainfall, therefore the initial abstraction for impervious and pervious area for the roof is 11.2 mm.

For those areas where the first 10 mm of rainfall could not be stored within the catchment area, the initial abstraction for impervious areas was 1.57 mm and for pervious areas was 4.67 mm which is consistent with the City of Ottawa *Sewer Design Guidelines* (November 2004).

For those areas where the subsequent 15 mm of rainfall is stored and subject to percolation, the initial abstraction was kept at 10 mm to provide a more conservative estimate of storage during flood events.

Time to Peak

The time to peak for the catchment areas modeled as rural areas was taken at 10 minutes (Areas A2, D and E) and 15 minutes (Area C). The time to peak is consistent with the time of concentration of 10 minutes for residential streets and 15 minutes for rear yards as per the City of Ottawa *Sewer Design Guidelines* (November 2004).

Summary and justification of parameters used in the evaluation of the site are further discussed in **Sections 2 and 3** and **Appendix A**.

2. DESIGN CRITERIA

As noted in **Section 1.2**, the stormwater design criteria for the site were based on the findings of the 2009 Pinecrest SWM Criteria Study[1].

2.1 Water Quantity Control

2.1.1 FIRST 25 MM OF RAINFALL

According to the 2009 Pinecrest SWM Criteria Study[1], future developments within the Pinecrest Creek watershed shall capture or infiltrate the first 10 mm of rainfall. The subsequent 15 mm shall be detained and released over a 48 hour time period. The objective of increasing on-site retention and detention is to "control and not aggravate existing erosion issues within the creek corridor" (2009 Pinecrest SWM Criteria Study[1]).

2.1.2 MAXIMUM ALLOWABLE RELEASE RATE

The post-development flow from the site shall not exceed 36 l/s/ha. The intent of this criterion is to not increase 100 year peak flows in Pinecrest Creek as per the 2009 Pinecrest SWM Criteria Study[1].

2.2 Water Quality Control

As indicated in the 2009 Pinecrest SWM Criteria Study[1]:

> "The equivalent of an enhanced level of treatment (TSS removal of 80%) is recommended. While this requirement could, in some cases, be accomplished by means of conventional measures (i.e. end of pipe facilities such as oil and grit separators), it is anticipated that Best Management Practices (BMP's) and Low Impact Development (LID's) that can provide the quantity and runoff volume control for the first 25 mm of rainfall (10 mm retention and 15 mm detention) will inherently provide a large measure of quality control. Although there is no accepted equivalency for enhanced treatment for volume control measures as of yet, the water quality benefit of such measures is demonstrated by local rainfall statistics which indicate that rainfall events with 10 mm or less occur 61% of the time and that rainfall events with 25 mm or less occur 86% of the time. In other words, the capture and detention of the first 25 mm of rainfall for mitigation of erosion impacts will provide a water quality control benefit as well."

3. PROPOSED STORMWATER MANAGEMENT SYSTEM

The proposed stormwater management system is designed to achieve the criteria described in **Section 2**. Analysis of the proposed system was undertaken using hydrological calculations and SWMHYMO modeling. The site was divided into nine catchment areas to reflect land use and surface treatment (see **Figure 2**). The proposed building sub-divides the site and therefore several storm sewer outlets are required. The catchment areas and parameters are summarized in the following table and are discussed in more detail in the following sections. Supporting calculations and justification of parameters, as well as a model schematic and SWMHYMO output files are presented in **Appendices A and B**, respectively.

Table 3.1 Site catchment areas and parameters

Area ID	Area Description	Surface	Area (ha)	Total Imperviousness (%)	Impervious Length (m)	Infiltration Parameter	Time to Peak (min)
A1a	Pathway	Impervious	0.0309	100	19	Horton	
A1b	Loading Dock	Impervious	0.0515	100	34	Horton	
A2	Lawn	Pervious	0.1718			CN 71	10
B	Building Roof	Impervious	0.5573	100	113	Horton	
C1	Pathway	Impervious	0.2324	100	71	Horton	
C2	Lawn	Pervious	0.4343			CN 71	15
D	Cafe Court	Pervious	0.0689			CN 71	10
E1	Mamidosewin Grove	Impervious	0.0777	100	49	Horton	
E2		Pervious	0.0438			CN 71	10
Total Area (ha)			**1.6686**				

3.1 System Concept

3.1.1 FIRST 25 MM OF RAINFALL

3.1.1.1 First 10 mm of Rainfall

The total site area is 16686 m^2. The required storage volume for the first 10 mm of rainfall was calculated as follows:

$$\text{Storage volume} = \text{Area } (m^2) \times 10 \text{ mm} \times (1 \text{ m} / 1000 \text{ mm})$$

The resulting storage volume to accommodate the first 10 mm of rainfall for the entire site is 166.86 m^3. The required storage provided within each catchment area is outlined in detail within **Table 3.2** and how the storage is provided each area is described in more detail below.

The majority of first 10 mm of storage will be provided in sand layers with no gravity outlets. The rainfall and runoff will be conveyed to the depressed areas within the catchments and subject to percolation, the accumulated runoff will infiltrate through the topsoil layer into the underlying sand layer. The water stored within the sand layer will percolate into the existing native soil material. The native soil material will remain undisturbed and be scarified. The soil composition below the sand layer is silty clay and a conservative percolation rate of 6.4 mm/h was taken (refer to **Appendix A** for supporting information and calculations). In addition, **Figures 3 and 4** present the surface and subsurface ponding provided on-site.

Table 3.2 Storage required and provided within each catchment area for first 10 mm of rainfall

Area ID	Catchment Area (m^2)	Storage Required (m^3)	Storage Provided (m^3)
A1a	309	3.09	0
A1b	515	5.15	0
A2	17.18	17.18	17.18
B	5573	55.73	65.13
C1	2324	23.24	0
C2	4343	43.43	66.67
D	689	6.89	6.89
E1	777	7.77	0
E2	438	4.38	12.15
Total	**16686**	**166.86**	**168.02**

- **Area A1a** – Area A1a is 0.0309 ha and consists of a portion of the site pathway which will convey runoff from the site uncontrolled. Storage of the first 10 mm of rainfall for this catchment area cannot be retained. Therefore, the 10 mm storage volume (3.09 m^3) will be compensated for by providing additional storage on the roof of the building (Area B).

- **Area A1b** – Area A1b is 0.0515 ha and consists of the building loading dock. Storage of the first 10 mm of rainfall for this catchment area cannot be retained. Therefore, the 10 mm storage volume (5.15 m^3) will be compensated for by providing additional storage on the roof of the building (Area B).

- **Area A2** – Area A2 is 0.1718 ha and consists of the perimeter of the lawn area that is landscaped with grass and trees. Storage will be constructed in the sand layer below the topsoil and seed surface treatment (refer to Cross-section A1-A1, **Drawing C04**). The first 10 mm of runoff will infiltrate to the sand layer, which provides 17.18 m^3 of storage. A high point extends the length of Area A2 (see **Figure 2**) which will result in runoff from this catchment area in excess of the first 10 mm of rainfall. The resulting in runoff will discharge to the existing off-site parking lot.

- **Area B** – Area B is 0.5573 ha and consists of the impervious roof of the student commons building. The roof will provide storage for the first 11.2 mm of rainfall. As noted for Areas A1a and A1b, addition storage will be provided on the roof to compensate for the uncontrolled release of the first 10 mm of rain from these areas. The roof drains will be raised to ensure that a minimum of 62.23 m^3 of storage is provided with no gravity outlet. Stored water on the roof will evaporate in approximately three days under average conditions. **Appendix A** presents the determination of the evaporation rate for the site. **Figure 3** presents the roof ponding plan including volume and elevations for the first 10 mm of rainfall storage. **Appendix C** presents a statement from the building design team with respect to accommodating of storage on the roof without a gravity outlet.

- **Area C1** – Area C1 consists of the pathways surrounding the building (see **Figure 2**) and is 0.2324 ha. The pathways are graded to direct runoff to grassed lawn (Area C2). The first 10 mm of rainfall cannot be retained in this catchment; however, compensation for the 10 mm runoff volume of 23.24 m^3 will be provided in Area C2.

- **Area C2** – Area C2 consists of the grassed lawn area and is 0.4343 ha. The first 10 mm of rainfall will be stored within the catchment. In addition, the first 10 mm of rainfall from Area C1 will be compensated within this catchment by providing additional storage. Storage will be provided by within a sand layer ocated below the topsoil and seed surface treatment, promoting infiltration and providing 66.67 m^3 of storage for the first 10 mm of rainfall (refer to Cross-section C2-C2, **Drawing C04**).

- **Area D** – Area D is 0.0689 ha and consists of the cafe court. It is a grassed surface provided with a sand layer below the topsoil and seed surface treatment. The sand layer promotes infiltration and provides 6.89 m^3 of storage for the first 10 mm of rainfall (refer to Cross-section D-D, **Drawing C04**).

- **Area E1** – Area E is referred to as the Mamidosewin Grove. More specifically Area E1 consists of the pathways within the grove and has an area of 0.0777 ha. The first 10 mm of rainfall cannot be retained on the pathways. Therefore, the pathways have been graded to drain to the grassed depressed areas. Compensation of the storage of the first 10 mm of rainfall (7.77 m^3) will be provided in Area E2.

- **Area E2** – Area E2 consists of grass or landscaped areas within the Mamidosewin Grove and is 0.0438 ha. The first 10 mm of rainfall will be stored within this catchment and compensation for the first 10 mm of storage for Area E2 will also be provided. The grass or landscaped areas are flat and provided with a clear stone layer below the topsoil and seed surface treatment (refer to Cross-section E2-E2, **Drawing C04**). The clear stone layer provides 12.15 m^3 of storage. This concept is referred to as the Rain Gardens on the enclosed figures and appendices.

3.1.1.2 Subsequent 15 mm of Rainfall

The subsequent 15 mm of rainfall is required to be released over a 48 hour time period as per the 2009 Pinecrest SWM Criteria Study[1].

An overall composite of the extended detention time for the entire site was determined from the extended detention time for each independent catchment area regardless of whether the area is controlled or uncontrolled. The results were used to develop a composite storage volume release over 48 hours for the entire site. More specifically, the subsequent 15 mm of rainfall does not have a specified required storage, however, the required detention time should be in excess of 48 hours. To simplify the calculation and due to the fact that the 10 mm and 15 mm storages share the same storage area, the composite time was based on the first 25 mm rainfall. The resulting composite is presented in **Appendix D**. Specific details regarding the determination of the composite extended release rate are presented below and **Table 3.3** summarizes the storage required and provided for the subsequent 15 mm of rainfall.

In general, impervious catchment areas on the site are either designed with ponding and orifice restriction to control the flow (Areas A1b and B) or runoff is conveyed to a grassed or pervious area where storage is provided (Areas C1 and E1). Area A1a is the only impervious catchment area which discharges from the site uncontrolled under all rainfall events.

Pervious areas are designed with either sand (Areas C2 and D) or clear stone infiltration basins (Area E2) and no gravity outflow. Release of water stored within the subsurface basins is via percolation. As mentioned in **Section 3.1.1.1**, the soil composition in the area is silty clay and a conservative percolation rate of 6.4 mm/h was used (refer to **Appendix A** for supporting information and calculations). In addition, **Figures 3 and 4** present the surface and subsurface ponding provided on-site.

The following summarizes the how the flow was determined for each catchment area contributing to the composite storage volume release over 48 hours:

- **Area A1a** – The extended detention time was simulated in SWMHYMO using the 25 mm 4 hour Chicago storm event. SWMHYMO output files are included in **Appendix B**.

- **Area A1b** –There is one low point in the loading dock area where a catchbasin is proposed. Runoff from the catchment area cascades to the low point and discharges to the storm sewer via the catchbasin (top of grate 84.60 m). Flow from the catchbasin is conveyed via a 375 mm diameter sewer to future MH 1 (see **Drawing C04**). Storage is provided in the catchbasin, pipe and manhole and flow release is controlled by an 83 mm x 83 mm orifice. The orifice sizing, stage-discharge and stage-storage curve for Area A1b is provided in **Appendix C**. Hydrological routing was used to determine extended detention and it was simulated in SWMHYMO (refer to **Appendix B** for the computer output).

- **Area A2** – Storage for the first 10 mm of rainfall is provided for this catchment area. Rainfall in excess of 10 mm discharges overland into the existing parking lot. The extended detention time for the subsequent 15 mm of rainfall for this catchment was simulated in SWMHYMO. Output files are included in **Appendix B**.

- **Area B** – The subsequent 15 mm of rainfall is slowly released via roof drains and subject to evaporation. The attenuated flow is released with a flow rate of 1.53 l/s via roof drains and evaporation rate from the roof is 2.95 mm/day. The extended detention time was evaluated with hydrological calculations (enclosed in **Appendix D**), which indicates that 148.63 m^3 of storage is provided for the first 25 mm of rainfall on the roof. Calculations with respect to determination of release rate via the 17 roof drains from the roof for the subsequent 15 mm are provided in **Appendix C**.

- **Area C1** – Effective runoff discharges to adjacent Area C2 (refer to Area C2 below for further detail).

- **Area C2** – Storage is provided in the infiltration basin comprised of sand, installed per Cross-section C2-C2, **Drawing C04**. This volume is subject to slow infiltration. The extended detention time was evaluated with hydrological calculations (enclosed in **Appendix D**), which indicate that 168.92 m^3 of storage is provided for the first 25 mm of rainfall.

- **Area D** – The overall grading is relatively flat, with a depression through the centre of the cafe court. Along this depression, the sand layer is deepened to a depth of 800 mm at a width of 3500 m (refer to Cross-section D-D, **Drawing C04**). Storage is provided within this infiltration basin and the volume is subject to slow infiltration. The extended detention time for the subsequent 15 mm of rainfall was evaluated with hydrological calculations (enclosed in **Appendix D**), which indicate that 17.23 m^3 of storage is provided.

- **Area E1** – Effective runoff discharges to adjacent Area E2 (refer to Area E2 below for further detail).

- **Area E2** – Storage is provided in the infiltration basin comprised of clear stone, installed per Cross-section E2-E2, **Drawing C04**. Perforated pipes are placed to join the depressed areas to provide equal distribution of storage to each area (refer to Cross-section E1-E1, **Drawing C04**). This volume is subject to slow infiltration. The extended detention time for the subsequent 15 mm of rainfall was evaluated with hydrological calculations (enclosed in **Appendix D**), which indicate that 30.38 m^3 of storage is provided. This concept is referred to as the Rain Gardens on the enclosed figures.

The following table summarizes the storage provided on-site for the first 25 mm of rainfall to the site (first 10 mm plus subsequent 15 mm).

Table 3.3 Total storage provided for each catchment for first 25 mm of rainfall

Area ID	Catchment Area (m^2)	Maximum Release Rate (l/s)	Storage Provided (m^3)		
			Subsequent 15 mm	First 10 mm	Total 25 mm
A1a	309	8	0	0	0
A1b	515	8	1.76	0	1.76
A2	17.18	1	0	17.18	17.18
B	5573	1.72	83.5	65.13	148.63
C1	2324	7.1	0	0	0
C2	4343		102.25	66.67	168.92
D	689	0.56	10.34	6.89	17.23
E1	777	0.91	0	0	0
E2	438		18.23	12.15	30.38
Total	**16686**	**27.29**	**216.08**	**168.02**	**384.1**

3.1.2 MAXIMUM 100 YEAR FLOW

Water quantity was evaluated using SWMHYMO for the 100 year 3 hour Chicago storm event as per the City of Ottawa *Sewer Design Guidelines* (November 2004). Relevant hydrological parameters are summarized **Table 3.1**. As mentioned in **Section 1.2**, initial abstraction was adjusted to 10 mm for those catchment areas where the first 10 mm of rainfall can be retained. Refer to **Appendix A** for justification and calculation of parameters used for the SWMHYMO modeling.

The maximum permissible release flow rate from the site is 36 l/s/ha which is consistent with the 2009 Pinecrest SWM Criteria Study[1]. The maximum flow was calculated as follows:

Maximum allowable release rate = Area (ha) x 36 l/s/ha

Maximum allowable release rate = 1.6686 ha x 36 l/s/ha = 60.07 l/s

The resulting maximum flow is therefore 60.1 l/s.

Each catchment area was evaluated in SWMHYMO during the 100 year storm event and the system was optimized to ensure the total release rate from the site was limited to 60.1 l/s. To meet the maximum allowable release rate, storage in excess of the first 10 mm of rainfall was provided on-site, where available. The following table summarizes the results of the SWMHYMO modeling. The SWMHYMO model schematic and computer output file are presented in **Appendix B**. In addition, **Figures 3 and 4** present the surface and subsurface ponding provided on-site.

Table 3.4 Summary of SWMHYMO modeling results for the 100 year 3 hour Chicago storm event

Area ID	Description	Unattenuated Flow (l/s)	Attenuated Flow (l/s)	Storage Required (m^3)*	Storage Provided (m^3)
A1a	Pathway	15			
A1b	Loading Dock	26	20	7.63	7.70
A2	Lawn	14			
B	Building Roof	267	5.53	300.5	307.2
C1	Pathway	115	14	155.4	180.4
C2	Lawn	29			
D	Cafe Court	6	0	15.84	16.1
E1	Mamidosewin Grove	39	7	36.10	36.8
E2		4			
Total Simulated Flow from Site (l/s)†			**60**	**515.47**	**548.2**

Notes: * Storage during the 100 year storm excludes the storage required to retain the first 10 mm of rainfall.

† Flow from each drainage area is discussed below. Flow from the drainage areas is not directly additive due to different times to peak.

- **Area A1a –** Based on the SWMHYMO hydrological model, the effective runoff from Area A1a discharges to the existing external parking lot at a maximum rate of 15 l/s.

- **Area A1b –** As discussed in **Section 3.1.1.2**, pipe storage is proposed for Area A1b. Storage in the pipe is utilized to a maximum elevation of 84.30 m, allowing for 0.3 m freeboard to the top of grate of the catchbasin. The resulting available storage volume is 7.7 m^3. Storage is achieved with a 83 mm x 83 mm orifice at the downstream end of the 375 mm diameter pipe, which slowly releases the runoff. The orifice was sized to fully utilize the storage. Refer to **Appendix C** for orifice sizing and location and details of the orifice are provided in **Drawing C04**.

Using the SWMHYMO hydrological model, it was determined that during the100 year storm event, 7.63 m^3 of storage is used with a release rate of 20 l/s. Stage-storage and stage-discharge curves are included in **Appendix C**.

- **Area A2 –** As discussed in **Sections 3.1.1.1 and 3.1.1.2**, Area A2 is provided with a sand layer that promotes infiltration. The sand layer is designed to provide infiltration for the first 10 mm of rainfall with runoff in excess of the first 10 mm to runoff the site. The initial abstraction was therefore adjusted in the SWMHYMO model to 10 mm. Refer to Cross-section A1-A1, **Drawing C04** for a detail of the sand layer.

Using the SWMHYMO hydrological model, it was determined that during the 100 year storm event the maximum release rate from Area A2 is 14 l/s.

- **Area B –** Using the SWMHYMO hydrological model, it was determined that during the 100 year storm event 300.5 m^3 of storage is used and the maximum total release rate from the roof drains is 5.53 l/s via 17 roof drains. The roof will be designed with the roof drains elevated above the storage provided for the first 10 mm of rainfall. **Figure 3** presents the roof ponding plan which includes 100 year storage volumes and elevations. **Appendix C** presents the applicable storage calculations and determination of roof release rate.

- **Area C1 –** Effective runoff from Area C1 discharges to adjacent Area C2 where it is stored. Based on the SWMHYMO hydrological model, the uncontrolled 100 year flow rate is 115 l/s. Refer to Area C2 below for further details regarding the storage provided.

- **Area C2 –** Area C2 is provided with surface storage, as well as the sand layer and infiltration basin discussed in **Sections 3.1.1.1 and 3.1.1.2**. As noted above, effective runoff from Area C1 flows overland to Area C2 and is stored.

  A swale runs north-south, bisecting the drainage area. The swale provides surface storage to attenuate runoff in addition to the infiltration basins discussed in **Section 3.1.1.2**. The infiltration basins are installed along the centreline of the swale. The perforated pipe is connected to a storm manhole prior to discharging into the existing 2100 mm diameter storm sewer. Flow is controlled at this manhole by a 70 mm x 70 mm orifice. Based on the SWMHYMO hydrological model, during the 100 year event, 155.4 m^3 of storage is utilized with a corresponding release flow rate of 14 l/s. Refer to **Figure 3** for the ponding plan and to **Appendix C** for orifice sizing.

- **Area D –** Attenuated flow on the relatively flat surface slowly infiltrates. It is proposed the area be provided with one catch basin that serves as an emergency overflow. Based on the SWMHYMO hydrological model, 15.84 m^3 of storage is required during the 100 year event.

- **Area E1 –** Effective runoff from Area E1 discharges to the adjacent E2 where it is stored. Based on the SWMHYMO hydrological model, the uncontrolled 100 year flow rate is 39 l/s. Refer to Area E2 below for further details regarding the storage provided.

- **Area E2 –** Surface flow from Area E1 and E2 will cascade across the Mamidosewin Grove and be retained within the infiltration basins to a maximum storage of 36.77 m^3. Once the maximum storage is reached the infiltration basins outlet via a proposed catchbasin and be conveyed to the storm sewer. Based on the SWMHYMO model, a maximum flow of 7 l/s will discharge during the 100 year event.

3.1.3 WATER QUALITY CONTROL

An Enhanced Level of Protection is required for the site as per the 2009 Pinecrest SWM Criteria Study[1]. This corresponds to 80% total suspended solid (TSS) removal commonly associated with the first 13 to 25 mm of runoff released over 24 hours, in accordance with the MOE *Stormwater Management Planning and Design Manual* (March 2003).

As indicated in previous sections, the first 10 mm and subsequent 15 mm of rainfall are retained on-site in subsurface storage within three catchment areas (Areas C, D and E) and roof storage (Area B). These areas slowly release the storage via percolation or roof runoff. The percentage of total suspended solid removal was calculated on an area basis and determined to be approximately 85%. The calculations are summarized in **Appendix D**.

4. STORMWATER SITE MANAGEMENT

During construction, existing conveyance systems can be exposed to significant sediment loadings. Although construction is only a temporary situation, it is proposed to introduce a number of mitigative construction techniques to reduce unnecessary construction sediment loadings. These will include:

- In trench groundwater will be pumped into a filter mechanism prior to release to the environment. Pumping in excess of 50,000 l/day will require a Permit To Take Water from the provincial Ministry of Environment. The geotechnical report will review this issue.

- Filter cloths will be placed on open structures such as catchbasins and manhole covers, and will remain in place until the project is completed. Regular monitoring will be required to ensure proper function of the cloth including replacement as required.

- Existing catchbasins on the streets adjacent to the streets are to be monitored to ensure that their sumps remain clean (cleaned as required).

- Silt fence on the perimeter of the site as per OPSD Standard 219.110 will be erected.

- Another method the contractor should try to utilize on the site during construction is to maintain the ground sloping to an artificial low spot which would include a settling bay to collect silt material. This could reduce the amount of silt material being pumped to the filter mechanism.

5. CONCLUSIONS AND RECOMMENDATIONS

The proposed stormwater management system is designed to achieve the following criteria, as established in the *Pinecrest / Centrepointe Stormwater Management Criteria Study* (JF Sabourin and Associates Inc. and JTB Environmental Systems Inc., June 2009)[1]:

- Water Quantity Control

  - First 25 mm of Rainfall

    Development shall capture or infiltrate the first 10 mm of rainfall. The subsequent 15 mm shall be detained and released over a 48 hour time period.

  - Maximum Allowable Release Rate

    The post-development flow from the site shall not exceed 36 l/s/ha.

- Water Quality Control

  The stormwater management system is to provide water quality control to an Enhanced Level of Protection (80% total suspended solids removal, in accordance with the MOE *Stormwater Management Planning and Design Manual* (March 2003).

The main features of the stormwater management system are roof storage and attenuation; surface storage on grassed areas; infiltration basins; and pipe storage. The release flow rate from the site to existing storm sewers is controlled with orifice plates installed in connecting manholes.

Based on experience, water quality monitoring is not proposed for the site, subject to City review and recommendation.

Report prepared by

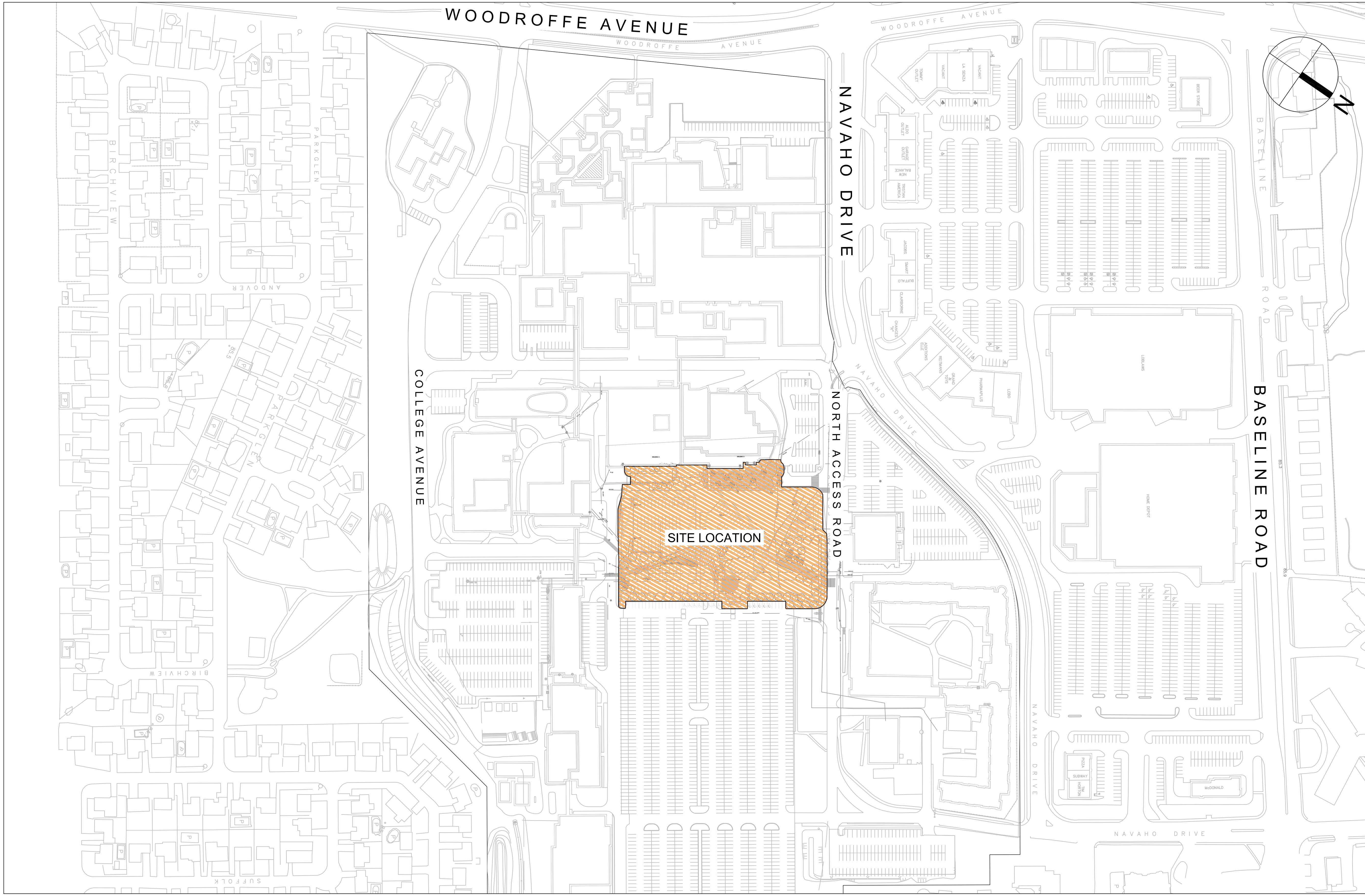
IBI GROUP

LICENSED PROFESSIONAL ENGINEER
R. F. D. BROWN
100078940
May 12, 2011
PROVINCE OF ONTARIO

Peter Spal, P.Eng.
Associate - Water Resources

Rikke Brown, P.Eng., LEED®AP
Project Engineer

J:\29062-AlgonquinBid\5.2 Reports\5.2.3 SWM\2011-05\WTR-rev2-servicing-2011-05.docx\



J:\29062-AlgonquinBid\5.9 Drawings\59civil\current\swm\29062-swm-Figures.dwg Sheet Set: ###

Plot Style: ---- Plot Scale: 1:1 Plotted At: May. 12, 11 1:54 PM Printed By: SLAVICA VUKIC Last Saved By: SVUKIC Last Saved At: May. 12, 11

IBI GROUP

Scale

N.T.S.

Project Title

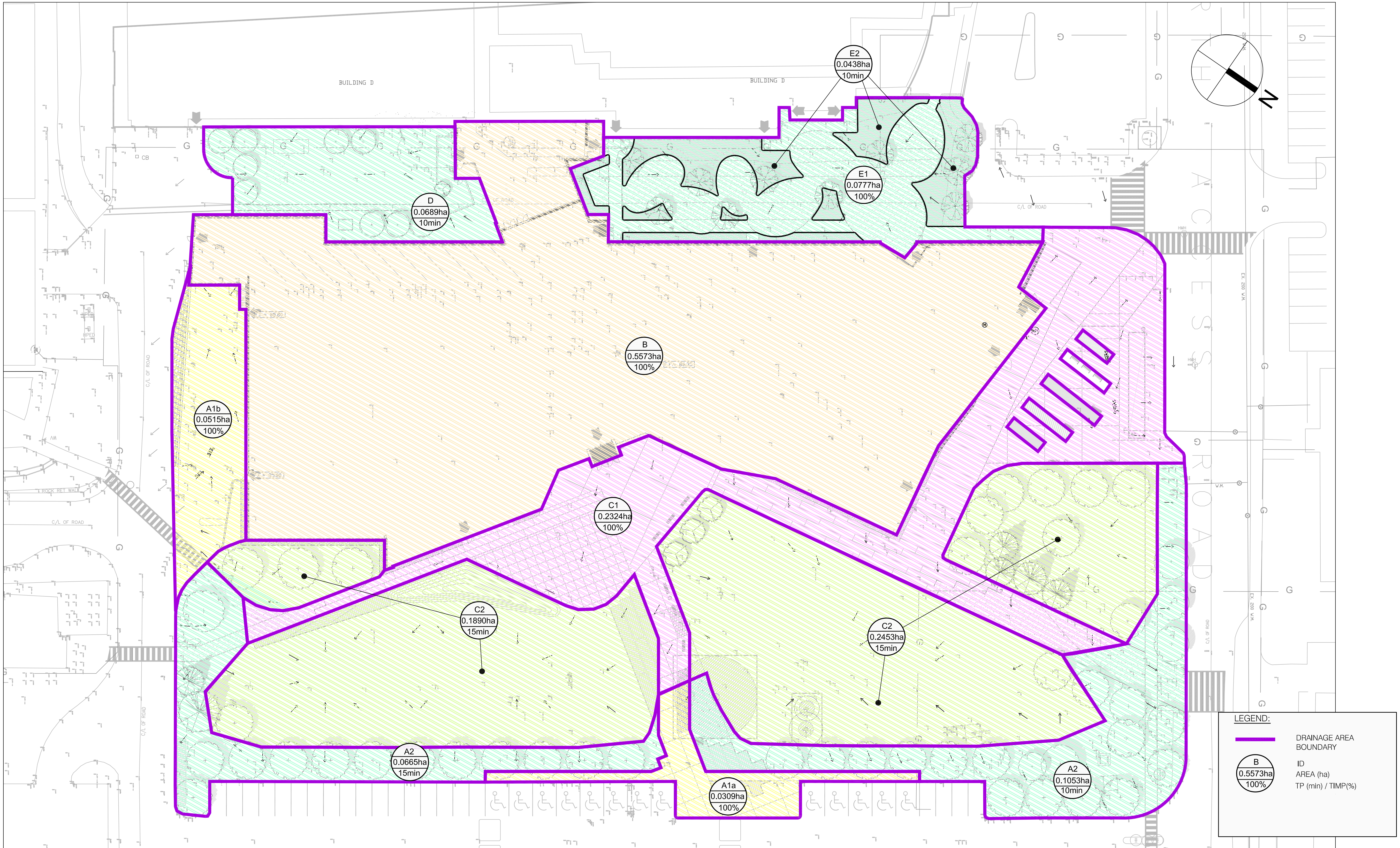
STORMWATER MANAGEMENT SERVICING REPORT
STUDENT COMMONS BUILDING
ALGONQUIN COLLEGE

Drawing Title

SITE LOCATION PLAN

Sheet No.

FIGURE 1



J:\29062-AlgonquinBld\5.9 Drawings\59civil\current\swm\29062-swm-Figures.dwg Layout Name: fig2 Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 5/12/2011 1:58 PM Last Saved By: SVukic Last Saved At: May. 12, 11

IBI GROUP

Scale

N.T.S.

Project Title

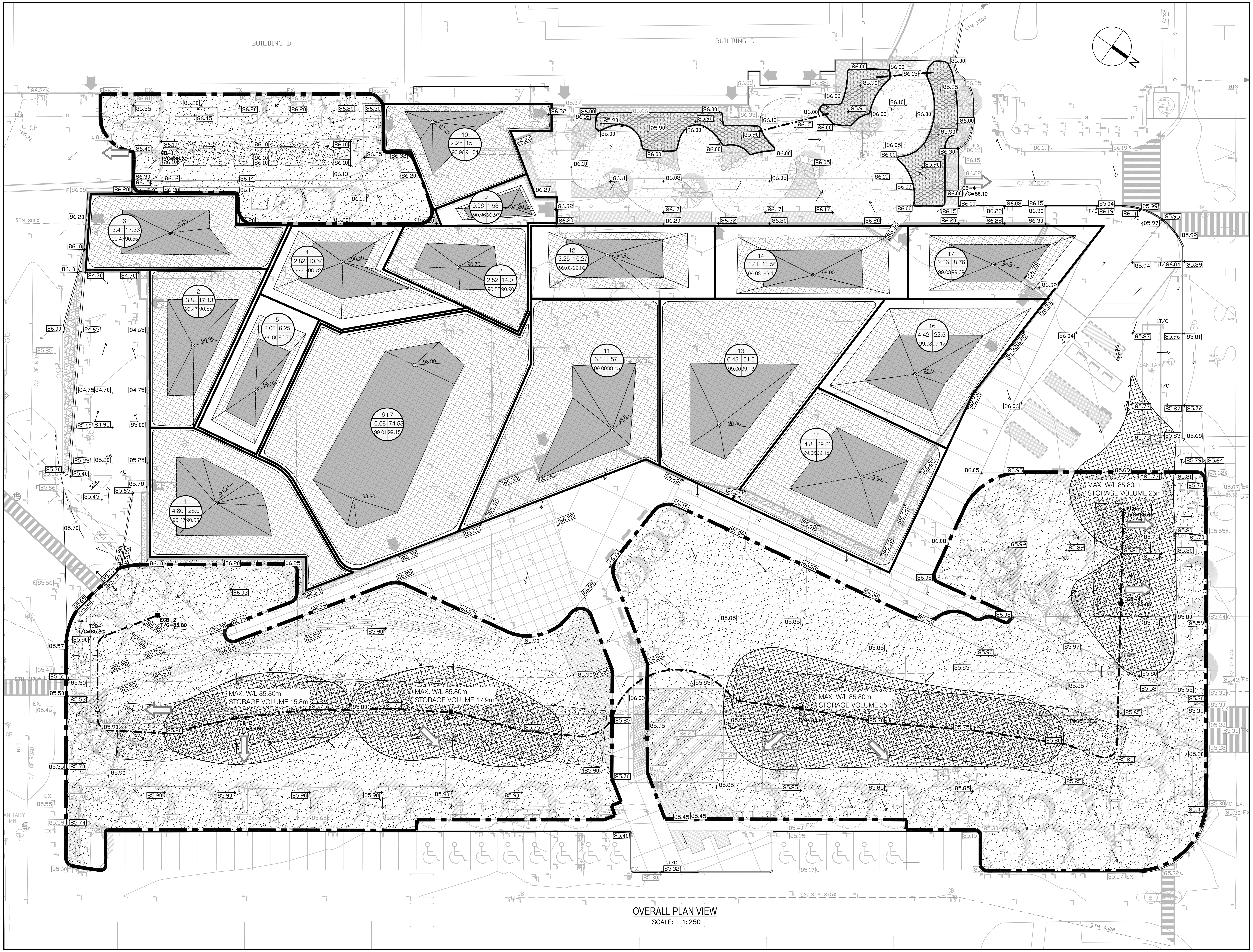
STORMWATER MANAGEMENT SERVICING REPORT
STUDENT COMMONS BUILDING
ALGONQUIN COLLEGE

Drawing Title

DRAINAGE AREA PLAN

Sheet No.

FIGURE 2



LEGEND:

- EXTENT OF 100mm SAND BELOW 150mm TOPSOIL + SEED OR SURFACE TREATMENT
- SURFACE PONDING
- EXTENT OF DEEPER SAND LAYER FOR STORAGE AND INFILTRATION
- EXTENT OF RAIN GARDENS
- 200mmØ SUBDRAIN
- EMERGENCY OVERLAND FLOW ROUTE
- 86.01 PROPOSED GRADES
- ROOF PONDING FIRST 10mm RAINFALL
- MAXIMUM ROOF PONDING (100 YEAR)
- 17: ROOF ID; 2.86: 10mm PONDING VOLUME (m³); 8.76: 100 YEAR PONDING VOLUME (m³); 99.03: 10mm PONDING ELEVATION (m); 99.09: 100 YEAR PONDING ELEVATION (m)
- ROOF DRAIN
- 90.35 LOWEST ELEVATION OF ROOF

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7			
6			
5			
4			
3	ISSUED FOR FINAL SPA RESUBMISSION		11-05-12
2	REVISED AS PER CITY COMMENTS		11-04-15
1	SITE PLAN APPLICATION		11-03-08

IBI GROUP
333 Preston Street
Tower 1, Suite 400
Ottawa, Ontario
Canada K1S 5N4
Tel (613)225-1311
FAX (613)225-9868

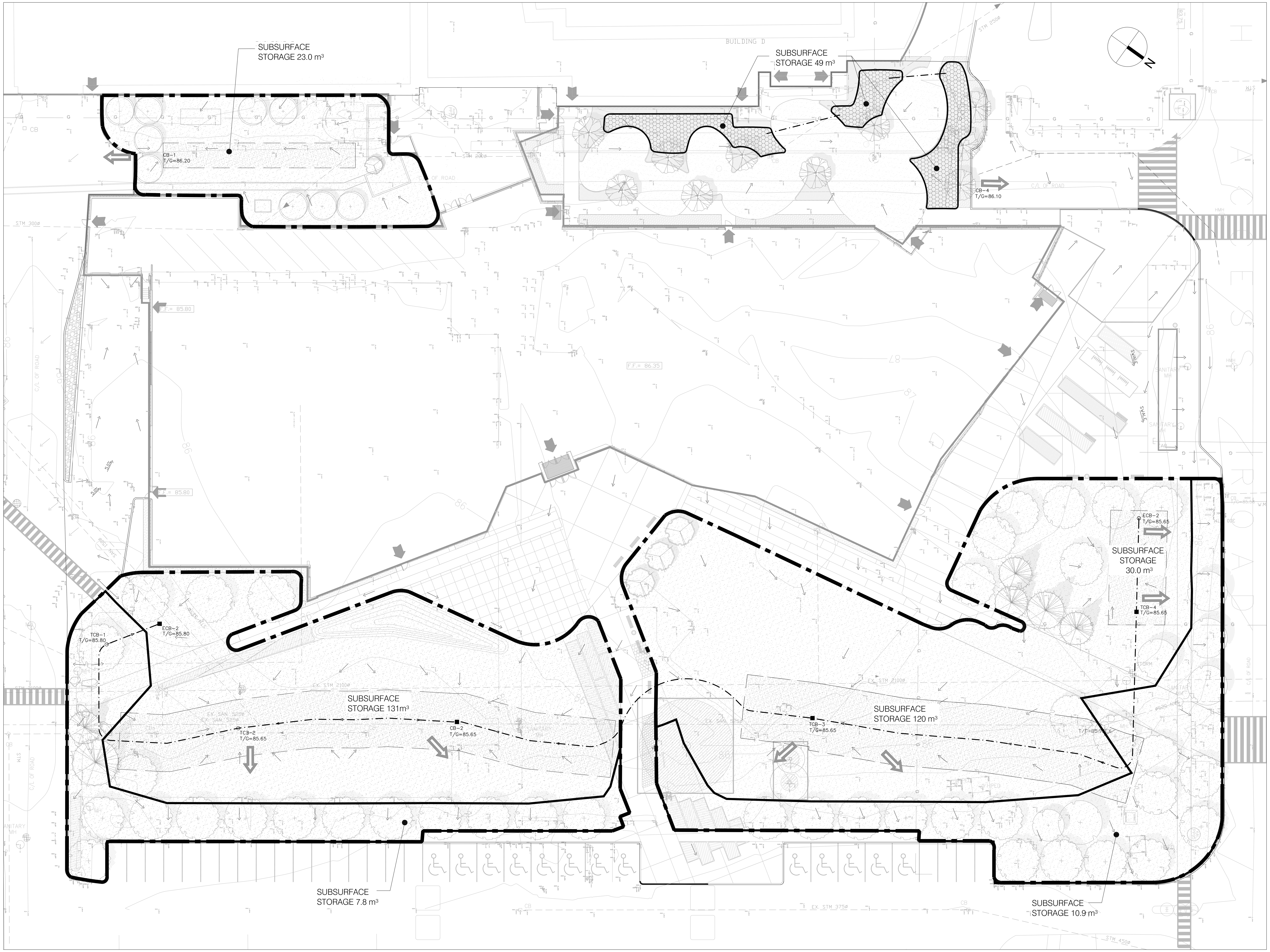
Project Title
STORMWATER MANAGEMENT SERVICING REPORT
STUDENT COMMONS BUILDING
ALGONQUIN COLLEGE

P. SPAL
R.F.D. BROWN
100078940

Drawing Title
SURFACE PONDING PLAN

Scale
1:250

Design	R.B.	Date	FEB. 2011
Drawn	S.V.	Checked	P.S.
Project No.	29062	Drawing No.	FIGURE 3



OVERALL PLAN VIEW
SCALE: 1:250

LEGEND:

- EXTENT OF 100mm SAND BELOW 150mm TOPSOIL + SEED OR SURFACE TREATMENT
- EXTENT OF DEEPER SAND LAYER FOR STORAGE AND INFILTRATION
- EXTENT OF RAIN GARDENS
- 200mmØ SUBDRAIN
- BOUNDARY BETWEEN CONTROLLED AND UNCONTROLLED AREAS
- EMERGENCY OVERLAND FLOW ROUTE

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7			
6			
5			
4			
3			
2	ISSUED FOR FINAL SPA RESUBMISSION		11-05-12
1	ISSUED TO CITY		11-04-15

IBI GROUP
333 Preston Street
Tower 1, Suite 400
Ottawa, Ontario
Canada K1S 5N4
Tel (613)225-1311
FAX (613)225-9868

Project Title
STORMWATER MANAGEMENT SERVICING REPORT
STUDENT COMMONS BUILDING
ALGONQUIN COLLEGE

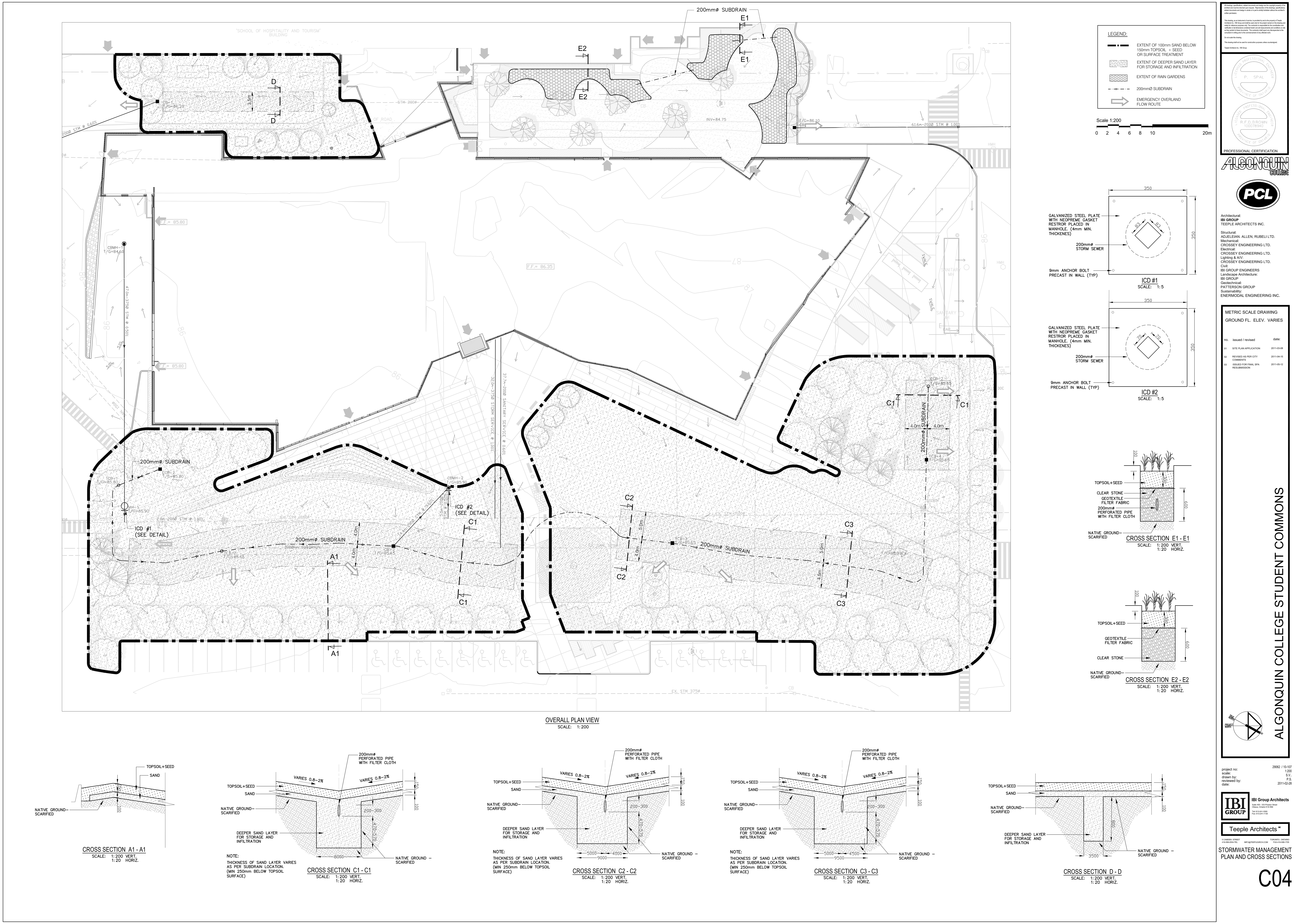
LICENSED PROFESSIONAL ENGINEER P. SPAL PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER R.F.D.BROWN 100078940 PROVINCE OF ONTARIO

Drawing Title
SUBSURFACE PONDING PLAN

Scale
1:250

Design	Date
R.B.	FEB. 2011
Drawn	Checked
S.V.	P.S.
Project No.	Drawing No.
29062	FIGURE 4



200mmø SUBDRAIN
E1
E2
D
LEGEND:
EXTENT OF 100mm SAND BELOW 150mm TOPSOIL + SEED OR SURFACE TREATMENT
EXTENT OF DEEPER SAND LAYER FOR STORAGE AND INFILTRATION
EXTENT OF RAIN GARDENS
200MMØ SUBDRAIN
EMERGENCY OVERLAND FLOW ROUTE
Scale 1:200
0 2 4 6 8 10 20m
GALVANIZED STEEL PLATE WITH NEOPREME GASKET RESTROR PLACED IN MANHOLE. (4mm MIN. THICKENES)
200mmø STORM SEWER
9mm ANCHOR BOLT PRECAST IN WALL (TYP)
350
ICD #1
SCALE: 1:5
ICD #2
SCALE: 1:5
ICD #1 (SEE DETAIL)
ICD #2 (SEE DETAIL)
A1
C1
C2
C3
4.0m
5.0m
TOPSOIL+SEED
CLEAR STONE
GEOTEXTILE FILTER FABRIC
200mmø PERFORATED PIPE WITH FILTER CLOTH
NATIVE GROUND-SCARIFIED
CROSS SECTION E1 - E1
SCALE: 1:200 VERT. 1:20 HORIZ.
CROSS SECTION E2 - E2
SCALE: 1:200 VERT. 1:20 HORIZ.
OVERALL PLAN VIEW
SCALE: 1:200
SAND
DEEPER SAND LAYER FOR STORAGE AND INFILTRATION
VARIES 0.8-2%
NOTE:
THICKNESS OF SAND LAYER VARIES AS PER SUBDRAIN LOCATION. (MIN 250mm BELOW TOPSOIL SURFACE)
CROSS SECTION A1 - A1
SCALE: 1:200 VERT. 1:20 HORIZ.
CROSS SECTION C1 - C1
SCALE: 1:200 VERT. 1:20 HORIZ.
CROSS SECTION C2 - C2
SCALE: 1:200 VERT. 1:20 HORIZ.
CROSS SECTION C3 - C3
SCALE: 1:200 VERT. 1:20 HORIZ.
CROSS SECTION D - D
SCALE: 1:200 VERT. 1:20 HORIZ.
PROFESSIONAL CERTIFICATION
ALGONQUIN COLLEGE
PCL
Architectural: IBI GROUP TEEPLE ARCHITECTS INC.
Structural: ADJELEIAN, ALLEN, RUBELI LTD.
Mechanical: CROSSEY ENGINEERING LTD.
Electrical: CROSSEY ENGINEERING LTD.
Lighting & A/V: CROSSEY ENGINEERING LTD.
Civil: IBI GROUP ENGINEERS
Landscape Architecture: IBI GROUP
Geotechnical: PATTERSON GROUP
Sustainability: ENERMODAL ENGINEERING INC.
METRIC SCALE DRAWING
GROUND FL. ELEV. VARIES
ALGONQUIN COLLEGE STUDENT COMMONS
IBI GROUP
IBI Group Architects
Teeple Architects
STORMWATER MANAGEMENT PLAN AND CROSS SECTIONS
C04

Appendix A
Supporting Calculations and Parameters

Appendix A

Parameters Used in SWMHYMO for Algonquin College Student Commons

Table 1. **Summary of SWMHYMO Parameters**

Area ID	Area (ha)	Land Use	Infiltration	Time to Peak (hr)	Imperviousness (%)		Length	
					Total	Directly Connected	Pervious	Impervious
A1a	0.0309	Concrete	Horton*		99.99	99.99	10	19
A1b	0.0515	Asphalt	Horton*		99.99	99.99	10	34
A2	0.1718	Grass and Trees	CN 71	0.17				
B	0.5573	Roof	Horton*		99.99	99.99	10	113
C1	0.2324	Asphalt and Concrete	Horton*		99.99	0.0001	10	71
C2	0.4343	Grass	CN 71	0.25				
D	0.0689	Grass and Trees	CN 71	0.17				
E1	0.0777	Compacted Gravel	Horton*		99.99	0.0001	10	49
E2	0.0438	Grass and Trees	CN 71	0.17				

Note: * Refer to the *Infiltration Parameters* section below for Horton's values used

The Algonquin Student Commons site was delineated into areas based on recipient catchbasin or sewer and on land use type (asphalt or grass). For those areas where the drainage area consisted of asphalt, the SWMHYMO "Calib Standhyd" routine was used. For those areas where the drainage area consists of grass or trees, the SWMHYMO routine of "Calib Nashyd" was used.

Infiltration Parameters

The infiltration parameters for the site were based on boreholes summarized in the soils report prepared by Paterson Group entitled *Geotechnical Investigation Proposed Theatre and Student Commons Building Algonquin College - Woodroffe Avenue Campus Ottawa, Ontario* (February 25, 2011). The area where stormwater measures will be applied is comprised of the following soils:

Table 1. Summary of Soils on the Algonquin Student Commons Building Site from Borehole Information

Borehole	Description	
10-1	Brown silty sand, trace gravel and grey sand to 0.46 m depth	Brown silty clay with some sand and organic matter (fill) to 1.68 m depth
10-2	Brown silty sand to 0.3 m depth	Brown, fine to medium sand, some silt (possible fill) to 2.4 m depth
10-3	Brown slight sand, trace clay and gravel to 0.35 depth	Grey brown and dark brown silty clay with trace of sand and organics to 2.49 m depth
10-6	Brown fine medium sand, some silt, trace gravel to 0.53 m depth	Grey brown and brown silty clay and some sand to 2.40 m depth
10-7	Grey sandy gravel, trace silt to 0.59 m depth	Dark brown and grey silt clay, trace sand and organics to 1.73 m depth
10-9	Grey sandy gravel, some silt to 0.45 m depth	Dark brown silty clay, trace gravel and organics to 1.68 m depth

Using the US Soil Conservation Services information, the hydrologic soils group was determined to be class B and C. The CN value was determined to be between 65 (Class B) to 76 (Class C). The CN value of 71 was chosen for the site.

For areas within the site modeled with the Calib Standhyd routine in SWMHYMO, where different loss methods may be chosen, such as CN and Horton, the equivalent Horton parameters to a CN of 71 were used to model those areas. The equivalent Horton values were determined with the assistance of Appendix A in the SWMHYMO user's manual, Table A.6 shown below:

APPENDIX A: Useful Tables *SWMHYMO User's Manual*

Table A6: Parameters for Horton's Infiltration Equation in Ontario based on Hydrologic Soil Group

Soil Group (USDA designation)	fo (mm/hr)	fc (mm/hr)	K (1/hr)
A	250	25	2
B	200	13	2
C	125	5	2
D	75	3	2

From: Introduction to Applied Hydrology, J.L. Daviau and K. Adamowski (1995)

NOTE: To convert sizes from mm/hr to inches/hr, divide by 25.4.

The soil class determined is between B and C, therefore an average of the Horton parameters for those classes was taken. The calculation of the parameters is summarized in the table below:

Table 2. **Horton Parameters Determined for Equivalent CN 71 for the Algonquin Student Commons Site**

Class	fo (mm/hr)	fc (mm/hr)	K (1/hr)
B	200	13	2
C	125	5	2
BC (average, used in SWMHYMO)	***162.5***	***9***	***2***

TIME TO PEAK

Time to Peak is used only for those areas modeled using the “Calib Nashyd’ routine. Taking into consideration the size of the drainage boundaries and maintaining a reasonable time step in he model, a time to peak of 10 minute (0.17 hr) was chosen for Areas A2, D and E2 and a time to peak of 15 minutes (0.25 hr) was chosen for Area C2.

IMPERVIOUSNESS

Imperviousness was determined for those areas where the “Calib Standhyd” routine was used. The drainage area consists entirely of hard surface (asphalt, concrete or roof).

Areas A1a, A1b and B

The drainage area is entirely imperviousness with no grass or opportunity for infiltration. The area is also entirely directly connected to the storm sewer system. Therefore,

TIMP = XIMP = 99.99%

Areas C1 and E1

The drainage area is entirely imperviousness with no grass or opportunity for infiltration. The areas discharge into a pervious area where it can infiltrate and store on-site prior to discharging into the storm sewer system. Therefore,

TIMP = 99.99%

XIMP = 0.0001%

LENGTH PARAMETER

The length parameter is required for the “Calib Standhyd” routine.

Pervious

A pervious length of 10 m was chosen for all areas with predominately impervious surfaces.

Impervious

L_M = measured length of trunk sewer within the subwatershed area

$$L_C = \sqrt{\frac{A}{1.5}}$$ where: A = area in m^2

$L_{AVG} = L_M + L_C / 2$

Area A1a

A = 0.0309 ha L_C = 14.35 m

L_M = 23 m

L_{AVG} = 14.35 + 23 / 2 = 19 m

Area A1b

A = 0.0515 ha L_C = 18.5 m

L_M = 49 m

L_{AVG} = 18.5 + 49 / 2 = 34 m

Area B

A = 0.5573 ha L_C = 60.95 m

L_M = 165 m

L_{AVG} = 60.95 + 165 / 2 =113 m

Area C1

A = 0.2324 ha L_C = 39.36 m

L_M = 102.1 m

L_{AVG} = 39.36 + 102.1 / 2 = 71 m

Area E1

A = 0.0777 ha L_C = 22.7 m

L_M = 75 m

L_{AVG} = 22.7 + 75 / 2 = 49 m

Appendix A

Determination of Evaporation Rate

The evaporation rate assumed for the Algonquin Student Commons Building for the roof areas was based on data obtained from Environment Canada[1].

There are two official Environment Canada weather stations within the City of Ottawa limits, the Ottawa International Airport (Ottawa Macdonald-Cartier Int'l Airport) and the Central Experimental Farm (Ottawa CDA). The Ottawa CDA station is the only one which has recorded evaporation rates for 29 years of data (1971 to 2000).

The recoded evaporation rate, according to Environment Canada[2], is defined as lake evaporation which occurs "from a small natural open waterbody having negligible heat storage and very little heat transfer at its bottom and sides. It represents water loss from ponds and small reservoirs but not from lakes that have very large heat storage capacities" (Environment Canada[2]).

The evaporation normals were calculated by Environment Canada as "means of daily means for a given station. This in effect is a measure of the rate of evaporation per day rather than a measure of total evaporation" (Environment Canada[2]).

The evaporation normals at the Central Experimental Farm, from Environment Canada[1], are summarized in the following table:

Table 1. Evaporation normals from 1971 to 2000 at the Central Experimental Farm

Months of Recorded Data	May	June	July	August	September	October
Evaporation Rate (mm/day)	3.6	4.3	4.5	3.7	2.4	1.4

From the above table, it should be noted that the evaporation rate at the Ottawa CDA ranges from a minimum 1.4 mm/day in October to a maximum of 4.5 mm/day in July.

For an estimate of evaporation, taking into account minimum and maximum rates, an average value was calculated and applied to the Algonquin Commons Building project. The average evaporation rate is 2.95 mm/day (1.4 + 4.5 mm/day / 2 = 2.95 mm/day).

References

1. Environment Canada, www.climate.weatheroffice.gc.ca/climate_normals

2. Environment Canada, www.climate.weatheroffice.gc.ca/prods_servs/normals_documentation_e.html

Appendix A

Percolation Rate

The soils for the area where the stormwater measures are applied was determined from boreholes taken and summarized in the soils report prepared by Paterson Group entitled *Geotechnical Investigation Proposed Theatre and Student Commons Building Algonquin College - Woodroffe Avenue Campus Ottawa, Ontario* (February 25, 2011). A summary of the soil types are presented below:

Borehole	**Description**	
10-1	Brown silty sand, trace gravel and grey sand to 0.46 m depth	Brown silty clay with some sand and organic matter (fill) to 1.68 m depth
10-2	Brown silty sand to 0.3 m depth	Brown, fine to medium sand, some silt (possible fill) to 2.4 m depth
10-3	Brown slight sand, trace clay and gravel to 0.35 depth	Grey brown and dark brown silty clay with trace of sand and organics to 2.49 m depth
10-6	Brown fine medium sand, some silt, trace gravel to 0.53 m depth	Grey brown and brown silty clay and some sand to 2.40 m depth
10-7	Grey sandy gravel, trace silt to 0.59 m depth	Dark brown and grey silty clay, trace sand and organics to 1.73 m depth
10-9	Grey sandy gravel, some silt to 0.45 m depth	Dark brown silty clay, trace gravel and organics to 1.68 m depth

The soil type where the infiltration trenches and rain gardens will be located is predominately silty clay.

The percolation rate range for silty clay soil is 61 - 120 minutes/inch (from Table 7-2, *Design Manual Onsite Wastewater Treatment and Disposal Systems*, U.S. Environmental Protection Agency Office of Water Program Operations, October 1980). A percolation rate range of 61 - 240 minutes/inch was chosen for the soil type on the site as a more conservative approach.

The conversion of minutes/inch to mm/hr is calculated as follows:

$$\frac{\min}{inch} = \frac{inch}{\min} \times \frac{60\min}{hour} \times \frac{25.4mm}{inch} = \frac{mm}{hour}$$

60 - 240 minutes/inch = 24.9 - 6.4 mm/hour

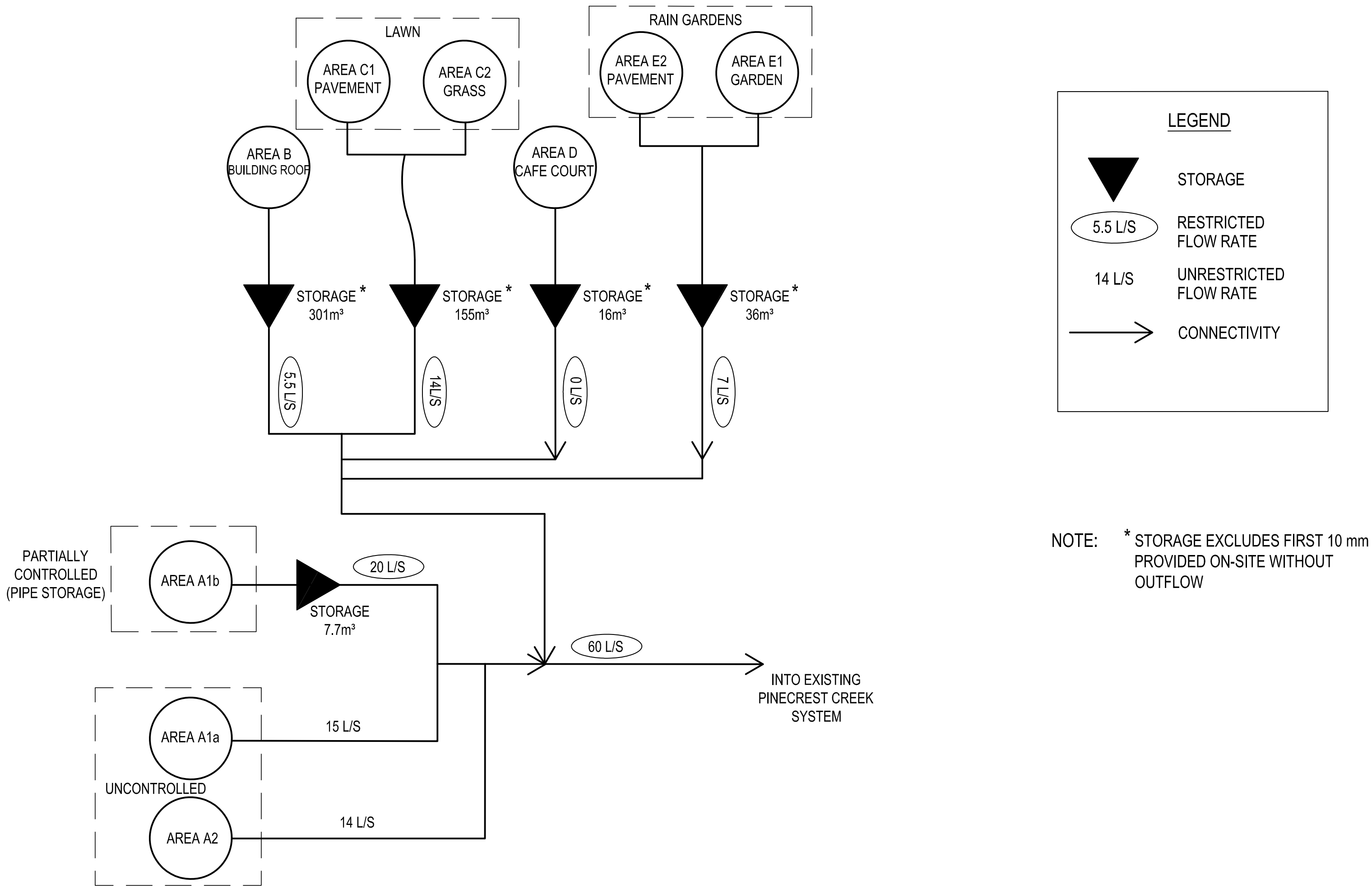
The percolation rate for the site was chosen as 6.4 mm/hr.

The percolation rate assumes under normal conditions a drop in centimetres in the water column over time. In this specific case, the infiltration basin is filled with either 70% sand and 30% water, or 60% clear stone and 40% water. Therefore, the drop in water column must be re-calculated accordingly:

For sand: 6.4 mm/hr / 0.3 = 21.3 mm/hr

For clear stone: 6.4 mm/hr / 0.4 = 16 mm/hr

Appendix B
SWMHYMO Schematic and Output



Project Title

STORMWATER MANAGEMENT
SERVICING REPORT

Drawing Title

SWMHYMO
DRAINAGE SCHEMATIC

Sheet No.

```
=============================================================================

 SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999  =========
 S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
 SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9 Ver. 4.02
     S   W W   M   M  H   H    Y    M   M  O   O      9999   9999 July 1999
 SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9 =========
                                                     9   9  9   9 # 3699242
      StormWater Management HYdrologic Model          999    999  =========

 ***************************************************************************
 *************************** SWMHYMO-99 Ver/4.02 ***************************
 *******  A single event and continuous hydrologic simulation model  *******
 *******     based on the principles of HYMO and its successors      *******
 *******                 OTTHYMO-83 and OTTHYMO-89.                  *******
 ***************************************************************************
 ******* Distributed by:  J.F. Sabourin and Associates Inc.           *******
 *******                  Ottawa,  Ontario: (613) 727-5199           *******
 *******                  Gatineau, Quebec: (819) 243-6858           *******
 *******                  E-Mail: swmhymo@jfsa.Com                   *******
 ***************************************************************************

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++ Licensed user: Cumming Cockburn Limited                     +++++++
 +++++++                Ottawa                SERIAL#:3699242        +++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ***************************************************************************
 *******            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *******
 *******            Maximum value for ID numbers  :     10           *******
 *******            Max. number of rainfall points:  15000           *******
 *******            Max. number of flow points    :  15000           *******
 ***************************************************************************


 ********************   D E T A I L E D   O U T P U T   *******************
 ***************************************************************************
 *       DATE: 2011-05-11     TIME: 17:16:23     RUN COUNTER: 004430       *
 ***************************************************************************
 * Input   filename: D:\SWMHYMO\29062\29062-4.DAT                          *
 * Output  filename: D:\SWMHYMO\29062\29062-4.out                          *
 * Summary filename: D:\SWMHYMO\29062\29062-4.sum                          *
 * User comments:                                                          *
 * 1:______________________________________________________________________*
 * 2:______________________________________________________________________*
 * 3:______________________________________________________________________*
 ***************************************************************************

-------------------------------------------------------------------------------
001:0001-----------------------------------------------------------------------
*#****************************************************************************
*#  Project Name:   Algonquin College
*#  Project Number: 29062
*#  Date        :   2010-11-24
*#  Modeller    :   MB
*#  Company     :   Cumming Cockburn Limited
*#  License #   :   3699242
*#****************************************************************************
*
*
*# SUMMARY OF PARAMETERS USED
*#
*# TIMP - hard surface (asphalt, crushed stone - 99.99%)
*# XIMP - directly connected to sewer - varies per area
*# Initial Abstraction - 1.57 mm Impervious
*#                     - 4.67 mm Pervious (both per City Guidelines)
```

```
*#                     - 10 mm where first 10 mm rain held on-site
*# CN value - 71 (Calib Nashyd)
*# Hortons - fc=162.5  fo=9  dcay=2  f=0.0 (Calib Standhyd)
*#           based on soils information 0.3 m below surface determined
*#           to be between class B and C from Paterson Group Geotechnical
*#           Investigation (February 2011)
*
*
--------------------
| START            |  Project  dir.: D:\SWMHYMO\29062\
--------------------  Rainfall dir.: D:\SWMHYMO\29062\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
-------------------------------------------------------------------------------
001:0002-----------------------------------------------------------------------
*
*
*
*#==============================================================
*# 100 YEAR 3 HOUR CHICAGO - 10 MINUTES TIME STEP
*# AS PER CITY OF OTTAWA SEWER DESIGN GUIDELINES (NOV 2004)
*#==============================================================
*
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1735.688
| Ptotal= 71.66 mm |                          B=   6.014
--------------------                          C=    .820
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =   .33

                    The CORRELATION coefficient is = .9997117

                     TIME        ENTERED            COMPUTED
                    (min)        (mm/hr)             (mm/hr)
                       5.         242.60              242.70
                      10.         179.00              178.56
                      15.         146.80              142.89
                      30.          91.90               91.87
                      60.          53.20               55.89
                     120.          31.50               32.89
                     360.          14.50               13.72
                     720.           8.00                7.83
                    1440.           4.30                4.45

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   6.046 |   1.00 178.559 |   1.83  11.059 |   2.67   5.760
               .33   7.542 |   1.17  54.049 |   2.00   9.285 |   2.83   5.280
               .50  10.159 |   1.33  27.319 |   2.17   8.024 |   3.00   4.879
               .67  15.969 |   1.50  18.240 |   2.33   7.080 |
               .83  40.655 |   1.67  13.737 |   2.50   6.347 |

-------------------------------------------------------------------------------
001:0003-----------------------------------------------------------------------
*
*
*# TOTAL ALLOWABLE RELEASE DURING 100 YEAR STORM 36 L/S/HA
*# AS PER PINECREST CREEK STUDY (JUNE 2009)
*# TOTAL AREA 1.6686 HA -> 1.654 X 36 = 60.07 L/S
*
*#============================
```

```
*# AREA A
*#===========================
*
*
*# AREA A1B - LOADING DOCK (PARTIAL CONTROL USING PIPE STORAGE)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 01:000101 DT= 1.00 |   Total Imp(%)=   99.99   Dir. Conn.(%)=   99.99
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      34.00        10.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=     178.56        63.05
                over (min)       1.00          5.00
     Storage Coeff.  (min)=       1.31 (ii)    5.00 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=        .91          .44
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .03          .00             .026 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.00            1.000
     RUNOFF VOLUME    (mm)=      70.09         8.90           70.086
     TOTAL RAINFALL   (mm)=      71.66        71.66           71.665
     RUNOFF COEFFICIENT   =        .98          .12             .978

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)=162.50          K  (1/hr)=  2.00
            Fc   (mm/hr)=  9.00     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0004---------------------------------------------------------------------
*
*# orifice size diamond 0.083 m (83 mm)
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(000101)   |
| OUT<10:(000104)   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |   (cms)     (ha.m.)
                            .000  .0000E+00   |     .016  .6600E-03
                            .006  .9000E-04   |     .017  .6800E-03
                            .008  .2000E-03   |     .018  .7000E-03
                            .010  .3000E-03   |     .019  .7300E-03
                            .012  .4200E-03   |     .020  .7500E-03
                            .013  .5400E-03   |     .020  .7700E-03
                            .014  .6300E-03   |     .000  .0000E+00

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (000101)         .05      .026     1.000     70.086
     OUTFLOW<10: (000104)         .05      .020     1.017     70.086

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   76.788
                  TIME SHIFT OF PEAK FLOW         (min)=     1.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.7632E-03

-----------------------------------------------------------------------------
001:0005---------------------------------------------------------------------
```

```
 *
 *
 *# AREA A1a - SIDEWALK TO PARKING LOT (UNCONTROLLED OVERLAND FLOW)
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=     .03
 | 01:000101 DT= 1.00 |   Total Imp(%)=   99.99   Dir. Conn.(%)=   99.99
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
       Surface Area     (ha)=        .03          .00
       Dep. Storage     (mm)=       1.57         4.67
       Average Slope     (%)=        .50         2.00
       Length            (m)=      19.00        10.00
       Mannings n          =        .013         .250

       Max.eff.Inten.(mm/hr)=     178.56        63.05
                  over (min)        1.00         5.00
       Storage Coeff.  (min)=        .92 (ii)    4.62 (ii)
       Unit Hyd. Tpeak (min)=       1.00         5.00
       Unit Hyd. peak  (cms)=       1.13          .45
                                                            *TOTALS*
       PEAK FLOW       (cms)=        .02          .00           .015 (iii)
       TIME TO PEAK    (hrs)=       1.00         1.00          1.000
       RUNOFF VOLUME    (mm)=      70.09         8.90         70.088
       TOTAL RAINFALL   (mm)=      71.66        71.66         71.665
       RUNOFF COEFFICIENT   =        .98          .12           .978

         (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
              Fo   (mm/hr)=162.50          K  (1/hr)=  2.00
              Fc   (mm/hr)=  9.00     Cum.Inf.   (mm)=   .00
        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
             THAN THE STORAGE COEFFICIENT.
       (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -------------------------------------------------------------------------------
 001:0006-----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000874) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 01:000101      .03     .015    1.00  70.09    .000
                 +ID2 10:000104      .05     .020    1.02  70.09    .000
                  =================================================
                  SUM 09:000874      .08     .035    1.00  70.09    .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------
 001:0007-----------------------------------------------------------------------
 *
 *# AREA A2 - GRASS SURFACE (UNCONTROLLED OVERLAND FLOW with 10 mm storage)
 *
 ----------------------
 | CALIB NASHYD        |   Area    (ha)=     .17   Curve Number   (CN)=71.00
 | 02:000102 DT= 1.00 |   Ia      (mm)=  10.000   # of Linear Res.(N)= 3.00
 ----------------------   U.H. Tp(hrs)=    .170

       Unit Hyd Qpeak  (cms)=     .039

       PEAK FLOW       (cms)=     .014 (i)
       TIME TO PEAK    (hrs)=    1.183
       RUNOFF VOLUME    (mm)=   22.987
       TOTAL RAINFALL   (mm)=   71.665
       RUNOFF COEFFICIENT   =     .321

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

```

-----------------------------------------------------------------------------
001:0008---------------------------------------------------------------------
*
--------------------
| ADD HYD (000103) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 02:000102      .17     .014    1.18  22.99    .000
                +ID2 09:000874      .08     .035    1.00  70.09    .000
                 ==================================================
                 SUM 03:000103      .25     .041    1.00  38.25    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0009---------------------------------------------------------------------
*
*#===========================
*# AREA B BUILDING ROOF
*#===========================
*
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .56
| 01:000101 DT= 1.00 |   Total Imp(%)=   99.99   Dir. Conn.(%)=   99.99
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .56          .00
     Dep. Storage     (mm)=      11.18        11.18
     Average Slope     (%)=        .50         2.00
     Length            (m)=     113.00        10.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=     178.56        49.49
                over (min)        3.00         7.00
     Storage Coeff.  (min)=       2.68 (ii)    6.75 (ii)
     Unit Hyd. Tpeak (min)=       3.00         7.00
     Unit Hyd. peak  (cms)=        .40          .18
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .27          .00           .267 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.05          1.000
     RUNOFF VOLUME    (mm)=      60.48         7.17         60.479
     TOTAL RAINFALL   (mm)=      71.66        71.66         71.665
     RUNOFF COEFFICIENT   =        .84          .10           .844

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)=162.50          K  (1/hr)=  2.00
            Fc   (mm/hr)=  9.00     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0010---------------------------------------------------------------------
*
*#==========================================================
*# RESERVOIR AREA B (controlled to 5 l/s)
*#==========================================================
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(000101)   |
| OUT<02:(000104)   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .006  .3100E-01
```

```

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (000101)        .56      .267     1.000     60.479
     OUTFLOW<02: (000104)        .56      .005     3.033     60.469

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=    2.005
                    TIME SHIFT OF PEAK FLOW         (min)=   122.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.3005E-01

-------------------------------------------------------------------------------
001:0011-----------------------------------------------------------------------
*
*
*#=============================
*# AREA C LAWN
*#=============================
*
*# AREA C1 - HARD SURFACES TO RUNOFF TO GRASS SURFACE (AREA C2)
*
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .23
| 01:000105 DT= 1.00 |   Total Imp(%)=   99.99   Dir. Conn.(%)=     .01
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .23          .00
     Dep. Storage     (mm)=      10.00        10.00
     Average Slope     (%)=        .50         2.00
     Length            (m)=      71.00        10.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56     ********
                over (min)        2.00         2.00
     Storage Coeff.  (min)=       2.03 (ii)    2.09 (ii)
     Unit Hyd. Tpeak (min)=       2.00         2.00
     Unit Hyd. peak  (cms)=        .58          .57
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .00          .12              .115 (iii)
     TIME TO PEAK    (hrs)=        .95         1.00             1.000
     RUNOFF VOLUME    (mm)=      61.66        71.65            71.652
     TOTAL RAINFALL   (mm)=      71.66        71.66            71.665
     RUNOFF COEFFICIENT   =        .86         1.00             1.000

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)=162.50          K  (1/hr)=  2.00
            Fc   (mm/hr)=  9.00     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0012-----------------------------------------------------------------------
*
*# AREA C2 - GRASS SURFACE
*
----------------------
| CALIB NASHYD       |   Area    (ha)=     .43   Curve Number   (CN)=71.00
| 04:000106 DT= 1.00 |   Ia      (mm)=  10.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .250

     Unit Hyd Qpeak  (cms)=     .066

     PEAK FLOW       (cms)=     .029 (i)
     TIME TO PEAK    (hrs)=    1.300
     RUNOFF VOLUME    (mm)=   22.988
```

```
      TOTAL RAINFALL   (mm)=   71.665
      RUNOFF COEFFICIENT   =     .321

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

 ------------------------------------------------------------------------------
 001:0013----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000107) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 01:000105      .23      .115    1.00  71.65    .000
                 +ID2 04:000106      .43      .029    1.30  22.99    .000
                  =======================================================
                  SUM 05:000107      .67      .123    1.00  39.95    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0014----------------------------------------------------------------------
 *
 *#===============================================================
 *# RESERVOIR AREA C
 *#===============================================================
 *
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>05:(000107)   |
 | OUT<06:(000108)   |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |   (cms)    (ha.m.)
                             .000  .0000E+00   |     .013  .1176E-01
                             .011  .9000E-03   |     .014  .1328E-01
                             .011  .2700E-02   |     .014  .1483E-01
                             .012  .4490E-02   |     .014  .1542E-01
                             .012  .6290E-02   |     .014  .1612E-01
                             .012  .8090E-02   |     .015  .1880E-01
                             .013  .9880E-02   |     .015  .2486E-01
                             .013  .1099E-01   |     .000  .0000E+00

      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
      --------------------       (ha)     (cms)     (hrs)       (mm)
      INFLOW >05: (000107)        .67      .123     1.000     39.951
      OUTFLOW<06: (000108)        .67      .014     2.067     39.951

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   11.603
                    TIME SHIFT OF PEAK FLOW        (min)=    64.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1554E-01

 ------------------------------------------------------------------------------
 001:0015----------------------------------------------------------------------
 *
 *#  ADD AREAS B AND C
 *
 --------------------
 | ADD HYD (000112) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 06:000108      .67      .014    2.07  39.95    .000
                 +ID2 02:000104      .56      .005    3.03  60.47    .000
                  =======================================================
                  SUM 01:000112     1.22      .019    2.25  49.29    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
```

```
001:0016---------------------------------------------------------------
*
*#===========================
*# AREA D CAFE COURT
*#===========================
*
*
----------------------
| CALIB NASHYD       |   Area    (ha)=     .07   Curve Number   (CN)=71.00
| 05:000109 DT= 1.00 |   Ia      (mm)=  10.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .015

     PEAK FLOW       (cms)=     .006 (i)
     TIME TO PEAK    (hrs)=    1.183
     RUNOFF VOLUME    (mm)=   22.984
     TOTAL RAINFALL   (mm)=   71.665
     RUNOFF COEFFICIENT   =     .321

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

-----------------------------------------------------------------------
001:0017---------------------------------------------------------------
*
*#=============================================================
*# RESERVOIR AREA D (0 l/s release)
*#=============================================================
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(000109)   |
| OUT<07:(000110)   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .000  .1585E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >05: (000109)        .07      .006     1.183     22.984
     OUTFLOW<07: (000110)        .07      .000      .000       .000

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=     .000
                   TIME SHIFT OF PEAK FLOW        (min)=   -71.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1584E-02

      *** WARNING: Outflow volume is less than inflow volume.
-----------------------------------------------------------------------
001:0018---------------------------------------------------------------
*
*
*# ADD AREAS B, C AND D
*
--------------------
| ADD HYD (000113) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                ID1 01:000112     1.22      .019    2.25  49.29    .000
               +ID2 07:000110      .07      .000     .00    .00    .000
                ====================================================
                SUM 06:000113     1.29      .019    2.25  46.67    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------
001:0019---------------------------------------------------------------
*
```

```
*#===========================
*# AREA E RAIN GARDENS
*#===========================
*
*# AREA E1 - HARD SURFACE (COMPACTED CRUSHED BRICK)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .08
| 01:000105 DT= 1.00 |   Total Imp(%)=   99.99   Dir. Conn.(%)=     .01
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .08          .00
     Dep. Storage     (mm)=      10.00        10.00
     Average Slope     (%)=        .50         2.00
     Length            (m)=      49.00        10.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56     ********
                over (min)       2.00         2.00
     Storage Coeff.  (min)=       1.63 (ii)    1.69 (ii)
     Unit Hyd. Tpeak (min)=       2.00         2.00
     Unit Hyd. peak  (cms)=        .73          .72
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .00          .04           .039 (iii)
     TIME TO PEAK    (hrs)=        .90         1.00          1.000
     RUNOFF VOLUME    (mm)=      61.66        71.65         71.652
     TOTAL RAINFALL   (mm)=      71.66        71.66         71.665
     RUNOFF COEFFICIENT   =        .86         1.00          1.000

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)=162.50           K  (1/hr)=  2.00
            Fc   (mm/hr)=  9.00     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0020-----------------------------------------------------------------------
*
*# AREA E2 - GARDEN AND LANDSCAPE SURFACES
*
----------------------
| CALIB NASHYD       |   Area    (ha)=     .04   Curve Number   (CN)=71.00
| 05:000111 DT= 1.00 |   Ia      (mm)=  10.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .170

     Unit Hyd Qpeak  (cms)=     .010

     PEAK FLOW       (cms)=     .004 (i)
     TIME TO PEAK    (hrs)=    1.183
     RUNOFF VOLUME    (mm)=   22.981
     TOTAL RAINFALL   (mm)=   71.665
     RUNOFF COEFFICIENT   =     .321

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

-------------------------------------------------------------------------------
001:0021-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000784) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                ID1 01:000105      .08      .039    1.00  71.65    .000
               +ID2 05:000111      .04      .004    1.18  22.98    .000
                =====================================================
                SUM 02:000784      .12      .040    1.00  54.11    .000
```

```

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0022-----------------------------------------------------------------------
*
*#============================================================
*# RESERVOIR AREA E (7 l/s release)
*#============================================================
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(000784)   |
| OUT<05:(000110)   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .007  .3680E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (000784)        .12      .040     1.000     54.106
     OUTFLOW<05: (000110)        .12      .007     1.367     54.102

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.315
                   TIME SHIFT OF PEAK FLOW        (min)=    22.00
                   MAXIMUM  STORAGE   USED      (ha.m.)=.3610E-02

-------------------------------------------------------------------------------
001:0023-----------------------------------------------------------------------
*
*
*# ADD AREAS B, C, D AND E
*
--------------------
| ADD HYD (000114) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                ID1 06:000113     1.29      .019    2.25  46.67    .000
               +ID2 05:000110      .12      .007    1.37  54.10    .000
                =====================================================
                SUM 07:000114     1.41      .026    1.75  47.31    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0024-----------------------------------------------------------------------
*
*
*# ADD UNCONTROLLED AREA A TO CONTROLLED AREAS (B, C, D AND E)
*
--------------------
| ADD HYD (000116) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                ID1 07:000114     1.41      .026    1.75  47.31    .000
               +ID2 03:000103      .25      .041    1.00  38.25    .000
                =====================================================
                SUM 10:000116     1.67      .060    1.00  45.93    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0025-----------------------------------------------------------------------
*
*
*
*# PARTIALLY CONTROLLED AREA A1a AND 25 MM UNCONTROLLED AREAS A1b AND A2 FOR WAT
*
```

```
*#==========================================================
*# 25 MM 4 HOUR CHICAGO STORM
*#==========================================================
*
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 738.000
| Ptotal= 25.05 mm |                          B=   8.050
--------------------                          C=    .865
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  4.00 hrs
                        Storm time step    =  2.00 min
                        Time to peak ratio =   .33

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .03   1.051 |   1.03   5.246 |   2.03   4.268 |   3.03   1.617
               .07   1.079 |   1.07   6.026 |   2.07   4.050 |   3.07   1.585
               .10   1.109 |   1.10   7.056 |   2.10   3.852 |   3.10   1.553
               .13   1.140 |   1.13   8.470 |   2.13   3.672 |   3.13   1.523
               .17   1.173 |   1.17  10.508 |   2.17   3.508 |   3.17   1.495
               .20   1.209 |   1.20  13.648 |   2.20   3.357 |   3.20   1.467
               .23   1.246 |   1.23  18.964 |   2.23   3.219 |   3.23   1.440
               .27   1.287 |   1.27  29.373 |   2.27   3.091 |   3.27   1.415
               .30   1.330 |   1.30  55.736 |   2.30   2.973 |   3.30   1.390
               .33   1.376 |   1.33 100.273 |   2.33   2.864 |   3.33   1.366
               .37   1.425 |   1.37  66.480 |   2.37   2.762 |   3.37   1.343
               .40   1.478 |   1.40  45.046 |   2.40   2.668 |   3.40   1.321
               .43   1.536 |   1.43  33.110 |   2.43   2.579 |   3.43   1.299
               .47   1.598 |   1.47  25.700 |   2.47   2.496 |   3.47   1.278
               .50   1.666 |   1.50  20.742 |   2.50   2.419 |   3.50   1.258
               .53   1.740 |   1.53  17.238 |   2.53   2.346 |   3.53   1.239
               .57   1.822 |   1.57  14.653 |   2.57   2.277 |   3.57   1.220
               .60   1.911 |   1.60  12.684 |   2.60   2.212 |   3.60   1.201
               .63   2.009 |   1.63  11.142 |   2.63   2.151 |   3.63   1.184
               .67   2.119 |   1.67   9.908 |   2.67   2.093 |   3.67   1.167
               .70   2.241 |   1.70   8.901 |   2.70   2.038 |   3.70   1.150
               .73   2.378 |   1.73   8.066 |   2.73   1.987 |   3.73   1.134
               .77   2.534 |   1.77   7.365 |   2.77   1.937 |   3.77   1.118
               .80   2.711 |   1.80   6.770 |   2.80   1.890 |   3.80   1.103
               .83   2.914 |   1.83   6.258 |   2.83   1.846 |   3.83   1.088
               .87   3.150 |   1.87   5.814 |   2.87   1.803 |   3.87   1.074
               .90   3.427 |   1.90   5.426 |   2.90   1.763 |   3.90   1.060
               .93   3.756 |   1.93   5.084 |   2.93   1.724 |   3.93   1.046
               .97   4.152 |   1.97   4.781 |   2.97   1.687 |   3.97   1.033
              1.00   4.638 |   2.00   4.511 |   3.00   1.651 |   4.00   1.020

-------------------------------------------------------------------------------
001:0026-----------------------------------------------------------------------
*
*#============================
*# AREA A
*#============================
*
*# AREA A1B - LOADING DOCK (PARTIAL CONTROL USING PIPE STORAGE)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 01:000101 DT= 1.00 |   Total Imp(%)=   99.99   Dir. Conn.(%)=   99.99
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      34.00        10.00
     Mannings n          =       .013         .250
```

```

     Max.eff.Inten.(mm/hr)=     100.27          .00
                over (min)        2.00         1.00
     Storage Coeff.  (min)=       1.64 (ii)     .00 (ii)
     Unit Hyd. Tpeak (min)=       2.00         2.00
     Unit Hyd. peak  (cms)=        .63          .00
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .01          .00             .012 (iii)
     TIME TO PEAK    (hrs)=       1.35          .00            1.350
     RUNOFF VOLUME    (mm)=      23.48          .00           23.479
     TOTAL RAINFALL   (mm)=      25.05        25.05           25.052
     RUNOFF COEFFICIENT   =        .94          .00             .937
      *** NOTE: The pervious area has no runoff.

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)=162.50          K  (1/hr)=  2.00
            Fc   (mm/hr)=  9.00     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0027------------------------------------------------------------------------
 *
 *# orifice size diamond 0.083 m (83 mm)
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>01:(000101)   |
 | OUT<10:(000104)   |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .016  .6600E-03
                             .006  .9000E-04   |     .017  .6800E-03
                             .008  .2000E-03   |     .018  .7000E-03
                             .010  .3000E-03   |     .019  .7300E-03
                             .012  .4200E-03   |     .020  .7500E-03
                             .013  .5400E-03   |     .020  .7700E-03
                             .014  .6300E-03   |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (000101)        .05      .012     1.350     23.479
     OUTFLOW<10: (000104)        .05      .008     1.400     23.479

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   66.842
                   TIME SHIFT OF PEAK FLOW        (min)=     3.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1762E-03

 --------------------------------------------------------------------------------
 001:0028------------------------------------------------------------------------
 *
 --------------------
 | PRINT HYD        |   AREA       (ha)=     .052
 | ID=10 (000104)   |   QPEAK     (cms)=     .008 (i)
 | DT= 1.00 PCYC= 1 |   TPEAK     (hrs)=    1.400
 --------------------   VOLUME     (mm)=   23.479

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
   TIME    FLOW |  TIME    FLOW |  TIME    FLOW |  TIME    FLOW |  TIME    FLOW
    hrs     cms |   hrs     cms |   hrs     cms |   hrs     cms |   hrs     cms
     .00    .000|    .85    .000|   1.70    .002|   2.55    .000|   3.40    .000
     .02    .000|    .87    .000|   1.72    .002|   2.57    .000|   3.42    .000
     .03    .000|    .88    .000|   1.73    .001|   2.58    .000|   3.43    .000
     .05    .000|    .90    .000|   1.75    .001|   2.60    .000|   3.45    .000
     .07    .000|    .92    .000|   1.77    .001|   2.62    .000|   3.47    .000
```

```
       .08    .000|    .93    .000|   1.78    .001|   2.63    .000|   3.48    .000
       .10    .000|    .95    .000|   1.80    .001|   2.65    .000|   3.50    .000
       .12    .000|    .97    .000|   1.82    .001|   2.67    .000|   3.52    .000
       .13    .000|    .98    .000|   1.83    .001|   2.68    .000|   3.53    .000
       .15    .000|   1.00    .000|   1.85    .001|   2.70    .000|   3.55    .000
       .17    .000|   1.02    .001|   1.87    .001|   2.72    .000|   3.57    .000
       .18    .000|   1.03    .001|   1.88    .001|   2.73    .000|   3.58    .000
       .20    .000|   1.05    .001|   1.90    .001|   2.75    .000|   3.60    .000
       .22    .000|   1.07    .001|   1.92    .001|   2.77    .000|   3.62    .000
       .23    .000|   1.08    .001|   1.93    .001|   2.78    .000|   3.63    .000
       .25    .000|   1.10    .001|   1.95    .001|   2.80    .000|   3.65    .000
       .27    .000|   1.12    .001|   1.97    .001|   2.82    .000|   3.67    .000
       .28    .000|   1.13    .001|   1.98    .001|   2.83    .000|   3.68    .000
       .30    .000|   1.15    .001|   2.00    .001|   2.85    .000|   3.70    .000
       .32    .000|   1.17    .001|   2.02    .001|   2.87    .000|   3.72    .000
       .33    .000|   1.18    .001|   2.03    .001|   2.88    .000|   3.73    .000
       .35    .000|   1.20    .001|   2.05    .001|   2.90    .000|   3.75    .000
       .37    .000|   1.22    .001|   2.07    .001|   2.92    .000|   3.77    .000
       .38    .000|   1.23    .002|   2.08    .001|   2.93    .000|   3.78    .000
       .40    .000|   1.25    .002|   2.10    .001|   2.95    .000|   3.80    .000
       .42    .000|   1.27    .002|   2.12    .001|   2.97    .000|   3.82    .000
       .43    .000|   1.28    .003|   2.13    .001|   2.98    .000|   3.83    .000
       .45    .000|   1.30    .004|   2.15    .001|   3.00    .000|   3.85    .000
       .47    .000|   1.32    .005|   2.17    .001|   3.02    .000|   3.87    .000
       .48    .000|   1.33    .006|   2.18    .001|   3.03    .000|   3.88    .000
       .50    .000|   1.35    .007|   2.20    .001|   3.05    .000|   3.90    .000
       .52    .000|   1.37    .007|   2.22    .001|   3.07    .000|   3.92    .000
       .53    .000|   1.38    .008|   2.23    .001|   3.08    .000|   3.93    .000
       .55    .000|   1.40    .008|   2.25    .000|   3.10    .000|   3.95    .000
       .57    .000|   1.42    .008|   2.27    .000|   3.12    .000|   3.97    .000
       .58    .000|   1.43    .008|   2.28    .000|   3.13    .000|   3.98    .000
       .60    .000|   1.45    .007|   2.30    .000|   3.15    .000|   4.00    .000
       .62    .000|   1.47    .007|   2.32    .000|   3.17    .000|   4.02    .000
       .63    .000|   1.48    .007|   2.33    .000|   3.18    .000|   4.03    .000
       .65    .000|   1.50    .006|   2.35    .000|   3.20    .000|   4.05    .000
       .67    .000|   1.52    .006|   2.37    .000|   3.22    .000|   4.07    .000
       .68    .000|   1.53    .005|   2.38    .000|   3.23    .000|   4.08    .000
       .70    .000|   1.55    .004|   2.40    .000|   3.25    .000|   4.10    .000
       .72    .000|   1.57    .004|   2.42    .000|   3.27    .000|   4.12    .000
       .73    .000|   1.58    .003|   2.43    .000|   3.28    .000|   4.13    .000
       .75    .000|   1.60    .003|   2.45    .000|   3.30    .000|   4.15    .000
       .77    .000|   1.62    .003|   2.47    .000|   3.32    .000|
       .78    .000|   1.63    .002|   2.48    .000|   3.33    .000|
       .80    .000|   1.65    .002|   2.50    .000|   3.35    .000|
       .82    .000|   1.67    .002|   2.52    .000|   3.37    .000|
       .83    .000|   1.68    .002|   2.53    .000|   3.38    .000|
-------------------------------------------------------------------------------
001:0029-----------------------------------------------------------------------
*
*# AREA A1a - SIDEWALK TO PARKING LOT (UNCONTROLLED OVERLAND FLOW)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 01:000101 DT= 1.00 |   Total Imp(%)=   99.99   Dir. Conn.(%)=   99.99
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .03          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      19.00        10.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     100.27          .00
                over (min)        1.00         1.00
     Storage Coeff.  (min)=       1.16 (ii)     .00 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
```

```
     Unit Hyd. peak  (cms)=        .98          .00
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .01          .00           .008 (iii)
     TIME TO PEAK    (hrs)=       1.33          .00          1.333
     RUNOFF VOLUME    (mm)=      23.48          .00         23.479
     TOTAL RAINFALL   (mm)=      25.05        25.05         25.052
     RUNOFF COEFFICIENT   =        .94          .00           .937
      *** NOTE: The pervious area has no runoff.

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)=162.50          K  (1/hr)=  2.00
            Fc   (mm/hr)=  9.00     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -------------------------------------------------------------------------------
 001:0030-----------------------------------------------------------------------
 *
 *
 --------------------
 | PRINT HYD         |   AREA      (ha)=     .031
 | ID=01 (000101)    |   QPEAK    (cms)=     .008 (i)
 | DT= 1.00 PCYC= 1 |   TPEAK    (hrs)=    1.333
 --------------------   VOLUME     (mm)=   23.479

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
   TIME    FLOW |  TIME    FLOW |  TIME    FLOW |  TIME    FLOW |  TIME    FLOW
    hrs     cms |   hrs     cms |   hrs     cms |   hrs     cms |   hrs     cms
    .00    .000|    .82    .000|   1.63    .001|   2.45    .000|   3.27    .000
    .02    .000|    .83    .000|   1.65    .001|   2.47    .000|   3.28    .000
    .03    .000|    .85    .000|   1.67    .001|   2.48    .000|   3.30    .000
    .05    .000|    .87    .000|   1.68    .001|   2.50    .000|   3.32    .000
    .07    .000|    .88    .000|   1.70    .001|   2.52    .000|   3.33    .000
    .08    .000|    .90    .000|   1.72    .001|   2.53    .000|   3.35    .000
    .10    .000|    .92    .000|   1.73    .001|   2.55    .000|   3.37    .000
    .12    .000|    .93    .000|   1.75    .001|   2.57    .000|   3.38    .000
    .13    .000|    .95    .000|   1.77    .001|   2.58    .000|   3.40    .000
    .15    .000|    .97    .000|   1.78    .001|   2.60    .000|   3.42    .000
    .17    .000|    .98    .000|   1.80    .001|   2.62    .000|   3.43    .000
    .18    .000|   1.00    .000|   1.82    .001|   2.63    .000|   3.45    .000
    .20    .000|   1.02    .000|   1.83    .001|   2.65    .000|   3.47    .000
    .22    .000|   1.03    .000|   1.85    .001|   2.67    .000|   3.48    .000
    .23    .000|   1.05    .000|   1.87    .001|   2.68    .000|   3.50    .000
    .25    .000|   1.07    .001|   1.88    .000|   2.70    .000|   3.52    .000
    .27    .000|   1.08    .001|   1.90    .000|   2.72    .000|   3.53    .000
    .28    .000|   1.10    .001|   1.92    .000|   2.73    .000|   3.55    .000
    .30    .000|   1.12    .001|   1.93    .000|   2.75    .000|   3.57    .000
    .32    .000|   1.13    .001|   1.95    .000|   2.77    .000|   3.58    .000
    .33    .000|   1.15    .001|   1.97    .000|   2.78    .000|   3.60    .000
    .35    .000|   1.17    .001|   1.98    .000|   2.80    .000|   3.62    .000
    .37    .000|   1.18    .001|   2.00    .000|   2.82    .000|   3.63    .000
    .38    .000|   1.20    .001|   2.02    .000|   2.83    .000|   3.65    .000
    .40    .000|   1.22    .001|   2.03    .000|   2.85    .000|   3.67    .000
    .42    .000|   1.23    .002|   2.05    .000|   2.87    .000|   3.68    .000
    .43    .000|   1.25    .002|   2.07    .000|   2.88    .000|   3.70    .000
    .45    .000|   1.27    .002|   2.08    .000|   2.90    .000|   3.72    .000
    .47    .000|   1.28    .004|   2.10    .000|   2.92    .000|   3.73    .000
    .48    .000|   1.30    .004|   2.12    .000|   2.93    .000|   3.75    .000
    .50    .000|   1.32    .007|   2.13    .000|   2.95    .000|   3.77    .000
    .52    .000|   1.33    .008|   2.15    .000|   2.97    .000|   3.78    .000
    .53    .000|   1.35    .007|   2.17    .000|   2.98    .000|   3.80    .000
    .55    .000|   1.37    .006|   2.18    .000|   3.00    .000|   3.82    .000
    .57    .000|   1.38    .005|   2.20    .000|   3.02    .000|   3.83    .000
    .58    .000|   1.40    .004|   2.22    .000|   3.03    .000|   3.85    .000
    .60    .000|   1.42    .003|   2.23    .000|   3.05    .000|   3.87    .000
```

```
    .62    .000|   1.43    .003|   2.25    .000|   3.07    .000|   3.88    .000
    .63    .000|   1.45    .003|   2.27    .000|   3.08    .000|   3.90    .000
    .65    .000|   1.47    .002|   2.28    .000|   3.10    .000|   3.92    .000
    .67    .000|   1.48    .002|   2.30    .000|   3.12    .000|   3.93    .000
    .68    .000|   1.50    .002|   2.32    .000|   3.13    .000|   3.95    .000
    .70    .000|   1.52    .002|   2.33    .000|   3.15    .000|   3.97    .000
    .72    .000|   1.53    .002|   2.35    .000|   3.17    .000|   3.98    .000
    .73    .000|   1.55    .001|   2.37    .000|   3.18    .000|   4.00    .000
    .75    .000|   1.57    .001|   2.38    .000|   3.20    .000|   4.02    .000
    .77    .000|   1.58    .001|   2.40    .000|   3.22    .000|   4.03    .000
    .78    .000|   1.60    .001|   2.42    .000|   3.23    .000|
    .80    .000|   1.62    .001|   2.43    .000|   3.25    .000|
 ------------------------------------------------------------------------------
 001:0031----------------------------------------------------------------------
 *
 *
 *# AREA A2 - GRASS SURFACE (UNCONTROLLED OVERLAND FLOW with 10 mm storage)
 *
 ----------------------
 | CALIB NASHYD       |   Area    (ha)=     .17   Curve Number   (CN)=71.00
 | 02:000102 DT= 1.00 |   Ia      (mm)=  10.000   # of Linear Res.(N)= 3.00
 ----------------------   U.H. Tp(hrs)=    .170

      Unit Hyd Qpeak  (cms)=     .039

      PEAK FLOW       (cms)=     .001 (i)
      TIME TO PEAK    (hrs)=    1.717
      RUNOFF VOLUME    (mm)=    1.905
      TOTAL RAINFALL   (mm)=   25.052
      RUNOFF COEFFICIENT   =     .076

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

 ------------------------------------------------------------------------------
 001:0032----------------------------------------------------------------------
 *
 --------------------
 | PRINT HYD        |   AREA       (ha)=     .172
 | ID=02 (000102)   |   QPEAK     (cms)=     .001 (i)
 | DT= 1.00 PCYC= 1 |   TPEAK     (hrs)=    1.717
 --------------------   VOLUME     (mm)=    1.905

      (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
   TIME    FLOW |  TIME    FLOW |  TIME    FLOW |  TIME    FLOW |  TIME    FLOW
    hrs     cms |   hrs     cms |   hrs     cms |   hrs     cms |   hrs     cms
    .00    .000|    .90    .000|   1.80    .001|   2.70    .000|   3.60    .000
    .02    .000|    .92    .000|   1.82    .001|   2.72    .000|   3.62    .000
    .03    .000|    .93    .000|   1.83    .001|   2.73    .000|   3.63    .000
    .05    .000|    .95    .000|   1.85    .001|   2.75    .000|   3.65    .000
    .07    .000|    .97    .000|   1.87    .001|   2.77    .000|   3.67    .000
    .08    .000|    .98    .000|   1.88    .001|   2.78    .000|   3.68    .000
    .10    .000|   1.00    .000|   1.90    .001|   2.80    .000|   3.70    .000
    .12    .000|   1.02    .000|   1.92    .001|   2.82    .000|   3.72    .000
    .13    .000|   1.03    .000|   1.93    .001|   2.83    .000|   3.73    .000
    .15    .000|   1.05    .000|   1.95    .001|   2.85    .000|   3.75    .000
    .17    .000|   1.07    .000|   1.97    .001|   2.87    .000|   3.77    .000
    .18    .000|   1.08    .000|   1.98    .001|   2.88    .000|   3.78    .000
    .20    .000|   1.10    .000|   2.00    .001|   2.90    .000|   3.80    .000
    .22    .000|   1.12    .000|   2.02    .001|   2.92    .000|   3.82    .000
    .23    .000|   1.13    .000|   2.03    .001|   2.93    .000|   3.83    .000
    .25    .000|   1.15    .000|   2.05    .001|   2.95    .000|   3.85    .000
    .27    .000|   1.17    .000|   2.07    .001|   2.97    .000|   3.87    .000
    .28    .000|   1.18    .000|   2.08    .001|   2.98    .000|   3.88    .000
    .30    .000|   1.20    .000|   2.10    .001|   3.00    .000|   3.90    .000
    .32    .000|   1.22    .000|   2.12    .000|   3.02    .000|   3.92    .000
    .33    .000|   1.23    .000|   2.13    .000|   3.03    .000|   3.93    .000
```

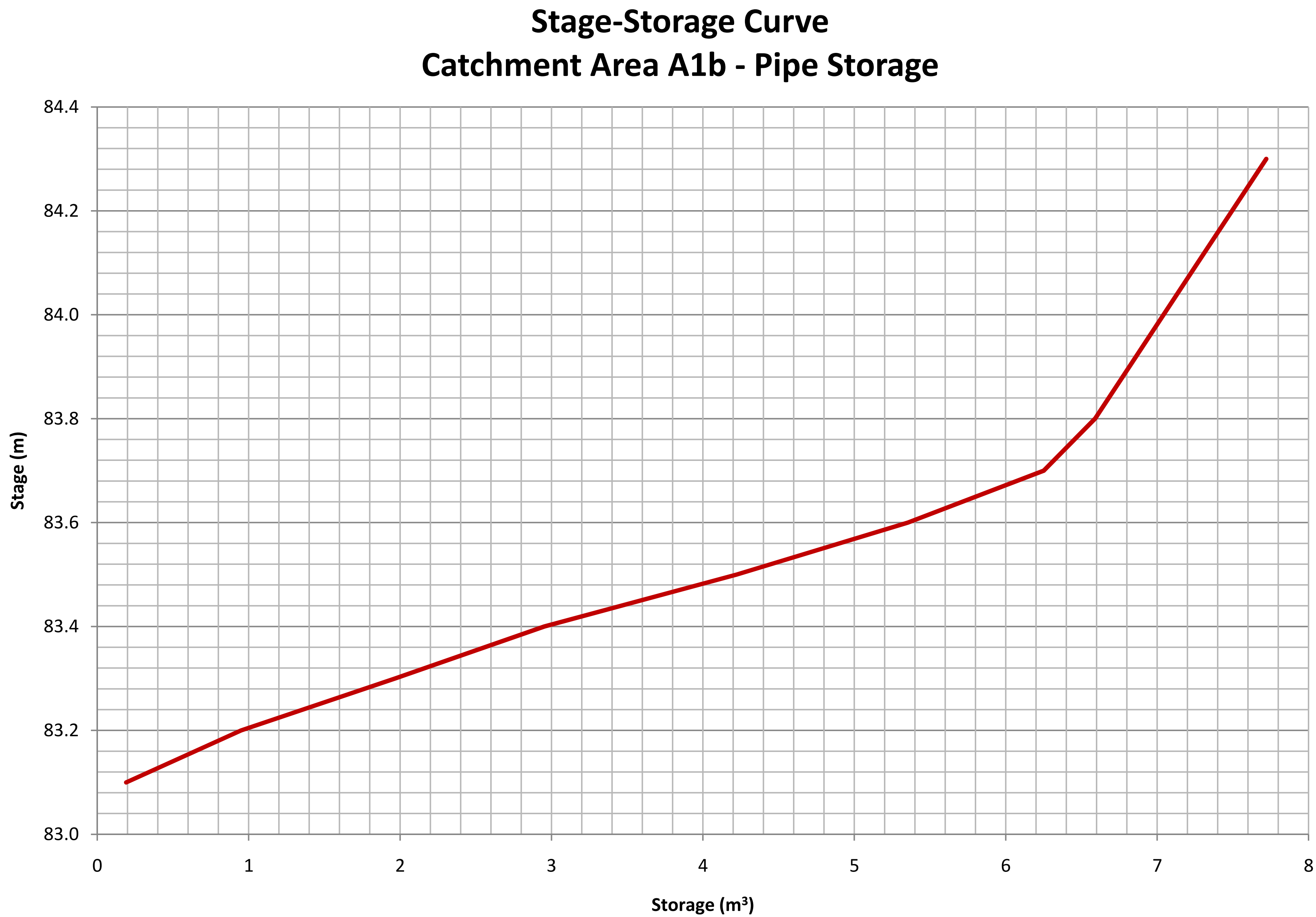
```
       .35    .000|  1.25    .000|  2.15    .000|  3.05    .000|  3.95    .000
       .37    .000|  1.27    .000|  2.17    .000|  3.07    .000|  3.97    .000
       .38    .000|  1.28    .000|  2.18    .000|  3.08    .000|  3.98    .000
       .40    .000|  1.30    .000|  2.20    .000|  3.10    .000|  4.00    .000
       .42    .000|  1.32    .000|  2.22    .000|  3.12    .000|  4.02    .000
       .43    .000|  1.33    .000|  2.23    .000|  3.13    .000|  4.03    .000
       .45    .000|  1.35    .000|  2.25    .000|  3.15    .000|  4.05    .000
       .47    .000|  1.37    .000|  2.27    .000|  3.17    .000|  4.07    .000
       .48    .000|  1.38    .000|  2.28    .000|  3.18    .000|  4.08    .000
       .50    .000|  1.40    .000|  2.30    .000|  3.20    .000|  4.10    .000
       .52    .000|  1.42    .000|  2.32    .000|  3.22    .000|  4.12    .000
       .53    .000|  1.43    .000|  2.33    .000|  3.23    .000|  4.13    .000
       .55    .000|  1.45    .000|  2.35    .000|  3.25    .000|  4.15    .000
       .57    .000|  1.47    .000|  2.37    .000|  3.27    .000|  4.17    .000
       .58    .000|  1.48    .000|  2.38    .000|  3.28    .000|  4.18    .000
       .60    .000|  1.50    .000|  2.40    .000|  3.30    .000|  4.20    .000
       .62    .000|  1.52    .000|  2.42    .000|  3.32    .000|  4.22    .000
       .63    .000|  1.53    .001|  2.43    .000|  3.33    .000|  4.23    .000
       .65    .000|  1.55    .001|  2.45    .000|  3.35    .000|  4.25    .000
       .67    .000|  1.57    .001|  2.47    .000|  3.37    .000|  4.27    .000
       .68    .000|  1.58    .001|  2.48    .000|  3.38    .000|  4.28    .000
       .70    .000|  1.60    .001|  2.50    .000|  3.40    .000|  4.30    .000
       .72    .000|  1.62    .001|  2.52    .000|  3.42    .000|  4.32    .000
       .73    .000|  1.63    .001|  2.53    .000|  3.43    .000|  4.33    .000
       .75    .000|  1.65    .001|  2.55    .000|  3.45    .000|  4.35    .000
       .77    .000|  1.67    .001|  2.57    .000|  3.47    .000|  4.37    .000
       .78    .000|  1.68    .001|  2.58    .000|  3.48    .000|  4.38    .000
       .80    .000|  1.70    .001|  2.60    .000|  3.50    .000|  4.40    .000
       .82    .000|  1.72    .001|  2.62    .000|  3.52    .000|  4.42    .000
       .83    .000|  1.73    .001|  2.63    .000|  3.53    .000|  4.43    .000
       .85    .000|  1.75    .001|  2.65    .000|  3.55    .000|  4.45    .000
       .87    .000|  1.77    .001|  2.67    .000|  3.57    .000|
       .88    .000|  1.78    .001|  2.68    .000|  3.58    .000|
-------------------------------------------------------------------------------
001:0033-----------------------------------------------------------------------
*
*
      FINISH
-------------------------------------------------------------------------------
*******************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0017 ROUTE RESERVOIR
      *** WARNING: Outflow volume is less than inflow volume.
 001:0026 CALIB STANDHYD
      *** NOTE: The pervious area has no runoff.
 001:0029 CALIB STANDHYD
      *** NOTE: The pervious area has no runoff.
   Simulation ended on 2011-05-11     at 17:16:24
===============================================================================
```

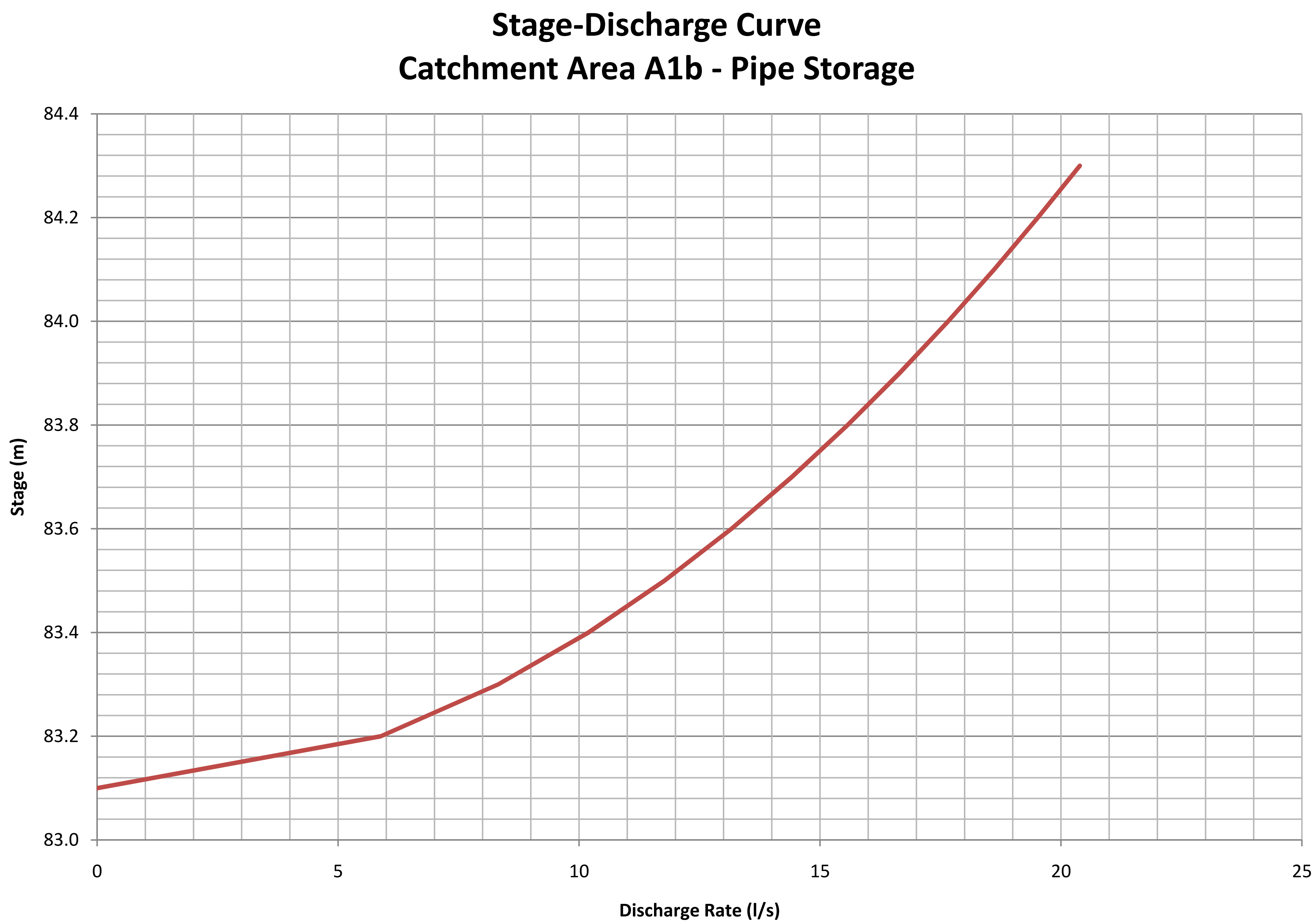
Appendix C

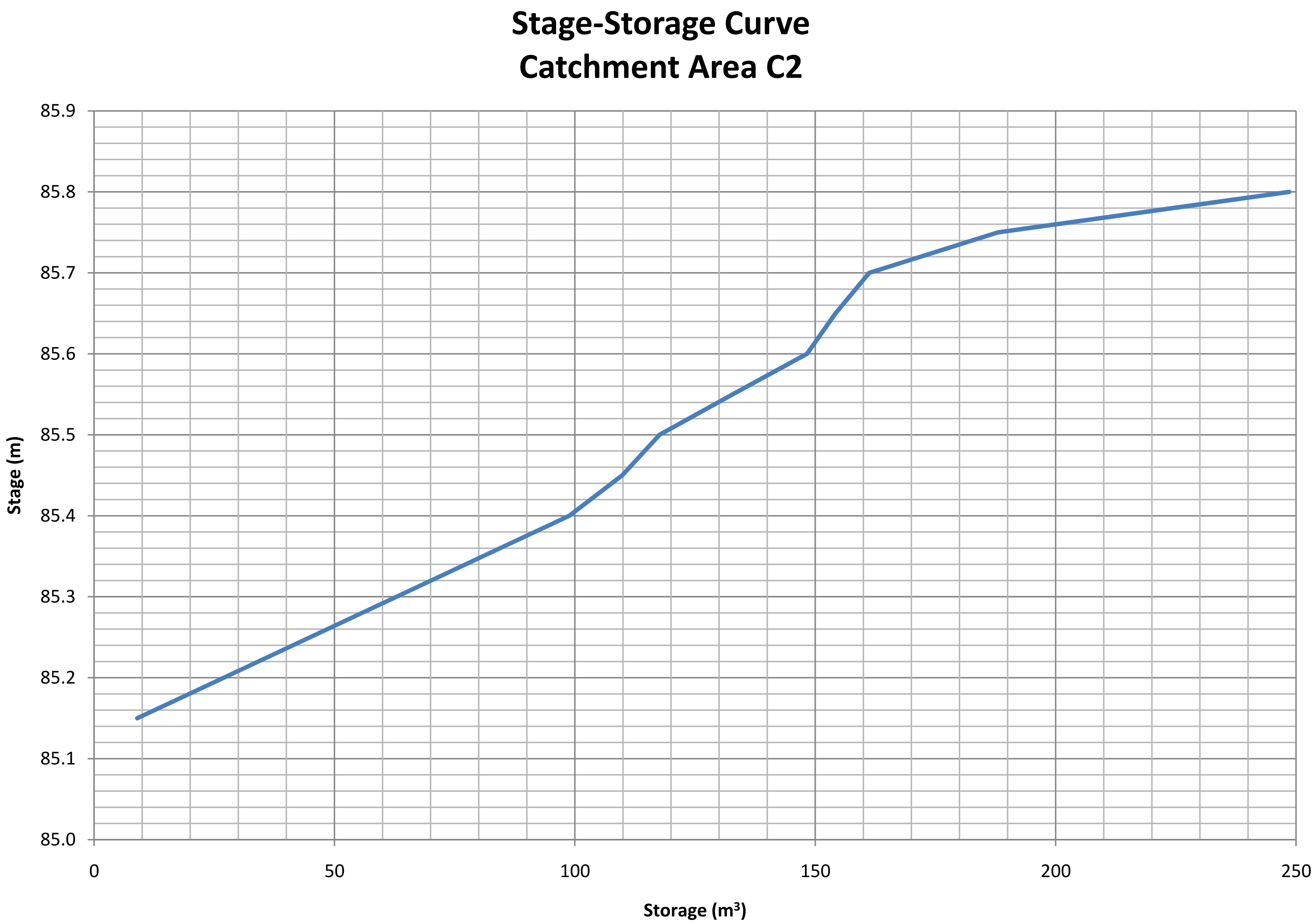
Orifice Calculations, Stage-Storage and Stage-Discharge Curves

Calculation of Orifice Dimensions

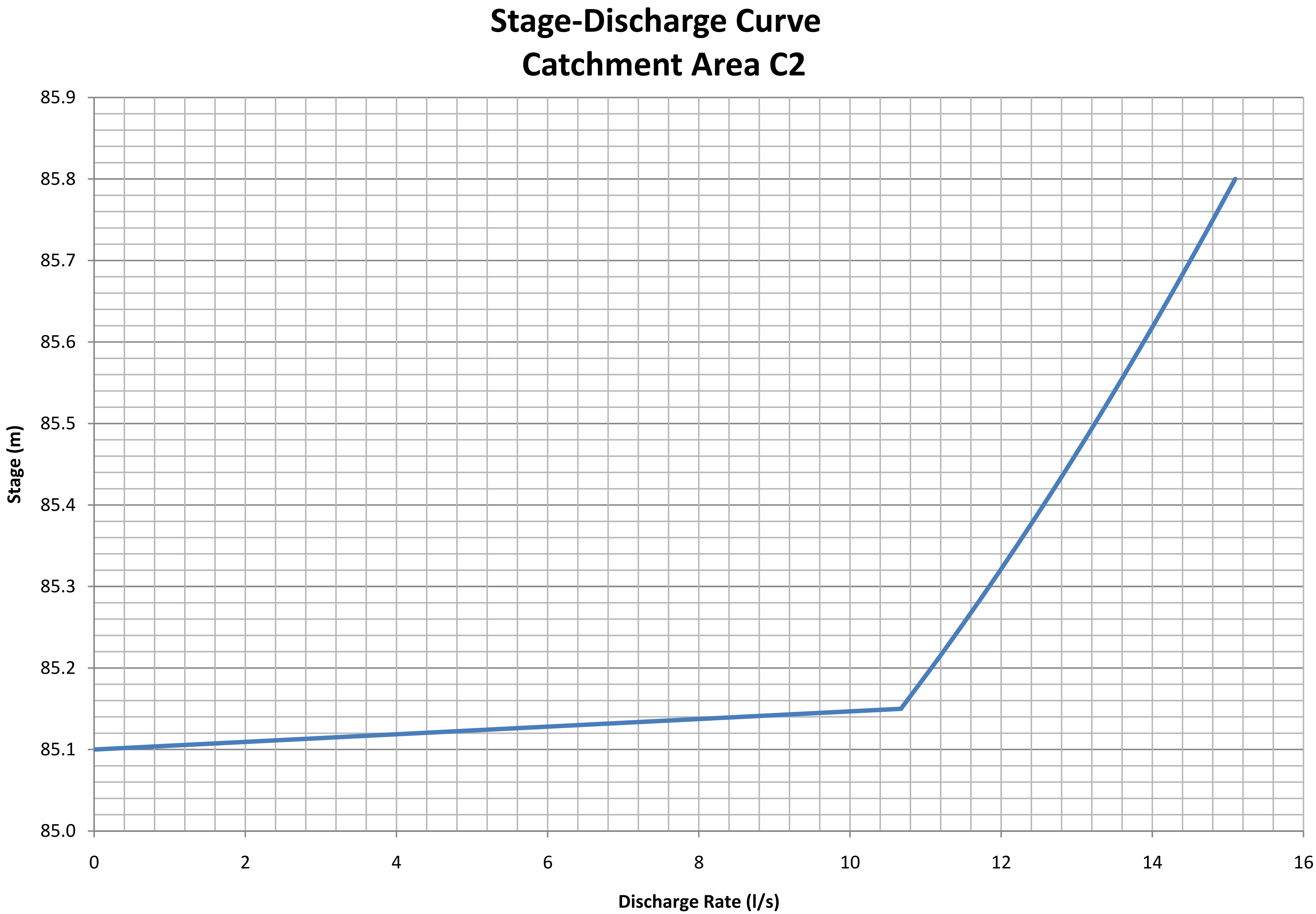
Orifice ICD	Location	Head (m)		Orifice axa (m)	Flow (l/s)
1	A1a	84.30-83.10 = 1.2	1.2	0.083	20.4
2	C2	85.80-84.5 = 1.3	1.3	0.07	15.1
	Cv	0.61			


Stage-Storage Curve
Catchment Area A1b - Pipe Storage
84.4
84.2
84.0
83.8
83.6
83.4
83.2
83.0
Stage (m)
0
1
2
3
4
5
6
7
8
Storage (m³)


Stage-Discharge Curve
Catchment Area A1b - Pipe Storage
84.4
84.2
84.0
83.8
83.6
83.4
83.2
83.0
Stage (m)
0
5
10
15
20
25
Discharge Rate (l/s)



Stage-Storage Curve
Catchment Area C2
Stage (m)
85.9
85.8
85.7
85.6
85.5
85.4
85.3
85.2
85.1
85.0
0
50
100
150
200
250
Storage (m³)



Stage-Discharge Curve
Catchment Area C2
85.9
85.8
85.7
85.6
85.5
85.4
85.3
85.2
85.1
85.0
Stage (m)
0
2
4
6
8
10
12
14
16
Discharge Rate (l/s)

Rikke Brown

From: Mike Petrescu [mpetrescu@aar.on.ca]
Sent: Tuesday, May 10, 2011 3:01 PM
To: Rikke Brown
Cc: Peter Spal; Donna Johnston
Subject: RE: ACSC - first 10 mm of rainfall stored on roof

Rikke,

This is to confirm that the roof framing design does provide the required strength to carry the 10mm (average) rainfall.

Regards,

Michael Petrescu-Comnene, P.Eng.
Partner

Adjeleian Allen Rubeli Limited
1005 - 75 Albert Street Ottawa, Ontario, K1P 5E7
phone:(613) 232-5786 Ext. 217 fax: (613) 230-8916
mpetrescu@aar.on.ca

From: Rikke Brown [mailto:Rikke.Brown@IBIGroup.com]
Sent: May 10, 2011 12:58 PM
To: Mike Petrescu
Cc: Peter Spal; Donna Johnston
Subject: ACSC - first 10 mm of rainfall stored on roof

Hi Mike,

As part of the City of Ottawa's review of the stormwater management report for the Algonquin Student Commons Site, which also discusses using storage on the roof, they asked whether the roof could withstand first 10 mm of rainfall as ice.

Could you please review and provide us with an email, which we would include in the appendix of our report, based on your review of the above?

If you need further information such as depth of ponding at each roof drain, etc, please let us know.

Thanks,
Rikke

Rikke Brown P.Eng., LEED® AP

IBI Group
400-333 Preston Street
Ottawa ON K1S 5N4 Canada

tel 613 225 1311 **ext** 501
fax 613 225 9868
email Rikke.Brown@IBIGroup.com

web www.ibigroup.com

Algonquin College Student Commons Building - Roof Ponding Plan and Roof Drain Release Rate

10 mm Storage

Required Storage (first 10 mm +1.2 mm): 62.23 m^3

		10 mm Volume Determination			
Roof ID	**Lowest Roof Elev. (m)**	**Measured Depth (m)**	**Measured Storage Area (m^2)**	**Calc Vol. Provided (m^3)**	**Storage Elev. (m)**
1	90.35	0.12	120	4.80	90.47
2	90.35	0.12	95	3.80	90.47
3	90.35	0.12	85	3.40	90.47
4	96.55	0.11	77	2.82	96.66
5	96.55	0.11	56	2.05	96.66
6	98.9	0.105	305	10.68	99.005
7	98.9				99.005
8	90.7	0.12	63	2.52	90.82
9	90.835	0.12	24	0.96	90.96
10	90.835	0.12	57	2.28	90.96
11	98.85	0.15	136	6.80	99.00
12	98.9	0.13	75	3.25	99.03
13	98.85	0.145	134	6.48	98.995
14	98.9	0.13	74	3.21	99.03
15	98.95	0.11	131	4.80	99.06
16	98.9	0.13	102	4.42	99.03
17	98.9	0.13	66	2.86	99.03
Total Volume Provided for First 10 mm on Roof (m^3)				**65.13**	

Algonquin College Student Commons Building - Roof Ponding Plan and Roof Drain Release Rate

Subsequent 15 mm Storage and Release

Roof Release
- based on Zurn Control-Flo Roof Drain (X4 opening -1.25 UK GPM / inch of head) - see attached details

		15 mm plus 10 mm		15 mm without 10 mm						
Roof ID	**Lowest Roof Elev. (m)**	**Measured Depth (m)***	**Calc Vol. Provided (m^3)***	**Calc Vol. Provided (m^3)**	**Storage Elev. (m)**	**Roof Drain Elev (m)**	**Head of Water at Roof Drain (m)**	**Head of Water at Roof Drain (inches)†**	**Roof Drain Outflow (UK GPM)¶**	**Roof Drain Outflow (l/s)£**
1	90.35	0.142	10.40	5.60	90.492	90.47	0.022	0.867	1.084	0.082
2	90.35	0.143	7.65	3.85	90.493	90.47	0.023	0.900	1.125	0.085
3	90.35	0.142	7.31	3.91	90.492	90.47	0.022	0.870	1.088	0.082
4	96.55	0.134	6.68	3.86	96.684	96.66	0.024	0.944	1.179	0.089
5	96.55	0.134	4.93	2.88	96.684	96.66	0.024	0.939	1.174	0.089
6	98.9	0.134	24.67	13.99	99.034	99.005	0.029	1.136	1.420	0.108
7	98.9				99.034	99.005	0.029	1.136	1.420	0.108
8	90.7	0.142	5.72	3.20	90.842	90.82	0.022	0.851	1.064	0.081
9	90.835	0.142	2.16	1.20	90.977	90.955	0.022	0.854	1.067	0.081
10	90.835	0.141	5.76	3.48	90.976	90.955	0.021	0.822	1.027	0.078
11	98.85	0.175	15.35	8.55	99.025	99	0.025	0.995	1.244	0.094
12	98.9	0.155	7.30	4.05	99.055	99.03	0.025	0.983	1.229	0.093
13	98.85	0.171	15.14	8.66	99.021	98.995	0.026	1.020	1.275	0.097
14	98.9	0.155	7.45	4.24	99.055	99.03	0.025	0.973	1.217	0.092
15	98.95	0.134	11.37	6.56	99.084	99.06	0.024	0.943	1.179	0.089
16	98.9	0.155	10.20	5.78	99.055	99.03	0.025	0.975	1.219	0.092
17	98.9	0.155	6.55	3.69	99.055	99.03	0.025	0.977	1.222	0.093
		Total Vol. (m^3)	**148.63**	**83.51**			**Total Outflow of Subsequent 15 mm rainfall (l/s)**			**1.53**

Notes: * Includes Depth and Volume from 10 mm
† 0.0254 m = 1 inch
¶ 1.25 UK GPM / inch of head (Zurn Drain - see attached details)
£ 0.0758 l/s = 1 UK GPM (gallons per minute)

Algonquin College Student Commons Building - Roof Ponding Plan and Roof Drain Release Rate

100 Year Storage and Release

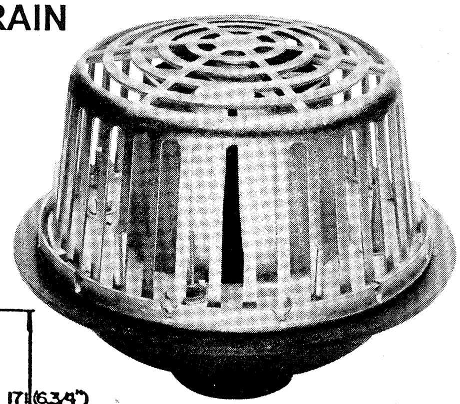
Roof Release
- based on Zurn Control-Flo Roof Drain (X4 opening -1.25 UK GPM / inch of head) - see attached details

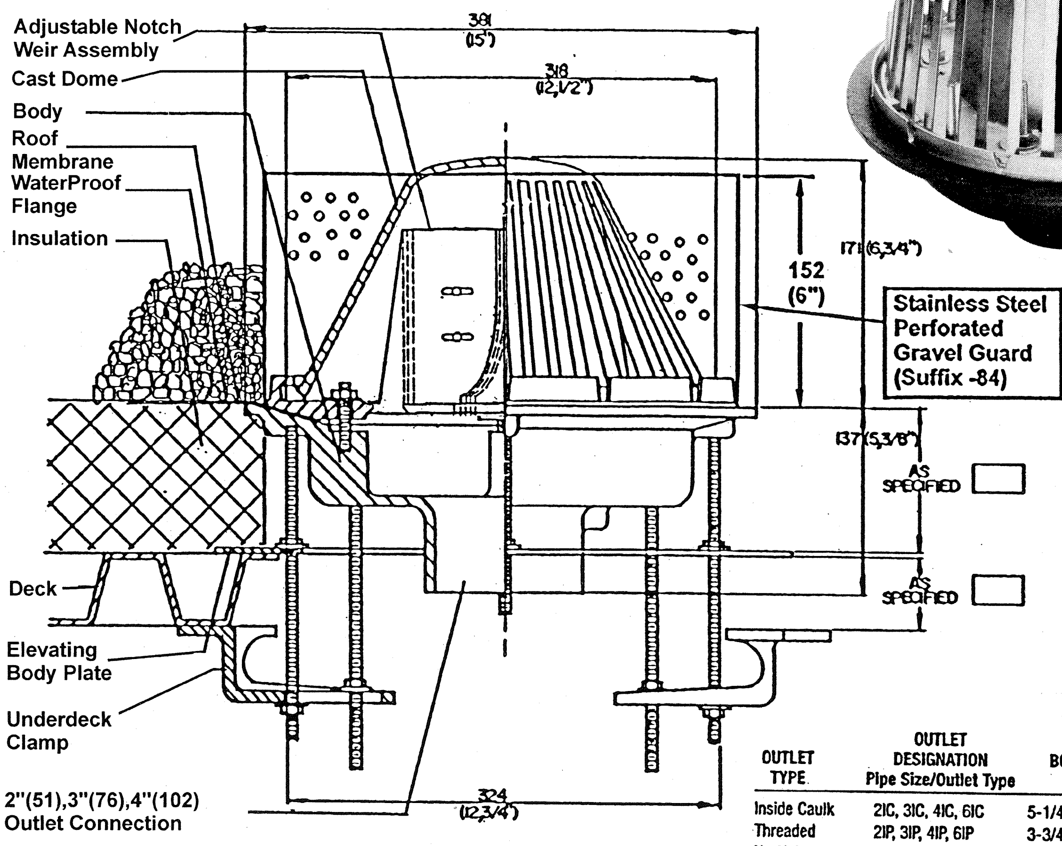
		100 yr plus 10 mm			**100 yr without 10 mm**						
Roof ID	**Lowest Roof Elev. (m)**	**Measured Depth (m)***	**Measured Storage Area (m^2)**	**Calc Vol. Provided (m^3)***	**Calc Vol. Provided (m^3)**	**Storage Elev. (m)**	**Roof Drain Elev (m)**	**Head of Water at Roof Drain (m)**	**Head of Water at Roof Drain (inches)†**	**Roof Drain Outflow (UK GPM)¶**	**Roof Drain Outflow (l/s)£**
1	90.35	0.2	375	25.00	20.20	90.55	90.47	0.08	3.15	3.94	0.298
2	90.35	0.2	257	17.13	13.33	90.55	90.47	0.08	3.15	3.94	0.298
3	90.35	0.2	260	17.33	13.93	90.55	90.47	0.08	3.15	3.94	0.298
4	96.55	0.17	184	10.54	7.72	96.72	96.66	0.06	2.44	3.05	0.231
5	96.55	0.16	120	6.25	4.19	96.71	96.66	0.05	1.82	2.27	0.172
6	98.9	0.25	895	74.58	63.91	99.15	99.005	0.14	5.71	7.14	0.541
7	98.9					99.15	99.005	0.14	5.71	7.14	0.541
8	90.7	0.2	210	14.00	11.48	90.90	90.82	0.08	3.15	3.94	0.298
9	90.835	0.14	33	1.53	0.57	90.97	90.955	0.02	0.76	0.95	0.072
10	90.835	0.2	225	15.00	12.72	91.04	90.955	0.08	3.15	3.94	0.298
11	98.85	0.3	570	57.00	50.20	99.15	99	0.15	5.91	7.38	0.560
12	98.9	0.19	158	10.27	7.02	99.09	99.03	0.06	2.56	3.20	0.242
13	98.85	0.28	544	51.51	45.03	99.13	98.995	0.14	5.48	6.84	0.519
14	98.9	0.20	175	11.56	8.35	99.10	99.03	0.07	2.68	3.35	0.254
15	98.95	0.2	440	29.33	24.53	99.15	99.06	0.09	3.54	4.43	0.336
16	98.9	0.22	303	22.50	18.08	99.12	99.03	0.09	3.65	4.57	0.346
17	98.9	0.19	139	8.76	5.90	99.09	99.03	0.06	2.33	2.91	0.221
			Total Vol. (m^3)	**372.3**	**307.2**					**Total Outflow of 100 Year Storm (l/s)**	**5.53**

Notes: * Includes Depth and Volume from 10 mm
† 0.0254 m = 1 inch
¶ 1.25 UK GPM / inch of head (Zurn Drain - see attached details)
£ 0.0758 l/s = 1 UK GPM (gallons per minute)

CONTROL-FLO ROOF DRAIN WITH ADJUSTABLE WEIR NOTCH 15" (381mm) DIAMETER ROOF DRAIN

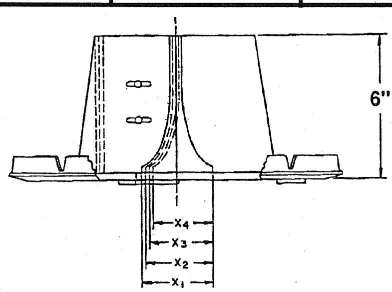
☒ ZA-105-10-77-EB-C-84





OUTLET TYPE	OUTLET DESIGNATION Pipe Size/Outlet Type	'E' BODY HT. DIM.
Inside Caulk	2IC, 3IC, 4IC, 6IC	5-1/4" [133mm]
Threaded	2IP, 3IP, 4IP, 6IP	3-3/4" [95mm]
No-Hub	2NH, 3NH, 4NH, 6NH	5-1/4" [133mm]
Neo-Loc	2NL, 3NL, 4NL	4-5/8" [117mm]

A Pipe Size Inches / [mm]	Approx. Wt. Lbs. / [kg]	Dome Open Area Sq.In. / [sq. cm]
2-3-4 [51-76-102]	34 [15]	148 [955]



Adjustable Notch Weir Assembly & Settings (Below)

OPENING	G.P.M. PER INCH OF HEAD	MAX. FLOW G.P.M.
X1	5	30
X2	3.75	22.5
X3	2.5	15
X4	1.25	7.5

PREFIXES

- ☐ Z- D.C.C.I. Body with Poly-Dome
- ☒ ZA- D.C.C.I. Body with Aluminum Dome

SUFFIXES

- ☐ -A Waterproof Flange
- ☐ -AR Acid-Resistant Epoxy Coated
- ☒ -C Underdeck Clamp
- ☐ -E Static Extension 1" (25mm) through 4"(102mm) (Specify Height) D.C. Galv.
  For Each Additional 1" (25mm) above 4" (102mm) D.C. Galv.
- ☒ -EB Elevating Body Plate
- ☐ -G Galvanized Cast Iron
- ☐ -R Roof Sump Receiver
- ☐ -SSM Stainless Mesh Screen over Dome
- ☐ -VP Vandal-Proof Secured Top
- ☒ -84 Stainless Steel Perforated Gravel Guard
- ☐ -85 Stainless Steel Perforated Extension For Each Additional 1" (25mm) above 6" (152mm) (Specify Height)(Formerly Z-121-8)
- ☐ -89 2"(51mm) High External Water Dam
- ☐ -90 90 Threaded Side Outlet Body 2" (51mm) through 4"(102mm)
- ☒ -10-77 Adjustable Weir Notch

Engineering Specification: Zurn #ZA-105-10-77-EB-C-84, 15" (381mm) diamter roof drain, dura-coated cast iron body with combination membrane flashing clamp/gravel guard with integral adjustable notch flow control assembly, cast aluminum dome, elevating body plate, underdeck clamp, 6" (152mm) high stainless steel perforated gravel guard.

Appendix D
Extended Detention Time,
Water Quality

APPENDIX D

Water Quality Control

Water quality control is required for the site to an Enhanced Level of Protection (80% total suspended solid removal).

The storage of the first 25 mm of precipitation is stored on-site and retained for 48 hours, predominately via infiltration. The 25 mm storm event is considered the water quality storm as per the MOE *Stormwater Management Planning and Design Manual* (March 2003). Removal efficiency is considered to be 100% for the following catchment areas:

There is a portion of the site which is not considered to be provided with water quality treatment (Drainage Areas A1a, A1b and A2) and is therefore calculated with a removal efficiency of 0%. The remainder of the site is considered treated with a removal efficiency of 100%. The following table summarizes the land use and justification for 100% removal efficiency.

Area ID	Land Use	Area (ha)	100% Removal Efficiency
B	Roof	0.5573	Evaporation of first 11 mm of rain and release of subsequent 15 mm via roof drains. The runoff from the roof is considered clean water.
C	Lawn and Pathways	0.2324 + 0.4343	Subsurface storage and released via percolation of first 25 mm of rainfall
D	Café Court	0.0689	Subsurface storage and released via percolation of first 25 mm of rainfall
E	Mamidosewin Grove	0.0777 + 0.0438	Subsurface storage and released via percolation of first 25 mm of rainfall
Total Area (ha)		**1.4144**	

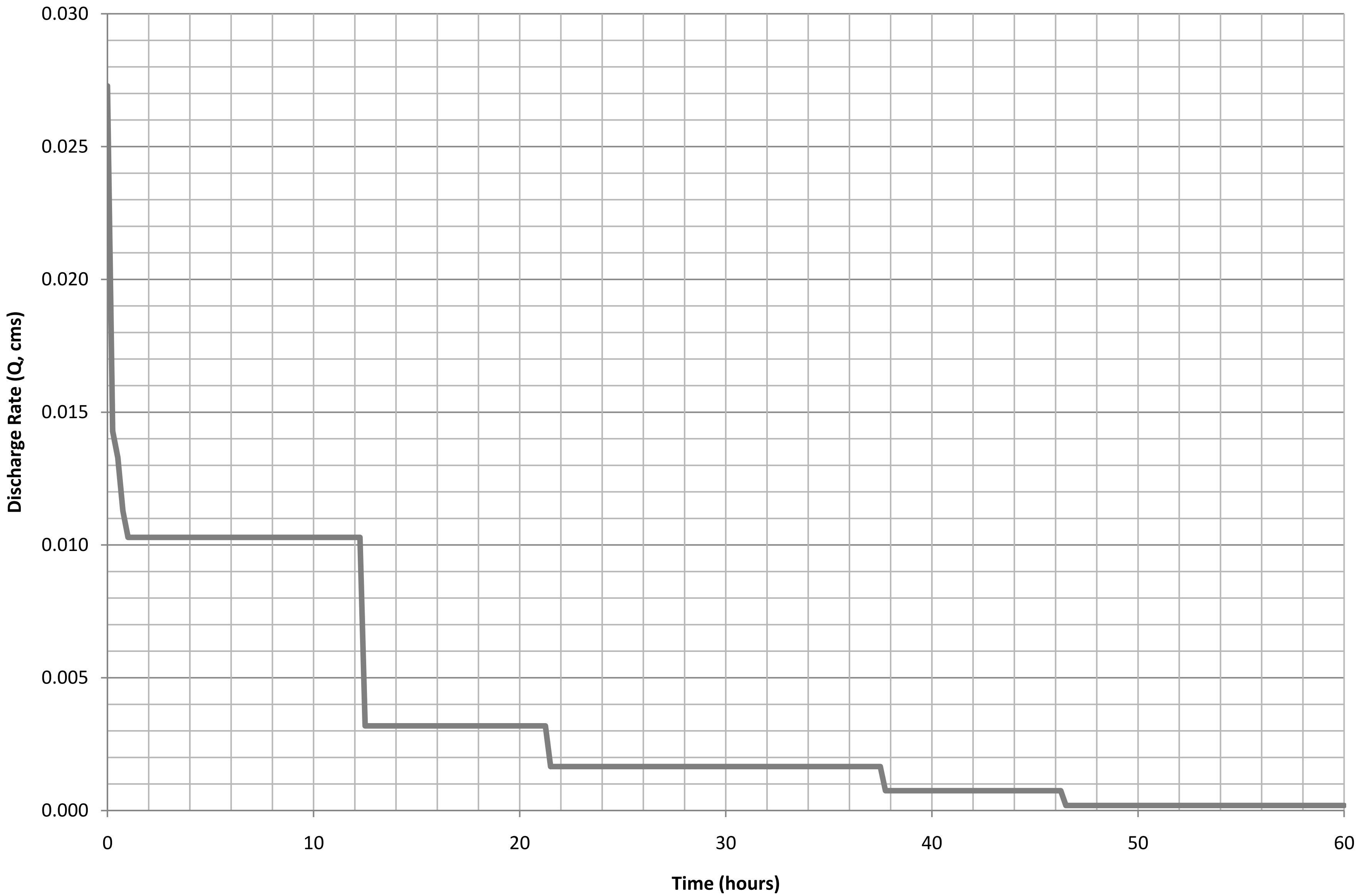
The percentage of total suspended solid removal was calculated based on a weighted average. The calculation is summarized below:

Total Area: 1.6686 ha

	Area (ha)	Percentage of Area Treated
Area treated:	1.4144 ha	100%
Area untreated:	0.2542 ha	0%
	Percentage of TSS removal	84.77%

The percentage of removal of total suspended solids (TSS) was determined to be 85.0%, which is greater than the required 80% TSS removal required.

Composite Extended Detention Time



Lawn
Drainage Area C

25 mm	**Drainage Area:**	6667	m^2
	Required Volume:	166.68	m^3

Surface Area m^2	**Percolation Rate mm/hr**	**Outflow, Q cms**	**Stage m**	**Depth of Storage m**	**Provided Storage Volume m^3**	**Time hours**	**Cummulative Time hours**
1198	21.3	0.0071	85.10	0.47	168.92	6.609375	0.00
1198	21.3	0.0071	85.00	0.37	132.98	5.203125	5.20
1198	21.3	0.0071	84.90	0.27	97.04	3.796875	9.00
1198	21.3	0.0071	84.80	0.17	61.10	2.390625	11.39
1198	21.3	0.0071	84.70	0.07	25.16	0.984375	12.38
1198	21.3	0.0071	84.63	0.00	0.00	0	12.38

Café Court
Drainage Area D

25 mm	**Drainage Area:**	689	m^2
	Required Volume:	17.23	m^3

Surface Area m^2	**Percolation Rate mm/hr**	**Outflow, Q cms**	**Stage m**	**Depth of Storage m**	**Storage Volume m^3**	**Time hours**	**Cummulative Time hours**
94.5	21.3	0.00056	85.71	0.61	17.23	8.54	0.00
94.5	21.3	0.00056	85.65	0.55	15.59	7.73	7.73
94.5	21.3	0.00056	85.60	0.50	14.17	7.03	14.77
94.5	21.3	0.00056	85.55	0.45	12.76	6.33	21.09
94.5	21.3	0.00056	85.50	0.40	11.34	5.62	26.72
94.5	21.3	0.00056	85.45	0.35	9.92	4.92	31.64
94.5	21.3	0.00056	85.40	0.30	8.50	4.22	35.86
94.5	21.3	0.00056	85.35	0.25	7.09	3.52	39.37
94.5	21.3	0.00056	85.30	0.20	5.67	2.81	42.19
94.5	21.3	0.00056	85.25	0.15	4.25	2.11	44.30
94.5	21.3	0.00056	85.20	0.10	2.83	1.41	45.70
94.5	21.3	0.00056	85.15	0.05	1.42	0.70	46.41
94.5	21.3	0.00056	85.10	0.00	0.00	0.00	46.41

Rain Gardens

Drainage Area E

25 mm	**Drainage Area:**	1215 m^2
	Required Volume:	30.38 m^3

Surface Area m^2	**Percolation Rate** mm/hr	**Outflow, Q** cms	**Depth of Storage** m	**Storage Volume** m^3	**Time** hours	**Cummulative Time** hours
204	16.0	0.00091	0.4	32.64	10.00	0.00
204	16.0	0.00091	0.35	28.56	8.75	8.75
204	16.0	0.00091	0.3	24.48	7.50	16.25
204	16.0	0.00091	0.25	20.40	6.25	22.50
204	16.0	0.00091	0.2	16.32	5.00	27.50
204	16.0	0.00091	0.15	12.24	3.75	31.25
204	16.0	0.00091	0.1	8.16	2.50	33.75
204	16.0	0.00091	0.05	4.08	1.25	35.00
204	16.0	0.00091	0	8.16	2.50	37.50

Roof

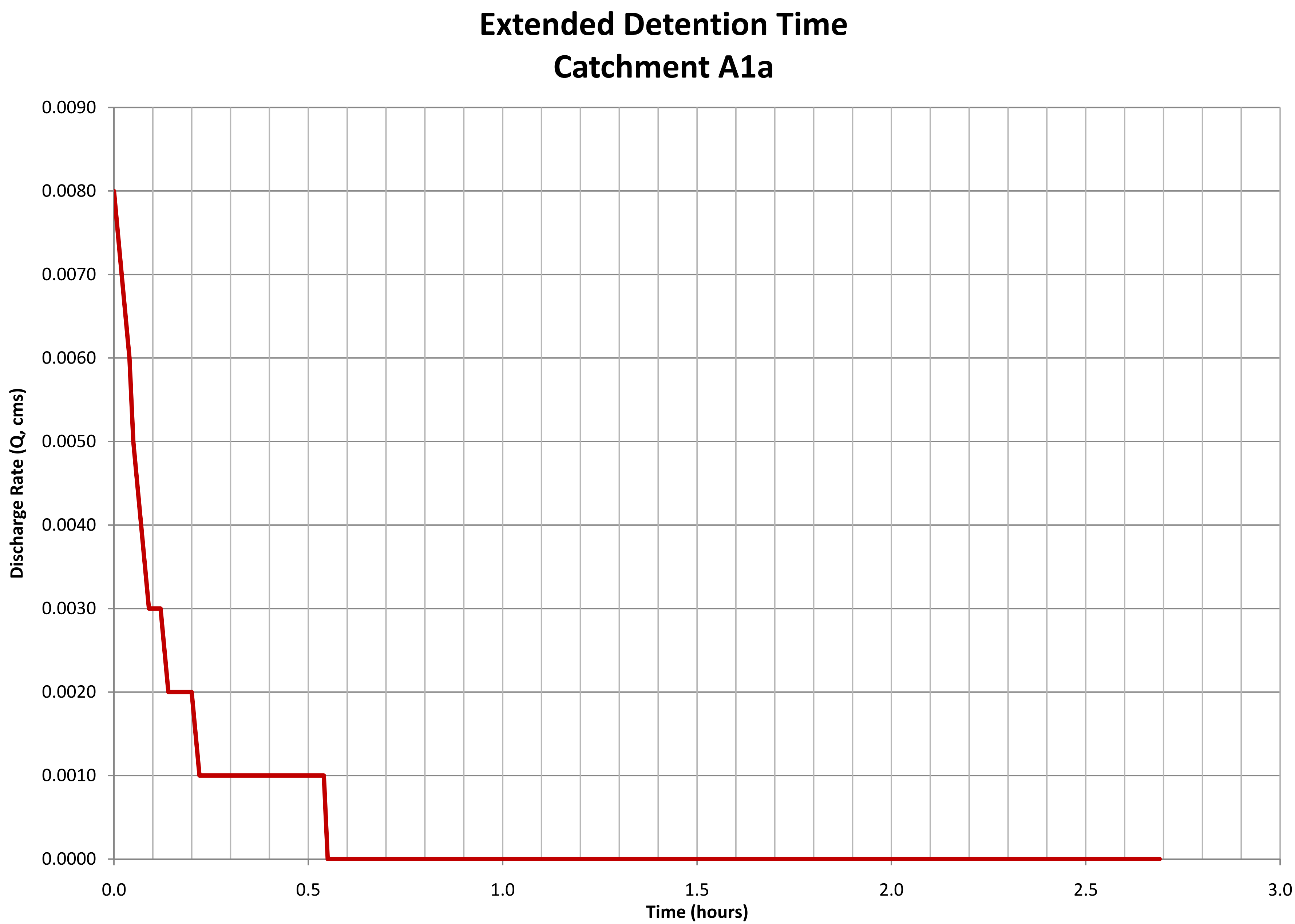
Drainage Area B

25 mm	**Drainage Area:**	5573 m^2
	Required Volume:	139.33 m^3

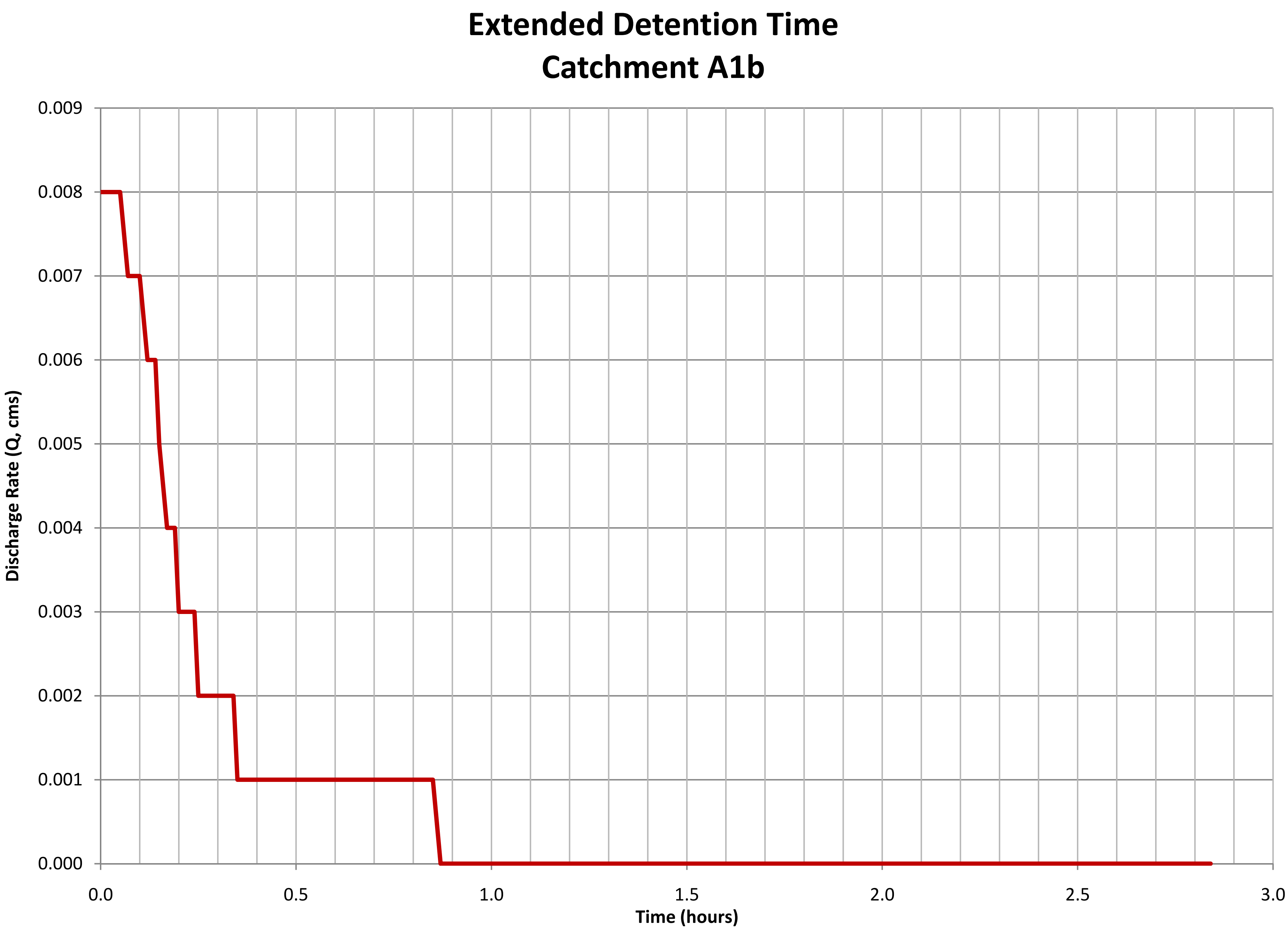
Note: An additional 6.57 m^3 of storage was added to the roof as compensation for the 10 mm released from Area A1a and A1b

Surface Area m^2	**Evapotranspiration Rate*** mm/hr	**Evapo. Outflow** cms	**Outflow - Roof Drains** cms	**Total Outflow, Q** cms	**Depth of Storage** mm	**Provided Storage Volume** m^3	**Time** hours	**Cummulative Time** hours
5567	0.123	0.00019	0.00153	0.00172	26.67	148.63	24.00	0.00
5567	0.123	0.00019	0.00153	0.00172	21.67	120.77	19.50	19.50
5567	0.123	0.00019	0.00153	0.00172	16.67	92.90	15.00	34.51
5567	0.123	0.00019	0	0.00019	11.67	65.04	95.04	129.55
5567	0.123	0.00019	0	0.00019	11	61.30	89.59	219.13
5567	0.123	0.00019	0	0.00019	10	55.73	81.44	300.58
5567	0.123	0.00019	0	0.00019	5	27.87	40.72	341.30
5567	0.123	0.00019	0	0.00019	0	0.00	0.00	341.30

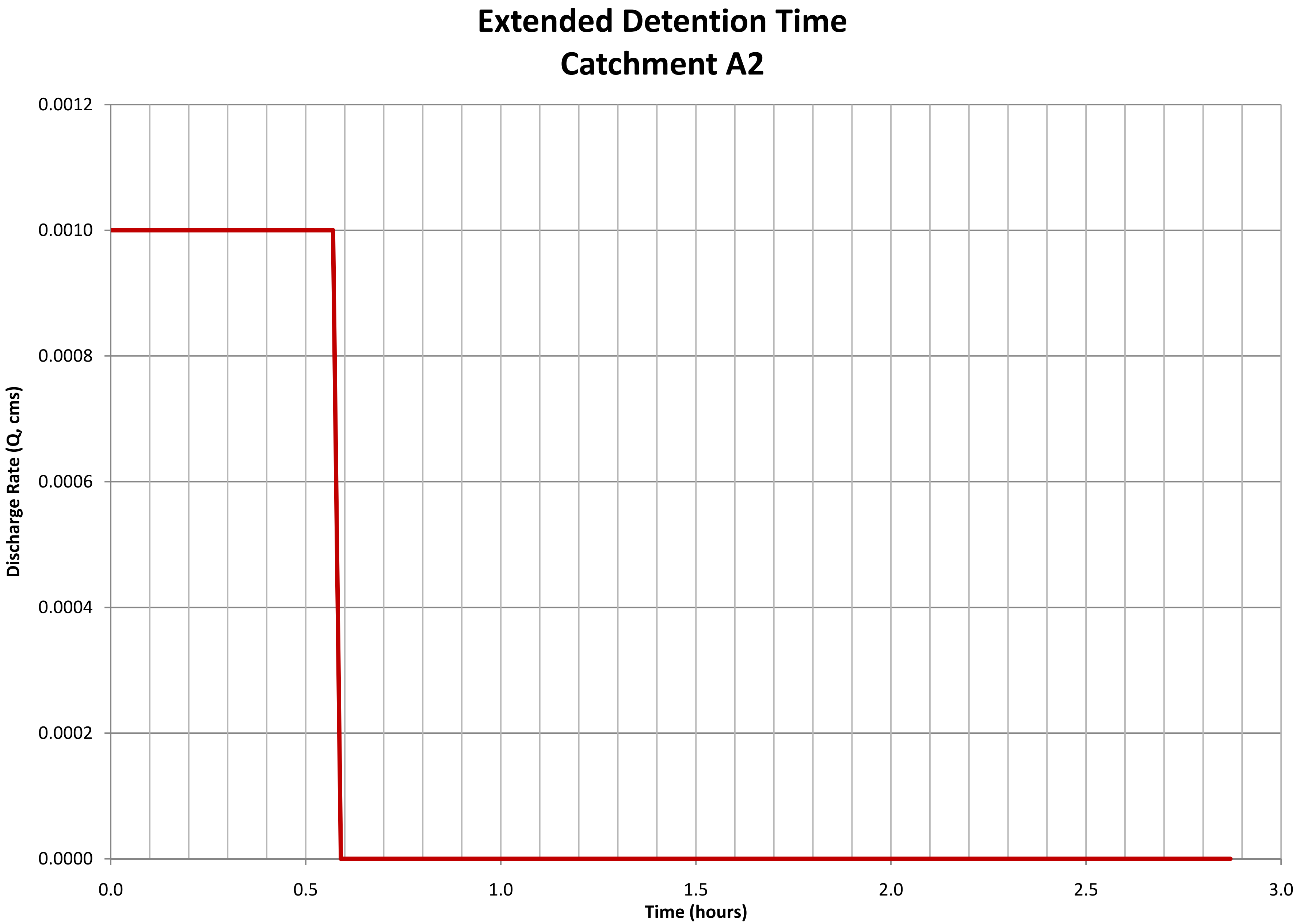
* Evapotranspiration Rate = 2.95 mm/day = 0.123 mm/hr (determined from Environment Canada data - see appendices)
† Roof drain release rate is 1.53 l/s (see **Appendix C**)



Extended Detention Time
Catchment A1a
0.0090
0.0080
0.0070
0.0060
0.0050
0.0040
0.0030
0.0020
0.0010
0.0000
Discharge Rate (Q, cms)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Time (hours)



Extended Detention Time
Catchment A1b
Discharge Rate (Q, cms)
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Time (hours)


Extended Detention Time
Catchment A2
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Discharge Rate (Q, cms)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Time (hours)

Appendix A-II

CONTENTS

Stormwater Management Report – Phase III Residence 32 pages

Algonquin College

POLICE/JUSTICE BUILDING
WOODROFFE CAMPUS

STORMWATER/DRAINAGE REPORT

February 1999

DOC03-257

TSH
engineers
architects
planners

Algonquin College

POLICE/JUSTICE BUILDING
WOODROFFE CAMPUS

STORMWATER/DRAINAGE REPORT

February 1999

totten sims hubicki associates
engineers architects planners

EXECUTIVE SUMMARY

The purpose of this report is to outline stormwater/drainage requirements in conjunction with a proposed Police/Justice Building at Algonquin College's Woodroofe Campus. The drainage issues and tentative solutions identified in this report are subject to detailed design and approval from the City of Nepean. Different pipe alignment options are possible which may satisfy site development drainage requirements identified in this report. As such the recommendations and findings presented herein should be considered as a starting point in the stormwater/drainage planning process.

FINDINGS

The findings of a previous stormwater management study and this drainage report are summarized as follows:

- An increase in the stormwater peak runoff rate, resulting from the proposed Police/Justice Building development, represents approximately 1% when compared to existing pre-development conditions. This change in runoff peak is considered to be small. It is felt this impact is insignificant and does not warrant implementation of stormwater management quantity controls at this time;

- Future development of vacant land at Algonquin College's Woodroffe campus, including additional paved parking area(s), should involve consideration of stormwater best management practices; and

- The proposed Police/Justice Building footprint overlaps:

    - an existing 525 mm diameter storm sewer which drains a large block of land to the east;
    - a local parking lot storm sewer (300 mm diameter and 450 mm diameter pipe) and catchbaisns; and
    - may potentially overlap a 2100 mm diameter trunk storm and a 525 mm diameter sanitary sewers.

  Impacts to local sewers and areas of conflict will have to be looked at and resolved as part of a design build submission.

RECOMMENDATIONS

Based on the findings, the following stormwater/drainage requirements and recommendations are provided in conjunction with the proposed Police/Justice Building:

1. In the absence on an approved stormwater management plan, it is recommended that a 1050 mm diameter storm sewer be constructed adjacent to the north limit of the proposed new building. This storm sewer represents the future storm sewer service corridor for development to the east. This sewer will replace the existing 525 mm diameter sewer displaced by the proposed building footprint.

The new sewer will require a connection into the 2100 mm diameter trunk storm sewer (manhole connection) and should be fitted, as an interim measure, with hydraulic control devices at all inlet locations. A ditch inlet manhole/catchbasin will be required at the upper end of the pipe for the purpose of a surface drainage swale connection. Catchbasin connections into the 1050 mm diameter pipe will be required where necessary to provide and maintain parking lot and building site drainage.

A 1050 mm diameter pipe is being recommended in this storm sewer service corridor location at this time in order to provide decision making flexibility for future development options. Such flexibility is judged to be desirable until stormwater management decisions and planning initiatives are approved.

Sewer sizing should be based on a 5 year design return period considering a future institutional land use in the current undeveloped portion of the Campus ($Q=2.08$ m^3/s, $n=0.013$, $S=0.7$ %). Please refer to the stormwater management study for further details.

2. A manhole connection (manhole or tee with drop pipe connection) is required for all storm sewer connections into the 2100 mm diameter trunk storm sewer. All connections, specifications and drop pipe details are subject to approval from the City of Nepean.

3. The section of the existing 525 mm storm sewer impacted by the proposed building will have to be disconnected and abandoned.

4. A drainage swale will be required to collect and drain runoff from the existing vacant field located south and east of the proposed building footprint. This swale will direct runoff to the ditch inlet on the 1050 mm diameter storm sewer.

5. Extension of an existing landscaping berm near the south limit of the College property (south of the proposed building) is required to direct runoff away from a local residential rear-yard catchbasin. This will prevent hydraulic surcharging of the service pipe lateral.

6. New catchbasins and storm pipe will be required for Parking Cells "C" and "B". A manhole drop-tee connection to the 2100 mm storm sewer will be required.

7. Two new catch basins will be required to provide drainage at a low depression area adjacent to the landscaping berm and to direct it away from the south side of proposed building. A storm sewer service pipe will be required to connect these catchbasins into the trunk storm sewer.

ALGONQUIN COLLEGE
POLICE/JUSTICE BUILDING
Stormwater/Drainage Report

TABLE OF CONTENTS

1.0 INTRODUCTION 1
- 1.1 General 1
- 1.2 Objective 1

2.0 BACKGROUND 1
- 2.1 Previous Studies 1
- 2.2 Site Description 1
- 2.3 Hydrological Modelling 3

3.0 POLICE/JUSTICE BUILDING LOCAL NEEDS 4
- 3.1 Existing Drainage Patterns 4
- 3.2 Existing Storm Drainage Infrastructure 4
- 3.3 Stormwater Management Requirements 4
- 3.4 Proposed Building Drainage Impacts 5
- 3.5 Building Stormwater/Drainage Requirements 5

Figure 1 Location Plan

Figure 2 Overall Site Plan

Figure 3 Existing Drainage Patterns

Figure 4 Stormwater/Drainage Requirements

99069ot
d94

1.0 INTRODUCTION

1.1 General

Algonquin College is currently proposing development of a Police/Justice Centre at its Woodroffe Campus. The City of Nepean has indicated to Algonquin College that there are some local drainage concerns associated with the proposed building development and has asked the College to identify stormwater management issues and develop a stormwater management plan. Totten Sims Hubicki Associates (TSH) was retained by Algonquin College to prepare a stormwater/drainage report for the proposed Police/Justice Building development.

1.2 Objective

The purpose of this report is to examine stormwater drainage requirements associated with the proposed Police/Justice Facility Building at the Woodroffe Campus. Stormwater management objectives of this report and a previous stormwater management study are as follows:

1. To satisfy the City of Nepean's Stormwater Management requirements and drainage concerns;

2. To identify stormwater management needs at the Algonquin College site; and

3. To identify stormwater/drainage requirements which must be met by prospective Design/Build teams preparing tender proposals for the proposed Police/Justice Building.

2.0 BACKGROUND

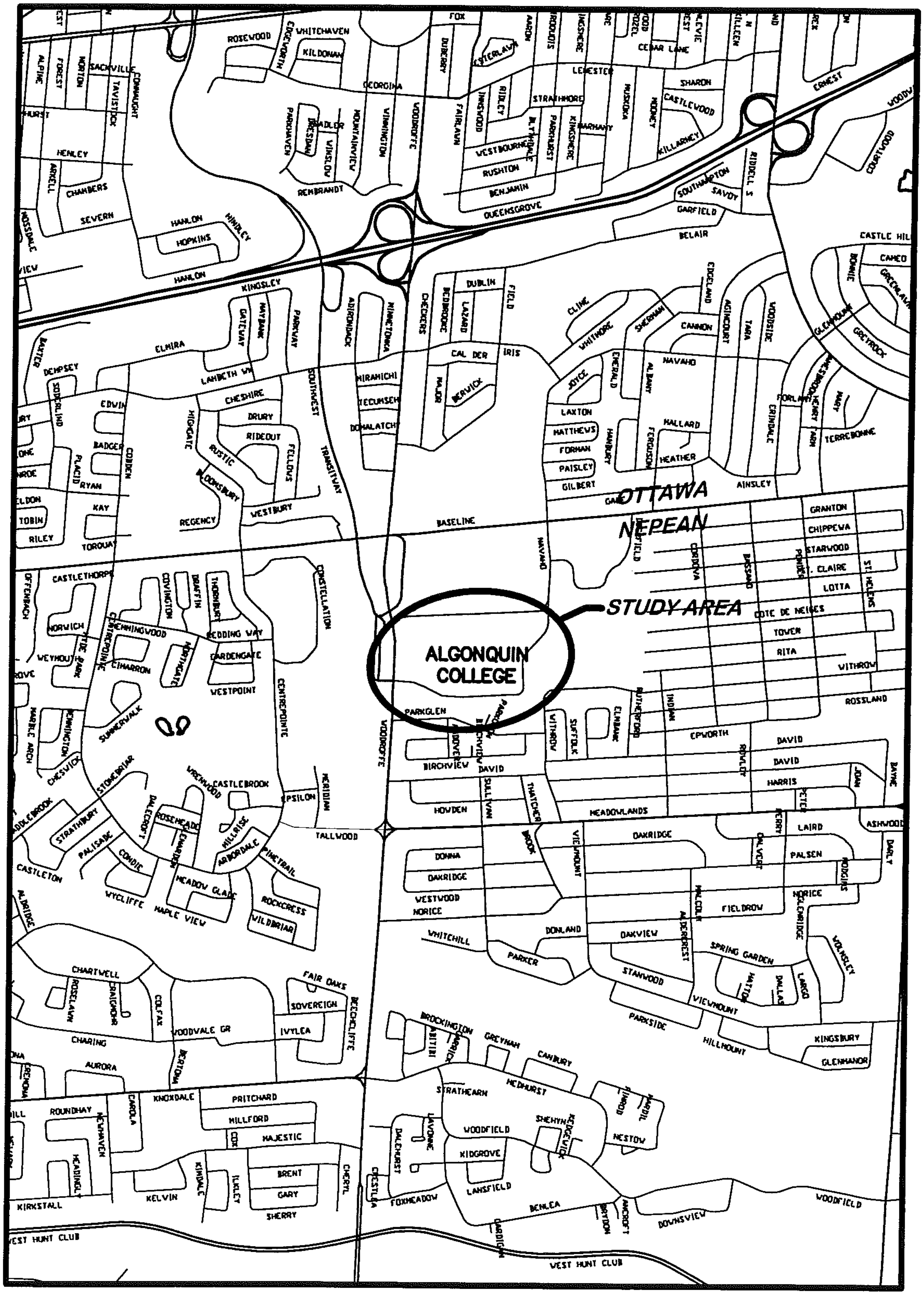
2.1 Previous Studies

In December 1998, TSH prepared a Stormwater Management (SWM) Study for the Woodroffe Campus. The scope of the SWM study was limited to examining stormwater management issues at a conceptual level and identifying some of the constraints and solutions related to objectives 1 and 2 as discussed in Section 1.2.

2.2 Site Description

Algonquin's Woodroffe Campus is located in the City of Nepean near the southeast corner of Woodroffe Avenue and Baseline Road. The campus site is located as illustrated in **Figure 1**. The Campus is within the Pinecrest Creek drainage area. Runoff from the Woodroffe Campus drains into a 2100 mm diameter trunk storm sewer running northerly through Algonquin College's property. The 2100 mm diameter trunk storm sewer outlets to Pinecrest Creek on the north side of Baseline Road. The Pinecrest Creek tributary area upstream of Baseline Road represents

FIGURE 1
LOCATION PLAN



approximately 300 hectares, based on the City of Nepean's sewershed base mapping.

The sub-watershed area examined in the SWM study encompasses the Woodroffe Campus which comprises approximately 42 hectares (ha) of land. The Woodroffe Campus sub-watershed area is illustrated in **Figure 2**. Algonquin College's property directly accounts for approximately 34.8 hectares (ha) of this catchment area with some 26.3 ha of land currently in institutional land use. The remaining 8.5 hectares of Algonquin's Woodroffe Campus site, comprising the eastern section of the Campus, is currently undeveloped.

In addition to Algonquin College's property, the 42 hectare area of land also includes approximately 5.9 ha of the residential land bordering the Campus to the east and south-east. The bordering residential areas drain onto Algonquin College's property through the undeveloped vacant land. This runoff in turn, drains into the existing 525 mm diameter storm sewer and a residential rear yard catchbasin.

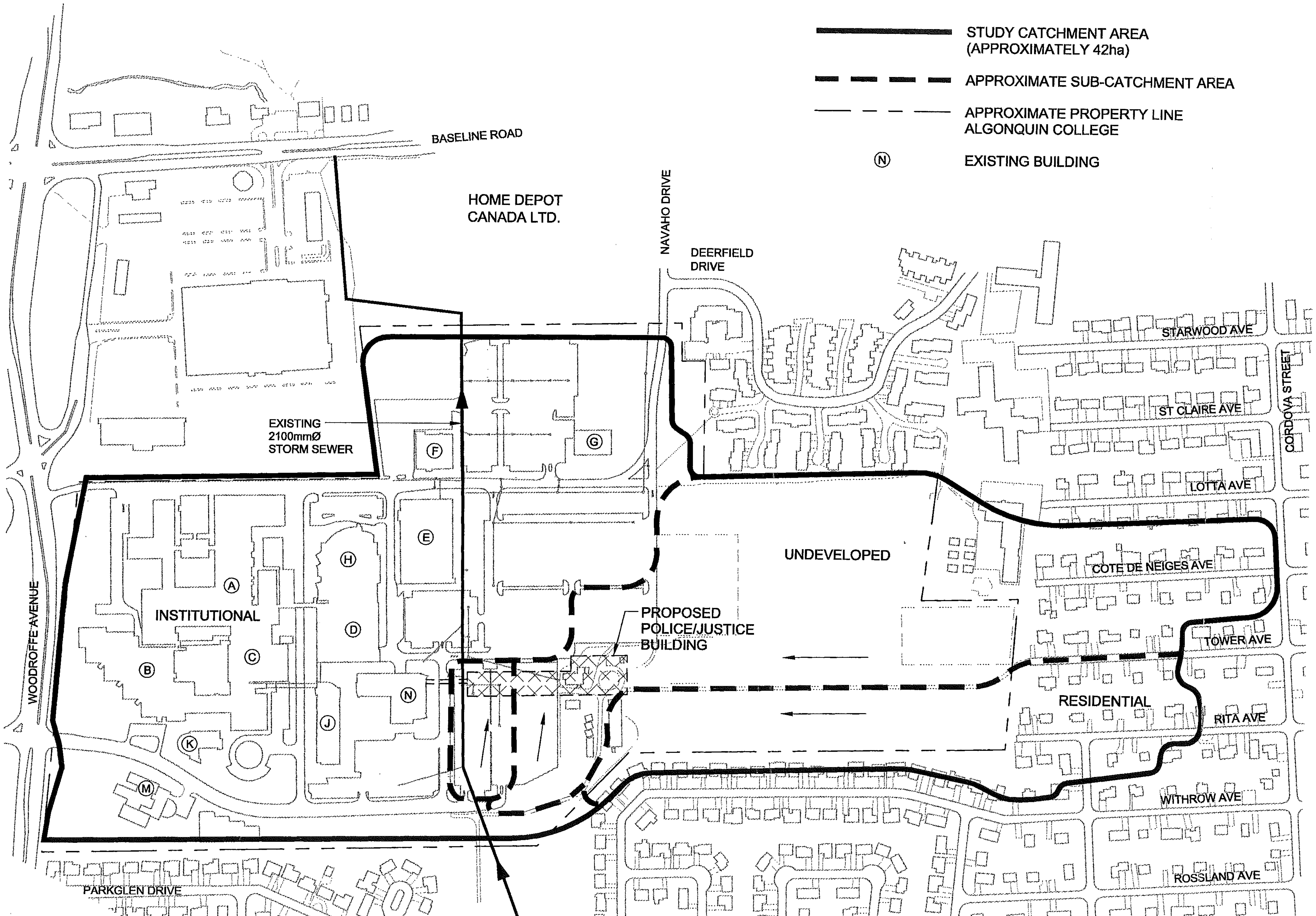
Land use and hydrological conditions in the 42 hectare sub-watershed area are summarized in **Table 1**.

Table 1
Sub-watershed Area Description

Land Use	Area (ha)	% Imperviousness
Woodroffe Campus Developed Land	26.3	60 %
Woodroffe Campus Undeveloped land (8.5 ha) Residential rear lots - Withrow Avenue (0.6 ha) High School property (1.3 ha)	10.4	10 %
Residential Land Use (Cote des Neiges Road, Tower Road and Rita Avenue)	5.3	35 %
Total Sub-Watershed Area / % Imp	**42**	**44 %**

Development of the proposed Police/Justice Building (exclusive of any additional on-site parking space) will result in approximately a 1% increase in the overall sub-watershed imperviousness.

The approximate footprint location of the proposed Police/Justice Building is shown in **Figure 2.** The proposed Police/Justice Building will be located approximately 150 metres east of Building 'N' and south of the Cell 'D' outdoor parking lot.



Note:

Proposed Police/Justice Building footprint as illustrated on this plan is approximate only.

totten sims hubicki associates
ENGINEERS ARCHITECTS AND PLANNERS

Orientation

Revisions

ALGONQUIN

PHYSICAL RESOURCES DEPARTMENT

1385 WOODROFFE AVENUE
NEPEAN, ONTARIO
K2G 1V8
TEL. (613) 727-7710
FAX. (613) 727-7601

Project

POLICE / JUSTICE BUILDING

Campus

WOODROFFE CAMPUS

Subject

STUDY CATCHMENT AREA

Scale 1:4000	Date FEB. 1999
Design J.S.	Drawing No Figure 2
Drawn R.V.D.	
Checked J.D.S.	CAD File No 12638-05

2.3 Hydrological Modelling

Hydrological modelling was conducted for the 42 hectare sub-watershed in the Woodroofe Campus Stormwater Management Study. A number of design storms were modelled under a variety of site development scenarios. A summary of modelled results for peak flow is presented in **Table 2.**

Table 2: Summary of Results - Peak Flow (m^3/s)

Return Period	Existing Conditions Scenario 1 Peak Flow (m^3/s)	Police/Justice Building Scenario 2		Ultimate Site Development			
				3A Residential		3B Institutional	
		Peak Flow (m^3/s)	*% Increase from Existing*	Peak Flow (m^3/s)	*% Increase from Existing*	Peak Flow (m^3/s)	*% Increase from Existing*
1:5 year	3.91	3.97	*1.5 %*	4.25	*8 %*	4.65	*16 %*
1:100 year	8.21	8.32	*1.3 %*	8.84	*7 %*	9.32	*12 %*

The three sub-watershed development conditions summarized in **Table 2** are described as follows:

- *Scenario 1*, Existing conditions with sub-watershed % impervious as per Table 1;
- *Scenario 2*, Police/Justice Building development resulting in an increase in overall sub-watershed imperviousness to 45 %;
- *Scenario 3A*, Ultimate residential development of Algonquin College vacant lands (50 % overall sub-watershed imperviousness; and
- *Scenario 3B*, Ultimate institutional development of Algonquin College vacant lands (57 % overall sub-watershed imperviousness.

As a result of the Police/Justice Building development (Scenario 2), peak flow rates for the 5 and 100 year return periods are anticipated to represent an increase of approximately 1.3 % to 1.5 % from peak flow rates generated under existing site conditions.

The hydrological model results indicate that stormwater best management practices (BMP's) are required for future ultimate development of Algonquin College's vacant land in order to maintain peak flow rates at pre-development levels. Selection of BMP's for the site will be required for future site development. BMP options are not required for the development of the proposed Police/Justice Building based solely on the objective of maintaining post development peak runoff rates at pre-development levels.

3.0 POLICE/JUSTICE BUILDING LOCAL NEEDS

3.1 Existing Drainage Patterns

Drainage patterns in the 42 hectare sub-watershed area are in a general westerly direction. Internal sub-catchments and drainage patterns are illustrated in **Figures 2 and 3**.

3.2 Existing Storm Drainage Infrastructure

Figure 3 shows the location of existing storm drainage infrastructure which will be impacted by construction of the proposed Police/Justice Building. The impacted storm drainage infrastructure includes:

- A 525 mm diameter storm sewer in parking lot "C";
- Drainage ditch No. 1 (refer to Figure 3), which conveys surface runnoff from a large proportion of the vacant land to the east of the proposed building location and a portion of parking lot "D";
- Drainage ditch No. 2, which collects runoff from the east half of parking lot "C" and low lying areas to the south;
- Three catchbasins and storm sewer service pipes connected into the 2100 mm diameter storm sewer. This local storm sewer drains parking lot "C" and a portion of parking lot "B".
- A residential rear yard catchbasin adjacent to the College property (corner of residential lots 31 and 32, fronting on Withrow Avenue).

3.3 Stormwater Management Requirements

The governing objective for this drainage report is considered to represent the City of Nepean's requirement that there be no significant increase in peak runoff for post development conditions when compared to the pre-development hydrological regime.

Increases in the peak runoff rate from existing conditions, resulting from the Police/Justice Building development, are considered to be insignificant and as such are not felt to warrant any special stormwater management controls at this time. The proposed building will not by itself result in any significant site change in percent imperviousness or peak flow rate. Additional development on existing vacant lands to the east involving a new building addition, a change in land use or construction of a new paved parking lot(s) in the future, will likely require the initiation of stormwater management controls.

For additional details on future SWM scenarios and BMP requirements, please refer to the Woodroofe Campus Stormwater Management Report, December 1998.

3.4 Proposed Building Drainage Impacts

For the purpose of this report, the Police/Justice Building footprint is assumed to be located on the north portion of parking lots "B" and "C", east of Building "N" and south of parking lot "D". Refer to **Figure 3** for location of the proposed building and existing storm drainage infrastructure.

The proposed building location will have the following stormwater/drainage impacts:

1. The proposed building footprint overlaps the 525 mm diameter storm sewer under parking lot "C". Relocation of this storm sewer will be required.

2. The proposed building location will block runoff in drainage ditch No. 2. Construction of new catchbasins and storm pipe to collect runoff adjacent to the building, and the low lying area are required.

3. The proposed building footprint overlaps existing parking lot catchbasins and storm pipes draining parking lots "B" and "C". Re-establishment of these catchbasins and pipe will be required.

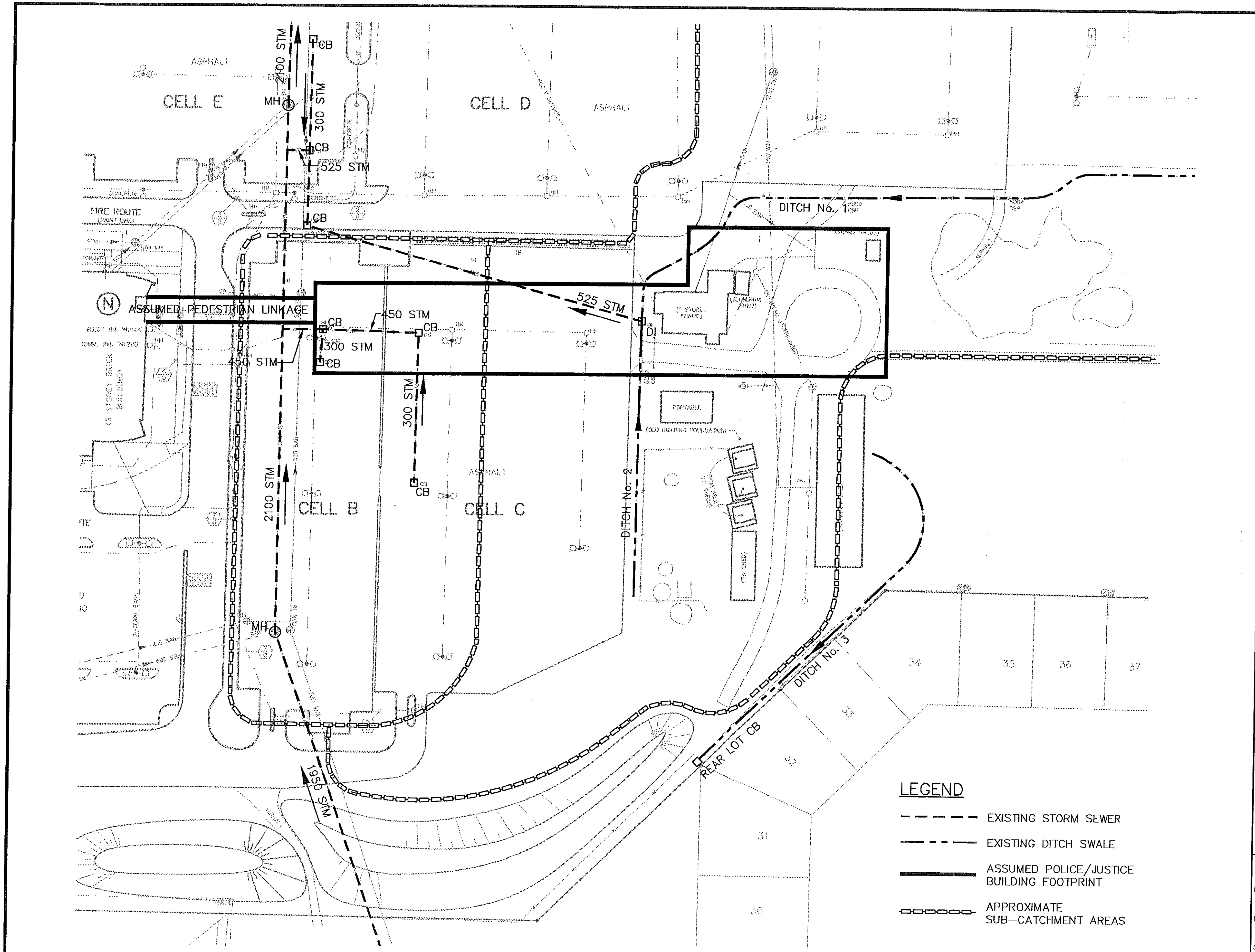
4. The City of Nepean has expressed concern with drainage problems associated with a residential rear yard catchbasin near the Algonquin College property line (Lots 31 and 32, fronting on Withrow Avenue). The City has asked that runoff from Algonquin College property be directed away from this location as part of the requirement for the proposed Police/Justice Building.

5. The proposed building footprint may potentially overlap a 2100 mm diameter trunk storm sewer and a 525 mm diameter sanitary sewer. Sufficient separation between the building footing and sewers is required.

3.5 Building Stormwater/Drainage Requirements

The proposed building footprint overlays existing storm sewer pipes and will block local runoff drainage. To minimize the impacts the following requirements are described below. Reference locations in the following descriptions are presented in **Figure 4**.

1. A sewer corridor and storm pipe will be required for connection to the 2100 mm diameter trunk sewer to provide drainage for the area east of the Police/Justice building location (refer to Figure 4). In the absence of an approved Stormwater Management Plan, a pipe diameter size of 1050 mm is recommended at this time.



Note:

Proposed Police/Justice Building footprint as illustrated on this plan is approximate only.

totten sims hubicki associates
ENGINEERS ARCHITECTS AND PLANNERS

Orientation	Revisions

ALGONQUIN

PHYSICAL RESOURCES DEPARTMENT
1385 WOODROFFE AVENUE
NEPEAN, ONTARIO
K2G 1V8
TEL. (613) 727-7710
FAX. (613) 727-7601

Project
POLICE / JUSTICE BUILDING

Campus
WOODROFFE CAMPUS

Subject
EXISTING DRAINAGE PATTERNS

Scale	Date
1:1000	FEB. 1999
Design: J.S.	Drawing No: Figure 3
Drawn: R.V.D.	
Checked: J.D.S.	CAD File No: 12638-03

This pipe diameter selection is based on the following assumptions: $Q_{5year}=2.08$ m^3/s; Manning's "n" for concrete=0.013; pipe placed at a slope of 0.7 %. The 1050 mm diameter pipe size is preliminary only and is subject to design and final pipe sizing confirmation.

2. A manhole connection (manhole or tee with drop pipe connection) is required for all storm sewer connections into the 2100 mm diameter trunk storm sewer. All connections, specifications and drop pipe details are subject to approval from the City of Nepean.

3. The section of the existing 525 mm diameter storm sewer, impacted by the proposed building footprint, will have to be disconnected and abandoned.

4. A new drainage swale is required from reference location 3 to the proposed ditch inlet/catch basin at location 2 (see Figure 4). This swale will intercept drainage from the remaining undeveloped portion of the Campus.

5. Extension of the existing landscaping berm is required to prevent hydraulic overloading of the rear yard catchbasin at reference location 4 (see Figure 4). For additional berm details and specifications refer to the following engineering drawing (submitted separately): Berm Layout, Woodroffe Campus Site Development Study, Algonquin College, February 1999, prepared by Totten Sims Hubicki Associates

6. New catchbasins and storm pipe will be required for parking lot drainage at reference location 5. A manhole or drop-tee connection to the 2100 mm storm sewer will be required.

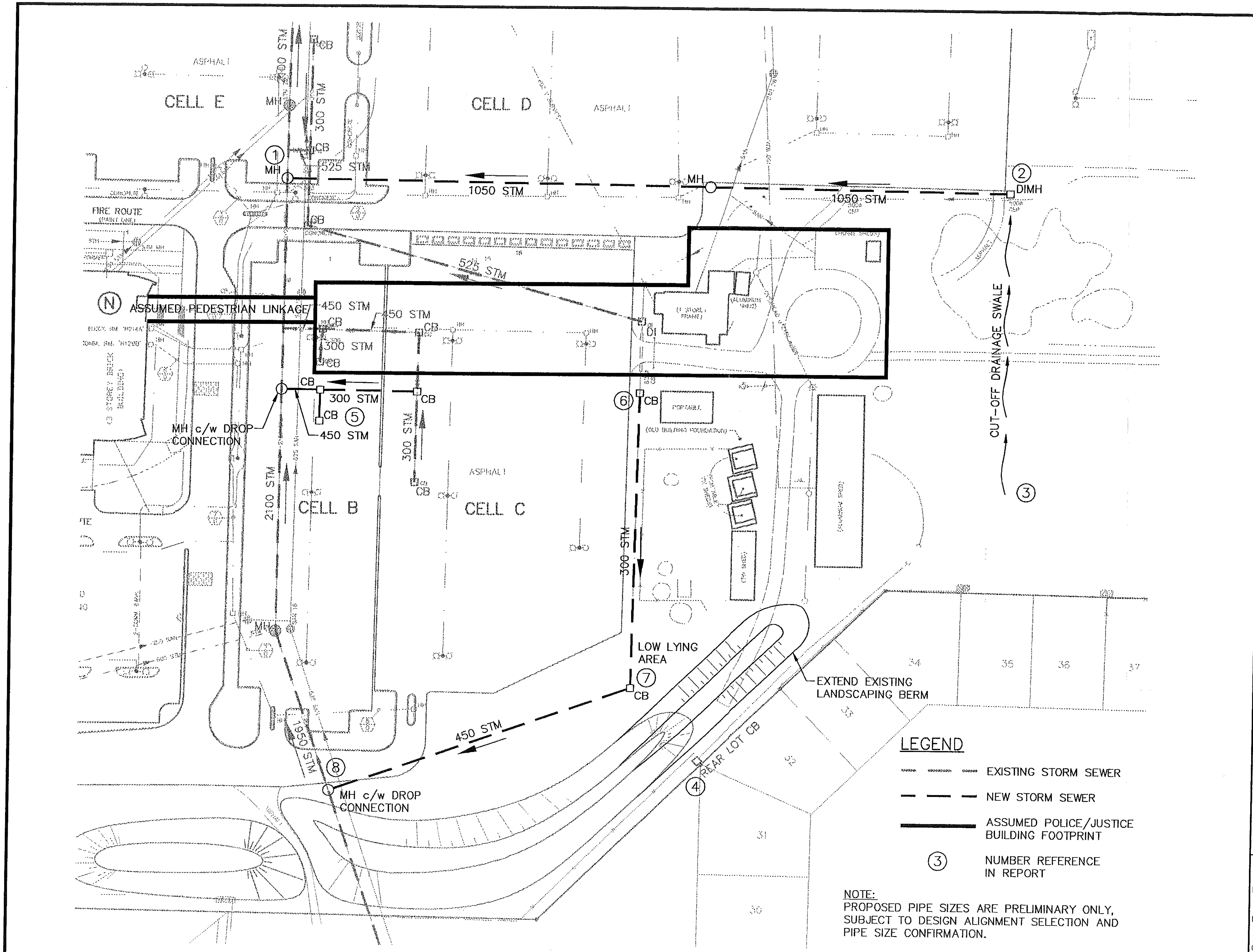
7. Two new catch basins are required at reference locations 6 and 7 (Figure 4). A storm sewer pipe is required to connect these catchbasins to the trunk storm sewer at reference location 8.

Report prepared by:
totten sims hubicki associates

Jason R. Schaefer, B Sc.Eng.
Water Resources/Environmental Engineering

Report reviewed by:
totten sims hubicki associates

John D. Stidwill, P. Eng.
Manager Municipal, Water Resources Engineering



Note:

Proposed Police/Justice Building footprint as illustrated on this plan is approximate only.

totten sims hubicki associates
ENGINEERS ARCHITECTS AND PLANNERS

Orientation

Revisions

ALGONQUIN

PHYSICAL RESOURCES DEPARTMENT

1385 WOODROFFE AVENUE
NEPEAN, ONTARIO
K2G 1V8
TEL. (613) 727-7710
FAX. (613) 727-7601

Project

POLICE / JUSTICE BUILDING

Campus

WOODROFFE CAMPUS

Subject

STORMWATER DRAINAGE REQUIRMENTS

Scale	Date
1:1000	FEB. 1999
Design: J.S.	Drawing No: Figure 4
Drawn: R.V.D.	
Checked: J.D.S.	CAD File No: 12639-04

Appendix A-III

CONTENTS

Stormwater Management Report – Police/Justice Building 15 pages

Algonquin College

POLICE/JUSTICE BUILDING
WOODROFFE CAMPUS

STORMWATER/DRAINAGE REPORT

February 1999

DOC03-257

TSH
engineers
architects
planners

Algonquin College

POLICE/JUSTICE BUILDING
WOODROFFE CAMPUS

STORMWATER/DRAINAGE REPORT

February 1999

totten sims hubicki associates
engineers architects planners

EXECUTIVE SUMMARY

The purpose of this report is to outline stormwater/drainage requirements in conjunction with a proposed Police/Justice Building at Algonquin College's Woodroofe Campus. The drainage issues and tentative solutions identified in this report are subject to detailed design and approval from the City of Nepean. Different pipe alignment options are possible which may satisfy site development drainage requirements identified in this report. As such the recommendations and findings presented herein should be considered as a starting point in the stormwater/drainage planning process.

FINDINGS

The findings of a previous stormwater management study and this drainage report are summarized as follows:

- An increase in the stormwater peak runoff rate, resulting from the proposed Police/Justice Building development, represents approximately 1% when compared to existing pre-development conditions. This change in runoff peak is considered to be small. It is felt this impact is insignificant and does not warrant implementation of stormwater management quantity controls at this time;

- Future development of vacant land at Algonquin College's Woodroffe campus, including additional paved parking area(s), should involve consideration of stormwater best management practices; and

- The proposed Police/Justice Building footprint overlaps:

    - an existing 525 mm diameter storm sewer which drains a large block of land to the east;
    - a local parking lot storm sewer (300 mm diameter and 450 mm diameter pipe) and catchbaisns; and
    - may potentially overlap a 2100 mm diameter trunk storm and a 525 mm diameter sanitary sewers.

  Impacts to local sewers and areas of conflict will have to be looked at and resolved as part of a design build submission.

RECOMMENDATIONS

Based on the findings, the following stormwater/drainage requirements and recommendations are provided in conjunction with the proposed Police/Justice Building:

1. In the absence on an approved stormwater management plan, it is recommended that a 1050 mm diameter storm sewer be constructed adjacent to the north limit of the proposed new building. This storm sewer represents the future storm sewer service corridor for development to the east. This sewer will replace the existing 525 mm diameter sewer displaced by the proposed building footprint.

The new sewer will require a connection into the 2100 mm diameter trunk storm sewer (manhole connection) and should be fitted, as an interim measure, with hydraulic control devices at all inlet locations. A ditch inlet manhole/catchbasin will be required at the upper end of the pipe for the purpose of a surface drainage swale connection. Catchbasin connections into the 1050 mm diameter pipe will be required where necessary to provide and maintain parking lot and building site drainage.

A 1050 mm diameter pipe is being recommended in this storm sewer service corridor location at this time in order to provide decision making flexibility for future development options. Such flexibility is judged to be desirable until stormwater management decisions and planning initiatives are approved.

Sewer sizing should be based on a 5 year design return period considering a future institutional land use in the current undeveloped portion of the Campus ($Q=2.08$ m^3/s, $n=0.013$, $S= 0.7$ %). Please refer to the stormwater management study for further details.

2. A manhole connection (manhole or tee with drop pipe connection) is required for all storm sewer connections into the 2100 mm diameter trunk storm sewer. All connections, specifications and drop pipe details are subject to approval from the City of Nepean.

3. The section of the existing 525 mm storm sewer impacted by the proposed building will have to be disconnected and abandoned.

4. A drainage swale will be required to collect and drain runoff from the existing vacant field located south and east of the proposed building footprint. This swale will direct runoff to the ditch inlet on the 1050 mm diameter storm sewer.

5. Extension of an existing landscaping berm near the south limit of the College property (south of the proposed building) is required to direct runoff away from a local residential rear-yard catchbasin. This will prevent hydraulic surcharging of the service pipe lateral.

6. New catchbasins and storm pipe will be required for Parking Cells "C" and "B". A manhole drop-tee connection to the 2100 mm storm sewer will be required.

7. Two new catch basins will be required to provide drainage at a low depression area adjacent to the landscaping berm and to direct it away from the south side of proposed building. A storm sewer service pipe will be required to connect these catchbasins into the trunk storm sewer.

ALGONQUIN COLLEGE
POLICE/JUSTICE BUILDING
Stormwater/Drainage Report

TABLE OF CONTENTS

1.0 INTRODUCTION 1
- 1.1 General 1
- 1.2 Objective 1

2.0 BACKGROUND 1
- 2.1 Previous Studies 1
- 2.2 Site Description 1
- 2.3 Hydrological Modelling 3

3.0 POLICE/JUSTICE BUILDING LOCAL NEEDS 4
- 3.1 Existing Drainage Patterns 4
- 3.2 Existing Storm Drainage Infrastructure 4
- 3.3 Stormwater Management Requirements 4
- 3.4 Proposed Building Drainage Impacts 5
- 3.5 Building Stormwater/Drainage Requirements 5

Figure 1 **Location Plan**

Figure 2 **Overall Site Plan**

Figure 3 **Existing Drainage Patterns**

Figure 4 **Stormwater/Drainage Requirements**

99069ot
d94

1.0 INTRODUCTION

1.1 General

Algonquin College is currently proposing development of a Police/Justice Centre at its Woodroffe Campus. The City of Nepean has indicated to Algonquin College that there are some local drainage concerns associated with the proposed building development and has asked the College to identify stormwater management issues and develop a stormwater management plan. Totten Sims Hubicki Associates (TSH) was retained by Algonquin College to prepare a stormwater/drainage report for the proposed Police/Justice Building development.

1.2 Objective

The purpose of this report is to examine stormwater drainage requirements associated with the proposed Police/Justice Facility Building at the Woodroffe Campus. Stormwater management objectives of this report and a previous stormwater management study are as follows:

1. To satisfy the City of Nepean's Stormwater Management requirements and drainage concerns;
2. To identify stormwater management needs at the Algonquin College site; and
3. To identify stormwater/drainage requirements which must be met by prospective Design/Build teams preparing tender proposals for the proposed Police/Justice Building.

2.0 BACKGROUND

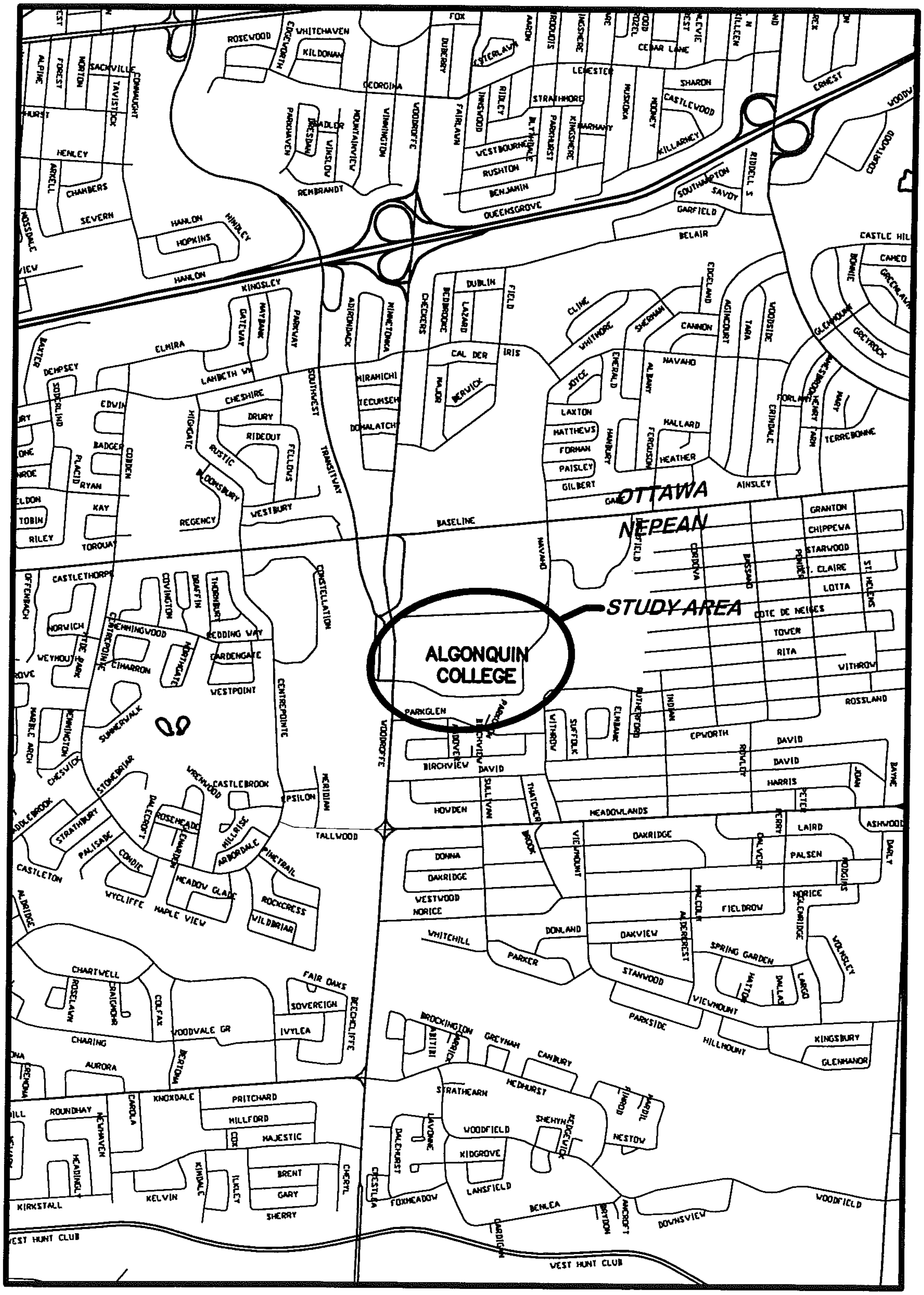
2.1 Previous Studies

In December 1998, TSH prepared a Stormwater Management (SWM) Study for the Woodroffe Campus. The scope of the SWM study was limited to examining stormwater management issues at a conceptual level and identifying some of the constraints and solutions related to objectives 1 and 2 as discussed in Section 1.2.

2.2 Site Description

Algonquin's Woodroffe Campus is located in the City of Nepean near the southeast corner of Woodroffe Avenue and Baseline Road. The campus site is located as illustrated in **Figure 1**. The Campus is within the Pinecrest Creek drainage area. Runoff from the Woodroffe Campus drains into a 2100 mm diameter trunk storm sewer running northerly through Algonquin College's property. The 2100 mm diameter trunk storm sewer outlets to Pinecrest Creek on the north side of Baseline Road. The Pinecrest Creek tributary area upstream of Baseline Road represents

FIGURE 1
LOCATION PLAN



approximately 300 hectares, based on the City of Nepean's sewershed base mapping.

The sub-watershed area examined in the SWM study encompasses the Woodroffe Campus which comprises approximately 42 hectares (ha) of land. The Woodroffe Campus sub-watershed area is illustrated in **Figure 2**. Algonquin College's property directly accounts for approximately 34.8 hectares (ha) of this catchment area with some 26.3 ha of land currently in institutional land use. The remaining 8.5 hectares of Algonquin's Woodroffe Campus site, comprising the eastern section of the Campus, is currently undeveloped.

In addition to Algonquin College's property, the 42 hectare area of land also includes approximately 5.9 ha of the residential land bordering the Campus to the east and south-east. The bordering residential areas drain onto Algonquin College's property through the undeveloped vacant land. This runoff in turn, drains into the existing 525 mm diameter storm sewer and a residential rear yard catchbasin.

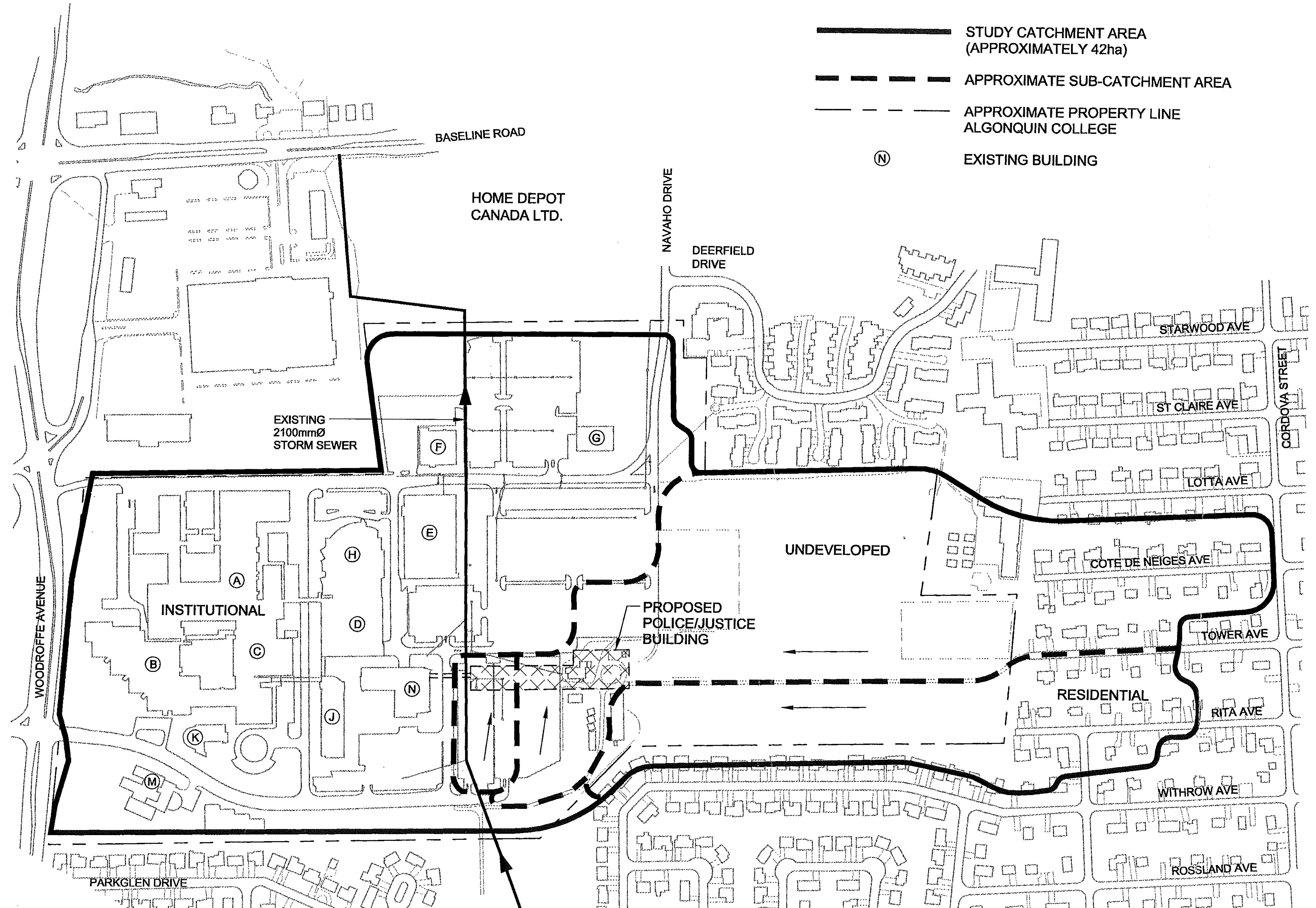
Land use and hydrological conditions in the 42 hectare sub-watershed area are summarized in **Table 1**.

Table 1
Sub-watershed Area Description

Land Use	Area (ha)	% Imperviousness
Woodroffe Campus Developed Land	26.3	60 %
Woodroffe Campus Undeveloped land (8.5 ha) Residential rear lots - Withrow Avenue (0.6 ha) High School property (1.3 ha)	10.4	10 %
Residential Land Use (Cote des Neiges Road, Tower Road and Rita Avenue)	5.3	35 %
Total Sub-Watershed Area / % Imp	**42**	**44 %**

Development of the proposed Police/Justice Building (exclusive of any additional on-site parking space) will result in approximately a 1% increase in the overall sub-watershed imperviousness.

The approximate footprint location of the proposed Police/Justice Building is shown in **Figure 2.** The proposed Police/Justice Building will be located approximately 150 metres east of Building 'N' and south of the Cell 'D' outdoor parking lot.



Note:

Proposed Police/Justice Building footprint as illustrated on this plan is approximate only.

totten sims hubicki associates
ENGINEERS ARCHITECTS AND PLANNERS

Orientation

Revisions

ALGONQUIN

PHYSICAL RESOURCES DEPARTMENT
1385 WOODROFFE AVENUE
NEPEAN, ONTARIO
K2G 1V8
TEL. (613) 727-7710
FAX. (613) 727-7601

Project
POLICE / JUSTICE BUILDING

Campus
WOODROFFE CAMPUS

Subject
STUDY CATCHMENT AREA

Scale 1:4000	Date FEB. 1999
Design J.S.	Drawing No Figure 2
Drawn R.V.D.	
Checked J.D.S.	CAD File No 12638-05

2.3 Hydrological Modelling

Hydrological modelling was conducted for the 42 hectare sub-watershed in the Woodroofe Campus Stormwater Management Study. A number of design storms were modelled under a variety of site development scenarios. A summary of modelled results for peak flow is presented in **Table 2.**

Table 2: Summary of Results - Peak Flow (m^3/s)

Return Period	Existing Conditions Scenario 1 Peak Flow (m^3/s)	Police/Justice Building Scenario 2		Ultimate Site Development			
				3A Residential		3B Institutional	
		Peak Flow (m^3/s)	*% Increase from Existing*	Peak Flow (m^3/s)	*% Increase from Existing*	Peak Flow (m^3/s)	*% Increase from Existing*
1:5 year	3.91	3.97	*1.5 %*	4.25	*8 %*	4.65	*16 %*
1:100 year	8.21	8.32	*1.3 %*	8.84	*7 %*	9.32	*12 %*

The three sub-watershed development conditions summarized in **Table 2** are described as follows:

- *Scenario 1*, Existing conditions with sub-watershed % impervious as per Table 1;
- *Scenario 2*, Police/Justice Building development resulting in an increase in overall sub-watershed imperviousness to 45 %;
- *Scenario 3A*, Ultimate residential development of Algonquin College vacant lands (50 % overall sub-watershed imperviousness; and
- *Scenario 3B*, Ultimate institutional development of Algonquin College vacant lands (57 % overall sub-watershed imperviousness.

As a result of the Police/Justice Building development (Scenario 2), peak flow rates for the 5 and 100 year return periods are anticipated to represent an increase of approximately 1.3 % to 1.5 % from peak flow rates generated under existing site conditions.

The hydrological model results indicate that stormwater best management practices (BMP's) are required for future ultimate development of Algonquin College's vacant land in order to maintain peak flow rates at pre-development levels. Selection of BMP's for the site will be required for future site development. BMP options are not required for the development of the proposed Police/Justice Building based solely on the objective of maintaining post development peak runoff rates at pre-development levels.

3.0 POLICE/JUSTICE BUILDING LOCAL NEEDS

3.1 Existing Drainage Patterns

Drainage patterns in the 42 hectare sub-watershed area are in a general westerly direction. Internal sub-catchments and drainage patterns are illustrated in **Figures 2 and 3**.

3.2 Existing Storm Drainage Infrastructure

Figure 3 shows the location of existing storm drainage infrastructure which will be impacted by construction of the proposed Police/Justice Building. The impacted storm drainage infrastructure includes:

- A 525 mm diameter storm sewer in parking lot "C";
- Drainage ditch No. 1 (refer to Figure 3), which conveys surface runnoff from a large proportion of the vacant land to the east of the proposed building location and a portion of parking lot "D";
- Drainage ditch No. 2, which collects runoff from the east half of parking lot "C" and low lying areas to the south;
- Three catchbasins and storm sewer service pipes connected into the 2100 mm diameter storm sewer. This local storm sewer drains parking lot "C" and a portion of parking lot "B".
- A residential rear yard catchbasin adjacent to the College property (corner of residential lots 31 and 32, fronting on Withrow Avenue).

3.3 Stormwater Management Requirements

The governing objective for this drainage report is considered to represent the City of Nepean's requirement that there be no significant increase in peak runoff for post development conditions when compared to the pre-development hydrological regime.

Increases in the peak runoff rate from existing conditions, resulting from the Police/Justice Building development, are considered to be insignificant and as such are not felt to warrant any special stormwater management controls at this time. The proposed building will not by itself result in any significant site change in percent imperviousness or peak flow rate. Additional development on existing vacant lands to the east involving a new building addition, a change in land use or construction of a new paved parking lot(s) in the future, will likely require the initiation of stormwater management controls.

For additional details on future SWM scenarios and BMP requirements, please refer to the Woodroofe Campus Stormwater Management Report, December 1998.

3.4 Proposed Building Drainage Impacts

For the purpose of this report, the Police/Justice Building footprint is assumed to be located on the north portion of parking lots "B" and "C", east of Building "N" and south of parking lot "D". Refer to **Figure 3** for location of the proposed building and existing storm drainage infrastructure.

The proposed building location will have the following stormwater/drainage impacts:

1. The proposed building footprint overlaps the 525 mm diameter storm sewer under parking lot "C". Relocation of this storm sewer will be required.

2. The proposed building location will block runoff in drainage ditch No. 2. Construction of new catchbasins and storm pipe to collect runoff adjacent to the building, and the low lying area are required.

3. The proposed building footprint overlaps existing parking lot catchbasins and storm pipes draining parking lots "B" and "C". Re-establishment of these catchbasins and pipe will be required.

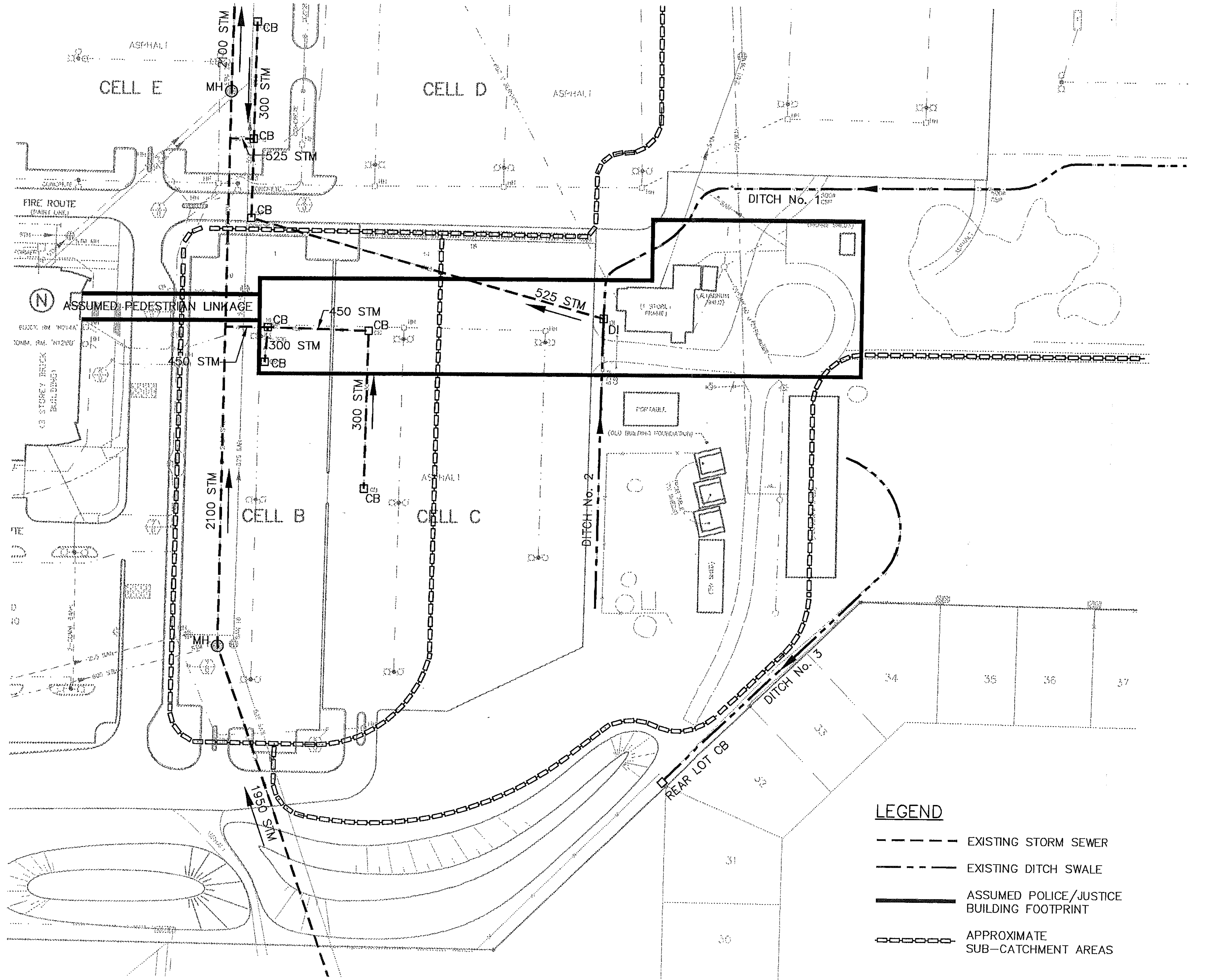
4. The City of Nepean has expressed concern with drainage problems associated with a residential rear yard catchbasin near the Algonquin College property line (Lots 31 and 32, fronting on Withrow Avenue). The City has asked that runoff from Algonquin College property be directed away from this location as part of the requirement for the proposed Police/Justice Building.

5. The proposed building footprint may potentially overlap a 2100 mm diameter trunk storm sewer and a 525 mm diameter sanitary sewer. Sufficient separation between the building footing and sewers is required.

3.5 Building Stormwater/Drainage Requirements

The proposed building footprint overlays existing storm sewer pipes and will block local runoff drainage. To minimize the impacts the following requirements are described below. Reference locations in the following descriptions are presented in **Figure 4**.

1. A sewer corridor and storm pipe will be required for connection to the 2100 mm diameter trunk sewer to provide drainage for the area east of the Police/Justice building location (refer to Figure 4). In the absence of an approved Stormwater Management Plan, a pipe diameter size of 1050 mm is recommended at this time.



Note:

Proposed Police/Justice Building footprint as illustrated on this plan is approximate only.

totten sims hubicki associates
ENGINEERS ARCHITECTS AND PLANNERS

Orientation

Revisions

ALGONQUIN

PHYSICAL RESOURCES DEPARTMENT

1385 WOODROFFE AVENUE
NEPEAN, ONTARIO
K2G 1V8
TEL. (613) 727-7710
FAX. (613) 727-7601

Project
POLICE / JUSTICE BUILDING

Campus
WOODROFFE CAMPUS

Subject
EXISTING DRAINAGE PATTERNS

Scale 1:1000	Date FEB. 1999
Design J.S.	Drawing No Figure 3
Drawn R.V.D.	
Checked J.D.S.	CAD File No 12638-03

This pipe diameter selection is based on the following assumptions: $Q_{5year}=2.08$ m^3/s; Manning's "n" for concrete=0.013; pipe placed at a slope of 0.7 %. The 1050 mm diameter pipe size is preliminary only and is subject to design and final pipe sizing confirmation.

2. A manhole connection (manhole or tee with drop pipe connection) is required for all storm sewer connections into the 2100 mm diameter trunk storm sewer. All connections, specifications and drop pipe details are subject to approval from the City of Nepean.

3. The section of the existing 525 mm diameter storm sewer, impacted by the proposed building footprint, will have to be disconnected and abandoned.

4. A new drainage swale is required from reference location 3 to the proposed ditch inlet/catch basin at location 2 (see Figure 4). This swale will intercept drainage from the remaining undeveloped portion of the Campus.

5. Extension of the existing landscaping berm is required to prevent hydraulic overloading of the rear yard catchbasin at reference location 4 (see Figure 4). For additional berm details and specifications refer to the following engineering drawing (submitted separately): Berm Layout, Woodroffe Campus Site Development Study, Algonquin College, February 1999, prepared by Totten Sims Hubicki Associates

6. New catchbasins and storm pipe will be required for parking lot drainage at reference location 5. A manhole or drop-tee connection to the 2100 mm storm sewer will be required.

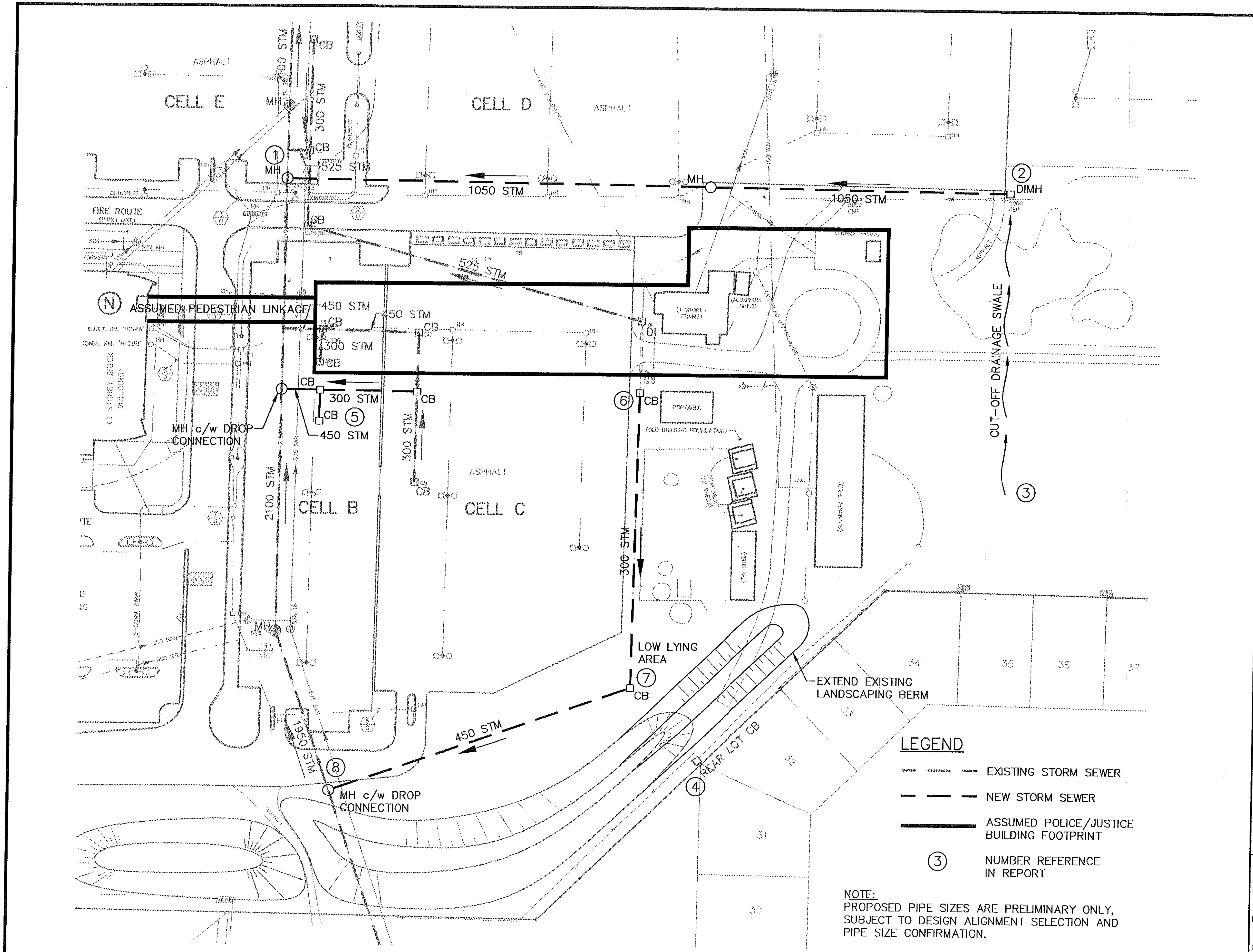
7. Two new catch basins are required at reference locations 6 and 7 (Figure 4). A storm sewer pipe is required to connect these catchbasins to the trunk storm sewer at reference location 8.

Report prepared by:
totten sims hubicki associates

Report reviewed by:
totten sims hubicki associates

Jason R. Schaefer, B Sc.Eng.
Water Resources/Environmental
Engineering

John D. Stidwill, P. Eng.
Manager Municipal, Water Resources
Engineering



Note:

Proposed Police/Justice Building footprint as illustrated on this plan is approximate only.

totten sims hubicki associates
ENGINEERS ARCHITECTS AND PLANNERS

Orientation

Revisions

ALGONQUIN

PHYSICAL RESOURCES DEPARTMENT

1385 WOODROFFE AVENUE
NEPEAN, ONTARIO
K2G 1V8
TEL. (613) 727-7710
FAX. (613) 727-7601

Project

POLICE / JUSTICE BUILDING

Campus

WOODROFFE CAMPUS

Subject

STORMWATER DRAINAGE REQUIRMENTS

Scale	Date
1:1000	FEB. 1999
Design: J.S.	Drawing No: Figure 4
Drawn: R.V.D.	
Checked: J.D.S.	CAD File No: 12639-04

Appendix A-IV

CONTENTS

Stormwater Management Report Sports Field 22 pages

R-1268

Approved
June 22, 2005
HP

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

STORMWATER MANAGEMENT REPORT

ALGONQUIN COLLEGE - WOODROFFE CAMPUS
SPORTS FIELD PROJECT

March, 2005
(Revised June 2005)

Prepared for:

ALGONQUIN COLLEGE STUDENTS' ASSOCIATION
1385 Woodroffe Avenue
Ottawa, Ontario
K2G 1V8

Prepared by:

J.L. RICHARDS & ASSOCIATES LIMITED
Consulting Engineers, Architects & Planners
864 Lady Ellen Place
Ottawa, Ontario
K1Z 5M2

JLR 20475

STORMWATER MANAGEMENT REPORT

ALGONQUIN COLLEGE - WOODROFFE CAMPUS
SPORTS FIELD PROJECT

- TABLE OF CONTENTS -

		PAGE
1.0	INTRODUCTION	1
2.0	EXISTING DRAINAGE CONDITIONS	1
3.0	PROPOSED SITE DRAINAGE	2
4.0	EROSION AND SEDIMENT CONTROL MEASURES	3
5.0	CONCLUSIONS AND RECOMMENDATIONS	4

- LIST OF APPENDICES -

APPENDIX 1 - Site Servicing, Grading and Field Drainage Layout and Detail Plans

APPENDIX 2 - Pre- and Post-Development Stormwater Runoff Calculations

- LIST OF FIGURES -

FIGURE 1 Key Location Plan

FIGURE 2 Proposed Sports Field Site Location Plan and Existing Storm Drainage

FIGURE 3 Storm Catchment and Drainage Areas

FIGURE 4 Existing Saint Nicholas School Site - 1999

FIGURE 5 Existing Saint Nicholas School Site - 2002

FIGURE 6 Pre-Development Land Use

FIGURE 7 Post-Development Land Use

STORMWATER MANAGEMENT REPORT

ALGONQUIN COLLEGE - WOODROFFE CAMPUS
SPORTS FIELD PROJECT

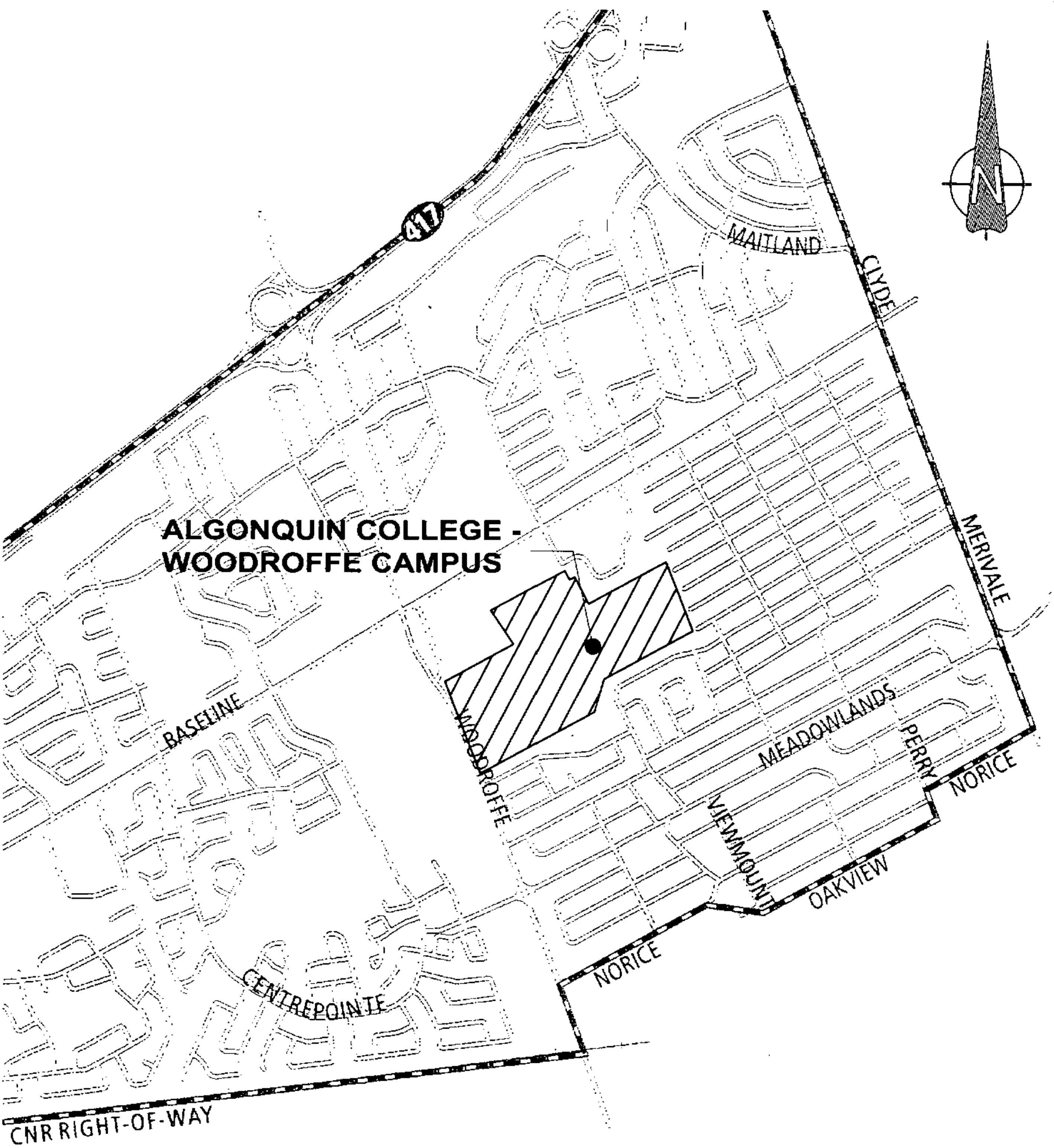
1.0 INTRODUCTION

The Algonquin College Woodroffe Campus is located at the southeast corner of the intersection of Baseline Road and Woodroffe Avenue (Figure 1). The Woodroffe Campus is the main College Campus located in Ottawa and has become the central focal point for development. St. Nicholas Public School, located at the northeast corner of the Campus property, was purchased by Algonquin College in the late summer of 2004 with the intent of incorporating the additional land into the Campus development. The Algonquin College Students' Association proposes to redevelop this site as an outdoor sports field complex.

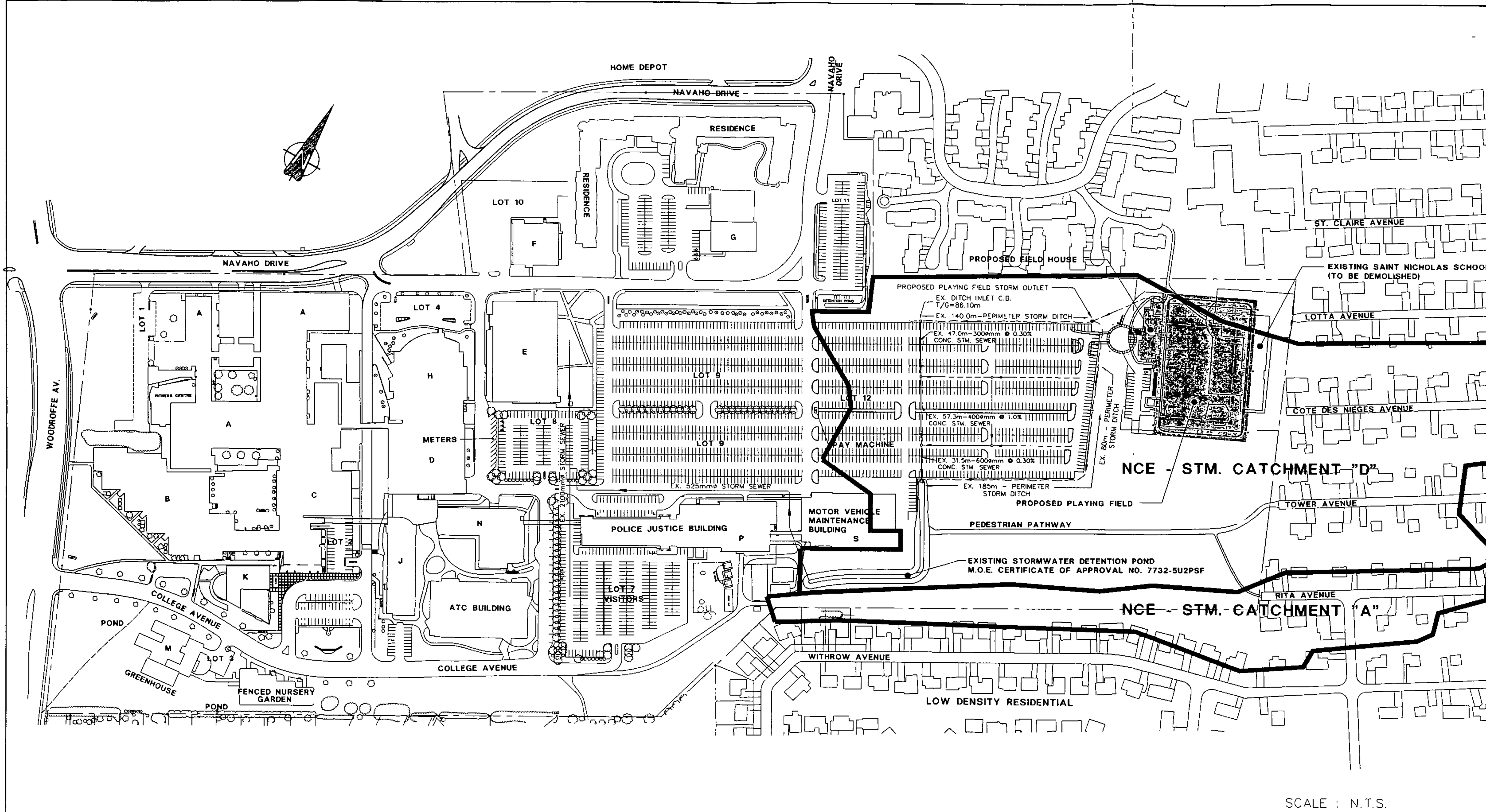
A Stormwater Management Report was prepared by National Capital Engineering (NCE) in June of 2001 outlining the key stormwater management objectives and recommendations for the projected land use development of the Woodroffe Campus up to and including the year 2015. This Report reviews the NCE Report objectives as they pertain to this proposed site redevelopment and the overall Campus.

2.0 EXISTING DRAINAGE CONDITIONS

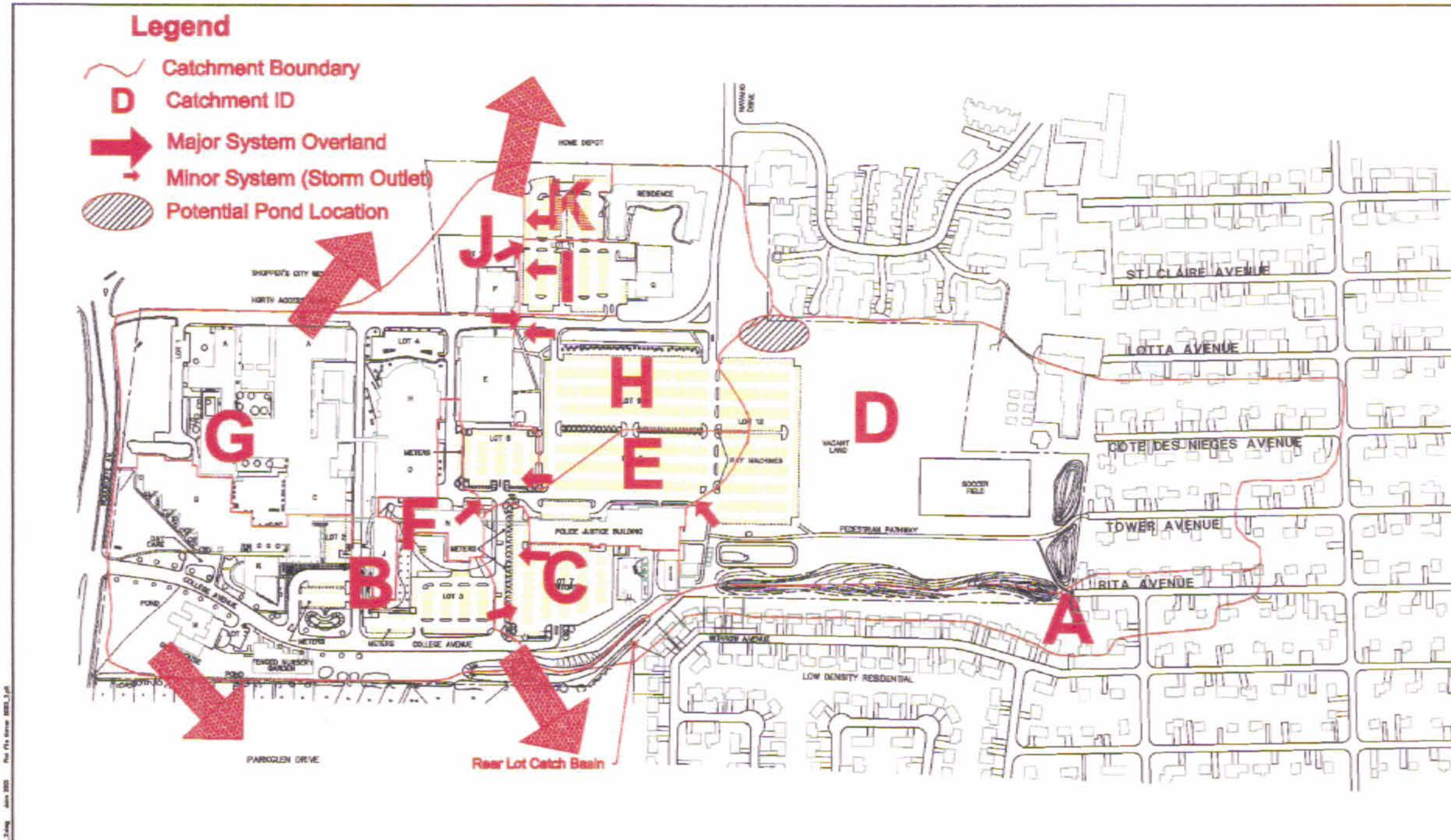
Figure 2 identifies the proposed Sports Field Campus development which includes an artificial turf playing field, Field House and parking area within the context of the existing drainage system. The existing catchment and storm drainage areas for the Woodroffe Campus are identified in the June 2001 Stormwater Management Report by NCE, as shown on Figure 3. Catchment area "D" includes off-site stormwater runoff from the existing residential development to the east and a portion of the old school site. Storm runoff from the residential area and the school site currently drains overland via ditches onto the easterly limit of the Campus property and sheet drains in a westerly direction to the perimeter collection ditch surrounding parking Lot 12. Runoff is conveyed to the existing stormwater detention pond immediately adjacent to the Motor Vehicle Maintenance Building, located at the southerly limit of the Campus property. The detention pond outlets to a 525 mm storm sewer which then discharges to the main 2100 mm trunk sewer. The trunk sewer contains Pinecrest Creek through the Campus and flows in a northerly direction eventually leading to an outlet in the ravine north of the commercial developments along Baseline Road.



PROJECT: ALGONQUIN COLLEGE WOODROFFE CAMPUS 1385 WOODROFFE AVENUE	DRAWING: KEY LOCATION PLAN	
J.L.Richards ENGINEERS·ARCHITECTS·PLANNERS J.L. Richards & Associates Limited 864 Lady Ellen Place Ottawa, ON Canada K1Z 5M2 Tel: 613 728 3571 Fax: 613 728 6012	DESIGN: DPU CHECKED: CAD FILE: 20475 C FIG1 PLOTTED: MARCH 4/05	DRAWING NO.: FIGURE 1 JLR NO: 20475



PROJECT:	DRAWING:			DRAWING NO.:
ALGONQUIN COLLEGE – WOODROFFE CAMPUS	PROPOSED SPORTS FIELD SITE LOCATION PLAN & EXISTING STORM DRAINAGE	J.L.Richards ENGINEERS·ARCHITECTS·PLANNERS — J.L. Richards & Associates Limited, 864 Lady Ellen Place, Ottawa, ON Canada K1Z 5M2, Tel: 613 728 3571, Fax: 613 728 6012	DESIGN: DPU CHECKED: CAD FILE: FIG2 – MOE PLOTTED: JUNE 2005	FIGURE 2 JLR NO.: 20475



NCE NATIONAL CAPITAL ENGINEERING Transportation and Value Engineers 100 Craig Henry Drive, Suite 202 Nepean, Ontario, K2G 5W3 TEL. (613) 228-8654 FAX. (613) 228-5453 E-Mail: natcap@on.aibn.com	ALGONQUIN COLLEGE PHYSICAL RESOURCES DEPARTMENT WOODROFFE CAMPUS	Project ALGONQUIN COLLEGE WOODROFFE CAMPUS STORMWATER MANAGEMENT STUDY Subject Catchments and Drainage	Scale 1 : 3000 Design S.S. Drawn S.S Checked S.J.T.	Date June 4, 2001 Drawing No FIGURE 2 CAD File No. 00-63_2.DWG

J.L.Richards ENGINEERS·ARCHITECTS·PLANNERS J.L. Richards & Associates Limited 864 Lady Ellen Place Ottawa, ON Canada K1Z 5M2 Tel: 613 728 3571 Fax: 613 728 6012	PROJECT: ALGONQUIN COLLEGE – WOODROFFE CAMPUS	DRAWING: STORM CATCHMENT AND DRAINAGE AREAS SCALE : N.T.S.	DESIGN: DPU CHECKED: CAD FILE: 20475 C FIG3 PLOTTED: JUNE 2005	DRAWING NO.: FIGURE 3 JLR NO: 20475

3.0 PROPOSED SITE DRAINAGE

The proposed Sports Field Complex development includes a single storey field house with a building footprint of approximately 533 sq.m and a separate parking area comprised of 20 spaces. The artificial turf playing field is approximately 64 m wide by 101 m long and will be surrounded by a runoff area and asphalt maintenance apron enclosed by a perimeter chainlink fence. A dome air structure will be erected during the fall to allow a portion of the playing field to be used during the winter.

Rainfall on the sports field will be collected by either a subdrain or a perimeter collection drain surrounding the playing field. Flow generated in the perimeter drain will outlet to the existing ditch at the northeast corner of parking Lot 12. The Sports Field perimeter collection drain has been sized to accommodate a 5-year storm event. During an infrequent storm event, the excess runoff will be directed away from the playing field surface toward catch basins, which will have storm leads connected to the perimeter collection drain, located outside the playing field along the north and east boundaries. Storm runoff will pond temporarily in designated areas to a maximum depth of 0.15 m before spilling over to the north and south via designated overland flow routes. Excess runoff to the west and south of the playing field will be directed overland into the existing perimeter ditch surrounding parking Lot 12. The majority of stormwater runoff collected from the sports field development will make its way into the existing stormwater detention pond located adjacent to the Motor Vehicle Maintenance Building. A small portion of the sports field development will continue to sheet drain off site in a northerly direction. A reduced copy of the proposed servicing, grading, and sports field drainage layout and detail plans has been included in Appendix 1.

The June 2001 NCE Stormwater Management Report identified the need for on-site stormwater storage for all future Campus development to control the projected increased Campus flow rate contributing to the 2100 mm diameter trunk sewer associated with the change in impervious areas. An analysis of the pre- and post-development runoff coefficient for the overall site area was performed as outlined in Appendix 2. A weighted runoff coefficient for the existing school site was compared with the weighted coefficient for the proposed sports field complex to determine if stormwater management would be warranted for this development.

Pre-development runoff coefficients were assigned according to existing land uses. An aerial photo of the existing school site is shown in Figures 4 and 5 of Appendix 2. The analysis found that the Sports Field Complex development would yield a weighted runoff coefficient equivalent to the original school site weighted runoff coefficient of 0.57. This implies that the post-development runoff generated by the sports field site is the same as the existing school site. A small portion of the northeast school property will drain into catchment area "D" after the sports field development has been completed that was not originally accounted for in the NCE Stormwater Management report. However, its contribution can be considered negligible given that the developed area will be predominantly artificial turf and the post-development weighted runoff coefficient is the same for the overall site. Furthermore, runoff generated from hard surfaces on the school site and directed to the lands north of the site have been eliminated. Therefore, stormwater quantity management will not be required since the flows contributing to the Campus 2100 mm diameter trunk sewer will not increase as a result of this development.

The June 2001 NCE Stormwater Management Report states that City of Ottawa staff were contacted concerning water quality control requirements and were informed "The City of Ottawa has no specific water quality control requirements for this development, but would request that best management practices such as swales and buffer strips be employed where possible, and possibly oil/grit separators where such best management practices are not feasible." Adjacent lands to the east and the sports field runoff will filter runoff from impervious surfaces via grassed swales and vegetated buffer strips prior to entering the Campus storm sewer system. All new catch basins will have sumps to maximize sediment capture.

4.0 EROSION AND SEDIMENT CONTROL MEASURES

Appropriate erosion and sediment control measures are proposed during all phases of construction in accordance with the Ministry of Natural Resources "Guidelines on Erosion and Sediment Control for Urban Construction Sites" and, as a minimum, will include the following :

- Catch basins will have a 0.5 m sump and will be inspected frequently and cleaned as required.

- Filter fabric will be placed underneath all catch basin/manhole covers. The filter fabric will be inspected regularly and replaced as required.

- Straw bale filter barriers and/or silt fences will be installed between lands under construction and all overland drainage corridors. Inspection of the straw bale filter barriers and/or silt fences will be conducted regularly. Repairs deemed necessary will be carried out without delay.

- A continuous silt fence will be placed on the down-gradient side of all disturbed areas and shall be maintained in working order during construction and surface stabilization period.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions presented in the Report are summarized as follows:

1. Storm C = 0.57. Runoff generated by the St. Nicholas School site sheet drains to the Algonquin College parking area storm sewer which, in turn, outlets to an on-site stormwater management pond.

2. The redevelopment of the St. Nicholas School site as a Sports Field Complex will result in the same amount of stormwater runoff being generated from the site since the post-development condition is equally pervious to the pre-development condition, i.e., pre- and post-development runoff coefficient C = 0.57.

As a result of the above, the following is recommended:

1. No on-site quantity stormwater management is proposed.

2. The perimeter of the sports field should be graded to allow major overland flows to pond to a maximum depth of 0.15 m prior to outletting to an existing ditch on the north side of the Campus, or sheet drain to the existing motor vehicle facility pond south of the Sports Field Complex.

3. Following construction, the Owner shall provide certification to the City, through a Professional Engineer, that all measures of the Erosion and Sediment Control Plan were implemented.

Prepared by :

J.L. RICHARDS & ASSOCIATES LIMITED

LICENSED PROFESSIONAL ENGINEER
D. P. UPTON
17/06/05
PROVINCE OF ONTARIO

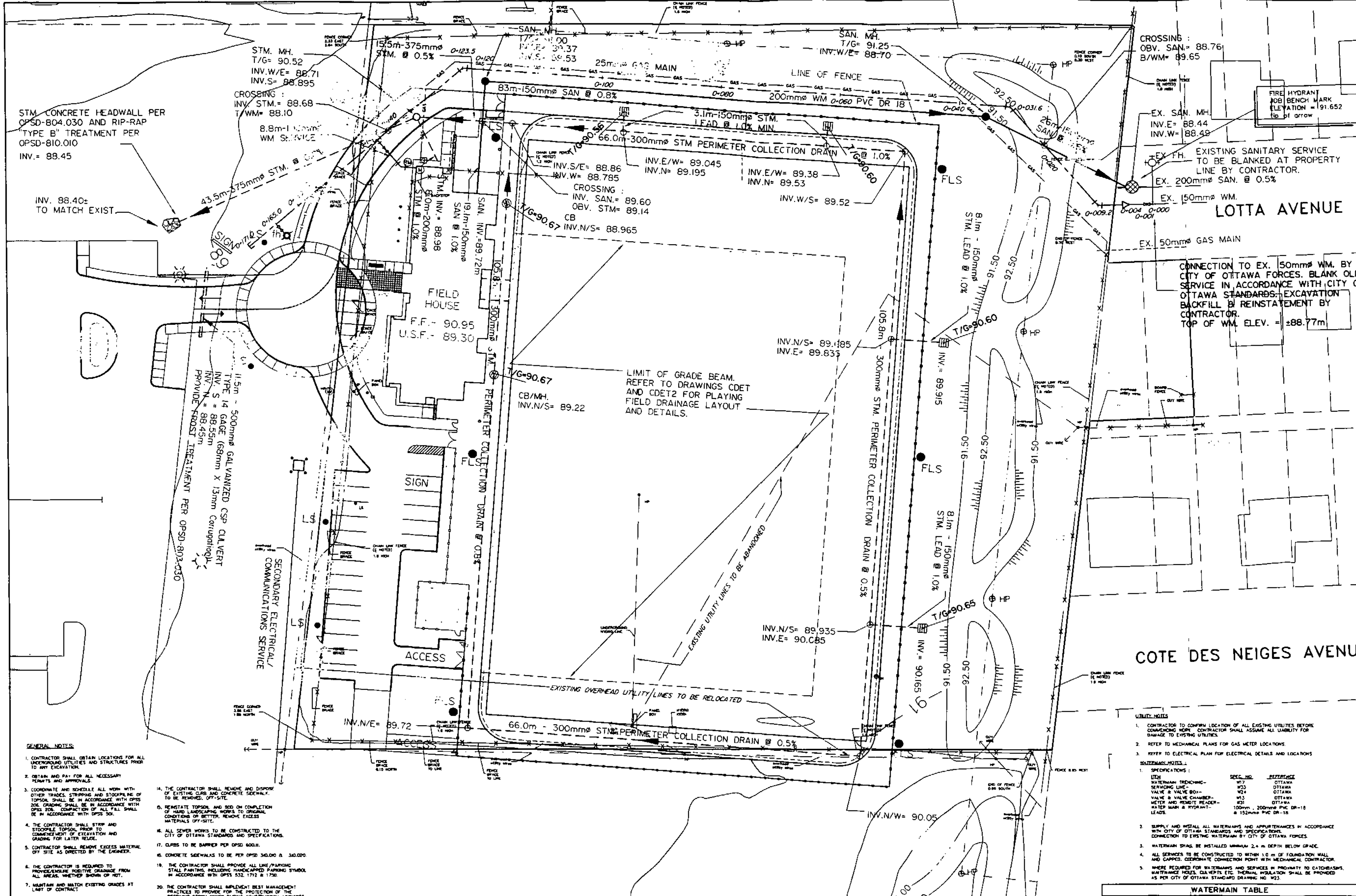
....
Derrick P. Upton, P.Eng.

Reviewed by:

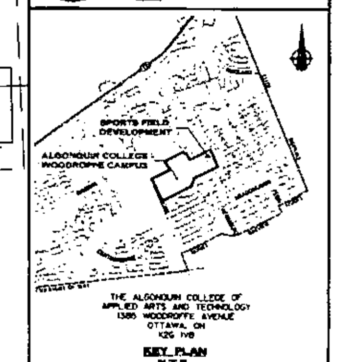
....
Lee Jablonski, P.Eng.

APPENDIX 1

SITE SERVICING, GRADING AND FIELD DRAINAGE LAYOUT AND DETAIL PLANS



Algonquin Students' Association



KEY PLAN
N.T.S.

LEGEND

- PROPOSED SANITARY SEWER & MANHOLE
- PROPOSED STORM SEWER & MANHOLE
- PROPOSED WATERMAIN, VALVE & HYDRANT
- PROPOSED CATCH BASIN
- PROPOSED CURB
- PROPOSED CONCRETE SIDEWALK
- REMOTE METER
- GAS SERVICE
- EXISTING GRANULAR 'B' CONSTRUCTION ACCESS ROUTE
- LIMIT OF LIGHT DUTY PARKING AREA PAVEMENT STRUCTURE

NOTE:

EXISTING GROUND ELEVATIONS AND SITE FEATURES PER WEBSTER & SIMMONDS SURVEYING LTD. TOPOGRAPHICAL SURVEY DRAWING APRIL 27/1993.

GENERAL NOTES:

1. CONTRACTOR SHALL OBTAIN LOCATIONS FOR ALL UNDERGROUND UTILITIES AND STRUCTURES PRIOR TO ANY EXCAVATION.
2. OBTAIN AND PAY FOR ALL NECESSARY PERMITS AND APPROVALS.
3. COORDINATE AND SCHEDULE ALL WORK WITH OTHER TRADES. STRIPPING AND STOCKPILING OF TOPSOIL SHALL BE IN ACCORDANCE WITH OPSS 206. GRADING SHALL BE IN ACCORDANCE WITH OPSS 206. COMPACTION OF ALL FILL SHALL BE IN ACCORDANCE WITH OPSS 501.
4. THE CONTRACTOR SHALL STRIP AND STOCKPILE TOPSOIL PRIOR TO COMMENCEMENT OF EXCAVATION AND GRADING FOR LATER REUSE.
5. CONTRACTOR SHALL REMOVE EXCESS MATERIAL OFF SITE AS DIRECTED BY THE ENGINEER.
6. THE CONTRACTOR IS REQUIRED TO PROVIDE/ENSURE POSITIVE DRAINAGE FROM ALL AREAS, WHETHER SHOWN OR NOT.
7. MAINTAIN AND MATCH EXISTING GRADES AT LIMIT OF CONTRACT.
8. PRIOR TO COMMENCING GRADING THE CONTRACTOR IS REQUIRED TO INFORM THE SITE ENGINEER OF HIS METHOD OF OPERATION TO CONFIRM TEMPORARY AND PERMANENT DRAINAGE. FLOW DIRECTION AND OUTLET LOCATIONS SHALL CONFORM TO THE DESIGN INTENT.
9. THE CONTRACTOR SHALL IMMEDIATELY REPORT ANY DISCREPANCIES ON THE DRAWING AS THEY RELATE TO SITE CONDITIONS TO THE ENGINEER PRIOR TO CONSTRUCTION.
10. CONTRACTOR IS RESPONSIBLE FOR ALL CONSTRUCTION SURVEY LAYOUT WHICH WILL REFERENCE PROJECT BENCH MARK AS NOTED (METRIC GEODETIC).
11. PROVIDE ALL PUMPING, TEMPORARY DITCHING FOR WATER FLOW AND FOR DEWATERING NECESSARY FOR THE PROPER PERFORMANCE OF THIS CONTRACT.
12. MAINTAIN AND KEEP CLEAR ALL PATHS UTILIZED DURING THE PERFORMANCE OF THE CONTRACT.
13. NO EXTRA PAYMENT SHALL BE MADE FOR THE USE OF MATS OR OTHER SUPPORTING DEVICES REQUIRED FOR ALL EQUIPMENT USED ON THIS CONTRACT AS A RESULT OF WET OR UNSTABLE GROUND CONDITIONS.
14. THE CONTRACTOR SHALL REMOVE AND DISPOSE OF EXISTING CURB AND CONCRETE SIDEWALK. TO BE REMOVED, OFF-SITE.
15. REINSTATE TOPSOIL AND SOD ON COMPLETION OF HARD LANDSCAPING WORKS TO ORIGINAL CONDITIONS OR BETTER. REMOVE EXCESS MATERIALS OFF-SITE.
16. ALL SEWER WORKS TO BE CONSTRUCTED TO THE CITY OF OTTAWA STANDARDS AND SPECIFICATIONS.
17. CURBS TO BE BARRIER PER OPSD 600.11.
18. CONCRETE SIDEWALKS TO BE PER OPSD 310.010 & 310.020.
19. THE CONTRACTOR SHALL PROVIDE ALL LINE/PARKING STALL PAINTING, INCLUDING HANDICAPPED PARKING SYMBOL IN ACCORDANCE WITH OPSS 532, 1712 & 1750.
20. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES TO PROVIDE FOR THE PROTECTION OF THE RECEIVING STORM SEWER DURING CONSTRUCTION ACTIVITIES. THESE PRACTICES ARE REQUIRED TO ENSURE NO SEDIMENT AND/OR ASSOCIATED POLLUTANTS ARE RELEASED TO THE RECEIVING WATERCOURSES. THESE PRACTICES INCLUDE THE INSTALLATION OF FILTER FABRIC BETWEEN ALL CATCH BASIN FRAMES AND COVERS DURING THE DURATION OF GRADING ACTIVITIES. REMOVE FILTER CLOTH FROM THE CATCH BASINS AFTER OBTAINING APPROVAL FROM THE ENGINEER. SEE EROSION AND SEDIMENT CONTROL MEASURES NOTES ON DRAWING NO. CG1.
21. (a) PARKING AREA PAVEMENT STRUCTURE :
    - 50mm HL3 SURFACE COURSE
    - 150mm OPSS GRANULAR "A" BASE
    - 300mm OPSS GRANULAR "B" TYPE II SUB-BASE

    (b) ACCESS ROAD PAVEMENT STRUCTURE :
    - 40mm HL3 SURFACE COURSE
    - 50mm HL8 BINDER COURSE
    - 150mm OPSS GRANULAR "A" BASE
    - 450mm OPSS GRANULAR "B" TYPE II SUB-BASE
22. CONTRACTOR SHALL SUBMIT RED-LINE MARKED UP "AS-BUILT" DRAWINGS OF THE WATERMAIN, STORM AND SANITARY SEWER SYSTEMS.
23. CONTRACTOR SHALL SUBMIT TELEVISION INSPECTION REPORTS & TAPES (2 COPIES) OF ALL STORM AND SANITARY SEWERS CONSTRUCTED.
24. REFER TO LANDSCAPE ARCHITECTS PLAN FOR PROTECTION/PRESERVATION OF EXISTING TREES, AND PATHWAY/LANDSCAPING DETAILS.
25. GEOTECHNICAL INVESTIGATION AND REPORT FOR SITE DEVELOPMENT PREPARED BY PATERSON GROUP INC. (REF.: REPORT NO. PG0271-1, JUNE 28/04 ; REPORT NO. PG0271-REP 02, MARCH 17/05 ; REPORT LETTER FILE NO. PG0271-FAX.02, APRIL 22/05 ; REPORT LETTER FILE NO. PG0271-FAX.03, APRIL 28/05)
26. THE CONTRACTOR SHALL REINSTATE ANY CITY OF OTTAWA PROPERTY DAMAGED AS A RESULT OF CONSTRUCTION TO ORIGINAL CONDITION OR BETTER.
27. ENSURE A MINIMUM CLEARANCE OF 2.0m IS PROVIDED BETWEEN ALL PROPOSED SEWERS AND TREES.

STORM AND SANITARY SEWER NOTES:

1. STORM SEWER TO BE INSTALLED AS PER OPSD 802.010. BEDDING SHALL BE GRANULAR 'A' COMPACTED TO 95% S.P.D. WHERE DISTURBANCE OF SUB-GRADE DOES OCCUR, IT MAY BE NECESSARY TO PLACE A SUB-BEDDING LAYER OF COMPACTED GRANULAR 'B' TYPE II BENEATH THE GRANULAR 'A' BEDDING. PLACE SUITABLE NATIVE MATERIAL OVER BEDDING COVER AND COMPACT TO AT LEAST 95% S.P.D.
2. INSULATE ALL STORM AND SANITARY SEWERS THAT HAVE LESS THAN 2.0m COVER WITH 50mm x 1200mm HI-40 INSULATION. PROVIDE 100mm CLEARANCE BETWEEN PIPE AND INSULATION.
3. ALL MANHOLES SHALL BE 1200mm DIAMETER
4. CATCH BASINS SHALL BE AS PER OPSD 705.010. FRAME AND GRATES SHALL BE AS PER OPSD 400.10.
5. CATCH BASIN MANHOLES SHALL BE AS PER OPSD 701.010. CATCH BASIN MANHOLE FRAME AND GRATE SHALL BE AS PER OPSD 400.02
6. CONTRACTOR SHALL PERFORM INFILTRATION/EXFILTRATION TESTING OF SANITARY SEWER IN ACCORDANCE WITH OPSS 410 AND CITY OF OTTAWA REQUIRMENTS. CONTRATOR SHALL DETERMINE GROUNDWATER ELEVATION PRIOR TO TESTING. PIEZOMETERS, IF REQUIRED, SHALL BE INSTALLED AND ABANDONED AT THE CONTRATOR'S EXPENSE. PIEZOMETERS SHALL BE REMOVED UPON SATISFACTORY COMPLETION OF TESTING. CONTRACTOR SHALL PERFORM LEAKAGE TEST OF SANITARY MANHOLES IN ACCORDANCE TO OPSS 407.26 AND/OR LOW PRESSURE AIR TESTING OF SEWERS IN ACCORDANCE TO OPSS 407.07.26 AND OPSS 410.07.01.16.
7. STORM AND SANITARY SEWER 150mm TO 375mm TO BE PVC DR 35 EXCEPT WHERE NOTED.
8. ALL SERVICES TO BE CONSTRUCTED TO WITHIN 1.0 m OF FOUNDATION WALL FOR CONNECTION TO BUILDING BY MECHANICAL CONTRACTOR AND BE TERMINATED WITH WATERTIGHT CAP. CO-ORDINATE POINT OF CONNECTION WITH MECHANICAL CONTRATOR.
9. CONNECTIONS TO EXISTING MANHOLES OR EXISTING SEWERS SHALL BE MADE IN MACHINE CUT HOLES SUITABLY GASKETTED TO PROVIDE WATERTIGHT CONNECTION.
10. ALL CATCH BASINS TO HAVE A 0.3m SUMP AND WILL BE INSPECTED FREQUENTLY AND CLEANED, AS REQUIRED.

UTILITY NOTES

1. CONTRACTOR TO CONFIRM LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. CONTRACTOR SHALL ASSUME ALL LIABILITY FOR DAMAGE TO EXISTING UTILITIES.
2. REFER TO MECHANICAL PLANS FOR GAS METER LOCATIONS.
3. REFER TO ELECTRICAL PLAN FOR ELECTRICAL DETAILS AND LOCATIONS

WATERMAIN NOTES :

1. SPECIFICATIONS :

ITEM	SPEC. NO.	REFERENCE
WATERMAIN TRENCHING-	W17	OTTAWA
SERVICING LINE-	W33	OTTAWA
VALVE & VALVE BOX-	W24	OTTAWA
VALVE & VALVE CHAMBER-	W13	OTTAWA
METER AND REMOTE READER-	W31	OTTAWA
WATER MAIN & HYDRANT-LEADS.	100mm , 200mmø PVC DR-18 & 152mmø PVC DR-18	

2. SUPPLY AND INSTALL ALL WATERMAINS AND APPURTENANCES IN ACCORDANCE WITH CITY OF OTTAWA STANDARDS AND SPECIFICATIONS. CONNECTION TO EXISTING WATERMAIN BY CITY OF OTTAWA FORCES.
3. WATERMAIN SHALL BE INSTALLED MINIMUM 2.4 m DEPTH BELOW GRADE.
4. ALL SERVICES TO BE CONSTRUCTED TO WITHIN 1.0 m OF FOUNDATION WALL AND CAPPED. COORDINATE CONNECTION POINT WITH MECHANICAL CONTRACTOR.
5. WHERE REQUIRED FOR WATERMAINS AND SERVICES IN PROXIMITY TO CATCHBASINS, MAINTENANCE HOLES, CULVERTS ETC. THERMAL INSULATION SHALL BE PROVIDED AS PER CITY OF OTTAWA STANDARD DRAWING NO. W23.

WATERMAIN TABLE

STATION	ELEVATION		DESCRIPTION
	FINISHED GRADE	TOP OF WATERMAIN	
0+000	91.17	±88.77	CONNECTION TO EXISTING 150mmø WATERMAIN
0+001	91.16	88.76	PROPOSED VALVE & VALVE BOX
0+004	91.10	88.70	PROPOSED 200 TO 150 REDUCER
0+009.2	90.90	88.50	PROPOSED 45° BEND (HORIZONTAL)
0+020	91.80	89.40	PROPOSED 200mmø WATERMAIN
0+031.6	92.00	89.60	PROPOSED 45° BEND (HORIZONTAL)
0+040	91.00	88.60	PROPOSED 200mmø WATERMAIN
0+060	90.70	88.30	PROPOSED 200mmø WATERMAIN
0+080	90.70	88.30	PROPOSED 200mmø WATERMAIN
0+100	90.70	88.30	PROPOSED 200mmø WATERMAIN
0+120	91.00	88.60	PROPOSED 200mmø WATERMAIN
0+123.3	91.10	88.70	PROPOSED 45° BEND (HORIZONTAL)
0+140	90.53	88.13	PROPOSED 200mmø WATERMAIN
0+142.5	90.53	88.13	PROPOSED BUILDING SERVICE (100x200 TEE, V & VB)
0+160	90.40	88.00	PROPOSED 200mmø WATERMAIN
0+165.0	90.20	87.80	PROPOSED VALVE & HYDRANT
0+171	89.80	87.40	PROPOSED CAPPED WATERMAIN

NO.	ISSUE	DATE
05	FOR BUILDING PERMIT	JUNE 08.05
04	SI-C2, GENERAL REVISIONS	MAY 10.05
03	GENERAL REVISIONS	APR.06.05
02	SITE SERVICING AND GRADING TENDER	MAR.17.05
01	SITE PLAN CONTROL	FEB.28.05

SCALE: 1:250

0 5 10 15 20m

J.L.Richards
ENGINEERS·ARCHITECTS·PLANNERS

J.L. Richards & Associates Limited
864 Lady Ellen Place
Ottawa, ON Canada
K1Z 5M2
Tel: 613 728 3571
Fax: 613 728 6012

PROFESSIONAL STAMP

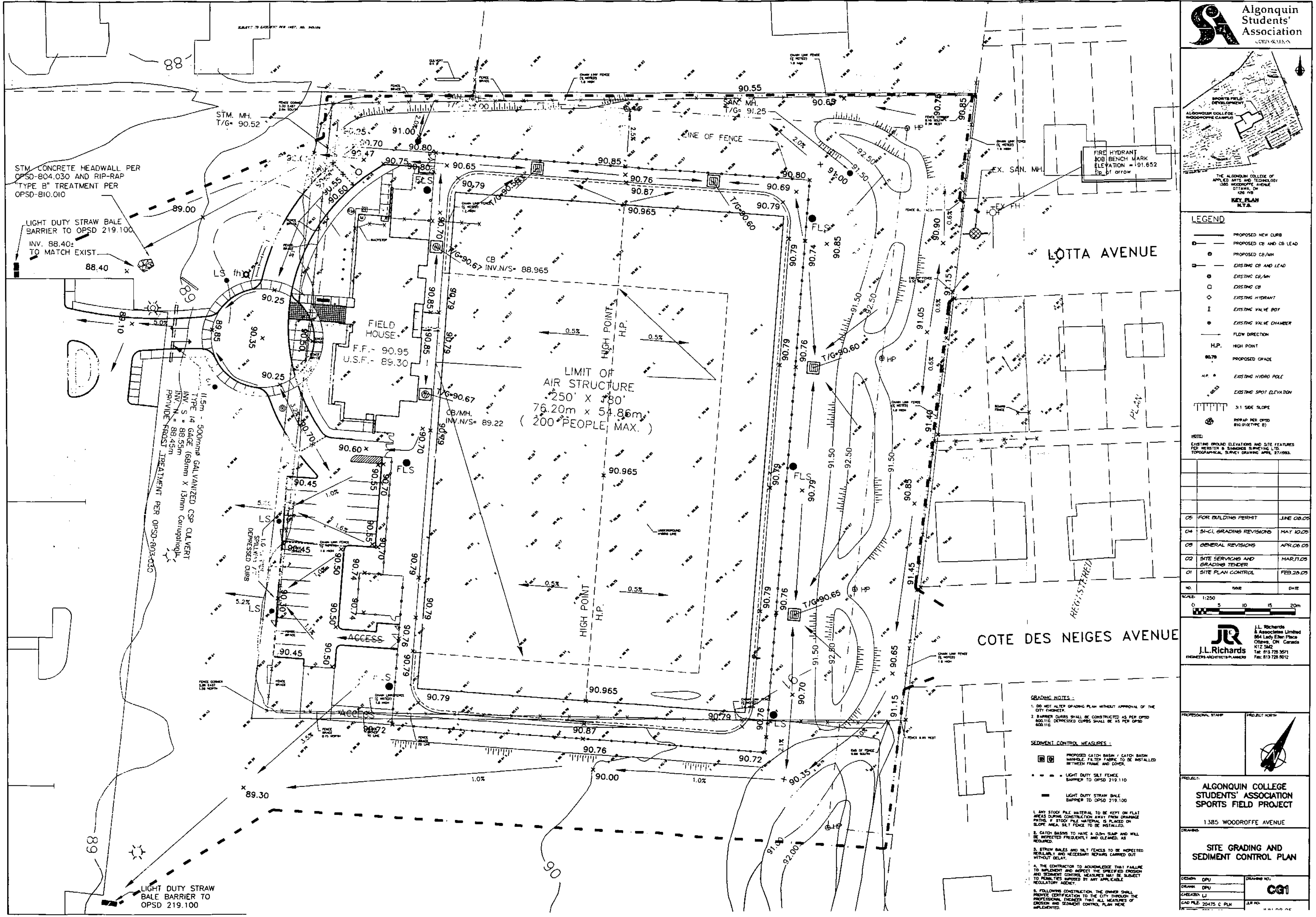
PROJECT NORTH

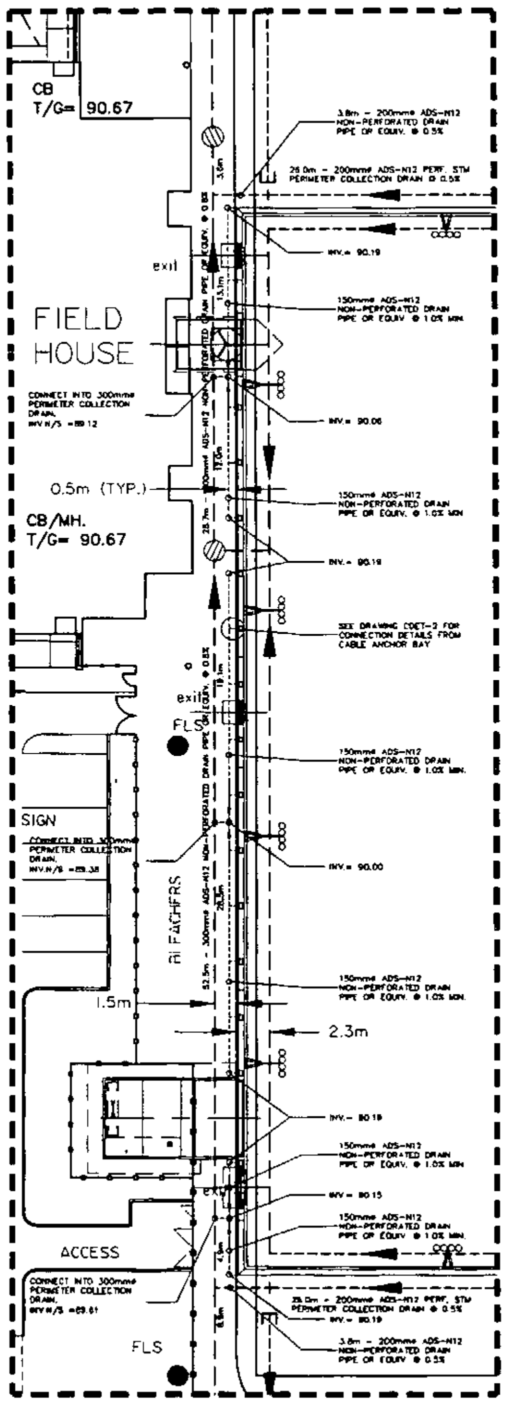
PROJECT:
ALGONQUIN COLLEGE STUDENTS' ASSOCIATION SPORTS FIELD PROJECT

1385 WOODROFFE AVENUE

DRAWING:
SITE SERVICING PLAN

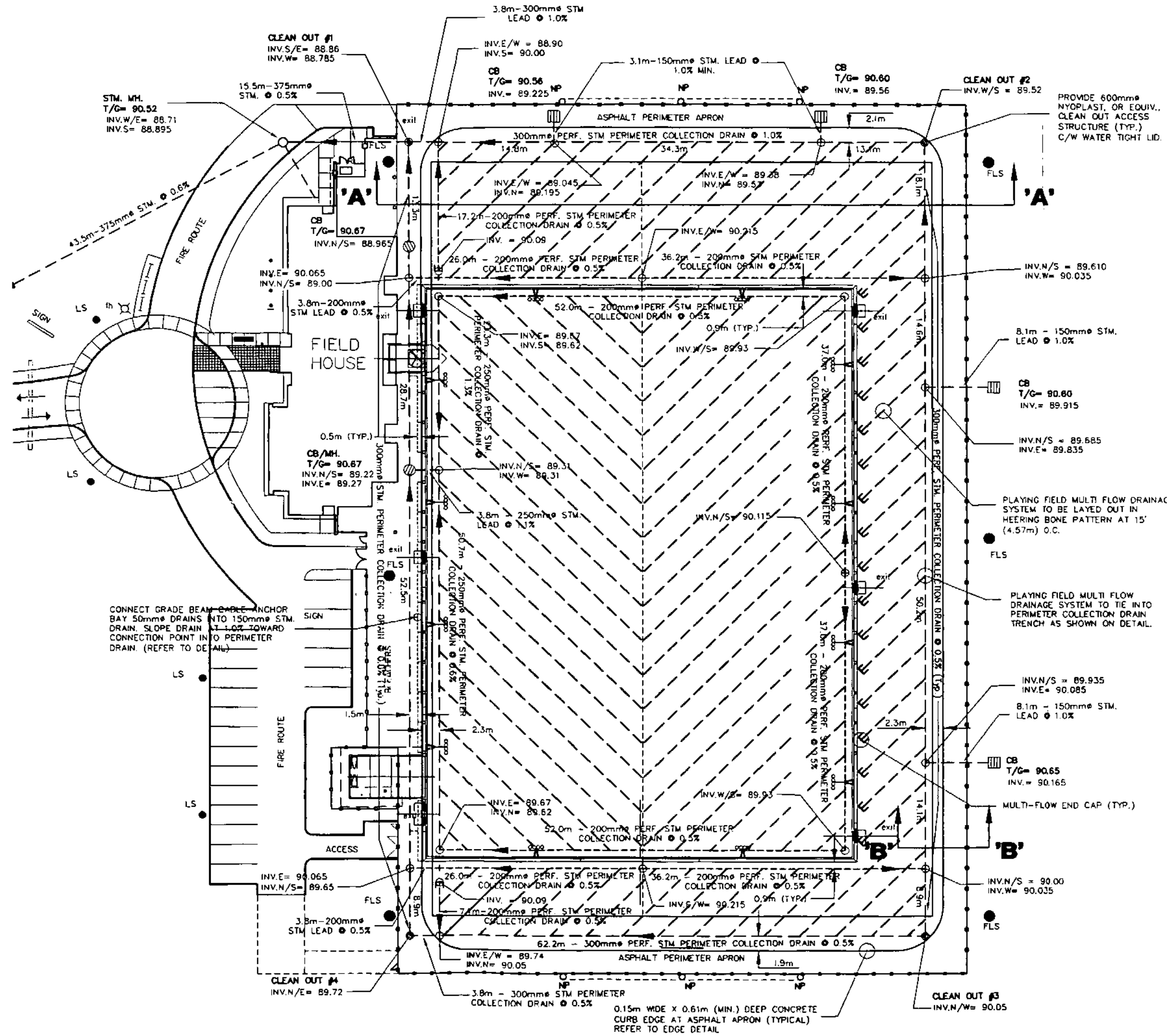
DESIGN	DPU	DRAWING NO.	CS1
DRAWN	DPU		
CHECKED	LJ		
CAD FILE	20475 C PLN	JLR NO.	20475
PLOTTED	FEB 24.05		


Algonquin Students' Association
LOTTA AVENUE
COTE DES NEIGES AVENUE
FIELD HOUSE
F.F.- 90.95
U.S.F.- 89.30
LIMIT OF AIR STRUCTURE
250' X 180'
76.20m x 54.86m
(200 PEOPLE MAX.)
HIGH POINT H.P.
STM. MH. T/G= 90.52
STM. CONCRETE HEADWALL PER OPSD-804.030 AND RIP-RAP "TYPE B" TREATMENT PER OPSD-810.010
LIGHT DUTY STRAW BALE BARRIER TO OPSD 219.100
INV. 88.40± TO MATCH EXIST.
11.5m - 500mmø GALVANIZED CSP CULVERT TYPE 14 GAGE (68mm X 13mm Corrugation) INV. S = 88.55m INV. N = 88.45m PROVIDE FROST TREATMENT PER OPSD-803.030
SAN. MH. T/G= 91.25
LINE OF FENCE
FIRE HYDRANT BOB BENCH MARK ELEVATION = 91.652 top of arrow
EX. SAN. MH.
CB INV.N/S= 88.965
CB/MH. INV.N/S= 89.22
ACCESS
SPILLWAY DEPRESSED CURB
LIGHT DUTY STRAW BALE BARRIER TO OPSD 219.100
THE ALGONQUIN COLLEGE OF APPLIED ARTS AND TECHNOLOGY 1385 WOODROFFE AVENUE OTTAWA, ON
KEY PLAN N.T.S.
LEGEND
PROPOSED NEW CURB
PROPOSED CB AND CB LEAD
PROPOSED CB/MH
EXISTING CB AND LEAD
EXISTING CB/MH
EXISTING CB
EXISTING HYDRANT
EXISTING VALVE BOX
EXISTING VALVE CHAMBER
FLOW DIRECTION
H.P. HIGH POINT
PROPOSED GRADE
EXISTING HYDRO POLE
EXISTING SPOT ELEVATION
3:1 SIDE SLOPE
RIPRAP PER OPSD 810.010(TYPE B)
NOTE:
EXISTING GROUND ELEVATIONS AND SITE FEATURES PER WEBSTER & SIMMONDS SURVEYING LTD. TOPOGRAPHICAL SURVEY DRAWING APRIL 27/1993.
05 FOR BUILDING PERMIT JUNE 08.05
04 SI-C1 GRADING REVISIONS MAY 10.05
03 GENERAL REVISIONS APR.06.05
02 SITE SERVICING AND GRADING TENDER MAR.11.05
01 SITE PLAN CONTROL FEB.28.05
NO. ISSUE DATE
SCALE: 1:250
J.L.Richards
ENGINEERS ARCHITECTS PLANNERS
Ottawa, ON Canada
Tel: 613 728 3571
Fax: 613 728 6012
GRADING NOTES :
1. DO NOT ALTER GRADING PLAN WITHOUT APPROVAL OF THE CITY ENGINEER.
2. BARRIER CURBS SHALL BE CONSTRUCTED AS PER OPSD 600.110. DEPRESSED CURBS SHALL BE AS PER OPSD 600.110.
SEDIMENT CONTROL MEASURES :
PROPOSED CATCH BASIN / CATCH BASIN MANHOLE. FILTER FABRIC TO BE INSTALLED BETWEEN FRAME AND COVER.
LIGHT DUTY SILT FENCE BARRIER TO OPSD 219.110
LIGHT DUTY STRAW BALE BARRIER TO OPSD 219.100
1. ANY STOCK PILE MATERIAL TO BE KEPT ON FLAT AREAS DURING CONSTRUCTION AWAY FROM DRAINAGE PATHS. IF STOCK PILE MATERIAL IS PLACED ON SLOPE AREA, SILT FENCE TO BE INSTALLED.
2. CATCH BASINS TO HAVE A 0.5m SUMP AND WILL BE INSPECTED FREQUENTLY AND CLEANED, AS REQUIRED.
3. STRAW BALES AND SILT FENCES TO BE INSPECTED REGULARLY AND NECESSARY REPAIRS CARRIED OUT WITHOUT DELAY.
4. THE CONTRACTOR TO ACKNOWLEDGE THAT FAILURE TO IMPLEMENT AND INSPECT THE SPECIFIED EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.
5. FOLLOWING CONSTRUCTION, THE OWNER SHALL PROVIDE CERTIFICATION TO THE CITY THROUGH THE PROFESSIONAL ENGINEER THAT ALL MEASURES OF EROSION AND SEDIMENT CONTROL PLAN WERE IMPLEMENTED.
PROFESSIONAL STAMP
PROJECT NORTH
PROJECT:
ALGONQUIN COLLEGE STUDENTS' ASSOCIATION SPORTS FIELD PROJECT
1385 WOODROFFE AVENUE
DRAWING:
SITE GRADING AND SEDIMENT CONTROL PLAN
DESIGN DPU
DRAWN DPU
CHECKED LJ
CAD FILE 20475 C PLN
DRAWING NO. CG1



DETAIL OF DRAIN ADJACENT TO WEST GRADE BEAM WALL

SCALE : 1:200 (METRIC)



SCALE 1:250 (METRIC)

Algonquin Students' Association Corporation

No.	ISSUE	DATE
03	FOR BUILDING PERMIT	JUNE 08.05
02	REVISED FIELD DRAIN LAYOUT PER ICI DESIGN	APR.01.05
01	SITE SERVICING AND GRADING TENDER	MAR.17.05

SCALE: AS NOTED

J.L.Richards
ENGINEERS·ARCHITECTS·PLANNERS
J.L. Richards & Associates Limited
864 Lady Ellen Place
Ottawa, ON Canada
K1Z 5M2
Tel: 613 728 3571
Fax: 613 728 6012

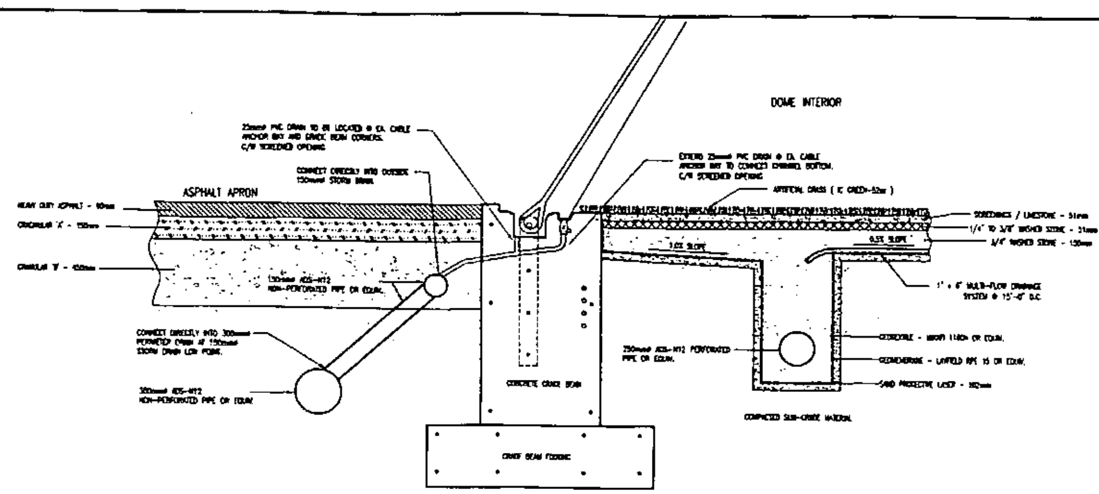
PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:
ALGONQUIN COLLEGE STUDENTS' ASSOCIATION SPORTS FIELD PROJECT
1385 WOODROFFE AVENUE

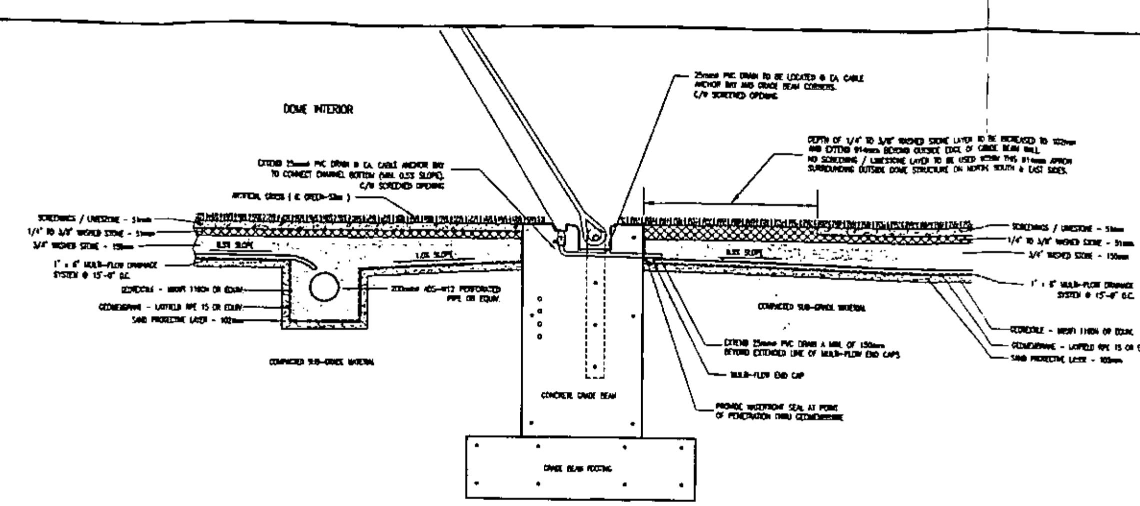
DRAWING:
SPORTS FIELD DRAINAGE LAYOUT AND DETAILS

DESIGN: DPU
DRAWN: DPU
CHECKED: LI
CAD FILE: 20475 C DET
PLOTTED: MAR.17.05
DRAWING NO.: CDET
JLR NO.: 20475



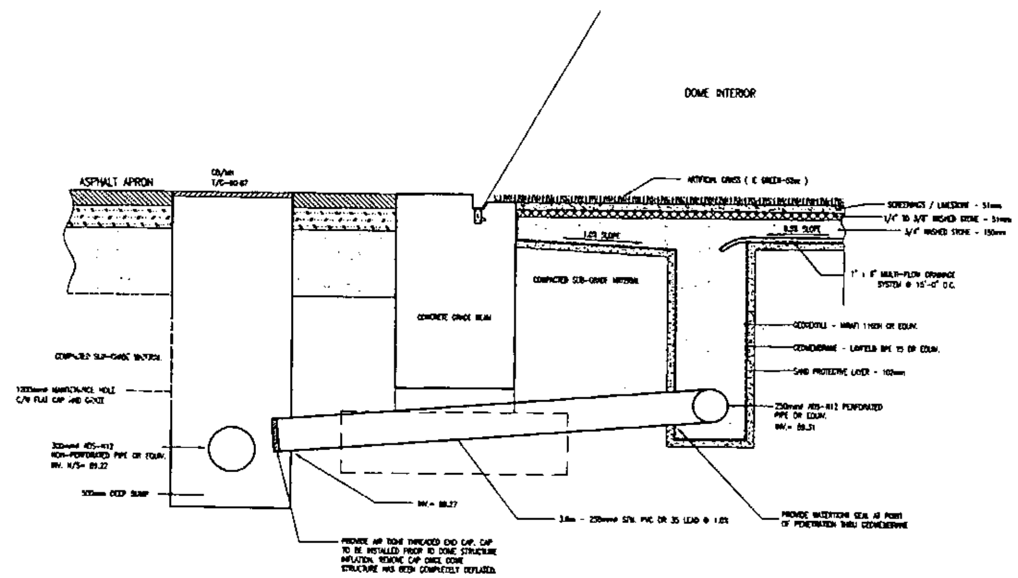
TYPICAL SECTION THRU GRADE BEAM (WEST SIDE)

N.T.S.



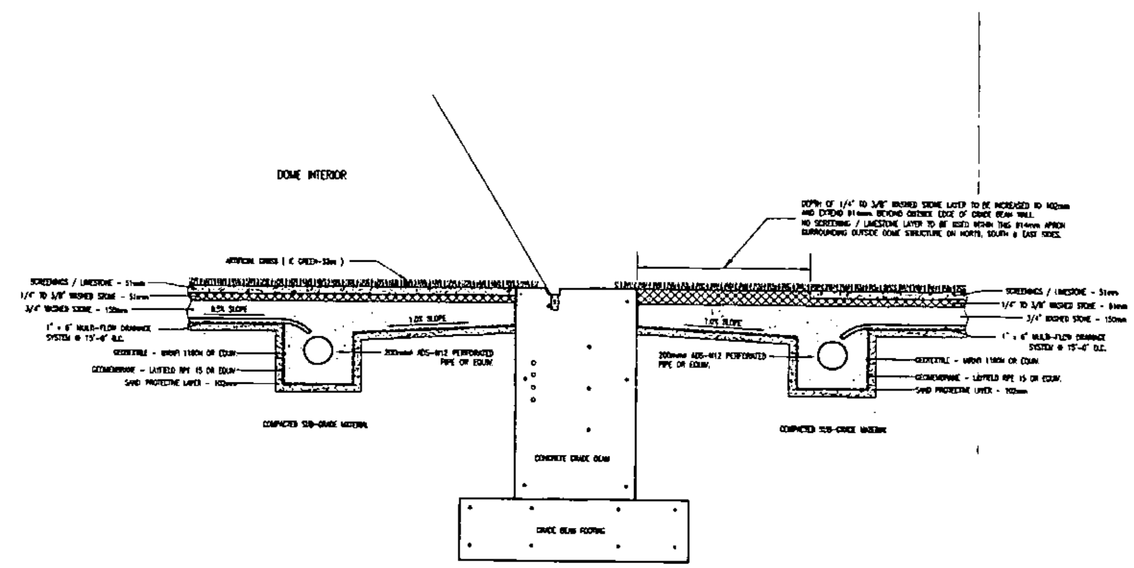
TYPICAL SECTION THRU GRADE BEAM (EAST SIDE)

N.T.S.



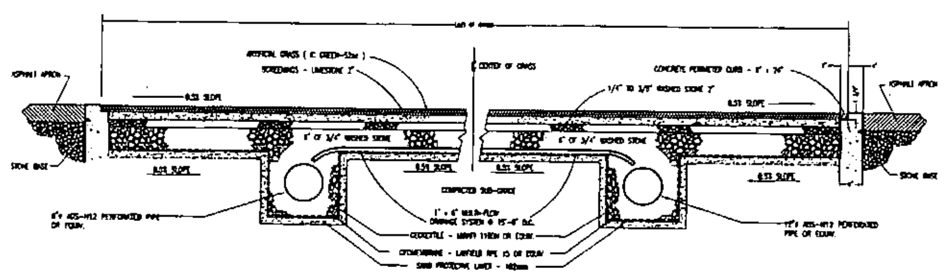
SECTION THRU GRADE BEAM AT INTERIOR PERIMETER COLLECTION DRAIN CONNECTION TO CATCH BASIN MANHOLE STRUCTURE

N.T.S.



TYPICAL SECTION THRU GRADE BEAM (NORTH AND SOUTH SIDES)

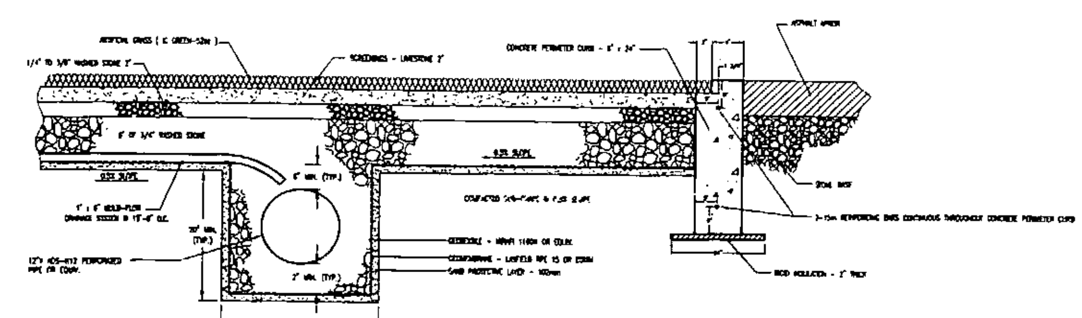
N.T.S.



TRANSVERSE SECTION THRU FIELD

SECTION 'A' - 'A'

(NOT TO SCALE)



TYPICAL FIELD COLLECTION DRAIN TRENCH AND CONCRETE PERIMETER CURB EDGE DETAIL

SECTION 'B' - 'B'

(NOT TO SCALE)

Algonquin Students' Association

NO.	ISSUE	DATE
01	FOR BUILDING PERMIT	JUNE 08.05

SCALE: AS NOTED

J.L.Richards
ENGINEERS·ARCHITECTS·PLANNERS

J.L. Richards & Associates Limited
864 Lady Ellen Place
Ottawa, ON Canada
K1Z 5M2
Tel: 613 728 3571
Fax: 613 728 6012

PROFESSIONAL STAMP | PROJECT NORTH

PROJECT:
ALGONQUIN COLLEGE STUDENTS' ASSOCIATION SPORTS FIELD PROJECT

1385 WOODROFFE AVENUE

DRAWING:
SPORTS FIELD DRAINAGE DETAILS

DESIGN: DPU
DRAWN: DPU
CHECKED: LJ
CAD FILE: 20475 C DET2
PLOTTED: MAR.17.05

DRAWING NO.: CDET2

JOB NO.: 20475

APPENDIX 2

PRE- AND POST-DEVELOPMENT STORMWATER RUNOFF CALCULATIONS

ROJECT:

ALGONQUIN COLLEGE
SPORTS FIELD PROJECT

DRAWING:

EXISTING SAINT NICHOLAS
SCHOOL SITE – 1999

J.L.Richards
ENGINEERS·ARCHITECTS·PLANNERS

J.L. Richards
& Associates Limited
864 Lady Ellen Place
Ottawa, ON Canada
K1Z 5M2
Tel: 613 728 3571
Fax: 613 728 6012

DESIGN: DPU	DRAWING NO.: FIGURE 4
CHECKED:	
CAD FILE: 20475 C FIG4	JLR NO: 20475
PLOTTED:	

PROJECT:

ALGONQUIN COLLEGE
SPORTS FIELD PROJECT

DRAWING:

EXISTING SAINT NICHOLAS
SCHOOL SITE – 2002

J.L.Richards
ENGINEERS·ARCHITECTS·PLANNERS

J.L. Richards
& Associates Limited
864 Lady Ellen Place
Ottawa, ON Canada
K1Z 5M2
Tel: 613 728 3571
Fax: 613 728 6012

DESIGN: DPU	DRAWING NO.: FIGURE 5
CHECKED:	
CAD FILE: 20475 C FIG5	JLR NO: 20475
PLOTTED:	

CITY OF OTTAWA

ALGONQUIN COLLEGE
SPORTS FIELD

Stormwater Management Calculations

SUMMARY OF TRIBUTARY AREAS

Existing Conditions (Pre-Development)

A_T = 1.7390 ha

A_{roof} = 0.1671 ha @ C=0.9
A_{asph} = 0.3944 ha @ C=0.9
A_{gravel} = 0.4976 ha @ C=0.7
A_{green} = 1.7390 ha - (0.1671 + 0.3944 + 0.4976) ha = 0.6799 ha @ C=0.2

C_{avg} = {(0.1671 + 0.3944) *0.9)+(0.4976 *0.7)+(0.6799*0.2)} / 1.7390
C_{avg} = **0.57**

$Q_5 = 2.78 \times C_{avg} \times I_5 \times A$
where: C_{avg}=0.57
A=1.7390 ha
I_5 = 70.25 mm/hr [1:5 year Intensity based on a T_c=20]

Q_5 = 2.78 x 0.57 x 70.25 mm/hr x 1.7390 ha = 193.6 L/s; USE 195 L/s

$Q_{100} = 2.78 \times C_{avg} \times I_{100} \times A$
where: C_{avg}=0.57
A=1.7390 ha
I_{100} = 119.95 mm/hr [1:100 year Intensity based on a T_c=20]

Q_{100} = 2.78 x 0.57 x 119.95 mm/hr x 1.7390 ha = 330.5 L/s; USE 330 L/s

Future Conditions (Post-Development)

Used Artificial Turf: C=0.5

A_T = 1.7390 ha

A_{roof} = 0.4906 ha @ C=0.9
A_{asph} = 0.2975 ha @ C=0.9
A_{turf} = 0.3074 ha @ C=0.5
A_{gravel} = 0.0092 ha @ C=0.7
A_{green} = 1.7390 ha - (0.4906 + 0.2975 + 0.3074 + 0.0092) ha = 0.6343 ha @ C=0.2

C_{avg} = {(0.4906 + 0.2975) *0.9)+(0.3074 *0.5)+(0.0092 *0.7)+(0.6343*0.2)} / 1.7390
C_{avg} = 0.57

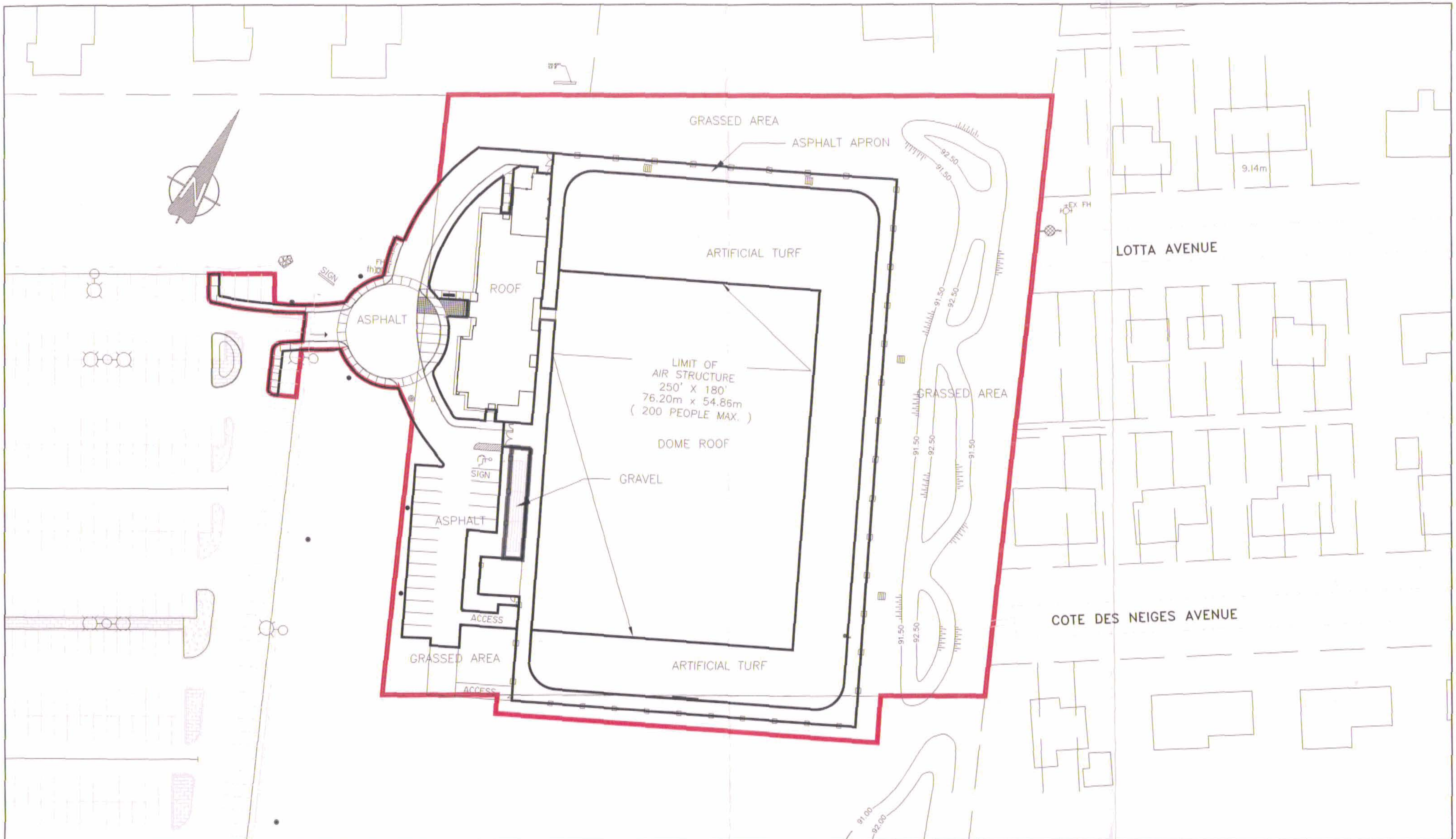
$Q_5 = 2.78 \times C_{avg} \times I_5 \times A$
where: C_{avg}=0.57
A=1.7390 ha
I_5 = 70.25 mm/hr [1:5 year Intensity based on a T_c=20]

Q_5 = 2.78 x 0.57 x 70.25 mm/hr x 1.7390 ha = 193.6 L/s; USE 195 L/s

$Q_{100} = 2.78 \times C_{avg} \times I_{100} \times A$
where: C_{avg}=0.57
A=1.7390 ha
I_{100} = 119.95 mm/hr [1:100 year Intensity based on a T_c=20]

Q_{100} = 2.78 x 0.57 x 119.95 mm/hr x 1.7390 ha = 330.5 L/s; USE 330 L/s

PROJECT:	DRAWING:		DESIGN: DPU	DRAWING NO.:
ALGONQUIN COLLEGE SPORTS FIELD	PRE-DEVELOPMENT LAND USE SCALE : 1:750 (METRIC)	J.L.Richards ENGINEERS·ARCHITECTS·PLANNERS J.L. Richards & Associates Limited 864 Lady Ellen Place Ottawa, ON Canada K1Z 5M2 Tel: 613 728 3571 Fax: 613 728 6012	CHECKED: LJ CAD FILE: 20475 C PLN PLOTTED: JUNE 2005	FIGURE 6 JLR NO: 20475



PROJECT: ALGONQUIN COLLEGE SPORTS FIELD	DRAWING: POST-DEVELOPMENT LAND USE SCALE : 1:750 (METRIC)	J.L.Richards ENGINEERS·ARCHITECTS·PLANNERS J.L. Richards & Associates Limited 864 Lady Ellen Place Ottawa, ON Canada K1Z 5M2 Tel: 613 728 3571 Fax: 613 728 6012	DESIGN: DPU CHECKED: LJ CAD FILE: 20475 C FIG7 PLOTTED: JUNE 2005	DRAWING NO.: FIGURE 7 JLR NO.: 20475

Appendix A-V

CONTENTS

Stormwater Management Report – ACCE Building 17 pages

REPORT

Stormwater Management Report

Algonquin College – Centre for Construction Trades and Building Sciences Building

Ottawa, Ontario

Presented to:

City of Ottawa

For:
Site Plan Control Approval
110 Laurier Avenue West, 4th Floor
Ottawa, Ontario, K1P 1J1

Report No. 2085345.001 December 10, 2008

L:\PROJ\2085345\300 - ENGINEERING\302 - INFRASTRUCTURE\08 STORMWATER\DRAINAGE REPORT MH.DOC

TABLE OF CONTENTS

		Page
1.	INTRODUCTION	1
2.	DRAINAGE PATTERN	1
3.	DESIGN CRITERIA	2
4.	STORM DESIGN CALCULATIONS	2
5.	CONCLUSIONS	4

LIST OF TABLES **After Page**

Table 4.1	Existing Site Conditions	2
Table 4.2	City of Ottawa Runoff Coefficient Restriction	2
Table 4.3	Storage Requirements for Asphalt Parking Lot	3
Table 4.4	Storage Requirements for Asphalt Roof	3
Table 4.5	Storage Requirements for Green Roof	3

LIST OF FIGURES

Figure 2.1	Site Location Plan	1
Figure 2.2	Existing Baseline Transit Station Drainage Patterns	1

APPENDICIES

Appendix A Transitway Station Rehabilitation Phase A – Baseline Station

Appendix B Centerpointe Expansion Study – Site Plan – Grading Plan

1. INTRODUCTION

Algonquin College is proposing a new Centre for Construction Trade and Building Sciences (CCTBS) for their Woodroffe Campus. The existing School of Transportation and Building Trades building was constructed over 20 years ago as a temporary location for the department. The facilities are outdated and unable to support the technologies required for today's industry. The new CCTBS will be able to help meet the needs for well trained workers for the construction industry in Eastern Ontario.

The proposed location for the CCTBS is on the west side of Woodroffe Avenue across form the existing campus. The CCTBS will be part of a larger campus expansion on the west side of Woodroffe Ave that will take place over the next few decades. The CCTBS will be constructed to a Leadership in Energy and Environmental Design (LEED) Gold standard. This will provide an environment for demonstrating and teaching new energy efficient technologies for the ever expanding green construction industry.

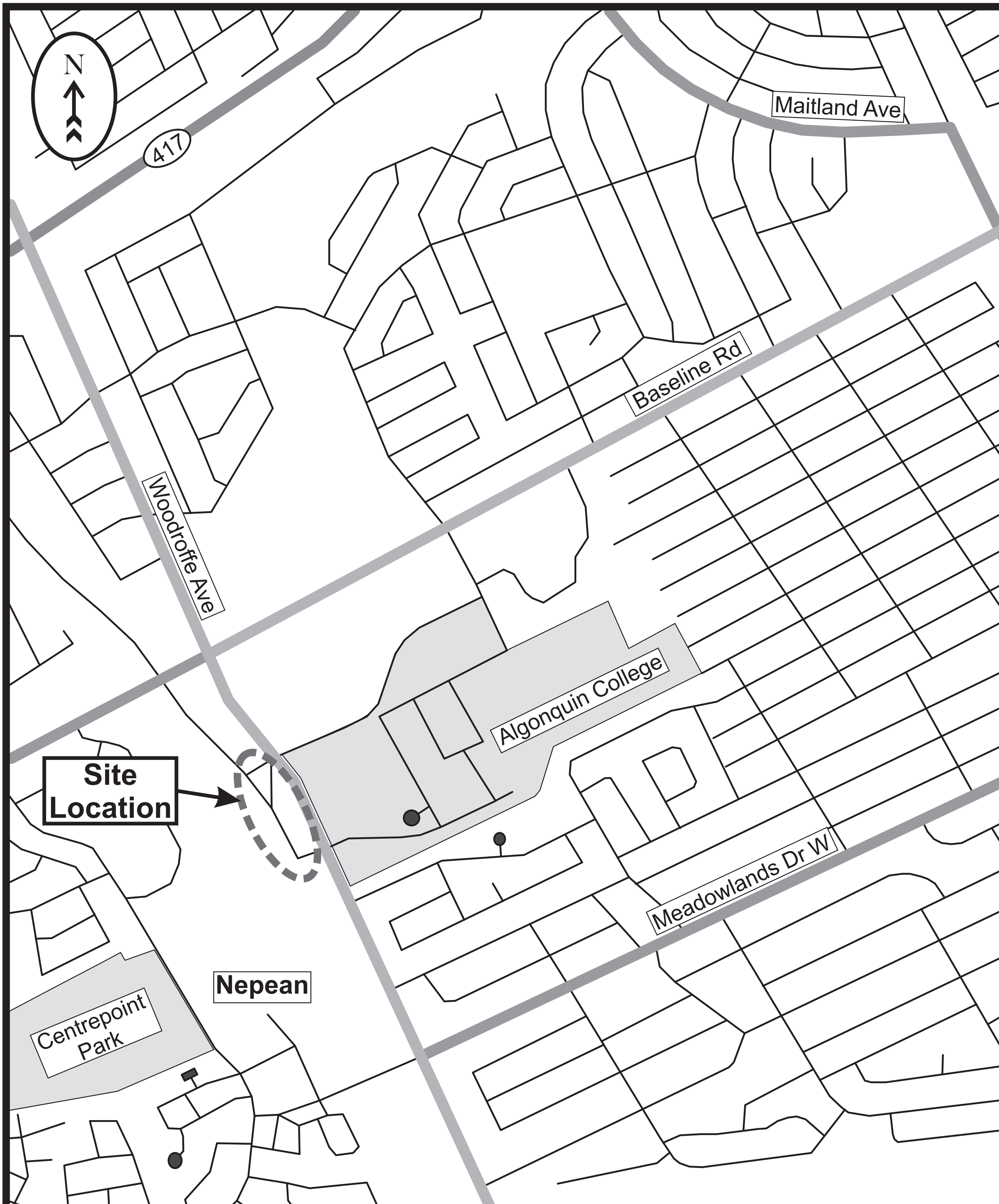
To gain City of Ottawa (City) approval for the CCTBS a stormwater management report is required. This report will determine the pre-construction flow estimates for the site which is currently occupied by the Baseline Transit Station, and calculate the post-construction flow estimates of the CCTBS. The City requires that the post-construction flow be limited to those associated with a runoff coefficient of 0.50. Any flow over and above the maximum allowable flow must be attenuated on site.

2. DRAINAGE PATTERN

The existing Baseline Transit Station (see Figure 2.1) is located on 1.15 ha of land located west of Woodroffe Avenue and just south of Baseline Road in the former City of Nepean. The Baseline Transit Station consists of an elevated platform in the center of the site with several small buildings, paved bus lanes on either side of the platform and landscaping surrounding the station. The Transit Station is serviced by a storm sewer along the west bus lane that drains into the storm sewer along the east bus lane. This sewer eventually drains into a 2440 mm storm sewer along Woodroffe Ave. The Woodroffe Ave. storm sewer outlets north to Pinecrest Creek.

The existing Baseline Transit storm sewer can be broken down into 18 drainage areas (see Figure 2.2). The outline of the CCTBS is overlain on the existing site and shows two areas (A3 and A14) which currently do not drain to the Baseline Transit Station storm sewer. Area A14 drains east to Woodroffe Ave. while Area A3 drains west to the southwest transitway. Since these areas eventually drain to the 2440 mm storm sewer on Woodroffe Ave., they were included in the calculation of the pre-construction drainage area.

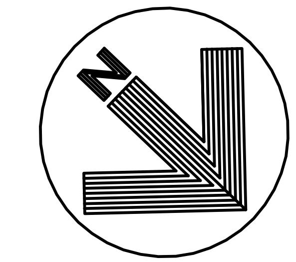
Some areas outside of the CCTBS outline are not included in the pre-construction drainage area, including a portion of areas A12 to A18. The size of the Baseline Station storm sewer was obtained from City drawings (see Appendix A). However, the slope is unknown; therefore, the pipes were modeled at the minimum slope allowed under the City of Ottawa guidelines that would provided sufficient capacity to carry the 5-year storm. This represents the worst case scenario. We expect the existing Baseline Station storm sewer has more capacity than what is assumed in the modeling.



MORRISON HERSHFIELD

Algonquin College
CCTBS Building - Site Location

Figure 2.1



GRAPHIC LEGEND

F= HYDRANT	
MANHOLE-STORM OR SANITARY SEWER	
CATCH BASIN	
CAP	
86.57	ELEVATION
PROPERTY LINE	
1	DRAINAGE NUMBER
0.48	RUNOFF COEFFICIENT
0.17	TOTAL AREA (ha)

SERVICE LEGEND

ABANDONED LINE	ABANDONED
PROPANE GAS	GAS — GAS
SANITARY SEWER	SAN — SAN
SERVICE WATER	W — W
STORM SEWER	ST — ST
OVERHEAD WIRES	OHW — OHW
BURIED POWER	P — P

GENERAL NOTES

ISSUE	DESCRIPTION	DATE	BY

MORRISON HERSHFIELD

EXISTING BASELINE TRANSIT STATION
DRAINAGE PATTERNS

SCALE: NTS

DATE: DECEMBER 2008

DESIGNED: EJD

DRAWN: GMC

APPROVED: FH

DRAWING No.:

FIGURE 2.2

3. DESIGN CRITERIA

It is assumed that the site falls under the City of Ottawa category of an existing separated area. This category requires the storm sewer system to convey the 5-year storm and requires attenuating of the 100-year storm. Drainage calculation records for the sewers on Woodroffe Avenue are not available from the City of Ottawa for reference. As such, the allowable discharge rate into the sewers in the post-construction must not exceed the lower of the discharge rate of the pre-construction condition or the peak flow associated with a runoff coefficient of 0.50.

The existing Transit way provides an overland flow outlet for the 100-year storm. However, the plan is to place the existing transitway in a trench. By lowering the transitway, the overland flow route would no longer be available. Therefore the onsite attenuation of the 100-year storm would be required for the proposed CCTBS. Stormwater detention alternatives have been investigated including rooftop storage and the use of underground cisterns.

There are two possible configurations for the roof of the CCTBS that will be explored in this report. The first configuration is the installation of a traditional asphalt roof over the entire building. The second configuration is the installation of a green roof on the high bay section of the building. The proposed green roof configuration is shown in Appendix B.

4. STORM DESIGN CALCULATIONS

The capacity calculations for the Baseline Station storm sewer are shown in Table 4.1. The capacity of the existing Baseline Station storm sewer was evaluated using the 5-year storm from the Ottawa IDF Curve. The Baseline Transit Station would be considered a commercial property. Therefore, the City of Ottawa Sewer Design Guidelines stipulate a time of concentration of 10 minutes. The Baseline Station storm sewer drains an area of 1.15 ha with a drainage breakdown as seen in Figure 2.2. The estimated pre-construction flow for the Baseline Station storm sewer is 156.75 L/s flowing into MH1.

The City of Ottawa has further restricted the allowable peak flow by reducing the runoff coefficient for the site from an existing value of 0.62 (calculated assuming a runoff coefficient of 0.90 for asphalt and 0.25 for landscaped areas) to 0.50. Table 4.2 shows the calculation of the 5 year storm runoff for the existing site assuming a runoff coefficient of 0.50. The City's runoff coefficient restriction of 0.50 results in a flow of 137.35 L/s (see Table 4.2) for the existing site. Therefore all flow in excess of 137.35 L/s must be stored on the CCTBS site.

A site that reduces both the peak flow and runoff volume by at least 25% is given LEED points. In order to reduce the flow by 25% the flow to the storm sewer would have to be 117.56 L/s (156.75 - 0.25 * 156.75 = 117.56). Therefore, to help achieve the Gold LEED standard, the flow from the CCTBS site will be reduced to 117.56 L/s.

Appendix B shows the proposed CCTBS building on the west side of Woodroffe Ave. The CCTBS will occupy an area of 1.15 ha, consisting of 0.74 ha building roof, 0.08 ha asphalt parking lot, and 0.33 ha of landscaping. There are two possible roof combinations for the proposed CCTBS. The first roof combination would be to place a traditional asphalt roof on the entire building. The second combination is to place a green roof on the one storey high bay

Table 4.1 - 5 Year Flows - Existing Site
Algonquin College
Existing Site Conditions

MORRISON HERSHFIELD

LOCATION			INDIVIDUAL							CUMULATIVE		DESIGN				PROPOSED SEWER									
Street / Areas	From	To	Asphalt Area	Lawn Areas	Bldg. Area	Gravel Area	Other	Total	R*A*N	Area	R*A*N	Time of Conc.	Rainfall Intensity	Peak Flow		Length	Size	Grade	Minimum Slope	Full Capacity	Full Velocity	Time of Flow	Reserve Capacity	Upstream Invert	Downstream Invert
			(ha)	(ha)	(ha)	(ha)	(ha)	(ha)		(ha)		(min.)	(mm/hr)	(L/s)	(m^3/s)	(m)	(mm)	(%)	(%)	(L/s)	(m/s)	(min)	(L/s)	(m)	(m)
Baseline Station	CB1	CB2	0.01	0.01				0.02	0.03	0.02	0.03	10.00	104.19	3.62	0.004	10	305	0.34	0.00	58.93	0.81	0.21	55.30		
Baseline Station	CB2	CB3	0.04	0.00				0.05	0.11	0.06	0.15	10.21	103.11	15.18	0.015	1	305	0.34	0.02	58.93	0.81	0.02	43.75		
Baseline Station	CB3	CB4	0.04	0.08				0.12	0.16	0.19	0.27	10.23	103.01	28.28	0.028	26	305	0.34	0.08	58.93	0.81	0.54	30.65		
Baseline Station	CB4	CB5	0.01	0.01				0.03	0.04	0.21	0.20	10.76	100.32	20.09	0.020	20	305	0.34	0.04	58.93	0.81	0.41	38.83		
Baseline Station	CB5	CB6	0.02	0.03				0.06	0.08	0.27	0.12	11.18	98.36	11.89	0.012	20	305	0.34	0.01	58.93	0.81	0.41	47.03		
Baseline Station	CB6	CB7	0.03	0.04				0.08	0.11	0.35	0.19	11.59	96.48	18.39	0.018	8	305	0.34	0.03	58.93	0.81	0.17	40.53		
Baseline Station	CB7	CB8	0.03	0.03				0.07	0.11	0.41	0.65	11.76	95.75	61.90	0.062	11	381	0.25	0.11	91.46	0.80	0.23	29.55		
Baseline Station	CB8	CB9	0.03	0.02				0.05	0.08	0.46	0.73	11.99	94.76	69.12	0.069	15	381	0.25	0.14	91.46	0.80	0.31	22.34		
Baseline Station	CB9	CB10	0.03	0.03				0.06	0.09	0.52	0.79	12.30	93.45	73.63	0.074	15	381	0.25	0.16	91.46	0.80	0.31	17.83		
Baseline Station	CB12	CB13	0.04					0.04	0.10	0.04	0.10	10.00	104.19	10.57	0.011	28	305	0.34	0.01	58.93	0.81	0.58	48.36		
Baseline Station	CB13	CB14	0.04					0.04	0.10	0.08	0.20	10.58	101.23	20.08	0.020	38	381	0.25	0.01	91.46	0.80	0.79	71.37		
Baseline Station	CB14	CB15	0.06					0.06	0.14	0.13	0.24	11.37	97.48	22.93	0.023	38	381	0.25	0.02	91.46	0.80	0.79	68.53		
Baseline Station	CB15	CB10	0.05					0.05	0.11	0.18	0.25	12.16	94.03	23.59	0.024	22	381	0.25	0.02	91.46	0.80	0.46	67.86		
Baseline Station	CB10	CB11	0.02	0.01				0.03	0.05	0.73	1.09	12.61	92.15	100.60	0.101	8	457	0.20	0.11	131.19	0.80	0.17	30.59		
Baseline Station	CB11	CB16	0.09	0.08				0.17	0.29	0.90	1.34	12.78	91.48	123.01	0.123	19	457	0.20	0.17	132.86	0.81	0.39	9.85		
Baseline Station	CB16	MH1	0.11	0.14				0.25	0.37	1.15	1.74	13.17	89.97	156.75	0.157	61	457	0.30	0.28	162.72	0.99	1.02	5.97		
END OF RUN - DISCHARGE TO EXISTING WOODROFFE AVENUE SEWER																									
Total			0.66	0.50				1.15	1.99																

Q = RAIN, where Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area: R = 0.90
Lawn Area: R = 0.25
Building Area: R = 0.85
Gravel Area: R = 0.50
Other: R = 0.40
Total Site: R = 0.62

$I = \frac{A}{(T_d + C)^B}$ where I = Rainfall Intensity (mm/hr) for a 5-Year Storm
T_d = Time of Concentration (min)
A = 998.071
B = 0.814
C = 6.053

Prepared by EJD

Checked by FH December 10, 2008

Project No. 2085345

ALGONQUIN COLLEGE

Table 4.2 - 5 Year Flows - Existing Site
Algonquin College
City of Ottawa Runoff Coefficient Restriction

MORRISON HERSHFIELD

LOCATION			INDIVIDUAL							CUMULATIVE		DESIGN				PROPOSED SEWER									
Street / Areas	From	To	Asphalt Area	Lawn Areas	Bldg. Area	Gravel Area	Other	Total	R*A*N	Area	R*A*N	Time of Conc.	Rainfall Intensity	Peak Flow		Length	Size	Grade	Minimum Slope	Full Capacity	Full Velocity	Time of Flow	Reserve Capacity	Upstream Invert	Downstream Invert
			(ha)	(ha)	(ha)	(ha)	(ha)	(ha)		(ha)		(min.)	(mm/hr)	(L/s)	(m^3/s)	(m)	(mm)	(%)	(%)	(L/s)	(m/s)	(min)	(L/s)	(m)	(m)
Baseline Station	CB1	CB2	0.01	0.01				0.02	0.03	0.02	0.03	10.00	104.19	2.63	0.003	10	305	0.34	0.00	58.93	0.81	0.21	56.30		
Baseline Station	CB2	CB3	0.04	0.00				0.05	0.06	0.06	0.09	10.21	103.11	9.26	0.009	1	305	0.34	0.01	58.93	0.81	0.02	49.66		
Baseline Station	CB3	CB4	0.04	0.08				0.12	0.17	0.19	0.24	10.23	103.01	24.42	0.024	26	305	0.34	0.06	58.93	0.81	0.54	34.50		
Baseline Station	CB4	CB5	0.01	0.01				0.03	0.04	0.21	0.21	10.76	100.32	20.86	0.021	20	305	0.34	0.04	58.93	0.81	0.41	38.06		
Baseline Station	CB5	CB6	0.02	0.03				0.06	0.08	0.27	0.11	11.18	98.36	11.12	0.011	20	305	0.34	0.01	58.93	0.81	0.41	47.81		
Baseline Station	CB6	CB7	0.03	0.04				0.08	0.10	0.35	0.18	11.59	96.48	17.54	0.018	8	305	0.34	0.03	58.93	0.81	0.17	41.38		
Baseline Station	CB7	CB8	0.03	0.03				0.07	0.09	0.41	0.57	11.76	95.75	54.86	0.055	11	381	0.25	0.09	91.46	0.80	0.23	36.60		
Baseline Station	CB8	CB9	0.03	0.02				0.05	0.07	0.46	0.64	11.99	94.76	60.65	0.061	15	381	0.25	0.11	91.46	0.80	0.31	30.81		
Baseline Station	CB9	CB10	0.03	0.03				0.06	0.08	0.52	0.69	12.30	93.45	64.81	0.065	15	381	0.25	0.13	91.46	0.80	0.31	26.65		
Baseline Station	CB12	CB13	0.04					0.04	0.06	0.04	0.06	10.00	104.19	5.87	0.006	28	305	0.34	0.00	58.93	0.81	0.58	53.05		
Baseline Station	CB13	CB14	0.04					0.04	0.05	0.08	0.11	10.58	101.23	11.16	0.011	38	381	0.25	0.00	91.46	0.80	0.79	80.30		
Baseline Station	CB14	CB15	0.06					0.06	0.08	0.13	0.13	11.37	97.48	12.74	0.013	38	381	0.25	0.00	91.46	0.80	0.79	78.72		
Baseline Station	CB15	CB10	0.05					0.05	0.06	0.18	0.14	12.16	94.03	13.11	0.013	22	381	0.25	0.01	91.46	0.80	0.46	78.35		
Baseline Station	CB10	CB11	0.02	0.01				0.03	0.04	0.73	0.88	12.61	92.15	80.72	0.081	8	457	0.20	0.07	131.19	0.80	0.17	50.47		
Baseline Station	CB11	CB16	0.09	0.08				0.17	0.24	0.90	1.13	12.78	91.48	103.28	0.103	19	457	0.20	0.12	132.86	0.81	0.39	29.58		
Baseline Station	CB16	MH1	0.11	0.14				0.25	0.35	1.15	1.53	13.17	89.97	137.35	0.137	61	457	0.30	0.21	162.72	0.99	1.02	25.37		
END OF RUN - DISCHARGE TO EXISTING WOODROFFE AVENUE SEWER																									
Total			0.66	0.50				1.15	1.61																

Q = RAIN, where Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area: R = 0.50
Lawn Area: R = 0.50
Building Area: R = 0.50
Gravel Area: R = 0.50
Other: R = 0.50
Total Site: R = 0.50

$I = \frac{A}{(T_d + C)^B}$ where I = Rainfall Intensity (mm/hr) for a 5-Year Storm
T_d = Time of Concentration (min)
A = 998.071
B = 0.814
C = 6.053

Prepared by EJD

Checked by FH December 10, 2008

Project No. 2085345

ALGONQUIN COLLEGE

section of the CCTBS (0.52 ha) and a traditional asphalt roof on the 5 storey classroom section of the CCTBS (0.22 ha). The runoff coefficient (R) for the landscaping was assumed to be 0.25, while for the asphalt roof and parking lot and the green roof were assumed to have coefficients of 0.90 and 0.50 respectively. The composite runoff coefficients for the CCTBS roof combinations are as follows.

<u>Traditional Asphalt Roof</u>
$R_{CCTBS} = (R_{Roof} * A_{Roof} + R_{Asphalt} * A_{Asphalt} + R_{Landscaping} * A_{Landscaping})/A_{CCTBS}$
$R_{CCTBS} = (0.90 * 0.74 \text{ ha} + 0.90 * 0.08 \text{ ha} + 0.25 * 0.33 \text{ ha})/ 1.15 \text{ ha}$
$R_{CCTBS} = 0.71$

<u>Green Roof</u>
$R_{CCTBS} = (R_{Roof} * A_{Roof} + R_{Green} * A_{Green} + R_{Asphalt} * A_{Asphalt} + R_{Landscaping} * A_{Landscaping})/A_{CCTBS}$
$R_{CCTBS} = (0.90 * 0.22 \text{ ha} + 0.50 * 0.52\text{ha} + 0.90 * 0.08 \text{ ha} + 0.25 * 0.33 \text{ ha})/ 1.15 \text{ ha}$
$R_{CCTBS} = 0.53$

To determine the storage required on the proposed CCTBS site, peak flows associated with the 100-year (Ottawa IDF Curve) storm on the proposed site were estimated. The first step in calculating the onsite storage was to determine how much storage could be accommodated in the landscaped area and the parking lot by use of Inlet Control Devices (ICDs). It was decided that storing storm water in the landscaped area in front of the main entrance is not desirable. However, the service parking lot proposed on the northwest corner of the site could store excess runoff. Table 4.3 shows the calculation of the peak flow for the service parking lot during the 100-year storm. The storage volume required is determined by subtracting the release rate from the 100-year peak flows to determine the excess runoff. The excess runoff is then multiplied by the time to calculate the storage volume required. This is done for a series of storm durations to determine the maximum storage volume required. The storage volume required for the service parking lot is approximately 24 m^3; this volume could be stored in the parking lot which will have a storage area available of 30 m x 15 m. Based on a maximum ponding depth of 0.3 m, the available storage volume would be 45 m^3.

To determine the release rate for the CCTBS roof, the release rate from the parking lot (5 L/s) and the landscaping area (40.95 L/s) is subtracted from the release rate of 117.56 L/s for the entire site. The remaining release rate for the CCTBS roof is 71.61 L/s. Using this release rate, the maximum required storage volume for the traditional asphalt roof was calculated to be 180.99 m^3 (see Table 4.4). This volume could be stored on the CCTBS roof by installing flow control roof drains. This represents an average depth of approximately 25 mm over the entire roof.

Table 4.5 shows the calculation for the volume required to be stored as 99.30 m^3 if a green roof was used on the CCTBS. Storm water cannot be stored on a green roof; therefore a cistern would have to be constructed on site, probably below grade. There is ample space on site below grade to accommodate a cistern of required size.

Table 4.3 - Storage Calculation

Algonquin College

Storage Requirements for Asphalt Parking Lot

MORRISON HERSHFIELD

Time	Intensity	Peak	Release	Storage	Storage
		Flow	Rate	Rate	Volume
(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
5	242.70	48.58	5.00	43.58	13.07
10	178.56	35.74	5.00	30.74	18.44
15	142.89	28.60	5.00	23.60	21.24
20	119.95	24.01	5.00	19.01	22.81
25	103.85	20.79	5.00	15.79	23.68
30	91.87	18.39	5.00	13.39	24.10
35	82.58	16.53	5.00	11.53	24.21
40	75.15	15.04	5.00	10.04	24.10
45	69.05	13.82	5.00	8.82	23.82
50	63.95	12.80	5.00	7.80	23.40

Proposed CCTBS Building

	Area (ha)	R	R*A*N
Classroom Roof	0.22	0.9	0.55
High Bay Roof	0.52	0.9	1.30
Parking Lot	0.08	0.9	0.20
Landscaping	0.33	0.25	0.23
CCTBS	1.15	0.71	2.28

N = 2.78

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 100-Year Storm

T_d = Time of Concentration (min)

A = 1735.69

B = 0.82

C = 6.014

ALGONQUIN COLLEGE

Table 4.4 - Storage Calculation
Algonquin College

MORRISON HERSHFIELD

Storage Requirements for Asphalt Roof

Time	Intensity	Peak	Release	Storage	Storage
		Flow	Rate	Rate	Volume
(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
5	242.70	449.36	71.61	377.75	113.33
10	178.56	330.60	71.61	258.99	155.39
15	142.89	264.57	71.61	192.96	173.66
20	119.95	222.09	71.61	150.48	180.57
25	103.85	192.27	71.61	120.66	180.99
30	91.87	170.09	71.61	98.48	177.27
35	82.58	152.89	71.61	81.28	170.69
40	75.15	139.13	71.61	67.52	162.05
45	69.05	127.85	71.61	56.24	151.84
50	63.95	118.41	71.61	46.80	140.40

Average Storage Height
24.46 mm

Proposed CCTBS Building

	Area (ha)	R	R*A*N
Classroom Roof	0.22	0.9	0.55
High Bay Roof	0.52	0.9	1.30
Parking Lot	0.08	0.9	0.20
Landscaping	0.33	0.25	0.23
CCTBS	1.15	0.71	2.28

N = 2.78

Release Rate

Existing site restriction	117.56	L/s
Subtract accounted for flows		
Landscaping	40.95	L/s
Parking lot	5.00	L/s
Allowable Release from Roofs	**71.61**	L/s

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 100-Year Storm
T_d = Time of Concentration (min)
A = 1735.69
B = 0.82
C = 6.014

ALGONQUIN COLLEGE

Table 4.5 - Storage Calculation

Algonquin College

Storage Requirements for Green Roof

Time	Intensity	Peak	Release	Storage	Storage
		Flow	Rate	Rate	Volume
(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
5	242.70	309.02	71.61	237.41	71.22
10	178.56	227.35	71.61	155.74	93.44
15	142.89	181.94	71.61	110.33	99.30
20	119.95	152.73	71.61	81.12	97.34
25	103.85	132.22	71.61	60.61	90.92
30	91.87	116.97	71.61	45.36	81.65
35	82.58	105.14	71.61	33.53	70.42
40	75.15	95.68	71.61	24.07	57.76
45	69.05	87.92	71.61	16.31	44.03
50	63.95	81.43	71.61	9.82	29.46

Proposed CCTBS Building

	Area (ha)	R	R*A*N
Classroom Roof	0.22	0.9	0.55
High Bay Roof	0.52	0.5	0.72
Parking Lot	0.08	0.9	0.20
Landscaping	0.33	0.25	0.23
CCTBS	1.15	0.53	1.70

N = 2.78

Release Rate

Existing site restriction	117.56	L/s
Subtract accounted for flows		
Landscaping	40.95	L/s
Parking lot	5.00	L/s
Allowable Release from Roofs	**71.61**	L/s

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 100-Year Storm

T_d = Time of Concentration (min)

A = 1735.69

B = 0.82

C = 6.014

5. CONCLUSIONS

The proposed CCTBS and adjacent landscape area will include a storm sewer system that will convey the storm runoff to the existing sewers on Woodroffe Avenue at a release rate that is 25 % less than the pre-development rate. Post-development runoff will be attenuated on site at the catchbasin in the parking lot and either on the roof or in an onsite cistern. The ponding areas will be designed to store the runoff excess from the 100 year design storm.

The design put forth in this report satisfies the City of Ottawa criteria for controlling the post-development flows and will not impose any extra load on the existing sewer systems.

APPENDIX A

Transitway Station Rehabilitation Phase A – Baseline Station

NO.	REVISIONS	BY	DATE
1	SUBMITTED FOR REVIEW	JES	02/08/09
2	ISSUED FOR TENDER	LSM	02/08/16
3	AS CONSTRUCTED	JES	04/03/29

Ainley CONSULTING ENGINEERS PLANNERS GROUP

NOTE:
The location of the utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned.
The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage

TRANSITWAY STATION REHABILITATION

PART A - BASELINE STATION

GEOMETRY AND GENERAL ARRANGEMENT

R. G. HEWITT, P.ENG. Director Infrastructure Services

V.K. SAHNI, P.ENG. Manager Construction Services - Structures

Dwn. AVH | Chkd. LSM | Des. DGAK | Chkd. LSM

Ottawa

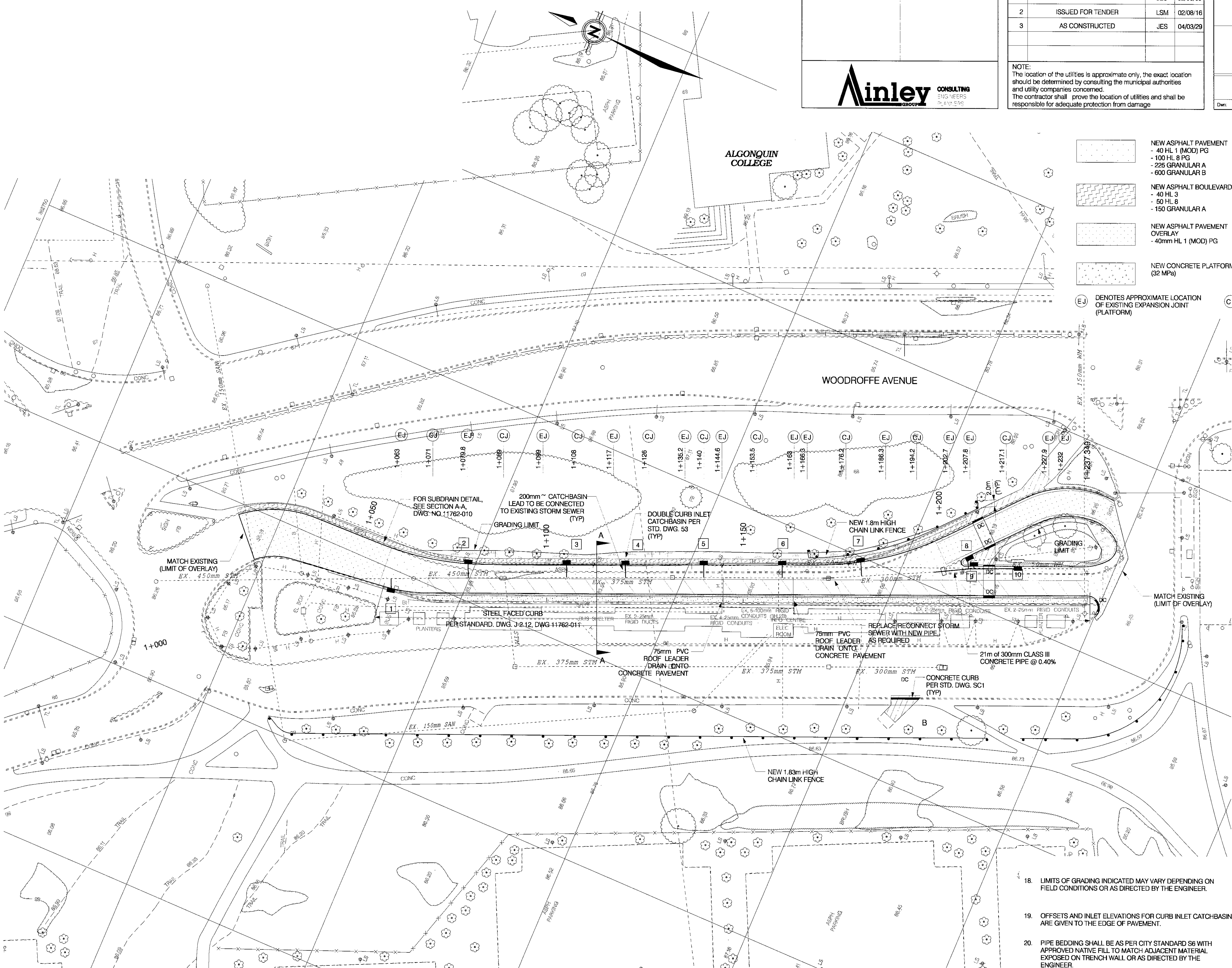
CONTRACT NO. ISB02-6028

DWG. NO. 11762-003

SHEET 3 OF 14

DATE: JULY 2002

SCALE: 0m 10 20



NEW ASPHALT PAVEMENT
- 40 HL 1 (MOD) PG
- 100 HL 8 PG
- 225 GRANULAR A
- 600 GRANULAR B

NEW CONCRETE SIDEWALK (32 MPa)

NEW ASPHALT BOULEVARD
- 40 HL 3
- 50 HL 8
- 150 GRANULAR A

COLOURED & TEXTURED CONCRETE (32 MPa)

NEW ASPHALT PAVEMENT OVERLAY
- 40mm HL 1 (MOD) PG

FULL DEPTH CONCRETE PAVEMENT
- 250mm (32 MPa)

NEW CONCRETE PLATFORM (32 MPa)

TOPSOIL AND SOD

EJ DENOTES APPROXIMATE LOCATION OF EXISTING EXPANSION JOINT (PLATFORM)

CJ DENOTES APPROXIMATE LOCATION OF EXISTING CONSTRUCTION JOINT (PLATFORM)

DC DEPRESSED CURB/ PEDESTRIAN ACCESS RAMP PER STD. DWG. SC 6

GENERAL NOTES

CLASS OF CONCRETE

1. CONCRETE PLATFORM: 32 MPa
   CONCRETE CURB: 32 MPa
   CONCRETE PAVEMENT: 32 MPa

REINFORCING STEEL

1. REINFORCING STEEL SHALL BE SUPPLIED IN ACCORDANCE WITH CSA G30.1B GRADE 400 UNLESS OTHERWISE SPECIFIED.
2. BARS MARKED WITH THE SUFFIX 'C' SHALL BE EPOXY COATED BARS.

CLEAR COVER TO REINFORCED STEEL

1. SLABS - CONCRETE PLATFORM TOP 75mm

CONSTRUCTION NOTES

1. ALL EARTH EXCAVATION PROTECTION AND SUPPORT SHALL BE CARRIED OUT IN ACCORDANCE WITH THE CONSTRUCTION SAFETY ACT. THE CONTRACTOR SHALL ENSURE STABILITY OF EXCAVATION FACES BY SHORING OR OTHER APPROPRIATE APPROVED MEANS.
2. LOCATION OF CONTROL, DUMMY AND EXPANSION JOINTS TO MATCH EXISTING PATTERN UNLESS OTHERWISE SPECIFIED.
3. WHERE NEW COLOURED CONCRETE IS TO BE PLACED ON EXISTING CONCRETE, THE CONTACT SURFACE SHALL BE TREATED WITH APPROVED BONDING AGENT UNLESS OTHERWISE NOTED
4. ALL EXPOSED CONCRETE CORNERS/EDGES SHALL BE PROVIDED WITH A 20mm CHAMFER UNLESS OTHERWISE NOTED.
5. CONCRETE WALKING SURFACES SHALL BE GIVEN A LIGHT BROOM FINISH.
6. SUPPORTS FOR REINFORCING STEEL (THIN SLAB) TO CONFORM TO OPSD-3922.010, DATED NOV. 2001.
7. EXPANSION JOINT MATERIAL TO BE RODOFOAM JOINT FILLER OR APPROVED EQUAL UNLESS OTHERWISE SPECIFIED.
8. ALL MATERIALS TO BE SUPPLIED IN ACCORDANCE WITH THE M.T.O. DESIGNATED SOURCES LIST UNLESS OTHERWISE SPECIFIED.
9. GRANULAR BACKFILL SHALL BE PLACED TO THE LIMITS INDICATED ON THE DRAWING TO 100% STANDARD DRY DENSITY.
10. CURING OF PLATFORM WITH BURLAP AND WATER PER OPSS-904.07.03.05.03 SHALL BE REQUIRED.
11. ALLOW A MINIMUM OF 24 HOURS BETWEEN PLACING OF ADJACENT SLABS.
12. PEDESTRIAN ACCESS TO SIDEWALKS AND WALKWAYS TO BE CONSTRUCTED AS CITY STANDARD SC 6. ACCESS TO PLATFORM SHALL BE CONSTRUCTED TO SUIT EXISTING SCORING PATTERN.
13. AFTER ASPHALT REMOVAL BY DRY GRINDING, IF PADDING IS REQUIRED, IT SHALL BE COMPLETED USING HL 8 ASPHALT TO LIMITS DETERMINED BY THE ENGINEER.
14. CONCRETE CURB PER CITY STANDARD SC 1.
15. CONCRETE SIDEWALK JOINTS SHALL CONFORM TO CITY STANDARD SC 5.
16. NEW SUBDRAIN SHALL BE PLACED ALONG THE ENTIRE LENGTH OF THE NEW CURB PER CITY STANDARD R 1.
17. EXISTING ASPHALT SHALL BE SAWCUT TO ALLOW PLACEMENT OF NEW CURB IN AREAS WHERE THE EXISTING ASPHALT SHALL REMAIN.
18. LIMITS OF GRADING INDICATED MAY VARY DEPENDING ON FIELD CONDITIONS OR AS DIRECTED BY THE ENGINEER.
19. OFFSETS AND INLET ELEVATIONS FOR CURB INLET CATCHBASINS ARE GIVEN TO THE EDGE OF PAVEMENT.
20. PIPE BEDDING SHALL BE AS PER CITY STANDARD S6 WITH APPROVED NATIVE FILL TO MATCH ADJACENT MATERIAL EXPOSED ON TRENCH WALL OR AS DIRECTED BY THE ENGINEER.
21. CURB INLET CATCHBASINS SHALL BE INSTALLED PER CITY STANDARD S 3.
22. BACKFILL AND ADJUSTMENTS FOR MANHOLES SHALL BE PER CITY STANDARD R 2.

AS CONSTRUCTED

$DATES $TIMES $FILES

APPENDIX B

Centerpointe Expansion Study – Site Plan – Grading Plan

TEMPORARY BASELINE STATION
FUTURE LRT / BRT
S/T EASEMENT INST. NO. LT1125014
EASEMENT INST. NO. CR716943
EXISTING WATERMAIN EASEMENT
EXISTING HYDRO EASEMENT
RECREATIONAL PATH
PROPOSED PROPERTY LINE
PEDESTRIAN BRIDGE
HARD and SOFT LANDSCAPE
EX 150mm ø WM
5 FLOORS ABOVE GRADE 120,000sf
TO BE REMOVED
30mx15mx0.3m PROPOSED STORM WATER STORAGE AREA
PROPOSED PAVED AREA
LANDSCAPING
FLOOR=87.10
PROPOSED ALGONQUIN CCTBS BUILDING
1 STOREY HIGH BAY SHOPS ABOVE GRADE 50,000sf
PROPOSED 150mm SANITARY SERVICE CONNECTION @ 2% SLOPE
PROPOSED 450mm STORM @ 2.0% SLOPE
PROPOSED 1200mm SANITARY MH
PROPOSED ENBRIDGE GAS IP HEADER SERVICE
EX 2440mm ø ST
EX 600mm ø SAN FM
EX 250mm ø SAN
S/T EASEMENT
WOODROFFE AVENUE
COLLEGE AVENUE
NAVAHO DRIVE
PROPOSED HYDRO POLE
GRAPHIC LEGEND
F= HYDRANT
MANHOLE-STORM OR SANITARY SEWER
CATCH BASIN
CAP
86.57 ELEVATION
PROPOSED WHITE ROOF
PROPOSED GREEN ROOF
LANDSCAPING
PARKING LOT
SERVICE LEGEND
ABANDONED LINE — ABANDONED
PROPANE GAS — GAS
SANITARY SEWER — SAN
SERVICE WATER — W
STORM SEWER — ST
OVERHEAD WIRES — OHW
BURIED POWER — P
GENERAL NOTES
ISSUE
DESCRIPTION
DATE
BY
MORRISON HERSHFIELD
CENTREPOINTE EXPANSION STUDY - SITE PLAN
GRADING PLAN
SCALE: 1:500
DATE: DECEMBER 2008
DESIGNED: EJD
DRAWN: GMC
APPROVED: FH
DRAWING No.:
APPENDIX B

Appendix A-VI

CONTENTS

Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area 26 pages

STORMWATER MANAGEMENT GUIDELINES FOR THE PINECREST CREEK/WESTBORO AREA

OTTAWA, ON

FINAL DRAFT REPORT

June 2012

Prepared for: Planning and Infrastructure
City of Ottawa

Prepared by:

JFSA Water Resources and Environmental Consultants

JFSA Ref. No.: 741(02)- 11

J.F. Sabourin and Associates Inc.
www.jfsa.com

PREFACE

This report and supporting appendices provide guidelines for stormwater management (SWM) and the use of SWM measures for infill new development and redevelopment projects in the Pinecrest Creek/Westboro area. The SWM Guidelines are a complement to the Pinecrest Creek/Westboro Stormwater Management Retrofit Study. The City of Ottawa initiated the SWM Retrofit Study to improve stormwater management in the Pinecrest Creek subwatershed and in the adjacent part of Westboro. The SWM Retrofit Study was one of 17 projects included in the City's Ottawa River Action Plan.

The Pinecrest Creek/Westboro area, like much of the core of the City, was developed before there was a requirement for municipalities to manage stormwater. For this reason, there are few facilities to treat stormwater in the area. Various conditions along the creek (erosion, flooding, water quality concerns, degraded health of the creek) and the Ottawa River (water quality concerns) stem in whole or in part from uncontrolled stormwater runoff.

Previous Work

In response to the on-going erosion in the Pinecrest Creek corridor, the National Capital Commission, which owns most of the creek corridor lands, commissioned a restoration plan in 2006 to identify a strategy to rehabilitate the creek's degraded condition. The restoration plan was also to improve the creek corridor's ability to accommodate the very "flashy" hydrology given current conditions (i.e., with no SWM measures to better manage excess runoff volumes). The resultant Pinecrest Creek Restoration Plan (JTB Environmental Services et al, 2007) identified and prioritized a number of stream rehabilitation projects along the length of the creek, some of which were implemented in 2008.

The City has also completed studies related to the impacts of wet weather flows on Westboro Beach and the Ottawa River (Baird & Associates, 2002; 2004; 2008). The untreated storm flows from both Pinecrest Creek, and from storm outfalls discharging directly to the Ottawa River upstream of the beach, have been identified as contributing factors to elevated bacterial counts in the Ottawa River. The elevated bacterial counts have resulted in frequent beach closures.

Prior to the initiation of the Pinecrest Creek/Westboro SWM Retrofit Study, a SWM criteria and targets study was accelerated through a separate, preliminary assignment to determine subwatershed based SWM criteria for a number of specific projects in the Pinecrest Creek subwatershed. This accelerated assessment was done to accommodate the imminent development schedule for those projects. The projects involved were: the Algonquin Centre for Construction Trades and Building Sciences (CCTBS) building, the associated relocation of the Southwest Transitway, and the City Archives building. The results of this preliminary assessment, referred to as the Pinecrest/Centrepointe SWM Criteria Study (J.F. Sabourin and Associates Inc. et al, 2010), have been integrated into the Pinecrest Creek/Westboro SWM Retrofit Study.

Role of the Guidelines

The Guidelines address serious and important surface runoff concerns. Pinecrest Creek/Westboro urban runoff is conveyed, by sewers and/or ditches, to either Pinecrest Creek or directly to the Ottawa River. The problem with uncontrolled runoff is that it jeopardizes that which is valued by all, namely - the health of local waterways, the use of beaches and swimming areas, and the security of persons and infrastructure due to increased flood risk and erosion.

By addressing the urban stormwater challenge, the situation over time can be improved. The next step is to describe the SWM criteria that are to be met by development and redevelopment sites and provide examples of how these criteria can be achieved. This is the purpose of this guideline document.

SWM GUIDELINES FOR THE PINECRESTCREEK/WESTBORO AREA NEW DEVELOPMENT, REDEVELOPMENT AND INFILL

Contents

PREFACE i

1. Introduction 1

2. DESIGN REVIEW AND APPROVALS OF SWM Control measure plans for Development, ReDevelopment and Infill in the PineCrest/Westboro ARea 3

2.1 General 3
2.2 Consultation and Planning for Stormwater Management 3
2.3 Application and Approval Process 3
2.3.1 Site Plan Control 4
2.3.2 Development Application Review Process 4
2.3.3 Building Permit Applications 5
2.4 Plans for SWM Measures: Submission Requirements 5

3. STORMWATER MANAGEMENT DESIGN 7

3.1 General 7
3.2 Introduction to Low Impact Development 7
3.3 Design of Stormwater Management Measures 8
3.3.1 Selecting Appropriate SWM Measures 8
3.3.1.1 Land Use *8*
3.3.1.2 Site Conditions *8*
3.3.2 SWM Measure Sizing 10
3.3.2.1 Lot Level SWM Measures – Quantity and Quality Control *10*
3.3.2.2 Minor System *10*
3.3.2.3 Major System *10*
3.3.2.4 External Drainage Areas *11*
3.3.3 Maintenance Considerations 11
3.3.4 SWM Requirements for the Pinecrest Creek and Westboro Area: Development Requiring Site Plan Control Approval 11
3.3.5 Flood Control Requirements 14
3.3.5.1 Draining Directly to the Ottawa River: *14*
3.3.5.2 Draining to Pinecrest Creek: *14*
3.3.6 Runoff Volume and Erosion Control Requirements 17
3.3.6.1 Draining to Pinecrest Creek Upstream of the ORP Pipe (Erosion Mitigation): *17*
3.3.7 Quality Control 18
3.4 SWM Requirements for the Pinecrest Creek and Westboro Area: Development Requiring a Building Permit Only 18
3.5 Sample Approaches 19

4. References 20

FIGURES

Figure 1.1: Pinecrest Creek/Westboro Study Area
Figure 3.1: Soil Permeabilities in the Pinecrest Creek /Westboro Study Area
Figure 3.2: Total Drainage Area and Divides for Pinecrest Creek, Ottawa River Parkway Pipe and the Ottawa River
Figure 3.3: Close-up of Drainage Divides for Pinecrest Creek, Ottawa River Parkway Pipe and the Ottawa River

TABLES

Table 3.1: SWM Guidelines for the Pinecrest Creek /Westboro Study Area
Table 3.2a: Approximate On-Site Storage Volume Requirements (SCS loss procedure)
Table 3.2b: Approximate On-Site Storage Volume Requirements (Horton's loss procedure)

APPENDICES

Appendix A: Examples of SWM Guidelines from Other Jurisdictions in Canada
Appendix B: Checklist for SWM Measures Submissions
Appendix C: Illustrated Glossary of Lot Level SWM Measures
Appendix D: Sample Approaches - Commercial, Multi- and High Density Residential, Small Residential Lot

Endorsement Disclaimer – SWM Guidelines

Reference herein to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement, recommendation, or favouring by the City of Ottawa, or its employees or agents, or by the Guidelines' authors.

Proponent and Designer's Responsibilities

This Guideline presents design recommendations and provides information to assist the designer in complying with the City's SWM criteria. When unusual circumstances or complex problems arise, the applicant and/or applicant's designer are responsible for identifying such conditions and notifying City staff and the appropriate review agencies.

Use of this Guideline does not release the designer from design responsibilities.

1. INTRODUCTION

These Guidelines provide direction for the implementation of stormwater management (SWM) measures for any new development and infill or redevelopment projects within the Pinecrest Creek/Westboro Area. The Guidelines are intended to augment the City of Ottawa Sewer Design Guidelines (November 2004) and the Revised Section 8 – Stormwater Management (September 2008).

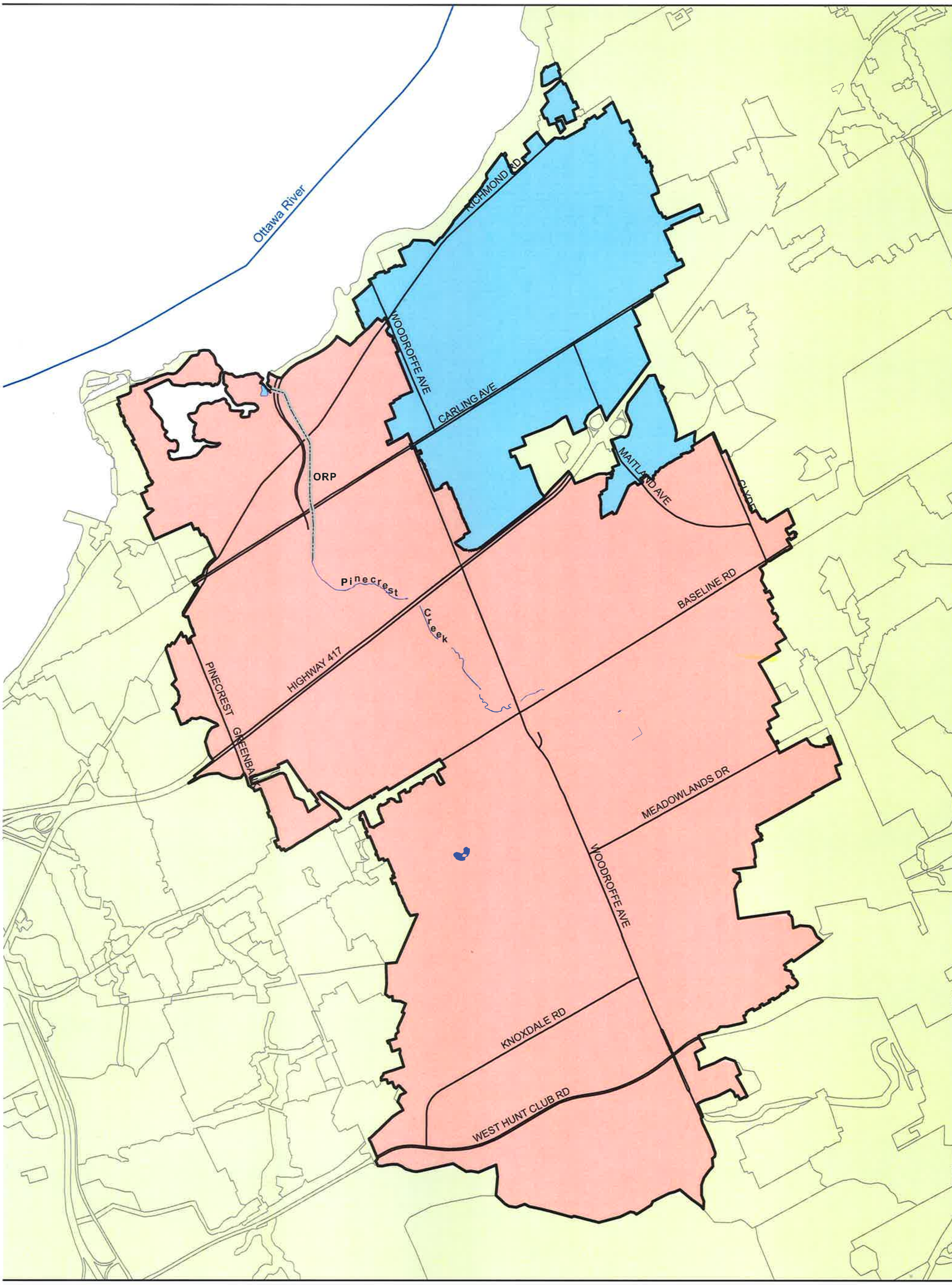
The Guidelines are not intended to be a stand-alone reference for information on the SWM measures cited. Design direction can be found in other references, including the Ministry of Environment's Stormwater Management Planning and Design Manual (2003) and the Credit Valley Conservation and Toronto and Region Conservation Authority's Low Impact Development Stormwater Management Planning and Design Guide (2010). The particular purpose of this guideline document is to identify criteria that are specific to the Pinecrest Creek/Westboro area; these criteria are over and above existing and typical requirements.

The Pinecrest Creek/Westboro study area, shown in Figure 1.1, is between West Hunt Club Road to the south, Greenbank Road/Pinecrest Road to the west, Merivale Road to the east and the Ottawa River to the north. The Westboro portion of the area is generally bound by the Queensway to the south, Woodroffe Avenue to the west, Churchill Avenue to the east and the Ottawa River to the north. Pinecrest Creek is a tributary of the Ottawa River, while the Westboro area drains directly to the Ottawa River via storm sewer outfalls.

The three stormwater management criteria that this guideline addresses are: water quality, peak flow and volume control requirements (to mitigate erosion). Addressing all three criteria will ensure that: the impacts of infill and redevelopment upon both receiving watercourses are mitigated; water quality is not adversely affected; flood risk along Pinecrest Creek is not increased; and, the cumulative impacts of any new developments, infill projects, or redevelopments will not have an adverse affect on the overall health of Pinecrest Creek. These criteria are to be met in addition to those outlined in the City's Sewer Design Guideline, with the most stringent requirements governing.

In all cases an understanding of the form and function of SWM measures and their early incorporation into the development's design is encouraged. In this way SWM measures can be used to achieve both development and environmental goals in the most cost effective manner.

SWM guidelines for water quality control, erosion control and water balance are being applied in jurisdictions across Canada, including the Cities of Toronto, Barrie, Pickering and London and the Lake Simcoe and Region Conservation Authority (LSRCA) in Ontario and the City of Chilliwack in British Columbia. (These examples of SWM guidelines criteria are summarized in Appendix A: Table A1). Several of the regions incorporate similar design criteria. For example, most of these Ontario municipalities require Enhanced Level 1 protection for water quality control, as per the Ontario Ministry of the Environment (MOE) SWM guidelines. It is also noted that for erosion control, most of these municipalities require that the runoff from the 25 to 30 mm storm be captured on-site and released slowly.



LEGEND:

Legend
- Ottawa River Parkway Pipe (ORP)
- Roads_Clipped
- Main Roads
- Pinecrest Creek
- BritanniaSWMpond
- Ottawa River
- Westboro Study Area
- Pinecrest Study Area
- Stormsewer_Outfalls

CLIENT: Ottawa

NOTES:
- The background data was provided by the City of Ottawa

0 185 370 740 1,110 1,480 Meters

N

NOV 2011 REV. 4

BY: JFSA Water Resources and Environmental Consultants

PROJECT: STORMWATER MANAGEMENT GUIDELINES FOR THE PINECREST CREEK / WESTBORO AREA

TITLE: Study Area

PROJECT No. 741(02)

DESIGN	KM
GIS	KM
CHECK	JFS
REVIEW	JFS

FIGURE 1.1

MAP REF.: 741_02\Design\GIS\Maps\StudyArea_revised2012_v4.mxd

2. DESIGN REVIEW AND APPROVALS OF SWM CONTROL MEASURE PLANS FOR DEVELOPMENT, REDEVELOPMENT AND INFILL IN THE PINECREST/WESTBORO AREA

2.1 General

This section of the Guidelines provides an overview of the City's application and approval process for development, redevelopment and infill and outlines where, in that process, SWM measure plans are considered and reviewed. Also included in this section and its appendices is a description of the review and approval process for SWM measure plans and what information SWM measure submissions should include.

2.2 Consultation and Planning for Stormwater Management

Discussion of SWM measures and the review of SWM measure plans for a proposed development could occur at the following points in the application and approval processes:

a) Pre-Application Consultation – The City strongly encourages applicants, whether pre-application consultation is mandatory or not, to contact City staff to discuss their proposal prior to submitting a formal application. The applicant should contact planning staff to confirm application requirements. This consultation provides an opportunity to discuss the site's SWM and to facilitate consideration of SWM measures early on in the planning of a site's development. Pre-application consultation is mandatory for those developments subject to Site Plan Control approval.

b) Site Plan Review and Approval - For those developments subject to Site Plan Control approval.

c) Building Permit Applications - For all proposed development; the Building Code Services Branch circulates the permit applications to the appropriate Development Review Branch for input.

2.3 Application and Approval Process

The application and approval requirements for site infill, redevelopment and/or development will depend on the following:

1. Does the proposed development meet the zoning?

   If the answer is "Yes" see question #2
   If the answer is "No", a change in zoning is required before proceeding further. Please refer to: http://www.ottawa.ca/residents/planning/zoning_en.html

   Do not know? Please refer to the website noted above.

   During the review of re-zoning applications City staff consider the SWM servicing, and the ability of the property under the proposed zoning to meet SWM requirements.

2. Does the proposed development require a Site Plan and Site Plan Control approval?

   If the answer is "Yes", see Section 2.3.2: Development Application Review Process.
   If the answer is "No", see Section 2.3.3: Building Permit Application.

   Do not know? See Section 2.3.1 for an explanation of Site Plans and Site Plan Control.

2.3.1 Site Plan Control

Note: The following information is provided by the City of Ottawa website. For further details and contact information please refer to:
http://www.ottawa.ca/residents/planning/dev_review_process/dev_application/17_3_5_en.html

Site Plan Control approval is required for commercial and industrial developments, for certain residential projects such as townhouse complexes and apartments, for certain changes in land use and for certain types of development in a Heritage Conservation District.

Generally, the following types of development require Site Plan Control approval:

1. Construction, erection or placing of buildings on lands or additions of 200 m^2 or more in size; and some changes in use; for example, new construction or additions larger than 200 m^2 such as a row of five (5) townhouses, a new drive-through, a new parking lot or an addition to a parking lot that produces ten (10) or more new parking spaces, new planned unit development;
2. Laying out or establishment of a commercial parking lot (and as noted above ten (10) or more new parking spaces is subject to Site Plan Control approval and a parking lot with fewer than ten (10) parking spaces is not);
3. Mobile home parks;
4. Most modifications to lands that have previously received Site Plan Control approval, where a Site Plan Agreement is registered on title; and
5. Applications for Change of Use where there is a requirement under the Zoning By-law for the provision of more than ten (10) parking spaces on the lot, or the owner wants to establish more than ten (10) parking spaces on the lot, or an automobile drive-through or a restaurant is proposed.

In general, single detached, semi-detached duplex, triplex dwellings and additions to street townhouses, as well as accessory buildings or additions under 200 m^2 do not require Site Plan Control approval. In addition, special needs housing/group homes and bed and breakfast establishments, pumping stations, communications towers of certain heights above ground level, Transitway buildings, temporary buildings and alterations and a community building in a park are exempt from Site Plan Control approval.

2.3.2 Development Application Review Process

Note: The following information is provided by the City of Ottawa website. For further details and contact information please refer to: http://www.ottawa.ca/residents/planning/dev_review_process/index_en.html

This application and approval process applies to proposed development, redevelopment and infill projects that require Site Plan Control approval. Depending on the nature of the proposed development (size, type) some of the steps noted below would not be required. However every development application must start with Step 1. The proponent is advised to contact planning staff to confirm the application requirements for his/her proposal.

The twelve steps of the development application review process, which are described in more detail on the City's review process website (url above), are as follows:

Step 1: Pre-Application Consultation – Applicants are strongly encouraged, whether pre-application consultation is mandatory or not, to contact City staff to discuss their proposal prior to submitting a formal application.
Step 2: Application Submission
Step 3: Application Deemed Complete / Reviewed for Adequacy

Step 4: Community "Heads Up" – At this stage, if pre-application public consultation took place with the ward Councillor and community organizations, the assigned staff proceeds directly to Step Five. If pre-application public consultation did not occur, the assigned staff will contact the ward councillor and community organizations who have requested "pre-consultation" to give them a "heads up" about the application. The ward Councillor and community organizations may also request that the assigned staff arrange a meeting with the applicant as part of the "heads up" step in the process.
Step 5: Circulation to Technical Agencies, Community Organizations and Ward Councillor
Step 6: Posting of On-Site Signs
Step 7: Community Information and Comment Session
Step 8: Issue Resolution - Staff Memorandum or Committee Report Preparation
Step 9: Notice of Decision by Staff (Applications Under Delegated Authority)
Step 10: Notice of Public Meeting
Step 11: Notice of Decision by Committee or Council
Step 12: Post Application

2.3.3 Building Permit Applications

Under the Ontario Building Code Act, a building permit is required for the construction of a new building, an addition, or alteration of any building or structure which results in a building area of over 10 m^2.

Building permits can be applied for at any time, however for those developments to which Site Plan Control applies, the permit will not be issued until a registered site plan agreement is in place.

The Building Code review process is designed to ensure that once the building or addition etc. is completed, the minimum building standards for health, safety, structural sufficiency, accessibility and energy conservation have been incorporated and that applicable law has been met. Applicable law in the case of infill residential could include: the Zoning By-law, Demolition Control By-law and the Heritage Act.

For information on the building permit process refer to:
http://ottawa.ca/residents/building_code/permits/index_en.html

2.4 Plans for SWM Measures: Submission Requirements

The following applies to those development proposals requiring **Site Plan Control**:

Submissions describing a development's SWM Control Measures will need to meet the City's SWM Plan submission requirements for format and level of detail. A checklist detailing the required content for the complete SWM measures component of a Site Plan Control submission is included in Appendix B.

The following applies to those development proposals requiring a **Building Permit**:

Development projects that involve construction of a new building, an addition, or alteration of any building or structure which results in a building area of over 10 m^2 (see Section 2.3.3) will require a building permit. This would involve development proposals that require Site Plan Control as well as those that do not.

The information required for a Building Permit application, including the information on the development's SWM measures, is defined by the City's Building By-Law (No. 2005-303). For example the information required by the City's Building By-Law for a House (new building) permit includes:

Grading Plan

- Existing and proposed grade elevations at all lot corners, midpoints, points of grade change, driveways and drainage structures
- Proposed finished floor, top of foundation and u/s footing elevations
- Slope and surface direction runoff, culvert conditions

A "House" is defined by the Ontario Building Code Section 2.20 as a detached house, semi-detached house, townhouse or row house containing not more than 2 dwelling units per house. Information on the City's Building Permit Application requirements and a link to the City's Building Code is provided at the following website:
http://ottawa.ca/en/licence_permit/building_code/homeowner_guide/application/index.html

3. STORMWATER MANAGEMENT DESIGN

3.1 General

This section of the Guidelines describes the SWM criteria for the Pinecrest Creek/Westboro area as well as the selection of appropriate SWM measures. The SWM criteria address flood, runoff volume and water quality control. Terms commonly used in at-source SWM are introduced and defined in the following sections.

3.2 Introduction to Low Impact Development

Low impact development (LID) has been defined as:

> *A stormwater management strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution by managing runoff as close to its source as possible. LID comprises a set of site design strategies that minimize runoff and distributed, small scale structural practices that mimic natural or predevelopment hydrology through the processes of infiltration, evapotranspiration, harvesting, filtration and detention of stormwater. These practices can effectively remove nutrients, pathogens and metals from runoff, and they reduce the volume and intensity of stormwater flows (CVC and TRCA, 2010).*

The two main types of SWM measures that prevent or intercept runoff close to its source are *lot level* and *conveyance* measures.

Lot level measures are on-site SWM practices and are also referred to as at-source controls. These measures can prevent pollutants from being picked up by runoff and can minimize the amount of runoff that leaves the site. They are therefore considered to be the first line of protection for maintaining the health of a watershed. Though each lot (public or private) may be relatively small in size, the use of lot level practices on the sheer number of lots and properties in urbanized areas can combine to provide a powerful and effective means of controlling both the quantity and quality of water moving through an urbanized watershed.

Stormwater conveyance systems direct or convey stormwater from one location to another. Conveyance measures include drainage ditches and storm sewers. SWM measures along the conveyance route can include stormwater exfiltration systems, grassed swales, SWM planters in the right-of-way, and street narrowing/reduced pavement width. Conveyance measures can be used in development/redevelopment sites which have laneways and roadways as part of the development. In these cases SWM measures, such as swales, perforated pipe systems, in-line underground storage system, etc., can be used on-site to provide water quantity, quality and volume control.

An illustrated glossary of a selection of lot level SWM Measures is provided in Appendix C of this guideline. Section 8.3.12: Best Management Practices of the City of Ottawa Sewer Design Guidelines (2008 edition) discuss lot level and conveyance measures. Other references for at-source SWM measures and LID in general are listed in Section 4 (References) of this document and can be found at the following websites:

- Designer's Guide for Low Impact Development Construction Version 1.0 (CVC 2011)
http://www.creditvalleyca.ca/sustainability/lid/images/CVC%20LID%20Manual-DRAFT%209-23-11.pdf

- Low Impact Development Stormwater Management Planning and Design Guide (CVC & TRCA, 2010):
http://www.sustainabletechnologies.ca/Portals/_Rainbow/Documents/LID%20SWM%20Guide%20-%20v1.0_2010_1_no%20appendices.pdf

- Urban Stormwater Retrofit Practices, Urban Subwatershed Restoration Manual Series, August 2007, Manual 3 (Center for Watershed Protection, Maryland, U.S.A.) http://www.cwp.org/
http://www.mawaterquality.org/capacity_building/documents/UrbanStormwaterRetrofitmanual.pdf

- Ontario Guidelines for Residential Rainwater Harvesting Systems:

http://www.sustainabletechnologies.ca/Portals/_Rainbow/Documents/ONTARIO_RWH_GUIDELINES_2010.pdf
http://www.sustainabletechnologies.ca/Portals/_Rainbow/Documents/ONTARIO_RWH_HANDBOOK_2010.pdf

- Permeable Interlocking Concrete Pavements (Interlocking Concrete Pavement Institute, Fourth Edition, 2011)

Available from: http://www.icpi.org

3.3 Design of Stormwater Management Measures

3.3.1 Selecting Appropriate SWM Measures

3.3.1.1 Land Use

The proposed land use and development type will determine in large part which SWM measures are potentially most useful or applicable to a given site. The designer should consider the site's general layout to assess the potential opportunities and challenges for on-site SWM measures early on in the design process.

Questions that designers can ask themselves to help identify SWM measure opportunities, and in SWM measure selection, are:

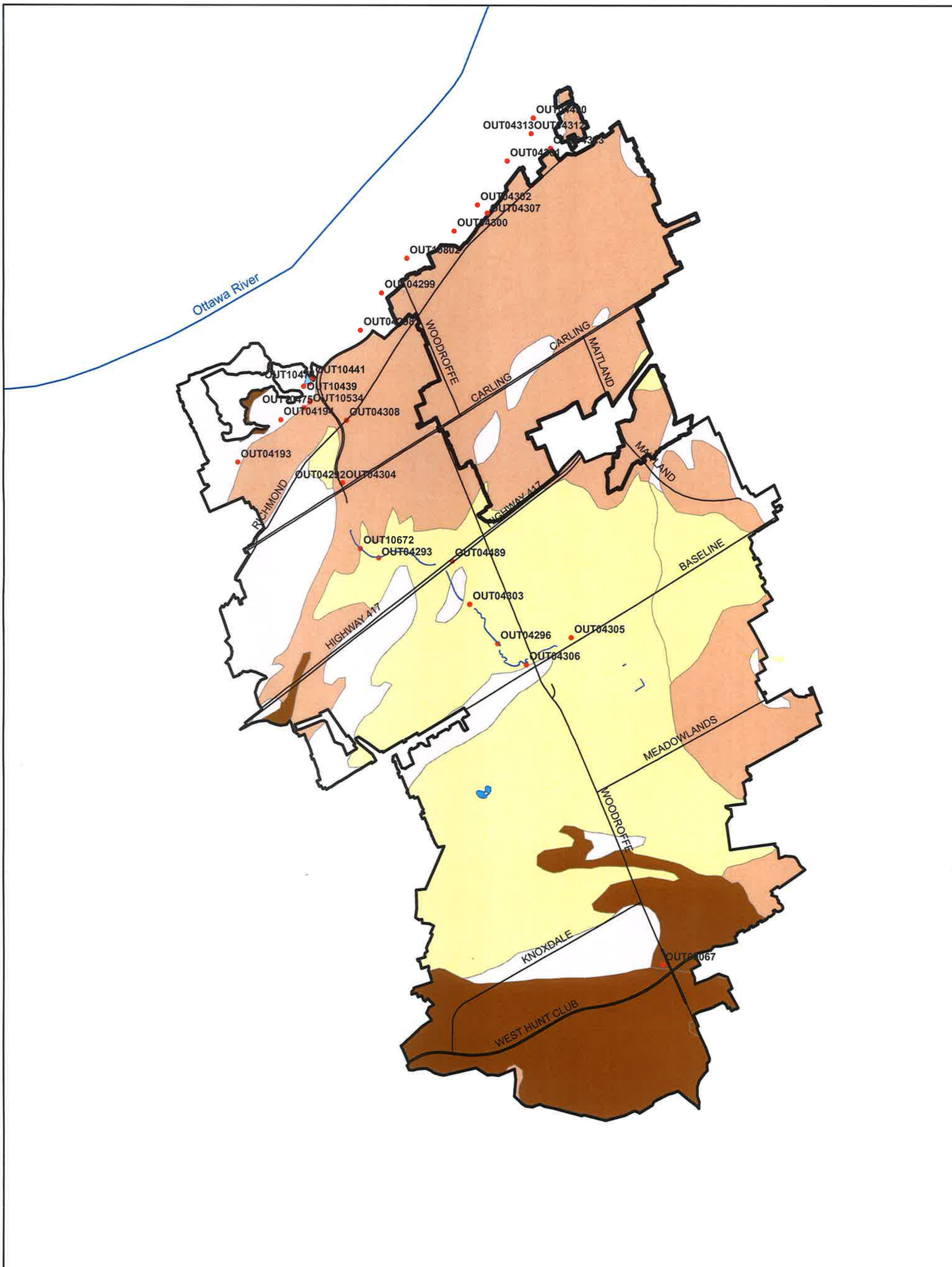
- What percentage of the site will be covered by hard surfaces?
- Is the development a new structure or a renovation/addition?
- If parking is provided, is it underground or above ground?
- Is the roof flat or sloped? Also, is a green roof an option/desirable?

Infiltration measures should not be used on sites or source areas where the land use or activity could generate higher concentrations of hydrocarbons, trace metals or toxicants than are found in typical stormwater runoff (e.g. vehicle refueling, handling areas for hazardous materials). This would include retail gasoline outlet sites due to the potential for spills. In addition these measures should be sited so that they will not receive runoff from high traffic areas where large amounts of de-icing salts are used. In addition, and as noted below, infiltration SWM measures should not be used in areas of possible subsurface contamination.

3.3.1.2 Site Conditions

The physical characteristics of the site, both pre- and post-development, affect which SWM measures are most suitable for a given site. Under certain site conditions the application of specific SWM measures may be impractical. There are several factors, in particular, that prevent the use of infiltration measures. Low native soil infiltration rates (less than 15 mm/hr for retention only and less than 1 mm/hr for combined retention/detention systems, per CVC and TRCA, 2010, p. 4-119) and shallow bedrock, potentially certain bedrock terrains (e.g. karst), and high water table conditions (within 1.0 m of the bottom of any infiltration measure, per CVC and TRCA, 2010) are not suitable for stormwater infiltration. The range in soil permeability that may be found across the study area is shown on Figure 3.1.

The proposed building layout will also influence which measures provide the most cost-effective stormwater management solution. For example, locating underground structures on the site may reduce the site's infiltration potential and increase the required on-site storage volumes, even if the underlying site's native soils have high infiltration rates.



LEGEND:
- Ottawa Storm Sewer Outlets
- Arterial Roads
- OttawaRiver

Soil Permeabilities
- Variable
- Low
- Low-Medium
- High
- Pinecrest Study Area
- Westboro Study Area

CLIENT: Ottawa

NOTES:
- The following data was provided by the City of Ottawa
- This information is based on regional mapping and should not be used for a source of site specific information.
- City of Ottawa Data Layers:
  - Hydrology
  - Infrastructure
  - Soil Permeabilities

0 200 400 800 1,200 1,600 Meters

N

NOV 2011 REV. 0

BY: JFSA Water Resources and Environmental Consultants

PROJECT: SWM GUIDELINES FOR THE PINECREST CREEK/WESTBORO AREA

TITLE: Soil Permeabilities in the Pinecrest/Westboro Area

PROJECT No. 741(02)

DESIGN	KM
GIS	KM
CHECK	JFS
REVIEW	JFS

FIGURE 3.1

MAP REF.: 741(02)\Design\Figures\DrainageAreas.mxd

3.3.2 SWM Measure Sizing

3.3.2.1 Lot Level SWM Measures – Quantity and Quality Control

The two most common concerns in stormwater management are the quality and quantity of rainfall runoff. Lot level SWM measures can be designed and implemented to address both concerns. Water quality and quantity sizing calculations for many SWM measures are provided in the Ministry of the Environment's March 2003 Stormwater Management Planning and Design Manual. The information sources noted in Section 3.3 and several of the manuals listed in the references section of this guideline document provide direction on sizing SWM measures to meet quality and quantity objectives.

The size, imperviousness and land use of areas draining to a SWM measure must be considered when selecting, locating, designing and sizing any SWM measure. Subsurface conditions must also be considered particularly for infiltration/runoff control measures. Native soil infiltration rates are a key factor for determining the appropriate SWM measures and their appropriate application. On-site infiltration testing is required for those developments subject to Site Plan Control approval and the infiltration test results are to be included in the Site Plan Control Application submission (see Appendix B: Checklist for SWM Measures Submissions - Note on Infiltration Tests for further guidance). Infiltration measures should not be used in areas of subsurface contamination.

3.3.2.2 Minor System

The minor system is the underground conveyance portion of a storm sewer network. This system is traditionally designed to convey frequent events, usually the 2, 5 or 10 year storms (City of Ottawa, 2008). Typically the minor system would be comprised of storm sewers which convey flows directly to a receiving watercourse, or end-of-pipe SWM facility without any flow or volume control.

When SWM measures are implemented in lieu of (or in combination with) traditional end-of-pipe SWM facilities, peak flow and runoff volume controls are usually incorporated within or along the minor system (in-line or off-line, respectively). The design of infiltration SWM measures that interact directly with the minor system, often providing stormwater capture to the minor system, typically require the use of perforated rather than solid pipes. Minor System SWM measures may provide detention for less frequent storms, up to and including the 100-year storm, however consideration must be given to ensuring self-cleansing conditions during more frequent storm events (e.g. 5 year).

3.3.2.3 Major System

When stormwater runoff exceeds the minor system capacity a system of overland flow routes/channels conveys the excess runoff to the receiving watercourse or SWM facility. This system of overland flow routes/channels is referred to as the major system. This excess runoff usually results from less frequent events including events up to and exceeding the 100-year storm.

As noted above, when SWM measures are used to control runoff on the lot, runoff from all storms up to the 100-year event will be captured and controlled on-site. Therefore, for developments that are required to control the 100-year design storm on-site the only major system flow path off the site will be the emergency overflow. The emergency overflow would be sized to convey storms in excess of the 100-year design storm.

3.3.2.4 External Drainage Areas

It is sometimes the case within existing urbanized areas that neighbouring runoff will drain uncontrolled onto the subject site. Existing grading constraints often prevent a designer from completely isolating the site from this runoff. Therefore, designers must account for the drainage from surrounding lands. Any runoff that flows onto the site from external areas must be directed and/or conveyed safely to the downstream storm network. The designer will have to confirm, through consultation with the City of Ottawa, whether or not the runoff from external areas will need to be controlled.

3.3.3 Maintenance Considerations

Regular maintenance of SWM measures is required in order for the measures to operate at their design level. Different measures require different types and levels of maintenance. The potential for SWM measures to clog over time must be considered during the design phase, and pre-treatment measures should be included in the SWM design to reduce the likelihood of clogging. The minimum required frequency of regular maintenance for each type of SWM measure will need to be taken into account. In addition to regular maintenance activities, most SWM measures require winter maintenance or winter-proofing. When pre-fabricated materials (e.g., rain barrels, underground storage units, etc.) are used as SWM measures the manufacturer's recommended maintenance requirements and schedule should be followed and met. References describing the type and level of maintenance required for the SWM measures, and agencies that can provide further information on maintenance, are cited in Section 3.2 and in the reference section of this guideline.

3.3.4 SWM Requirements for the Pinecrest Creek and Westboro Area: Development Requiring Site Plan Control Approval

This section augments the City of Ottawa Sewer Design Guidelines Revised Section 8 – Stormwater Management, Sept 2008 by providing SWM criteria that specifically address the needs of the Pinecrest Creek subwatershed and the portions of Westboro that drain to the Ottawa River upstream of Westboro Beach. Direction is provided for the implementation of SWM measures for any infill, new or re-development in the area over and above the requirements of the Sewer Design Guideline.

The three stormwater management criteria addressed are quality, quantity and volume control (erosion) requirements. Addressing all three will help ensure that the overall health of the Creek and local reach of the Ottawa River is not adversely affected by the cumulative impacts of any new developments, or redevelopments. These criteria have been tailored to specific constraints in the receiving watercourse or outlet as well the type (residential, institutional/commercial/industrial (ICI), etc.) and scale (single lot versus. site plan control, etc.) of development. In other words, not all criteria are applicable to all development sites in the study area.

A summary of the SWM criteria for the Pinecrest Creek/Westboro area is provided in Table 3.1: SWM Guidelines for the Pinecrest Creek/Westboro Area.

Table 3.1: SWM Guidelines for the Pinecrest Creek / Westboro Study Area

	Development Type	Runoff Volume Reduction	Water Quality	Water Quantity	
			TSS Removal	Flood Flow Management	Erosion Control
All Locations					
Residential Development *Not* Requiring Site Plan Control Approval					
1	all soil infiltration rates	Provision of a minimum depth of 300mm of amended topsoil over all front yard landscaped areas; and Direction/redirection of downspouts/roof drainage to landscaped areas to minimize runoff.	Inherent TSS removal from on-site retention in landscaped areas.	Not applicable	Not applicable
Draining to the Ottawa River					
Commercial/Institutional and Industrial Developments - discharging directly to the Ottawa River *					
2	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	On-site removal of 80% of TSS.	As per City's Sewer Design Guideline(Section 8.3.7.3, revised Sept. 2008).	Not applicable
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amended soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	On-site removal of 80% of TSS.	As per City's Sewer Design Guideline(Section 8.3.7.3, revised Sept. 2008).	Not applicable
Residential Development Requiring Site Plan Control Approval - discharging directly to the Ottawa River					
3	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	Inherent TSS removal due to on-site retention of the first 10 mm rainfall.	As per City's Sewer Design Guideline(Section 8.3.7.3, revised Sept. 2008).	Not applicable
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amended soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	Inherent TSS removal from on-site retention in landscaped areas.	As per City's Sewer Design Guideline(Section 8.3.7.3, revised Sept. 2008).	Not applicable
Draining to Pinecrest Creek					
Commercial/Institutional and Industrial Developments - discharging upstream of the Ottawa River Parkway (ORP) pipe inlet *					
4	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	On-site removal of 80% of TSS.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Control (detain) the runoff from the 25 mm design storm such that the peak outflow from the site does not exceed 5.8 L/s/ha.
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amended soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	On-site removal of 80% of TSS.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Control (detain) the runoff from the 25 mm design storm such that the peak outflow from the site does not exceed 5.8 L/s/ha.

Table 3.1: SWM Guidelines for the Pinecrest Creek / Westboro Study Area

Development Type		Runoff Volume Reduction	Water Quality	Water Quantity	
			TSS Removal	Flood Flow Management	Erosion Control
Commercial/Institutional and Industrial Developments - discharging directly to Ottawa River Parkway (ORP) pipe *					
5	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	On-site removal of 80% of TSS.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Not applicable
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amended soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	On-site removal of 80% of TSS.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Not applicable
Residential Development Requiring Site Plan Control Approval - discharging upstream of Ottawa River Parkway (ORP) pipe inlet					
6	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	Inherent TSS removal due to on-site retention of the 10 mm and detention of the 25 mm design storms.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Control (detain) the runoff from the 25 mm design storm such that the peak outflow from the site does not exceed 5.8 L/s/ha.
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amended soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	Inherent TSS removal due to on-site retention in landscaped areas and detention of the 25 mm design storm.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Control (detain) the runoff from the 25 mm design storm such that the peak outflow from the site does not exceed 5.8 L/s/ha.
Residential Development Requiring Site Plan Control Approval - discharging directly to Ottawa River Parkway (ORP) pipe					
7	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	Inherent TSS removal due to on-site retention of the 10 mm design storm.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Not applicable
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amended soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	Inherent TSS removal from on-site retention in landscaped areas.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Not applicable

*Infiltration measures should not be used on sites or source areas where the land use or activity could generate higher concentrations of hydrocarbons, trace metals or toxicants than are found in typical stormwater runoff (e.g., vehicle refueling, handling areas for hazardous materials, etc.). This would include retail gasoline outlet sites due to the potential for spills. In addition, these measures should be sited so that they will not receive runoff from high traffic areas where large amounts of de-icing salts are used. The design of these systems shall be in accordance with the guidance in the Stormwater Management Planning and Design Manual (MOE, 2003) and the Low Impact Development Stormwater Management Planning and Design Guide (CVC & TRCA, 2010).

Note: For a mixed use property, if surface parking has been provided the site will be considered commercial. If surface parking has not been provided, the site will be considered residential for the purposes of applying the SWM criteria in this table.

3.3.5 Flood Control Requirements

Flood control criteria are specified based upon the catchment's receiving watercourse (Pinecrest Creek or the Ottawa River) or storm sewer (the Ottawa River Parkway (ORP) pipe or local storm sewer outlet). For example, there are no flood control requirements for discharge directly to the Ottawa River, whereas the limited capacity of the ORP pipe requires a higher level of control to avoid increasing flood risk. (Pinecrest Creek flows are conveyed by the ORP pipe from just south of Carling Avenue to the Ottawa River.)

Note: Flood control requirements are applied only to those developments requiring Site Plan Control.

3.3.5.1 Draining Directly to the Ottawa River:

Developments requiring Site Plan Control that are serviced by outfalls draining directly to the Ottawa River (shown in Figures 3.2 and 3.3) shall provide sufficient flood control storage to meet the most limiting downstream storm sewer capacity. Per the City's Sewer Design Guideline, the capacity of the downstream receiving system shall be assessed when connecting to an existing storm sewer. The allowable release rate to the existing system is to be confirmed with the City.

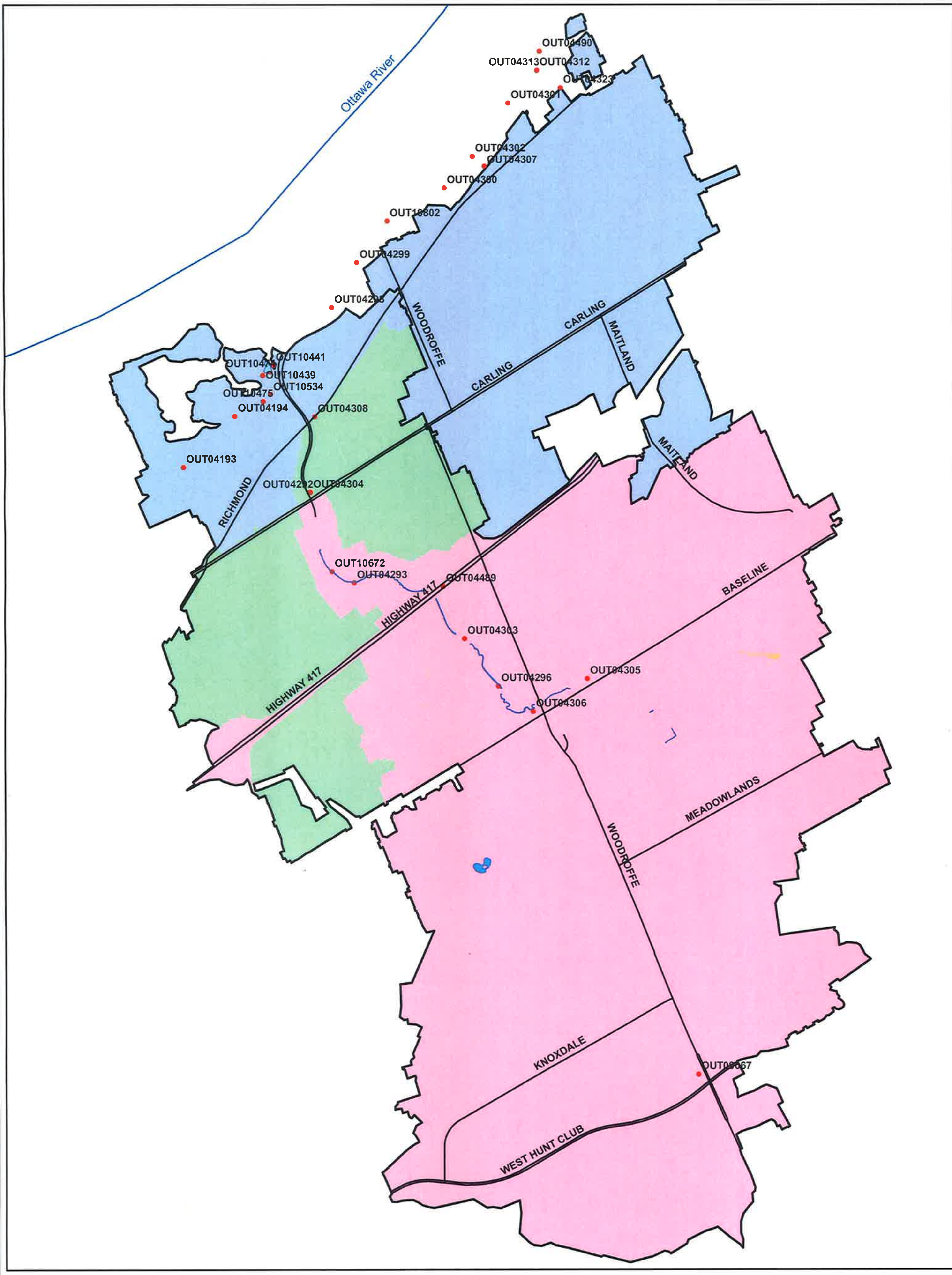
3.3.5.2 Draining to Pinecrest Creek:

Developments draining to Pinecrest Creek (either upstream of or directly into the ORP pipe) that require Site Plan Control shall provide sufficient flood control storage to address the most limiting downstream capacity (either the local sewer or the inlet to the ORP). The catchments that discharge to Pinecrest Creek upstream or directly into the ORP are identified in Figures 3.2 and 3.3.

To maintain existing peak flow and headwater conditions up to and including the 1:100 year storm at the inlet of the ORP pipe, all future development projects that require Site Plan Control approval shall control the 1:100-year discharge from the site to a maximum rate of 33.5 L/s/ha. This unit flow target has been set based on the hydrologic (SWMHYMO) modelling conducted for the Pinecrest Creek/Westboro Stormwater Management Retrofit Study (May 2011). From that modelling, the existing unit flow rate, at the ORP, for the critical design storm (24-hour 100-year SCS Type II) was found to be 33.5 L/s/ha.

Other flow restrictions, such as limiting storm sewer capacities, may also exist and should be identified by the proponent in consultation with the City.

The proponent shall, at the design stage, demonstrate that the proposed design can achieve the target release flow rates. For planning purposes, approximate on-site storage volumes to achieve the required control are provided below in Tables 3.2a and 3.2b. These approximate on-site storage volumes listed in Tables 3.2a and 3.2b were calculated using the SCS loss procedure and the Horton's Infiltration procedure, respectively. Designers should use the Horton's infiltration procedure for urban developments, unless otherwise directed by the City of Ottawa.



LEGEND:
- Ottawa Storm Sewer Outlets
- Arterial Roads
- OttawaRiver
- Areas Draining to the Ottawa River
- Areas Draining to the Ottawa River Parkway (ORP) Pipe
- Areas Draining to Pinecrest Creek

CLIENT: Ottawa

NOTES:
- The following background data were provided by the City of Ottawa

0 150 300 600 900 1,200 Meters

N

NOV 2011

REV. 1

BY: JFSA Water Resources and Environmental Consultants

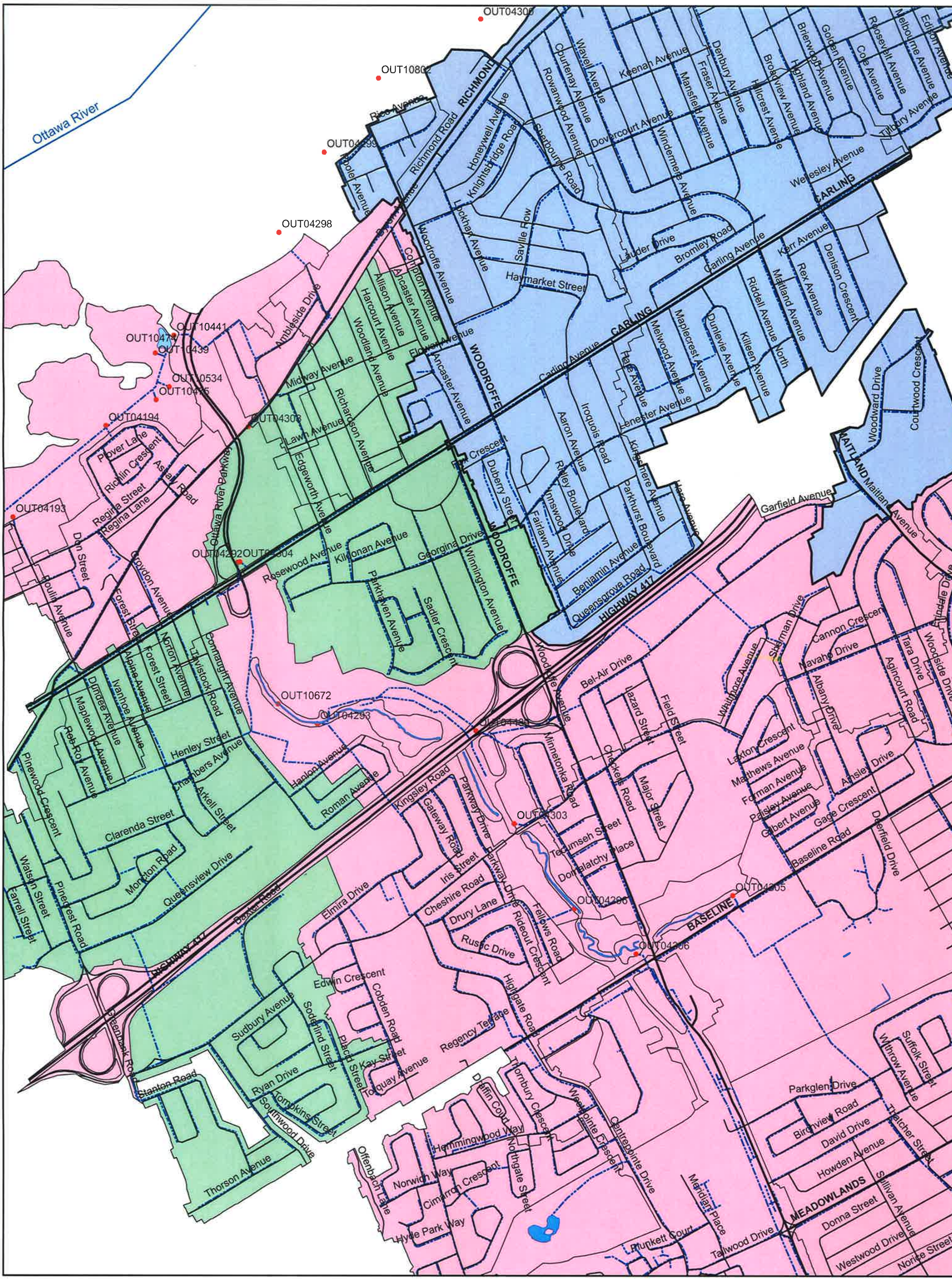
PROJECT: SWM GUIDELINES FOR THE PINECREST CREEK/WESTBORO AREA

TITLE: Total Drainage Area and Divides for Pinecrest Creek, Ottawa River Parkway Pipe & the Ottawa River

PROJECT No. 741(02)		
DESIGN	KM	
GIS	KM	
CHECK	JFS	
REVIEW	JFS	

FIGURE 3.2

MAP REF.: 741(02)\Design\Figures\DrainageAreas.mxd



LEGEND:
- Ottawa Storm Sewer Outlets
- Storm Sewers
- Roads
- Arterial Roads
- OttawaRiver
- Areas Draining to the Ottawa River
- Areas Draining to the Ottawa River Parkway (ORP) Pipe
- Areas Draining to Pinecrest Creek or the Ottawa River*

CLIENT: Ottawa

NOTES:
- The following background data were provided by the City of Ottawa

0 75 150 300 450 600 Meters

N

JUNE 2012 | REV. 0

BY: JFSA Water Resources and Environmental Consultants

PROJECT: SWM GUIDELINES FOR THE PINECREST CREEK/WESTBORO AREA

TITLE: Close-up of Drainage Divides for Pinecrest Creek, Ottawa River Parkway Pipe & the Ottawa River

PROJECT No. 741(02)

DESIGN	KM
GIS	KM
CHECK	JFS
REVIEW	JFS

FIGURE 3.3

MAP REF.: 741(02)\Design\Figures\DrainageAreas_Close-up.mxd

Table 3.2a: Approximate On-Site Storage Volume Requirements (SCS)

To control flows to 33.5 L/s/ha

Imperviousness		
50%	75%	95%
310 m^3/ha	420 m^3/ha	530 m^3/ha

Parameters: Ximp = 40 %, 65 % & 95% respectively
CN = 74, CN* = 63.9
SLPP = 1.0 %, SLPPI = 0.75%
All other parameters as per the City of Ottawa Sewer Design Guidelines (2004).

Table 3.2b: Approximate On-Site Storage Volume Requirements (Horton's)

To control flows to 33.5 L/s/ha

Imperviousness		
50%	75%	95%
380 m^3/ha	455 m^3/ha	540 m^3/ha

Parameters: Same as for Table 3.2a except for infiltration parameters.
Horton's infiltration parameters (f_0, fc and DCAY and F)
as per the City of Ottawa Sewer Design Guidelines (2004).

Note that the volume provided on-site to meet other design criteria (i.e., runoff volume control and/or erosion control) can provide a portion of the volume required to attenuate the 100-year storm as well. The designer will need to provide detailed calculations showing how the different storage volumes and control structures (typically orifices or weirs) will interact so that the volume that is being accounted for will act as effective storage during the 100-year storm. Furthermore, the storage volumes accounted for must be provided by permanent structures that will not be removed or modified over time. Refer to Appendix D for examples of these types of calculations within the sample approaches.

3.3.6 Runoff Volume and Erosion Control Requirements

Runoff volume control requirements are specified for the purposes of erosion mitigation only for those catchments that drain to the open portion of Pinecrest Creek located upstream of the ORP pipe.

3.3.6.1 Draining to Pinecrest Creek Upstream of the ORP Pipe (Erosion Mitigation):

The following runoff volume control criteria were determined from hydrologic and hydraulic analyses completed during the preparation of the Pinecrest/Centrepointe Stormwater Management Criteria Study (February 2010) and further analyses completed for the Pinecrest Creek/Westboro Stormwater Management Retrofit Study (May 2011). Catchments draining to Pinecrest Creek upstream of the ORP pipe are shown on Figures 3.2 and 3.3.

1) To mitigate the cumulative impacts of infill and redevelopment and not aggravate existing erosion within the creek corridor, future developments that require Site Plan Control approval shall retain,

capture or infiltrate the first 10 mm of rainfall. This 10 mm target can be partially achieved by the default initial abstraction (IA) values applicable in urban areas. The City of Ottawa Sewer Design Guidelines allows a designer to account for a 4.67 mm IA on all soft landscaped surfaces and a 1.57 mm IA on all hardscaped surfaces. A wide range of measures may be used to achieve this criterion, many of which are described in Appendix C.

2) In addition to the above, future developments that require Site Plan Control approval shall control site runoff from the 25 mm 4-hour Chicago design storm to a maximum peak flow of 5.8 L/s/ha. This peak flow target is based on releasing 25 mm of runoff over a 24 hour time period, using a peaking factor of 2 (i.e. assuming that the peak outflow is equal to twice the average outflow). A wide range of measures can be considered to achieve this criterion, many of which are described in Appendix C.

Note that, as outlined in Table 3.1, all developments draining to Pinecrest Creek upstream of the ORP pipe shall control site runoff from the 25 mm 4-hour Chicago storm to a peak unit outflow rate of 5.8 L/s/ha regardless of whether or not the first 10 mm of runoff volume will be retained on-site. The required on-site storage volume, to control the runoff of the 25mm storm, will vary from site to site based on the amount of volume retained or infiltrated.

3.3.7 Quality Control

The water quality control requirements noted here are based on the receiving watercourse and MOE guidelines with some qualifications as described below.

The equivalent of an enhanced level of treatment (TSS removal of 80%) is required for water quality control on ICI sites. While this requirement could, in some cases, be accomplished by means of conventional measures (i.e., end-of-pipe facilities such as oil and grit separators), it is anticipated that SWM measures that can provide runoff volume control for the first 10mm of rainfall will also contribute to achieving an enhanced level of treatment. Although an accepted equivalency for enhanced treatment is not available for volume control measures as of yet, the water quality benefit of such measures is demonstrated by local rainfall statistics which indicate that rainfalls of 10 mm or less occur comprise on average 61% of all events (these data were derived by the City of Ottawa based on the percent rank of consecutive day rainfall events recorded at the Experimental Farm from 1890 through 2008). It is therefore considered that the capture and retention of the 10 mm storm will provide a water quality control benefit.

- Future developments that require Site Plan Control approval shall capture, retain or infiltrate the first 10 mm of rainfall. This 10 mm target can be partially achieved by the default initial abstraction (IA) values applicable in urban areas. The City of Ottawa Sewer Design Guidelines allows a designer to account for a 4.67 mm IA on all soft landscaped surfaces and a 1.57 mm IA on all hardscaped surfaces.
- ICI developments will require measures over and above the retention of the first 10mm to achieve an enhanced level of treatment.
- Residential developments that require Site Plan Control approval will not require measures over and above the retention of the first 10 mm.

3.4 SWM Requirements for the Pinecrest Creek and Westboro Area: Development Requiring a Building Permit Only

In recognition of the relatively small scale of these types of developments and the need for a simple but effective means of achieving the benefits of reducing runoff volume, the minimum requirement for these sites is:

- Provision of a minimum depth of 0.30 m of amended topsoil over all landscaped areas; and
- Direction/redirection of downspouts/roof drainage to landscaped areas to minimize runoff.

Amended Topsoil:
Amended topsoil refers to topsoil with an organic content of 8 to 15% by weight, or 30 to 40% by volume (CVC & TRCA, 2010). To be most effective with regard to providing the optimal amount of infiltration on-site, the front-yard lot grading should be limited to a maximum of 2%, if possible while still meeting the surrounding existing grades.

Downspout Redirection:
Downspout redirection is the diversion of flow from rooftops (or impervious surfaces) to pervious areas. This prevents the routing of stormwater to impervious surfaces which drain directly to storm sewer systems. In order for downspout redirection to produce a measurable benefit, it requires a minimum flow path length of 5 m across a pervious surface before flowing onto an impervious surface, or into a storm sewer system. Discharge locations for roof downspouts should be a distance of at least 3 m away from building foundations and should be directed towards a pervious surface. If a pervious surface is not directly available around the immediate perimeter of the building, the downspout can run underground and discharge as a 'pop-up' outlet at the nearest pervious surface.

Appendix D provides further details on this approach and a specification to be included with building permit applications.

The above approach represents the minimum requirement for sites requiring a building permit application only. However, there are also many other measures that could be used to minimize runoff volume including: permeable paver driveways; infiltration trenches, rainwater harvesting, green roofs, rain gardens, etc. These measures necessarily require more information (e.g., site infiltration testing) and in some cases, considerable design effort by qualified professionals. ***While the use of these measures is not required to meet the minimum requirement, a sample design approach (refer to Appendix D) has been provided to illustrate how such measures could be applied to small scale/single lot development.***

3.5 Sample Approaches

Appendix D contains sample design approaches that demonstrate how these criteria can be achieved for the following types of development:

i) Commercial;
ii) Residential (town homes requiring Site Plan Control approval);
iii) Residential (condominium requiring Site Plan Control approval); and
iv) Residential (single lot requiring building permit only).

4. REFERENCES

Baird & Associates. 2008. Assessment of Bacterial Conditions at Westboro Beach. Report prepared Environmental Programs and Technical Support, Transportation, Utilities And Public Works Dept., City of Ottawa. September 2008. 82 p.

Baird & Associates. 2004. Assessment of Bacterial Conditions at Westboro Beach in 2003. Report prepared Environmental Programs and Technical Support, Transportation, Utilities And Public Works Dept., City of Ottawa. Final Report May 5, 2004. 43 p.

Baird & Associates. 2002. Assessment of Bacterial Conditions at Westboro Beach. Report prepared Environmental Programs and Technical Support, Transportation, Utilities And Public Works Dept., City of Ottawa. Final Report September 2002. 52 p.

Center for Watershed Protection. 2007. Urban Subwatershed Restoration Manual No. 3 – Urban Retrofit Practices (version 1.0). Prepared for Office of Wastewater Management U.S. Environmental Protection Agency, July 2007.

[Adapted from the document's Foreword] The Center for Watershed Protection (Maryland, U.S.A) has produced a series of manuals that describes the techniques to restore small urban watersheds. The entire series of manuals was written to organize the enormous amount of information needed to restore small urban watersheds into a format that can easily be accessed by watershed groups, municipal staff, environmental consultants and other users.

Urban Stormwater Retrofit Practices is the fourth manual in the series and it focuses on stormwater retrofit practices that can capture and treat stormwater runoff before it is delivered to the stream. The manual describes both off-site storage and on-site retrofit techniques that can be used to remove stormwater pollutants, minimize channel erosion, and help restore stream hydrology. Guidance on choosing the best locations in a subwatershed for retrofitting is provided in a series of 13 profile sheets. The manual then presents a method to assess retrofit potential at the subwatershed level, including methods to conduct a retrofit inventory, assess candidate sites, screen for priority projects, and evaluate their expected cumulative benefit. The manual concludes by offering tips on retrofit design, permitting, construction, and maintenance considerations.

City of Ottawa. 2004. Sewer Design Guidelines. First Edition, November 2004. SDG001. Section 8: Stormwater Management updated in September 2008.

[Adapted from Section 1 of the document] This new Ottawa Sewer Design Guideline supersedes all of the sewer related policies, procedures, practices and design guidelines of all the former Municipalities and the Regional Municipality, now part of the new City of Ottawa.

The document was prepared to guide the designer and the development industry in the design of municipal sewer systems that will meet the requirements of the City of Ottawa.

The information presented in this document sets out the base requirements to be satisfied in the planning and design of municipal sewer systems within the City of Ottawa. The guidelines are to be used as a reference document for planners, consultants, designers, engineers, and other practitioners engaged in work for the City of Ottawa. The guidelines will also be applicable to *the preparation of engineering drawings and associated reports on behalf of developers or other proponents subject to the approval of the City of Ottawa.*

Credit Valley Conservation (CVC) and Toronto and Region Conservation Authority (TRCA). 2010. Low Impact Development Stormwater Management Planning and Design Guide. Version 1.0.

[Adapted from the document's Preface] This document was developed by CVC and TRCA as a tool to help developers, consultants, municipalities and landowners understand and implement sustainable stormwater planning and practices in the CVC and TRCA watersheds. The guide is intended to provide engineers, ecologists and planners with up-to-date information and direction on landscape-based stormwater management planning and low impact development stormwater management practices such as rainwater harvesting, green roofs, bioretention, permeable pavement, soakaways and swales. The information contained in the guide is to help practitioners adopt landscape-based stormwater management approaches, and to help in the selection, design, construction and monitoring of more sustainable stormwater management practices.

The creators of the manual did not intend for it to be a stand-alone document. It is intended to augment the Ontario Ministry of the Environment's 2003 Stormwater Management Planning and Design Manual, which provides design criteria for "conventional" end-of-pipe stormwater management practices such as wet ponds and constructed wetlands. It is also a companion document to other stormwater related guidance documents prepared by CVC and TRCA.

J.F. Sabourin and Associates Inc. and JTB Environmental Systems Inc.2011. Pinecrest Creek/Westboro Stormwater Management Retrofit Study. Prepared for the City of Ottawa, May 2011.

This final report and supporting appendices document the work carried out for the Pinecrest Creek/Westboro Stormwater Management Retrofit Study from September 2009 to May 2011.

The City of Ottawa (the City) initiated the Pinecrest Creek/Westboro Stormwater Management Retrofit Study to improve stormwater management in the Pinecrest Creek subwatershed and adjacent Westboro area. When implemented, the Retrofit Plan developed and selected by this study will help to: improve water quality in Pinecrest Creek and the Ottawa River; reduce flooding and erosion along the Creek; improve the health of the Creek; and reduce closures at Westboro Beach.

J.F. Sabourin and Associates Inc. and JTB Environmental Systems Inc.2010. Pinecrest/Centrepointe Stormwater Management Criteria Study. Prepared for the City of Ottawa, February 2010.

Pinecrest-Centrepointe SWM Criteria Study's main objective was to develop stormwater management (SWM) criteria for the catchment area draining to the storm outfalls immediately north of Baseline Road in the City of Ottawa. The Centrepointe catchment area encompasses the Centrepointe lands, the Baseline-Woodroffe Southwest Transitway station, the Woodroffe campus of Algonquin College and all other drainage tributary to the outfalls. Runoff from the Centrepointe catchment area discharges to Pinecrest Creek.

The development/redevelopment of a number of projects within this catchment area, namely the Algonquin EDC-CTBS building, the associated relocation of the Southwest Transitway and the City Archives building, was imminent. The SWM design criteria were determined on a subwatershed basis for these specific projects. The SWM criteria address runoff volume control,

flood control, and water quality control for these sites. Given the highly developed state of land use in the catchment and the condition of the receiving watercourse, the criteria strove for maximum volume control to alleviate known erosion issues. This final report and supporting appendices document the work carried out to develop SWM criteria for the study area.

JTB Environmental Systems Inc., J.F. Sabourin and Associates Inc. and LGL Environmental Research Associates. 2007. Pinecrest Creek Restoration Plan – Integrating Fluvial Geomorphology, Hydrology and Ecology. Report prepared for the National Capital Commission, March 2007.

In response to the on-going erosion in the Pinecrest Creek corridor, the National Capital Commission, which owns most of the Creek corridor lands, commissioned this restoration plan in 2006 to identify a strategy to rehabilitate the Creek's degraded condition, and to improve its ability to accommodate the very "flashy" hydrology given current conditions with no SWM retrofit measures to better manage excess runoff volumes. The final report describes the Restoration Plan for the 2.3 kilometre above-ground section of Pinecrest Creek between Baseline Road and the Pinecrest Drain inlet, south of Carling Avenue. The report and appendices also document the work carried out by the Pinecrest Creek Fluvial Geomorphology Study undertaken in preparation of the Restoration Plan.

Ontario Ministry of the Environment (MOE), 2003. Stormwater Management Planning and Design Manual. March 2003. Queen's Printer for Ontario. ISBN 0-7794-2969-9. PIBS 4329e.

The MOE manual provides design criteria for "conventional" end-of-pipe stormwater management practices such as wet ponds and constructed wetlands but provides only limited information about lot level and conveyance controls. The manual does, however, emphasize the use of a "treatment train" approach to reduce the impacts of stormwater. This manual provides guidance for incorporating more traditional practices such as wet ponds and wetlands into the overall stormwater management planning and design process.

Appendix A-VII

CONTENTS

Stormwater Management Report – NE Parking Lot 41 pages

AMENDED REPORT

Stormwater Management Report

Algonquin College – Student Commons Building Displaced Parking Lot

Ottawa, Ontario

Presented to:

City of Ottawa

For:
Site Plan Control Approval
File Number: D07-12-10-0183
110 Laurier Avenue West, 4th Floor
Ottawa, Ontario, K1P 1J1

Prepared By:

Frank Hendriksen, M.Sc.Eng., P.Eng.
fhendriksen@morrisonhershfield.com

Report No. 2085345.02 November 9, 2011

L:\PROJ\2085345.02\ENGINEERING DATA BY DISCIPLINE\INFRASTRUCTURE\STORMWATER MANAGEMENT REPORT\SWM REPORT - DISPLACED PARKING AREA\SITE PLAN SUBMISSION - NOV 9 2011\DRAINAGE REPORT 11092011.DOC

TABLE OF CONTENTS

		Page
1.	INTRODUCTION	1
2.	EXISTING CONDITIONS	1
3.	DESIGN CRITERIA	2
4.	STORM DESIGN CALCULATIONS	3
	4.1 Displaced Parking Site	3
	4.2 Swale	6
	4.3 Pinecrest/Centrepointe Stormwater Management Criteria Study	7
	4.4 Proposed Stormwater Management Scheme	7
	4.4.1 On-Site	7
	4.4.2 Off-Site	7
	4.4.3 Water Quality Control	8
	4.4.4 Proposed SWM Scheme	8
5.	CONCLUSIONS	8

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES		AFTER PAGE
Table 4.1	Displaced Parking Pre-Development Flows	4
Table 4.2	Displaced Parking Post-Development Flows	4
Table 4.3A	Displaced Parking Storage Calculations – 100 Year	4
Table 4.3B	Displaced Parking Storage Calculations – 5 Year	4
Table 4.4	Displaced Parking Orifice Size Calculations	5
Table 4.5	Displaced Parking Inlet Control Device Flow Calculations	6
Table 4.6	Displaced Parking Culvert Design	7

LIST OF FIGURES

Figure 1.1	Site Location Plan	1
Figure 2.1	Existing and Proposed Stormwater System	2
Figure 4.1	Proposed Displaced Parking Site – Existing and Proposed Conditions	3
Figure 4.2	Proposed Swale – Drainage Catchment Area's	6

APPENDICES

Appendix A	City of Ottawa Memo regarding Stormwater Management Criteria
Appendix B	Site Plan Approval Drawings
Appendix C	SWMHYMO Output File
Appendix D	Letter to City of Ottawa

1. INTRODUCTION

Morrison Hershfield Limited has been retained by Algonquin College to provide services related to obtaining Site Plan Control Approval for the proposed Student Commons Building to be located within the Algonquin College campus located on Woodroffe Avenue. The proposed location of the building is an existing parking lot and grassed area to the immediate east of Buildings D and H. To replace the lost parking, a new parking area is proposed. The new parking will be located in the northeastern portion of the campus, to the north of an existing parking lot and immediately to the west of the Indoor Dome Structure and Building Z. The location of the proposed parking is shown in **Figure 1.1** (Site Location Plan).

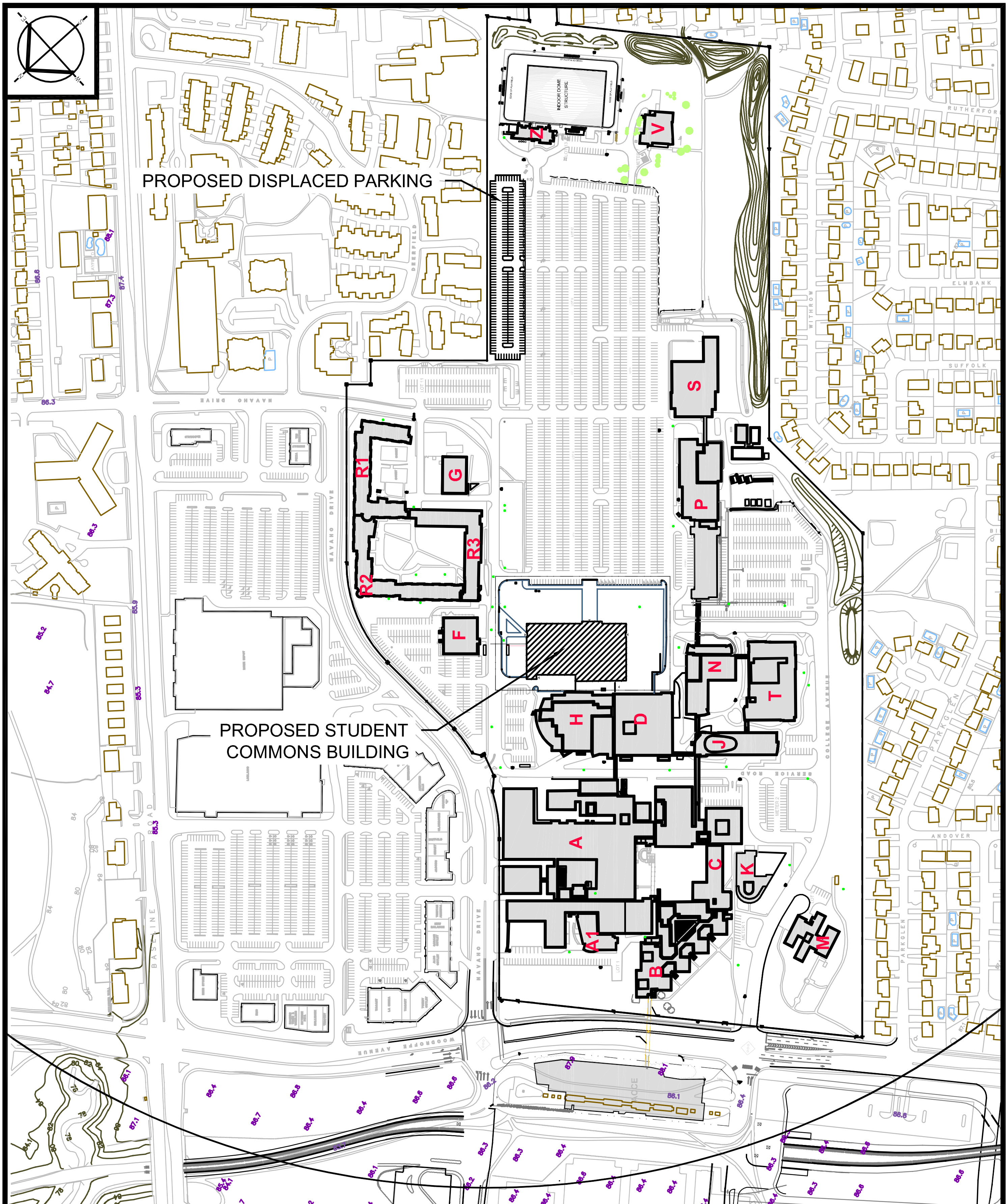
This report addresses the stormwater management requirements for the proposed new parking lot. Both pre- and post-construction design flows were reviewed for the existing grassed area that will be used as parking. A stormwater management scheme is proposed to meet the recently adopted provisions of the *Pinecrest/Centrepointe Stormwater Management Criteria Study* (J.F. Sabourin & Associates, June 2009).

2. EXISTING CONDITIONS

The proposed parking lot will be located on approximately 0.6 ha of an existing grassed area within the Woodroffe Avenue Algonquin College Campus. The site is located on the east side of the campus on the north side of the existing parking area to the west of Building N as shown in **Figure 1.1**.

The Algonquin College Campus is serviced private stormsewers that drain to a 2100mm dia. sewer which runs in a northerly direction through the campus. This sewer also services the residential development immediately to the south of the college (Ryan Farm). To the north of the campus, the sewer outlets to Pinecrest Creek at Baseline Road.

The area of the new parking lot is currently grass covered. Building Z and the Sports Complex outlet to the ditch located along the south side of the proposed parking area. Runoff from this ditch is captured by a catchbasin on the northern edge of the existing parking area. As part of



MORRISON HERSHFIELD

ALGONQUIN COLLEGE
STUDENT COMMONS BUILDING
SITE LOCATION

Figure 1.1

the parking lot design, this ditch will be eliminated and the external runoff will be routed through the new parking lot's drainage system. Existing and proposed drainage systems are shown in **Figure 2.1**. It should be noted that information regarding the existing stormsewer network within the campus was obtained from Algonquin College. Information regarding the size and slope the stormsewers was limited. All information is shown in **Figure 2.1**.

3. DESIGN CRITERIA

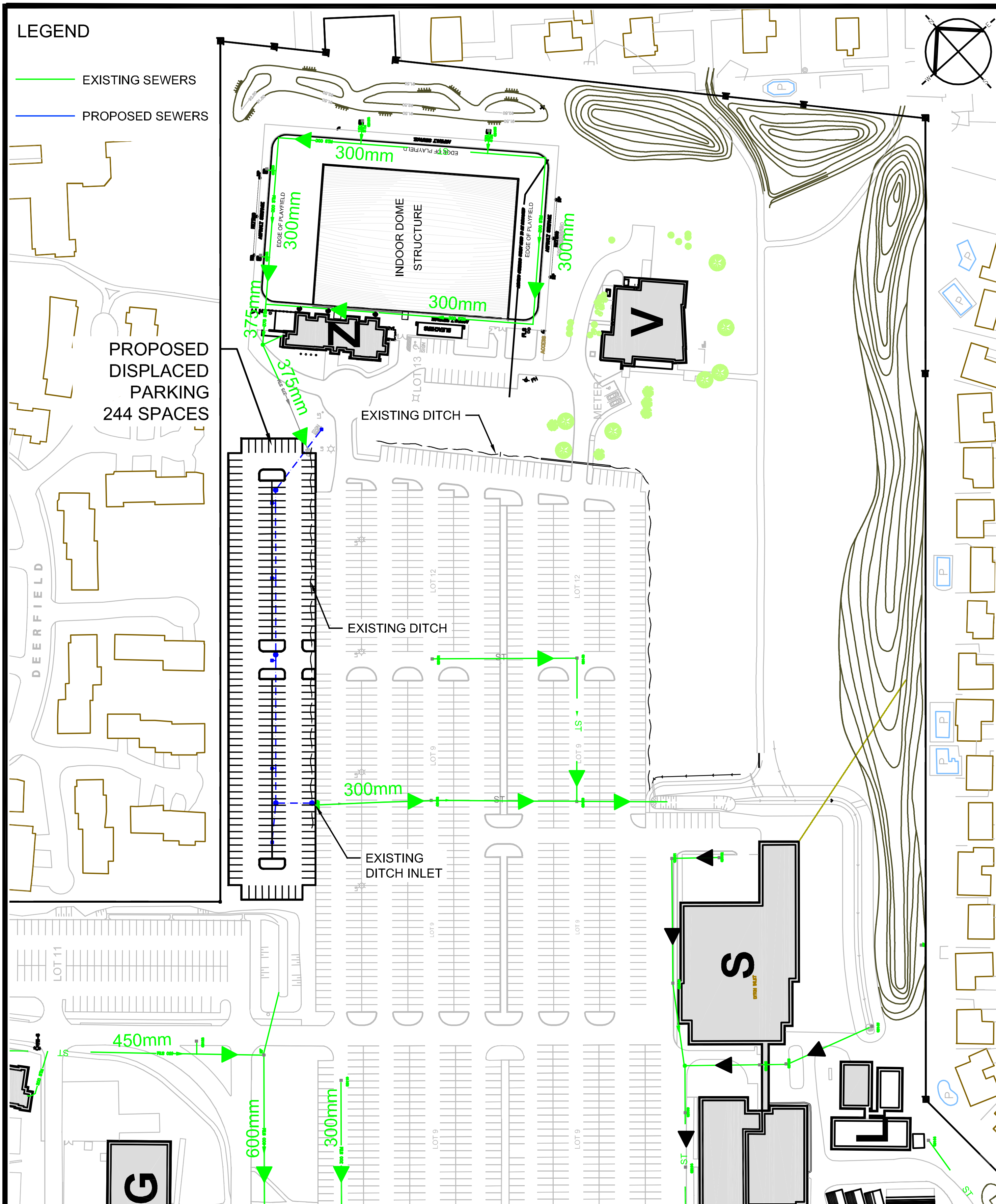
It is assumed that the site falls under the City of Ottawa category of an existing separated sewer area. This category requires the stormsewer system to convey the 5-year storm and requires attenuating the 100-year storm. Additionally, the allowable discharge rate into the sewers in the post-construction scenario must not exceed the lower of the discharge rate of the pre-construction condition or the peak flow associated with a runoff coefficient of 0.50.

The City of Ottawa has also indicated that any new or redevelopment within the Pinecrest Creek watershed must adhere to the recommendations of the *Pinecrest/Centrepointe Stormwater Management Criteria Study*.

The criteria for the maximum equivalent runoff coefficients and the allowable flows were provided in a memo from the City of Ottawa Project Manager for Infrastructure Approvals, dated April 22, 2010. This memo can be found in **Appendix A**. The site specific requirements for the run-off coefficient are as follows:

- The allowable runoff coefficient for hard surface infill where there are separated sewers is 0.5;
- The allowable runoff coefficient for grassed infill must not exceed the pre-development runoff;
- On-site detention techniques are required to limit run-off from the site to a maximum equivalent runoff coefficient of 0.5; and,
- The run-off coefficient can be increased by 25% to a limit of 1.0 for the 100 year storm event.

The following City of Ottawa design criteria is applied when determining sewer flows:



Morrison Hershfield

ALGONQUIN COLLEGE EXISTING STORMWATER SYSTEM

Figure 2.1

- 5 year storm event;
- Flows to the stormsewer in excess of the 5 year storm release rate, up to and including the 100 year storm event, must be detained on site.

Additional design criteria outlined in the *Pinecrest/Centrepointe Stormwater Management Criteria Study* are as follows:

- The first 10mm of precipitation must be retained on site;
- The subsequent 15mm of run-off must be detained on site and released over a period of not less than 48 hours;
- The 100 year peak flow must be controlled to a maximum rate of 36 L/s/ha (based on a 24 hour storm), and;
- The “Enhanced” water quality criteria as defined by the MOE “Stormwater Management Planning and Design Manual” must be met.

A meeting was held on March 3, 2011 with the City of Ottawa to discuss the requirements of the Pinecrest/Centrepointe Stormwater Management Criteria Study for the proposed Student Commons Building Displaced Parking Lot.

Further to this meeting, the City has indicated that the stormwater management measures to meet the criteria outlined in the *Pinecrest/Centrepointe Stormwater Management Criteria Study* may be implemented elsewhere on the campus but that these measures must be implemented concurrent with the construction of the displaced parking lot.

4. STORM DESIGN CALCULATIONS

4.1 Displaced Parking Site

The proposed displaced parking site is shown in **Figure 4.1** which shows both the existing conditions and the layout of the proposed parking area. The layout for the proposed displaced parking lot was revised as a result of comments from previous submissions to the City, resulting in a higher impervious area. The impervious area was increased from 5744m^2 to 5802m^2. The calculation of the pre-development and post

EXISTING

PROPOSED

MORRISON HERSHFIELD

STUDENT COMMONS DISPLACED PARKING
STORMWATER MANAGEMENT AREA

Figure 4.1

development flows within the parking lot and surrounding area is shown in **Table 4.1** and **Table 4.2**. The flows were generated using the 5-year storm from the Ottawa IDF Curve. The estimated pre-development flow for the proposed displaced parking site is 96 L/s.

To determine the storage required within the proposed displaced parking site, peak flows associated with the 100-year (Ottawa IDF Curve) storm on the proposed site were estimated. The first step in calculating the onsite storage was to determine how much storage would be required. **Table 4.3A** shows the peak flow calculations for the 100-year storm and the resultant flows to be attenuated in order to keep flows below the 96 L/s restriction. The remaining flows above the allowable release rate will be stored in the parking area and underground in oversized stormsewers. The storage volume required is determined by subtracting the release rate from the 100-year peak flows to determine the excess runoff. The excess runoff is then multiplied by the time to obtain the storage volume required. This is done for a series of storm durations to determine the maximum storage volume. The storage volume required for the parking lot is approximately 196 m^3. The storage volume available within the ponding area in the proposed parking lot is 136 m^3. These ponding areas are based on a maximum of 0.3 m of ponding at each catchbasin. This is less than the 196 m^3 required. Therefore, the proposed stormsewer between DI1 and MH4 & MH4 and MH 3 will be upsized to a 900 mm to store the remaining 60 m^3. Detailed modeling at the individual catchbasins reduced the surface storage to approximately 100 m^3.

The storage required within the proposed displaced parking lot was also determined for the 5-year storm. The same steps that were outlined above were used to determine the required storage. The ponding volume associated with the 5-year storm is approximately 46 m^3, refer to **Table 4.3B.**

The storm sewers in the displaced parking lot will act as a storage reservoir so the entire storm sewer will frequently be under surcharge conditions. Under these circumstances, velocities are very low and hydraulic grade line losses at the manholes are negligible.

Table 4.1
STORM SEWER DESIGN SHEET
Pre Development Flows
(Algonquin College Proposed Student Commons Building Displaced Parking Area)

LOCATION	INDIVIDUAL						CUMULATIVE		DESIGN			
Street / Areas	Asphalt Area	Lawn Area	Building Area	Gravel Area	Total	R*A*N	Area	R*A*N	Time of Conc.	Rainfall Intensity	Peak Flow	
	(ha)	(ha)	(ha)	(ha)	(ha)		(ha)		(min.)	(mm/hr)	(L/s)	(m^3/s)
Sports Complex	0.17	1.10	0.05		1.32	1.31	1.32	1.31	20.00	70.25	91.89	0.092
Proposed Displaced Parking Area		0.60			0.60	0.42	1.92	1.73	28.87	55.35	95.59	0.096

Q = RAIN, where Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area (Existing): 0.90
Asphalt Area (Proposed) 0.50
Lawn Area: 0.25
Building Area: 0.85
Gravel Area: 0.50

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 5-Year Storm
T_d = Time of Concentration (min)
A = 998.071
B = 0.814
C = 6.053

July 7, 2010

Project No. 2085345.02

Table 4.2
STORM SEWER DESIGN SHEET
Post Development Flows
(Algonquin College Proposed Student Commons Building Displaced Parking Area)

LOCATION					INDIVIDUAL						CUMULATIVE		DESIGN				PROPOSED SEWER											PIPE VOLUME
					Asphalt Area	Lawn Area	Building Area	Gravel Area	Total	R*A*N	Area	R*A*N	Time of Conc.	Rainfall Intensity	Peak Flow		Length	Size	Minimum Size	Grade	Minimum Slope	Full Capacity	Full Velocity	Time of Flow	Reserve Capacity	Upstream Invert	Downstream Invert	Volume
	From	Top of Grate	To	Top of Grate	(ha)	(ha)	(ha)	(ha)	(ha)		(ha)		(min.)	(mm/hr)	(L/s)	(m^3/s)	(m)	(mm)	(mm)	(%)	(%)	(L/s)	(m/s)	(min)	(L/s)	(m)	(m)	(m3)
Existing Sports Complex Area	MHG	90.52	Headwall	89.10	0.11	0.94	0.05		1.10	1.05	1.10	1.05	20.00	70.25	73.53	0.074	33	375	351	0.25	0.18	87.67	0.79	0.69	14.14	88.71	88.63	3.643
Proposed	DI1	88.45	MH4	88.32	0.06	0.16			0.22	0.26	1.32	1.31	21.16	67.81	88.70	0.089	27.5	375	364	0.30	0.26	96.03	0.87	0.53	7.33	85.59	85.51	3.036
Proposed	CB5	88.10	Mainline		0.1336				0.13	0.19	0.13	0.19	10.00	104.19	19.35	0.019	3	250	191	0.45	0.11	39.89	0.81	0.06	20.54	85.76	85.75	0.147
Proposed	CB4	87.75	Mainline		0.0919				0.09	0.13	0.09	0.13	10.00	104.19	13.31	0.013	3	250	166	0.45	0.05	39.89	0.81	0.06	26.58	85.68	85.66	0.147
Proposed	MH4	88.32	MH3	87.40					0.00	0.00	1.55	1.62	21.68	66.76	108.25	0.108	65	450	392	0.30	0.14	156.16	0.98	1.10	47.91	85.51	85.32	10.333
Proposed	CB3	87.20	Mainline		0.1100				0.11	0.15	0.11	0.15	10.00	104.19	15.93	0.016	3	250	177	0.45	0.07	39.89	0.81	0.06	23.96	85.42	85.40	0.147
Proposed	CB2	86.37	Mainline		0.1500				0.15	0.21	0.15	0.21	10.00	104.19	21.72	0.022	3	250	199	0.45	0.13	39.89	0.81	0.06	18.17	85.30	85.28	0.147
Proposed	MH3	87.40	MH2	86.51					0.00	0.00	1.81	1.98	22.79	64.68	128.24	0.128	59	450	418	0.30	0.20	156.16	0.98	1.00	27.92	85.32	85.14	9.379
Proposed	CB1	86.27	MH2	86.51	0.1302				0.13	0.18	0.13	0.18	10.00	104.19	18.86	0.019	15	250	189	0.45	0.10	39.89	0.81	0.31	21.04	85.21	85.14	0.736
Proposed	MH2	86.51	MH1	86.54					0.00	0.00	1.94	2.16	23.79	62.90	136.11	0.136	13	450	427	0.30	0.23	156.16	0.98	0.22	20.05	85.14	85.10	2.067
TOTAL																	224.5											29.78

Q = RAIN, where Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area (Existing): 0.90
Asphalt Area (Proposed): 0.50
Lawn Area: 0.25
Building Area: 0.85
Gravel Area: 0.50
Total:

$I = \frac{A}{(T_d + C)^B}$ where I = Rainfall Intensity (mm/hr) for a 5-Year Storm
T_d = Time of Concentration (min)
A = 998.071
B = 0.814
C = 6.053

November 23, 2010

Project No. 2085345.02

LOCATION					INDIVIDUAL						CUMULATIVE		DESIGN				PROPOSED SEWER											PIPE VOLUME
					Asphalt Area	Lawn Area	Building Area	Gravel Area	Total	R*A*N	Area	R*A*N	Time of Conc.	Rainfall Intensity	Peak Flow		Length	Size	Minimum Size	Grade	Minimum Slope	Full Capacity	Full Velocity	Time of Flow	Reserve Capacity	Upstream Invert	Downstream Invert	Volume
	From	Top of Grate	To	Top of Grate	(ha)	(ha)	(ha)	(ha)	(ha)		(ha)		(min.)	(mm/hr)	(L/s)	(m^3/s)	(m)	(mm)	(mm)	(%)	(%)	(L/s)	(m/s)	(min)	(L/s)	(m)	(m)	(m3)
Existing Sports Complex Area	MHG	90.52	Headwall	89.10	0.11	0.94	0.05		1.10	1.05	1.10	1.05	20.00	70.25	73.53	0.074	33	375	351	0.25	0.18	87.67	0.79	0.69	14.14	88.71	88.63	3.643
Proposed	DI1	88.45	MH4	88.37	0.06	0.16			0.22	0.26	1.32	1.31	20.69	68.77	89.95	0.090	27.5	900	450	0.10	0.00	572.47	0.90	0.51	482.53	85.34	85.32	17.486
Proposed	CB5	88.10	Mainline		0.1336				0.13	0.19	0.13	0.19	10.00	104.19	19.35	0.019	3	250	191	0.45	0.11	39.89	0.81	0.06	20.54	85.58	85.56	0.147
Proposed	CB4	87.75	Mainline		0.0919				0.09	0.13	0.09	0.13	10.00	104.19	13.31	0.013	3	250	166	0.45	0.05	39.89	0.81	0.06	26.58	85.55	85.53	0.147
Proposed	MH4	88.37	MH3	87.40					0.00	0.00	1.55	1.62	21.20	67.72	109.80	0.110	64.6	900	485	0.10	0.00	572.47	0.90	1.20	462.67	85.32	85.25	41.076
Proposed	CB3	87.20	Mainline		0.1100				0.11	0.15	0.11	0.15	10.00	104.19	15.93	0.016	3	250	177	0.45	0.07	39.89	0.81	0.06	23.96	85.36	85.34	0.147
Proposed	CB2	86.37	Mainline		0.1500				0.15	0.21	0.15	0.21	10.00	104.19	21.72	0.022	3	250	199	0.45	0.13	39.89	0.81	0.06	18.17	85.27	85.26	0.147
Proposed	MH3	87.40	MH2	86.52					0.00	0.00	1.81	1.98	22.40	65.39	129.66	0.130	58.5	450	449	0.21	0.21	130.65	0.82	1.19	0.99	85.25	85.13	9.299
Proposed	CB1	86.27	MH2	86.52	0.1302				0.13	0.18	0.13	0.18	10.00	104.19	18.86	0.019	15	250	189	0.45	0.10	39.89	0.81	0.31	21.04	85.20	85.13	0.736
Proposed	MH2	86.52	MH1	86.54					0.00	0.00	1.94	2.16	23.59	63.25	136.86	0.137	13	450	450	0.23	0.23	136.73	0.86	0.25	(0.13)	85.13	85.10	2.067
TOTAL					0.6157												223.6											74.90

Q = RAIN, where Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area (Existing): 0.90
Asphalt Area (Proposed): 0.50
Lawn Area: 0.25
Building Area: 0.85
Gravel Area: 0.50
Total:

$I = \frac{A}{(T_d + C)^B}$ where I = Rainfall Intensity (mm/hr) for a 5-Year Storm
T_d = Time of Concentration (min)
A = 998.071
B = 0.814
C = 6.053

November 23, 2010

November 23, 2010 Update

Project No. 2085345.02

Table 4.3A

100 YEAR STORM - STORAGE CALCULATIONS

(Algonquin College Proposed Student Commons Building Displaced Parking Area)

Catchbasin 1

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
10	178.56	32	4.69	28	16.58
15	142.89	26	4.69	21	19.06
20	119.95	22	4.69	17	20.43
25	103.85	19	4.69	14	21.16
30	91.87	17	4.69	12	21.49
35	82.58	15	4.69	10	21.54
40	75.15	14	4.69	9	21.39
45	69.05	12	4.69	8	21.09
50	63.95	12	4.69	7	20.66
55	59.62	11	4.69	6	20.14
60	55.89	10	4.69	5	19.54
1440	4.45	1	4.69	0	0.00

Area = 0.1302 (ha)
R = 0.5
N = 2.78
RAN = 0.1810

Catchbasin 2

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
10	178.56	37	5.40	32	19.10
15	142.89	30	5.40	24	21.95
20	119.95	25	5.40	20	23.53
25	103.85	22	5.40	16	24.38
30	91.87	19	5.40	14	24.76
35	82.58	17	5.40	12	24.82
40	75.15	16	5.40	10	24.64
45	69.05	14	5.40	9	24.29
50	63.95	13	5.40	8	23.80
55	59.62	12	5.40	7	23.20
60	55.89	12	5.40	6	22.51
1440	4.45	1	5.40	0	0.00

Area = 0.15 (ha)
R = 0.5
N = 2.78
RAN = 0.2085

Catchbasin 3

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
10	178.56	27	3.96	23	14.01
15	142.89	22	3.96	18	16.10
20	119.95	18	3.96	14	17.26
25	103.85	16	3.96	12	17.88
30	91.87	14	3.96	10	18.16
35	82.58	13	3.96	9	18.20
40	75.15	11	3.96	8	18.07
45	69.05	11	3.96	7	17.81
50	63.95	10	3.96	6	17.46
55	59.62	9	3.96	5	17.02
60	55.89	9	3.96	5	16.51
1440	4.45	1	3.96	0	0.00

Area = 0.11 (ha)
R = 0.5
N = 2.78
RAN = 0.1529

Catchbasin 5

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
10	178.56	33	4.81	28	17.01
15	142.89	27	4.81	22	19.55
20	119.95	22	4.81	17	20.96
25	103.85	19	4.81	14	21.71
30	91.87	17	4.81	12	22.05
35	82.58	15	4.81	11	22.10
40	75.15	14	4.81	9	21.95
45	69.05	13	4.81	8	21.64
50	63.95	12	4.81	7	21.20
55	59.62	11	4.81	6	20.67
60	55.89	10	4.81	6	20.05
1440	4.45	1	4.81	0	0.00

Area = 0.1336 (ha)
R = 0.5
N = 2.78
RAN = 0.1857

Catchbasin 4

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
10	178.56	23	3.31	20	11.70
15	142.89	18	3.31	15	13.45
20	119.95	15	3.31	12	14.42
25	103.85	13	3.31	10	14.94
30	91.87	12	3.31	8	15.17
35	82.58	11	3.31	7	15.20
40	75.15	10	3.31	6	15.10
45	69.05	9	3.31	6	14.88
50	63.95	8	3.31	5	14.58
55	59.62	8	3.31	4	14.22
60	55.89	7	3.31	4	13.79
1440	4.45	1	3.31	0	0.00

Area = 0.0919 (ha)
R = 0.5
N = 2.78
RAN = 0.1277

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 100-Year Storm
T_d = Time of Concentration (min)
A = 1735.688
B = 0.82
C = 6.014

Table 4.3B

5 YEAR STORM - STORAGE CALCULATIONS

(Algonquin College Proposed Student Commons Building Displaced Parking Area)

Catchbasin 1

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
10	104.19	19	4.69	14	8.50
15	83.56	15	4.69	10	9.39
20	70.25	13	4.69	8	9.63
25	60.90	11	4.69	6	9.50
30	53.93	10	4.69	5	9.13
35	48.52	9	4.69	4	8.60
40	44.18	8	4.69	3	7.94
45	40.63	7	4.69	3	7.20
50	37.65	7	4.69	2	6.38
55	35.12	6	4.69	2	5.51
60	32.94	6	4.69	1	4.59
1440	2.67	0	4.69	0	0.00

Area = 0.1302 (ha)
R = 0.5
N = 2.78
RAN = 0.1810

Catchbasin 2

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
10	104.19	22	5.40	16	9.79
15	83.56	17	5.40	12	10.82
20	70.25	15	5.40	9	11.10
25	60.90	13	5.40	7	10.95
30	53.93	11	5.40	6	10.52
35	48.52	10	5.40	5	9.90
40	44.18	9	5.40	4	9.15
45	40.63	8	5.40	3	8.29
50	37.65	8	5.40	2	7.35
55	35.12	7	5.40	2	6.35
60	32.94	7	5.40	1	5.29
1440	2.67	1	5.40	0	0.00

Area = 0.15 (ha)
R = 0.5
N = 2.78
RAN = 0.2085

Catchbasin 3

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
10	104.19	16	3.96	12	7.18
15	83.56	13	3.96	9	7.93
20	70.25	11	3.96	7	8.14
25	60.90	9	3.96	5	8.03
30	53.93	8	3.96	4	7.71
35	48.52	7	3.96	3	7.26
40	44.18	7	3.96	3	6.71
45	40.63	6	3.96	2	6.08
50	37.65	6	3.96	2	5.39
55	35.12	5	3.96	1	4.65
60	32.94	5	3.96	1	3.88
1440	2.67	0	3.96	0	0.00

Area = 0.11 (ha)
R = 0.5
N = 2.78
RAN = 0.1529

Catchbasin 5

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
10	104.19	19	4.81	15	8.72
15	83.56	16	4.81	11	9.64
20	70.25	13	4.81	8	9.88
25	60.90	11	4.81	6	9.75
30	53.93	10	4.81	5	9.37
35	48.52	9	4.81	4	8.82
40	44.18	8	4.81	3	8.15
45	40.63	8	4.81	3	7.39
50	37.65	7	4.81	2	6.55
55	35.12	7	4.81	2	5.65
60	32.94	6	4.81	1	4.71
1440	2.67	0	4.81	0	0.00

Area = 0.1336 (ha)
R = 0.5
N = 2.78
RAN = 0.1857

Catchbasin 4

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
10	104.19	13	3.31	10	6.00
15	83.56	11	3.31	7	6.63
20	70.25	9	3.31	6	6.80
25	60.90	8	3.31	4	6.71
30	53.93	7	3.31	4	6.44
35	48.52	6	3.31	3	6.07
40	44.18	6	3.31	2	5.61
45	40.63	5	3.31	2	5.08
50	37.65	5	3.31	2	4.50
55	35.12	4	3.31	1	3.89
60	32.94	4	3.31	1	3.24
1440	2.67	0	3.31	0	0.00

Area = 0.0919 (ha)
R = 0.5
N = 2.78
RAN = 0.1277

$I = \dfrac{A}{(T_d + C)^B}$

where I = Rainfall Intensity (mm/hr) for a 5-Year Storm
T_d = Time of Concentration (min)
A = 998.071
B = 0.814
C = 6.053

The overland flow route for the displaced parking lot is the proposed swale located on the north and east side of the displaced parking lot and the existing parking lot to the south of the displaced parking lot.

When the storm design sheet (**Table 4.2)** was updated to reflect the increased parking area, the proposed 450mm stormsewer between MH2 and MH1 was under capacity by 0.13 L/s (0.09%). Since the entire stormsewer system will become surcharged under 5-year flow conditions, this segment of the stormsewer will not need to be increased to accommodate an additional 0.13 L/s. The stormsewers within the parking lot have a total pipe storage of 74.5 m^3. This is 14.5 m^3 more than the required 60 m^3.

A SWMHYMO model was constructed to evaluate the storage requirements associated with maximum allowable flowrate of 36 L/s/ha as stipulated in the *Pinecrest/Centrepointe Stormwater Management Criteria Study*. Results of the modeling indicate that a storage volume of approximately 300 m^3 is required. This is consistent with the values presented in Table 11 of the *Pinecrest/Centrepointe Stormwater Management Criteria Study*. Refer to **Appendix C** for the SWMHYMO output files.

A ditch inlet (DI1) is proposed to the east of the proposed parking lot site. The ditch inlet will collect the existing flows from the Sports Complex and surrounding area and connect into the stormwater system in the parking lot. The proposed stormwater system consists of surface storage that outlets via five (5) catchbasins, four (4) manholes, and an oversize stormsewer. The existing ditch inlet (CB137), located on the south side of the proposed parking lot, will be removed and replaced with a storm manhole (MH1). The proposed stormwater system will connect to the north of (MH1) and the existing stormwater system for parking lot 12 will connect to the south of (MH1). At (MH1) the proposed north inlet will have a larger pipe diameter than the existing south outlet. As a result of this, an orifice will be installed on the existing stormsewer that outlets at the south of (MH1). The orifice equation was used to calculate the size of the orifice as shown in **Table 4.4**. Based on the post-development flow of 96 L/s an orifice of 200 mm is required to control the flows. In addition, standard inlet control devices will be installed on four (4) of the proposed catchbasins in the parking lot. These inlet control devices are

Table 4.4

ORIFICE SIZE CALCULATIONS

(Algonquin College Proposed Student Commons Building Displaced Parking Area)

Orifice Equation: $Q=CA(2gh)^{0.5}$

Manhole 1

Pipe Diameter (mm) = 200
Pipe Area (m^2) = 0.031
C = 0.61
g (m/s^2) = 9.81
Datum (m) = 85.25

El. (m)	Height (m)	Q (m^3/s)
85.25	0.00	0.000
85.35	0.10	0.027
85.45	0.20	0.038
85.55	0.30	0.046
85.65	0.40	0.054
85.75	0.50	0.060
85.85	0.60	0.066
85.95	0.70	0.071
86.05	0.80	0.076
86.15	0.90	0.080
86.25	1.00	0.085
86.35	1.10	0.089
86.45	1.20	0.093
86.47	1.22	0.094
86.55	1.30	0.097
86.65	1.40	0.100
86.75	1.50	0.104
86.85	1.60	0.107
86.95	1.70	0.111
87.05	1.80	0.114
87.15	1.90	0.117

Catchbasin 2

Pipe Diameter (mm) = 75
Pipe Area (m^2) = 0.004
C = 0.61
g (m/s^2) = 9.81
Datum (m) = 86.37

El. (m)	Height (m)	Q (m^3/s)
86.37	0.00	0.0000
85.30	0.05	0.0027
85.35	0.10	0.0038
85.40	0.15	0.0046
85.45	0.20	0.0053
85.50	0.25	0.0060
85.55	0.30	0.0065
85.60	0.35	0.0071
85.65	0.40	0.0075
85.70	0.45	0.0080
85.75	0.50	0.0084
85.80	0.55	0.0088
85.85	0.60	0.0092
85.90	0.65	0.0096
85.95	0.70	0.0100
86.00	0.75	0.0103
86.05	0.80	0.0107
86.10	0.85	0.0110
86.15	0.90	0.0113
86.20	0.95	0.0116
86.25	1.00	0.0119

Catchbasin 3

Pipe Diameter (mm) = 58
Pipe Area (m^2) = 0.003
C = 0.61
g (m/s^2) = 9.81
Datum (m) = 87.20

El. (m)	Height (m)	Q (m^3/s)
87.20	0.00	0.0000
85.30	0.05	0.0016
85.35	0.10	0.0023
85.40	0.15	0.0028
85.45	0.20	0.0032
85.50	0.25	0.0036
85.55	0.30	0.0039
85.60	0.35	0.0042
85.65	0.40	0.0045
85.70	0.45	0.0048
85.75	0.50	0.0050
85.80	0.55	0.0053
85.85	0.60	0.0055
85.90	0.65	0.0058
85.95	0.70	0.0060
86.00	0.75	0.0062
86.05	0.80	0.0064
86.10	0.85	0.0066
86.15	0.90	0.0068
86.20	0.95	0.0070
86.25	1.00	0.0071

Catchbasin 4

Pipe Diameter (mm) = 56
Pipe Area (m^2) = 0.002
C = 0.61
g (m/s^2) = 9.81
Datum (m) = 87.75

El. (m)	Height (m)	Q (m^3/s)
87.75	0.00	0.0000
85.30	0.05	0.0015
85.35	0.10	0.0021
85.40	0.15	0.0026
85.45	0.20	0.0030
85.50	0.25	0.0033
85.55	0.30	0.0036
85.60	0.35	0.0039
85.65	0.40	0.0042
85.70	0.45	0.0045
85.75	0.50	0.0047
85.80	0.55	0.0049
85.85	0.60	0.0052
85.90	0.65	0.0054
85.95	0.70	0.0056
86.00	0.75	0.0058
86.05	0.80	0.0059
86.10	0.85	0.0061
86.15	0.90	0.0063
86.20	0.95	0.0065
86.25	1.00	0.0067

Catchbasin 5

Pipe Diameter (mm) = 71
Pipe Area (m^2) = 0.004
C = 0.61
g (m/s^2) = 9.81
Datum (m) = 88.10

El. (m)	Height (m)	Q (m^3/s)
88.10	0.00	0.0000
85.30	0.05	0.0024
85.35	0.10	0.0034
85.40	0.15	0.0041
85.45	0.20	0.0048
85.50	0.25	0.0053
85.55	0.30	0.0059
85.60	0.35	0.0063
85.65	0.40	0.0068
85.70	0.45	0.0072
85.75	0.50	0.0076
85.80	0.55	0.0079
85.85	0.60	0.0083
85.90	0.65	0.0086
85.95	0.70	0.0089
86.00	0.75	0.0093
86.05	0.80	0.0096
86.10	0.85	0.0099
86.15	0.90	0.0101
86.20	0.95	0.0104
86.25	1.00	0.0107

required since the parking lot will be used to store water. The calculations used to determine the inlet control flow restrictions are shown in **Table 4.5**. The proposed stormwater system design allows the flows to exit the site along the same flow path that is currently used. The proposed changes to the stormwater system are shown in the Site Plan Approval Drawings in **Appendix B.**

4.2 Swale

The proposed swale, located along the north side of the proposed parking lot, has a drainage area of approximately 0.90 ha. The drainage area includes existing Algonquin Parking Lot 11 (approximately 0.34 ha) and existing grassed lands to the north and east of the proposed parking lot. The catchment areas for the proposed swale are shown in **Figure 4.2**.

After the site plan approval submission that was made on November 24, 2010, three (3) 400mm HDPE culverts were added along the swale to provide pedestrian crossing points. The culverts were seized based on the calculated peak flows (rational method). The City of Ottawa Sewer Design Guidelines recommend a time of concentration of 10 minutes for commercial, institutional and industrial land uses. Since the proposed site area does not meet the above mentioned land uses, the time of concentration was calculated using the Federal Aviation Agency Method, shown below.

$T_c = 3.26(1.1\text{-}C)L^{0.5}/S^{0.333}$

Where,

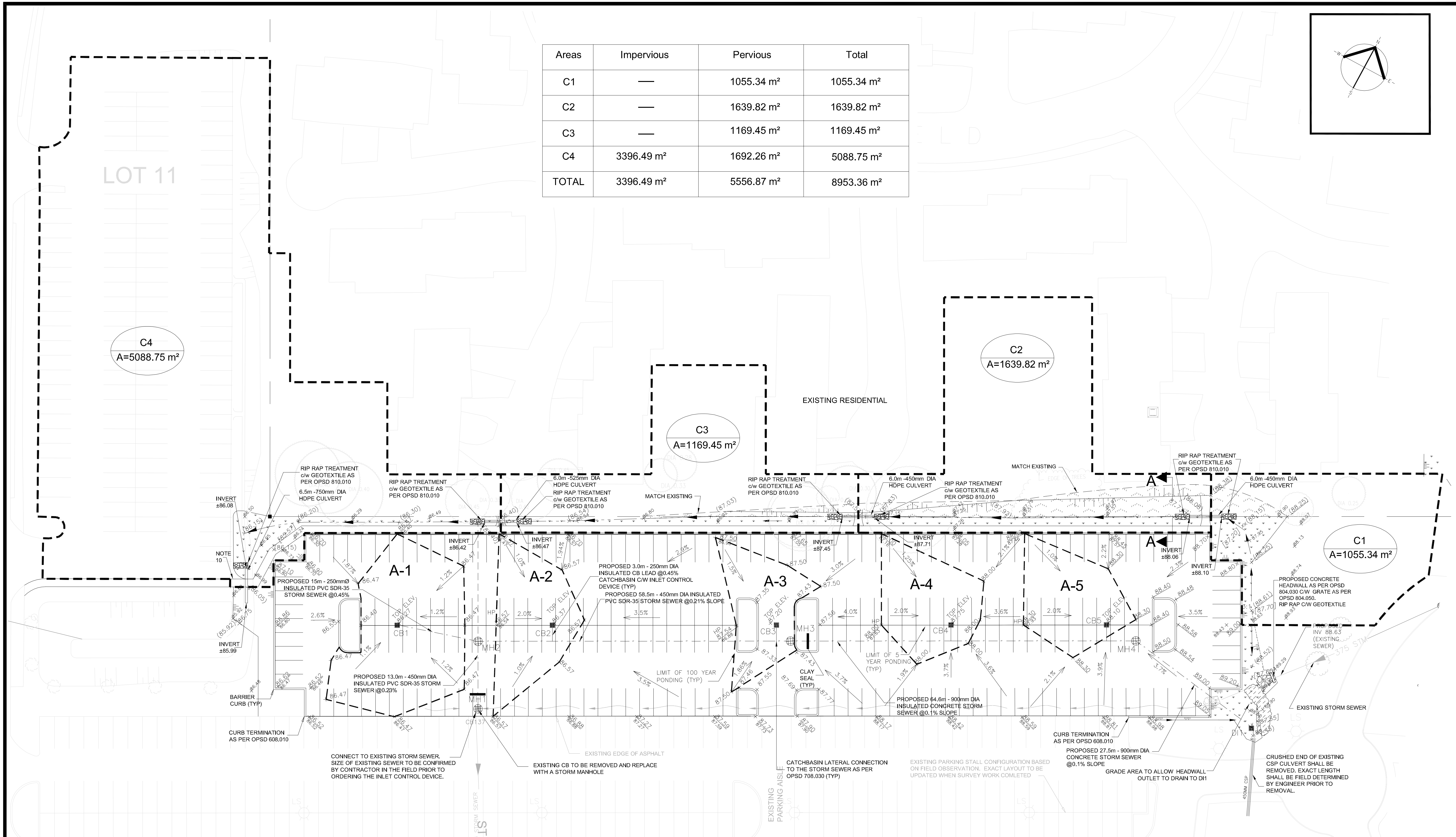
C = rational method runoff coefficient

L = length of overland flow (m)

S = slope (%)

A runoff coefficient of 0.3 was used in the above formula to calculate the time of concentration. The value was selected from Table 5.7 in the City of Ottawa Sewer Design Guidelines based on the soil type for the proposed drainage basin. The time of concentration obtained at the inlet of the first culvert was 10.28 minutes. The system was analyzed using a time of concentration of 10 minutes.

Areas	Impervious	Pervious	Total
C1	—	1055.34 m²	1055.34 m²
C2	—	1639.82 m²	1639.82 m²
C3	—	1169.45 m²	1169.45 m²
C4	3396.49 m²	1692.26 m²	5088.75 m²
TOTAL	3396.49 m²	5556.87 m²	8953.36 m²



MORRISON HERSHFIELD

STUDENT COMMONS DISPLACED PARKING
SWALE CATCHMENT AREAS

Figure 4.2

Table 4.5

INLET CONTROL DEVICE - FLOW CALCULATIONS

(Algonquin College Proposed Student Commons Building Displaced Parking Area)

Catchbasin No.	Area (ha)	Area (m2)	Fraction of Total Area	Flow (L/s)
1	0.1302	1302	0.2115	4.69
2	0.1500	1500	0.2436	5.40
3	0.1100	1100	0.1787	3.96
4	0.0919	919	0.1493	3.31
5	0.1336	1336	0.2170	4.81
TOTAL	**0.6157**	**6157**	**1**	**22.17**

Maximum Flow Rate (L/s/ha)	36
Parking Lot Area (ha)	0.6157
Flow Rate (L/s)	22.1652

The culvert design sheet is shown in **Table 4.6**. The culverts were sized using Manning's equation.

4.3 Pinecrest/Centrepointe Stormwater Management Criteria Study

The maximum release rate for the proposed parking lot is 36 L/s/ha as outlined in the *Pinecrest/Centrepointe Stormwater Management Criteria Study*. For the 0.62 ha site the maximum release rate permitted is 22 L/s for the 100 year storm. To meet this requirement, an additional storage volume of approximately 100 m^3 is required (300-196).

The initial 10mm of precipitation must be retained. This means that no off-site discharge must occur for the runoff associated with the first 10 mm of precipitation. This represents a volume of approximately 53 m^3 (52.7). The second 15 mm of precipitation (93 m^3) must be released over a period of at least 48 hours. The study indicates that for sites where retention of the first 10 mm of precipitation is problematic, a combination of 15 mm or greater detention, in-stream work, or accounting for the 10 mm within other projects could be considered. From a practical perspective, it would appear that a stormwater management scheme that addresses all previously discussed criteria would be preferable.

4.4 Proposed Stormwater Management Scheme

4.4.1 On-Site

On-site storage is proposed to control off-site flows to the 5-year predevelopment rate of 96 L/s. To achieve this, a combination of surface and subsurface reservoirs will be constructed with total storage capacity of 196 m^3.

4.4.2 Off-Site

To meet the criteria outlined in the *Pinecrest/Centrepointe Stormwater Management Criteria Study,* additional storage is required as follows:

- To meet the 36 L/s/ha maximum discharge requirement: 100 m^3.
- First 10 mm of precipitation: 53 m^3.

Table 4.6
CULVERT DESIGN SHEET
Proposed Swale Flows
(Algonquin College Proposed Student Commons Building Displaced Parking Area)

LOCATION					INDIVIDUAL						CUMULATIVE		DESIGN				PROPOSED SEWER										
					Asphalt Area	Lawn Area	Building Area	Gravel Area	Total	R*A*N	Area	R*A*N	Time of Conc.	Rainfall Intensity	Peak Flow		Length	Size	Minimum Size	Grade	Minimum Slope	Full Capacity	Full Velocity	Time of Flow	Reserve Capacity	Upstream Invert	Downstream Invert
	From	Top of Grate	To	Top of Grate	(ha)	(ha)	(ha)	(ha)	(ha)		(ha)		(min.)	(mm/hr)	(L/s)	(m^3/s)	(m)	(mm)	(mm)	(%)	(%)	(L/s)	(m/s)	(min)	(L/s)	(m)	(m)
Swale	CI1	88.15	CO1	88.15		0.106			0.106	0.07	0.11	0.07	10.00	104.19	7.68	0.008	6	400	297	0.01	0.00	17.00	0.14	0.74	9.33	88.10	88.06
Swale	CI2	88.15	CO2	88.15		0.164			0.164	0.11	0.27	0.19	34.17	49.33	9.26	0.009	6	400	224	0.04	0.00	43.35	0.34	0.29	34.10	87.71	87.45
Swale	CI3	86.72	CO3	86.72		0.117			0.117	0.08	0.39	0.27	51.83	36.68	9.87	0.010	6	400	313	0.01	0.00	19.01	0.15	0.66	9.14	86.47	86.42
Culvert West Side of Parking Lot	CI4	87.00	CO4	87.00	0.34	0.170			0.510	0.97	0.90	1.24	74.06	28.16	34.85	0.035	6.5	500	456	0.01	0.01	44.43	0.23	0.48	9.58	86.08	85.99
TOTAL																											

Q = RAIN, where Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area (Existing): 0.90
Asphalt Area (Proposed): 0.50
Lawn Area: 0.25
Building Area: 0.85
Gravel Area: 0.50
Total:

$I = \frac{A}{(T_d + C)^B}$ where I = Rainfall Intensity (mm/hr) for a 5-Year Storm
T_d = Time of Concentration (min)
A = 998.071
B = 0.814
C = 6.053

January 14, 2011

Project No. 2085345.02

Approximate ±

- Next 15 mm of precipitation: 93 m^3.

Total additional volume requirement: 256 m^3.

4.4.3 Water Quality Control

The *Pinecrest/Centrepointe Stormwater Management Criteria Study* recommends that water quality treatment to the 'enhanced' (80% TSS removal) is implemented. Given the requirement for extensive storage and slow release, it would appear logical to incorporate this requirement in a single stormwater management facility.

4.4.4 Proposed SWM Scheme

Opportunities for additional storage/treatment within the existing campus are limited. Minor system discharge from the displaced parking is to the existing parking lot to the south and from there to a ditch along the boundary between the campus and the adjacent residential development (Ryan Farm). It is proposed that this ditch be modified to provide the additional storage. A control structure would limit downstream release so that the entire storage volume (approximately 450 m^3) is released over a period of 72 hours. In our opinion, the increased detention time will reduce off-site flows to within the criteria outlined in the Pinecrest*/Centrepointe Stormwater Management Criteria Study* and allow for TSS removal to the 'enhanced level'.

5. CONCLUSIONS

The proposed displaced parking lot site will connect into the existing private storm water system within the Algonquin College campus and reduce the post-construction release rate into the stormsewer system to meet City of Ottawa requirements. The post-development runoff from the parking lot will be controlled by an orifice in manhole (MH1) and inlet control devices on four (4) of the proposed catchbasins. The excess runoff from the 5 and 100 year design storms will be attenuated within the proposed parking lot and stormwater system.

Further attenuation and treatment will be provided by a downstream reservoir of approximately 450 m^3. Discharge from this reservoir will be controlled to an average rate of 1.7 L/s (72 hour detention).

APPENDIX A

CITY OF OTTAWA MEMO REGARDING STORMWATER MANAGEMENT CRITERIA

22 April 2010

To / Destinataire	**Kim Howie, P.Eng., Morrison Hershfield**
From / Expéditeur	**Syd Robertson, Project Manager, Infrastructure Approvals** **Development Review Process, Urban Services Branch**
Subject / Object	**Stormwater Management Criteria** **For Infill Developments in the Urban Core**

Please note the following general guidelines apply to Stormwater Management for infill sites in the City's Urban Core. These guidelines may be modified such as in the case of small residential infills where on-site storage may not be practical. Please contact the assigned IAD Project Manager for the Site Specific SWM Criteria that would apply.

Maximum Equivalent Run-off Coefficients (C)

1. For infill properties where a runoff coefficient for the site was not factored into the design of the sewer system:

    i. Grassed infill: Maximum equivalent post-development C to equal pre-development "C".

    ii. Hard surface infill in a combined sewer area:
    - Post C=0.4 for area under development.

    iii. Hard surface infill where there are separated sewers:
    - Post C=0.5 for area under development

2. Where design information exists, those coefficients will supersede the above.

3. If the design C is unavailable and the consultant wishes to use a higher C, it will incumbent on the consultant to produce supporting information for the C they propose to use.

4. On-site detention techniques shall be required to limit run-off from the subject site to a maximum equivalent runoff coefficient (C) as determined above.

5. Increase C by 25%, to a limit of 1.0, for the 100 yr storm event.

.

Q(allowable) in Combined Sewer Areas:

- 2-yr storm event
- Time of Duration: 20 min; Rainfall Intensity: 52.03 mm/h
- Maximum Equivalent 'C' as determined above.
- Flows to the storm sewer, in excess of the 2-year storm release rate, up to and including the 100-year storm event, must be detained on site.

Note: *Refer to sewer design manual (p.5.7, item 5.1.5.1 - first bullet) if storm outlet is to a combined sewer.*

Q(allowable) in Separated Sewer Areas:

- 5-yr storm event
- Time of Duration: 20 min; Rainfall Intensity: 70.3 mm/h
- Maximum Equivalent ‘C’ as determined above.
- Flows to the storm sewer in excess of the 5-year storm release rate, up to and including the 100-year storm event, must be detained on site.

Note that a more stringent SWM Criteria (Quantity & Quality) may apply based on the receiving watercourse and RVCA comments.

Use the IDF information derived from Meteorological Services of Canada rainfall data, taken from the MacDonald Cartier Airport, collected 1967 to 1997.

Ottawa IDF Table: 1967 to 1997

Time of Duration (min)	Rainfall Intensity (5Yr) (mm/h)	Rainfall Intensity (100 yr) (mm/h)
5	141.2	242.7
10	104.2	178.6
15	83.6	142.9
20	70.3	120.0
25	60.9	103.8
30	53.9	91.9
35	48.5	82.6
40	44.2	75.1
45	40.6	69.1
50	37.7	63.9
55	35.1	59.6
60	32.9	55.9
65	31	52.6
70	29.4	49.8
75	27.89	47.3
80	26.6	45.0
85	25.6	43.0
90	24.29	41.1
95	23.3	39.4
100	22.4	37.9
105	21.6	36.5
110	20.8	35.2

Additional information is available in the City of Ottawa Sewer Design Guidelines.

APPENDIX B

SITE PLAN APPROVAL DRAWINGS


KEY PLAN
Baseline Rd
SITE
PROPOSED DISPLACED PARKING LOT
OBLITERATE EXISTING PAVEMENT MARKINGS
EXISTING STORM SEWER
PROPOSED STORMWATER MANAGEMENT FACILITY
INDOOR DOME STRUCTURE
EDGE OF PLAYFIELD
BLEACHERS
LOT 8
LOT 9
LOT 12
LOT 7
R3
G
Z
V
P
S
L
WITHROW
REVISIONS
NO. | DESCRIPTION | BY | DATE
2 | REVISED AND RE-ISSUED FOR SITE PLAN CONTROL | GSH
1 | ISSUED FOR SITE PLAN CONTROL | GSH
F. HENDRIKSEN
LICENSED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO
MORRISON HERSHFIELD
ALGONQUIN COLLEGE
ALGONQUIN COLLEGE
STUDENT COMMONS DISPLACED PARKING
SITE PLAN
SCALE:
1:750
DWG No.:
00
DESIGN: FH
DRAWN: CR
REVIEWED: GSH

ISTING STORM SEWER ENTERS CITY RIGHT OF WAY ON NA AHO DRI E
NAVAHO DRIVE
LCBO
PHARMAPLUS
GRAND & TOYS
REITMANS
ADDITIONS ELLE
JACOBS
SMART
BUFFALO
CLAIRBORNE
CHANCES "R"
R1
R2
R3
COURT
F
G
LOT 10
LOT 11
DEERFIELD
NORTH ACCESS ROAD
ISTING 2100 STORM SEWER
PROPOSED DISPLACED PARKING LOT
LOT 14
LOT 9
LOT 12
LOT 8
ISTING STORM SEWER
A
H
D
C
K
J
N
P
S
T
L
V
Z
INDOOR DOME STRUCTURE
PROPOSED STORMWATER MANAGEMENT FACILITY
LOT 2
LOT 7
METER PARKING
HOLE NO. 4
COLLEGE A ENUE
KEY PLAN
Baseline Rd
Woodroffe Ave
SITE
REVISIONS
NO. DESCRIPTION BY DATE
2 REVISED AND RE-ISSUED FOR SITE PLAN CONTROL GSH
1 ISSUED FOR SITE PLAN CONTROL GSH
F. HENDRIKSEN
LICENSED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO
MORRISON HERSHFIELD
ALGONQUIN COLLEGE
ALGONQUIN COLLEGE
STUDENT COMMONS DISPLACED PARKING
SERVICING PLAN
SCALE:
0m 10 20 40
1:1000
DWG No.:
01
DESIGN: FH
DRAWN: CR
REVIEWED: GSH

NOTE:

HALF SIZE DRAWINGS NOT T0 SCALE

ALL DIMENSIONS ARE IN METRES
UNLESS OTHERWISE INDICATED

ISSUE	DESCRIPTION	DATE	BY
7	REVISED AND RE-ISSUED FOR SITE PLAN APPROVAL	NOV 9 2011	KEH
6	REVISED AND RE-ISSUED FOR SITE PLAN APPROVAL	APR 8 2011	KEH
5	REVISED AND RE-ISSUED FOR SITE PLAN APPROVAL	JAN 14 2011	KEH
4	RE-ISSUED FOR SITE PLAN APPROVAL	NOV 23 2010	KEH
3	RE-ISSUED FOR SITE PLAN APPROVAL	OCT 05 2010	KEH
2	RE-ISSUED FOR SITE PLAN APPROVAL	AUG 6 2010	KEH
1	ISSUED FOR SITE PLAN APPROVAL	JULY 7 2010	KEH

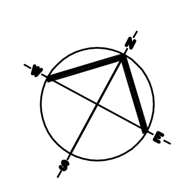
LICENSED PROFESSIONAL ENGINEER F. HENDRIKSEN 2011/11/09 PROVINCE OF ONTARIO

MORRISON HERSHFIELD

ALGONQUIN COLLEGE - 1385 WOODROFFE AVE.
STUDENT COMMONS DISPLACED PARKING
SITE PLAN

SCALE: 1:250 DATE: NOV 9, 2011

DESIGN: JPR
DRAWN: TAM
REVIEWED: KH
DRAWING No.: 1



STRUCTURE	STRUCTURE TYPE	COVER TYPE	TOP OF COVER	INLET CONTROL DEVICE		INVERTS			
				TYPE/MODEL	FLOW (L/s)	NORTH	EAST	SOUTH	WEST
DI1	OPSD 701.011	OPSD 403.010	88.63	-	-	85.34 87.55(3)			
CB1	OPSD 705.010	OPSD 400.070	86.25	-	-		85.21		
CB2	OPSD 705.010	OPSD 400.070	86.35	75mm Orifice Plate	5.40			85.27	
CB3	OPSD 705.010	OPSD 400.070	87.17	58mm Orifice Plate	3.96			85.34	
CB4	OPSD 705.010	OPSD 400.070	87.73	56mm Orifice Plate	3.31			85.54	
CB5	OPSD 705.010	OPSD 400.070	88.07	71mm Orifice Plate	4.81			85.56	
MH1	OPSD 701.010	OPSD 401.010 'B'	86.55	200mm Orifice Plate	96.0	85.10		85.08 (1)	
MH2	OPSD 701.010	OPSD 401.010 'B'	86.52	-	-	85.25 (3)	85.12	85.12	85.12
MH3	OPSD 701.012	OPSD 401.010 'B'	87.38	-	-		85.22		85.22
MH4	OPSD 701.012	OPSD 401.010 'B'	88.32	-	-			85.32	85.32
Headwall	OPSD 804.030	OPSD 804.050	-	-	-				88.63 (2)

Notes:
(1) Existing 300mm diameter invert elevation
(2) Approximate outlet elevation - to be confirmed in the field.
(3) Proposed subdrain elevation

Catchbasin Storage Areas

Catchbasin No.	Area (m2)	Depth (m)	Volume (m3)	5-Year Ponding Volume (m3)	100-Year Ponding Volume (m3)
1.00	635.00	0.20	42.33	9.63	21.54
2.00	347.00	0.20	23.13	11.10	24.82
3.00	231.00	0.20	15.40	8.14	18.20
4.00	319.00	0.25	26.58	6.80	15.20
5.00	306.00	0.20	20.40	9.88	22.10

NOTES:

1. SELECT SUBGRADE MATERIAL SHALL BE PLACED IN MAXIMUM 300mm THICK LIFTS AND COMPACTED TO AT LEAST 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY.

2. SUBGRADE SURFACE FOR THE PAVEMENT AREAS SHALL BE PROOF ROLLED WITH A LARGE (10 TONNE MINIMUM) STEEL DRUM ROLLER UNDER DRY CONDITIONS.

3. ANY SOFT AREAS EXPOSED FROM THE PROOF ROLLING SHALL BE SUBEXCAVATED AND REPLACED WITH SUITABLE EARTH BORROW.

4. THE CATCH BASINS SHALL BE PROVIDED WITH 3m (MINIMUM) LONG PERFORATED SUB DRAINS WHICH EXTEND IN AT LEAST TWO DIRECTIONS FROM THE CATCH BASINS AT THE PAVEMENT SUBGRADE LEVEL.

5. OPSS 1860 CLASS I WOVEN GEOTEXTILE SHALL BE PLACED OVER SOFT AREAS IN SUBGRADE PRIOR TO PLACING GRANULAR MATERIAL AS DIRECTED BY ENGINEER

6. 1.5m WIDE CLAY SEALS SHALL BE INSTALLED ALONG THE TRENCH EVERY 150m AS PER CITY OF OTTAWA STANDARD DWG S8.

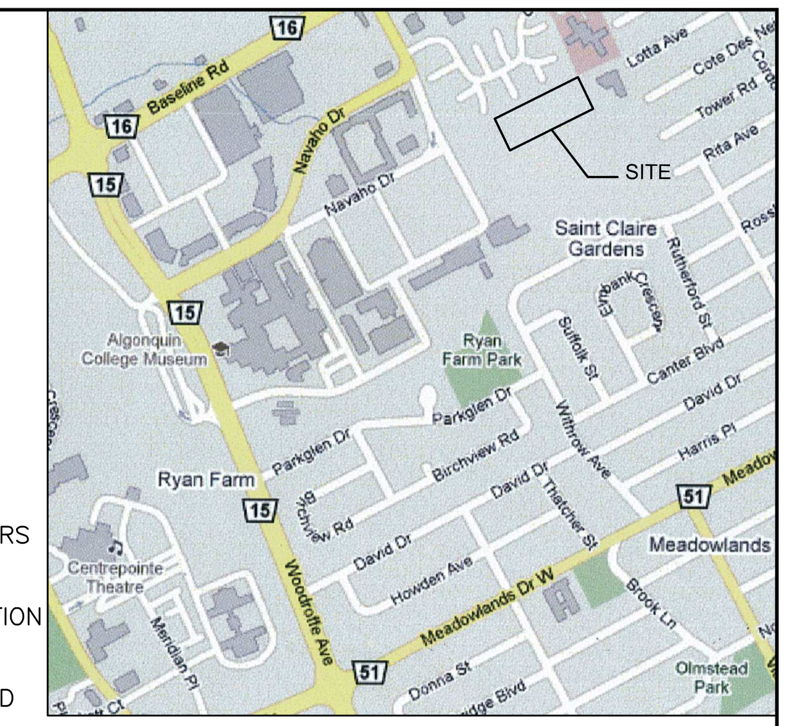
7. TRENCH EXCAVATION, PIPE BEDDING, BACKFILL AND INSULATION TO BE IN ACCORDANCE WITH GEOTECHNICAL INVESTIGATION REPORT PREPARED BY HOULE CHEVRIER ENGINEERING DATED AUGUST 2010.

8. DRAWING TO BE READ IN CONJUNCTION WITH STORM WATER MANAGEMENT REPORT, ALGONQUIN COLLEGE – STUDENT COMMONS BUILDING DISPLACED PARKING LOT PREPARED BY MH DATED SEPTEMBER 2010. FIGURE 2.1, WITHIN THE REPORT, SHOWS THE EXISTING STORM WATER SYSTEM.

9. SIDEWALK TO MATCH TOP OF EXISTING CURB AND SLOPE 2% AWAY FROM CURB.

UTILITY NOTE:

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.



KEY PLAN

NOTES
ELEVATIONS ON THIS PLAN ARE GEODETIC AND ARE DERIVED FROM MUNICIPAL BENCHMARK No.3695 HAVING A PUBLISHED ELEVATION OF 86.752m.

NOTE:
HALF SIZE DRAWINGS NOT T0 SCALE

ISSUE	DESCRIPTION	DATE	BY	ISSUE	DESCRIPTION	DATE	BY
				4	RE–ISSUED FOR SITE PLAN APPROVAL	NOV 23 2010	KEH
7	REVISED AND RE–ISSUED FOR SITE PLAN APPROVAL	NOV 9 2011	KEH	3	RE–ISSUED FOR SITE PLAN APPROVAL	OCT 04 2010	KEH
6	REVISED AND RE–ISSUED FOR SITE PLAN APPROVAL	APR 8 2011	KEH	2	RE–ISSUED FOR SITE PLAN APPROVAL	AUG 6 2010	KEH
5	REVISED AND RE–ISSUED FOR SITE PLAN APPROVAL	JAN 14 2011	KEH	1	ISSUED FOR SITE PLAN APPROVAL	JULY 7 2010	KEH

LICENSED PROFESSIONAL ENGINEER F. HENDRIKSEN 2011/11/09 PROVINCE OF ONTARIO

MORRISON HERSHFIELD

ALGONQUIN COLLEGE - 1385 WOODROFFE AVE.
STUDENT COMMONS DISPLACED PARKING
SERVICING AND GRADING

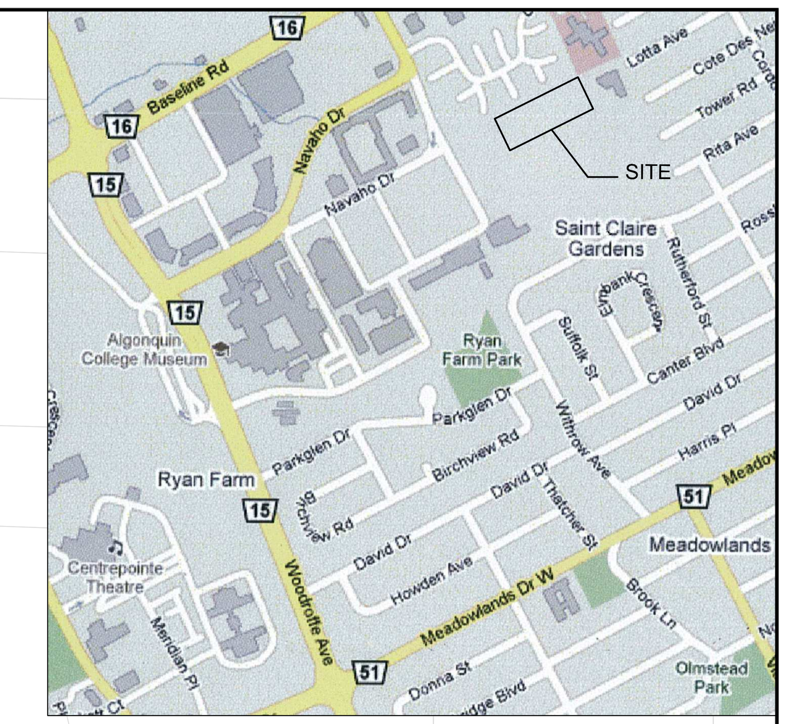
DESIGN:	JPR
DRAWN:	TAM
REVIEWED:	KH
DRAWING No.:	2
SCALE:	1:250
DATE:	NOV 9, 2011

NOTE:

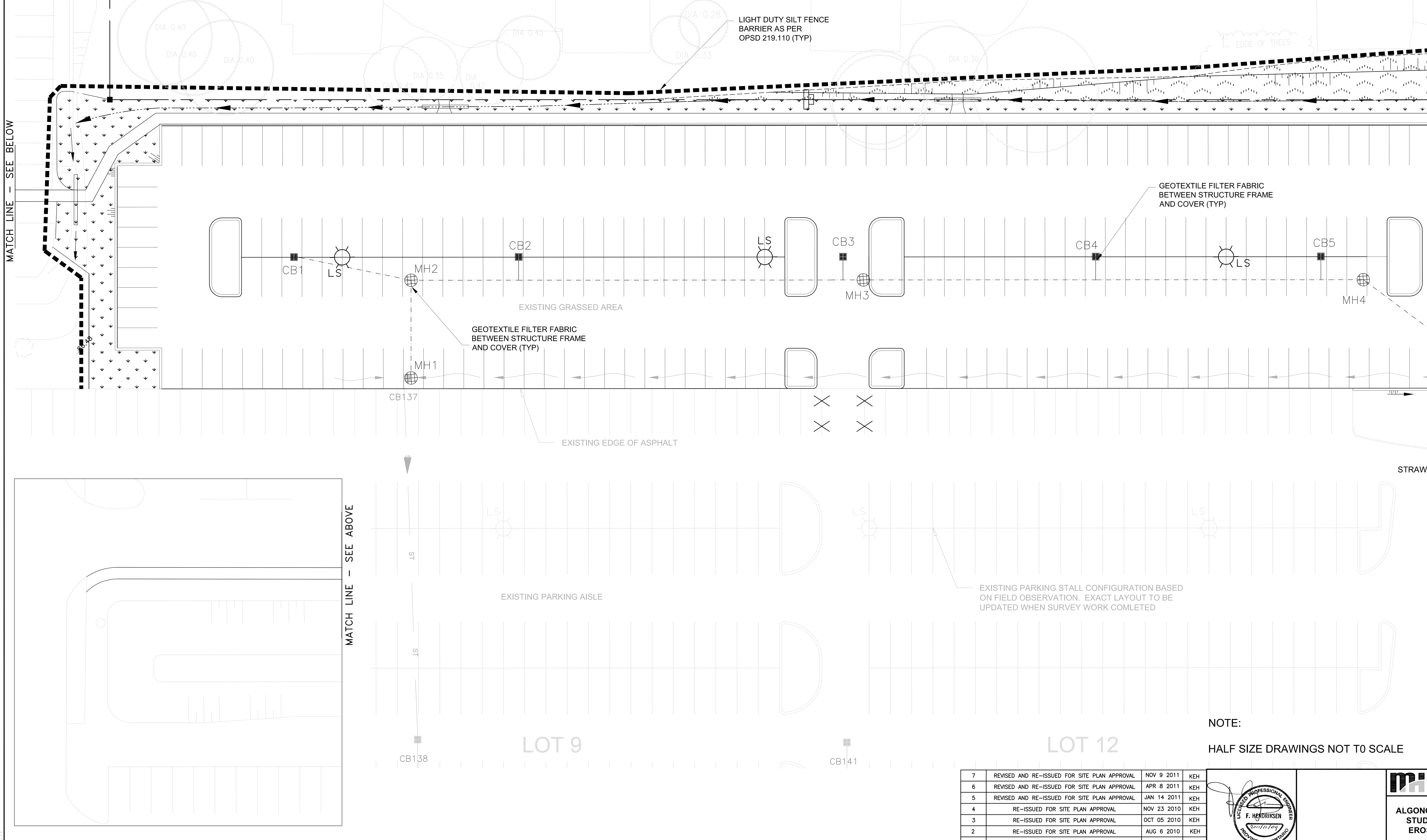
THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL, USING FILTER CLOTH UNDER THE GRATES OF CATCHBASINS AND MANHOLES AND INSTALLING SILT FENCES AND OTHER EFFECTIVE SEDIMENT TRAPS. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALITIES IMPOSED BY AN APPLICABLE REGULATORY AGENCY.

UTILITY NOTE:

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.



KEY PLAN



NOTE:

HALF SIZE DRAWINGS NOT T0 SCALE

LEGEND:

	STORAGE AREA
	STORM SEWERS
	SANITARY SEWERS
	WATERMAINS
86.52 / 86.46	PROPOSED GRADE / EXISTING GRADE
(86.52)	SWALE GRADE
	FLOW DIRECTION
	SEED & MULCH
MH#	PROPOSED MANHOLE
CB#	PROPOSED CATCH BASIN
	SHRUBS TO BE REMOVED
	TEMPORARY STRAW BALE FLOW CHECK (OPSD 219.120)
LS	LIGHT STANDARD

ISSUE	DESCRIPTION	DATE	BY
7	REVISED AND RE-ISSUED FOR SITE PLAN APPROVAL	NOV 9 2011	KEH
6	REVISED AND RE-ISSUED FOR SITE PLAN APPROVAL	APR 8 2011	KEH
5	REVISED AND RE-ISSUED FOR SITE PLAN APPROVAL	JAN 14 2011	KEH
4	RE-ISSUED FOR SITE PLAN APPROVAL	NOV 23 2010	KEH
3	RE-ISSUED FOR SITE PLAN APPROVAL	OCT 05 2010	KEH
2	RE-ISSUED FOR SITE PLAN APPROVAL	AUG 6 2010	KEH
1	ISSUED FOR SITE PLAN APPROVAL	JULY 7 2010	KEH

LICENSED PROFESSIONAL ENGINEER F. HENDRIKSEN PROVINCE OF ONTARIO

MORRISON HERSHFIELD

ALGONQUIN COLLEGE - 1385 WOODROFFE AVE.
STUDENT COMMONS DISPLACED PARKING
EROSION AND SEDIMENT CONTROL PLAN

SCALE: 1:250 DATE: NOV 9, 2011

DESIGN: JPR
DRAWN: TAM
REVIEWED: KH
DRAWING No.: 3

APPENDIX C

SWMHYMO OUTPUT FILES

```
=============================================================================

 SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999     999  =========
 S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9   9   9
 SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9   9   9 Ver. 4.02
     S   W W   M   M  H   H    Y    M   M  O   O       9999    9999 July 1999
 SSSSS   W W   M   M  H   H    Y    M   M   OOO           9       9 =========
                                                      9   9   9   9 # 3573794
      StormWater Management HYdrologic Model           999     999  =========

 **************************************************************************
 ************************** SWMHYMO-99 Ver/4.02 **************************
 *******  A single event and continuous hydrologic simulation model  *******
 *******     based on the principles of HYMO and its successors       *******
 *******                OTTHYMO-83 and OTTHYMO-89.                    *******
 **************************************************************************
 ******* Distributed by:  J.F. Sabourin and Associates Inc.            *******
 *******                 Ottawa,  Ontario: (613) 727-5199             *******
 *******                 Gatineau, Quebec: (819) 243-6858             *******
 *******                 E-Mail: swmhymo@jfsa.Com                     *******
 **************************************************************************

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++ Licensed user: Morrison Hershfield Ltd                      +++++++
 +++++++                Ottawa                  SERIAL#:3573794      +++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 **************************************************************************
 *******            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *******
 *******            Maximum value for ID numbers  :     10           *******
 *******            Max. number of rainfall points:  15000           *******
 *******            Max. number of flow points    :  15000           *******
 **************************************************************************


 ********************  D E T A I L E D   O U T P U T  ********************
 **************************************************************************
 *      DATE: 2011-03-25      TIME: 14:46:45     RUN COUNTER: 000348      *
 **************************************************************************
 * Input   filename: C:\SWMHYM~1\PROJECTS\208534~1.02A\Algon.dat          *
 * Output  filename: C:\SWMHYM~1\PROJECTS\208534~1.02A\Algon.out          *
 * Summary filename: C:\SWMHYM~1\PROJECTS\208534~1.02A\Algon.sum          *
 * User comments:                                                         *
 * 1:_____________________________________________________________________*
 * 2:_____________________________________________________________________*
 * 3:_____________________________________________________________________*
 **************************************************************************

-------------------------------------------------------------------------------
001:0001-----------------------------------------------------------------------
*
* SWMHYMO MODEL INPUT DATA
*
* PROJECT: Algonquin College Student Commons Building Displaced Parking Lot
* JOB NUMBER: 2085345.02
* DATE: Feb 11 2011 SM
*
*
*-------------------------------------------------------------------------------
*
--------------------
| START            |  Project  dir.: C:\SWMHYM~1\PROJECTS\208534~1.02A\
--------------------  Rainfall dir.: C:\SWMHYM~1\PROJECTS\208534~1.02A\
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
-------------------------------------------------------------------------------
001:0002-----------------------------------------------------------------------
*
*-------------------------------------------------------------------------------
*
* SCS 24 HOUR STROM
```

```
*
 --------------------
 | MASS STORM        |     Filename: C:\SWMHYM~1\PROJECTS\208534~1.02A\SCS24H
 | Ptotal= 98.00 mm  |     Comments: SCS Type II 24 HR MASS CURVE
 --------------------
                           Duration of storm        =   24.00 hrs
                           Mass curve time step     =   15.00 min
                           Selected storm time step =   15.00 min
                           Volume of derived storm  =   98.00 mm

              TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .25   1.176 |  6.25   1.568 | 12.25  14.112 | 18.25   1.960
               .50   1.176 |  6.50   1.960 | 12.50  14.112 | 18.50   1.568
               .75    .784 |  6.75   1.568 | 12.75   7.448 | 18.75   1.960
              1.00   1.176 |  7.00   1.960 | 13.00   7.056 | 19.00   1.568
              1.25   1.176 |  7.25   1.960 | 13.25   5.488 | 19.25   1.960
              1.50   1.176 |  7.50   2.352 | 13.50   5.096 | 19.50   1.568
              1.75    .784 |  7.75   1.960 | 13.75   4.312 | 19.75   1.960
              2.00   1.176 |  8.00   2.352 | 14.00   3.920 | 20.00   1.568
              2.25   1.176 |  8.25   2.352 | 14.25   3.136 | 20.25   1.176
              2.50   1.568 |  8.50   2.744 | 14.50   2.744 | 20.50   1.176
              2.75   1.176 |  8.75   2.744 | 14.75   3.136 | 20.75   1.176
              3.00   1.176 |  9.00   2.744 | 15.00   2.744 | 21.00   1.176
              3.25   1.176 |  9.25   3.136 | 15.25   3.136 | 21.25   1.176
              3.50   1.568 |  9.50   3.136 | 15.50   2.744 | 21.50   1.176
              3.75   1.176 |  9.75   3.528 | 15.75   3.136 | 21.75   1.176
              4.00   1.176 | 10.00   3.528 | 16.00   2.744 | 22.00   1.176
              4.25   1.568 | 10.25   4.312 | 16.25   1.960 | 22.25   1.176
              4.50   1.568 | 10.50   4.704 | 16.50   1.568 | 22.50   1.176
              4.75   1.568 | 10.75   5.880 | 16.75   1.960 | 22.75   1.176
              5.00   1.568 | 11.00   6.272 | 17.00   1.568 | 23.00   1.176
              5.25   1.568 | 11.25   9.408 | 17.25   1.960 | 23.25   1.176
              5.50   1.568 | 11.50   9.408 | 17.50   1.568 | 23.50   1.176
              5.75   1.568 | 11.75  29.008 | 17.75   1.960 | 23.75   1.176
              6.00   1.568 | 12.00 119.952 | 18.00   1.568 | 24.00   1.176

--------------------------------------------------------------------------------
001:0003------------------------------------------------------------------------
*
*-------------------------------------------------------------------------------
*
* Catchment 1
*
----------------------
| CALIB STANDHYD      |   Area     (ha)=      .62
| 01:000101 DT= 5.00  |   Total Imp(%)=    99.00    Dir. Conn.(%)=   99.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=        .61          .01
     Dep. Storage      (mm)=       1.50         4.00
     Average Slope      (%)=       3.32          .01
     Length             (m)=      39.00          .01
     Mannings n            =       .013         .200

     Max.eff.Inten.(mm/hr)=      119.95       119.08
                over (min)         5.00         5.00
     Storage Coeff.  (min)=         .94 (ii)    1.14 (ii)
     Unit Hyd. Tpeak (min)=        5.00         5.00
     Unit Hyd. peak  (cms)=         .34          .34
                                                             *TOTALS*
     PEAK FLOW       (cms)=         .20          .00           .207 (iii)
     TIME TO PEAK    (hrs)=       12.00        12.00         12.000
     RUNOFF VOLUME    (mm)=       96.50        89.09         96.426
     TOTAL RAINFALL   (mm)=       98.00        98.00         98.000
     RUNOFF COEFFICIENT   =         .98          .91           .984
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
```

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

 -------------------------------------------------------------------------------
 001:0004-----------------------------------------------------------------------
 *
 *
 *
 * Pond
 *
 * Discharges 22 L/s
 *
 --------------------
 | ROUTE RESERVOIR    |    Requested routing time step =  5.0 min.
 |  IN>01:(000101)    |
 | OUT<02:(000108)    |    =========  OUTLFOW STORAGE TABLE  =========
 --------------------      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)    (ha.m.)   |    (cms)    (ha.m.)
                              .000  .0000E+00   |     .022  .3020E-01
                              .021  .2950E-01   |     .000  .0000E+00

    ROUTING RESULTS               AREA      QPEAK      TPEAK        R.V.
    --------------------          (ha)      (cms)      (hrs)        (mm)
    INFLOW >01: (000101)           .62       .207     12.000      96.426
    OUTFLOW<02: (000108)           .62       .022     12.500      96.424
   OVERFLOW<03: (000109)           .00       .000       .000        .000

                     TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                     CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                     PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                     PEAK   FLOW   REDUCTION [Qout/Qin](%)=   10.628
                     TIME SHIFT OF PEAK FLOW         (min)=    30.00
                     MAXIMUM  STORAGE   USED       (ha.m.)=.3020E-01

 -------------------------------------------------------------------------------
 001:0005-----------------------------------------------------------------------
 *------------------------------------------------------------------------------
 *
 --------------------
 | PRINT HYD          |  AREA       (ha)=     .620
 | ID=01 (000101)     |  QPEAK     (cms)=     .207 (i)
 | DT= 5.00 PCYC=-1   |  TPEAK     (hrs)=   12.000
 --------------------    VOLUME     (mm)=   96.426

      (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
 -------------------------------------------------------------------------------
 001:0006-----------------------------------------------------------------------
 *
 *------------------------------------------------------------------------------
      FINISH
 -------------------------------------------------------------------------------
 *******************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
  001:0003 CALIB STANDHYD
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.
    Simulation ended on 2011-03-25     at 14:46:46
 ===============================================================================
```

APPENDIX D

LETTER TO CITY OF OTTAWA

MORRISON HERSHFIELD

April 11, 2011

City of Ottawa
Infrastructure Services and Community Sustainability
110 Laurier Avenue West
Ottawa, ON. K1P 1J1
Attn: Will Bailie

Dear Mr. Bailie:

Re: Algonquin College Student Commons Building Displaced Parking Lot
Stormwater Management Report
File Number: D07-12-10-0183

The following comments are provided in response to the letter that was dated February 2, 2011.

1. The original Stormwater Management Report must be revised. An addendum is not acceptable, due to risk of confusion between the original report and the addendum.

   The Stormwater Management Report was updated to include the Addendum that was issued on January 17th, 2011.

   Refer to Section 4.2 in the revised report for further details.

2. The addendum does not adequately address the requirements of the Pinecrest/Centrepointe Stormwater Management Criteria Study with regard to the retention and disposal on site of the initial 10mm of precipitation or the retention and release over 48 hours of the second 15mm of precipitation. While it may be possible for a portion of these requirements to be incorporated into the new Student Commons Building, the SWM report should show how this will be achieved.

   a. Provide calculations for the quantities to be compensated off site (i.e. the volumes associated with the 10mm and 15mm quantities)

      The volumes associated with the initial 10 mm of precipitation and the second 15 mm of precipitation are shown below.

      Initial 10mm of Precipitation = 52.7 m3

      Second 15mm of Precipitation = 93 m3

      Refer to Section 4.3 in the revised report for further details.

   b. Provide calculations for the allowed release rate for the retained second 15mm quantity.

The Pinecrest/Centrepointe study indicated that for sites where retention of the first 10mm of precipitation is problematic, a combination of 15mm or greater detention, in-stream work, or accounting for the 10mm within others project could be considered.

It is proposed that the ditch, located along the boundary between the campus and the adjacent residential development (Ryan Farm), be modified to provide the additional storage that is required. A control structure would limit the downstream release so the entire storage volume is released over a period of 72 hours, resulting in an average rate of 1.7 L/s. In our opinion, the increased detention time will reduce the off-site flows to within the criteria outlined in the Pinecrest/Centrepoint Stormwater Management Criteria Study

Refer to Section 4.4 in the revised report for further details.

c. Can any portions of these quantities be managed at the parking lot site? The design of the SCB will need to accommodate the 10mm and 15mm amounts for its own site in addition to the amounts moved over from the parking lot expansion; thus any amount that can be managed at the parking lot will east the requirement for compensation at the SCB site.

   To meet the criteria outlined in the Pinecrest/Centrepointe Stormwater Management Criteria Study additional off-site storage is required. Opportunities for additional storage/treatment within the existing campus are limited. The minor system discharge from the displaced parking is to the existing parking lot to the south and from there to a ditch along the boundary between the campus and the adjacent residential development (Ryan Farm). It is proposed that this ditch be modified to provide the additional storage.

   Refer to Section 4.3 within the revised report for further details.

   i. Consider installing soak pits at the manholes and/or oversizing the storm sewer pipes for storage and gradual release. Other options include using perforated pipes in the swale and stormwater planters, among others. For any methods adopted, provide calculations to show how much water is retained or infiltrated.

      The storm sewer within the parking lot was oversized.

      A perforated sub-drain was proposed along the swale.

      We cannot achieve infiltration at the proposed site for the displaced parking lot. The geotechnical report states that stiff to very stiff silty clays extend below the water table. As such, infiltration is minimal.

3. The addendum does not show how 'enhanced' water quality treatment will be achieved. The Pinecrest Creek/Centrepoint Stormwater Management Study recommends 'enhanced' stormwater treatment (i.e. 80% reduction in TSS).

   The proposed modifications to the ditch located along the boundary between the campus and the adjacent residential development (Ryan Farm) will allow for TSS removal.

   Refer to Section 4.4 within the revised report for further details.

4. The storm main between MH4, MH3 and MH2 is shown passing under parking islands. The landscape plan indicated that there will be trees planted in these islands over the proposed main. Can the main be relocated to prevent possible future root damage to the storm main? An added benefit would be that it will be easier to access the main for maintenance or repairs if it does not pass under the concrete curb of the parking islands.

   We contacted John Wright at Corush Sunderland Wright Limited and received the following comment.

   > ***"The trees within the island will have limited growth due to the unit paver surround and limited soil volume. We recommended one tree in each island but Planning insisted on two. I would not expect these tress to grow much larger than 100mm caliper and their roots are unlikely to extend beyond the curb line or deeper than 1m."***

5. There is no drop across MH2, MH3 and MH4. Inlet and outlet inverts are the same. There is no provision for hydraulic grade loss across the MH. Please provide justification of correction.

   The storm sewer in the parking lot will act as a storage reservoir so the entire storm sewer will frequently be under surcharge conditions. Under these circumstances, velocities are very low and hydraulic grade line losses at the manholes are negligible.

6. Provide detail on proposed inlet control devices (ICD).

   a. Include standard detail drawing. Show details on grading drawing.

      The City of Ottawa Standard Detail Drawing S4.1 Vortex ICD Installation was not added to the contract drawings. The proposed Vortex inlet control devices were replaced with plate orifices directly under the catchbasins.

   b. Provide calculations used to determine ICD flow restrictions.

      Refer to Table 4.5 in the revised report.

   c. Proposed plug device ICD and MH1 should be replaced with a plate orifice or similar. More detail is required.

The proposed plug device at MH1 will be replaced with a plate orifice.

d. Why is there no ICD for CB1?

An inlet control device is not required on proposed structure CB1. The catchbasin is being controlled at proposed structure MH1.

e. Proposed vortex units will be submerged by water ponding in 1:100 year event. Special ventilation will be required. Contact manufacturer for design information and include with submission.

The proposed vortex units will be replaced with orifice plates.

f. If individual ICD's are applied to catch basins then each corresponding drainage area must be modeled. Provide a table with calculations for each CB 1 through 5. A separate calculation will be required for MH1. Flows contributing will be the steady state flows from CB1 through CB5 plus the uncontrolled flow from the east areas.

Refer to Table 4.3 A & 4.3B in the revised report.

g. Page 4, paragraph 4 of the SWM report states, 'The storage volume available within the oversized sewer system (74.5 m3) and the catchbasin structures (3.5 m3) will be utilized first leaving no additional ponding within the parking area.' Show how ICD's in CB1 through CB5 will not cause ponding in the 1:5 year event.

Refer to Table 4.3B in the revised report.

7. It looks like the proposed swale construction will encroach on the north side property line.

   The proposed swale on the north side of the side will encroach on the north property line. We have been in contact with Minto and obtained their approval for the placement of the swale on their property and the proposed pathway adjacent to the property line.

8. On the design sheet, the sports complex shows 0.94 ha of lawn area, 0.11 ha of pavement plus 0.05 ha of building. The does not match Figure 2.1, where the building appears larger than the pavement area. Please confirm relative areas for calculation of C coefficient.

   The area associated with the indoor dome structure shown in Figure 2.1 was considered as grass, not as a building. The reasoning behind this was that the dome structure only covers the sports field during the winter months. The peak flows during the winter months tend to be less than the peak flows during the spring/summer/fall months. Hence, the area associated with the dome structure was considered grass as it will be an open sports field for the majority of the year.

9. Where is the overland flow route?

   The overland flow route is the proposed swale located on the north and east side of the proposed displaced parking lot and the existing parking lot to the south of the proposed displaced parking lot.

10. The 10L/s 100-year peak flow rate is not correct for the comparison to the 36L/s/ha release rate – the comparison should be to the 100 year SCS 24 hour peak flow, not to the rational method 24 hour peak as presented in the report.

    The maximum release rate for the displaced parking lot is 36 L/s/ha as outlined in the Pinecrest/Centrepointe Stormwater Management Criteria Study. For the 0.62ha site the maximum release rate permitted is 22 L/s for the 100 year storm. The 100 year peak flow associated with the SCS 24 hour storm is 207 L/s (refer to the SWMHYMO output file). This flow will be controlled to the maximum permitted release rate of 22 L/s. To meet this requirement a total storage volume of 300 m3 is required. The displaced parking lot has a total storage capacity of 196 m3. An additional storage volume of approximately 100 m3 is required.

    Refer to Section 4.3 of the revised report for further details.

Yours truly,
Morrison Hershfield Limited

Frank Hendriksen, M.Sc.Eng., P.Eng.

L:\PROJ\2085345.02\ENGINEERING DATA BY DISCIPLINE\INFRASTRUCTURE\STORMWATER MANAGEMENT REPORT\SWM REPORT - DISPLACED PARKING AREA\SITE PLAN APPROVAL SUBMISSION - APR 8 2011\LETTER.DOC

Appendix A-VIII

CONTENTS

NE Parking Lot – Site Plan Approval Supporting Documents 23 pages

February 20, 2013

Gary Holowach
Senior Project Manager
Morrison Hershfield
2440 Done Reid Drive
Ottawa, ON K1H 1E1

**RE: Algonquin College Displacement Parking Lot – Site Plan Extension Application
1385 Woodroffe Avenue, Ottawa, ON**

Good day Gary,

Please find enclosed with this letter the following materials from our submission of the Site Plan Extension application for the above noted property submitted to the City on February 8th, 2013 the following materials:

- One (1) copy of the Cover Letter prepared by FOTENN Consultants Inc.;
- One (1) copy of Application Form for Site Plan Extension prepared by FOTENN Consultants Inc.; and
- The original receipt for the Application Fees totaling $2,944.00.

If you have any questions of comments, please don't hesitate to contact me.

Regards,

Brian Casagrande, MCIP RPP
Manager | Development Planning
FOTENN Consultants Inc.

February 8, 2013

Richard Buchanan
Program Manager, Development Review
Planning & Growth Management Department
City of Ottawa
110 Laurier Avenue
Ottawa, ON K1P 1J1

RE: **Extension of Site Plan Approval – Displacement Parking Lot**
Algonquin College, City of Ottawa

Good afternoon Richard,

Please find enclosed with this letter an application for Site Plan Approval extension for temporary displacement parking lot located in the northeastern sector of the Algonquin College campus. Further to my discussion with John Smit, the extension is being requested as the Site Plan Approval, which will soon expire, was tied to the construction of a Stormwater Management pond designed in accordance with the Pinecrest Creek Stormwater Management Plan. The College is currently undertaking a comprehensive stormwater review of its campus and as a result would appreciate the flexibility of proposing alternative stormwater solutions that would both achieve the City's objectives as well as the College's. We trust that this is satisfies any concerns that you may have and is sufficient to deem the extension acceptable.

Included with this letter are the following materials:

- One (1) copy a Site Plan Approval Application form; and
- A cheque in the amount of &2,944.00 to cover application fees.

Please don't hesitate to contact me 613-730-5709 x 235 or at Casagrande@fotenn.com if you have any questions.

Regards,

B. Casagrande

Brian Casagrande, RPP MCIP
Manager | Development Services
FOTENN Consultants Inc.

OFFICE USE ONLY

Application #: ______________ Ward #: ______________ File Lead: ______________

Application Received (dd/mm/yyyy): ______________

Client Service Centre Staff: ______________ Fee Received: $

SITE PLAN CONTROL

APPLICATION FORM

Section 41 of the Planning Act, RSO 1990, as amended

Notice of Public Record

All information and materials required in support of your application shall be made available to the public, as indicated by Section 1.0.1 of *The Planning Act*, R.S.O. 1990, C.P.13.

Municipal Freedom of Information and Protection Act

Personal information on this form is collected under the Authority of *The Planning Act* and will be used to process this application.

SECTION 1: BACKGROUND INFORMATION

** Mandatory Field*

***Site Address or Location:** *1385 Woodroffe Avenue*

Have you pre-consulted with City Staff? ○ Yes ◉ No

If yes, please indicate the date of the pre-consultation.

Have you pre-consulted with the Urban Design Review Panel? ○ Yes ◉ No

If yes, please indicate the date of the pre-consultation.

For any and all previously approved, and concurrent development application(s), please list application numbers:

Application #'s: *D07-12-10-0183*

Applicant/Agent Information:

Name: *FOTENN CONSULTANTS INC (c/o Brian Casagrande)*

Mailing Address: *223 McLeod Street, Ottawa, ON K2P 0Z8*

Telephone: *613-730-5709 x 235* Email Address: *casagrande@fotenn.com*

Registered Property Owner Information: ☐ Same as above

Name: *Algonquin College (c/o John Dalziel)*

Mailing Address: *1385 Woodroffe Avenue, Ottawa, ON K2G 1V8*

Telephone: *613-727-4723* Email Address: *dalziej@algonquincollege.com*

SITE DETAILS

Legal Description:	*CON 1 RF PT Lots 34 and 35; RP 4R 20144 Parts 1 tp 4*
What is the land currently used for?	*Institutional / Parking*

Lot frontage: ____ m   Lot depth: ____ m   Lot area: ____ m^2

OR   Lot area: (irregular lot) 368,264 m^2

PROPOSAL DETAILS

Type of development proposed (new buildings or additions, land use(s), number of unit(s), proposed tenure, etc.):

Extension of Site Plan Approval for an existing temporary parking lot

What is your anticipated date for start of construction? Date (dd/mm/yyyy):

Will the roadway be modified as a result of this proposal? ○ Yes ◉ No

Development Information

1. Indicate the gross floor area of all newly proposed buildings/additions.		m^2
2. Indicate the gross floor area of all existing buildings.		m^2
3. Indicate the combined number of parking spaces (existing and proposed).	244	spaces
4. What is the maximum building height proposed?		m
5. How many storeys are proposed?		storeys
6. Indicate the proposed lot coverage (total area of all building footprints divided by total lot area x 100%)		%
7. If applicable, indicate the percentage of landscaped area within all parking lots (area of landscaping within parking lots divided by parking lot area x 100%).	17	%
8. Indicate the percentage of the total site that is occupied by vegetation and landscaping (total area of all landscaping and vegetation divided by lot area x 100%).		%

COMMUNITY NOTIFICATION

Is this application subject to public consultation? ○ Yes ◉ No

If Yes:

Have you contacted the Ward Councillor to explain this proposal? ○ Yes ○ No

Have you contacted the Registered Community Organization's representative(s) to explain this proposal? ○ Yes ○ No

If Yes, indicate the name of the Registered Community Organization(s): *Indicate the name of the Registered Community Organization(s) here.*

SECTION 2: APPLICATION TYPE AND FEES

For more information please review the Criteria for Identifying Site Plan Control Application Types.

Please visit the City's website for additional information on Site Plan Control.

Fees must be paid in full at the time of application submission.

Please select and fill in only one of the three options for fee payment below.

Application for New Development

1. Manager Approval, Public Consultation	$19,524.71
2. Two Stage Site Plan Process (Initial Fee)	$12,350.00
3. Manager Approval, No Public Consultation	$6,060.71
4. Site Plan for Street Townhouse not Previously Approved through Subdivision Process	$2,944.00
5. Rural based, Small Scale, No Public Consultation	$639.00

PLUS Initial Engineering Design Review and Inspection Fee (only if 1, 2, or 3 above is selected)

Value of Infrastructure and Landscaping < $50,000	$1,000.00
Value of Infrastructure and Landscaping $50,000 to $300,000	$5,000.00
Value of Infrastructure and Landscaping > $300,000	$10,000.00

PLUS Initial Conservation Authority Fee (only if 1 or 2 above is selected)

Central Planning Area - Wards 7, 8, 9, 12, 13, 14, 15, 16, 17, 18.	$90.00
Remainder of City	$880.00

OR

Revision of an Existing Application

Manager Approval, Public Consultation.	$18,419.57
Manager Approval, No Public Consultation	$3,812.57
Staff Approval	$2,944.00
Rural based, Small Scale, No Public Consultation	$639.00

(Initial Engineering Design Review and Inspection fee and Initial Conservation Authority fee not applicable)

OR

Extension of an Existing Application (selected)

Manager Approval, No Public Consultation (more than 12 months)	$3,812.57
Staff Approval (less than 12 months) (selected)	$2,944.00
Rural based, Small Scale, No Public Consultation	$639.00

(Initial Engineering Design Review and Inspection fee and Initial Conservation Authority fee not applicable)

Are multiple Applications being submitted? Yes / No (No selected)

Each planning fee will be reduced by 10% if two or more planning applications are submitted at the same time and for the same lands. Committee of Adjustment, Conservation Authority, and Engineering Design Review and Inspection fees are not subject to this reduction. If "Yes" is checked, the fee will be adjusted accordingly.

Fees Total: $2,944.00

SECTION 3: SUBMISSION REQUIREMENTS

Study and plan requirements are outlined for the applicant during Pre-application Consultation. If your application is not subject to Pre-application Consultation (i.e. it does not require public consultation) you are strongly encouraged to contact the Planning and Growth Management Department to discuss study and plan submission requirements. If you fail to consult with staff, the City cannot guarantee the completeness or accuracy of your application submission, which may result in processing delays. A help guide can be viewed in order to prepare studies and plans, as well as gather information on general development considerations.

Standard Plans (mandatory submission requirements)

- ✓ Site Plan
- ✓ Landscape Plan
- ✓ Grade Control and Drainage Plan
- ✓ Site Servicing Plan
- ✓ Survey Plan **(2 copies)**

(55 copies if application is subject to public consultation, otherwise **35 copies)**
Landscaping and site servicing information may be combined on one plan.

Potential Studies and Plans (may be required at submission or prior to final approval)

Engineering

- Community Transportation Study and/ or Transportation Impact Study / Brief **(12 copies)**
- Assessment of Adequacy of Public Service / Site Servicing Study **(6 copies)**
- Servicing Options Report **(5 copies)**
- Hydraulic Watermain Analysis **(3 copies)**
- Stormwater Management Report / Brief **(6 copies)**
- Composite Utility Plan **(2 copies)**
- Geotechnical Study / Slope Stability Study **(4 copies)**
- Groundwater Impact Study **(6 copies)**
- Wellhead Protection Plan **(6 copies)**
- Erosion and Sediment Control Plan **(8 copies)**
- Hydrogeological and Terrain Analysis **(5 copies)**
- Noise / Vibration Study **(3 copies)**
- Reasonable Use Study **(5 copies)**
- Roadway Modification Plan **(55 copies** if application is subject to public consultation, otherwise **35 copies)**

Planning / Design

- Planning Rationale including Design Statement and Integrated Environmental Review Statement **(4 copies)***
- Architectural Elevation Drawings (dimensioned) **(3 copies)**
- Concept Plan showing Ultimate Use of Lands **(3 copies)**
- Plan Showing Parking Garage Layout **(2 copies)**
- Minimum Distance Separation (MDS) **(3 copies)**

* If the application falls within a design priority area and is subject to review by the Urban Design Review Panel, the planning rationale does not need to include a design statement or urban design analyses.

- Agrology and Soil Capability Study **(5 copies)**
- Cultural Heritage Impact Statement **(3 copies)**
- Archeological Resource Assessment **(3 copies)**
- Sun Shadow Study **(3 copies)**
- Urban Design Review Panel - Submission Package

Environmental

- Phase 1 Environmental Site Assessment **(5 copies)**
- Phase 2 Environmental Site Assessment **(5 copies)**
- Record of Site Condition **(4 copies)**
- Tree Conservation Report **(5 copies)**
- Mine Hazard Study / Abandoned Pit or Quarry Study **(4 copies)**
- Impact Assessment of Adjacent Waste Disposal / Former Landfill Site **(6 copies)**
- Assessment of Landform Features **(7 copies)**
- Mineral Resource Impact Assessment **(4 copies)**
- Environmental Impact Statement **(11 copies)**

If a Tree Conservation Report and Environmental Impact Statement are required, the Tree Conservation Report should be included within the Environmental Impact Statement

Technical Requirements

- All plans and drawings must be produced on A1-sized paper and folded to 21.6 cm x 27.9 cm (8½"x 11"). A scale of 1:200 is recommended for the Site and Landscape Plans.

- Note that many of the plans and studies collected with this application must be signed, sealed and dated by a qualified engineer, architect, surveyor, planner or designated specialist. The City will not review a plan or study if it is missing this information.

- Electronic copies of all required studies and the site plan must be supplied on a Compact Disk (CD is preferred to DVD) in Adobe .pdf format. Ensure that the CD(s) accompanies your application submission. These documents will be made publicly available on the City's Development Application Search Tool.

- The applicant will be requested to submit two A1-sized Mylar copies of each plan just prior to final approval.

Legal Requirements

- All signatures requested through this document must be hand-written.

Financial Requirements

- When an application requires public notice, a large black and white sign describing the proposal is posted on the subject property. The fee for this service is included as part of the application cost ($565). However, additional signage, if required will be invoiced to the applicant at a cost of $282.50 per sign.

- Additional fees may be required throughout the development review process, including, but not limited to, parkland dedication, peer review of technical reports, Conservation Authority fees, agreements and associated fees and applicable securities.

SECTION 4: DECLARATIONS

Authorization by the Owner allowing the Applicant to submit the Application

The Registered Property Owner must complete this section to authorize an Applicant to act on his or her behalf, and declare that the information provided within this application is accurate and true.

If the application is to be signed by an Applicant on behalf of the Owner, the following authorization must be completed or the owner must submit a letter of authorization. Declarations included within this section must contain original signatures and seals.

I, Enter the Name of the Owner am the owner of the land that is subject of this application and I authorize

Enter the Name of the Applicant to make this application on my behalf.

Date (dd/mm/yyyy):

Signature of Owner

Consent - Development Application Client Satisfaction Survey - Optional

I, Name of the Applicant or Owner consent to the City of Ottawa conducting a Client Satisfaction Survey by

mailing to me a paper questionnaire at the following address: Address to send paper copy of the survey

e-mailing me an electronic questionnaire at E-mail address to send electronic copy of the survey

The purpose of this voluntary survey is to measure my level of satisfaction with the development application process and assist the City of Ottawa to improve services. The survey is anonymous. My name will not appear on the questionnaire nor will my responses be linked to my identity. The survey will take approximately 15-20 minutes to complete and be mailed to me after the development application process is complete

Signature

Date

Affidavit or Sworn Declaration that the Information is Accurate

The person carrying out the application (Registered Property Owner or Applicant) must complete the sworn declarations in this section:

I, Name of the Applicant or Owner , of the City of Enter City solemnly declare that all of the above statements contained in the application are true and I make this solemn declaration conscientiously believing it to be true and knowing that it is of the same force and effect as if made under Oath and by virtue of *The Canada Evidence Act.*

SWORN (or Declared) BEFORE ME

At Office where the declaration was sworn ,

This Day day of Month , Year

Commissioner of Oaths

Signature of Applicant or Owner

SECTION 5: ENVIRONMENTAL SITE ASSESSMENT

Part 1: Statement of the Site Owner Concerning Environmental Site Assessment (ESA)

The Owner / Applicant must complete Section A, regardless of whether a Phase 1 ESA has been completed for the site.

Where an ESA is required, the Owner or Applicant and the Consultant responsible for preparing the study, must complete both Sections A and B below.

Section A:

☐ I acknowledge that the City of Ottawa is not responsible for the identification and / or remediation of contaminated sites. I also agree, whether in (or as a result of) any action or proceeding for environmental clean-up of any damage or otherwise related to the site or any other lands impacted by the site, that I will not make any claim whatsoever against the City of Ottawa, its respective directors, officers, employees, or agents, or any of the foregoing, for or in respect of any loss, damage, injury or costs.

Section B:

This is to certify that as the Owner / Applicant of the site, I have hired: *Name of consultant*

as the principal consultant to undertake a Phase 1 Environmental Assessment. I have undertaken reasonable inquiry into the previous ownership and uses of the property and to the best of my knowledge I have provided to the principal consultant, information relevant to the principal consultant's investigation of the environmental condition of the site. I agree to provide copies of the said Phase 1 Environmental Site Assessment on request.

Name: *Enter Name of applicant or owner*

Address: *Enter Address for correspondence*

____
Signature of Applicant or Owner

Date (dd/mm/yyyy):

SECTION 5: ENVIRONMENTAL SITE ASSESSMENT (continued)

Part 2: Affidavit of Principal Consultant Concerning Environmental Site Assessment

I, Enter name of consultant , of the City of Enter name of city

MAKE OATH AND SAY AS FOLLOWS:

I am the Position or title , of Firm or company name

and have personal knowledge of the matters set out below.

I, Enter consultant or firm/company , was retained or employed as the principal environmental consultant to undertake or supervise the Phase 1 Environmental Site Assessment of the site located at Enter the site or property address here

The assessment activities at the site have been completed in accordance with the Canadian Standards Association's Phase 1 Environmental Site Assessment, CAN/CSA Z768-01, as amended. (Or alternatively, the *"Standard practice for Environmental Assessments: Phase 1 Environmental Site Assessment Process"*, ASTM E1527-00, ASTM International and *"Standard Practice for Environmental Site Assessments: Transaction Screen Process"*, ASTM E1528-00, ASTM International).

- ◯ I **am** employed or retained by the Owner/Applicant, or the company operating on the site in another capacity.
- ◯ I **am not** employed or retained by the Owner/Applicant, or the company operating on the site in another capacity.

Findings of the said Phase 1 Environmental Site Assessment are that:

- ◯ There **are no** issues of actual or potential environmental concern with respect to soil and / or groundwater quality and a Phase 2 Environmental Site Assessment will not be required; or
- ◯ There **are** issues of actual or potential environmental concern with respect to soil and / or groundwater quality and a Phase 2 Environmental Site Assessment is required to investigate the identified issues.

SWORN (Or Declared) BEFORE ME

At the Example: Ottawa office , of Enter firm/complany name ,

In the Example: City of Ottawa ,

This Day day of Month , Year

________________________ Commissioner of Oaths

________________________ Signature of Consultant

Address of consultant: Enter address of consultant

Telephone # of consultant: Telephone number of consultant

May 13, 2013

Steve Belan
Planner II, Development Review
Planning & Growth Management Department
City of Ottawa
110 Laurier Avenue
Ottawa, ON K1P 1J1

**RE: Extension of Site Plan Approval – Displacement Parking Lot
Algonquin College, City of Ottawa**

Good day Steve,

In response to your email dated March 05, 2013 we offer the following letter to summarize the current and future steps the College is taking in order to improve the college and better prepare and maintain itself as a leader in the Community.

We expect this letter will satisfy the City's concerns, however one item requested by the City was to outline potential interim stormwater management solutions to employ while the College develops longer term strategies. FOTENN brought this matter to Morrison Hershfield and they concluded that no financially responsible options could be implemented on an interim basis that would produce meaningful stormwater management results. The following items, however, are offered as important steps taken by the College and we hope that the City will consider these items as valuable contributions to the responsible development of the campus and the city as a whole.

Applications Submitted Regarding Campus Development

The College has submitted several applications since 2009 in response to growth pressures and with a desire to intensify and create a more ecologically responsible campus. These developments include the following:

1) The Algonquin Centre for Construction Excellence, completed in 2011, was built to LEED Platinum standards including complete integration with the City's transportation network, a biowall and a green roof. As part of the development of the ACCE, the college built an elevated, protected pedestrian bridge connecting the building to the main campus area.

2) The Student Commons building, completed in 2012, was also built to LEED Gold standards and is an early indication of the College's intent to intensify their campus and replace the existing parking areas with buildings. As part of this redevelopment project, the College implemented several Stormwater Management strategies to simultaneously meet and exceed the requirements for LEED Gold certification, the City of Ottawa's Infill and Pinecrest Creek requirements, and Ministry of the Environment's requirements. These stormwater practices include:
    a. Retention of the first 10 mm of rainfall up to 168 m^3 through infiltration trenches;
    b. Retention and release over a period not less than 48 hours for the following 15 mm up to 216 m^3 through roof drains and infiltration;

c. Control 100 year peak flow up to 548 m^3 through surface and storm sewer storage with some rooftop storage; and
d. Provide 85% Total Suspended Solids removal for 'enhanced' treatment (MOE only requires 80%).

3) The Displacement Parking Lot, completed in 2011 and the subject of this application extension, was developed as a temporary response to the Student Commons building. As the College works toward developing a Transportation Master Plan and a College Water Strategy, this parking lot satisfies a temporary demand which will be reduced as the aforementioned plans seek to increase the modal share of the College's staff and student-body and improve the Colleges environmental impact. Again, the ACCE building (Integration with Transit) and the Student Commons building (Intensification of lands formally used for parking) are both examples of the direction the College is moving in.

   As a part of the development of the Displacement Parking Lot the College proposed the construction of Stormwater Management Facility to be located at the south end of the Campus. The SWM Facility was designed to meet the requirements of the Pinecrest Creek Stormwater Management Plan. This Facility has been placed on hold pending development of a campus-wide Management Plan. The College is concerned with the value of investing in such a large facility without first knowing that this is an appropriate investment relative to the comprehensive needs of the campus over the long term.

4) The Temporary Parking lot was submitted in 2011 as a result of a potential need for additional parking. The College cancelled the application and is no longer seeking the additional parking spaces.

<u>Future Commitments</u>
Further to the applications described above, the College has also made several comprehensive planning commitments to aid in guiding the future development of the Campus. These projects are at following stages of development and are described below. These projects include:

1) A Transportation Master Plan (TMP) that is currently under development at the College. The TMP is currently in Phase 1 of its development where to this date, the College has held three (3) Team Engagement Meetings, the most recent of which was held on April 24th, which has culminated in the development of a Vision and Guiding Principles, and Objectives and Strategies of the Plan. Phase 2 will begin shortly which is intended to focus on the Woodroffe Campus with the aim of developing a short term implementation plan. Phase 2 is slated to be completed by the end of June 2013.

2) A College Water Strategy has recently been initiated by the College by requesting and receiving a proposal for the development of a College-wide Project Vision and Principles. This portion of the process provides the foundation for the following phase which would be the development of the Stormwater Management Plan based on the defined Vision and Principles and the requirements of the Pinecrest Creek watershed drainage area. This process is expected to begin in September 2013 with completion slated for early 2014 at which point the development of the SWM plan will begin.

We trust that the above information satisfies any concerns the City may have. In the event that you have any questions or would like further clarification on any of the above items, please don't hesitate to contact me at 613-730-5709 x 231 or at szilagyi@fotenn.com or Brian Casagrande at 613-730-5709 x 233 or at casagrande@fotenn.com.

Regards,

Mike Szilagyi, RPP MCIP
Planner
FOTENN Consultants Inc.

Ottawa

June 12, 2013

File Number D07-07-13-0005

Mike Szilagyi
FOTENN Consultants Inc.
223 McLeod Street
Ottawa, ON K2P 0Z8

Dear Mr. Szilagyi

Re: Extension of Site Plan Approval – Displacement Parking Lot Algonquin College, City of Ottawa

Thank you for your letter dated May 13, 2013, which summarize the current and future steps the College is taking in order to address the City's concerns regarding existing and future development on the Woodroffe campus.

In the past, development applications have been made by the College without the benefit of an overall Master Servicing Plan for the campus. In your letter you have outlined the steps the College is making to address some components necessary to provide the City with a direction for dealing with our concerns, in particular with regards to stormwater management of the site.

Your letter has fulfilled our requests for information on the timelines and commitments for these plans. This will allow us to proceed with the application to extend the site plan approval for the Displacement Parking Lot. As part of the ~~extension the City will remove requirements for the Stormwater Management Facility~~ at this time.

We acknowledge that the College is in the process of reviewing its overall building requirements and appreciates the efforts made to produce these guiding documents. Going forward, the City has the expectation that a Master Servicing Plan will be created that will not only address the College's stormwater strategy, but, will also consider future requirement for water and sewer services as well.

The City expects that the College will have completed these studies prior to making any future development applications.

Regard,

Steve Belan, RPP MCIP
Planner
Urban Services
City of Ottawa.

cc: John Smit, Manager, Urban Services

Ottawa

File No. D07-12-13-0025

October 18, 2013

Michael Szilagyi
Fotenn Consultants Inc.
223 McLeod Street
Ottawa, ON K2P 0Z8

Dear Mr. Szilagyi:

Subject: **Site Plan Control Application – Extension of Time Limit**
1385 Woodroffe Avenue.
File No: D07-12-13-0025

The subject Site Plan Control application submitted on February 8, 2013; has been approved subject to the conditions contained in the attached Delegated Authority report.

This decision extends the time limit of the previous approval (file # D07-12-10-0183) for twelve (12) months to allow for the execution and registration of an Amending Agreement. This decision includes all the same required conditions, plans and reports with the exception of the following plans and report related to the Stormwater Management Facility, which will be part of the future Water Strategy for the entire campus:

Grading and Drainage Plan, Algonquin College Stormwater Management Facility, Drawing 02, prepared by **Morrison Hershfield, Revision 3,** revised 28-Sep-2011.

Landscaping, Algonquin College Stormwater Management Facility, Drawing 08, prepared by **Morrison Hershfield, Revision 3,** revised 28-Sep-2011.

Stormwater Management Report, Report No. 2085345.13, dated **Nov. 2011**, prepared by **Morrison Hershfield Ltd.**

The Owner(s) are required to pay engineering design, review and inspection fees, and submit securities, which are based on the cost estimated provide by the Owner's agents. The cost estimates from the previous approval will need to be amended to order to prepare the Amending Agreement for this site.

It is important to note that this Site Plan Control Approval may lapse if the agreement is not executed by October 17, 2014.

Please contact me at 613-580-2424, extension 27591 or e-mail Steve.Belan@ottawa.ca if you have any questions in this regard.

Yours truly,

Steve Belan, Planner
Planning and Growth Management Department

Attach. (incl. distribution)

c.c. Councillor Rick Chiarelli - College
Syd Robertson, Infrastructure Approvals, Planning and Growth Management Department
Mike Levasseur, Zoning Plan Examiner, Building Code Services
J. Honshorst, Utility/Development Co-ordination Unit, Infrastructure Services Dept
Ermis Durofil, Program Manager, By-laws, Permits and Inspections, PGM
Charlie Argue, Program Manager, Development Inspection West, PGM
Christine Enta, Legal Counsel, City Clerk & Solicitor Department
Laura Sweet, City Clerk & Solicitor Department
Joumana Tannouri, Securities Administrator, Finance Department
Algonquin College, c/o Mike Rushton, 1385 Woodroffe Avenue, Ottawa, ON K2G 1V8

Ottawa

SITE PLAN CONTROL APPROVAL APPLICATION
DELEGATED AUTHORITY REPORT
MANAGER, DEVELOPMENT REVIEW
PLANNING AND GROWTH MANAGEMENT DEPARTMENT

Site Location: 1385 Woodroffe Ave

File No.: D07-12-13-0025

Date of Application: February 11, 2013

This SITE PLAN CONTROL application submitted by FoTenn Consultants Inc., on behalf of Algonquin College, is APPROVED as shown on the following plan(s):

1. **Site Plan, Algonquin College – 1385 Woodroffe Ave. Student Commons Displaced Parking, Drawing 1,** prepared by **Morrison Hershfield,** dated **Nov. 9, 2011, Revision 7.**

2. **Servicing and Grading Plan, Algonquin College – 1385 Woodroffe Ave. Student Commons Displaced Parking, Drawing 2,** prepared by **Morrison Hershfield,** dated **Nov. 9, 2011, Revision 7.**

3. **Erosion and Sediment Control Plan, Algonquin College – 1385 Woodroffe Ave. Student Commons Displaced Parking, Drawing 3,** prepared by **Morrison Hershfield,** dated **Nov. 9, 2011, Revision 7.**

4. **Landscape Plan, Proposed Surface Parking, Drawing L1,** prepared by **Corush Sunderland Wright** dated **22 June 2010 Revision 7.**

5. **Servicing Plan, Algonquin College Student Commons Displaced Parking, Drawing 01,** prepared by **Morrison Hershfield, Revision 2.**

And as detailed in the following report(s):

1. Phase I Environmental Site Assesment, Ref. No. 10-259, dated June 2010, prepared by Houle Chevrier Engineering
2. Geotechnical Investigation, Report No. 10-343, dated August 2010, prepared by Houle Chevrier Engineering

And subject to the following Standard and Special Conditions:

Standard Conditions

1. The applicant shall enter into a standard site development agreement consisting of the following conditions. In the event the Owner fails to enter into such agreement within one year, this approval shall lapse.

2. The Owner(s) shall obtain such permits as may be required from Municipal or Provincial authorities and shall file copies thereof with the General Manager, Planning & Growth Management Department.

3. The Owner(s) shall reinstate at its expense, to the satisfaction of the General Manager, Planning & Growth Management Department, any property of the City, including, but not limited to, sidewalks and curbs, boulevards, that are damaged as a result of the subject development.

4. The Owner(s) shall be required to install construction fencing at its expense, in such a location as may be determined by the General Manager, Planning & Growth Management Department.

Special Conditions

5. The Owner's Geotechnical Engineer shall ensure that the recommendations of the approved Geotechnical Investigation, Report No. 10-343, dated August 2010, prepared by Houle Chevrier Engineering, are fully implemented and provide certificates of compliance, with respect to all recommendations and provisions of the report, to the satisfaction of the General Manager, Planning and Growth Management Department.

6. Prior to the Site Plan Approval, the applicant shall provide a certificate, from an acceptable professional engineer, that the site lighting has been designed to meet the following criteria:
   a. It must be designed using only fixtures that meet the criteria for Full Cut-Off (Sharp cut-off) Classification, as recognized by the Illuminating Engineering Society of North America (IESNA or IES), and;
   b. It must result in minimal light spillage onto adjacent properties. As a guideline, 0.5 fc is normally the maximum allowable spillage.

   Upon completion of the works, the applicant must provide certification satisfactory to the City that the site lighting has been constructed in accordance with the applicant's design prior to the City releasing any associated securities.

Oct 17, 2013
Date

Steve Belan
Assigned Planner, Urban Services
Planning and Growth Management Department

Attach: Site Plan Control Application approval – Supporting Information

Ottawa

SITE PLAN CONTROL APPROVAL APPLICATION
SUPPORTING INFORMATION

SITE LOCATION

1385 Woodroffe Avenue, D07-12-13-0025

SYNOPSIS OF APPLICATION

The College obtained site plan approval to construct a 244 space parking area in order to replace 251 parking spaces lost as a result of construction of a new student commons building. The new parking area is located in the northeast corner of the campus with existing parking to the south and west. Adjacent land uses include a row-house development to the north and a sports dome to the east. The area measures approximately 6,000 m2 and was originally a grassed area.

Previous site plan approval addressed increased runoff by requiring the College to improve an existing ditch to provide improved quality and quantity control of stormwater. Since then, the College has undertaken a commitment to develop an overall master plan for the Woodroffe Campus including a transportation plan and a water strategy. The improvements to the ditch will be delayed until the completion of the water strategy. In this way the College will avoid constructing improvements that may not be consistent with the future water strategy.

This approval will amend the pervious approval by removing the need to improve the ditch. In the interim there are quantity controls that have been installed in the new parking area. The ditch is vegetated and thereby offering some quality control. This approval will also extend the previous approval for another year to allow the College to complete the amending agreement and works.

DECISION AND RATIONALE

This application is approved for the following reasons:

- The proposal is in conformity with the policies outlined in the city of Ottawa Official Plan. The proposed site plan and use meets the existing Zoning provisions of the I2 zone in the City of Ottawa Zoning By-law.

- An amendment to the registered Site Plan Agreement is required to ensure that works associated with the implementation of this Site Plan are undertaken in accordance with municipal standards, verified through on-site inspections and that the proper securities are posted to ensure completion of site works.

- The site is to be developed on full municipal services. Building locations, landscaping and parking reflect good site plan design principles.

CONSULTATION DETAILS

Councillor Rick Chiarelli - College is aware of the application.

Public Comments

This application was subject to the Public Notification and Consultation Policy.

No negative comments were received.

APPLICATION PROCESS TIMELINE STATUS

This Site Plan application was not processed by the On Time Decision Date established for the processing of an application that has Manager Delegated Authority due to the complexity of the issues associated with stormwater management.

Contact : Steve Belan Tel: 613-580-2424, extension 27591, fax 613-560-6006 or e-mail : Steve.Belan@ottawa.ca

PUBLIC NOTIFICATION OF DECISION LIST

Site Plan Control Application:

Site Address: 1385 Woodroffe Avenue

File No.: D07-12-13-0025

The persons, community organizations, advisory committees and/or technical agencies noted on the attached lists are to be notified of the decision, given they have provided comments and/or requested to be notified of the decision, through the Department's Public Notification and Consultation or Technical Circulation Processes:

Fotenn Consultants Inc.
223 McLeod Street
Ottawa, ON K2P 0Z8

Algonquin College
c/o Mike Rushton
1385 Woodroffe Avenue
Ottawa, ON K2G 1V8

The supporting information attached to the notification of the decision does not need to be be bilingual, because no comments were received in French.

Appendix A-IX

CONTENTS

Stormwater Management Report – IELCIIE Building (Building C) 51 pages

REPORT

Stormwater Management Report & Assessment of Adequacy of Public Services Report

Algonquin College – The Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship

Presented to:

City of Ottawa

For:
Site Plan Control Approval
110 Laurier Avenue West, 4th Floor
Ottawa, Ontario, K1P 1J1

Report No. 2085345.44 REV January 26, 2017

L:\PROJ\2085345\2085345.44 BUILDING C ADDITION CIVIL WORKS\300 - ENGINEERING\08 STORMWATER\DRAINAGE REPORT RE01262017SDM.DOC

TABLE OF CONTENTS

Page

1. INTRODUCTION 1
2. EXISTING CONDITIONS 1
   2.1 Existing Water System 3
   2.2 Existing Sanitary Sewer System 5
   2.3 Existing Storm Sewer System and Drainage 7
3. PROPOSED DEVELOPMENT FLOWS AND APPROACH 9
   3.1 Water Servicing 9
   3.2 Sanitary Servicing 9
   3.3 Stormwater Servicing 9
4. DESIGN CRITERIA 11
5. STORM DESIGN CALCULATIONS 13
   5.1 Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) Site 13
   5.2 Pinecrest Creek Stormwater Management Guidelines 23
6. CONCLUSIONS 26
7. CLOSURE 27

LIST OF TABLES

Table 1: (IELCIIE) Building – 5 Year Pre-Development Flow 15

Table 2: (IELCIIE) Building – Existing Roof Flow Estimation 16

Table 3: (IELCIIE) Building – 5 Year Pre-Development Flow –Reduced Runoff Coefficient 17

Table 4: (IELCIIE) Building - Post Development Storage Calculations 19

Table 5: (IELCIIE) Building – Orifice Size 20

Table 6: (IELCIIE) Building – Stress Test (100 Year Plus 20%) Ponding Elevation 22

Table 7: (IELCIIE) Building – Pinecrest Creek Design Criteria Calculations 25

TABLE OF CONTENTS (Continued)

Page

LIST OF FIGURES

Figure 1: Site Location 2

Figure 2: Existing Watermain Distribution System 4

Figure 3: Existing Sanitary Sewer Network 6

Figure 4: Existing Storm Sewer Network 8

Figure 5: Stormwater Management Areas 14

APPENDICES

Appendix A City of Ottawa Site Plan Approval Pre-Consultation Meeting Notes

Appendix B Algonquin College Existing Stormwater Shortfall

Appendix C Site Plan Approval Drawings

Appendix D Responses to City of Ottawa Comments Received October 28, 2016

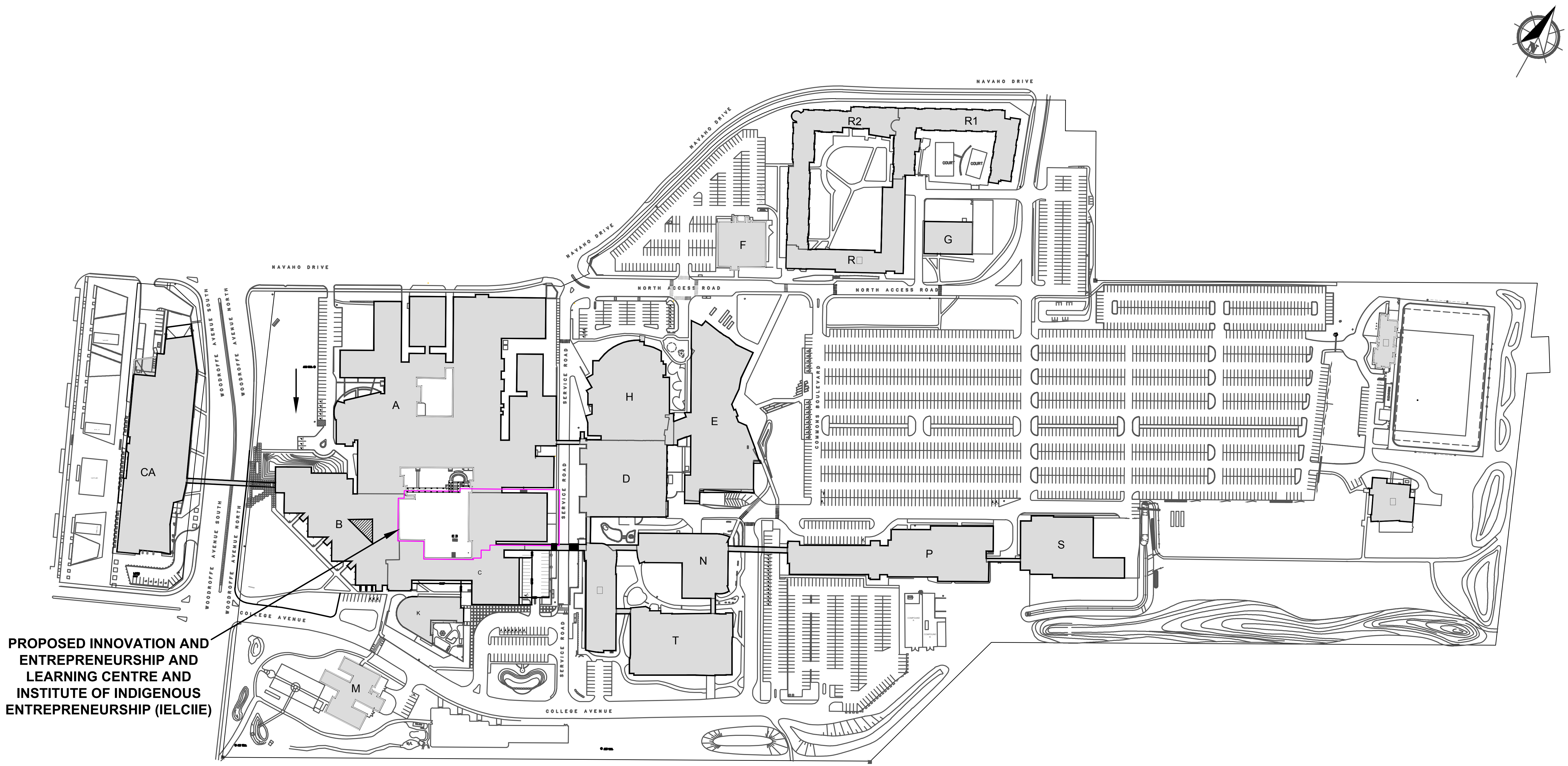
1. INTRODUCTION

Morrison Hershfield Limited has been retained by Edward J. Cuhaci and Associates Architects Incorporated to provide services related to obtaining Site Plan Control Approval for the proposed Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) building to be located within the Algonquin College's Woodroffe Avenue campus. The location of the building is on the east and south side of the existing courtyard surrounded by existing Buildings A, B, and C. IELCIIE building will consist of a one (1) storey addition to the existing two (2) storey building located on the east side of the existing courtyard, resulting in a gross floor area of approximately 2,517m^2 and a one (1) storey addition on the south side of the existing courtyard, resulting in a new construction gross floor area of approximately 493m^2. **Figure 1** presents a site location plan for the project.

To gain City of Ottawa (City) approval for the IELCIIE building, a stormwater management and site serviceability report is required. This report will determine the pre-construction flow estimates for the building and calculate the post-construction flow estimates for the IELCIIE building. The pre-construction and post-construction flows will also be compared. The post-construction flows must meet stormwater management criteria provided by the City. The existing water, sanitary, and storm services for the proposed site will be reviewed and proposed services will be discussed.

2. EXISTING CONDITIONS

The building that will house the Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) is located on approximately 0.30ha of land within the Algonquin College Woodroffe Avenue Campus as shown on **Figure 1**. The site is generally bounded by Building A to the north, the existing Service Road to the east, Building C to the south and the existing courtyard (which is surrounded by Building A, B and C) on the west. The site presently consists of an existing building and grassed courtyard. Approximately 0.25ha of the floor area of the building addition will be created by adding a storey to an existing two (2) storey building. The remaining 0.05ha of the required floor space is in a building addition that will be located on the existing grassed courtyard.



Morrison Hershfield

SITE PLAN LOCATION

Figure 1

2.1 Existing Water System

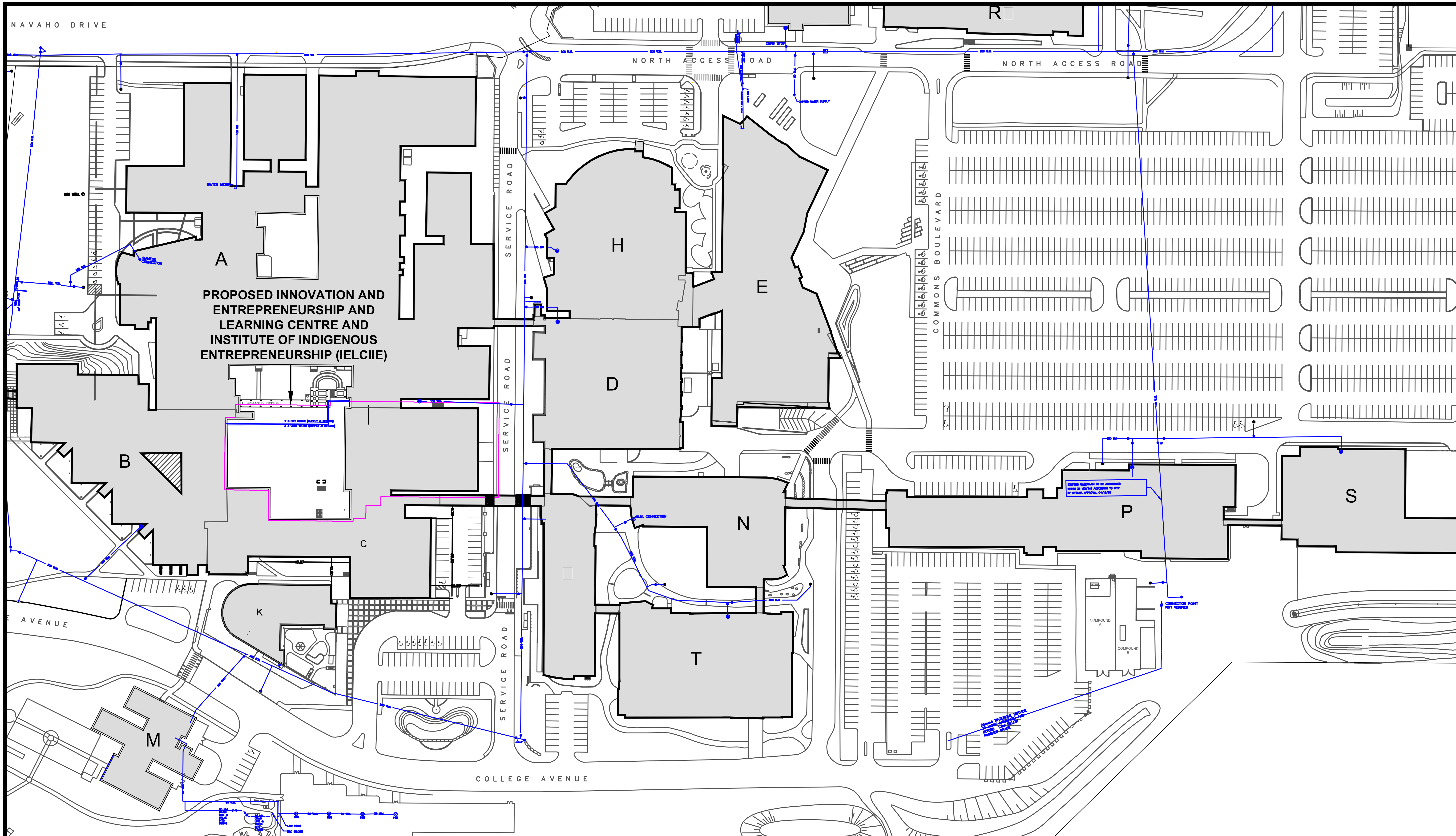
The existing campus of Algonquin College is located within the 2W Pressure Zone in the City of Ottawa. The 2W Pressure Zone is one of the largest pressure zones in the City. It covers areas west of the Rideau River and south of Highway 417, including portions of Barrhaven and Kanata. The 2W Pressure Zone receives water pumped directly from the Britannia Water Purification Plant through a transmission main varying in size from 1524mm at the plant discharge down to 1220mm in the Barrhaven area. There are two storage reservoirs within the 2W pressure zone – the Barrhaven Reservoir and the Glen Cairn Reservoir. The maximum hydraulic grade line (HGL) at these reservoirs is 131m.

The existing Algonquin College Woodroffe Campus consists of a private water distribution system which is fed from three separate City owned watermains:

1. 203mm on Navaho Drive at Woodroffe Avenue;
2. 203mm on Navaho Drive at Baseline Road; and
3. 152mm on Lotta Avenue to the east of campus.

The 203mm watermains on Navaho Drive are fed from the City system through existing 406mm watermains located on Woodroffe Avenue and Baseline Road. A 1220mm transmission main is also located on Woodroffe Avenue, with existing connections to the 406mm watermain on Woodroffe Avenue at Parkglen Drive, David Drive, and at Navaho Drive. The 1220mm backbone watermain continues south on Woodroffe Avenue and east on David Drive as a 762mm backbone watermain.

The existing private water distribution system within the campus provides a 203mm link from the two 203mm City watermains on the north and west side of the campus. A 203mm loop feeds the cluster of existing buildings between Woodroffe Avenue and the private service road to the west of Buildings H, D and J. A 305mm watermain from the 203mm loop feeds buildings J, N and T. There is also a 152mm branch to the east that feeds Buildings P and S. The 152mm branch from Lotta Avenue supplies water to the Indoor Dome Structure, Building Z and Building V. The existing water distribution system is shown in **Figure 2**.



MORRISON HERSHFIELD

EXISTING WATERMAIN DISTRIBUTION SYSTEM

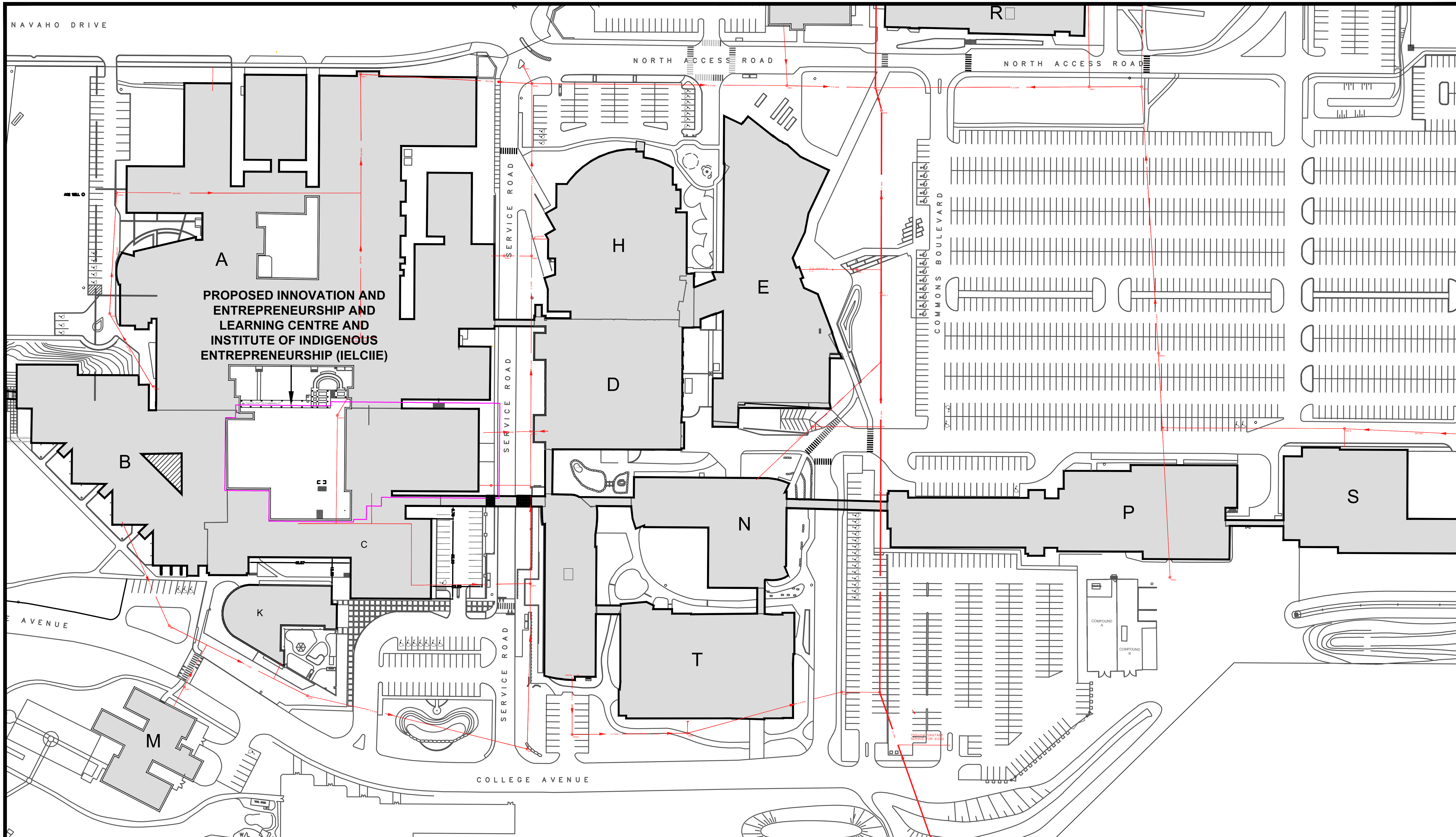
Figure 2

2.2 Existing Sanitary Sewer System

The Algonquin College Woodroffe Avenue Campus contains private sanitary sewers which drain to a 525mm diameter sanitary sewer which runs south to north through the campus. This sewer conveys flows from the residential development immediately to the south as well as flows from the campus. The sewer runs through the campus and heads north to Baseline Road, where it connects to a 750mm diameter City sanitary sewer which runs west to Woodroffe Avenue. The Baseline Road sewer connects to the 1200mm diameter Woodroffe Collector, which runs north on Woodroffe Avenue. A small portion of the existing campus (Building Z and Indoor Dome Structure) is serviced from Lotta Avenue.

A 250mm diameter sanitary sewer runs south to north underneath the private service road located to the east of Building C and ultimately intersects with the 525mm diameter sanitary sewer which runs south to north through the campus. The building appears to have two service laterals. A 200mm diameter service lateral that exits the building on the east side near the southeast corner and a 250mm diameter sewer that exits the building on the east side near the northeast corner. Both service laterals connect to the existing 250mm diameter sanitary sewer that is previously described. The foot print of the proposed Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) building is not expected to impact these existing sewers. However, the proposed one (1) storey addition in the existing courtyard falls directly on top of the 200mm diameter service lateral. The existing sanitary system is shown in **Figure 3**.

The Woodroffe Collector is the main trunk sanitary sewer serving this area and surcharging during wet weather has been addressed through the construction of a diversion chamber and pumping station located on Woodroffe Avenue at Highway 417. The diversion chamber can be operated remotely to divert flows from the Woodroffe Collector to the pumping station. The pumping station then pumps flows south on Woodroffe Avenue through a 600mm forcemain to the Lynwood Collector south of Norice Street.



Morrison Hershfield

EXISTING SANITARY SEWER NETWORK

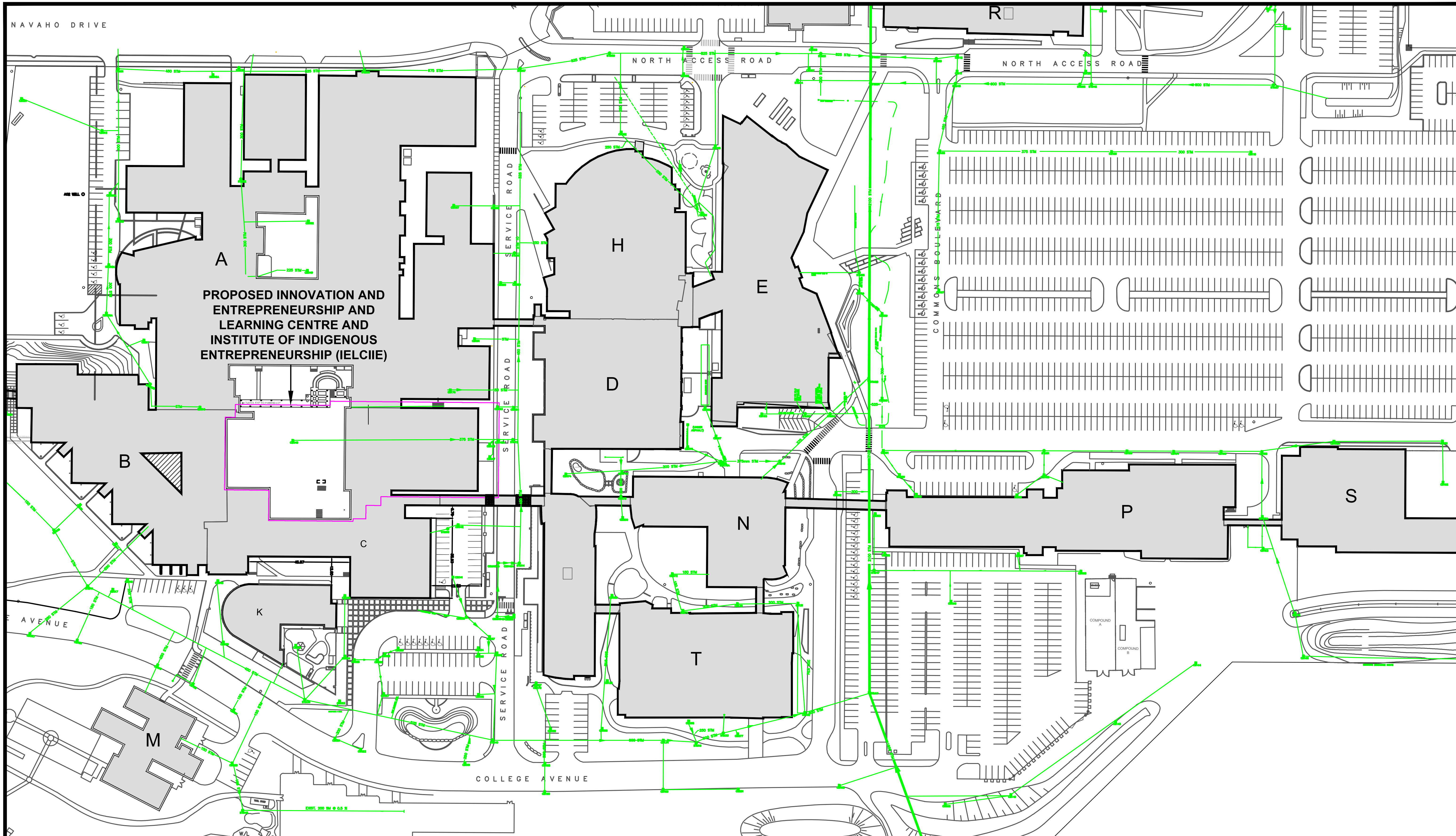
Figure 3

2.3 Existing Storm Sewer System and Drainage

The Algonquin College Woodroffe Campus contains private storm sewers which drain to an existing 2100mm diameter trunk storm sewer which runs south to north through the campus. This storm sewer conveys flows from the residential development immediately to the south as well as flows from the campus. The storm sewer runs through campus and heads north to Baseline Road, where it discharges to Pinecrest Creek.

A catchbasin is located in the grassed courtyard. The catchbasin is serviced by a 375mm diameter storm lateral that outlets to the 450/525mm diameter storm sewer which runs from south to north along the Service Road. This storm sewer intersects with an 825mm diameter storm sewer which runs from west to east along the North Service Road. This storm sewer intersects with the existing 2100mm diameter trunk storm sewer which runs from south to north through the campus. The footprint of the proposed Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) building is not expected to impact these existing sewers. The existing storm sewer system is shown in **Figure 4**.

The National Capital Commission (NCC) has carried out studies on Pinecrest Creek. The studies identified a number of flow and erosion concerns. To address these concerns, specific stormwater management requirements were developed for the watershed ("Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area", prepared by J.F. Sabourin & Associates, June 2012). Consequently, any new developments within the Pinecrest Creek/Westboro watershed must adhere to the criteria outlined in the "Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area"



MORRISON HERSHFIELD

EXISTING STORM SEWER NETWORK

Figure 4

3. PROPOSED DEVELOPMENT FLOWS AND APPROACH

3.1 Water Servicing

An assessment of the existing water distribution system is currently in progress. A technical memo will follow at a later date to present the analysis findings.

3.2 Sanitary Servicing

It is proposed that the Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) building be service from the existing 250mm diameter sanitary service for Building C. The service connects to the 250mm diameter sanitary sewer which runs south to north underneath the private service road located to the east of Building C and ultimately intersects with the 525mm diameter sanitary sewer which runs south to north through the campus.

The existing peak flow for Building C was estimated to be 4.2L/s and the proposed peak flow for the Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) building is 5.2L/s. The proposed works results in an approximate peak flow increase of 1.0L/s. The peak flows were provided by Goodkey, Weedmark & Associates Limited Consulting Engineers.

The existing 250mm diameter service has an approximate length of 23.0m and an assumed slope of 1.0% which results in a capacity of approximately 59.0L/s. The existing 250mm diameter service has sufficient capacity to accommodate the proposed peak flow 5.2L/s.

3.3 Stormwater Servicing

It is proposed that the Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) building be service from the existing 375mm diameter storm service for Building C. The service connects to the 450mm/525mm diameter storm sewer which runs south to north underneath the private service road located to the east of Building C and ultimately intersects with the 2100mm diameter storm sewer which runs south to north through the campus.

The courtyard and proposed one (1) storey addition in the courtyard has an estimated 5 year pre-development flow of 20L/s. An orifice diameter of 75m flow rate to 20L/s into the 375mm diameter storm service. The existing Building C portion that is proposed to receive a one (1) storey addition has an estimated pre-development flow of 60L/s. This results in a combined controlled flow of approximately 80L/s discharging to the 375mm diameter storm service.

The existing 375mm diameter service has an approximate length of 94.0m and slope of 0.3% which results in a capacity of 94.0L/s. The existing 375mm diameter service has sufficient capacity to accommodate the proposed flow rate of 80L/s.

4. DESIGN CRITERIA

The Algonquin College Woodroffe Avenue Campus falls within the Pinecrest Creek watershed. The design criteria for the Pinecrest Creek/Westboro watersheds are outlined in the Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area, prepared by J.F. Sabourin & Associates (June 2012) which include the following criteria for institutional/commercial/industrial developments discharging upstream of the Ottawa River Parkway pipe inlet.

- The first 10mm of precipitation must be retained on site;
- The subsequent 15mm of run-off must be detained on site such that the peak outflow from the site does not exceed 5.8L/s/ha;
- The 100 year discharge from the site should be controlled to the more stringent of the following criteria:
  - Maximum rate of 33.5L/s/ha
  - City of Ottawa Sewer Design Guidelines (Section 8.3.7.3)
- The “Enhanced” (80% total suspended solid removal) water quality criteria as defined by the MOE “Stormwater Management Planning and Design Manual” must be met.

The City of Ottawa has indicated that the Pinecrest Creek Stormwater Management Guidelines do not have to be met directly for the proposed Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) site. The deficit that will result from this project will be addressed in an overall Stormwater Management Master Plan for the Algonquin College Woodroffe Campus which is currently under development. Therefore, the City of Ottawa Sewer Design Guidelines for infill developments within the urban core will be applied to the proposed site.

The site falls under the City of Ottawa category of infill developments within the urban core. In accordance with the City of Ottawa Sewer Design Guidelines, this category requires the following stormwater management criteria:

- Flows to the storm sewer in excess of the 5 year storm pre-development release rate, up to and including the 100 year storm event must be retained on site;
- The allowable runoff coefficient for hard surface infill is 0.5;

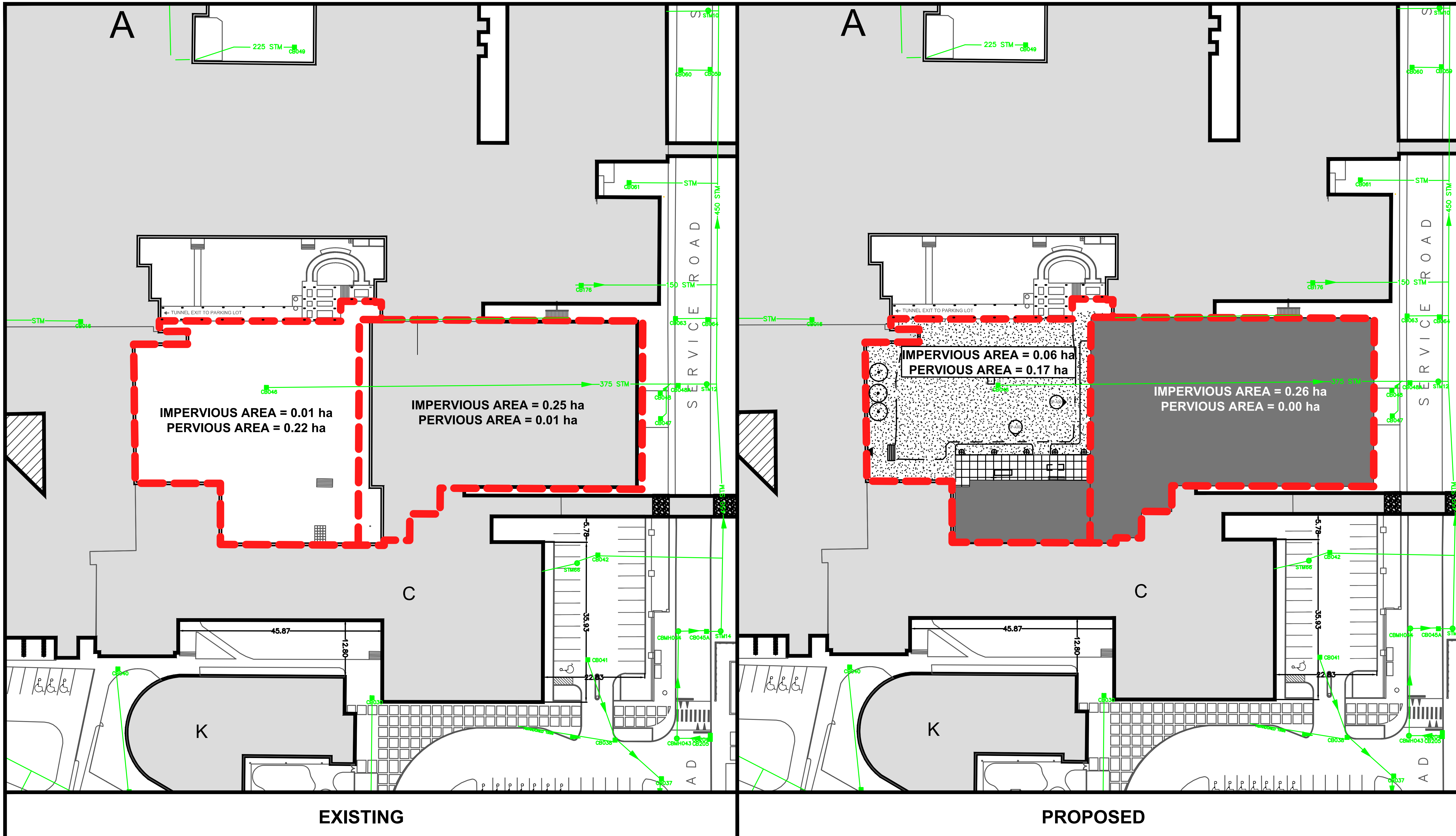
- The allowable runoff coefficient for grassed infill must not exceed the pre-development runoff;
- On-site detention techniques are required to limit runoff from the site to a maximum equivalent runoff coefficient of 0.5; and
- The run-off coefficient can be increased by 25% to a limit of 1.0 for the 100 year storm event.

5. STORM DESIGN CALCULATIONS

5.1 Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) Site

The Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) site is shown in **Figure 5** with both the existing conditions of the site as well as the proposed Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) layout. The pre-development flow was estimated to be 20L/s for the existing courtyard using the 5-year storm (Ottawa IDF Curve) as shown in **Table 1**. This flow discharges to the courtyard catchbasin serviced by a 375mm diameter storm service lateral that ultimately discharges to the existing 2100mm diameter trunk sewer that exits the campus to the north. The pre-development flow for the existing portion of Building C, proposed to receive a one (1) storey addition, was estimated to be 60L/s, as shown in **Table 2**. It is assumed that the existing roof drains discharge to the 375mm diameter storm service lateral. This results in a total pre-development flow of 80L/s for the Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) site.

The City of Ottawa restricts the allowable peak flow further by stipulating that a runoff coefficient of 0.50 be used for hard surfaces. The estimated pre-development flow calculated in **Table 1** assumes a runoff coefficient of 0.90 for hard surfaces and 0.30 for soft surfaces. **Table 3** shows the pre-development calculation of the 5 year storm (Ottawa IDF Curve) assuming runoff coefficients of 0.50 and 0.30 for hard and soft surfaces respectively. Since infill development (developing vacant land within the existing urban area) will only occur in the courtyard, the reduced runoff coefficient of 0.50 was not applied to the existing building area. The City's runoff coefficient restriction results in a total pre-development flow of 20L/s for the existing courtyard. Therefore, all flow in excess of 80L/s must be stored on the Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) site.



Morrison Hershfield

IELCIIE BUILDING
STORMWATER MANAGEMENT AREAS

Figure 5

Table 1
Algonquin College - Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship
5 Year Pre-Development Flow

LOCATION	INDIVIDUAL							DESIGN			
Areas	Asphalt Area (ha)	Lawn Areas (ha)	Bldg. Area (ha)	Gravel Area (ha)	Other (ha)	Total (ha)	R*A*N	Time of Conc. (min.)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Peak Flow (m^3/s)
Existing Courtyard	0.00	0.22	0.00			0.23	0.20	10.00	104.19	20.33	0.020
									TOTAL	20.33	0.020

Q = RAIN, where Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area: R = 0.90
Landscaped Area: R = 0.30
Building Area: R = 0.90
Gravel Area: R = 0.60
Composite: R = 0.31

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 5-Year Storm
T_d = Time of Concentration (min)
A = 998.071
B = 0.814
C = 6.053

Table 2
Algonquin College - Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship
Existing Roof Flow Estimation

Building	Area[1] (ha)	Number of Roof Drains[2]	Maximum Ponding Depth[3] (m)	Average Ponding Depth (m)	Approximate Volume		Approximate Release Rate Per Drain[4]		Approximate Total Release Rate[5]	
					(m3)	(ha-m)	(m3/s)	(L/s)	(m3/s)	(L/s)
C	0.20	11	0.15	0.075	98	0.00980	0.005	5.43	0.060	59.71

(1) Assumed approximately 80% of existing roof area for potential runoff storage
(2) Preventative Roof Maintenance, July 2013 (Roof Areas 10, 11, 12, 13, 14, 15, 16, 19)
(3) Based on Ontario Building Code
(4) Release rate per drain calculated with Orifice equations based on 4" diameter roof drain (as provided by mechanical)
(5) Based on 11 roof drains

Orifice Eqn.: $Q=CA\ (2gh)^{0.5}$

Pipe Diameter (mm) = 100
Pipe Area (m^2) = 0.008
C = 0.57
g (m/s^2) = 9.81
h (m) = 0.075
Flow Rate (m^3/s) = 0.005

Table 3
Algonquin College - Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship
5 Year Pre-Development Flow - City of Ottawa Reduced Runoff Coefficient

LOCATION	INDIVIDUAL							DESIGN			
Areas	Asphalt Area	Lawn Areas	Bldg. Area	Gravel Area	Other	Total	R*A*N	Time of Conc.	Rainfall Intensity	Peak Flow	
	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)		(min.)	(mm/hr)	(L/s)	(m^3/s)
Existing Courtyard	0.00	0.22	0.00			0.23	0.19	10.00	104.19	19.85	0.020
									TOTAL	19.85	0.020

Q = RAIN, where Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area: R = 0.50
Landscaped Area: R = 0.30
Building Area: R = 0.50
Gravel Area: R = 0.50
Composite: R = 0.29

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 5-Year Storm
T_d = Time of Concentration (min)
A = 998.071
B = 0.814
C = 6.053

To determine the storage volume required for the courtyard (Catchment 1), peak flows associated with the 100 year (Ottawa IDF Curve) storm were estimated. The first step in calculating the onsite storage was to determine how much storage would be required. **Table 4** shows the peak flow calculations for the 100-year storm and the resultant storage in order to keep flows below the 20L/s allowable release rate. Flows above this rate must be detained on site. The storage volume required is determined by subtracting the release rate from the 100-year peak flows to determine the excess runoff. The excess runoff is then multiplied by the time step to calculate the storage volume required. This is done for a series of storm intensities to determine the maximum storage volume required. The storage volume required is approximately 26m^3. Due to the limited surface storage, this volume can be stored in an underground storage system and released at the controlled pre-development rate into the existing 375mm diameter storm sewer.

The roof drains on the existing portion of Building C, proposed to receive a one (1) storey addition should be limited to a combined maximum release rate of 60L/s to maintain pre-development conditions.

To determine the storage volume required for the one (1) storey addition of Building C (Catchment 2), peak flows associated with the 100-year (Ottawa IDF Curve) storm were estimated. The first step in calculating the onsite storage was to determine how much storage would be required. **Table 4** shows the peak flow calculations for the 100-year storm and the resultant storage in order to keep flows below the allowable release rate. The maximum storage volume required was estimated using the previously described method. The storage volume required was found to be approximately 42m^3. The design of the proposed roof layout (curved) does not provide roof top storage. Therefore, flows greater than 60L/s must be collected and conveyed to the proposed underground storage system in the courtyard.

The underground storage system in the courtyard must have a capacity of approximately 68m^3 (26 + 42) to capture the flows up to an including the 100 year storm event at a release rate of 20L/s. The orifice equation was used to calculate the size of the orifice, as shown in **Table 5**. Based on the pre-development flow of 20L/s, an orifice diameter of 75mm is required to control the flows.

Table 4

Algonquin College - Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship

Post Development - Storage Calculations

100 Year Storm Storage Volume - Courtyard

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
5	242.70	83	20	63	18.86
10	178.56	61	20	41	24.60
15	142.89	49	20	29	25.96
20	119.95	41	20	21	25.23
25	103.85	35	20	16	23.30
30	91.87	31	20	11	20.62
35	82.58	28	20	8	17.40
40	75.15	26	20	6	13.81
45	69.05	24	20	4	9.93
50	63.95	22	20	2	5.82
55	59.62	20	20	0	1.53
60	55.89	19	20	-1	-2.90
1440	4.45	2	20	-18	-1584.38

Post Development Areas

	Area (ha)	R	R*	R*A*N
Building:	0.04	0.90	1.00	0.12
Asphalt:	0.02	0.90	1.00	0.05
Landscaped:	0.17	0.30	0.38	0.17

R* = values increased by 25% to a maximum value of 1 for the 100 year storm

N = 2.78

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 100-Year Storm
T_d = Time of Concentration (min)
A = 1735.688
B = 0.82
C = 6.014

100 Year Storm Storage Volume - Roof

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
5	242.70	175	60	115	34.49
10	178.56	129	60	69	41.28
15	142.89	103	60	43	38.82
20	119.95	86	60	27	31.94
25	103.85	75	60	15	22.55
30	91.87	66	60	6	11.54
35	82.58	59	60	0	-0.58
40	75.15	54	60	-6	-13.50
45	69.05	50	60	-10	-27.03
50	63.95	46	60	-14	-41.04
55	59.62	43	60	-17	-55.43
60	55.89	40	60	-19	-70.13
1440	4.45	3	60	-57	-4882.04

Post Development Areas

	Area (ha)	R	R*	R*A*N
Building:	0.26	0.90	1.00	0.72

R* = values increased by 25% to a maximum value of 1 for the 100 year storm

N = 2.78

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 100-Year Storm
T_d = Time of Concentration (min)
A = 1735.688
B = 0.82
C = 6.014

Table 5
Algonquin College - Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship
Orifice Size

Orifice Eqn.: **$Q=CA\ (2gh)^{0.5}$**

Pipe Diameter (mm) = 75
Pipe Area (m^2) = 0.004
C = 0.57
g (m/s^2) = 9.81
h (m) = 3.25
Flow Rate (m^3/s) = 0.020

Datum = Centre of Orifice

El. (m)	Height (m)	Q (m^3/s)
82.80	0.00	0.000
83.05	0.25	0.006
83.30	0.50	0.008
83.55	0.75	0.010
83.80	1.00	0.011
84.05	1.25	0.012
84.30	1.50	0.014
84.55	1.75	0.015
84.80	2.00	0.016
85.05	2.25	0.017
85.30	2.50	0.018
85.55	2.75	0.018
85.80	3.00	0.019
89.05	3.25	0.020

To determine the ponding elevation during the stress event, peak flows and storage volumes associated with the 100-year (Ottawa IDF Curve) plus 20% storm were calculated. Similar to the steps outlined above, a storage volume associated with the 10-year plus 20% storm is approximately 92m^3. The proposed underground storage system has an approximate volume of 75m^3. The remaining 17m^3 of stormwater runoff will pond above the catchbasin in the courtyard, resulting in an approximate surface ponding elevation of 86.17m. The surface ponding elevation during the stress test event (100 year plus 20%) is below the lowest building opening of 87.30m. Refer to **Table 6** for detail calculations.

Table 6
Algonquin College - Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship
Stress Test Event (100 Year Plus 20%) - Ponding Elevation

100 Year Plus 20% Storm Storage Volume - Courtyard

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
5	242.70	99	20	79	23.82
10	178.56	73	20	53	31.90
15	142.89	58	20	39	34.72
20	119.95	49	20	29	35.04
25	103.85	42	20	23	33.92
30	91.87	38	20	18	31.89
35	82.58	34	20	14	29.22
40	75.15	31	20	11	26.10
45	69.05	28	20	8	22.64
50	63.95	26	20	6	18.90
55	59.62	24	20	5	14.94
60	55.89	23	20	3	10.81
1440	4.45	2	20	-18	-1558.19

Post Development Areas

	Area (ha)	R	R*	R*A*N
Building:	0.04	0.90	1.00	0.12
Asphalt:	0.02	0.90	1.00	0.05
Landscaped:	0.17	0.30	0.38	0.17

R* = values increased by 25% to a maximum value of 1 for the 100 year storm

N = 2.78

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 100-Year Storm
T_d = Time of Concentration (min)
A = 1735.69
B = 0.82
C = 6.014

100 Year Plus 20% Storm Storage Volume - Roof

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
5	242.70	210	60	150	44.97
10	178.56	154	60	94	56.70
15	142.89	123	60	64	57.33
20	119.95	104	60	44	52.66
25	103.85	90	60	30	44.97
30	91.87	79	60	20	35.34
35	82.58	71	60	12	24.38
40	75.15	65	60	5	12.46
45	69.05	60	60	0	-0.20
50	63.95	55	60	-4	-13.42
55	59.62	51	60	-8	-27.11
60	55.89	48	60	-11	-41.16
1440	4.45	4	60	-56	-4826.72

Post Development Areas

	Area (ha)	R	R*	R*A*N
Building:	0.26	0.90	1.00	0.72

R* = values increased by 25% to a maximum value of 1 for the 100 year storm

N = 2.78

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 100-Year Storm
T_d = Time of Concentration (min)
A = 1735.69
B = 0.82
C = 6.014

100 Year Plus 20% Storage Volume =	92	(m3)
Underground Storage System Volume =	75	(m3)
Surface Ponding Volume =	17	(m3)

$$\boxed{Volume\ = \pi r^2 \frac{h}{3}}$$

where,

Height (h) =	120	(mm)
Radius (r) =	12.0	(m)
Volume =	18.1	(m3)
Catchbasin Elevation =	86.05	(m)
Surface Ponding Height =	0.120	(m)
100 Year Plus 20% Surface Ponding Elevation =	86.17	(m)
Building Finished Floor Elevation =	87.30	(m)

5.2 Pinecrest Creek Stormwater Management Guidelines

The design requirements for the proposed Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) site based on "Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area", dated June 2012, are as follows, refer to **Table 7**:

1. Runoff Volume Reduction

   The on-site retention of the 10mm design storm equates to an approximate storage volume of 6.0 m^3.

   Volume = (2.28mm) x (0.23ha) = 5.24m^3

2. Water Quality – Total Suspended Solids (TSS) Removal

   On-site removal of 80% of TSS will be required. A stormwater management facility with significant depth may not be technically feasible. Therefore, a constructed wetland may be the only feasible end-of-pipe stormwater management practice. For an impervious level of approximately 35%, an approximate storage volume of 19.0m^3 would be required for a constructed wetland. The use of oil grit separators (OGSs) may also be considered.

   Volume = (80m3/ha) x (0.23ha) = 18.40m^3

3. Water Quantity – Flood Management

   For the site's 1:100 year discharge to not exceed 33.5L/s/ha, the 100 year storm must be released at a maximum rate of approximately 8.0L/s.

   Release Rate = (33.5L/s/ha) x (0.23ha) = 7.71L/s

4. Water Quantity – Erosion Control

   The detention of the 25mm design storm equates to an approximate storage volume of 14.0m^3 that must be detained and released at approximately 1.0L/s.

   Volume = (8.03mm – 2.28mm) x (0.23ha) = 13.23m^3

   Release Rate = (5.8L/s/ha) x (0.23ha) = 1.33L/s

The City of Ottawa has indicated in the site plan pre-consultation meeting that the Pinecrest Creek Stormwater Management Guidelines do not have to be met directly for the proposed

Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) site. The deficit that will result from this project will be addressed in an overall Stormwater Management Master Plan for the Algonquin College Woodroffe Campus which is currently under development. Refer to **Appendix A**.

The existing stormwater deficit for the Woodroffe Algonquin College was documented in a memorandum dated September 30th, 2016 and issued to the City of Ottawa. Refer to **Appendix B**.

Table 7
Algonquin College - Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship
Pinecrest Creek Design Criteria Calculations

Courtyard Area (ha) =	0.23

Runoff Volume Reduction

10mm Runoff Volume SWMHYMO (mm) =	2.28
10mm Design Storm Runoff Volume (m3) =	5.24

Water Quality - TSS Removal

Impervious Level (%) =	35
Storage Volume for Impervious Level (m3/ha)[1] =	80
Storage Volume (m3) =	18.40

(1) Table 3.2 Water Quality Storage Requirements based on Receiving Waters, Ministry of the Environment and Climate Change Stormwater Management Planning & Design Manual
(SWMP Type - Wetland and Impervious Level - 35%)

Water Quantity - Flood Management

Release Rate (L/s/ha) =	33.50
Release Rate (L/s) =	7.71

Water Quantity - Erosion Control

Release Rate (L/s/ha) =	5.80
Release Rate (L/s) =	1.33
25mm Runoff Volume SWMHYMO (mm) =	8.03
25mm Design Storm Runoff Volume (m3) =	13.23

6. CONCLUSIONS

The proposed Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) building will connect into the existing:

- Water service for Building C that connects to the 200mm diameter watermain located underneath the Private Service Road located to the east of Building C. An assessment of the existing water distribution system is currently in progress. A technical memo will follow at a later date presenting the analysis findings;
- 250mm diameter sanitary service for Building C that connects to the 250mm diameter sewer located underneath the Private Service Road located to the east of Building C. This sanitary service has sufficient capacity to accommodate the additional flows from the proposed building; and
- 375mm diameter storm service for Building C which ultimately outlets to Pinecrest Creek. The post development release rate into the storm sewer system is reduced from pre-development release rates to meet the City of Ottawa requirements of a runoff coefficient of 0.5. Post development runoff will be attenuated on site using underground storage designed to store the excess runoff from the 100 year design storm. This storm service has sufficient capacity to accommodate the proposed flow for the site.

7. CLOSURE

We trust that this report is sufficient for your current requirements. Please contact us with any questions or clarifications.

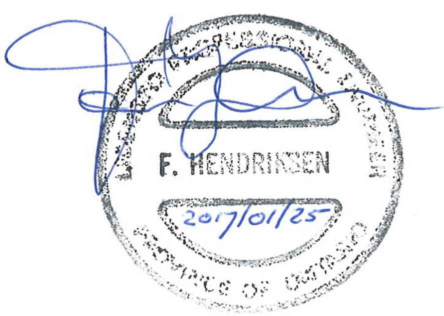
Sincerely,

Morrison Hershfield Limited

Prepared By:

Sarah Mitchelson, P.Eng.

Municipal Engineer



Reviewed By:

Frank Hendriksen, M.Sc. Eng., P.Eng.

Senior Water Resources Engineer

APPENDIX A

CITY OF OTTAWA SITE PLAN APPROVAL PRE-CONSULTATION MEETING NOTES

Sarah Mitchelson

From: Sarah Mitchelson
Sent: Thursday, September 15, 2016 4:31 PM
To: Sarah Mitchelson
Subject: FW: Algonquin, Building C Expansion

From: Charmet, Patrick [mailto:Patrick.Charmet@colliersprojectleaders.com]
Sent: Thursday, June 02, 2016 5:00 PM
To: Gauthier, Steve <Steve.Gauthier@ottawa.ca>; Todd Schonewille (schonet@algonquincollege.com) <schonet@algonquincollege.com>; Trembley, Len <Len.Trembley@colliersprojectleaders.com>; Zofia Jurewicz (Zofiaj@cuhaci.com) <Zofiaj@cuhaci.com>; Brian Casagrande (casagrande@fotenn.com) <casagrande@fotenn.com>; Moise, Christopher <christopher.moise@ottawa.ca>; Dubyk, Wally <Wally.Dubyk@ottawa.ca>; Gary Holowach <GHolowach@morrisonhershfield.com>; syd.robertson@ottawa.ca
Cc: Michael Leckman (mleckman@dsai.ca) <mleckman@dsai.ca>; John Dalziel (dalziej@algonquincollege.com) <dalziej@algonquincollege.com>; David J. Rossetti (DJRossetti@pcl.com) <DJRossetti@pcl.com>; 'RCorneau@pcl.com' <RCorneau@pcl.com>; Mottalib, Abdul <Abdul.Mottalib@ottawa.ca>; 'szilagyi@fotenn.com' <szilagyi@fotenn.com>; 'jl@jbla.ca' <jl@jbla.ca>
Subject: RE: Algonquin, Building C Expansion

Hi All,

Steve, Chris, Wally, Syd, thank you kindly for meeting yesterday afternoon. Please see below for my summary notes and actions from our meeting yesterday about Site Plan Approval (SPA):

Attended:

- Brian Casagrande from Fotenn
- Todd Schonewille from Algonquin
- Zofia Jurewicz from Cuhaci
- Gary Holowach from Morrison Hershfield (MH)
- Pat Charmet from Colliers Project Leaders
- Steve Gauthier, City Planner
- Syd Robertson, City Infrastructure ← *I assumed Syd's email as syd.robertson@ottawa.ca. Please fwd to him if that is incorrect.*
- Wally Dubyk, City Transportation
- Christopher Moise, City Architect

As discussed:

- **Steve to send an email list of requirements for the SPA submission**.
- Transportation: Gary recommended no need for studies or report. There will be no net difference.
- **Gary to get transportation manager to provide 1-page letter for SPA application indicating so.**
- Site servicing: project does not require large site servicing and would be factored into the stormwater masterplan that MH is preparing for the campus, expected by Fall 2016. The vision in that plan is to keep all water onsite (pre=post) Stormwater would be handled with the courtyard
- **Gary to provide a brief summary of waste water and stormwater for SPA application**. Would not include modelling but would reference what is being planned in the stormwater masterplan and erosion sediment control.

- Survey plan: extent of survey is to be determined.

- **Gary will provide the survey that was done for Algonquin Student Commons, as an example of the extent required.**
- **Gary will review if Algonquin has a certified site plan for the entire campus.**
- **Steve to follow-up on the required extent by email.**

- This project should not need a rigorous design review because it is internal to the campus but, for SPA application, will need:

- **Zofia to provide building elevations and renderings for SPA application**
- **Zofia to provide design brief with planning rationale for SPA application**
- **Pat to provide Phase 1 ESA for SPA application, which may be available through what was done for Cogen project by Golder**
- **Pat to provide geotechnical investigation (already completed) for SPA application**

- Algonquin is targetting to submit SPA application in mid-June 2016
- SPA review duration was first noted as 6 weeks but Steve was not aware

- **Steve to review timeline for SPA with Richard and confirm by email**

- We confirmed that the SPA is required but is only a revision (not a new application) and does not require public consultation.
- Building C was measured as 18,972.5 sqm and addition was measured as 2,820.9 sqm, equal to 14.9% increase.

Best regards,

Patrick Charmet BEng, MBA, PMP
Project Manager
COLLIERS PROJECT LEADERS | Formerly MHPM Project Leaders
Main 613 216 4345 x3297 | Mobile 613 863 6392
1900 City Park Drive, Suite 402 | Ottawa, ON K1J 1A3 | Canada
patrick.charmet@colliersprojectleaders.com

-----Original Appointment-----
From: Gauthier, Steve [mailto:Steve.Gauthier@ottawa.ca]
Sent: Friday, May 27, 2016 4:25 PM
To: Gauthier, Steve; Michael Leckman (mleckman@dsai.ca); Todd Schonewille (schonet@algonquincollege.com); John Dalziel (dalziej@algonquincollege.com); Trembley, Len; Zofia Jurewicz (Zofiaj@cuhaci.com); David J. Rossetti (DJRossetti@pcl.com); Brian Casagrande (casagrande@fotenn.com); Moise, Christopher; Mottalib, Abdul; Dubyk, Wally; Charmet, Patrick; 'RCorneau@pcl.com'; 'szilagyi@fotenn.com'; 'GHolowach@morrisonhershfield.com'; 'jl@jbla.ca'
Subject: Algonquin, Building C Expansion
When: Wednesday, June 01, 2016 2:00 PM-3:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Laurier 110 - Room 4114E (AV Enabled)

When: Wednesday, June 01, 2016 2:00 PM-3:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Laurier 110 - Room 4114E (AV Enabled)

Note: The GMT offset above does not reflect daylight saving time adjustments.

~~*~*~*~*~*~*~*~*

Hi all,

This invite replaces the one sent earlier today by Patrick Charmet.

The meeting will be held at City Hall, 110 Laurier Ave West, 4th Floor East. Please call my extension from the waiting room.

Steve Gauthier, MCIP, RPP
Planner
Development Review, Urban Services
Urbaniste
Revue des projets d'aménagement, Services urbains

City of Ottawa | Ville d'Ottawa
613.580.2424 ext./poste 27889
ottawa.ca/planning / ottawa.ca/urbanisme

APPENDIX B

ALGONQUIN COLLEGE – EXISTING STORMWATER SHORTFALL

MEMORANDUM

MORRISON HERSHFIELD

TO:	Gary Holowach	ACTION BY:	
FROM:	Sarah Mitchelson	FOR INFO OF:	City of Ottawa
PLEASE RESPOND BY:		PROJECT No.:	2085345.43
RE:	DRAFT – Algonquin College Stormwater Management Master Plan	DATE:	September 30, 2016

C:\USERS\GHOLOWACH\DESKTOP\ALGONQUIN COLLEGE SWM MATER PLAN_TECHNICAL MEMO.DOCX

Morrison Hershfield Limited was retained by Algonquin College to provide professional engineering services associated with the development of a Stormwater Management Plan for the Woodroffe Campus, located at 1385 Woodroffe Avenue in Ottawa, Ontario.

1.0 - Existing Conditions

The Campus covers an area of approximately 35ha that includes academic/residential buildings, a sports complex, asphalt parking lots, administrative office and utility buildings, and landscaped areas. Drainage is through a series of on-site storm sewers that outlet to a 2100mm diameter trunk storm sewer. The 2100mm diameter trunk storm sewer bisects the Campus from south to north (directly east of Building E, F, N, and T) and discharges to Pinecrest Creek, north of Baseline Road. The trunk sewer also conveys storm runoff from the residential area to the south of the Campus (Ryan Farm).

2.0- Design Criteria

2.1 - Pinecrest Creek Stormwater Management Guidelines

Any new and infill development or redevelopment projects within the Pinecrest Creek/Westboro Watershed Areas must implement stormwater management (SWM) measures that meet the criteria outlined in the “Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area” (J.F. Sabourin and Associates Inc., June 2012). Since the Algonquin College Woodroffe Campus is within the Pinecrest Creek watershed, these stormwater management guideline apply to the Campus.

The guidelines specific to the Pinecrest Creek/Westboro impose special conditions for water quality, peak flow and volume control. Implementation of these additional criteria is intended to ensure that the impact of infill and redevelopment upon Pinecrest Creek are mitigated as follows:

- Water quality is not adversely affected;
- Flood risk along Pinecrest Creek is not increased; and

- The cumulative impacts of any new developments, infill projects, or redevelopments will not have an adverse effect on the overall health of Pinecrest Creek,

These criteria are in addition to those outlined in the City of Ottawa Sewer design Guidelines and Ministry of the Environment and Climate Change (MOECC) Stormwater Management Planning and Design Manual, with the most stringent requirements governing.

The criteria have been tailored to specific constraints in Pinecrest Creek and the type (residential, institutional/commercial/industrial (ICI), etc.) and scale (single lot vs. sit plan control, etc.) of development. The stormwater management criteria for institutional/commercial/industrial developments that discharge to Pinecrest Creek are summarized in **Table 1**.

Table 1: Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area

Development Type	Runoff Volume Reduction	Water Quality TSS Removal	Water Quantity	
			Flood Management	Erosion Control
Draining to Pinecrest Creek				
Institutional/Commercial/Industrial Developments – discharging upstream of the Ottawa River				
Sites with soil infiltration rates ≥ 1mm/hour.	Minimum on-site retention of the 10mm design storm.	On site removal of 80% TSS.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5L/s/ha. ii) City of Ottawa Sewer Design Guidelines (Section 8.3.7.3).	Control (detain) the runoff from the 25mm design storm such that the peak outflow from the site does not exceed 5.8L/s/ha.
Sites with soil infiltration < 1mm/hour	If the entire property is underlain by native soils with infiltration rates < 1mm/hour, no infiltrating stormwater management measures may be used. A minimum depth of 300mm of amended soil shall be provided below all from yard landscaped areas. A green roof and/or rain harvesting measures could be implements to provide further volume reduction.			

*Guidelines obtained from “Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area”, dated June 2012, prepared by J.F. Sabourin and Associates Inc.

2.2 - City of Ottawa Sewer Design Guidelines (October 2012)

Any existing separated sewer area within the City of Ottawa must implement stormwater management (SWM) measures that meet the criteria outlined in the "City of Ottawa Sewer Design Guidelines" (City of Ottawa, October 2012). Since the Algonquin College Woodroffe Campus is located within an existing separated sewer area, the following stormwater management guidelines apply to the Campus:

- Control runoff to the 5-year pre-development flow;
- Flows to the storm sewer in excess of the 5-year storm release rate, up to and including the 100-year storm event, must be detained on site;
- Grassed infill areas: maximum equivalent post development runoff coefficient to equal pre-development runoff coefficient;
- Hard surface infill area: post development runoff coefficient to equal 0.5;
- On site detentions techniques shall be required to limit run-off from the subject site to a maximum equivalent runoff coefficient; and
- Increase runoff coefficient by 25%, to a limit of 1.0, for the 100 year storm event.

3.0 - Stormwater Model

The existing SWMHYMO model was converted to PCSWMM to incorporate low impact development (LISD) stormwater management practices into the proposed stormwater management plan for the Campus.

The following controls were incorporated into the PCSWMM model based on previous engineering reports:

- Student Commons Building site controlled to a release rate of 60.1L/s in accordance with *"Stormwater Management Servicing Report Student Commons Building"*, prepared by IBI Group May 2011.
- Student Commons Building Displaced Parking Lot (NE Parking Lot) site controlled to a release rate of 96L/s in accordance with *"Stormwater Management Report Algonquin College – Student Commons Displaced Parking Lot"*, prepared by Morrison Hershfield Limited November 2011.

- Algonquin Centre for Construction Excellence (ACCE) Building site controlled to a release rate of 45L/s in accordance with *"Algonquin Centre for Construction Excellence (ACCE) Building Site Servicing and Stormwater Management Report"*, prepared by Delcan Corporations January 2010.

The following rooftop controls were estimated and incorporated into the PCSWMM model:

- Release rate of 41mm/hr for buildings located within subcatchment A1 (B, K, M and T);
- Release rate of 33mm/hr for buildings located within subcatchment A2 (A, C, D, H and J);
- Release rate of 33mm/hr for buildings located within subcatchment A3 (F, G, R1, R2 and R3);
- Release rate of 30mm/hr for buildings located within subcatchment A4 (N, P, and S);
- Release rate of 29mm/hr for buildings located within subcatchment A5 (V); and
- Release rate of 64mm/hr for buildings located within subcatchment A8 (Z).

The release rates were estimated based on an assumed maximum ponding depth of 150mm, an assumed individual roof drain release rate of 1.89L/s, building roof area, and number of roof drains obtained from drawings prepared for the Preventative Roof Maintenance project, July 2013.

3.1 - Existing Conditions

Analysis of the existing drainage system was completed using hydrological calculations, the previously mentioned background documents, and PCSWMM modeling. The Campus on the east side of Woodroffe Avenue was divided into eleven (11) different subcatchment areas and the Campus on the west side of Woodroffe was divided into one (1) subcatchment area.

The peak flows for the 3 hour and 6 hour Chicago design storms are summarized in **Table 2**. It should be noted that the peak flows presented in Table 2 only represent the peak flows generated from the Campus and do not include downstream flows that contribute to the existing 2100mm diameter trunk storm sewer that bisects the Campus from south to north.

Table 2: Peak Flows

Design Storm	Return Period	Peak Flow (m3/s)	
		East Side of Woodroffe Avenue	West Side of Woodroffe Avenue
3 Hour Chicago	5 Year	5.47	0.05
	10 Year	6.68	0.05
	100 Year	11.09	0.05
6 Hour Chicago	5 Year	3.51	0.05
	10 Year	4.19	0.05
	100 Year	6.47	0.05

4.0 – Pinecrest Creek Stormwater Management Guideline Deficit

The following projects on the Campus have proceeded and will proceed without adhering to the Pinecrest Creek Stormwater Management Guidelines:

- Student Commons Building Displaced Parking Lot (NE Parking Lot); and
- Innovation and Entrepreneurship and Learning Centre and institute of Indigenous Entrepreneurship (IELCIIE) Building.

The City of Ottawa indicated that these projects could proceed without adhering to the Pinecrest Creek Stormwater Management Guidelines but the deficits as a results of both projects would need to be addressed in the overall Stormwater Management Mater Plan for the Algonquin College Woodroffe Campus which is currently under development. Therefore, the City of Ottawa Sewer Design Guidelines for infill developments within the urban core were/will be applied to the sites.

4.1 – Student Commons Building Deficit

1. *Runoff Volume Reduction*

   The on-site retention of the 10mm design storm equates to an approximate storage volume of 57m^3.

   Volume = (8.35mm) x (0.68ha) = 5.15m^3

2. *Water Quality – Total Suspended Solids (TSS) Removal*

   On-site removal of 80% of TSS will be required. A stormwater management facility with significant depth may not be technically feasible. Therefore, a constructed wetland may be the only feasible end-of-pipe stormwater management practice. For an impervious level greater than 85%, an approximate storage volume of 96.0m^3 would be required for a constructed wetland. Modifications will be made a necessary as the stormwater management design progresses. The use of oil grit separators (OGSs) may also be considered.

   Volume = (140m3/ha) x (0.68ha) = 95.20m^3

3. *Water Quantity – Flood Management*

   For the site's 1:100 year discharge to not exceed 33.5L/s/ha, the 100 year storm must be released at a maximum rate of approximately 23L/s.

   Release Rate = (33.5L/s/ha) x (0.68ha) = 22.78L/s

4. *Water Quantity – Erosion Control*

   The detention of the 25mm design storm equates to an approximate storage volume of 102m^3 that must be detained and released at approximately 4L/s.

   Volume = (23.22mm – 8.35mm) x (0.68ha) = 101.12m^3

   Release Rate = (5.8L/s/ha) x (0.68ha) = 3.94L/s

4.2 – IELCIIE Building Deficit

1. *Runoff Volume Reduction*

   The on-site retention of the 10mm design storm equates to an approximate storage volume of 6.0m3.

   Volume = (2.28mm) x (0.23ha) = 5.15m^3

2. *Water Quality – Total Suspended Solids (TSS) Removal*

   On-site removal of 80% of TSS will be required. A stormwater management facility with significant depth may not be technically feasible. Therefore, a constructed wetland may be the only feasible end-of-pipe stormwater management practice. For an impervious level of approximately 35%, an approximate storage volume of 19.0m^3 would be required for a constructed wetland. Modifications will be made a necessary as the stormwater management design progresses. The use of oil grit separators (OGSs) may also be considered.

   Volume = (80m3/ha) x (0.23ha) = 18.10m^3

3. *Water Quantity – Flood Management*

For the site's 1:100 year discharge to not exceed 33.5L/s/ha, the 100 year storm must be released at a maximum rate of approximately 8L/s.

Release Rate = (33.5L/s/ha) x (0.23ha) = 7.58L/s

4. *Water Quantity – Erosion Control*

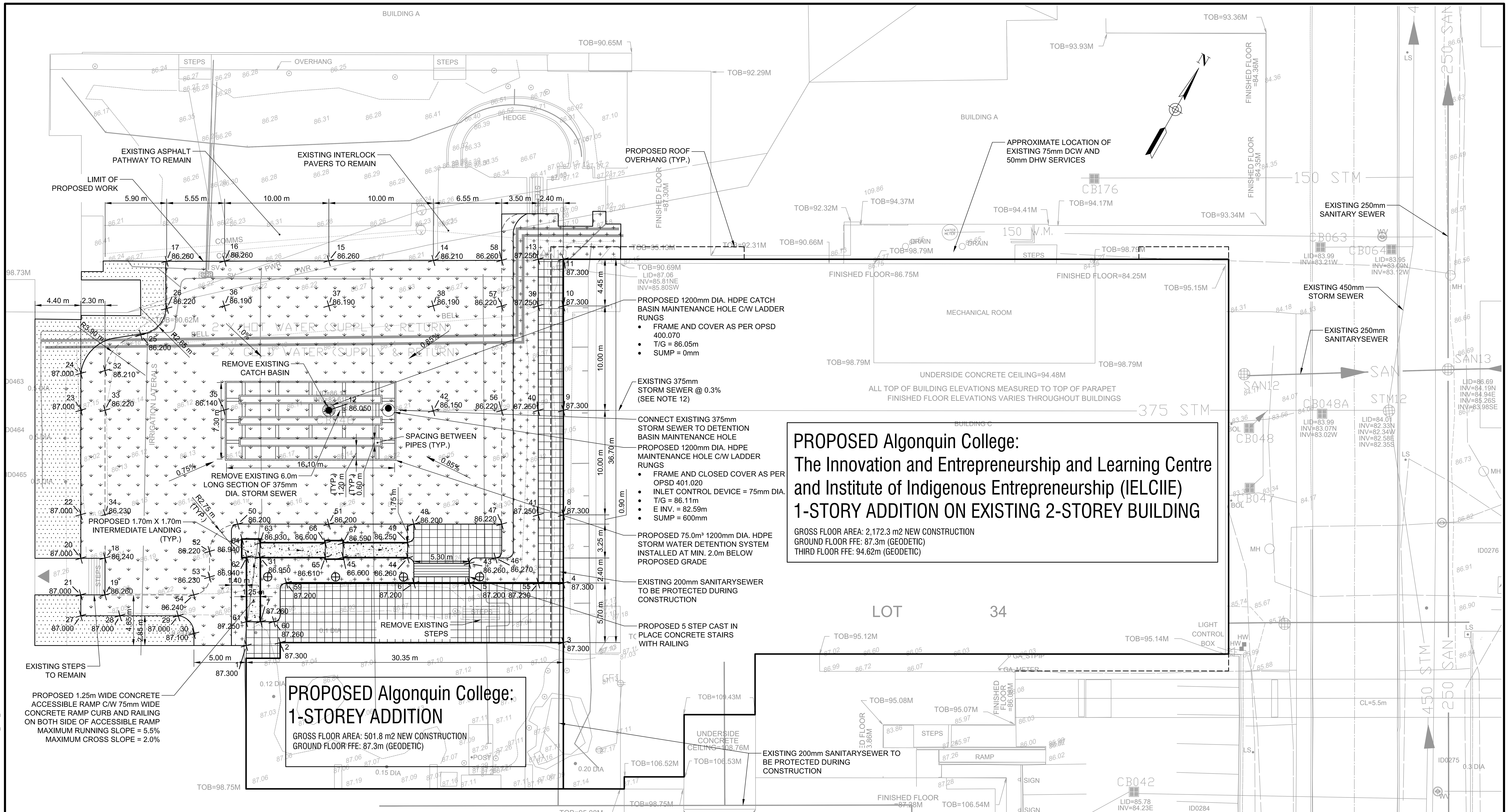
The detention of the 25mm design storm equates to an approximate storage volume of $14m^3$ that must be detained and released at approximately 2L/s.

Volume = (8.03mm – 2.28mm) x (0.23ha) = $13.01m^3$

Release Rate = (5.8L/s/ha) x (0.23ha) = 1.31L/s

APPENDIX C

SITE PLAN APPROVAL DRAWINGS



NOTES

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS.
3. THE LOCATION OF ALL UTILITIES IS APPROXIMATE ONLY. THE EXACT LOCATION SHOULD BE DETERMINED BY CONSULTING THE MUNICIPAL AUTHORITIES AND UTILITY COMPANIES CONCERNED. THE CONTRACTOR SHALL PROVE THE LOCATION OF UTILITIES; SHALL BE RESPONSIBLE FOR ADEQUATE PROTECTION FROM DAMAGE; AND, BE RESPONSIBLE FOR REPAIR OF DAMAGE THAT MAY OCCUR.
4. REINSTATE ALL DISTURBED/DAMAGED AREAS TO THEIR ORIGINAL CONDITION.
5. PROVIDE POSITIVE DRAINAGE, MATCHING EXISTING OVERALL DRAINAGE PATTERN INDICATED.
6. ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CITY OF OTTAWA AND/OR ONTARIO PROVINCIAL STANDARDS.
7. PROPOSED WORK TO BE SERVICED FROM EXISTING STORM, SANITARY AND WATER SERVICES FOR BUILDING C.
8. EXCAVATION, PIPE BEDDING, TRENCH BACKFILL, SEEPAGE BARRIERS SHALL BE IN ACCORDANCE WITH GEOTECHNICAL INVESTIGATION "BUILDING C EXPANSION AND INFILL BUILDING ALGONQUIN COLLEGE" PREPARED BY HOULE CHEVRIER ENGINEERING, MAY 26, 2016
9. STORM AND SANITARY SEWERS WITH LESS THAN 2.0m COVER SHALL BE INSULATED.
10. WATERMAINS WITH LESS THAN 2.4M COVER SHALL BE INSULATED.
11. DRAINAGE SLOPES ARE FOR INFORMATIONAL PURPOSES ONLY. IN THE CASE OF DISCREPANCY WITH THE SURROUNDING GRADES, THE GRADES SHALL GOVERN.
12. CCTV OF THE EXISTING 375mm DIAMETER STORM SEWER TO BE COMPLETED PRE AND POST CONSTRUCTION FROM THE COURTYARD TO THE CONNECTION AT THE SERVICE ROAD.

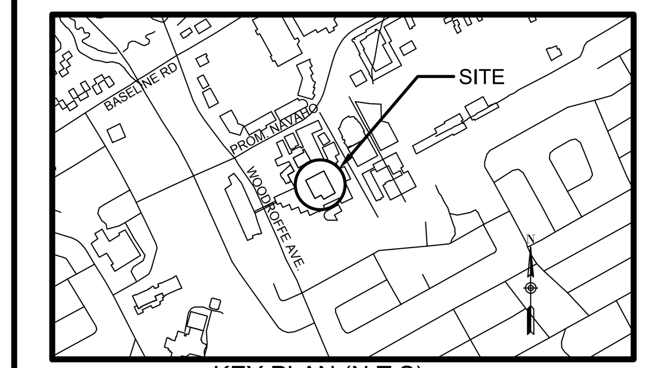
SURVEY NOTES

1. COORDINATES ARE REFERRED TO MTM ZONE 9, NAD83 (CSRS) (2010) AND ARE DERIVED FROM REAL TIME NETWORK OBSERVATIONS.
2. ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM, AND ARE DERIVED FROM SURVEY OF CANADA FIRST ORDER BENCHMARK NO.0011964U3695, HAVING A PUBLISHED ORTHOMETRIC ELEVATION OF 86.752m.

Point Number	Northing	Easting	Elevation (m)
1	5023390.786	362941.463	87.30
2	5023392.607	362944.167	87.30
3	5023405.744	362967.879	87.30
4	5023410.731	362965.116	87.30
5	5023406.364	362957.235	87.20
6	5023403.796	362952.599	87.20
7	5023393.453	362941.568	87.26
8	5023416.439	362961.953	87.30
9	5023425.186	362957.106	87.30
10	5023433.932	362952.259	87.30
11	5023437.841	362950.094	87.30
12	5023414.330	362937.459	86.05
13	5023436.678	362947.994	87.25
14	5023431.713	362939.268	86.21
15	5023426.832	362930.529	86.26
16	5023421.967	362921.816	86.26
17	5023419.264	362916.976	86.26
18	5023391.563	362925.574	86.24
19	5023388.473	362927.286	86.26
20	5023390.414	362923.563	87.00
21	5023387.353	362925.260	87.00
22	5023394.069	362921.538	87.00
23	5023402.815	362916.691	87.00
24	5023405.895	362914.984	87.00
25	5023411.895	362918.227	86.20
26	5023415.337	362919.184	86.22
27	5023385.601	362926.230	87.00
28	5023387.425	362929.502	87.00
29	5023390.122	362934.388	87.00
30	5023389.356	362936.527	87.10
31	5023398.818	362938.509	86.95
32	5023407.253	362916.880	86.21
33	5023403.937	362918.717	86.22
34	5023395.190	362923.564	86.23

Point Number	Northing	Easting	Elevation (m)
35	5023409.448	362928.658	86.14
36	5023418.206	362923.878	86.19
37	5023423.057	362932.612	86.19
38	5023427.900	362941.361	86.19
39	5023432.770	362950.160	87.25
40	5023424.018	362955.010	87.25
41	5023415.280	362959.853	87.25
42	5023419.130	362946.232	86.15
43	5023408.000	362956.329	86.26
44	5023405.608	362950.918	86.26
45	5023402.676	362945.472	86.60
46	5023409.680	362958.267	86.27
47	5023412.805	362957.221	86.22
48	5023408.729	362949.865	86.20
49	5023406.916	362950.184	86.25
50	5023400.556	362935.117	86.20
51	5023404.784	362942.746	86.20
52	5023396.963	362934.021	86.22
53	5023394.816	362935.211	86.23
54	5023392.596	362934.726	86.24
55	5023409.568	362963.017	87.23
56	5023422.316	362951.951	86.22
57	5023431.073	362947.094	86.22
58	5023434.891	362944.983	86.26
59	5023397.883	362941.930	87.20
60	5023394.065	362942.673	87.26
61	5023392.780	362940.354	87.25
62	5023398.212	362937.417	86.94
63	5023399.998	362937.855	86.93
64	5023399.481	362936.198	86.94
65	5023401.852	362943.985	86.61
66	5023403.033	362943.330	86.60
67	5023403.856	362944.817	86.59

0 m 2.5 5.0 10



KEY PLAN (N.T.S)

ISSUED

No.	Date	Description
1	2016/09/16	ISSUED FOR SITE PLAN APPLICATION
2	2016/11/03	ISSUED FOR 30% CD COSTING
3	2017/02/07	RE ISSUED FOR SITE PLAN APPLICATION

NEW CONSTRUCTION LEGEND

- EXISTING PLANTING BED TO REMAIN
- PROPOSED PLANTING BED
- PROPOSED CONCRETE PAVERS
- 100mm TOPSOIL AND SOD REINSTATEMENT
- 100mm TOPSOIL AND SOD REINSTATEMENT
- PROPOSED BOTTOM OF SLOPE
- OVERLAND FLOW DIRECTION
- PROPOSED CATCH BASIN
- PROPOSED LIGHT BOLLARD
- EXISTING ELEVATION
- PROPOSED ELEVATION

Edward J. Cuhaci and Associates Architects Inc.
171 Slater Street, Suite 100, Ottawa, Canada K1P 5H7
Tel: 613 236 7135 Fax: 613 236 1944 info@cuhaci.com www.cuhaci.com

James B. Lennox & Associates Inc.
3332 Carling Avenue, Ottawa, Canada K2H 5A8
Tel: 613 722 5168 Fax: 1 866 343 3942 www.jbla.ca

Morrison Hershfield
2440 Don Reid Drive, Ottawa, Canada K1H 1E1
Tel: 613 739 2910 Fax: 613 739 4926 www.morrisonhershfield.com

LICENSED PROFESSIONAL ENGINEER
S. D. MITCHELSON
100128064
02/07/2017
PROVINCE OF ONTARIO

Algonquin College - Innovation,Entrepreneurship and LearningCentre and Institute of IndigenousEntrepreneurship (IELCIIE)

1385 Woodroffe AvenueOttawa, OntarioK2G 3G7

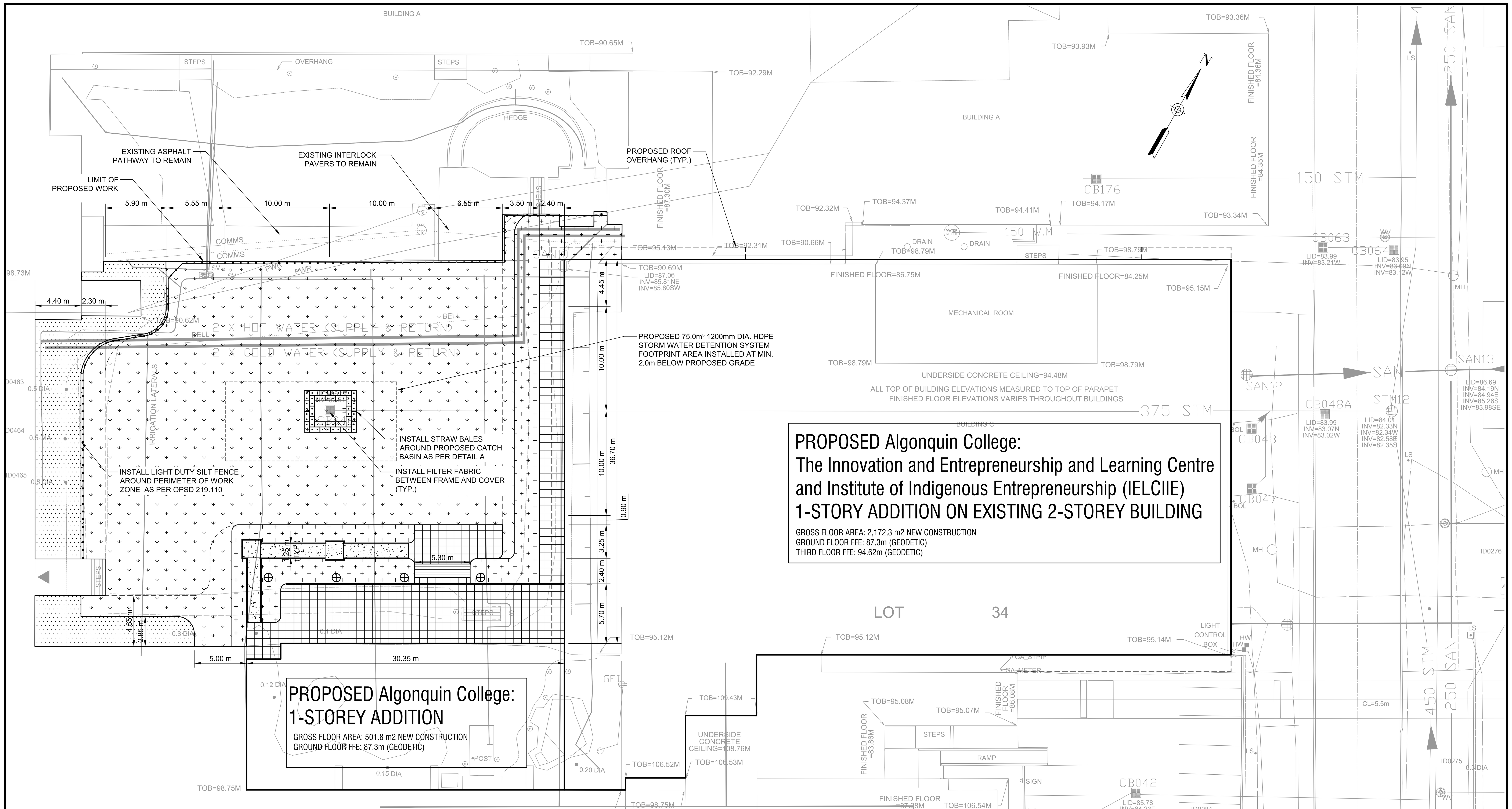
Site Servicing and Grading

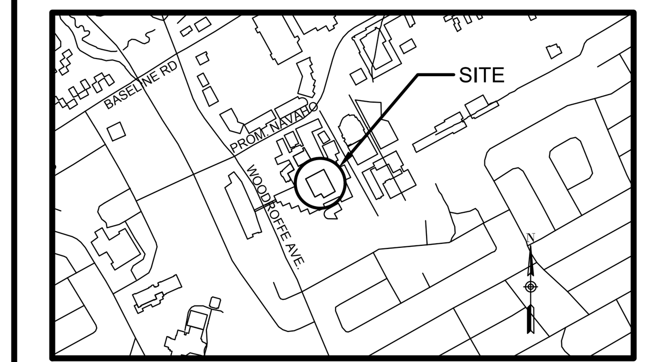
Scale: 1:200 (FULL SIZE)
Project No: 1618
Date: 2017/01/26

SP-C1

C:\Users\clin\Revit_Files\1618-Algonquin Bldg C-Building_SPA_clin.rvt

9/7/2016 2:55:37 PM




KEY PLAN (N.T.S)

ISSUED

No.	Date	Description
1	2016/09/16	ISSUED FOR SITE PLAN APPLICATION
2	2016/11/03	ISSUED FOR 30% CD COSTING
3	2017/02/07	RE ISSUED FOR SITE PLAN APPLICATION

NEW CONSTRUCTION LEGEND

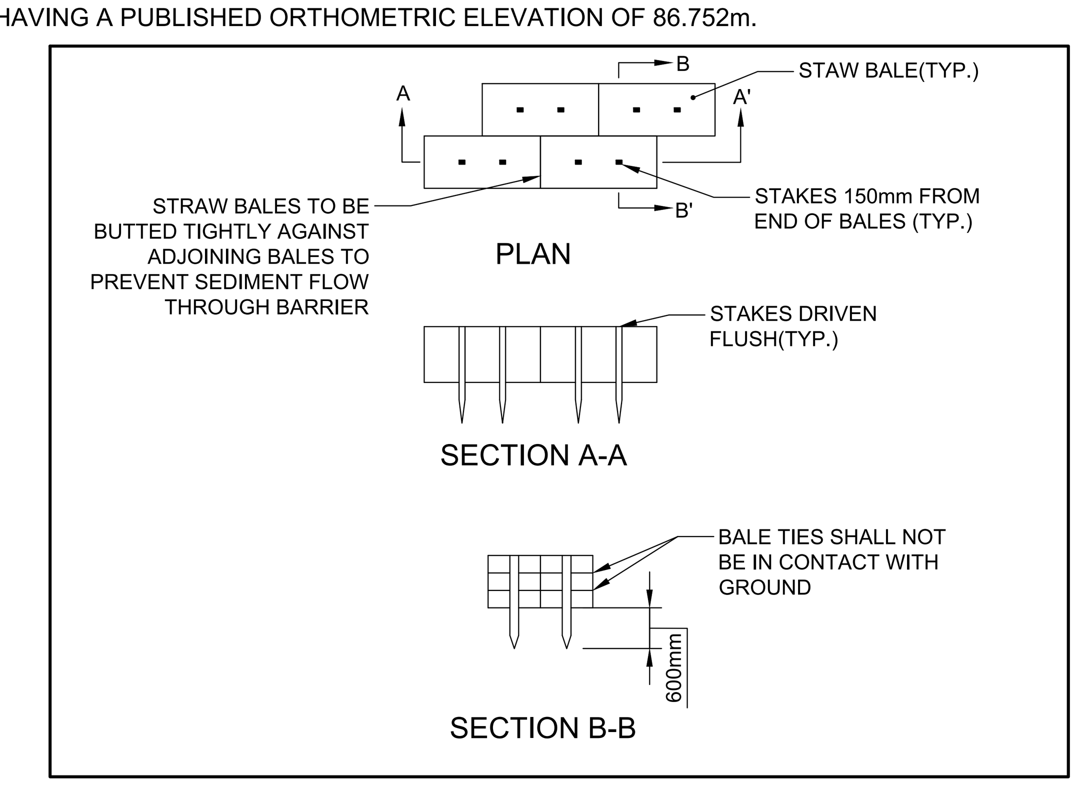
- EXISTING PLANTING BED TO REMAIN
- PROPOSED PLANTING BED
- PROPOSED CONCRETE PAVERS
- 100mm TOPSOIL AND SOD REINSTATEMENT
- 100mm TOPSOIL AND SOD REINSTATEMENT
- PROPOSED BOTTOM OF SLOPE
- OVERLAND FLOW DIRECTION
- PROPOSED CATCH BASIN
- PROPOSED LIGHT BOLLARD
- EXISTING ELEVATION
- PROPOSED ELEVATION

NOTES

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS.
3. THE LOCATION OF ALL UTILITIES IS APPROXIMATE ONLY. THE EXACT LOCATION SHOULD BE DETERMINED BY CONSULTING THE MUNICIPAL AUTHORITIES AND UTILITY COMPANIES CONCERNED. THE CONTRACTOR SHALL PROVE THE LOCATION OF UTILITIES; SHALL BE RESPONSIBLE FOR ADEQUATE PROTECTION FROM DAMAGE; AND, BE RESPONSIBLE FOR REPAIR OF DAMAGE THAT MAY OCCUR.
4. REINSTATE ALL DISTURBED/DAMAGED AREAS TO THEIR ORIGINAL CONDITION.
5. PROVIDE POSITIVE DRAINAGE, MATCHING EXISTING OVERALL DRAINAGE PATTERN INDICATED.
6. ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CITY OF OTTAWA AND/OR ONTARIO PROVINCIAL STANDARDS.
7. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATER COURSE, DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL, USING FILTER CLOTH UNDER THE GRATES OF CATCHBASINS AND MANHOLES AND INSTALLING SILT FENCES AND OTHER EFFECTIVE SEDIMENT TRAPS. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.
8. EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE IMPLEMENTED PRIOR TO CONSTRUCTION AND REMAIN IN PLACE UNTIL VEGETATION IS ESTABLISHED. REGULAR INSPECTION AND MAINTENANCE OF THE EROSION AND SEDIMENT MEASURES SHALL BE UNDERTAKEN. THE IMPLEMENTATION AND ADJUSTMENT AND/OR CORRECTIVE MAINTENANCE OF THE EROSION AND SEDIMENT MEASURES IS AN INTEGRAL PART PLAN AND MUST BE IMPLEMENTED.
9. THE CONTRACTOR SHALL INSTALL LIGHT DUTY SILT FENCE (OPSD 219.110) AROUND THE PERIMETER OF THE WORK ZONE.
10. THE CONTRACTOR SHALL INSTALL STRAW BALE AROUND THE CATCH BASIN IN THE COURTYARD.
11. GEOTEXTILE FILTER FABRIC SHALL BE PLACED BETWEEN THE STRUCTURE FRAME AND COVER FOR ALL MANHOLES, CATHBASINS AND CATCHBASINS MANHOLES.
12. THE LOCATION OF UTILITIES IS APPROXIMATE ONLY, THE EXACT LOCATION SHOULD BE DETERMINED BY CONSULTING THE MUNICIPAL AUTHORITIES AND UTILITY COMPANIES CONCERNED. THE CONTRACTOR SHALL PROVE THE LOCATION OF UTILITIES AND SHALL BE RESPONSIBLE FOR ADEQUATE PROTECTION FROM DAMAGE.

SURVEY NOTES

1. COORDINATES ARE REFERRED TO MTM ZONE 9, NAD83 (CSRS) (2010) AND ARE DERIVED FROM REAL TIME NETWORK OBSERVATIONS.
2. ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM, AND ARE DERIVED FROM SURVEY OF CANADA FIRST ORDER BENCHMARK NO.0011964U3695, HAVING A PUBLISHED ORTHOMETRIC ELEVATION OF 86.752m.



SEDIMENT CONTROL WITH STRAW BALES

DETAIL A / C2
N.T.S

Edward J. Cuhaci and Associates Architects Inc.
171 Slater Street, Suite 100, Ottawa, Canada K1P 5H7
Tel: 613 236 7135 Fax: 613 236 1944 info@cuhaci.com www.cuhaci.com

James B. Lennox & Associates Inc.
3332 Carling Avenue, Ottawa, Canada K2H 5A8
Tel: 613 722 5168 Fax: 1 866 343 3942 www.jbla.ca

Morrison Hershfield
2440 Don Reid Drive, Ottawa, Canada K1H 1E1
Tel: 613 739 2910 Fax: 613 739 4926 www.morrisonhershfield.com

LICENSED PROFESSIONAL ENGINEER
S. D. MITCHELSON
100128064
02/07/2017
PROVINCE OF ONTARIO

Algonquin College - Innovation,Entrepreneurship and LearningCentre and Institute of IndigenousEntrepreneurship (IELCIIE)

1385 Woodroffe AvenueOttawa, OntarioK2G 3G7

Erosion and Sediment Control

Scale: 1:200 (FULL SIZE)
Project No: 1618
Date: 2016/09/16

SP-C2

C:\Users\cln\Revit_Files\1618-Algonquin Bldg C-Building_SPA_cln.rvt
9/7/2016 2:55:37 PM

APPENDIX D

RESPONSES TO CITY OF OTTAWA COMMENTS RECEIVED OCTOBER 28, 2016

MEMORANDUM

MORRISON HERSHFIELD

TO:	City of Ottawa 110 Laurier Avenue West, 4th Floor Ottawa, Ontario K1P 1J1 **Attn: Nadege Balima**	ACTION BY:	
FROM:	Sarah Mitchelson	FOR INFO OF:	Gary Holowach Patrick Roger Sarah Low Zofia Jurewicz
PLEASE RESPOND BY:		PROJECT No.:	2085345.44
RE:	Algonquin College – The Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) Stormwater Management Report & Assessment of Adequacy of Public Services Report	DATE:	January 26, 2017

L:\PROJ\2085345\2085345.44 BUILDING C ADDITION CIVIL WORKS\300 - ENGINEERING\08 STORMWATER\ME01262017 - IELCCIE STIE PLAN REVIEW COMMENT RESPONSES.DOCX

Please find below our civil responses to the site plan control comments dated October 28, 2016 from Syd Robertson for the proposed Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) building at the Algonquin College Woodroffe Campus:

Site Servicing and Grading, Proj. No. 1618, Dwg No. SP-C1, prepared by Morrison Hershfield, Rev 1 (16 Sep 2016)

1. Dwg. No. 1, listed above, shows a sanitary sewermain from SAN MH10, located at the northwest corner of the existing two-storey building, connecting to a 200mm diameter sanitary sewermain located on the south side of the proposed one-storey addition. Please include this sewermain on Dwg.SP-C1 and provide information on how the pipe will be protected during construction and from point loads where it will pass through or beneath the two proposed foundation walls.

    The existing 200mm diameter sanitary sewer is shown on Drawing SP-C1 and a general utility protection note is provided on both Drawing SP-C1 and SP-C2.

2. Provide a CCTV inspection video and report of the existing 375 storm sewermain that will service the proposed storage structure, from the existing CB to STM MH 12.

A CCTV inspection will be completed pre and post construction of the existing 375mm diameter storm sewer. A copy of the pre and post construction inspection videos and reports will be provided to the City of Ottawa once complete.

3. Replace the proposed Box Culvert (OPSD 3920.100) with a Box Chamber sized to your requirements, designed to accommodate the 375mm dia outlet pipe and the 600mm sump. Provide a shop drawing from the manufacture for the proposed Box Chamber.

   The material of the proposed underground storage system has been changed from concrete to plastic due to transportation of material into the courtyard during the construction.

   Shop drawings are typically produced by the manufacturer at the construction stage. Different Contractors may use different manufacturers.

4. Properly draw the Box Chamber to scale noting that based on the information provided, the bottom of the chamber is 4-metres below the T/G and the chamber volume is 31.5 cu.m.

   The proposed underground storage system is shown to scale. The dimensions, volumes and key elevations have been included on the drawing.

5. Specify a Type B Open Cover as per OPSD 401.010 instead OPDS 400.07 which is for a 600 x 600 Catchbasin.

   The proposed cover (OPSD 400.070) is required for the collection of stormwater runoff – the structure is a catchbasin manhole.

6. Provide percent slope above all grading arrows.

   Slopes have been added above all grading directional arrows. It should be noted that all drainage slopes are for informational purposes only. In the case of discrepancy with surrounding grades, the grades shall govern.

7. Clearly identify all adjacent fire hydrant and confirm if the hydrant location satisfies the OBC requirements.

   The existing fire hydrant is shown on Drawing SP-C1.

   Refer to response by others regarding fire hydrant location and OBC requirements.

8. Clearly show the location of the Fire Dept. connection

   Refer to the Site Plan Drawing prepared by the Architect for the location of the fire department connection.

9. Fire Access Routes – confirm the maximum unobstructed path of travel:
   a. 90m (max) between the hydrant and the principle entrance (for buildings without fire dept. connections) - OBC Sect. 3.2.5.2.(4)

      Refer to response by others.

   b. 45m (max) between the hydrant and the fire dept. connection – OBC Sect. 3.2.5.2.(3).

      Refer to response by others.

10. Clearly show and label (pipe diameter and slope) of the existing sanitary sewermain located on the west side and south side of the existing two-storey building. Include invert elevations on the downstream sanitary manholes.

    The existing diameter of the sanitary sewer is shown and existing manholes inverts are shown in grey.

Erosion and Sediment Control, Proj. No. 1618, Dwg No. SP-C2, prepared by Morrison Hershfield, Rev 1 (16 Sep 2016)

11. Delete the straw bales and the reference to OPSD 219.180 in the area of the proposed Box Chamber – OPSD 219.180 applies to ditches only

    Straw bales will remain in place as an erosion and sediment control measure. The OPSD reference has been removed and replaced with a different detail.

12. Clearly identify on Plan SP-C2, the structures requiring filter fabric as per note 11

    Structures requiring filter fabric have been identified on Drawing SP-C2.

Tree Conservation Report and Landscape Plan, Dwg No. SP-L1, prepared by James B. Lennox and Associates Inc.

Geotechnical Investigation Report, Proj. No. 62341.08, prepared by Houle Chevrier Engineering, dated 26 May 2016

13. Have the geotechnical consultant review and provide comments on the locations of the existing trees to remain on-site and their impact on the adjacent buildings. Refer to section 5.53 – Effects on Trees, in the Geotechnical Investigation Report.

    Refer to response by others.

SWM Report and Assessment of Adequacy of Public Services Report, Report No. 2085345.44, prepared by Morrison Hershfield, dated 16 Sep 2016

14. Complete the assessment of the water distribution system that services Bldg C. Have the mechanical consultant determine the water demands of Building C, including the two proposed building additions, and determine the boundary conditions at the point of the water service connects to the private watermain.

    An assessment of the existing water distribution system is currently in progress. A technical memo will follow at a later date to present the analysis findings.

15. Determine if stormwater storage can be provided on the rooftop of the proposed third storey addition to reduce the amount of storage required in the courtyard, thus reducing the size of the Box Chamber. The storage table indicates that no storage is proposed for the 100-yr storm event at the proposed rooftop release rate of 60 L/s. Provide storage tables for both the 5-yr & 100-yr storm events.

    Based on the roof design of the proposed third storey addition, there is no rooftop storage available for stormwater runoff.

16. Also note the attached Technical Bulletin, PIEDTB-2016-01, regarding changes to the City’s Sewer Design Guidelines and ensure that these revisions are adhered to in the SWM proposal.

    Technical Bulletin PIEDTB-2016-01 revisions to the City of Ottawa Sewer Design Guidelines were accounted for.

Student Commons Displaced Parking Servicing Plan, Dwg No. 01, prepared by Morrison Hershfield, Rev 2 (09 Nov 2011)

17. Provide an updated copy of this drawing since it shows the existing private storm and sanitary sewer systems, adjacent to the subject site, and their connection points to the municipal sewer systems.

    The drawing has been updated for reference purposes only.

18. The footprint of the campus should be updated to include the completed Student Commons Building

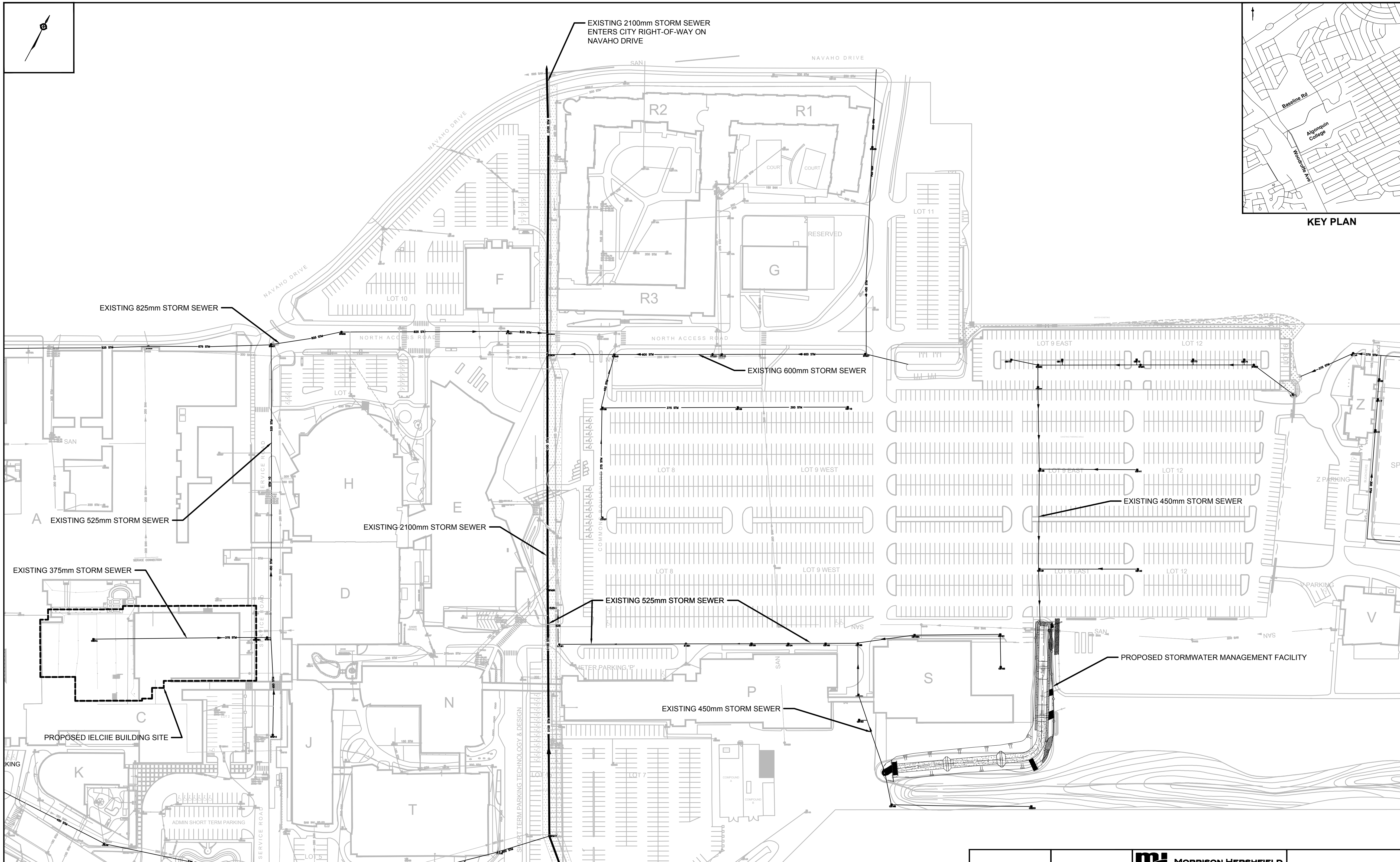
    The Campus footprint has been updated to include the Student Commons Building.

19. Hatch the area of the subject so that it is clearly identified on the plan.

    The proposed IELCIIE site has been shown on the drawing.

20. Increase the intensity of the existing sewer systems within the limits of the drawing, similar to the line weight of the existing storm sewermains downstream of the Displaced Parking Lot.

    The intensity on the larger diameter storm sewers have been increased.



L:\proj\2085345\2085345.44 Building C Addition Civil Works\300 - Engineering\01 Drawings\Algonquin College Student Commons Displaced Parking Servicing Plan Dwg No1.dwg
LAST SAVED: Thursday, January 26, 2017

REVISIONS NO.	DESCRIPTION	BY	DATE
3	REVISED AS REQUESTED BY THE CITY	SM	26-JAN-17
2	REVISED AND RE-ISSUED FOR SITE PLAN CONTROL	GSH	09-NOV-11
1	ISSUED FOR SITE PLAN CONTROL	GSH	28-SEP-11

MORRISON HERSHFIELD

ALGONQUIN COLLEGE
STUDENT COMMONS DISPLACED PARKING
SERVICING PLAN

SCALE (FULL SIZE): 0m 10 20 40 — 1:1000

DWG No.: 01

DESIGN: FH | DRAWN: CR | REVIEWED: GSH

Appendix A-X

CONTENTS

IELCIIE Building (Building C) – Site Plan Approval Supporting Documents 31 pages

Properties

PIN	04691 - 0281 LT
Description	PART OF LOTS 34 AND 35, CONCESSION 1, RIDEAU FRONT (NEPEAN) BEING PART 1 ON PLAN 5R-14187 SAVE AND EXCEPT PARTS 2, 4, 5 AND 9 ON PLAN 4R-17557 AND PART 1 ON 4R-26099, PART 1 ON 4R27987. SUBJECT TO AN EASEMENT IN FAVOUR OF THE HYDRO-ELECTRIC COMMISSION OF THE CITY OF NEPEAN OVER PART 1 ON PLAN 4R-12162 SAVE AND EXCEPT PART 9 ON PLAN 4R-17557 AS IN LT1012354.; SUBJECT TO AN EASEMENT IN GROSS OVER PT 2 PL 4R26099 AS IN OC1641664; SUBJECT TO AN EASEMENT IN GROSS OVER PT 2 PL 4R27987 AS IN OC1641666; CITY OF OTTAWA
Address	OTTAWA

Consideration

Consideration $ 1.00

Applicant(s)

The notice is based on or affects a valid and existing estate, right, interest or equity in land

Name CITY OF OTTAWA

Address for Service C/O Mgr Real Estate Services
REPDO Mail Code 01-86
110 Laurier Avenue West
Ottawa, ON
K1P 1J1

file: L0106-WOOD (NM)

This document is not authorized under Power of Attorney by this party.

This document is being authorized by a municipal corporation Jim Watson, Mayor & Caitlin Salter-MacDonald, Deputy City Clerk.

Party To(s) — *Capacity* — *Share*

Name THE ALGONQUIN COLLEGE OF APPLIED ARTS AND TECHNOLOGY

Address for Service 1385 Woodroffe Ave.
Ottawa, Ontario

I, Duane McNair, VP, have the authority to bind the corporation

This document is not authorized under Power of Attorney by this party.

Statements

This notice is pursuant to Section 71 of the Land Titles Act.

This notice is for an indeterminate period

Schedule: See Schedules

Signed By

Steven Alexander Bannister	110 Laurier Av. W., 3rd floor Ottawa K1P 1J1	acting for Applicant(s)	Signed	2017 08 16

Tel 613-580-2400

Fax 613-560-1383

I have the authority to sign and register the document on behalf of the Applicant(s).

Submitted By

CITY OF OTTAWA	110 Laurier Av. W., 3rd floor Ottawa K1P 1J1	2017 08 16

Tel 613-580-2400

Fax 613-560-1383

Fees/Taxes/Payment

Statutory Registration Fee	$63.35
Total Paid	$63.35

THIS SITE PLAN AGREEMENT made in duplicate the 24th day of May, 2017.

BETWEEN:

THE ALGONQUIN COLLEGE OF APPLIED ARTS AND TECHNOLOGY

Hereinafter called the "Owner"

OF THE FIRST PART

AND:

CITY OF OTTAWA

Hereinafter called the "City"

OF THE SECOND PART

WHEREAS the Owner is the owner of the lands and premises described in Schedule "A" of this Agreement;

AND WHEREAS the Owner and the City have agreed to certain matters hereinafter expressed relating to the planning and development of the said lands pursuant to the City's Site Plan Control By-law, as amended, and in accordance with Section 41 of the *Planning Act,* R.S.O. 1990, c. P.13, as amended, and as approved on May 24, 2017;

THIS AGREEMENT WITNESSETH that in consideration of the sum of One Dollar ($1.00) of lawful money of Canada paid by the City to the Owner, the receipt whereof is hereby acknowledged, and other good and valuable consideration, the parties hereto agree to the following terms and conditions:

1. In this Agreement:

"ACCEPTANCE" means the date on which the City accepts all Works and obligations which are constructed, installed, supplied or performed by the Owner pursuant to this Agreement and further referred to in this Agreement;

"AGREEMENT" means this Agreement and the Schedules which shall be deemed to be covenants as though specifically set out therein;

"APPROVAL" means the date on which the City is satisfied that certain Works have been constructed, installed or performed to the satisfaction of the City, and further referred to in this Agreement;

"AS-BUILT" means a revised set of drawings submitted by the Owner upon completion of a project reflecting all changes made in the specifications and working drawings during the construction process, and showing the exact dimensions, geometry, and location of all elements of the Works completed during construction, as certified by an Ontario Land Surveyor or a Professional Engineer, licensed in the Province of Ontario;

"CHIEF BUILDING OFFICIAL" means the senior officer of the Building Code Services Branch of the Planning, Infrastructure and Economic Development Department of the City or his/her designate;

"CITY" means the City of Ottawa and includes its successors and assigns and its officers, employees, agents, contractors and subcontractors;

"CITY SPECIFICATIONS OR STANDARDS" means the detailed description of construction materials, workmanship and standards of Works to be carried out by the Owner as prescribed by the City and its amendment from time to time by the City and which are hereby incorporated by reference to and shall form part of this Agreement as though the same were attached thereto;

"CITY TREASURER" means the General Manager and City Treasurer of the Corporate Services Department of the City or his/her designate;

"COUNCIL" means the Council of the City;

"GENERAL MANAGER, PLANNING, INFRASTRUCTURE AND ECONOMIC DEVELOPMENT" means the senior officer of the Planning, Infrastructure and Economic Development of the City or his/her designate;

"GENERAL MANAGER, PUBLIC WORKS AND ENVIRONMENTAL SERVICES" means the senior officer of the Public Works and Environmental Services Department of the City or his/her designate;

"LANDSCAPE ARCHITECT" means a landscape architect in good standing with the Ontario Association of Landscape Architects or the Canadian Society of Landscape Architects;

"LETTER OF CREDIT" means the letter of credit provided by the Owner to the City in accordance with the requirements of Section 8 of this Agreement;

"MAINTAIN" means to repair, replace, reinstate and/or keep operational;

"MANAGER, DEVELOPMENT REVIEW" means the Manager of Development Review in the Planning, Infrastructure and Economic Development and includes Manager, Development Review (Urban Services), Manager, Development Review (Suburban Services) and Manager, Development Review, (Rural Services);

"OWNER" means the party of the First Part, its heirs, executors, administrators, successors and assigns and agents thereof or contractor or subcontractor carrying out the Works for or on behalf of the Owner;

"PLAN" or **"SITE PLAN"** means the Site Plan Approval by Council or a delegate of Council to act in the capacity of Council and includes the lands described in Schedule "A";

"ROAD" means those public roads or any part thereof, any daylighting triangles, and any areas of road widening shown or laid out on the Site Plan. The use of "Streets" or "Public Highway" shall be synonymous with "Road";

"WORKS" means those services, installations, structures, buildings and other works listed in and required by this Agreement.

2. **Lands**

The lands to which this Agreement shall apply are those described in Schedule "A" hereto, and may be referred to herein as "site", "development", "subject lands" or "lands".

3. **Scope of Works and Conformity**

The Owner acknowledges and agrees to construct and maintain the proposed development in conformity with this Agreement and Schedules attached hereto, at its sole expense. It is understood and agreed that written approval of the City, in a form determined solely by the City, is required prior to any departure from the specifications of this Agreement and Schedules.

4. **Copies of Plans to be kept on Site**

Copies of the approved plans shall be kept on site throughout the period of construction for the guidance of City staff and those employed to construct the Works. Large scale copies of the said plans shall be available from the offices of the General Manager, Planning, Infrastructure and Economic Development.

5. **Entire Approval/Revisions to Plans**

The Owner acknowledges and agrees that the provisions of this Agreement do not comprise the entire site plan approval and reference must be made to the actual approval document, obtained from the General Manager, Planning, Infrastructure and Economic Development, and the Owner acknowledges and agrees to satisfy all conditions of approval and abide by all municipal by-laws, statutes and regulations. The Owner further acknowledges and agrees that reference must be made to the latest approved plans containing any approved revisions. These approved revised plans shall also be kept on site in accordance with Clause 4 of this Agreement.

6. **Registration and Issuance of Building Permits**

The City shall cause this Agreement to be registered against the lands to which it applies immediately following execution by the parties hereto and the Owner agrees not to register any other instrument against the subject lands until this has been accomplished. The Owner may apply for, but not request nor require the City to issue building permits for the construction of the Works on the said lands, until this Agreement has been signed and until all of the payments and performance deposits required of the Owner by the terms and conditions of this Agreement have been made.

7. **Financial Requirements**

The Owner shall pay to the City, by cash or certified cheque, the charges and fees, as set out in Schedule "B" attached hereto and other financial requirements, if applicable to the Owner as a Provincial Crown Agency, including but not limited to legal fees, development charges, road cuts and building permit fees that may be required by the City as established by by-law or resolution of Council from time to time, which pertain to this development and are not specifically referred to herein. It is the Owner's responsibility to verify which financial requirements are applicable to this development and the Owner shall pay same when required by the City.

8. **Performance Deposits**

All Works required to be provided and maintained in this Agreement shall be provided and maintained by the Owner at its sole risk and expense and shall be to the satisfaction of the City. In order to ensure that such Works are provided and maintained by the Owner, the Owner shall deposit with the City, before this Agreement is executed by the City, a sum in cash, certified cheque or by irrevocable letter(s) of credit in a form and from a financial institution/user approved by the City Treasurer, which deposit however made, may be referred to hereafter as a "performance deposit" or "performance redeposit". The performance deposit shall be based upon the total estimated cost of the Works required to be constructed or installed. The estimate of the cost of the Works and the amount of the performance deposit shall be those prescribed in Schedule "B", attached hereto, as approved by the General Manager, Planning, Infrastructure and Economic Development.

9. **Letters of Credit - Renewal**

If the Owner satisfies the provisions of Clause 8 by depositing irrevocable letter(s) of credit with the City, the following provisions shall apply:

(a) Until the Acceptance or Approval of all Works required to be provided and maintained by the Owner pursuant to this Agreement, to the satisfaction of the City, it will be a condition of the letter of credit that it shall be deemed to be automatically extended without amendment from year to year from the existing or any expiration date thereof, unless at least thirty (30) days prior to any such future expiration date, the financial institution which issued the letter of credit notifies the City in writing by registered mail that it elects not to consider the letter of credit to be renewable for any additional period.

(b) Until the Acceptance or Approval of all Works required to be provided and maintained by the Owner pursuant to this Agreement, to the satisfaction of the City, the irrevocable letter(s) of credit shall continue to be automatically extended in the same manner as provided in sub-clause (a) hereof.

(c) If the Owner and/or financial institution fails to extend the letter(s) of credit as required under sub-clauses (a) and (b) hereof as required by the City, such failure shall be deemed to be a breach of this Agreement by the Owner, and the City, without notice to the Owner, may call upon any part or the whole amount of the existing letter(s) of credit notwithstanding anything otherwise contained herein. Any amount received by the City shall be held by the City in the same manner as if it had originally been cash deposited under the provisions of Clause 8.

10. **Insurance Policy**

(a) The Owner shall obtain, before the execution of this Agreement, and keep in force during construction of the Works, Commercial General Liability insurance from an insurance company licensed to do business in Ontario, providing insurance in the amount of not less than Two Million ($2,000,000.00) Dollars, per occurrence, exclusive of interest, and costs against loss or damage resulting from bodily injury to, or death of one or more persons and loss of or damage to property. Such policy shall name the City of Ottawa as an additional insured thereunder.

(b) The policy shall provide coverage against claims for damage or injury including death to a person or persons, for damage to property of the City or any other public or private property resulting from or arising out of any act or omission on the part of the Owner or any of its servants or agents during the construction, installation or maintenance of any Works to be performed upon public rights-of-way pursuant to this Agreement. The policy shall include completed operations coverage and shall be maintained in full force until final Acceptance of the Works by the City.

(c) The policy shall include written contractual liability, cross liability, contingent employer's liability, personal injury, liability with respect to non-owned licensed vehicles, premises and operations liability, Owner's and contractor's protective coverage, as well as severability of interest clause. The policy shall have no exclusion pertaining to shoring, blasting, excavating, underpinning, demolition, pile driving, caisson work and work below ground surface including tunneling and grading. The Owner shall forward to the City, prior to the signing of this Agreement by the City, a Certificate of Liability Insurance. This Certificate of Insurance shall be signed by an authorized employee of the insurance company providing the insurance. Such insurance policy shall contain an endorsement to provide the City and the Owner with not less than thirty (30) days written notice of cancellation.

11. **Failure to Comply**

The Owner acknowledges and agrees that failure to comply with any term or condition herein may result in the City taking such action to enforce compliance, as deemed appropriate by the City.

12. **Implementation of Reports/Studies**

All reports and/or studies required as a result of the Works in this Agreement shall be implemented to the City's satisfaction at the sole expense of the Owner.

13. **Completion Time Limit**

Failure by the Owner to complete all Works required by this Agreement within the time limit specified in Schedule "B" hereof or as extended, in writing, by the General Manager, Planning, Infrastructure and Economic Development, at his sole discretion, shall constitute a default, in which case the City may avail itself of the remedies hereinafter prescribed or available to it in law.

14. **Expiry**

If a building permit has not been issued within two years of the date of signing of this Agreement by the Owner, the Approval herein shall be null and void, at the City's discretion, unless an extension is granted in writing by the General Manager, Planning, Infrastructure and Economic Development.

15. **Default**

(a) In the event of a default by the Owner or its assigns in the provision and maintenance of all Works required to be done by the Owner pursuant to this Agreement, the City may enter upon the lands and complete all Works that are in default, at the expense of the Owner. The City may authorize the use of any or all of the performance deposit(s) held by the City pursuant to Clause 8 to pay for the cost of the City carrying out such Works. "Cost" and "expense of the Owner" in this clause shall be actual cost incurred by the City plus 25% of such cost as a charge for overhead. Any costs incurred by the City pursuant to this clause which are in excess of the amount of any deposit held by the City pursuant to Clause 8 shall be paid by the Owner to the City within thirty (30) days of the mailing of an invoice by the City, for such amount in excess, addressed to the

Owner at its last known address. Any costs referred to in this clause may be recovered by the City in like manner as municipal taxes pursuant to the provisions of Section 446(3) of the *Municipal Act, 2001*, S.O. 2001, c. 25, as amended.

(b) The total cost for Works upon which the performance deposit is based, is the sum of the estimated cost of each of the Works to be provided by the Owner, to the satisfaction of the General Manager, Planning, Infrastructure and Economic Development, as described in Schedule "B" herein. Nothing contained herein shall be construed as limiting the use of the deposit on a proportional basis in the event of a default by the Owner, but rather the whole or such part of the performance deposit, as deemed necessary by the City, may be used to rectify the default.

16. **<u>Release of Performance Deposit</u>**

On Acceptance or Approval of all Works to be provided and maintained by the Owner in accordance with this Agreement, the Owner shall be entitled to have released to it the performance deposit then held by the City.

17. **<u>Partial Release of Performance Deposit</u>**

(a) One partial release of the performance deposit may be permitted prior to final inspection and Approval as described in Clause 18. Until final release of the performance deposit, the Owner agrees that the City shall retain a minimum performance deposit in an amount that is the greater of 10% of the total amount of the cost of Works for the site required by Schedule "B" herein, or Ten Thousand ($10,000.00) Dollars.

(b) If the performance deposit is less than Ten Thousand ($10,000.00) Dollars, the full amount shall be retained until final release.

18. **<u>Inspection - Release of Performance Deposit</u>**

The Owner acknowledges and agrees that it is the Owner's responsibility to make an application to the General Manager, Planning, Infrastructure and Economic Development for the inspection of any completed Works for which the Owner wishes the release of a performance deposit. Said application must be submitted at least sixty (60) days prior to the expiry of any letter of credit held as a performance deposit by the City. Inspections for release of a performance deposit will not be undertaken during winter conditions. The City shall use all reasonable efforts to reply to requests for release in a timely manner.

19. **<u>Transfer of Performance Deposit</u>**

The Owner acknowledges and agrees that the City shall hold in its possession the performance deposit until Acceptance or Approval of the Works in accordance with the approved Plans to the satisfaction of the City. The Owner further acknowledges and agrees:

(a) that it shall be responsible to arrange for the transfer or replacement of the performance deposit provided to the City prior to the sale or transfer of the Owner's lands;

(b) that if the performance deposit has not been replaced prior to the sale or transfer of the Owner's lands, the City may, to the benefit of the new registered owner, apply the deposit for any Works as approved by the City which have not been completed pursuant to the Plans, and for this purpose, the City Treasurer is hereby authorized to call in any letter of credit or other deposit provided. The balance of deposit held, if any, will be refunded to the Owner who provided the deposit, upon Acceptance and Approval of the Works to the satisfaction of the City.

20. **<u>Continued Maintenance after Release of Performance Deposit</u>**

(a) While this Agreement is in effect, the Owner shall maintain all site specific and surrounding landscaping, including all road allowances abutting the lands, so as to provide a neat and tidy appearance, to a standard satisfactory to the General

Manager, Planning, Infrastructure and Economic Development. Maintenance shall include but not be limited to the regular watering, weeding, and cutting or pruning of all grass, shrubs and trees. All other landscape materials, such as fencing and walkway surfaces, shall similarly be maintained in a manner satisfactory to the City. All grass, shrubs and trees shall be replaced if they become unhealthy or die. Any vegetation, which by its size or nature creates a hazard or becomes a nuisance, shall be replaced with planting materials approved by the City. All curbs, asphalt, catch basins and other drainage facilities shall be maintained so as to ensure their continued, proper and safe functioning. All traffic aisles, parking stalls and accesses shall be kept free of snow and all painted markings shall be maintained so as to be clearly visible. All other matters and things to be provided and maintained by the Owner pursuant to this Agreement shall be so continually maintained to the satisfaction of the City.

(b) If, in the sole opinion of the City, the Owner has defaulted in the maintenance of the Works to be provided, the Owner shall rectify, to the satisfaction of the City, all such Works as are in default, within sixty (60) days of mailing of a notification by the City addressed to the Owner at its last known address, or within a time deemed reasonable by the City and stipulated in writing. If, in the opinion of the City, the Owner has not rectified all such Works as are in default after said stipulated time period, the City may enter upon the lands and do all such Works as are in default, at the expense of the Owner. Actual cost incurred by the City in carrying out such Works plus 25% of such cost as a charge for overhead, shall be paid by the Owner to the City within thirty (30) days of mailing of an invoice by the City addressed to the Owner at its last known address or such costs may be recovered by the City in like manner as municipal taxes pursuant to the provisions of Section 446(3) of the *Municipal Act, 2001*, S.O. 2001, c. 25, as amended.

21. **Relocation of Utilities and Provision of Easements**

The Owner shall obtain approval for, arrange for and pay for the cost of the relocation of any existing utilities which are necessary due to this development to the satisfaction of, and at a time satisfactory to the authority having jurisdiction, together with the granting of such new easements as may be required and the release of any existing easements which are rendered unnecessary.

22. **Release of Plans**

The Owner hereby releases to the City its rights to any approved drawings that form part of this Agreement, for the purposes of tendering the construction upon default of this Agreement. The Owner shall also ensure that appropriate releases to the City are obtained from the Owner's consultants, if required.

23. **Notices**

Any notice required to be given herein shall be in writing and shall be delivered personally or by prepaid registered mail and, if to the City, shall be addressed to the office of the General Manager, Planning, Infrastructure and Economic Development at 110 Laurier Avenue West, 4th Floor, Ottawa, Ontario, K1P 1J1, or at such other address at which the City offices are located in the future and, if to the Owner or its agent, at the addresses provided in the application submitted for approval of the subject development, or at such other address as the Owner may advise the City in writing.

23. **Subsequent Parties and Gender**

This Agreement shall enure to the benefit of and be binding upon the parties hereto and their respective heirs, executors, administrators, successors and assigns, and all covenants and agreements herein contained, assumed by, or imposed upon the Owner are deemed to be covenants which run with and bind the lands and every part thereof. All covenants herein contained shall be construed to be several as well as joint, and wherever the singular or masculine is used, it shall be construed as if the plural or the feminine or the neuter, as the case may be, had been used where the context or the party or the parties hereto so require, and the rest of the sentence shall be construed as if the grammatical and terminological changes thereby rendered necessary had been made.

25. **Indemnity**

The Owner, on behalf of himself, his heirs, executors, administrators and assigns, including his successors in title, covenants and agrees to indemnify and save harmless the City from all actions, causes of actions, suits, claims or demands whatsoever which arise directly or by reason of this Agreement and the construction and maintenance or the improper or inadequate construction and/or maintenance of the Works. The City (as well any of its successors or assigns) other than as against the Owner, unconditionally and irrevocably waives and releases all claims, remedies, recourse or rights against the Crown in right of Ontario (the Crown), in any way relating to or in respect of this Agreement or any previous Site Plan Agreement with the Owner, and agrees that it shall have no remedies, recourse or rights in any way relating to or in respect to this Agreement against the Crown in right of Ontario, any ministry, minister, agent, agency, servant, employee or representative of the Crown or any director, officer, servant, agent, employee or representative of a Crown agency or a corporation in which the Crown holds a majority of the shares or appoints a majority of the directors or member.

26. **Release of Agreement**

The provisions of the City's Delegation of Authority By-Law, being By-Law No. 2016-369, as amended, apply with respect to the release of this Agreement.

27. **Schedules**

The following Schedules are attached hereto and form part of this Agreement:

Schedule "A"	Description of Lands to which this Agreement Applies
Schedule "B"	Performance Deposits and Fees/Financial Requirements
Schedule "C"	City Standards or Specifications
Schedule "D"	Site Specific Conditions
Schedule "E"	List of Approved Plans and Approved Reports

28. **Clause Headings**

All clause headings are for ease of reference only and shall not affect the construction or interpretation of this Agreement.

IN WITNESS WHEREOF THE Owner has hereunto affixed the Corporate Seal of the Company duly attested to by its proper signing officers duly authorized in that behalf.

DATED AT OTAWA this 3rd **day of August, 2017.**

SIGNED, SEALED & DELIVERED **In the presence of:**	**THE ALGONQUIN COLLEGE OF APPLIED ARTS AND TECHNOLOGY**
	Name: Duane McNair **Title** Vice President, Finance and Administration
	Name: **Title:**
	I/We have authority to bind the Corporation

IN WITNESS WHEREOF the City of Ottawa has hereunto affixed its Corporate Seal duly attested to by its Mayor and City Clerk.

DATED AT OTTAWA this 14th **day of August, 2017.**

SIGNED, SEALED & DELIVERED **In the presence of:**	**CITY OF OTTAWA**
Approved for execution KM City Solicitor	**Jim Watson, Mayor** **Caitlin Salter-MacDonald, Deputy City Clerk**
	We have authority to bind the Corporation

SCHEDULE "A"

DESCRIPTION OF LANDS TO WHICH THIS AGREEMENT APPLIES

All and singular that certain parcel or tract of land and premises situate, lying and being in the City of Ottawa, being composed of:

DESCRIPTION	P.I.N.
Part of Lots 34 and 35, Concession 1, Rideau Front (Nepean) being Part 1 on Plan 5R-14187 save and except Parts 2, 4, 5 and 9 on Plan 4R-17557 and Part 1 on 4R-26099, Part 1 on 4R-27987, subject to an easement in favour of The Hydro-Electric Commission of the City of Nepean over Part 1 on Plan 4R-12162 save and except Part 9 on Plan 4R-17557 as in LT1012354; subject to an easement in gross over Part 2 Plan 4R-26099 as in OC1641664; subject to an easement in gross over Part 2 Plan 4R-27987 as in OC1641666; City of Ottawa	04691 – 0281 (LT)

SCHEDULE "B"

PERFORMANCE DEPOSITS AND FEES/FINANCIAL REQUIREMENTS

ESTIMATED COST OF WORKS TO BE CONSTRUCTED

Works on Private Property – Soft Servicing	
Landscaping	$ 50,128.96
Sub Total Soft Servicing	**$ 50,128.96**
Works on Private Property – Hard Servicing	
Storm Sewer	$ 20,700.00
Culvert	$ 75,000.00
Roads	$ 81,650.00
Structural	$ 12,000.00
Sub Total Hard Servicing	**$189,350.00**
TOTAL PRIVATELY OWNED WORKS	**$239,478.96**
TOTAL ESTIMATED COST OF WORKS	**$239,478.96**

SECURITIES AND CASH PAYABLE

File No. D07-12-16-0137

DEVELOPER: THE ALGONQUIN COLLEGE OF APPLIED ARTS AND TECHNOLOGY

DEVELOPMENT LOCATION: 1385 WOODROFFE AVENUE

1.	**Security Amount Required**	
	100% of Total Estimated Cost of Works on Public Property	$ 0.00
	50% of Total Estimated Cost of Works on Private Property	$119,739.48
	TOTAL SECURITY BY LETTER OF CREDIT:	**$119,739.48**
2.	**Cash Payable**	
	2.1 Design Review and Inspection Fee 4% of Hard Costs ($189,350.00 x 4% = $7,574.00) 2% of Soft Costs ($50,128.96 x 2% = $1,002.58)	$ 8,576.58
	2.2 HST on Total Design Review and Inspection Fee	$ 1,114.96
	2.3 Cash in Lieu of Parkland	$ 0.00
	2.4 Parkland Assessment Fee	$ 0.00
	HST on Parkland Assessment Fee	$ 0.00
	TOTAL CASH PAYABLE BY CERTIFIED CHEQUE:	**$ 9,691.54**

E & O E

City of Ottawa HST Registration Number: 86393 5995 RT0001

Comment:

3. Prior to the execution of this Agreement, the Owner shall pay the City the said sum of $9,691.54 in accordance with Clause 7 – Financial Requirements, contained herein.

4. Prior to the execution of this Agreement, the Owner shall deposit with the City the said sum of $119,739.48, in accordance with Clause 8 – Performance Deposits, contained herein.

Time Limit for Completion of Works:

5. All Works for which performance deposits are required shall be completed within the following time limit from the date of registration of this Agreement, unless an extension is granted in writing by the General Manager, Planning, Infrastructure and Economic Development.

Time Limit: 24 months

SCHEDULE "C"

CITY STANDARDS OR SPECIFICATIONS

Engineering

1. **Extension of Municipal Services**

The City will have no responsibility to install any extension to municipal services which may be required in order for the Owner to comply with this Agreement or with any provincial or municipal laws or by-laws. In cases where such an extension of municipal services is required, the Works shall be undertaken by and at the expense of the Owner and construction shall be to the Standards or Specifications of the City for the installation of such municipal services. The Owner shall provide public liability insurance in a form acceptable to the City for any Works involving the extension of municipal services and obtain any required approvals and permits of the City.

2. **Works on City Road Allowances**

Any Works required to be done by the Owner on City road allowances shall be according to the specifications and by-laws of the City. The Owner, or its contractor, shall be required to obtain all the necessary permits for road cuts prior to the disruption of the City road allowance and it is further understood and agreed that the aforementioned cuts shall be reinstated to the satisfaction of the General Manager, Planning, Infrastructure and Economic Development.

3. **Approvals**

The Owner shall obtain all necessary approvals from the Ministry of the Environment and Climate Change and the City with regard to the installation of the storm and sanitary sewers and watermains and the provision of sewage holding/treatment facilities. In addition, the Owner shall obtain all other permits, licenses and approvals from all other federal, provincial or regulatory agencies, as may be required.

4. **Utilities**

The Owner shall be required to coordinate the preparation of an overall utility distribution plan showing the location (shared or otherwise) and installation, timing and phasing of all required utilities (on-ground, below-ground) through liaison with the appropriate electrical, gas, telephone and cable authorities and including on-site drainage facilities and streetscaping, such location plan being to the satisfaction of all affected authorities and the City, and to be approved prior to the issuance of a building permit for the development.

5. **Storm Water Management**

(a) The Owner shall require that the storm water management calculations be submitted in writing by a Professional Engineer, licensed in the Province of Ontario, to the General Manager, Planning, Infrastructure and Economic Development for his approval. Upon Acceptance and Approval of the Works, a written certification from said Professional Engineer and As-Built plans must be submitted to the General Manager, Planning, Infrastructure and Economic Development, confirming that the storm water management measures have been implemented as per the approved design.

(b) The Owner shall be responsible for the repair and maintenance of the storm water control facility until Acceptance by the General Manager, Public Works and Environmental Services.

6. **Erosion and Sediment Control**

The Owner agrees to implement the erosion and sediment control plan to provide for protection of the receiving storm sewer or water course during construction activities. This plan, to be used during construction, is intended to ensure that no sediment and/or associated pollutants are discharged to a receiving water course which could degrade water quality and/or impair fish or other aquatic habitat. The methods used should be regularly maintained to ensure effectiveness of the methods and compliance with provincial/federal legislation pertaining to water quality and habitat.

7. **Street Cleaning**

On a continuous basis during development, the Owner shall maintain all streets within the area in order to ensure that they are clear of mud, dust and other material resulting from vehicles involved in development to the satisfaction of the General Manager, Planning, Infrastructure and Economic Development. The Owner shall prevent the 'flushing' of dirt and debris associated with development Work into any sewers. Upon any default by the Owner to maintain the streets, the General Manager, Planning, Infrastructure and Economic Development may, in his discretion, arrange for the required cleaning to be performed, and all costs incurred by the City shall be recovered pursuant to Clause 15 of this Agreement.

8. **Performance of Works**

The Owner shall ensure that the performance of Works required as a result of this Agreement, whether by the Owner or its employees, servants, agents, contractors or subcontractors, shall be so performed as not to constitute a nuisance or disturbance to abutting or nearby properties or the owners thereof. The Owner shall comply with and ensure that all of its contractors and subcontractors comply with any written instructions issued by the City concerning any such nuisance or disturbance regardless of whether such instructions require positive action or discontinuance of action.

9. **Site Servicing**

The Owner shall design and construct all site servicing to the approval of the General Manager, Planning, Infrastructure and Economic Development.

Inspection

10. **Dye Test Inspection**

(a) The Owner shall not convey the subject lands or allow any building on the lands to be occupied until the Owner has filed written certification with the General Manager, Planning, Infrastructure and Economic Development that the plumbing and lateral services have received and passed a dye test inspection.

(b) The Owner shall submit written certification to the General Manager, Planning, Infrastructure and Economic Development, that all sanitary sewers and manholes, except private building sanitary sewer connections, have passed leakage testing. This verification will include certified test results for all sections of sanitary sewers constructed as part of this development.

(c) Such certification as described in subsection (a) and (b) above, shall be provided by a Professional Engineer, licensed in the Province of Ontario, retained by the Owner and approved by the City.

11. **Testing**

The Owner may be required by the City to perform qualitative and quantitative testing, at the Owner's expense, of any materials which have been or are proposed to be used in the construction of any of the Works required by this Agreement to determine whether they are in conformity with applicable standards as determined by the General Manager, Planning, Infrastructure and Economic Development.

12. **Video Examination**

Video examination of storm and sanitary sewers 200mm or larger in diameter shall be required by the General Manager, Planning, Infrastructure and Economic Development, at the Owner's expense, before final Acceptance or Approval of the Works.

Fire Requirements

13. **Fire Fighting Performance Standards**

Every Owner of a building or structure shall ensure that its building is served by access routes for fire fighting, as required, designed and constructed in accordance with the *Building Code Act, 1992*, S.O., 1992, c.23, as amended, and regulations made thereunder. The approved access routes shall be maintained in accordance with the *Fire*

Protection and Prevention Act, 1997, S.O. 1997, c.4, as amended. The Owner further agrees to abide by any City by-law relating to the maintenance and signage of such access routes. The locations of any fire hydrants and siamese connections on the site shall be in accordance with the Ontario Building Code, O. Reg. 332/12, as amended. The required fire hydrant shall be installed and in service prior to the commencement of any structural framing for buildings in the subject development.

14. **Fire Fighting Maintenance Standards**

(a) Hydrants shall be maintained in operating condition, free of snow and ice accumulations and readily available and unobstructed for use at all times in accordance with the Ontario Fire Code, O. Reg. 213/07, as amended, and the requirements of the City.

(b) The Owner acknowledges and agrees that no driveway serving any lot shall be located within 3.0 metres of a fire hydrant. No person shall obstruct the access to any fire hydrant. Vegetation or other objects shall not be planted or placed within a 3.0 metre corridor between the hydrant and the curb, or within a 1.5 metre radius beside or behind a hydrant, without the express written consent of the City.

15. **Fire Lanes and Parking Spaces for the Physically Disabled**

(a) The Owner acknowledges and agrees to provide, maintain and post signs designating fire lanes and parking for the physically disabled in conformity with City by-laws. The Owner shall ensure that fire lanes are kept free and clear of vehicles and that parking spaces for the physically disabled are not illegally occupied.

(b) The Owner shall, if necessary, request the City's assistance and agrees to permit the police and/or municipal law enforcement officers to enter upon the lands for the purposes of patrolling areas where parking is not permitted, and to allow the ticketing of any vehicles that are in contravention of the parking regulations with respect to fire lanes or parking spaces for the physically disabled.

Landscaping

16. **Inspections and Maintenance**

(a) Maintenance of plant material by the Owner shall begin immediately following completion of each portion of planting. Maintenance shall consist of watering, weeding, and rodent, pest and disease control in accordance with generally accepted horticultural practices. Should the Owner pass the maintenance of plant material onto the subsequent owner, the Owner shall remain responsible for replacement. In addition, the Owner shall provide, for the City's approval, a copy of the maintenance directions provided to subsequent owners.

(b) The plant material shall be guaranteed until Acceptance and the Owner shall replace any plant material, as determined by the City and be in accordance with the approved landscape plan.

General

17. **Snow Storage**

Any portion of the lands which is intended to be used for snow storage shall be shown on the approved Site Plan or as otherwise approved by the General Manager, Planning, Infrastructure and Economic Development. The grading and drainage patterns and/or servicing of the site shall not be compromised by the storage of snow. Snow storage areas shall be setback a minimum of 1.5 metres from property lines, foundations, fencing or landscaping. Snow storage areas shall not occupy driveways, aisles, required parking spaces, or any portion of a road allowance.

18. **Dumping**

The Owner shall not dump, or permit to be dumped, any fill and/or debris on adjacent lands, and/or road allowances, except as may be approved in writing by the General Manager, Planning, Infrastructure and Economic Development.

19. **Exterior Lighting**

All exterior lighting proposed for the subject lands shall be installed only in the locations and in accordance with specifications shown on the approved plans referenced herein unless otherwise approved in writing by the General Manager, Planning, Infrastructure and Economic Development. Sharp cut-off fixtures or, in exceptional circumstances only, an alternative fixture design approved by the General Manager, Planning, Infrastructure and Economic Development, shall be used to minimize possible lighting glare onto adjacent properties. It is noted that exterior lighting includes exterior building lighting.

20. **Municipal Number Signs**

The Owner shall provide and erect or affix, at its expense, such municipal number signs, illuminated or otherwise, in such locations and of such a size, design and colour as submitted to and approved by the Chief Building Official, prior to occupancy of any buildings, or part thereof.

21. **Waste Handling**

(a) The Owner shall provide, to the City's satisfaction, an enclosed environmentally acceptable solid waste disposal system and handling facilities for waste generated from the development. In the event that exterior waste storage, central collection pads or other handling facilities are proposed on the subject lands, then the location and the screening of the said facilities shall be shown on the approved Site Plan. Uses that require food processing or food storage, which could generate an effluent or leachate, shall have the area around the disposal facility graded so that this material is directed to the sanitary sewer, subject to the approval of the General Manager, Planning, Infrastructure and Economic Development.

(b) The Owner acknowledges and agrees that not all types of developments will be serviced by the City's waste collection program. The Owner is responsible for determining if this service will be provided by the City and, if not, shall arrange for separate private service contracts for the proper collection and disposal of waste from the development.

22. **Retention and Protection of Existing Trees**

All those existing trees on the subject lands which are to be retained and protected as detailed on the approved Site Plan or landscape plan shall be protected by fencing to the satisfaction of the City prior to the commencement of any development on the said lands. It is further understood and agreed that in the event that any existing tree, which has been designated for retention, is damaged or destroyed in any manner whatsoever during the development, that the Owner, at its own expense, shall replace the damaged or destroyed tree(s) with a species of a height and calliper as determined and approved by the General Manager, Planning, Infrastructure and Economic Development.

23. **Mailboxes**

In cases where the development provided for in this Agreement is for ground oriented multiple family residential use, the Owner shall install a mailbox on the front of each dwelling unit, to the satisfaction of the General Manager, Planning, Infrastructure and Economic Development.

Plans

24. **Submission of Approved Plans**

The Owner shall file with the General Manager, Planning, Infrastructure and Economic Development, one digital copy of all approved plans referenced in the Schedules to this Agreement, in a format acceptable to the General Manager, Planning, Infrastructure and Economic Development. The boundaries of the land within the development application shall be referenced to the Horizontal Control Network in accordance with City requirements and guidelines for referencing legal surveys.

25. **Provision of As-Built Drawings**

(a) The Owner shall submit to the Chief Building Official a certified building location survey, prepared by a licensed Ontario Land Surveyor, including foundation elevations, upon completion of the foundation to ensure interim compliance with the relevant City Zoning By-law, being By-law No. 2008-250, as amended.

(b) The Owner shall supply to the General Manager, Planning, Infrastructure and Economic Development, one set of mylar or plastic film As-Built road, grading and service drawings including the location of all Works, certified under seal by a Professional Engineer, licensed in the Province of Ontario, for City records upon Acceptance and Approval of the Works. Furthermore, the Owner shall provide the As-Built information and the attribute data for the Works in a form that is compatible with the City's computerized systems.

SCHEDULE "D"

SITE SPECIFIC CONDITIONS

1. **Execution of Agreement Within One Year**

The Owner shall enter into this Site Plan Agreement, including all standard and special conditions, financial and otherwise, as required by the City. The Owner acknowledges and agrees that the approval shall lapse within one (1) year of Site Plan approval if the Owner has not executed this Agreement and has not completed the conditions required to be satisfied prior to execution of this Agreement.

2. **Prior Site Plan Agreement**

The Owner acknowledges and agrees that all terms and conditions of the Site Plan Agreement entered into between The Algonquin College of Applied Arts and Technology and the City of Ottawa, registered as Instrument No. OC1259965 on July 20, 2011 are reconfirmed and are in full force and effect except as otherwise varied or amended in this Agreement. The Owner further acknowledges and agrees that the relevant portion of the Approved Plans referenced in Schedule "E" hereto shall supercede and replace and/or be in addition to, as the case may be, the relevant sections of the corresponding Plans contained in the previous Site Plan Agreement(s).

3. **Permits**

The Owner shall obtain such permits as may be required from municipal or provincial authorities and shall file copies thereof with the General Manager, Planning, Infrastructure and Economic Development.

4. **Waste Reduction Workplan Summary**

Prior to the issuance of a building permit, the Owner acknowledges and agrees to prepare a waste reduction workplan summary for the construction project as required by O.Reg. 102/94, being "Waste Audits and Waste Reduction Work Plans" made under the *Environmental Protection Act*, RSO 1990, c E.19, as amended, to the satisfaction of the General Manager, Planning, Infrastructure and Economic Development. The Owner further acknowledges and agrees to provide a copy of the said waste reduction workplan summary to the General Manager, Planning, Infrastructure and Economic Development.

5. **Water Supply For Fire Fighting**

The Owner shall provide adequate water supply for fire fighting for every building. Water supplies may be provided from a public water works system, automatic fire pumps and pressure tanks or gravity tanks.

6. **Reinstatement of City Property**

The Owner shall reinstate, at its expense and to the satisfaction of the General Manager, Planning, Infrastructure and Economic Development, any property of the City, including, but not limited to, sidewalks, curbs and boulevards, which is damaged as a result of the subject development.

7. **Construction Fencing**

The Owner acknowledges and agrees to install construction fencing, at its expense, in such location as may be determined by the General Manager, Planning, Infrastructure and Economic Development.

8. **Completion of Works**

The Owner acknowledges and agrees that no new building shall be occupied on the lands, nor will the Owner convey title to any building until all requirements with respect to completion of the Works as identified in this Agreement have been carried out and received Approval by the General Manager, Planning, Infrastructure and Economic Development, including the installation of municipal numbering provided in a permanent location visible during both day and night and the installation of any street name sign on relevant streets. Notwithstanding the non-completion of the foregoing Works, conveyance and/or occupancy of a lot or structure may otherwise be permitted, if in the sole opinion of the General Manager, Planning, Infrastructure and Economic Development, the aforesaid Works are proceeding satisfactorily toward completion. The Owner shall obtain the prior consent of the General Manager, Planning, Infrastructure and Economic Development for such conveyance and/or occupancy in writing.

9. **Pinecrest Creek**

The Owner acknowledges and agrees that the requirements of the receiving watercourse (Pinecrest Creek) have not been satisfied and that the deficit will be addressed in a Stormwater Management Master Plan which shall be prepared to establish an overall stormwater management strategy for the entire Algonquin College Campus site. The strategy shall comply with the Memorandum entitled DRAFT – Algonquin College Stormwater Management Master Plan, prepared by Morrison Hershfield (Project No. 2085345.43) dated September 30, 2016, all to the satisfaction of the General Manager, Planning, Infrastructure and Economic Development.

10. **Designated Substances Survey**

Prior to demolition of any existing buildings located on the lands described in Schedule "A" herein, the Owner acknowledges and agrees to complete a designated substance survey and submit the findings and recommendations for the proper handling and disposal of waste as identified in said survey, to the satisfaction of the General Manager, Planning, Infrastructure and Economic Development, and in accordance with Best Management Practices. The survey shall address, but not be limited to:

(a) O.Reg. 278/05: Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations under the *Occupational Health and Safety Act*, R.S.O. 1990, c.O.1, as amended (O.Reg. 278/05);

(b) Guideline - Lead on Construction Projects, prepared by the Ontario Ministry of Labour - Occupational Health and Safety Branch, published September 2004 and revised April 2011, as amended;

(c) O.Reg. 213/91: Construction Projects under the *Occupational Health and Safety Act*, R.S.O. 1990, c.O.1, as amended (O.Reg. 213/91);

(d) Registration Guidance Manual for Generators of Liquid Industrial and Hazardous Waste, prepared by the Ontario Ministry of the Environment and Climate Change, published April 1995 and revised January 2016, as amended, to be used in conjunction with R.R.O. 1990, Reg. 347: General-Waste Management under the *Environmental Protection Act,* R.S.O. 1990, c.E.19, as amended (R.R.O. 1990, Reg. 347);

(e) R.R.O. 1990, Reg. 362: Waste Management – PCB's under the *Environmental Protection Act,* R.S.O. 1990, c.E.19, as amended (R.R.O. 1990, Reg. 362).

11. **Inlet Control Devices**

The Owner acknowledges and agrees to install and maintain in good working order the required roof-top and in-ground stormwater inlet control devices, as recommended in the approved Site Servicing and Grading Plan, referenced in Schedule "E" herein. The Owner further acknowledges and agrees it shall assume all maintenance and replacement responsibilities in perpetuity. The Owner shall keep all records of inspection and maintenance in perpetuity, and shall provide said records to the City upon its request.

12. **Geotechnical Investigation**

The Owner acknowledges and agrees that it shall retain the services of a geotechnical engineer, licensed in the Province of Ontario, to ensure that the recommendations of the Geotechnical Investigation Report (the "Report"), referenced in Schedule "E" herein, are fully implemented. The Owner further acknowledges and agrees that it shall provide the General Manager, Planning, Infrastructure and Economic Development with confirmation issued by the geotechnical engineer that the Owner has complied with all recommendations and provisions of the Report, prior to construction of the foundation and at the completion of the Works, which confirmation shall be to the satisfaction of the General Manager, Planning, Infrastructure and Economic Development.

13. **Stormwater Works Certification**

Upon completion of all stormwater management Works, the Owner acknowledges and agrees to retain the services of a Professional Engineer, licensed in the Province of Ontario, to ensure that all measures have been implemented in conformity with the approved Plans and Reports, referenced in Schedule "E" herein. The Owner further acknowledges and agrees to provide the General Manager, Planning, Infrastructure and Economic Development with certificates of compliance issued by a Professional Engineer, licensed in the Province of Ontario, confirming that all recommendations and provisions have been implemented in accordance with the approved Plans and Reports referenced in Schedule "E" herein.

SCHEDULE "E"
LIST OF APPROVED PLANS AND REPORTS

The plans and reports listed below shall be deemed to form part of this Agreement as though they had been physically incorporated herein.

Plans

1. **Site Servicing and Grading,** Drawing SP-C1, prepared by Morrison Hershfield, dated 2017/01/26, revision 4 dated 2017/04/21, approved by the City on May 24, 2017.

2. **Erosion and Sediment Control,** Drawing SP-C2, prepared by Morrison Hershfield, dated 2016/09/16, revision 3 dated 2017/02/07, approved by the City on May 24, 2017.

3. **Site Plan,** Drawing SP-A010, prepared by Edward J. Cuhaci and Associates Architects Inc., dated 30/01/2017, revision 6 dated 06/04/2016, approved by the City on May 24, 2017.

4. **Location Plan, Site Information, Zoning,** Drawing SP-A011, prepared by Diamond Schmitt Architects and Edward J. Cuhaci and Associates Architects Inc., dated 9/19/2016, revision 3 dated 2017/04/06, approved by the City on May 24, 2017.

5. **Tree Conservation Report & Landscape Plan,** Drawing SP-L1, prepared by James B. Lennox & Associates Inc., dated July-2016, revision 4 dated 07/03/2017, approved by the City on May 24, 2017.

Reports:

1. **Stormwater Management Report & Assessment of Adequacy of Public Services Report – Algonquin College – The Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE)**, prepared by Morrison Hershfield, Report No. 2085345.44 dated September 16, 2016, revised January 26, 2017.

2. **Memorandum: Water Distribution Analysis for Algonquin College Building 'C' Addition – The Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE)**, prepared by Morrison Hershfield, Project No. 2085345.44 dated March 2, 2017.

3. **Geotechnical Investigation – Building C Expansion and Infill Building, Algonquin College, 1385 Woodroffe Avenue,** prepared by Houle Chevrier Engineering, Project 62341.08 dated May 26, 2016.

4. **Phase I Environmental Site Assessment – Algonquin College Woodroffe Campus – Building C, 1385 Woodroffe Avenue, Ottawa, Ontario**, prepared by DST Consulting Engineers Inc., File No. OE-OT-021851, dated September 2016.

Originals of Schedule "E" may be viewed at the City of Ottawa, Planning, Infrastructure and Economic Development Department, 110 Laurier Avenue West, 4th Floor, Ottawa, Ontario, K1P 1J1.

SITE PLAN CONTROL APPROVAL APPLICATION
DELEGATED AUTHORITY REPORT
MANAGER, DEVELOPMENT REVIEW, URBAN SERVICES

Site Location: 1385 Woodroffe Avenue

File No.: D07-12-16-0137

Date of Application: September 23, 2016

This SITE PLAN CONTROL application submitted by Duane McNair, on behalf of Algonquin College, is APPROVED as shown on the following plan(s):

1. **Site Servicing and Grading**, Drawing SP-C1, prepared by Morrison Hershfield, dated 2017/01/26, revision 4 dated 2017/04/21.

2. **Erosion & Sediment Control**, Drawing SP-C2, prepared by Morrison Hershfield, dated 2016/09/16, revision 3 dated 2017/02/07.

3. **Site Plan**, Drawing SP-A010, prepared by Diamond Schmitt Architects and Edward J. Cuhaci and Associates Architects Inc., dated 30/01/2017, revision 6 dated 06/04/2016.

4. **Location Plan, Site Information, Zoning**, Drawing SP-A011, prepared by JDiamond Schmitt Architects and Edward J. Cuhaci and Associates Architects Inc., dated 9/19/2016, revision 3 dated 2017/04/06.

5. **Tree Conservation Report & Landscape Plan**, Drawing No. SP-L1, prepared by James B. Lennox & Associates Inc., dated July - 2016, revision 4 dated 07/03/2017.

And as detailed in the following report(s):

1. **Stormwater Management Report & Assessment of Adequacy of Public Services Report - Algonquin College - The innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE)**, prepared by Morrison Hershfield (Report No. 2085345.44), dated September 16, 2016, revised January 26, 2017.

2. **Memorandum: Water Distribution Analysis for Algonquin College Building 'C' Addition - The Innovation and Entrepreneurship and Learning Centre and**

Institute of Indigenous Entrepreneurship (IELCIIE), prepared by Morrison Hershfield (Project No. 2085345.44), dated March 2, 2017.

3. **Geotechnical Investigation - Building C Expansion and Infill Building, Algonquin College, 1385 Woodroffe Avenue**, prepared by Houle Chevrier Engineering, dated May 26, 2016.

4. **Phase I Environmental Site Assessment - Algonquin College Woodroffe Campus - Building C, 1385 Woodroffe Avenue, Ottawa, Ontario**, prepared by DST Consulting Engineers, dated September 2016.

And subject to the following Standard and Special Conditions:

Standard Conditions

1. The Owner shall enter into a standard site development agreement consisting of the following conditions. In the event the Owner fails to enter into such agreement within one year, this approval shall lapse.

2. The Owner shall obtain such permits as may be required from Municipal or Provincial authorities and shall file copies thereof with the General Manager, Planning, Infrastructure and Economic Development Department.

3. The Owner acknowledges and agrees, prior to the issuance of a building permit to prepare a waste reduction work plan summary for the construction project, as required by O.Reg 102/94, being "Waste Audits and Waste Reduction Work Plans" made under the *Environmental Protection Act*, RSO 1990, c E.19, as amended and provide a copy of said summary to the General Manager, Planning, Infrastructure and Economic Development Department.

4. The Owner shall provide adequate water supply for fire-fighting for every building. Water supplies may be provided from a public water works system, automatic fire pumps, pressure tanks or gravity tanks.

5. The Owner shall reinstate, at its expense and to the satisfaction of the General Manager, Planning, Infrastructure and Economic Development Department, any property of the City, including, but not limited to, sidewalks, curbs and boulevards, which is damaged as a result of the subject development.

6. The Owner acknowledges and agrees to install construction fencing, at its expense, in such a location as may be determined by the General Manager, Planning, Infrastructure and Economic Development Department.

7. The Owner acknowledges and agrees that no new building shall be occupied on the lands, nor will the Owner convey title to any building until all requirements with respect to completion of the Works as identified in this Agreement have been

carried out and received Approval by the General Manager, Planning, Infrastructure and Economic Development Department, including the installation of municipal numbering provided in a permanent location visible during both day and night and the installation of any street name sign on relevant streets. Notwithstanding the non-completion of the foregoing Works, conveyance and/or occupancy of a lot or structure may otherwise be permitted, if in the sole opinion of the General Manager, Planning, Infrastructure and Economic Development Department, the aforesaid Works are proceeding satisfactorily toward completion. The Owner shall obtain the prior consent of the General Manager, Planning, Infrastructure and Economic Development Department for such conveyance and/or occupancy in writing.

Special Conditions

8. The Owner acknowledges and agrees that the requirements of the receiving watercourse (Pinecrest Creek) are not satisfied and that the deficit will be addressed in a Stormwater Management Master Plan which shall be prepared to establish an overall stormwater management strategy for the entire Algonquin College Campus site. The said strategy shall comply with the Memorandum entitled *DRAFT- Algonquin College Stormwater Management Master Plan, prepared by Morrison Hershfield (Project No. 2085345.43), dated September 30, 2016*, all to the satisfaction of the General Manager, Planning, Infrastructure and Economic Development Department.

9. Prior to demolition of any existing buildings located on the lands described in Schedule "A" herein, the Owner acknowledges and agrees to complete a designated substances survey and submit the findings and recommendations for the proper handling and disposal of waste as identified in said survey, to the satisfaction of the General Manager, Planning, Infrastructure and Economic Development Department, and in accordance with Best Management Practices. The survey shall address but not be limited to:

    a. Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations, *Occupational Health and Safety Act*, O.Reg 278/05, as amended, (O.Reg 278/05);

    b. Guideline for Lead on Construction Projects, prepared by the Ontario Ministry of Labour - Occupational Health and Safety Branch, published September 2004 and revised April 2011, as amended;

    c. Construction Projects, *Occupational Health and Safety Act*, O.Reg 213/91, as amended, (O.Reg 213/91);

    d. Registration Guidance Manual for Generators of Liquid Industrial and Hazardous Waste, prepared by the Ontario Ministry of the Environment, published April 1995 and revised June 2011, as amended, to be used in conjunction with General-Waste Management, *Environmental Protection Act,* R.R.O. 1990, Reg. 347, as amended, (O.Reg 347);

e. Waste Management – PCB's, *Environmental Protection At,* R.R.O. 1990, Reg. 362, as amended, (O.Reg 362).

10. The Owner acknowledges and agrees to install and maintain in good working order the required roof-top and in-ground stormwater inlet control devices, as recommended in the approved Site Servicing and Grading Plan, referenced in Schedule "E" herein. The Owner further acknowledges and agrees it shall assume all maintenance and replacement responsibilities in perpetuity. The Owner shall keep all records of inspection and maintenance in perpetuity, and shall provide said records to the City upon its request.

Date	Derrick Moodie, Manager, Development Review Development Review, West Planning, Infrastructure and Economic Development Department

Enclosure: Site Plan Control Application approval – Supporting Information

SITE PLAN CONTROL APPROVAL APPLICATION
SUPPORTING INFORMATION

File Number: D07-12-16-0137

SITE LOCATION

The subject site is municipally known as 1385 Woodroffe Avenue and is currently developed as The Algonquin College Woodroffe Campus.

SYNOPSIS OF APPLICATION

The Site Plan Control application is to construct additions and renovations to the existing building ‘C’ on the Algonquin College Woodroffe Campus to establish the Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE).

The Campus is located on the east side of Woodroffe Avenue, south of Baseline Road, within the College Ward (8). The overall Algonquin College Woodroffe Campus includes college buildings, surface parking, landscaped areas, and sports fields. Building ‘C’ specifically faces Co-generation Plant to the north, existing fire route/drop-off/parking area to the south, existing court yard to the west and an existing internal college road to the east.

Building ‘C’ has an existing gross floor area of approximately 17,401 square metres and the proposed three-storey addition is approximately 3,001 square metres in size, which includes a 454 square metre single storey addition and a vertical addition located on top of the two storey portion of the existing Building ‘C’. Renovations to the existing building will include a new curtain wall façade composed of glazing and metal panels, and a curved roof. The addition is positioned to overlook the existing green courtyard and the components of the project are being designed with the intent to obtain LEED Gold Certification.

DECISION AND RATIONALE

This application is approved for the following reasons:

- The subject site is designated General Urban Area in the Official Plan. The proposed addition and existing institutional use are consistent with the policies of this designation and all applicable policies of the Official Plan.

- The proposed development conforms to the I2 - Major Institutional Zone.

- The proposed design represents desirable development and good planning.

CONSULTATION DETAILS

Councillor Rick Chiarelli has concurred with the proposed conditions of approval.

Public Comments

This application was not subject to the Public Notification and Consultation Policy.

Technical Agency/Public Body Comments

1. N/A

Advisory Committee Comments

Ottawa Accessibility Advisory Committee

1. Provide a ramp to allow access for the handicapped. Even a broken leg would restrict access.

2. Since work is being done in the courtyard, it would be an ideal time to allow access from

Response to Comments – Advisory Committees

1. The access ramp will be provided.

2. Accessibility from adjoining building was improved.

APPLICATION PROCESS TIMELINE STATUS

This Site Plan application was processed by the On Time Decision Date established for the processing of an application that has Manager Delegated Authority.

Contact: Steve Gauthier Tel: 613-580-2424, ext.27889, fax 613-580-2576 or e-mail: steve.gauthier@ottawa.ca

Appendix A-XI

CONTENTS

Stormwater Management Report – Building S	11 pages

MEMORANDUM

TO: Gary Holowach		ACTION BY:	
FROM: Meaghan Dustin		FOR INFO OF:	
PLEASE RESPOND BY:		PROJECT No.:	2085345.46
RE: Building S Extension SWM		DATE:	April 18, 2017

L:\PROJ\2085345\2085345.46 BUILDING S ADDITION SWM ANALYSIS\300 - ENGINEERING\08 - STORMWATER\BUILDING S RE18042017.DOCX

Morrison Hershfield Limited was retained by Algonquin College to provide professional engineering services associated with the development of a Stormwater Management Plan for the Building S Addition, located on the Algonquin Ottawa Campus.

This memo outlines the stormwater management requirements that the redevelopment at this site must follow. The calculations completed are for the purpose of accommodating this area as part of the stormwater pond currently being designed for the Ottawa Campus. The intent is to equate predevelopment flow with post development flow on-site (following City of Ottawa criteria outlined below), and to address the Pinecrest Creek/Westboro Area Stormwater Management Guidelines through use of the pond.

1. Existing Conditions

Building S currently faces an asphalt area consisting of access roads and parking lots. The proposed extension, that will cover $342m^2$, will be built on this impervious area. Drainage is through a series of on-site storm sewers that outlet to a 2100mm diameter trunk sewer. The trunk discharges to Pinecrest Creek, immediately north of Baseline Road.

2. Design Criteria

2.1 - Pinecrest Creek Stormwater Management Guidelines

Any new and infill development or redevelopment projects within the Pinecrest Creek/Westboro Watershed Areas must implement stormwater management (SWM) measures that meet the criteria outlined in the "Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area" (J.F. Sabourin and Associates Inc., June 2012). Since the Algonquin College Woodroffe Campus is within the Pinecrest Creek watershed, these stormwater management guidelines apply to the Campus.

The guidelines specific to the Pinecrest Creek/Westboro impose special conditions for water quality, peak flow and volume control. Implementation of these additional criteria is intended to ensure that the impact of infill and redevelopment upon Pinecrest Creek is mitigated as follows:

- Water quality is not adversely affected;
- Flood risk along Pinecrest Creek is not increased; and
- The cumulative impacts of any new developments, infill projects, or redevelopments will not have an adverse effect on the overall health of Pinecrest Creek,

These criteria are in addition to those outlined in the City of Ottawa Sewer design Guidelines and Ministry of the Environment and Climate Change (MOECC) Stormwater Management Planning and Design Manual, with the most stringent requirements governing.

The criteria have been tailored to specific constraints in Pinecrest Creek and the type (residential, institutional/commercial/industrial (ICI), etc.) and scale (single lot vs. sit plan control, etc.) of development. The stormwater management criteria for institutional/commercial/industrial developments that discharge to Pinecrest Creek are summarized in **Table 1**.

Table 1: Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area(1)

Development Type	Runoff Volume Reduction	Water Quality TSS Removal	Water Quantity	
			Flood Management	**Erosion Control**
Draining to Pinecrest Creek				
Institutional/Commercial/Industrial Developments – discharging upstream of the Ottawa River				
Sites with soil infiltration rates ≥ 1mm/hour.	Minimum on-site retention of the 10mm design storm.	On site removal of 80% TSS.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5L/s/ha. ii) City of Ottawa Sewer Design	Control (detain) the runoff from the 25mm design storm such that the peak outflow from the site does not exceed 5.8L/s/ha.
Sites with soil infiltration < 1mm/hour	If the entire property is underlain by native soils with infiltration rates < 1mm/hour, no infiltrating stormwater management measures may be used. A minimum depth of 300mm of amended soil shall be provided below all from yard landscaped areas. A green roof			

	and/or rain harvesting measures could be implements to provide further volume reduction.		Guidelines (Section 8.3.7.3).	

(1) Guidelines obtained from "Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area", dated June 2012, prepared by J.F. Sabourin and Associates Inc.

2.2 - City of Ottawa Sewer Design Guidelines (October 2012)

Any existing separated sewer area within the City of Ottawa must implement stormwater management (SWM) measures that meet the criteria outlined in the "City of Ottawa Sewer Design Guidelines" (City of Ottawa, October 2012). Since the Algonquin College Woodroffe Campus is located within an existing separated sewer area, the following stormwater management guidelines apply to the Campus:

- Control runoff to the 5-year pre-development flow;
- Flows to the storm sewer in excess of the 5-year storm release rate, up to and including the 100-year storm event, must be detained on site;
- Grassed infill areas: maximum equivalent post development runoff coefficient to equal pre-development runoff coefficient;
- Hard surface infill area: post development runoff coefficient to equal 0.5;
- On site detentions techniques shall be required to limit run-off from the subject site to a maximum equivalent runoff coefficient; and
- Increase runoff coefficient by 25%, to a limit of 1.0, for the 100 year storm event.

3. Pinecrest Creek Stormwater Management Guidelines

The design requirements for the proposed Building S extension based on "Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area", dated June 2012, are as follows, refer to **Table 4** in **Appendix A**:

1. Runoff Volume Reduction

   The on-site retention of the 10mm design storm equates to an approximate storage volume of $3.0m^3$.

   Volume = (8.35mm) x (0.03ha) = $2.86m^3$

2. Water Quality – Total Suspended Solids (TSS) Removal

On-site removal of 80% of TSS will be required. A stormwater management facility with significant depth may not be technically feasible. Therefore, a constructed wetland may be the only feasible end-of-pipe stormwater management practice. For an impervious level of approximately 99%, an approximate storage volume of $5.0m^3$ would be required for a constructed wetland. The use of oil grit separators (OGSs) may also be considered.

Volume = (140m3/ha) x (0.03ha) = 4.79m3

3. Water Quantity – Flood Management

For the site's 1:100 year discharge to not exceed 33.5L/s/ha, the 100 year storm must be released at a maximum rate of approximately 1.0L/s.

Release Rate = (33.5L/s/ha) x (0.03ha) = 1.15L/s

4. Water Quantity – Erosion Control

The detention of the 25mm design storm equates to an approximate storage volume of $5m^3$ that must be detained and released at approximately 0.2L/s.

Volume = (23.2mm – 8.35mm) x (0.03ha) = $5.08m^3$

Release Rate = (5.8L/s/ha) x (0.03ha) = 0.20L/s

4. Roof Drains

There are four (4) roof drains on the proposed Building S addition, which has two levels. Information provided by Suzanne Gibson of Bryden Martel Architects Incorporated indicated that the total hydraulic load would be 9.19L/s. The lower roof has 2 roof drains yielding a flow of 1.88 L.s and the upper roof has 2 roof drains yielding a flow of 7.31L/s. The upper roof will need to be controlled to 5.0L/s to adhere to the City of Ottawa Sewer Design Guidelines.

5. Closure

We trust that this memo is sufficient for your current requirements. Please contact the undersigned with any questions or clarifications.

Sincerely,
Morrison Hershfield Limited

Meaghan Dustin

Prepared By:
Meaghan Dustin, B.Eng.
Water Resource E.I.T.

F. HENDRIKSEN
2017/04/18

Reviewed By:
Frank Hendriksen, M.Sc.Eng., P.Eng.
Senior Water Resources Engineer

APPENDIX A: CALCULATIONS

Table 1
Algonquin College - Building S Extension
Pre-Development Flow

LOCATION	INDIVIDUAL							DESIGN			
Areas	Asphalt Area (ha)	Lawn Areas (ha)	Bldg. Area (ha)	Gravel Area (ha)	Other (ha)	Total (ha)	R*A*N	Time of Conc. (min.)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Peak Flow (m^3/s)
Existing parking lot	0.03					0.03	0.09	10.00	104.19	8.9	0.009
									TOTAL	8.9	0.009

Q = RAIN, where Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area: R = 0.90
Landscaped Area: R = 0.30
Building Area: R = 0.90
Gravel Area: R = 0.60
Composite: R = 0.90

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 5-Year Storm
T_d = Time of Concentration (min)
A = 998.071
B = 0.814
C = 6.053

Table 2
Algonquin College - Building S Extension
Pre-Development Flow - City of Ottawa Reduced Runoff Coefficient

LOCATION	INDIVIDUAL							DESIGN			
Areas	Asphalt Area (ha)	Lawn Areas (ha)	Bldg. Area (ha)	Gravel Area (ha)	Other (ha)	Total (ha)	R*A*N	Time of Conc. (min.)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Peak Flow (m^3/s)
Existing parking lot	0.03					0.03	0.05	10.00	104.19	5.0	0.005
									TOTAL	5.0	0.005

Q = RAIN, where Q = Peak flow (L/s)
R = Runoff coefficient
A = Area (ha)
I = Rainfall intensity (mm/hr)
N = 2.78

Asphalt Area: R = 0.50
Landscaped Area: R = 0.30
Building Area: R = 0.50
Gravel Area: R = 0.50
Composite: R = 0.50

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 5-Year Storm
T_d = Time of Concentration (min)
A = 998.071
B = 0.814
C = 6.053

Table 3
Algonquin College - Building S Extension
Post Development - Storage Calculations

100 Year Storm Storage Volume

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
5	242.70	23	5	18	5.42
10	178.56	17	5	12	7.19
15	142.89	14	5	9	7.73
20	119.95	11	5	6	7.69
25	103.85	10	5	5	7.31
30	91.87	9	5	4	6.72
35	82.58	8	5	3	5.99
40	75.15	7	5	2	5.15
45	69.05	7	5	2	4.23
50	63.95	6	5	1	3.24
55	59.62	6	5	1	2.21
60	55.89	5	5	0	1.13
1440	4.45	0	5	-5	-395.46

Post Development Areas

	Area (ha)	R	R*	R*A*N
Building:	0.03	0.90	1.00	0.10

R* = values increased by 25% to a maximum value of 1 for the 100 year storm

N = 2.78

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 100-Year Storm
T_d = Time of Concentration (min)
A = 1735.688
B = 0.82
C = 6.014

100 Year Storm plus 20% Storage Volume

Time (min)	Intensity (mm/hr)	Peak Flow (L/s)	Release Rate (L/s)	Storage Rate (L/s)	Storage Volume (m^3)
5	291.24	28	5	23	6.81
10	214.27	20	5	15	9.22
15	171.47	16	5	11	10.17
20	143.94	14	5	9	10.42
25	124.62	12	5	7	10.27
30	110.24	10	5	5	9.87
35	99.09	9	5	4	9.29
40	90.17	9	5	4	8.58
45	82.86	8	5	3	7.77
50	76.74	7	5	2	6.89
55	71.55	7	5	2	5.95
60	67.07	6	5	1	4.96
1440	5.34	1	5	-4	-388.16

Post Development Areas

	Area (ha)	R	R*	R*A*N
Building:	0.03	0.90	1.00	0.10

R* = values increased by 25% to a maximum value of 1 for the 100 year storm

N = 2.78

$$I = \frac{A}{(T_d + C)^B}$$

where I = Rainfall Intensity (mm/hr) for a 100-Year Storm plus 20%
T_d = Time of Concentration (min)
A = 1735.688
B = 0.82
C = 6.014

Proposed One (1) Storey Addition on Existing Building - Roof Characteristics

Total One (1) Storey Addition Roof Area (m2) = 342
Total Flat Roof Area (m2) = 342
Flat Roof Percentage (%) = 100

Maximum Ponding Depth (mm) = 150
Ponding Depth Used for Storage (mm) = 0
Storage Capacity (m3) = 0

Table 4
Algonquin College - Building S Addition
Pinecrest Creek Design Criteria Calculations

Building S Extension (ha) = 0.03

Runoff Volume Reduction

10mm Runoff Volume SWMHYMO (mm) = 8.35
10mm Design Storm Runoff Volume (m3) = 2.86

Water Quality - TSS Removal

Impervious Level (%) = 99
Storage Volume for Impervious Level (m3/ha)[1] = 140
Storage Volume (m3) = 4.79
Stroage Volume for Extended Detention (m3/ha) = 40
Extended Detention Volume (m3) = 1
Permanent Pool Volume (m3) = 3

(1) Table 3.2 Water Quality Storage Requirements based on Receiving Waters, Ministry of the Environment and Climate Change Stormwater Management Planning & Design Manual
(SWMP Type - Wetland and Impervious Level - 85%)

Water Quantity - Flood Management

Release Rate (L/s/ha) = 33.50
Release Rate (L/s) = 1.15

Water Quantity - Erosion Control

Release Rate (L/s/ha) = 5.80
Release Rate (L/s) = 0.20
25mm Runoff Volume SWMHYMO (mm) = 23.20
25mm Design Storm Runoff Volume (m3) = 5.08

From: John Dalziel <dalziej@algonquincollege.com>
Sent: Thursday, November 03, 2016 3:59 PM
To: Phillip Rouble; Gary Holowach
Subject: Fwd: S building update

John Dalziel,Bsc.,QS, PQS, LEED Green Assoc., GSC.
Associate Director, Facilities Development
Physical Resources Department
Algonquin College | 1385 Woodroffe Avenue | Ottawa | Ontario | K2G 1V8 | Canada
P: 613-727-4723 X 6674 | C: 613-291-1605 | F: 613-727-7706

mailto:dalziej@algonquincollege.com

one

Begin forwarded message:

From: Scott McDermott <mcderms@algonquincollege.com>
Date: November 3, 2016 at 3:16:08 PM EDT
To: John Dalziel <dalziej@algonquincollege.com>
Subject: S building update

Hello

Meeting with the city went well

They Just want us to provide a memo to confirm our intentions on future storm water mgt And they will flag this as a requirement of our permit but no need for planning approval process so schedule looks achievable

Regards

Sent from my iPhone

Appendix B

Stormwater Design Calculations

Appendix B-I

CONTENTS

Existing Subcatchment Areas & Hydrological Parameters 1 pages

Algonquin College
Stormwater Management - Pond Design Report
Appendix B-I: Existing Subcatchment Areas & Hydrological Parameters

Subcatchment	Area (ha)	Building			Grass Area (ha)	Asphalt/Concrete Area (ha)	Gravel Area (ha)	CN	Pervious				Impervious			
		Name	Area (ha)	Total Area (ha)					Area (ha)	Ratio	Length (m)	Slope (%)	Area (ha)	Ratio	Length (m)	Slope (%)
1	6.11	B	0.51	1.14	3.21	1.76	0.00	85.39	3.21	0.53	57.00	1.42	2.90	0.47	57.00	1.00
		K	0.11													
		M	0.14													
		T	0.37													
2	5.66	A	1.76	3.26	1.30	1.09	0.00	92.47	1.30	0.23	120.00	2.78	4.36	0.77	130.00	1.92
		C	0.56													
		D	0.33													
		H	0.42													
		J	0.19													
3	5.44	F	0.13	1.01	1.83	2.60	0.00	89.93	1.83	0.34	36.00	1.61	3.61	0.66	103.00	1.89
		G	0.09													
		R1	0.28													
		R2	0.28													
		R3	0.24													
4	5.41	N	0.25	1.05	0.70	3.23	0.43	94.18	1.13	0.21	13.00	15.38	4.28	0.79	116.00	1.43
		P	0.48													
		S	0.29													
		Salt Storage Sheds	0.02													
5	3.91	V	0.09	0.09	3.73	0.08	0.00	75.10	3.73	0.95	425.00	2.04	0.18	0.05	0.00	0.00
6	3.08	-	0.00	0.00	0.00	3.08	0.00	98.00	0.00	0.00	0.00	0.00	3.08	1.00	140.00	1.90
7	0.67	-	0.00	0.00	0.07	0.61	0.00	95.62	0.07	0.10	34.00	4.03	0.61	0.90	25.00	2.00
8	1.65	Z	0.05	0.05	1.39	0.21	0.00	77.77	1.39	0.84	85.00	1.76	0.26	0.16	37.00	2.03
9	1.67	E	0.56	0.56	0.72	0.39	0.00	71.00	0.72	0.43	10.00	2.00	0.95	0.57	113.00	0.50
10	1.03	-	0.00	0.00	0.05	0.98	0.00	96.85	0.05	0.05	200.00	1.24	0.98	0.95	35.00	3.23

Runoff Coefficients		CN Values (Soil Type C)	
Asphalt/Concrete=	0.9	Asphalt/Concrete=	98
Building =	0.9	Building =	98
Gravel =	0.7	Gravel =	89
Grass =	0.5	Grass =	74

Appendix B-II

CONTENTS

Existing Building Roof Characteristics 1 pages

Algonquin College
Stormwater Management - Pond Design Report
Appendix B-II: Existing Building Roof Characteristics

Catchment	Building										
	Name	Area (ha)	Number of Roof Drains[4]	Approximate Drainage Length per Drain (m)	Approximate Drainage Slope per Drain (%)	Maximum Ponding Depth (m)	Approximate Volume		Approximate Release Rate		
							(m3)	(ha-m)	(m3/s)	(L/s)	(mm/hr)
1	B	0.51	38			0.15	256	0.02559	0.07182	71.82	41.80
	K	0.11	8			0.15	57	0.00570	0.01512	15.12	
	M	0.14	6			0.15	70	0.00695	0.01134	11.34	
	T	0.37	18			0.15	187	0.01873	0.03402	34.02	
2	A	1.76	64			0.15	881	0.08812	0.12096	120.96	33.38
	C	0.56	30			0.15	279	0.02789	0.05670	56.70	
	D	0.33	9			0.15	166	0.01656	0.01701	17.01	
	H	0.42	42			0.15	211	0.02114	0.07938	79.38	
	J	0.19	15			0.15	94	0.00937	0.02835	28.35	
3	F	0.13	7			0.15	65	0.00653	0.01323	13.23	33.37
	G	0.09	-	-	-	-	-	-	-	-	
	R1	0.28	13			0.15	138	0.01376	0.02457	24.57	
	R2	0.28	9			0.15	141	0.01406	0.01701	17.01	
	R3[2]	0.24	13			0.13	106	0.01061	0.03081	30.81	
4	N	0.25	14			0.15	123	0.01231	0.02646	26.46	29.93
	P	0.48	19			0.15	242	0.02424	0.03591	35.91	
	S	0.29	12			0.15	146	0.01461	0.02268	22.68	
	Salt Storage Sheds	0.02	-	-	-	-	-	-	-	-	
5	V	0.09	4			0.15	47	0.00469	0.00756	7.56	29.02
6	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-
8	Z	0.05	5			0.15	27	0.00266	0.00945	9.45	63.92
9	E[1]	0.56	17	113	0.5	0.15	307	0.03072	0.00553	5.53	3.54
10	-	-	-	-	-	-	-	-	-	-	-

(1) Stormwater Management Servicing Report Student Commons Building, May 2011
(2) Algonquin College - Phase III Residence Stormwater Management Report, January 2003
(3) Stormwater Management Report Algonquin College - Centre for Construction Trades and Building Sciences Building, December 2008
(4) Preventative Roof Maintenance, July 2013

Appendix B-III

CONTENTS

SWMHYMO Model – Existing Conditions Schematic	1 pages
SWMHYMO Model – Existing Conditions	360 pages

E5Y3H-dat

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
START               TIME = 0.0
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM       IUNITS=[2], TD=[3](hrs), TPRAT=[0.333], CSDT=[15](min)
                    ICASEcs=[1], A=[998.071], B=[6.053], C=[0.814]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                 [   0.0 ,  0.0    ]
                                 [0.00945,  0.00266]
                                 [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
```

```
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.096 ,  0.0175 ]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
```

```
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.00756,  0.00469]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
```

```
                                          LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7, 8
(south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[4.36](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[1+2+3]
```

```
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.13230,  0.05698]
                                  [   -1  ,  -1     ]
                          IDovf=[7], NHYDovf=["107"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[6+7+9]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[3.26](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
```

```
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.30240,  0.16307]
                                    [   -1  ,  -1     ]
                          IDovf=[5], NHYDovf=["105"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[2.40](ha),
                    XIMP=[0.46], TIMP=[0.46], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.78](%),
                                         LGP=[120](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+5+6]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
```

```
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08562,  0.04495]
                                    [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[2+3+5]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.023 ,  0.0003 ]
                                    [ 0.032 ,  0.0023 ]
                                    [ 0.039 ,  0.0082 ]
                                    [ 0.045 ,  0.0192 ]
                                    [ 0.050 ,  0.0336 ]
```

```
                                  [ 0.055 ,  0.0470 ]
                                  [ 0.060 ,  0.0548 ]
                                  [   -1  ,    -1   ]
                         IDovf=[5], NHYDovf=["105"]
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[3+5]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[3], NHYD=["TOTAL"], IDs to add=[8+4+1+7+6+9+2]
*
*%-----------------|------------------------------------------------------------|
FINISH
```

```
===================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                     9   9  9   9   # 3573794
        StormWater Management HYdrologic Model          999    999    =========

    ********************************************************************************
    ***************************** SWMHYMO Ver/4.05  ******************************
    *********  A single event and continuous hydrologic simulation model  *********
    *********     based on the principles of HYMO and its successors      *********
    *********                  OTTHYMO-83 and OTTHYMO-89.                 *********
    ********************************************************************************
    ********* Distributed by:  J.F. Sabourin and Associates Inc.         *********
    *********                  Ottawa,  Ontario: (613) 836-3884          *********
    *********                  Gatineau, Quebec: (819) 243-6858          *********
    *********                  E-Mail: swmhymo@jfsa.Com                  *********
    ********************************************************************************

    ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
    +++++++++ Licensed user: Morrison Hershfield Ltd.                    +++++++++
    +++++++++                Ottawa                 SERIAL#:3573794       +++++++++
    ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

    ********************************************************************************
    *********            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *********
    *********            Maximum value for ID numbers  :     10           *********
    *********            Max. number of rainfall points: 105408           *********
    *********            Max. number of flow points    : 105408           *********
    ********************************************************************************


    **********************   D E T A I L E D   O U T P U T   *********************
    ********************************************************************************
    *         DATE: 2018-10-19     TIME: 14:50:56     RUN COUNTER: 000303          *
    ********************************************************************************
    * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E5Y3H.DAT          *
    * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E5Y3H.out          *
    * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E5Y3H.sum          *
    * User comments:                                                               *
    * 1:___________________________________________________________________________*
    * 2:___________________________________________________________________________*
    * 3:___________________________________________________________________________*
    ********************************************************************************

   ------------------------------------------------------------------------------------
   001:0001----------------------------------------------------------------------------
   *#******************************************************************************
   *#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
   *#  Project Number : [2085345.16]
   *#  Date           : 02-07-2014
   *#  Revised        : 01-20-2015
   *#  Revised        : 01-03-2017
   *#  Revised        : 06-28-2018
   *#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
   *#                              October 2018
   *#  Modeller       : [SM]
   *#  Company        : Morrison Hershfield Ltd
   *#  License #      : 3573794
   *#******************************************************************************
   *
   --------------------
   | START              |  Project  dir.:
   C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
   --------------------  Rainfall dir.:
   C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------
001:0002------------------------------------------------------------------------
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM     |    IDF curve parameters: A= 998.071
| Ptotal= 42.48 mm  |                          B=   6.053
--------------------                           C=    .814
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 15.00 min
                        Time to peak ratio =   .33

              TIME    RAIN |    TIME    RAIN |    TIME    RAIN |    TIME    RAIN
               hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr
               .25   4.178 |    1.00  83.557 |    1.75   7.304 |    2.50   3.836
               .50   6.429 |    1.25  21.363 |    2.00   5.570 |    2.75   3.337
               .75  16.065 |    1.50  10.789 |    2.25   4.530 |    3.00   2.962

--------------------------------------------------------------------------------
001:0003------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .05
| 01:101    DT= 1.00  |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .05           .00
     Dep. Storage     (mm)=         1.57          4.67
     Average Slope     (%)=          .50          2.00
     Length            (m)=        42.00         10.00
     Mannings n           =         .013          .200

     Max.eff.Inten.(mm/hr)=        83.56         45.57
                over (min)          2.00          6.00
     Storage Coeff.  (min)=         2.01 (ii)     5.69 (ii)
     Unit Hyd. Tpeak (min)=         2.00          6.00
     Unit Hyd. peak  (cms)=          .56           .20
                                                                *TOTALS*
     PEAK FLOW       (cms)=          .01           .00            .012 (iii)
     TIME TO PEAK    (hrs)=         1.00          1.03           1.000
     RUNOFF VOLUME    (mm)=        40.91          8.82          40.589
     TOTAL RAINFALL   (mm)=        42.48         42.48          42.480
     RUNOFF COEFFICIENT   =          .96           .21            .955

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0004------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
```

```
| IN>01:(101    )  |
| OUT<02:(102    )  |    =========  OUTLFOW STORAGE TABLE  =========
--------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                           .000  .0000E+00   |     .009  .2660E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )       .05      .012     1.000     40.589
     OUTFLOW<02: (102    )       .05      .004     1.100     40.588
    OVERFLOW<03: (103    )       .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   31.285
                   TIME SHIFT OF PEAK FLOW          (min)=     6.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1015E-02

--------------------------------------------------------------------------------------
001:0005------------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=    1.60
| 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02         1.58
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.03         1.76
     Length            (m)=      37.00        85.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        31.12
                over (min)        1.00        17.00
     Storage Coeff.  (min)=       1.22 (ii)   17.31 (ii)
     Unit Hyd. Tpeak (min)=       1.00        17.00
     Unit Hyd. peak  (cms)=        .95          .07
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .00          .07                .075 (iii)
     TIME TO PEAK    (hrs)=        .95         1.20               1.200
     RUNOFF VOLUME    (mm)=      40.91         8.82               9.139
     TOTAL RAINFALL   (mm)=      42.48        42.48              42.480
     RUNOFF COEFFICIENT   =        .96          .21                .215
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------------
001:0006------------------------------------------------------------------------------
*
------------------------
| ADD HYD (105       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 02:102            .05      .004    1.10  40.59    .000
                    +ID2 03:103            .00      .000     .00    .00    .000  **DRY**
                    +ID3 04:104           1.60      .075    1.20   9.14    .000
                     ===========================================================
                     SUM 05:105           1.65      .078    1.18  10.09    .000
```

```
   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0007------------------------------------------------------------------------
*
----------------------
| COMPUTE DUALHYD    |    Average inlet capacities   [CINLET] =    .096  (cms)
| TotalHyd 05:105    |    Number of inlets in system [NINLET] =       1
----------------------    Total minor system capacity         =    .096  (cms)
                          Total major system storage [TMJSTO] =      70.(cu.m.)

                  ID: NHYD         AREA      QPEAK     TPEAK     R.V.      DWF
                                   (ha)      (cms)     (hrs)     (mm)     (cms)
     TOTAL HYD.   05:105           1.65       .078     1.183   10.092      .000
     ======================================================================
     MAJOR SYST   06:106            .00       .000      .000     .000      .000
     MINOR SYST   07:107           1.65       .078     1.183   10.092      .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

     Maximum MAJOR SYSTEM storage used =       0.(cu.m.)

--------------------------------------------------------------------------------
001:0008------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
----------------------
| CALIB STANDHYD     |    Area    (ha)=     .67
| 08:108    DT= 1.00 |    Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .60          .07
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.00         4.03
     Length            (m)=      25.00        34.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        44.64
                over (min)        1.00         7.00
     Storage Coeff.  (min)=        .97 (ii)    7.24 (ii)
     Unit Hyd. Tpeak (min)=       1.00         7.00
     Unit Hyd. peak  (cms)=       1.09          .16
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .14          .01              .145 (iii)
     TIME TO PEAK    (hrs)=        .98         1.05             1.000
     RUNOFF VOLUME    (mm)=      40.91         8.82            37.701
     TOTAL RAINFALL   (mm)=      42.48        42.48            42.480
     RUNOFF COEFFICIENT   =        .96          .21              .887

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0009------------------------------------------------------------------------
*
*Combine Subcatchments 7 & 8
*
------------------------
| ADD HYD (109       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.     DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)    (cms)
                     ID1 07:107            1.65      .078     1.18   10.09     .000
                    +ID2 08:108             .67      .145     1.00   37.70     .000
                     ============================================================
```

```
                      SUM 09:109            2.32     .188    1.00  18.07    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
001:0010----------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .096  .1750E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )       2.32      .188     1.000     18.065
     OUTFLOW<01: (101    )       2.32      .086     1.283     18.065
    OVERFLOW<02: (102    )        .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   46.024
                  TIME SHIFT OF PEAK FLOW         (min)=    17.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.1577E-01

------------------------------------------------------------------------------
001:0011----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.08
| 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.05          .03
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.90          .01
     Length            (m)=     140.00        40.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        35.27
                over (min)        3.00        49.00
     Storage Coeff.  (min)=       2.77 (ii)   48.67 (ii)
     Unit Hyd. Tpeak (min)=       3.00        49.00
     Unit Hyd. peak  (cms)=        .40          .02
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .70          .00          .704 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.72         1.000
     RUNOFF VOLUME    (mm)=      40.91         8.82        40.589
     TOTAL RAINFALL   (mm)=      42.48        42.48        42.480
     RUNOFF COEFFICIENT   =        .96          .21          .955

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
001:0012----------------------------------------------------------------------
```

```
*
*Combine Subcatchment 6 and Overflows
*
------------------------
| ADD HYD (104        ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                   (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 06:106             .00      .000      .00     .00     .000  **DRY**
                    +ID2 02:102             .00      .000      .00     .00     .000  **DRY**
                    +ID3 03:103            3.08      .704     1.00   40.59     .000
                     ============================================================
                     SUM 04:104            3.08      .704     1.00   40.59     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0013------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .09
| 08:108    DT= 1.00  |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .09          .00
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=         .50         2.00
     Length            (m)=       42.00        10.00
     Mannings n          =         .013         .200

     Max.eff.Inten.(mm/hr)=       83.56        45.57
                over (min)         2.00         6.00
     Storage Coeff.  (min)=        2.01 (ii)    5.69 (ii)
     Unit Hyd. Tpeak (min)=        2.00         6.00
     Unit Hyd. peak  (cms)=         .56          .20
                                                                 *TOTALS*
     PEAK FLOW       (cms)=         .02          .00               .021 (iii)
     TIME TO PEAK    (hrs)=        1.00         1.03              1.000
     RUNOFF VOLUME    (mm)=       40.91         8.82             40.589
     TOTAL RAINFALL   (mm)=       42.48        42.48             42.480
     RUNOFF COEFFICIENT   =         .96          .21               .955

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0014------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)    |   (cms)    (ha.m.)
                           .000  .0000E+00    |    .008  .4690E-02

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )         .09      .021     1.000     40.589
     OUTFLOW<09: (109    )         .09      .004     1.300     40.588
    OVERFLOW<02: (102    )         .00      .000      .000       .000
```

```

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   17.437
                    TIME SHIFT OF PEAK FLOW          (min)=    18.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2245E-02

 ------------------------------------------------------------------------------------
 001:0015-----------------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    3.82
 | 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .76          3.06
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=        .01          2.04
      Length            (m)=        .01        425.00
      Mannings n          =       .013          .200

      Max.eff.Inten.(mm/hr)=      83.56         35.27
                 over (min)        1.00         38.00
      Storage Coeff.  (min)=        .04 (ii)    38.48 (ii)
      Unit Hyd. Tpeak (min)=       1.00         38.00
      Unit Hyd. peak  (cms)=       1.70           .03
                                                               *TOTALS*
      PEAK FLOW       (cms)=        .18           .07            .191 (iii)
      TIME TO PEAK    (hrs)=        .78          1.53           1.000
      RUNOFF VOLUME    (mm)=      40.91          8.82          15.237
      TOTAL RAINFALL   (mm)=      42.48         42.48          42.480
      RUNOFF COEFFICIENT   =        .96           .21            .359

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0016-----------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (105       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 09:109            .09      .004    1.30  40.59    .000
                    +ID2 02:102            .00      .000     .00    .00    .000   **DRY**
                    +ID3 03:103           3.82      .191    1.00  15.24    .000
                     ============================================================
                     SUM 05:105           3.91      .194    1.00  15.82    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------------
 001:0017-----------------------------------------------------------------------------
 *
 *Combine Subcatchments 5, 6, 7 & 8
 *
 ------------------------
 | ADD HYD (108       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101           2.32      .086    1.28  18.07    .000
                    +ID2 04:104           3.08      .704    1.00  40.59    .000
```

```
                         +ID3 05:105            3.91      .194    1.00  15.82    .000
                          ===========================================================
                          SUM 08:108            9.31      .965    1.00  24.57    .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

   --------------------------------------------------------------------------------
   001:0018------------------------------------------------------------------------
   *
   *SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7,
   *
   *Total Building Area - Includes Building N, P, S & Salt Storage Sheds
   *
   ----------------------
   | CALIB STANDHYD      |   Area    (ha)=    1.05
   | 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
   ----------------------
                               IMPERVIOUS    PERVIOUS (i)
        Surface Area     (ha)=       1.04          .01
        Dep. Storage     (mm)=       1.57         4.67
        Average Slope     (%)=        .50         2.00
        Length            (m)=      42.00        10.00
        Mannings n           =       .013         .200

        Max.eff.Inten.(mm/hr)=      83.56        45.57
                   over (min)        2.00         6.00
        Storage Coeff.  (min)=       2.01 (ii)    5.69 (ii)
        Unit Hyd. Tpeak (min)=       2.00         6.00
        Unit Hyd. peak  (cms)=        .56          .20
                                                                 *TOTALS*
        PEAK FLOW       (cms)=        .24          .00             .242 (iii)
        TIME TO PEAK    (hrs)=       1.00         1.03            1.000
        RUNOFF VOLUME    (mm)=      40.91         8.82           40.589
        TOTAL RAINFALL   (mm)=      42.48        42.48           42.480
        RUNOFF COEFFICIENT   =        .96          .21             .955

          (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
               Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
               Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
         (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
              THAN THE STORAGE COEFFICIENT.
        (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

   --------------------------------------------------------------------------------
   001:0019------------------------------------------------------------------------
   *
   *Roof storage volume and release rate were estimated
   *
   ---------------------
   | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
   |  IN>09:(109    )   |
   | OUT<01:(101    )   |    =========  OUTFLOW STORAGE TABLE  =========
   ---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                               (cms)    (ha.m.)    |    (cms)    (ha.m.)
                                .000  .0000E+00    |     .085  .5115E-01

        ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
        --------------------         (ha)     (cms)     (hrs)       (mm)
        INFLOW >09: (109    )        1.05      .242     1.000     40.589
        OUTFLOW<01: (101    )        1.05      .043     1.300     40.589
       OVERFLOW<02: (102    )         .00      .000      .000       .000

                        TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                        CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                        PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                        PEAK   FLOW   REDUCTION [Qout/Qin](%)=   17.866
                        TIME SHIFT OF PEAK FLOW          (min)=    18.00
```

```
                         MAXIMUM  STORAGE   USED       (ha.m.)=.2602E-01

------------------------------------------------------------------------------
001:0020----------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.36
| 03:103    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.23          1.13
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.43         15.38
     Length            (m)=     116.00         13.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         46.47
                over (min)        3.00          5.00
     Storage Coeff.  (min)=       2.70 (ii)     5.01 (ii)
     Unit Hyd. Tpeak (min)=       3.00          5.00
     Unit Hyd. peak  (cms)=        .40           .23
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .75           .11             .858 (iii)
     TIME TO PEAK    (hrs)=       1.00          1.02            1.000
     RUNOFF VOLUME    (mm)=      40.91          8.82           32.566
     TOTAL RAINFALL   (mm)=      42.48         42.48           42.480
     RUNOFF COEFFICIENT   =        .96           .21             .767

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
001:0021----------------------------------------------------------------------
*
-------------------------
| ADD HYD (104       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101            1.05      .043    1.30  40.59    .000
                    +ID2 02:102             .00      .000     .00    .00    .000  **DRY**
                    +ID3 03:103            4.36      .858    1.00  32.57    .000
                     =========================================================
                     SUM 04:104            5.41      .893    1.00  34.12    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
001:0022----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.14
| 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.13           .01
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n          =        .013          .200
```

```
     Max.eff.Inten.(mm/hr)=      83.56        45.57
                over (min)        2.00         6.00
     Storage Coeff.  (min)=       2.01 (ii)    5.69 (ii)
     Unit Hyd. Tpeak (min)=       2.00         6.00
     Unit Hyd. peak  (cms)=        .56          .20
                                                         *TOTALS*
     PEAK FLOW       (cms)=        .26          .00           .263 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.03          1.000
     RUNOFF VOLUME    (mm)=      40.91         8.82         40.589
     TOTAL RAINFALL   (mm)=      42.48        42.48         42.480
     RUNOFF COEFFICIENT   =        .96          .21           .955

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0023------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(105    )  |
| OUT<06:(106    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .132  .5698E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >05: (105    )       1.14      .263     1.000     40.589
     OUTFLOW<06: (106    )       1.14      .060     1.267     40.589
    OVERFLOW<07: (107    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   22.969
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2600E-01

--------------------------------------------------------------------------------
001:0024------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.97
| 09:109    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.74         3.23
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.00         1.42
     Length            (m)=      57.00        57.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        35.27
                over (min)        2.00        15.00
     Storage Coeff.  (min)=       1.96 (ii)   14.80 (ii)
     Unit Hyd. Tpeak (min)=       2.00        15.00
     Unit Hyd. peak  (cms)=        .57          .08
                                                         *TOTALS*
```

```
     PEAK FLOW       (cms)=       .40          .17           .499 (iii)
     TIME TO PEAK    (hrs)=      1.00         1.17          1.000
     RUNOFF VOLUME    (mm)=     40.91         8.82         20.050
     TOTAL RAINFALL   (mm)=     42.48        42.48         42.480
     RUNOFF COEFFICIENT   =       .96          .21           .472

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

----------------------------------------------------------------------------------------
001:0025--------------------------------------------------------------------------------
*
------------------------
| ADD HYD (101       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106           1.14      .060    1.27  40.59    .000
                    +ID2 07:107            .00      .000     .00    .00    .000   **DRY**
                    +ID3 09:109           4.97      .499    1.00  20.05    .000
                     ==========================================================
                     SUM 01:101           6.11      .550    1.00  23.88    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

----------------------------------------------------------------------------------------
001:0026--------------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.26
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      3.23          .03
     Dep. Storage     (mm)=      1.57         4.67
     Average Slope     (%)=       .50         2.00
     Length            (m)=     42.00        10.00
     Mannings n           =      .013         .200

     Max.eff.Inten.(mm/hr)=     83.56        45.57
                over (min)       2.00         6.00
     Storage Coeff.  (min)=      2.01 (ii)    5.69 (ii)
     Unit Hyd. Tpeak (min)=      2.00         6.00
     Unit Hyd. peak  (cms)=       .56          .20
                                                            *TOTALS*
     PEAK FLOW       (cms)=       .75          .00           .752 (iii)
     TIME TO PEAK    (hrs)=      1.00         1.03          1.000
     RUNOFF VOLUME    (mm)=     40.91         8.82         40.589
     TOTAL RAINFALL   (mm)=     42.48        42.48         42.480
     RUNOFF COEFFICIENT   =       .96          .21           .955

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

----------------------------------------------------------------------------------------
001:0027--------------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
```

```
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .302  .1631E+00

     ROUTING RESULTS                AREA     QPEAK     TPEAK        R.V.
     --------------------           (ha)     (cms)     (hrs)        (mm)
     INFLOW >02: (102    )          3.26      .752     1.000      40.589
     OUTFLOW<03: (103    )          3.26      .146     1.283      40.589
    OVERFLOW<05: (105    )           .00      .000      .000        .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =          0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=        .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=        .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.442
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.7880E-01

--------------------------------------------------------------------------------
001:0028------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    2.40
| 06:106    DT= 1.00 |   Total Imp(%)=   46.00   Dir. Conn.(%)=   46.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.10         1.30
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.92         2.78
     Length            (m)=     130.00       120.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        24.05
                over (min)        3.00        22.00
     Storage Coeff.  (min)=       2.64 (ii)   21.76 (ii)
     Unit Hyd. Tpeak (min)=       3.00        22.00
     Unit Hyd. peak  (cms)=        .41          .05
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .26          .05             .273 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.27            1.000
     RUNOFF VOLUME    (mm)=      40.91         8.82           23.580
     TOTAL RAINFALL   (mm)=      42.48        42.48           42.480
     RUNOFF COEFFICIENT   =        .96          .21             .555

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0029------------------------------------------------------------------------
*
------------------------
| ADD HYD (107       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 03:103           3.26      .146    1.28  40.59    .000
                    +ID2 05:105            .00      .000     .00    .00    .000  **DRY**
                    +ID3 06:106           2.40      .273    1.00  23.58    .000
                     ============================================================
                     SUM 07:107           5.66      .393    1.00  33.38    .000
```

```
   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
001:0030----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.01
| 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=       1.00          .01
     Dep. Storage      (mm)=       1.57         4.67
     Average Slope      (%)=        .50         2.00
     Length             (m)=      42.00        10.00
     Mannings n           =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        45.57
                over (min)        2.00         6.00
     Storage Coeff.  (min)=       2.01 (ii)    5.69 (ii)
     Unit Hyd. Tpeak (min)=       2.00         6.00
     Unit Hyd. peak  (cms)=        .56          .20
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .23          .00            .233 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.03           1.000
     RUNOFF VOLUME    (mm)=      40.91         8.82          40.589
     TOTAL RAINFALL   (mm)=      42.48        42.48          42.480
     RUNOFF COEFFICIENT   =        .96          .21            .955

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
001:0031----------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
|  IN>09:(109    )   |
| OUT<02:(102    )   |    =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .086  .4495E-01

     ROUTING RESULTS              AREA      QPEAK      TPEAK        R.V.
     --------------------         (ha)      (cms)      (hrs)        (mm)
     INFLOW >09: (109    )        1.01       .233      1.000      40.589
     OUTFLOW<02: (102    )        1.01       .046      1.283      40.589
    OVERFLOW<03: (103    )         .00       .000       .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =          0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=        .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=        .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.843
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2426E-01

------------------------------------------------------------------------------
001:0032----------------------------------------------------------------------
```

```
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.43
| 05:105    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.61          1.82
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.89          1.61
     Length            (m)=     103.00         36.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         40.41
                over (min)        2.00         11.00
     Storage Coeff.  (min)=       2.31 (ii)    11.19 (ii)
     Unit Hyd. Tpeak (min)=       2.00         11.00
     Unit Hyd. peak  (cms)=        .51           .10
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .61           .12             .694 (iii)
     TIME TO PEAK    (hrs)=       1.00          1.10            1.000
     RUNOFF VOLUME    (mm)=      40.91          8.82           27.752
     TOTAL RAINFALL   (mm)=      42.48         42.48           42.480
     RUNOFF COEFFICIENT   =        .96           .21             .653

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0033-----------------------------------------------------------------------------
*
------------------------
| ADD HYD (106        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 02:102            1.01      .046    1.28  40.59    .000
                    +ID2 03:103             .00      .000     .00    .00    .000  **DRY**
                    +ID3 05:105            4.43      .694    1.00  27.75    .000
                     ==========================================================
                     SUM 06:106            5.44      .732    1.00  30.14    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0034-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.67
| 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .95           .72
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=     113.00         10.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         44.64
                over (min)        4.00          7.00
     Storage Coeff.  (min)=       3.64 (ii)     7.35 (ii)
     Unit Hyd. Tpeak (min)=       4.00          7.00
```

```
      Unit Hyd. peak  (cms)=        .30          .16
                                                            *TOTALS*
      PEAK FLOW       (cms)=        .22          .06           .272 (iii)
      TIME TO PEAK    (hrs)=       1.00         1.05          1.000
      RUNOFF VOLUME    (mm)=      40.91         8.82         27.111
      TOTAL RAINFALL   (mm)=      42.48        42.48         42.480
      RUNOFF COEFFICIENT   =        .96          .21           .638

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20      Cum.Inf.   (mm)=    .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0035----------------------------------------------------------------------
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>02:(102    )  |
 | OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |      .045  .1920E-01
                             .023  .3000E-03    |      .050  .3360E-01
                             .032  .2300E-02    |      .055  .4700E-01
                             .039  .8200E-02    |      .060  .5480E-01

      ROUTING RESULTS             AREA      QPEAK      TPEAK       R.V.
      --------------------        (ha)      (cms)      (hrs)       (mm)
      INFLOW >02: (102    )       1.67       .272      1.000     27.111
      OUTFLOW<03: (103    )       1.67       .047      1.350     27.111
     OVERFLOW<05: (105    )        .00       .000       .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   17.220
                    TIME SHIFT OF PEAK FLOW         (min)=    21.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2448E-01

 ------------------------------------------------------------------------------
 001:0036----------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (109        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 03:103            1.67      .047    1.35  27.11    .000
                     +ID2 05:105             .00      .000     .00    .00    .000  **DRY**
                      ============================================================
                      SUM 09:109            1.67      .047    1.35  27.11    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0037----------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
 *
 ----------------------
 | CALIB STANDHYD     |    Area    (ha)=    1.03
 | 02:102    DT= 1.00 |    Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .98          .05
      Dep. Storage     (mm)=       1.57         4.67
```

```
      Average Slope     (%)=       3.23         1.24
      Length            (m)=      35.00       200.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=      83.56        11.76
                 over (min)        1.00        45.00
      Storage Coeff.  (min)=       1.03 (ii)   45.09 (ii)
      Unit Hyd. Tpeak (min)=       1.00        45.00
      Unit Hyd. peak  (cms)=       1.06          .03
                                                              *TOTALS*
      PEAK FLOW       (cms)=        .23          .00             .227 (iii)
      TIME TO PEAK    (hrs)=        .98         1.65            1.000
      RUNOFF VOLUME    (mm)=      40.91         8.82           39.305
      TOTAL RAINFALL   (mm)=      42.48        42.48           42.480
      RUNOFF COEFFICIENT   =        .96          .21             .925

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -----------------------------------------------------------------------------------
 001:0038---------------------------------------------------------------------------
 *
 *Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
 *
 ------------------------
 | ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 08:108             9.31      .965     1.00  24.57    .000
                    +ID2 04:104             5.41      .893     1.00  34.12    .000
                    +ID3 01:101             6.11      .550     1.00  23.88    .000
                    +ID4 07:107             5.66      .393     1.00  33.38    .000
                    +ID5 06:106             5.44      .732     1.00  30.14    .000
                    +ID6 09:109             1.67      .047     1.35  27.11    .000
                    +ID7 02:102             1.03      .227     1.00  39.31    .000
                     =======================================================
                     SUM 03:TOTAL          34.63     3.803     1.00  28.82    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -----------------------------------------------------------------------------------
 001:0039---------------------------------------------------------------------------
 *
       FINISH
 -----------------------------------------------------------------------------------
 ***********************************************************************************
      WARNINGS / ERRORS / NOTES
      ------------------------
  001:0005 CALIB STANDHYD
       *** WARNING: For areas with impervious ratios below
                    20%, this routine may not be applicable.
    Simulation ended on 2018-10-19     at 14:50:58
 ===================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
START               TIME = 0.0
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM       IUNITS=[2], TD=[6](hrs), TPRAT=[0.333], CSDT=[15](min)
                    ICASEcs=[1], A=[998.071], B=[6.053], C=[0.814]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.00945,  0.00266]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
```

```
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.096 ,  0.0175 ]
                                  [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
```

```
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.00756,  0.00469]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
```

```
                                        LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7, 8
(south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[4.36](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[1+2+3]
```

```
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                   [   0.0 ,  0.0    ]
                                   [0.13230,  0.05698]
                                   [   -1  ,  -1     ]
                          IDovf=[7], NHYDovf=["107"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[6+7+9]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[3.26](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
```

```
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.30240,  0.16307]
                                    [   -1  ,  -1     ]
                          IDovf=[5], NHYDovf=["105"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[2.40](ha),
                    XIMP=[0.46], TIMP=[0.46], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.78](%),
                                         LGP=[120](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+5+6]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
```

```
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.08562,  0.04495]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[2+3+5]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.023 ,  0.0003 ]
                                  [ 0.032 ,  0.0023 ]
                                  [ 0.039 ,  0.0082 ]
                                  [ 0.045 ,  0.0192 ]
                                  [ 0.050 ,  0.0336 ]
```

```
                                       E5Y6H
                                   [ 0.055 ,  0.0470 ]
                                   [ 0.060 ,  0.0548 ]
                                   [   -1  ,    -1   ]
                         IDovf=[5], NHYDovf=["105"]
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[3+5]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[3], NHYD=["TOTAL"], IDs to add=[8+4+1+7+6+9+2]
*
*%-----------------|------------------------------------------------------------|
FINISH
```

```
================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                       9   9  9   9   # 3573794
        StormWater Management HYdrologic Model          999    999    =========

 *******************************************************************************
 ***************************** SWMHYMO Ver/4.05  ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                   OTTHYMO-83 and OTTHYMO-89.                 *********
 *******************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 *******************************************************************************

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 ++++++++++ Licensed user: Morrison Hershfield Ltd.                    +++++++++
 +++++++++                Ottawa                SERIAL#:3573794        +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 *******************************************************************************
 *********            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *********
 *********            Maximum value for ID numbers  :     10           *********
 *********            Max. number of rainfall points: 105408           *********
 *********            Max. number of flow points    : 105408           *********
 *******************************************************************************


 **********************   D E T A I L E D   O U T P U T   *********************
 *******************************************************************************
 *         DATE: 2018-10-19     TIME: 14:51:31     RUN COUNTER: 000305        *
 *******************************************************************************
 * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E5Y6H.DAT         *
 * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E5Y6H.out         *
 * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E5Y6H.sum         *
 * User comments:                                                             *
 * 1:_________________________________________________________________________*
 * 2:_________________________________________________________________________*
 * 3:_________________________________________________________________________*
 *******************************************************************************

--------------------------------------------------------------------------------
001:0001------------------------------------------------------------------------
*#******************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
*#                              October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#******************************************************************************
*
--------------------
| START             |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
```

```
     TZERO =    .00 hrs on         0
     METOUT=    2 (output = METRIC)
     NRUN  = 001
     NSTORM=    0
 ---------------------------------------------------------------------------------
 001:0002-------------------------------------------------------------------------
 *
 * 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
 *
 --------------------
 | CHICAGO STORM     |     IDF curve parameters: A= 998.071
 | Ptotal= 49.03 mm |                            B=   6.053
 --------------------                            C=    .814
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  6.00 hrs
                         Storm time step    = 15.00 min
                         Time to peak ratio =   .33

              TIME    RAIN |    TIME    RAIN |    TIME    RAIN |    TIME    RAIN
               hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr
               .25   1.872 |    1.75  16.065 |    3.25   4.530 |    4.75   2.236
               .50   2.152 |    2.00  83.557 |    3.50   3.836 |    5.00   2.073
               .75   2.546 |    2.25  21.363 |    3.75   3.337 |    5.25   1.934
              1.00   3.146 |    2.50  10.789 |    4.00   2.962 |    5.50   1.814
              1.25   4.178 |    2.75   7.304 |    4.25   2.668 |    5.75   1.709
              1.50   6.429 |    3.00   5.570 |    4.50   2.431 |    6.00   1.617

 ---------------------------------------------------------------------------------
 001:0003-------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 8: Building Z and Sport Field
 *
 *Total Building Area - Includes Building Z
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=     .05
 | 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .05          .00
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .50         2.00
      Length            (m)=      42.00        10.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=      83.56        49.09
                 over (min)        2.00         6.00
      Storage Coeff.  (min)=       2.01 (ii)    5.58 (ii)
      Unit Hyd. Tpeak (min)=       2.00         6.00
      Unit Hyd. peak  (cms)=        .56          .20
                                                                   *TOTALS*
      PEAK FLOW       (cms)=        .01          .00                  .012 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.02                 2.000
      RUNOFF VOLUME    (mm)=      47.46        10.09                47.086
      TOTAL RAINFALL   (mm)=      49.03        49.03                49.029
      RUNOFF COEFFICIENT   =        .97          .21                  .960

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.    (mm)=    .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------------
 001:0004-------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
```

```
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<02:(102    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .009  .2660E-02

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )         .05      .012     2.000     47.086
     OUTFLOW<02: (102    )         .05      .004     2.100     47.085
    OVERFLOW<03: (103    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =          0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=        .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=        .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.357
                   TIME SHIFT OF PEAK FLOW         (min)=     6.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1051E-02

--------------------------------------------------------------------------------
001:0005------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.60
| 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
----------------------
                                    IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .02          1.58
     Dep. Storage     (mm)=         1.57          4.67
     Average Slope     (%)=         2.03          1.76
     Length            (m)=        37.00         85.00
     Mannings n           =         .013          .200

     Max.eff.Inten.(mm/hr)=        83.56         37.74
                over (min)          1.00         16.00
     Storage Coeff.  (min)=         1.22 (ii)    16.11 (ii)
     Unit Hyd. Tpeak (min)=         1.00         16.00
     Unit Hyd. peak  (cms)=          .95           .07
                                                                *TOTALS*
     PEAK FLOW       (cms)=          .00           .09             .089 (iii)
     TIME TO PEAK    (hrs)=         1.95          2.17            2.167
     RUNOFF VOLUME    (mm)=        47.46         10.09           10.459
     TOTAL RAINFALL   (mm)=        49.03         49.03           49.029
     RUNOFF COEFFICIENT   =          .97           .21             .213
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0006------------------------------------------------------------------------
*
------------------------
| ADD HYD (105       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 02:102            .05      .004    2.10  47.09    .000
                    +ID2 03:103            .00      .000     .00    .00    .000  **DRY**
```

```
                          +ID3 04:104            1.60      .089    2.17  10.46    .000
                           ============================================================
                           SUM 05:105            1.65      .093    2.17  11.57    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------------
 001:0007----------------------------------------------------------------------------
 *
 ----------------------
 | COMPUTE DUALHYD     |   Average inlet capacities   [CINLET] =    .096  (cms)
 | TotalHyd 05:105     |   Number of inlets in system [NINLET] =       1
 ----------------------    Total minor system capacity         =    .096  (cms)
                           Total major system storage [TMJSTO] =      70.(cu.m.)

                      ID: NHYD         AREA      QPEAK      TPEAK     R.V.      DWF
                                       (ha)      (cms)      (hrs)     (mm)     (cms)
      TOTAL HYD.   05:105              1.65       .093      2.167    11.569     .000
      ========================================================================
      MAJOR SYST   06:106               .00       .000       .000      .000     .000
      MINOR SYST   07:107              1.65       .093      2.167    11.569     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

      Maximum MAJOR SYSTEM storage used =       0.(cu.m.)

 ------------------------------------------------------------------------------------
 001:0008----------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 7: North East Parking Lot
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=     .67
 | 08:108    DT= 1.00  |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .60           .07
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=       2.00          4.03
      Length            (m)=      25.00         34.00
      Mannings n          =        .013          .200

      Max.eff.Inten.(mm/hr)=      83.56         48.29
                 over (min)        1.00          7.00
      Storage Coeff.  (min)=        .97 (ii)     7.04 (ii)
      Unit Hyd. Tpeak (min)=       1.00          7.00
      Unit Hyd. peak  (cms)=       1.09           .16
                                                                *TOTALS*
      PEAK FLOW       (cms)=        .14           .01              .146 (iii)
      TIME TO PEAK    (hrs)=       1.98          2.03             2.000
      RUNOFF VOLUME    (mm)=      47.46         10.09            43.722
      TOTAL RAINFALL   (mm)=      49.03         49.03            49.029
      RUNOFF COEFFICIENT   =        .97           .21              .892

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0009----------------------------------------------------------------------------
 *
 *Combine Subcatchments 7 & 8
 *
 ------------------------
 | ADD HYD (109        ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
 ------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
```

```
                          ID1 07:107            1.65      .093     2.17  11.57     .000
                         +ID2 08:108             .67      .146     2.00  43.72     .000
                          ===========================================================
                          SUM 09:109            2.32      .202     2.00  20.85     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0010-----------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .096  .1750E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )        2.32      .202     2.000     20.855
     OUTFLOW<01: (101    )        2.32      .095     2.283     20.855
    OVERFLOW<02: (102    )         .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =          0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=        .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=        .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   46.911
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1724E-01

-------------------------------------------------------------------------------------
001:0011-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.08
| 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        3.05          .03
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=        1.90          .01
     Length            (m)=      140.00        40.00
     Mannings n           =        .013         .200

     Max.eff.Inten.(mm/hr)=       83.56        40.25
                over (min)         3.00        46.00
     Storage Coeff.  (min)=        2.77 (ii)   46.31 (ii)
     Unit Hyd. Tpeak (min)=        3.00        46.00
     Unit Hyd. peak  (cms)=         .40          .02
                                                               *TOTALS*
     PEAK FLOW       (cms)=         .70          .00             .704 (iii)
     TIME TO PEAK    (hrs)=        2.00         2.67            2.000
     RUNOFF VOLUME    (mm)=       47.46        10.09           47.086
     TOTAL RAINFALL   (mm)=       49.03        49.03           49.029
     RUNOFF COEFFICIENT   =         .97          .21             .960

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
 ----------------------------------------------------------------------------
 001:0012--------------------------------------------------------------------
 *
 *Combine Subcatchment 6 and Overflows
 *
 ------------------------
 | ADD HYD (104        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                      ID1 06:106              .00      .000      .00     .00    .000  **DRY**
                     +ID2 02:102              .00      .000      .00     .00    .000  **DRY**
                     +ID3 03:103             3.08      .704     2.00   47.09    .000
                      ============================================================
                      SUM 04:104             3.08      .704     2.00   47.09    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------
 001:0013--------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 5: Building V and Snow Dump
 *
 *Total Building Area - Includes Building V
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=     .09
 | 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                                 IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=         .09           .00
      Dep. Storage     (mm)=        1.57          4.67
      Average Slope     (%)=         .50          2.00
      Length            (m)=       42.00         10.00
      Mannings n          =         .013          .200

      Max.eff.Inten.(mm/hr)=       83.56         49.09
                 over (min)        2.00          6.00
      Storage Coeff.  (min)=        2.01 (ii)     5.58 (ii)
      Unit Hyd. Tpeak (min)=        2.00          6.00
      Unit Hyd. peak  (cms)=         .56           .20
                                                             *TOTALS*
      PEAK FLOW       (cms)=         .02           .00           .021 (iii)
      TIME TO PEAK    (hrs)=        2.00          2.02          2.000
      RUNOFF VOLUME    (mm)=       47.46         10.09         47.086
      TOTAL RAINFALL   (mm)=       49.03         49.03         49.029
      RUNOFF COEFFICIENT   =         .97           .21           .960

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0014--------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
 |  IN>08:(108    )   |
 | OUT<09:(109    )   |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                             (cms)    (ha.m.)    |    (cms)    (ha.m.)
                              .000  .0000E+00    |     .008  .4690E-02

      ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
      --------------------         (ha)     (cms)     (hrs)       (mm)
```

```
      INFLOW >08: (108    )        .09      .021     2.000     47.086
     OUTFLOW<09: (109    )        .09      .004     2.283     47.085
    OVERFLOW<02: (102    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.285
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2356E-02

 --------------------------------------------------------------------------------
 001:0015------------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    3.82
 | 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .76         3.06
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .01         2.04
      Length            (m)=        .01       425.00
      Mannings n          =       .013         .200

      Max.eff.Inten.(mm/hr)=      83.56         9.17
                 over (min)       1.00        66.00
      Storage Coeff.  (min)=        .04 (ii)   65.93 (ii)
      Unit Hyd. Tpeak (min)=       1.00        66.00
      Unit Hyd. peak  (cms)=       1.70          .02
                                                            *TOTALS*
      PEAK FLOW       (cms)=        .18          .05           .183 (iii)
      TIME TO PEAK    (hrs)=       1.77         3.00          2.000
      RUNOFF VOLUME    (mm)=      47.46        10.09         17.560
      TOTAL RAINFALL   (mm)=      49.03        49.03         49.029
      RUNOFF COEFFICIENT   =        .97          .21           .358

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0016------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (105      ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 09:109            .09      .004    2.28  47.09    .000
                    +ID2 02:102            .00      .000     .00    .00    .000  **DRY**
                    +ID3 03:103           3.82      .183    2.00  17.56    .000
                     ============================================================
                     SUM 05:105           3.91      .186    2.00  18.24    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0017------------------------------------------------------------------------
 *
 *Combine Subcatchments 5, 6, 7 & 8
 *
 ------------------------
 | ADD HYD (108      ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
```

```
-----------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                    ID1 01:101            2.32      .095    2.28  20.85    .000
                   +ID2 04:104            3.08      .704    2.00  47.09    .000
                   +ID3 05:105            3.91      .186    2.00  18.24    .000
                    ============================================================
                    SUM 08:108            9.31      .961    2.00  28.43    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0018------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7,
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=    1.05
| 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.04          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        49.09
                over (min)        2.00         6.00
     Storage Coeff.  (min)=       2.01 (ii)    5.58 (ii)
     Unit Hyd. Tpeak (min)=       2.00         6.00
     Unit Hyd. peak  (cms)=        .56          .20
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .24          .00           .242 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.02          2.000
     RUNOFF VOLUME    (mm)=      47.46        10.09         47.086
     TOTAL RAINFALL   (mm)=      49.03        49.03         49.029
     RUNOFF COEFFICIENT   =        .97          .21           .960

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0019------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
--------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTFLOW STORAGE TABLE  =========
--------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .085  .5115E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )        1.05      .242     2.000     47.086
     OUTFLOW<01: (101    )        1.05      .045     2.283     47.086
    OVERFLOW<02: (102    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00

```

```

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.727
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2728E-01

 --------------------------------------------------------------------------------
 001:0020------------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    4.36
 | 03:103    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       3.23         1.13
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=       1.43        15.38
      Length            (m)=     116.00        13.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=      83.56        49.86
                 over (min)        3.00         5.00
      Storage Coeff.  (min)=       2.70 (ii)    4.95 (ii)
      Unit Hyd. Tpeak (min)=       3.00         5.00
      Unit Hyd. peak  (cms)=        .40          .23
                                                                *TOTALS*
      PEAK FLOW       (cms)=        .75          .13               .871 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.02              2.000
      RUNOFF VOLUME    (mm)=      47.46        10.09             37.742
      TOTAL RAINFALL   (mm)=      49.03        49.03             49.029
      RUNOFF COEFFICIENT   =        .97          .21               .770

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0021------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (104       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 01:101            1.05      .045    2.28  47.09    .000
                     +ID2 02:102             .00      .000     .00    .00    .000  **DRY**
                     +ID3 03:103            4.36      .871    2.00  37.74    .000
                      ==========================================================
                      SUM 04:104            5.41      .909    2.00  39.56    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0022------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 1: Building B, K, M & T
 *
 *Total Building Area - Includes Building B, K, M & T
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.14
 | 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       1.13          .01
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .50         2.00
```

```
    Length              (m)=      42.00         10.00
    Mannings n            =        .013          .200

    Max.eff.Inten.(mm/hr)=      83.56         49.09
               over (min)        2.00          6.00
    Storage Coeff.  (min)=       2.01 (ii)     5.58 (ii)
    Unit Hyd. Tpeak (min)=       2.00          6.00
    Unit Hyd. peak  (cms)=        .56           .20
                                                            *TOTALS*
    PEAK FLOW       (cms)=        .26           .00            .263 (iii)
    TIME TO PEAK    (hrs)=       2.00          2.02           2.000
    RUNOFF VOLUME    (mm)=      47.46         10.09          47.086
    TOTAL RAINFALL   (mm)=      49.03         49.03          49.029
    RUNOFF COEFFICIENT   =        .97           .21            .960

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
           Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0023---------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(105    )  |
| OUT<06:(106    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .132  .5698E-01

    ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
    --------------------        (ha)     (cms)     (hrs)       (mm)
    INFLOW >05: (105    )       1.14      .263     2.000     47.086
    OUTFLOW<06: (106    )       1.14      .063     2.267     47.086
   OVERFLOW<07: (107    )        .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   23.899
                  TIME SHIFT OF PEAK FLOW         (min)=    16.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.2707E-01

-----------------------------------------------------------------------------
001:0024---------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.97
| 09:109    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=       1.74          3.23
    Dep. Storage     (mm)=       1.57          4.67
    Average Slope     (%)=       1.00          1.42
    Length            (m)=      57.00         57.00
    Mannings n          =        .013          .200

    Max.eff.Inten.(mm/hr)=      83.56         41.44
               over (min)        2.00         14.00
    Storage Coeff.  (min)=       1.96 (ii)    13.99 (ii)
```

```
    Unit Hyd. Tpeak (min)=       2.00         14.00
    Unit Hyd. peak  (cms)=        .57           .08
                                                          *TOTALS*
    PEAK FLOW       (cms)=        .40           .20           .532 (iii)
    TIME TO PEAK    (hrs)=       2.00          2.13          2.000
    RUNOFF VOLUME    (mm)=      47.46         10.09         23.167
    TOTAL RAINFALL   (mm)=      49.03         49.03         49.029
    RUNOFF COEFFICIENT   =        .97           .21           .473

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
           Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0025---------------------------------------------------------------------
*
------------------------
| ADD HYD (101        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106            1.14      .063    2.27  47.09    .000
                    +ID2 07:107             .00      .000     .00    .00    .000  **DRY**
                    +ID3 09:109            4.97      .532    2.00  23.17    .000
                     ============================================================
                     SUM 01:101            6.11      .586    2.00  27.63    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0026---------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.26
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=       3.23           .03
    Dep. Storage     (mm)=       1.57          4.67
    Average Slope     (%)=        .50          2.00
    Length            (m)=      42.00         10.00
    Mannings n           =       .013          .200

    Max.eff.Inten.(mm/hr)=      83.56         49.09
               over (min)        2.00          6.00
    Storage Coeff.  (min)=       2.01 (ii)     5.58 (ii)
    Unit Hyd. Tpeak (min)=       2.00          6.00
    Unit Hyd. peak  (cms)=        .56           .20
                                                          *TOTALS*
    PEAK FLOW       (cms)=        .75           .00           .752 (iii)
    TIME TO PEAK    (hrs)=       2.00          2.02          2.000
    RUNOFF VOLUME    (mm)=      47.46         10.09         47.086
    TOTAL RAINFALL   (mm)=      49.03         49.03         49.029
    RUNOFF COEFFICIENT   =        .97           .21           .960

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
           Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0027---------------------------------------------------------------------
```

```
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>02:(102    )   |
| OUT<03:(103    )   |    =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |      .302  .1631E+00

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )        3.26      .752     2.000     47.086
     OUTFLOW<03: (103    )        3.26      .153     2.283     47.086
    OVERFLOW<05: (105    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.331
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.8247E-01

-------------------------------------------------------------------------------
001:0028-----------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots and Roads
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=    2.40
| 06:106    DT= 1.00 |   Total Imp(%)=   46.00   Dir. Conn.(%)=   46.00
---------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.10          1.30
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.92          2.78
     Length            (m)=     130.00        120.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         30.19
                over (min)        3.00         20.00
     Storage Coeff.  (min)=       2.64 (ii)    20.10 (ii)
     Unit Hyd. Tpeak (min)=       3.00         20.00
     Unit Hyd. peak  (cms)=        .41           .06
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .26           .06            .281 (iii)
     TIME TO PEAK    (hrs)=       2.00          2.23           2.000
     RUNOFF VOLUME    (mm)=      47.46         10.09          27.278
     TOTAL RAINFALL   (mm)=      49.03         49.03          49.029
     RUNOFF COEFFICIENT   =        .97           .21            .556

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0029-----------------------------------------------------------------------
*
------------------------
| ADD HYD (107       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 03:103          3.26      .153     2.28  47.09    .000
                    +ID2 05:105           .00      .000      .00    .00    .000  **DRY**
                    +ID3 06:106          2.40      .281     2.00  27.28    .000
```

```
                        ============================================================
                        SUM 07:107            5.66     .409    2.00  38.69    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0030------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.01
| 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.00          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        49.09
                over (min)        2.00         6.00
     Storage Coeff.  (min)=       2.01 (ii)    5.58 (ii)
     Unit Hyd. Tpeak (min)=       2.00         6.00
     Unit Hyd. peak  (cms)=        .56          .20
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .23          .00            .233 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.02           2.000
     RUNOFF VOLUME    (mm)=      47.46        10.09          47.086
     TOTAL RAINFALL   (mm)=      49.03        49.03          49.029
     RUNOFF COEFFICIENT   =        .97          .21            .960

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0031------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<02:(102    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .086  .4495E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )      1.01      .233     2.000     47.086
     OUTFLOW<02: (102    )      1.01      .048     2.283     47.086
    OVERFLOW<03: (103    )       .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.737
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2537E-01
```

```

--------------------------------------------------------------------------------
001:0032------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.43
| 05:105    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.61          1.82
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.89          1.61
     Length            (m)=     103.00         36.00
     Mannings n          =       .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         44.66
                over (min)        2.00         11.00
     Storage Coeff.  (min)=       2.31 (ii)    10.85 (ii)
     Unit Hyd. Tpeak (min)=       2.00         11.00
     Unit Hyd. peak  (cms)=        .51           .10
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .61           .13           .711 (iii)
     TIME TO PEAK    (hrs)=       2.00          2.10          2.000
     RUNOFF VOLUME    (mm)=      47.46         10.09         32.136
     TOTAL RAINFALL   (mm)=      49.03         49.03         49.029
     RUNOFF COEFFICIENT   =        .97           .21           .655

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0033------------------------------------------------------------------------
*
------------------------
| ADD HYD (106       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 02:102           1.01      .048    2.28  47.09    .000
                    +ID2 03:103            .00      .000     .00    .00    .000   **DRY**
                    +ID3 05:105           4.43      .711    2.00  32.14    .000
                     ============================================================
                     SUM 06:106           5.44      .752    2.00  34.91    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0034------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.67
| 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .95           .72
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=     113.00         10.00
     Mannings n          =       .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         48.29
```

```
                 over (min)        4.00         7.00
      Storage Coeff.  (min)=       3.64 (ii)    7.23 (ii)
      Unit Hyd. Tpeak (min)=       4.00         7.00
      Unit Hyd. peak  (cms)=        .30          .16
                                                               *TOTALS*
      PEAK FLOW       (cms)=        .22          .07              .280 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.03             2.000
      RUNOFF VOLUME    (mm)=      47.46        10.09            31.389
      TOTAL RAINFALL   (mm)=      49.03        49.03            49.029
      RUNOFF COEFFICIENT   =        .97          .21              .640

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0035------------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .045  .1920E-01
                            .023  .3000E-03    |     .050  .3360E-01
                            .032  .2300E-02    |     .055  .4700E-01
                            .039  .8200E-02    |     .060  .5480E-01

      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
      --------------------       (ha)     (cms)     (hrs)       (mm)
      INFLOW >02: (102    )       1.67      .280     2.000     31.389
      OUTFLOW<03: (103    )       1.67      .047     2.350     31.389
     OVERFLOW<05: (105    )        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   16.821
                    TIME SHIFT OF PEAK FLOW         (min)=    21.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2533E-01

--------------------------------------------------------------------------------
001:0036------------------------------------------------------------------------
*
------------------------
| ADD HYD (109       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 03:103           1.67      .047    2.35  31.39    .000
                     +ID2 05:105            .00      .000     .00    .00    .000  **DRY**
                      ============================================================
                      SUM 09:109           1.67      .047    2.35  31.39    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0037------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.03
| 02:102    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
```

```
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .98          .05
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=        3.23         1.24
     Length            (m)=       35.00       200.00
     Mannings n          =         .013         .200

     Max.eff.Inten.(mm/hr)=       83.56        14.76
                over (min)         1.00        41.00
     Storage Coeff.  (min)=        1.03 (ii)   41.26 (ii)
     Unit Hyd. Tpeak (min)=        1.00        41.00
     Unit Hyd. peak  (cms)=        1.06          .03
                                                            *TOTALS*
     PEAK FLOW       (cms)=         .23          .00           .227 (iii)
     TIME TO PEAK    (hrs)=        2.00         2.58          2.000
     RUNOFF VOLUME    (mm)=       47.46        10.09         45.591
     TOTAL RAINFALL   (mm)=       49.03        49.03         49.029
     RUNOFF COEFFICIENT   =         .97          .21           .930

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0038------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                    ID1 08:108             9.31     .961    2.00  28.43    .000
                   +ID2 04:104             5.41     .909    2.00  39.56    .000
                   +ID3 01:101             6.11     .586    2.00  27.63    .000
                   +ID4 07:107             5.66     .409    2.00  38.69    .000
                   +ID5 06:106             5.44     .752    2.00  34.91    .000
                   +ID6 09:109             1.67     .047    2.35  31.39    .000
                   +ID7 02:102             1.03     .227    2.00  45.59    .000
                    ==========================================================
                    SUM 03:TOTAL          34.63    3.886    2.00  33.38    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0039------------------------------------------------------------------------
*
      FINISH
--------------------------------------------------------------------------------
********************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 14:51:33
================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
START               TIME = 0.0
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM       IUNITS=[2], TD=[12](hrs), TPRAT=[0.333], CSDT=[15](min)
                    ICASEcs=[1], A=[998.071], B=[6.053], C=[0.814]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.00945,  0.00266]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
```

```
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.096 ,  0.0175 ]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
```

```
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.00756,  0.00469]
                                  [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
```

```
                                   LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7, 8
(south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[4.36](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[1+2+3]
```

```
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.13230,  0.05698]
                                    [   -1  ,  -1     ]
                          IDovf=[7], NHYDovf=["107"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[6+7+9]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[3.26](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
```

```
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.30240,  0.16307]
                                    [   -1  ,  -1     ]
                          IDovf=[5], NHYDovf=["105"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[2.40](ha),
                    XIMP=[0.46], TIMP=[0.46], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.78](%),
                                         LGP=[120](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+5+6]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
```

```
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.08562,  0.04495]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[2+3+5]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.023 ,  0.0003 ]
                                  [ 0.032 ,  0.0023 ]
                                  [ 0.039 ,  0.0082 ]
                                  [ 0.045 ,  0.0192 ]
                                  [ 0.050 ,  0.0336 ]
```

```
                                       E5Y12H
                                    [ 0.055 ,  0.0470 ]
                                    [ 0.060 ,  0.0548 ]
                                    [   -1  ,    -1   ]
                          IDovf=[5], NHYDovf=["105"]
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[3+5]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[3], NHYD=["TOTAL"], IDs to add=[8+4+1+7+6+9+2]
*
*%-----------------|-----------------------------------------------------------|
FINISH
```

```
==================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                       9   9  9   9   # 3573794
        StormWater Management HYdrologic Model          999    999    =========

 ********************************************************************************
 ***************************** SWMHYMO Ver/4.05  ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                OTTHYMO-83 and OTTHYMO-89.                   *********
 ********************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ********************************************************************************

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Morrison Hershfield Ltd.                     +++++++++
 +++++++++                Ottawa                SERIAL#:3573794        +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ********************************************************************************
 *********             ++++++ PROGRAM ARRAY DIMENSIONS ++++++          *********
 *********             Maximum value for ID numbers  :     10          *********
 *********             Max. number of rainfall points: 105408          *********
 *********             Max. number of flow points    : 105408          *********
 ********************************************************************************


 **********************   D E T A I L E D   O U T P U T   *********************
 ********************************************************************************
 *         DATE: 2018-10-19     TIME: 14:51:43     RUN COUNTER: 000306          *
 ********************************************************************************
 * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E5Y12H.DAT          *
 * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E5Y12H.out          *
 * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E5Y12H.sum          *
 * User comments:                                                               *
 * 1:___________________________________________________________________________*
 * 2:___________________________________________________________________________*
 * 3:___________________________________________________________________________*
 ********************************************************************************

----------------------------------------------------------------------------------
001:0001--------------------------------------------------------------------------
*#*******************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
*#                              October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*******************************************************************************
*
--------------------
| START             |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
```

```
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
------------------------------------------------------------------------------------------
001:0002----------------------------------------------------------------------------------
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 998.071
| Ptotal= 56.17 mm |                          B=   6.053
--------------------                          C=    .814
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 12.00 hrs
                        Storm time step    = 15.00 min
                        Time to peak ratio =   .33

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .25    .961 |   3.25   4.178 |   6.25   2.668 |   9.25   1.282
               .50   1.020 |   3.50   6.429 |   6.50   2.431 |   9.50   1.232
               .75   1.087 |   3.75  16.065 |   6.75   2.236 |   9.75   1.187
              1.00   1.165 |   4.00  83.557 |   7.00   2.073 |  10.00   1.145
              1.25   1.256 |   4.25  21.363 |   7.25   1.934 |  10.25   1.106
              1.50   1.364 |   4.50  10.789 |   7.50   1.814 |  10.50   1.070
              1.75   1.497 |   4.75   7.304 |   7.75   1.709 |  10.75   1.037
              2.00   1.661 |   5.00   5.570 |   8.00   1.617 |  11.00   1.006
              2.25   1.872 |   5.25   4.530 |   8.25   1.535 |  11.25    .976
              2.50   2.152 |   5.50   3.836 |   8.50   1.462 |  11.50    .949
              2.75   2.546 |   5.75   3.337 |   8.75   1.396 |  11.75    .923
              3.00   3.146 |   6.00   2.962 |   9.00   1.336 |  12.00    .899

------------------------------------------------------------------------------------------
001:0003----------------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        52.62
                over (min)        2.00         5.00
     Storage Coeff.  (min)=       2.01 (ii)    5.48 (ii)
     Unit Hyd. Tpeak (min)=       2.00         5.00
     Unit Hyd. peak  (cms)=        .56          .21
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .01          .00             .012 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.02            4.000
     RUNOFF VOLUME    (mm)=      54.60        11.19           54.164
     TOTAL RAINFALL   (mm)=      56.17        56.17           56.168
     RUNOFF COEFFICIENT   =        .97          .20             .964

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
```

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

-------------------------------------------------------------------------------
001:0004-----------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
--------------------
| ROUTE RESERVOIR  |    Requested routing time step =  1.0 min.
|  IN>01:(101    ) |
| OUT<02:(102    ) |    =========  OUTLFOW STORAGE TABLE  =========
--------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                           .000  .0000E+00   |     .009  .2660E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )       .05      .012     4.000     54.164
     OUTFLOW<02: (102    )       .05      .004     4.083     54.163
    OVERFLOW<03: (103    )       .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.721
                   TIME SHIFT OF PEAK FLOW         (min)=     5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1064E-02

-------------------------------------------------------------------------------
001:0005-----------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
---------------------
| CALIB STANDHYD    |   Area    (ha)=    1.60
| 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02         1.58
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.03         1.76
     Length            (m)=      37.00        85.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        44.30
                over (min)        1.00        15.00
     Storage Coeff.  (min)=       1.22 (ii)   15.19 (ii)
     Unit Hyd. Tpeak (min)=       1.00        15.00
     Unit Hyd. peak  (cms)=        .95          .07
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .00          .10           .102 (iii)
     TIME TO PEAK    (hrs)=       3.97         4.15          4.150
     RUNOFF VOLUME    (mm)=      54.60        11.19         11.620
     TOTAL RAINFALL   (mm)=      56.17        56.17         56.168
     RUNOFF COEFFICIENT   =        .97          .20           .207
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0006-----------------------------------------------------------------------
```

```
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 02:102             .05      .004     4.08  54.16    .000
                    +ID2 03:103             .00      .000      .00    .00    .000   **DRY**
                    +ID3 04:104            1.60      .102     4.15  11.62    .000
                     ==========================================================
                     SUM 05:105            1.65      .106     4.15  12.91    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0007----------------------------------------------------------------------------
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .096  (cms)
| TotalHyd 05:105    |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity          =    .096  (cms)
                         Total major system storage [TMJSTO] =      70.(cu.m.)

                  ID: NHYD         AREA     QPEAK     TPEAK     R.V.      DWF
                                   (ha)     (cms)     (hrs)     (mm)     (cms)
     TOTAL HYD.   05:105           1.65      .106     4.150    12.909     .000
     ======================================================================
     MAJOR SYST   06:106            .00      .000      .000      .000     .000
     MINOR SYST   07:107           1.65      .096     4.083    12.937     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

     Maximum MAJOR SYSTEM storage used =       4.(cu.m.)

------------------------------------------------------------------------------------
001:0008----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .67
| 08:108    DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .60          .07
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.00         4.03
     Length            (m)=      25.00        34.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        51.26
                over (min)        1.00         7.00
     Storage Coeff.  (min)=        .97 (ii)     6.90 (ii)
     Unit Hyd. Tpeak (min)=       1.00         7.00
     Unit Hyd. peak  (cms)=       1.09          .16
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .14          .01           .147 (iii)
     TIME TO PEAK    (hrs)=       3.98         4.03          4.000
     RUNOFF VOLUME    (mm)=      54.60        11.19         50.256
     TOTAL RAINFALL   (mm)=      56.17        56.17         56.168
     RUNOFF COEFFICIENT   =        .97          .20           .895

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0009----------------------------------------------------------------------------
```

```
*
*Combine Subcatchments 7 & 8
*
------------------------
| ADD HYD (109        ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                   (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 07:107             1.65      .096     4.08   12.94     .000
                    +ID2 08:108              .67      .147     4.00   50.26     .000
                     ============================================================
                     SUM 09:109             2.32      .216     4.00   23.71     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0010-----------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .096  .1750E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )        2.32      .216     4.000     23.715
     OUTFLOW<01: (101    )        2.27      .096     4.217     23.715
    OVERFLOW<02: (102    )         .05      .038     4.217     23.715

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        1
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .10
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .55


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   44.419
                   TIME SHIFT OF PEAK FLOW         (min)=    13.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1748E-01

-------------------------------------------------------------------------------------
001:0011-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.08
| 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        3.05          .03
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=        1.90          .01
     Length            (m)=      140.00        40.00
     Mannings n           =        .013         .200

     Max.eff.Inten.(mm/hr)=       83.56        44.30
                over (min)         3.00        45.00
     Storage Coeff.  (min)=        2.77 (ii)   44.67 (ii)
     Unit Hyd. Tpeak (min)=        3.00        45.00
     Unit Hyd. peak  (cms)=         .40          .03
                                                              *TOTALS*
     PEAK FLOW       (cms)=         .70          .00             .704 (iii)
     TIME TO PEAK    (hrs)=        4.00         4.63            4.000
     RUNOFF VOLUME    (mm)=       54.60        11.19           54.164
     TOTAL RAINFALL   (mm)=       56.17        56.17           56.168
     RUNOFF COEFFICIENT   =         .97          .20             .964
```

```
        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0012----------------------------------------------------------------------------
*
*Combine Subcatchment 6 and Overflows
*
------------------------
| ADD HYD (104        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106             .00      .000     .00    .00    .000  **DRY**
                    +ID2 02:102             .05      .038    4.22  23.71    .000
                    +ID3 03:103            3.08      .704    4.00  54.16    .000
                     ============================================================
                     SUM 04:104            3.13      .704    4.00  53.70    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0013----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .09
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09           .00
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         52.62
                over (min)        2.00          5.00
     Storage Coeff.  (min)=       2.01 (ii)     5.48 (ii)
     Unit Hyd. Tpeak (min)=       2.00          5.00
     Unit Hyd. peak  (cms)=        .56           .21
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .02           .00             .021 (iii)
     TIME TO PEAK    (hrs)=       4.00          4.02            4.000
     RUNOFF VOLUME    (mm)=      54.60         11.19           54.163
     TOTAL RAINFALL   (mm)=      56.17         56.17           56.168
     RUNOFF COEFFICIENT   =        .97           .20             .964

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0014----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )   |
| OUT<09:(109    )   |    =========  OUTFLOW STORAGE TABLE  =========
```

```
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)    |   (cms)    (ha.m.)
                           .000  .0000E+00    |    .008  .4690E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )       .09      .021     4.000     54.163
     OUTFLOW<09: (109    )       .09      .004     4.283     54.163
    OVERFLOW<02: (102    )       .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.803
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2423E-02

--------------------------------------------------------------------------------------
001:0015------------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.82
| 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .76         3.06
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .01         2.04
     Length            (m)=        .01       425.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        11.00
                over (min)        1.00        61.00
     Storage Coeff.  (min)=        .04 (ii)   61.30 (ii)
     Unit Hyd. Tpeak (min)=       1.00        61.00
     Unit Hyd. peak  (cms)=       1.70          .02
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .18          .06             .185 (iii)
     TIME TO PEAK    (hrs)=       3.77         4.90            4.000
     RUNOFF VOLUME    (mm)=      54.60        11.19           19.868
     TOTAL RAINFALL   (mm)=      56.17        56.17           56.168
     RUNOFF COEFFICIENT   =        .97          .20             .354

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------------
001:0016------------------------------------------------------------------------------
*
------------------------
| ADD HYD (105       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 09:109            .09      .004     4.28  54.16    .000
                    +ID2 02:102            .00      .000      .00    .00    .000  **DRY**
                    +ID3 03:103           3.82      .185     4.00  19.87    .000
                     ============================================================
                     SUM 05:105           3.91      .188     4.00  20.66    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------------
```

```
001:0017------------------------------------------------------------------------
*
*Combine Subcatchments 5, 6, 7 & 8
*
------------------------
| ADD HYD (108       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101            2.27      .096    4.22  23.71    .000
                    +ID2 04:104            3.13      .704    4.00  53.70    .000
                    +ID3 05:105            3.91      .188    4.00  20.66    .000
                     =========================================================
                     SUM 08:108            9.31      .966    4.00  32.50    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0018------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7,
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.05
| 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.04           .01
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         52.62
                over (min)        2.00          5.00
     Storage Coeff.  (min)=       2.01 (ii)     5.48 (ii)
     Unit Hyd. Tpeak (min)=       2.00          5.00
     Unit Hyd. peak  (cms)=        .56           .21
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .24           .00              .242 (iii)
     TIME TO PEAK    (hrs)=       4.00          4.02             4.000
     RUNOFF VOLUME    (mm)=      54.60         11.19            54.164
     TOTAL RAINFALL   (mm)=      56.17         56.17            56.168
     RUNOFF COEFFICIENT   =        .97           .20              .964

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0019------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .085  .5115E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )        1.05      .242     4.000     54.164
     OUTFLOW<01: (101    )        1.05      .047     4.283     54.163
```

```
    OVERFLOW<02: (102   )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.241
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2804E-01

--------------------------------------------------------------------------------
001:0020------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.36
| 03:103    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.23          1.13
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.43         15.38
     Length            (m)=     116.00         13.00
     Mannings n          =       .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         52.62
                over (min)        3.00          5.00
     Storage Coeff.  (min)=       2.70 (ii)     4.90 (ii)
     Unit Hyd. Tpeak (min)=       3.00          5.00
     Unit Hyd. peak  (cms)=        .40           .23
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .75           .14           .882 (iii)
     TIME TO PEAK    (hrs)=       4.00          4.02          4.000
     RUNOFF VOLUME    (mm)=      54.60         11.19         43.311
     TOTAL RAINFALL   (mm)=      56.17         56.17         56.168
     RUNOFF COEFFICIENT   =        .97           .20           .771

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0021------------------------------------------------------------------------
*
------------------------
| ADD HYD (104       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101           1.05      .047    4.28  54.16    .000
                    +ID2 02:102            .00      .000     .00    .00    .000  **DRY**
                    +ID3 03:103           4.36      .882    4.00  43.31    .000
                     ============================================================
                     SUM 04:104           5.41      .921    4.00  45.42    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0022------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.14
```

```
| 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.13           .01
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=         .50          2.00
     Length            (m)=       42.00         10.00
     Mannings n          =         .013          .200

     Max.eff.Inten.(mm/hr)=       83.56         52.62
                over (min)         2.00          5.00
     Storage Coeff.  (min)=        2.01 (ii)     5.48 (ii)
     Unit Hyd. Tpeak (min)=        2.00          5.00
     Unit Hyd. peak  (cms)=         .56           .21
                                                                *TOTALS*
     PEAK FLOW       (cms)=         .26           .00             .263 (iii)
     TIME TO PEAK    (hrs)=        4.00          4.02            4.000
     RUNOFF VOLUME    (mm)=       54.60         11.19           54.163
     TOTAL RAINFALL   (mm)=       56.17         56.17           56.168
     RUNOFF COEFFICIENT   =         .97           .20             .964

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0023-----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(105    )  |
| OUT<06:(106    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .132  .5698E-01

     ROUTING RESULTS              AREA      QPEAK      TPEAK        R.V.
     --------------------         (ha)      (cms)      (hrs)        (mm)
     INFLOW >05: (105    )        1.14       .263      4.000      54.163
     OUTFLOW<06: (106    )        1.14       .064      4.267      54.163
    OVERFLOW<07: (107    )         .00       .000       .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   24.349
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2760E-01

-------------------------------------------------------------------------------------
001:0024-----------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.97
| 09:109    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.74          3.23
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        1.00          1.42
```

```
      Length             (m)=      57.00         57.00
      Mannings n           =        .013          .200

      Max.eff.Inten.(mm/hr)=      83.56         45.33
                 over (min)        2.00         14.00
      Storage Coeff.  (min)=       1.96 (ii)    13.57 (ii)
      Unit Hyd. Tpeak (min)=       2.00         14.00
      Unit Hyd. peak  (cms)=        .57           .08
                                                               *TOTALS*
      PEAK FLOW       (cms)=        .40           .22             .552 (iii)
      TIME TO PEAK    (hrs)=       4.00          4.13            4.000
      RUNOFF VOLUME    (mm)=      54.60         11.19           26.380
      TOTAL RAINFALL   (mm)=      56.17         56.17           56.168
      RUNOFF COEFFICIENT   =        .97           .20             .470

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -------------------------------------------------------------------------------------
 001:0025-----------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (101        ) | ID: NHYD          AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                    (ha)     (cms)    (hrs)   (mm)   (cms)
                      ID1 06:106             1.14      .064     4.27  54.16    .000
                     +ID2 07:107              .00      .000      .00    .00    .000   **DRY**
                     +ID3 09:109             4.97      .552     4.00  26.38    .000
                      ============================================================
                      SUM 01:101             6.11      .608     4.00  31.56    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------------
 001:0026-----------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 2: Building A, C, D, H & J
 *
 *Total Building Area - Includes Building A, C, D, H & J
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    3.26
 | 02:102    DT= 1.00  |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       3.23           .03
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=        .50          2.00
      Length            (m)=      42.00         10.00
      Mannings n          =        .013          .200

      Max.eff.Inten.(mm/hr)=      83.56         52.62
                 over (min)        2.00          5.00
      Storage Coeff.  (min)=       2.01 (ii)     5.48 (ii)
      Unit Hyd. Tpeak (min)=       2.00          5.00
      Unit Hyd. peak  (cms)=        .56           .21
                                                               *TOTALS*
      PEAK FLOW       (cms)=        .75           .00             .752 (iii)
      TIME TO PEAK    (hrs)=       4.00          4.02            4.000
      RUNOFF VOLUME    (mm)=      54.60         11.19           54.164
      TOTAL RAINFALL   (mm)=      56.17         56.17           56.168
      RUNOFF COEFFICIENT   =        .97           .20             .964

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
```

```
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0027------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .302  .1631E+00

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )       3.26      .752     4.000     54.164
     OUTFLOW<03: (103    )       3.26      .157     4.283     54.163
    OVERFLOW<05: (105    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.829
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.8455E-01

--------------------------------------------------------------------------------
001:0028------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    2.40
| 06:106    DT= 1.00 |   Total Imp(%)=   46.00   Dir. Conn.(%)=   46.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.10         1.30
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.92         2.78
     Length            (m)=     130.00       120.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        34.98
                over (min)        3.00        19.00
     Storage Coeff.  (min)=       2.64 (ii)   19.10 (ii)
     Unit Hyd. Tpeak (min)=       3.00        19.00
     Unit Hyd. peak  (cms)=        .41          .06
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .26          .07            .287 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.22           4.000
     RUNOFF VOLUME    (mm)=      54.60        11.19          31.155
     TOTAL RAINFALL   (mm)=      56.17        56.17          56.168
     RUNOFF COEFFICIENT   =        .97          .20            .555

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0029------------------------------------------------------------------------
*
```

```
------------------------
| ADD HYD (107        ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 03:103           3.26      .157     4.28   54.16     .000
                    +ID2 05:105            .00      .000      .00     .00     .000   **DRY**
                    +ID3 06:106           2.40      .287     4.00   31.16     .000
                     ============================================================
                     SUM 07:107           5.66      .420     4.00   44.41     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0030----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.01
| 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.00          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        52.62
                over (min)        2.00         5.00
     Storage Coeff.  (min)=       2.01 (ii)    5.48 (ii)
     Unit Hyd. Tpeak (min)=       2.00         5.00
     Unit Hyd. peak  (cms)=        .56          .21
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .23          .00            .233 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.02           4.000
     RUNOFF VOLUME    (mm)=      54.60        11.19          54.163
     TOTAL RAINFALL   (mm)=      56.17        56.17          56.168
     RUNOFF COEFFICIENT   =        .97          .20            .964

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20      Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0031----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>09:(109    )   |
| OUT<02:(102    )   |    =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE  |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)  |    (cms)    (ha.m.)
                             .000  .0000E+00  |     .086  .4495E-01

     ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
     --------------------          (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )         1.01      .233     4.000     54.163
     OUTFLOW<02: (102    )         1.01      .049     4.283     54.163
    OVERFLOW<03: (103    )          .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =          0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=        .00
```

```
                      PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                      PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.230
                      TIME SHIFT OF PEAK FLOW         (min)=    17.00
                      MAXIMUM  STORAGE   USED       (ha.m.)=.2600E-01

------------------------------------------------------------------------------------
001:0032----------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.43
| 05:105    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.61         1.82
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.89         1.61
     Length            (m)=     103.00        36.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        48.12
                over (min)        2.00        11.00
     Storage Coeff.  (min)=       2.31 (ii)   10.60 (ii)
     Unit Hyd. Tpeak (min)=       2.00        11.00
     Unit Hyd. peak  (cms)=        .51          .11
                                                                 *TOTALS*
     PEAK FLOW       (cms)=        .61          .15                .725 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.08               4.000
     RUNOFF VOLUME    (mm)=      54.60        11.19              36.799
     TOTAL RAINFALL   (mm)=      56.17        56.17              56.168
     RUNOFF COEFFICIENT   =        .97          .20                .655

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0033----------------------------------------------------------------------------
*
------------------------
| ADD HYD (106       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 02:102            1.01      .049     4.28  54.16    .000
                    +ID2 03:103             .00      .000      .00    .00    .000  **DRY**
                    +ID3 05:105            4.43      .725     4.00  36.80    .000
                     ============================================================
                     SUM 06:106            5.44      .767     4.00  40.02    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0034----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.67
| 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .95          .72
```

```
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=     113.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        51.26
                over (min)        4.00         7.00
     Storage Coeff.  (min)=       3.64 (ii)    7.15 (ii)
     Unit Hyd. Tpeak (min)=       4.00         7.00
     Unit Hyd. peak  (cms)=        .30          .16
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .22          .07            .287 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.03           4.000
     RUNOFF VOLUME    (mm)=      54.60        11.19          35.931
     TOTAL RAINFALL   (mm)=      56.17        56.17          56.168
     RUNOFF COEFFICIENT   =        .97          .20            .640

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20      Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0035---------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .045  .1920E-01
                            .023  .3000E-03   |     .050  .3360E-01
                            .032  .2300E-02   |     .055  .4700E-01
                            .039  .8200E-02   |     .060  .5480E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )        1.67      .287     4.000     35.931
     OUTFLOW<03: (103    )        1.67      .047     4.350     35.931
    OVERFLOW<05: (105    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   16.514
                   TIME SHIFT OF PEAK FLOW         (min)=    21.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2604E-01

-----------------------------------------------------------------------------
001:0036---------------------------------------------------------------------
*
------------------------
| ADD HYD (109       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                    ID1 03:103            1.67      .047    4.35  35.93    .000
                   +ID2 05:105             .00      .000     .00    .00    .000  **DRY**
                    ===========================================================
                    SUM 09:109            1.67      .047    4.35  35.93    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0037---------------------------------------------------------------------
*
```

```
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.03
| 02:102    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .98           .05
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       3.23          1.24
     Length            (m)=      35.00        200.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         17.21
                over (min)        1.00         39.00
     Storage Coeff.  (min)=       1.03 (ii)    38.86 (ii)
     Unit Hyd. Tpeak (min)=       1.00         39.00
     Unit Hyd. peak  (cms)=       1.06           .03
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .23           .00              .227 (iii)
     TIME TO PEAK    (hrs)=       4.00          4.53             4.000
     RUNOFF VOLUME    (mm)=      54.60         11.19            52.427
     TOTAL RAINFALL   (mm)=      56.17         56.17            56.168
     RUNOFF COEFFICIENT   =        .97           .20              .933

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0038----------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 08:108            9.31     .966    4.00  32.50    .000
                    +ID2 04:104            5.41     .921    4.00  45.42    .000
                    +ID3 01:101            6.11     .608    4.00  31.56    .000
                    +ID4 07:107            5.66     .420    4.00  44.41    .000
                    +ID5 06:106            5.44     .767    4.00  40.02    .000
                    +ID6 09:109            1.67     .047    4.35  35.93    .000
                    +ID7 02:102            1.03     .227    4.00  52.43    .000
                     ===========================================================
                     SUM 03:TOTAL         34.63    3.952    4.00  38.24    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0039----------------------------------------------------------------------------
*
      FINISH
------------------------------------------------------------------------------------
************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 14:51:44
====================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
START               TIME = 0.0
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM       IUNITS=[2], TD=[24](hrs), TPRAT=[0.333], CSDT=[15](min)
                    ICASEcs=[1], A=[998.071], B=[6.053], C=[0.814]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.00945,  0.00266]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
```

```
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.096 ,  0.0175 ]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
```

```
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.00756,  0.00469]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
```

```
                                LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7, 8
(south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,   -1    ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[4.36](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[1+2+3]
```

```
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.13230,  0.05698]
                                    [   -1  ,  -1     ]
                          IDovf=[7], NHYDovf=["107"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[6+7+9]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[3.26](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
```

```
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.30240,  0.16307]
                                    [   -1  ,  -1     ]
                          IDovf=[5], NHYDovf=["105"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[2.40](ha),
                    XIMP=[0.46], TIMP=[0.46], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.78](%),
                                         LGP=[120](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+5+6]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
```

```
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.08562,  0.04495]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[2+3+5]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.023 ,  0.0003 ]
                                  [ 0.032 ,  0.0023 ]
                                  [ 0.039 ,  0.0082 ]
                                  [ 0.045 ,  0.0192 ]
                                  [ 0.050 ,  0.0336 ]
```

```
                                       E5Y24H
                                    [ 0.055 ,  0.0470 ]
                                    [ 0.060 ,  0.0548 ]
                                    [   -1  ,    -1   ]
                          IDovf=[5], NHYDovf=["105"]
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[3+5]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[3], NHYD=["TOTAL"], IDs to add=[8+4+1+7+6+9+2]
*
*%-----------------|------------------------------------------------------------|
FINISH
```

```
=================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                       9   9  9   9   # 3573794
        StormWater Management HYdrologic Model          999    999    =========

 ********************************************************************************
 ***************************** SWMHYMO Ver/4.05  ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                  OTTHYMO-83 and OTTHYMO-89.                  *********
 ********************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ********************************************************************************


 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Morrison Hershfield Ltd.                     +++++++++
 +++++++++                Ottawa                SERIAL#:3573794        +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ********************************************************************************
 *********            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *********
 *********            Maximum value for ID numbers  :     10           *********
 *********            Max. number of rainfall points: 105408           *********
 *********            Max. number of flow points    : 105408           *********
 ********************************************************************************



 **********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2018-10-19     TIME: 14:51:57     RUN COUNTER: 000307         *
 ********************************************************************************
 * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E5Y24H.DAT         *
 * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E5Y24H.out         *
 * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E5Y24H.sum         *
 * User comments:                                                              *
 * 1:__________________________________________________________________________*
 * 2:__________________________________________________________________________*
 * 3:__________________________________________________________________________*
 ********************************************************************************

--------------------------------------------------------------------------------
001:0001------------------------------------------------------------------------
*#*******************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
*#                              October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*******************************************************************************
*
--------------------
| START              |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
```

```
     TZERO =   .00 hrs on        0
     METOUT=   2 (output = METRIC)
     NRUN  = 001
     NSTORM=   0
-------------------------------------------------------------------------------
001:0002-----------------------------------------------------------------------
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 998.071
| Ptotal= 64.12 mm |                          B=   6.053
--------------------                          C=    .814
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 24.00 hrs
                        Storm time step    = 15.00 min
                        Time to peak ratio =   .33

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .25    .521 |   6.25   1.872 |  12.25   1.535 |  18.25    .731
               .50    .536 |   6.50   2.152 |  12.50   1.462 |  18.50    .716
               .75    .551 |   6.75   2.546 |  12.75   1.396 |  18.75    .702
              1.00    .568 |   7.00   3.146 |  13.00   1.336 |  19.00    .689
              1.25    .585 |   7.25   4.178 |  13.25   1.282 |  19.25    .676
              1.50    .604 |   7.50   6.429 |  13.50   1.232 |  19.50    .664
              1.75    .624 |   7.75  16.065 |  13.75   1.187 |  19.75    .652
              2.00    .646 |   8.00  83.557 |  14.00   1.145 |  20.00    .641
              2.25    .669 |   8.25  21.363 |  14.25   1.106 |  20.25    .630
              2.50    .695 |   8.50  10.789 |  14.50   1.070 |  20.50    .620
              2.75    .723 |   8.75   7.304 |  14.75   1.037 |  20.75    .610
              3.00    .753 |   9.00   5.570 |  15.00   1.006 |  21.00    .600
              3.25    .786 |   9.25   4.530 |  15.25    .976 |  21.25    .590
              3.50    .823 |   9.50   3.836 |  15.50    .949 |  21.50    .581
              3.75    .864 |   9.75   3.337 |  15.75    .923 |  21.75    .573
              4.00    .910 |  10.00   2.962 |  16.00    .899 |  22.00    .564
              4.25    .961 |  10.25   2.668 |  16.25    .876 |  22.25    .556
              4.50   1.020 |  10.50   2.431 |  16.50    .854 |  22.50    .548
              4.75   1.087 |  10.75   2.236 |  16.75    .834 |  22.75    .540
              5.00   1.165 |  11.00   2.073 |  17.00    .815 |  23.00    .533
              5.25   1.256 |  11.25   1.934 |  17.25    .796 |  23.25    .526
              5.50   1.364 |  11.50   1.814 |  17.50    .779 |  23.50    .519
              5.75   1.497 |  11.75   1.709 |  17.75    .762 |  23.75    .512
              6.00   1.661 |  12.00   1.617 |  18.00    .746 |  24.00    .505

-------------------------------------------------------------------------------
001:0003-----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        57.01
                over (min)        2.00         5.00
     Storage Coeff.  (min)=       2.01 (ii)    5.37 (ii)
     Unit Hyd. Tpeak (min)=       2.00         5.00
     Unit Hyd. peak  (cms)=        .56          .22
```

```
                                                                  *TOTALS*
     PEAK FLOW       (cms)=        .01          .00            .012 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.02           8.000
     RUNOFF VOLUME    (mm)=      62.54        13.08          62.053
     TOTAL RAINFALL   (mm)=      64.12        64.12          64.117
     RUNOFF COEFFICIENT   =        .98          .20            .968

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0004-----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<02:(102    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .009  .2660E-02

     ROUTING RESULTS             AREA      QPEAK     TPEAK       R.V.
     --------------------        (ha)      (cms)     (hrs)       (mm)
     INFLOW >01: (101    )        .05       .012     8.000     62.053
     OUTFLOW<02: (102    )        .05       .004     8.083     62.052
    OVERFLOW<03: (103    )        .00       .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.762
                   TIME SHIFT OF PEAK FLOW         (min)=     5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1066E-02

-------------------------------------------------------------------------------------
001:0005-----------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.60
| 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02         1.58
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.03         1.76
     Length            (m)=      37.00        85.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        51.53
                over (min)        1.00        14.00
     Storage Coeff.  (min)=       1.22 (ii)   14.37 (ii)
     Unit Hyd. Tpeak (min)=       1.00        14.00
     Unit Hyd. peak  (cms)=        .95          .08
                                                                  *TOTALS*
     PEAK FLOW       (cms)=        .00          .12            .121 (iii)
     TIME TO PEAK    (hrs)=       7.97         8.13           8.133
     RUNOFF VOLUME    (mm)=      62.54        13.08          13.573
     TOTAL RAINFALL   (mm)=      64.12        64.12          64.117
     RUNOFF COEFFICIENT   =        .98          .20            .212
```

```
        *** WARNING: For areas with impervious ratios below
                     20%, this routine may not be applicable.

         (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
              Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
              Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
             THAN THE STORAGE COEFFICIENT.
       (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -------------------------------------------------------------------------------------
 001:0006-----------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (105        ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 02:102               .05      .004    8.08  62.05    .000
                    +ID2 03:103               .00      .000     .00    .00    .000  **DRY**
                    +ID3 04:104              1.60      .121    8.13  13.57    .000
                     ============================================================
                     SUM 05:105              1.65      .125    8.13  15.04    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------------
 001:0007-----------------------------------------------------------------------------
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .096  (cms)
 | TotalHyd 05:105    |   Number of inlets in system [NINLET] =       1
 ----------------------   Total minor system capacity         =    .096  (cms)
                          Total major system storage [TMJSTO] =      70.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)     (cms)
      TOTAL HYD.  05:105          1.65      .125     8.133   15.042     .000
      =======================================================================
      MAJOR SYST  06:106           .00      .000      .000     .000     .000
      MINOR SYST  07:107          1.65      .096     8.433   15.159     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

      Maximum MAJOR SYSTEM storage used =      16.(cu.m.)

 -------------------------------------------------------------------------------------
 001:0008-----------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 7: North East Parking Lot
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .67
 | 08:108    DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
 ----------------------
                                IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .60           .07
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=       2.00          4.03
      Length            (m)=      25.00         34.00
      Mannings n          =        .013          .200

      Max.eff.Inten.(mm/hr)=      83.56         55.99
                 over (min)       1.00          7.00
      Storage Coeff.  (min)=        .97 (ii)     6.69 (ii)
      Unit Hyd. Tpeak (min)=       1.00          7.00
      Unit Hyd. peak  (cms)=       1.09           .17
                                                              *TOTALS*
      PEAK FLOW       (cms)=        .14           .01            .148 (iii)
      TIME TO PEAK    (hrs)=       7.98          8.03           8.000
      RUNOFF VOLUME    (mm)=      62.55         13.08          57.600
```

```
     TOTAL RAINFALL   (mm)=      64.12        64.12         64.117
     RUNOFF COEFFICIENT   =        .98          .20           .898

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

----------------------------------------------------------------------------------------
001:0009--------------------------------------------------------------------------------
*
*Combine Subcatchments 7 & 8
*
------------------------
| ADD HYD (109        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 07:107            1.65      .096    8.43  15.16    .000
                    +ID2 08:108             .67      .148    8.00  57.60    .000
                     ===============================================================
                     SUM 09:109            2.32      .238    8.00  27.42    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

----------------------------------------------------------------------------------------
001:0010--------------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .096  .1750E-01

     ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
     --------------------          (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )        2.32      .238     8.000     27.416
     OUTFLOW<01: (101    )        2.22      .096     8.167     27.416
    OVERFLOW<02: (102    )         .10      .040     8.167     27.416

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        1
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .28
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .95


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   40.370
                   TIME SHIFT OF PEAK FLOW         (min)=    10.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1751E-01

----------------------------------------------------------------------------------------
001:0011--------------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.08
| 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        3.05          .03
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=        1.90          .01
     Length            (m)=      140.00        40.00
     Mannings n          =         .013         .200
```

```
     Max.eff.Inten.(mm/hr)=      83.56         50.76
                over (min)        3.00         42.00
     Storage Coeff.  (min)=       2.77 (ii)    42.46 (ii)
     Unit Hyd. Tpeak (min)=       3.00         42.00
     Unit Hyd. peak  (cms)=        .40           .03
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .70           .00              .704 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.58             8.000
     RUNOFF VOLUME    (mm)=      62.54         13.08            62.053
     TOTAL RAINFALL   (mm)=      64.12         64.12            64.117
     RUNOFF COEFFICIENT   =        .98           .20              .968

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0012------------------------------------------------------------------------
*
*Combine Subcatchment 6 and Overflows
*
------------------------
| ADD HYD (104        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106             .00      .000     .00    .00    .000  **DRY**
                    +ID2 02:102             .10      .040    8.17  27.42    .000
                    +ID3 03:103            3.08      .704    8.00  62.05    .000
                     ============================================================
                     SUM 04:104            3.18      .704    8.00  60.95    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0013------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .09
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09           .00
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         57.01
                over (min)        2.00          5.00
     Storage Coeff.  (min)=       2.01 (ii)     5.37 (ii)
     Unit Hyd. Tpeak (min)=       2.00          5.00
     Unit Hyd. peak  (cms)=        .56           .22
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .02           .00              .021 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.02             8.000
     RUNOFF VOLUME    (mm)=      62.55         13.08            62.053
     TOTAL RAINFALL   (mm)=      64.12         64.12            64.117
     RUNOFF COEFFICIENT   =        .98           .20              .968

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0014----------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>08:(108    )  |
 | OUT<09:(109    )  |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .008  .4690E-02

      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
      --------------------       (ha)     (cms)     (hrs)       (mm)
      INFLOW >08: (108    )       .09      .021     8.000     62.053
      OUTFLOW<09: (109    )       .09      .004     8.283     62.052
     OVERFLOW<02: (102    )       .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.994
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2450E-02

 ------------------------------------------------------------------------------
 001:0015----------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    3.82
 | 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=         .76         3.06
      Dep. Storage     (mm)=        1.57         4.67
      Average Slope     (%)=         .01         2.04
      Length            (m)=         .01       425.00
      Mannings n          =         .013         .200

      Max.eff.Inten.(mm/hr)=       83.56        14.27
                 over (min)        1.00        55.00
      Storage Coeff.  (min)=         .04 (ii)   55.25 (ii)
      Unit Hyd. Tpeak (min)=        1.00        55.00
      Unit Hyd. peak  (cms)=        1.70          .02
                                                               *TOTALS*
      PEAK FLOW       (cms)=         .18          .07             .188 (iii)
      TIME TO PEAK    (hrs)=        7.77         8.80            8.000
      RUNOFF VOLUME    (mm)=       62.55        13.08           22.972
      TOTAL RAINFALL   (mm)=       64.12        64.12           64.117
      RUNOFF COEFFICIENT   =         .98          .20             .358

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0016----------------------------------------------------------------------
 *
```

```
 ------------------------
 | ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.     DWF
 ------------------------                 (ha)     (cms)    (hrs)   (mm)    (cms)
                     ID1 09:109             .09      .004     8.28  62.05     .000
                    +ID2 02:102             .00      .000      .00    .00     .000   **DRY**
                    +ID3 03:103            3.82      .188     8.00  22.97     .000
                     ============================================================
                     SUM 05:105            3.91      .191     8.00  23.87     .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------------
 001:0017----------------------------------------------------------------------------
 *
 *Combine Subcatchments 5, 6, 7 & 8
 *
 ------------------------
 | ADD HYD (108        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.     DWF
 ------------------------                 (ha)     (cms)    (hrs)   (mm)    (cms)
                     ID1 01:101            2.22      .096     8.17  27.42     .000
                    +ID2 04:104            3.18      .704     8.00  60.95     .000
                    +ID3 05:105            3.91      .191     8.00  23.87     .000
                     ============================================================
                     SUM 08:108            9.31      .973     8.00  37.39     .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------------
 001:0018----------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7,
 *
 *Total Building Area - Includes Building N, P, S & Salt Storage Sheds
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.05
 | 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       1.04          .01
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .50         2.00
      Length            (m)=      42.00        10.00
      Mannings n          =       .013         .200

      Max.eff.Inten.(mm/hr)=      83.56        57.01
                 over (min)        2.00         5.00
      Storage Coeff.  (min)=       2.01 (ii)    5.37 (ii)
      Unit Hyd. Tpeak (min)=       2.00         5.00
      Unit Hyd. peak  (cms)=        .56          .22
                                                                *TOTALS*
      PEAK FLOW       (cms)=        .24          .00              .243 (iii)
      TIME TO PEAK    (hrs)=       8.00         8.02             8.000
      RUNOFF VOLUME    (mm)=      62.54        13.08            62.053
      TOTAL RAINFALL   (mm)=      64.12        64.12            64.117
      RUNOFF COEFFICIENT   =        .98          .20              .968

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0019----------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
```

```
 ---------------------
 | ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
 |  IN>09:(109    )   |
 | OUT<01:(101    )   |     =========  OUTFLOW STORAGE TABLE  =========
 ---------------------      OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                              (cms)    (ha.m.)    |    (cms)    (ha.m.)
                               .000  .0000E+00    |     .085  .5115E-01

      ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
      --------------------          (ha)     (cms)     (hrs)       (mm)
      INFLOW >09: (109    )         1.05      .243     8.000     62.053
      OUTFLOW<01: (101    )         1.05      .047     8.283     62.052
     OVERFLOW<02: (102    )          .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.425
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2833E-01

 ------------------------------------------------------------------------------
 001:0020----------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD      |    Area    (ha)=    4.36
 | 03:103    DT= 1.00 |    Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
 ----------------------
                                     IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        3.23          1.13
      Dep. Storage     (mm)=        1.57          4.67
      Average Slope     (%)=        1.43         15.38
      Length            (m)=      116.00         13.00
      Mannings n          =         .013          .200

      Max.eff.Inten.(mm/hr)=       83.56         57.01
                 over (min)         3.00          5.00
      Storage Coeff.  (min)=        2.70 (ii)     4.83 (ii)
      Unit Hyd. Tpeak (min)=        3.00          5.00
      Unit Hyd. peak  (cms)=         .40           .23
                                                                *TOTALS*
      PEAK FLOW       (cms)=         .75           .15             .899 (iii)
      TIME TO PEAK    (hrs)=        8.00          8.02            8.000
      RUNOFF VOLUME    (mm)=       62.54         13.08           49.685
      TOTAL RAINFALL   (mm)=       64.12         64.12           64.117
      RUNOFF COEFFICIENT   =         .98           .20             .775

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0021----------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (104       ) |   ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                     (ha)     (cms)    (hrs)   (mm)   (cms)
                      ID1 01:101             1.05      .047     8.28  62.05    .000
                     +ID2 02:102              .00      .000      .00    .00    .000   **DRY**
                     +ID3 03:103             4.36      .899     8.00  49.69    .000
                      =======================================================
                      SUM 04:104             5.41      .939     8.00  52.09    .000
```

```
   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0022----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
---------------------
| CALIB STANDHYD      |   Area     (ha)=    1.14
| 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                                   IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.13           .01
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         57.01
                over (min)        2.00          5.00
     Storage Coeff.  (min)=       2.01 (ii)     5.37 (ii)
     Unit Hyd. Tpeak (min)=       2.00          5.00
     Unit Hyd. peak  (cms)=        .56           .22
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .26           .00              .263 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.02             8.000
     RUNOFF VOLUME    (mm)=      62.54         13.08            62.053
     TOTAL RAINFALL   (mm)=      64.12         64.12            64.117
     RUNOFF COEFFICIENT   =        .98           .20              .968

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0023----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
|  IN>05:(105    )  |
| OUT<06:(106    )  |     =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .132  .5698E-01

     ROUTING RESULTS              AREA      QPEAK      TPEAK        R.V.
     --------------------         (ha)      (cms)      (hrs)        (mm)
     INFLOW >05: (105    )        1.14       .263      8.000      62.053
     OUTFLOW<06: (106    )        1.14       .064      8.267      62.053
    OVERFLOW<07: (107    )         .00       .000       .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   24.457
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2774E-01

------------------------------------------------------------------------------------
```

```
001:0024---------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
---------------------
| CALIB STANDHYD      |   Area    (ha)=    4.97
| 09:109    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.74         3.23
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.00         1.42
     Length            (m)=      57.00        57.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        52.26
                over (min)        2.00        13.00
     Storage Coeff.  (min)=       1.96 (ii)   12.93 (ii)
     Unit Hyd. Tpeak (min)=       2.00        13.00
     Unit Hyd. peak  (cms)=        .57          .09
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .40          .26            .598 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.12           8.000
     RUNOFF VOLUME    (mm)=      62.54        13.08          30.392
     TOTAL RAINFALL   (mm)=      64.12        64.12          64.117
     RUNOFF COEFFICIENT   =        .98          .20            .474

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0025---------------------------------------------------------------------------
*
-----------------------
| ADD HYD (101       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
-----------------------                    (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 06:106            1.14      .064     8.27   62.05    .000
                    +ID2 07:107             .00      .000      .00     .00    .000   **DRY**
                    +ID3 09:109            4.97      .598     8.00   30.39    .000
                     ============================================================
                     SUM 01:101            6.11      .655     8.00   36.30    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0026---------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
---------------------
| CALIB STANDHYD      |   Area    (ha)=    3.26
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.23          .03
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        57.01
                over (min)        2.00         5.00
     Storage Coeff.  (min)=       2.01 (ii)    5.37 (ii)
```

```
     Unit Hyd. Tpeak (min)=       2.00          5.00
     Unit Hyd. peak  (cms)=        .56           .22
                                                                 *TOTALS*
     PEAK FLOW       (cms)=        .75           .00               .753 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.02              8.000
     RUNOFF VOLUME    (mm)=      62.54         13.08             62.053
     TOTAL RAINFALL   (mm)=      64.12         64.12             64.117
     RUNOFF COEFFICIENT   =        .98           .20               .968

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0027------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>02:(102    )   |
| OUT<03:(103    )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .302  .1631E+00

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )        3.26      .753     8.000     62.053
     OUTFLOW<03: (103    )        3.26      .158     8.283     62.053
    OVERFLOW<05: (105    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS   =          0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=         .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=         .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.988
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.8525E-01

--------------------------------------------------------------------------------
001:0028------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    2.40
| 06:106    DT= 1.00  |   Total Imp(%)=   46.00   Dir. Conn.(%)=   46.00
----------------------
                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.10          1.30
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.92          2.78
     Length            (m)=     130.00        120.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         42.30
                over (min)        3.00         18.00
     Storage Coeff.  (min)=       2.64 (ii)    17.90 (ii)
     Unit Hyd. Tpeak (min)=       3.00         18.00
     Unit Hyd. peak  (cms)=        .41           .06
                                                                 *TOTALS*
     PEAK FLOW       (cms)=        .26           .08               .298 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.20              8.000
     RUNOFF VOLUME    (mm)=      62.54         13.08             35.834
     TOTAL RAINFALL   (mm)=      64.12         64.12             64.117
```

```
     RUNOFF COEFFICIENT   =        .98          .20           .559

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0029----------------------------------------------------------------------------
*
------------------------
| ADD HYD (107        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 03:103            3.26      .158    8.28  62.05    .000
                    +ID2 05:105             .00      .000     .00    .00    .000  **DRY**
                    +ID3 06:106            2.40      .298    8.00  35.83    .000
                     ============================================================
                     SUM 07:107            5.66      .432    8.00  50.94    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0030----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.01
| 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.00          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        57.01
                over (min)        2.00         5.00
     Storage Coeff.  (min)=       2.01 (ii)    5.37 (ii)
     Unit Hyd. Tpeak (min)=       2.00         5.00
     Unit Hyd. peak  (cms)=        .56          .22
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .23          .00           .233 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.02          8.000
     RUNOFF VOLUME    (mm)=      62.54        13.08         62.053
     TOTAL RAINFALL   (mm)=      64.12        64.12         64.117
     RUNOFF COEFFICIENT   =        .98          .20           .968

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0031----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<02:(102    )  |    =========  OUTFLOW STORAGE TABLE  =========
```

```
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .086  .4495E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )       1.01      .233     8.000     62.053
     OUTFLOW<02: (102    )       1.01      .050     8.283     62.053
    OVERFLOW<03: (103    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.382
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2620E-01

-------------------------------------------------------------------------------------
001:0032----------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.43
| 05:105    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        2.61         1.82
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=        1.89         1.61
     Length            (m)=      103.00        36.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=       83.56        54.26
                over (min)         2.00        10.00
     Storage Coeff.  (min)=        2.31 (ii)   10.21 (ii)
     Unit Hyd. Tpeak (min)=        2.00        10.00
     Unit Hyd. peak  (cms)=         .51          .11
                                                              *TOTALS*
     PEAK FLOW       (cms)=         .61          .17             .757 (iii)
     TIME TO PEAK    (hrs)=        8.00         8.07            8.000
     RUNOFF VOLUME    (mm)=       62.54        13.08           42.265
     TOTAL RAINFALL   (mm)=       64.12        64.12           64.117
     RUNOFF COEFFICIENT   =         .98          .20             .659

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0033----------------------------------------------------------------------------
*
------------------------
| ADD HYD (106       ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 02:102           1.01      .050     8.28   62.05     .000
                    +ID2 03:103            .00      .000      .00     .00     .000   **DRY**
                    +ID3 05:105           4.43      .757     8.00   42.26     .000
                     ============================================================
                     SUM 06:106           5.44      .799     8.00   45.94     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0034----------------------------------------------------------------------------
```

```
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.67
| 02:102    DT= 1.00  |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .95          .72
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=     113.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        55.99
                over (min)        4.00         7.00
     Storage Coeff.  (min)=       3.64 (ii)    7.03 (ii)
     Unit Hyd. Tpeak (min)=       4.00         7.00
     Unit Hyd. peak  (cms)=        .30          .16
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .22          .08                .298 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.03               8.000
     RUNOFF VOLUME    (mm)=      62.54        13.08              41.276
     TOTAL RAINFALL   (mm)=      64.12        64.12              64.117
     RUNOFF COEFFICIENT   =        .98          .20                .644

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------------
001:0035---------------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>02:(102    )   |
| OUT<03:(103    )   |    =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .045  .1920E-01
                             .023  .3000E-03    |     .050  .3360E-01
                             .032  .2300E-02    |     .055  .4700E-01
                             .039  .8200E-02    |     .060  .5480E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )        1.67      .298     8.000     41.276
     OUTFLOW<03: (103    )        1.67      .048     8.350     41.276
    OVERFLOW<05: (105    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   16.059
                   TIME SHIFT OF PEAK FLOW         (min)=    21.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2724E-01

-----------------------------------------------------------------------------------
001:0036---------------------------------------------------------------------------
*
------------------------
```

```
| ADD HYD (109         ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                      (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 03:103               1.67      .048     8.35   41.28     .000
                    +ID2 05:105                .00      .000      .00     .00     .000  **DRY**
                     ==========================================================
                     SUM 09:109               1.67      .048     8.35   41.28     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0037----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.03
| 02:102    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=        .98          .05
     Dep. Storage      (mm)=       1.57         4.67
     Average Slope      (%)=       3.23         1.24
     Length             (m)=      35.00       200.00
     Mannings n           =        .013         .200

     Max.eff.Inten.(mm/hr)=       83.56        22.42
                over (min)         1.00        35.00
     Storage Coeff.  (min)=        1.03 (ii)   35.06 (ii)
     Unit Hyd. Tpeak (min)=        1.00        35.00
     Unit Hyd. peak  (cms)=        1.06          .03
                                                            *TOTALS*
     PEAK FLOW       (cms)=         .23          .00           .228 (iii)
     TIME TO PEAK    (hrs)=        8.00         8.47          8.000
     RUNOFF VOLUME    (mm)=       62.55        13.08         60.074
     TOTAL RAINFALL   (mm)=       64.12        64.12         64.117
     RUNOFF COEFFICIENT   =         .98          .20           .937

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0038----------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                      (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 08:108               9.31      .973     8.00   37.39     .000
                    +ID2 04:104               5.41      .939     8.00   52.09     .000
                    +ID3 01:101               6.11      .655     8.00   36.30     .000
                    +ID4 07:107               5.66      .432     8.00   50.94     .000
                    +ID5 06:106               5.44      .799     8.00   45.94     .000
                    +ID6 09:109               1.67      .048     8.35   41.28     .000
                    +ID7 02:102               1.03      .228     8.00   60.07     .000
                     ==========================================================
                     SUM 03:TOTAL            34.63     4.068     8.00   43.91     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0039----------------------------------------------------------------------------
*
      FINISH
------------------------------------------------------------------------------------
```

```
**************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 14:51:58
======================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
START                TIME = 0.0
*
* 100 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM        IUNITS=[2], TD=[3](hrs), TPRAT=[0.333], CSDT=[15](min)
                     ICASEcs=[1], A=[1735.688], B=[6.014], C=[0.820]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD       ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                     XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                     Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                             DCAY=[4.14](/hr), F=[0](mm),
                     Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                          LGP=[10](m), MNP=[0.2], SCP=[0](min),
                     Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                          LGI=[42](m), MNI=[0.013], SCI=[0](min),
                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR      IDout=[2],   NHYD=["102"],  IDin=[1],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                       (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.00945,  0.00266]
                                    [   -1  ,  -1     ]
                           IDovf=[3], NHYDovf=["103"]
*
```

```
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.096 ,  0.0175 ]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
```

```
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.00756,  0.00469]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
```

```
                                        LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7, 8
(south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[1],  NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[4.36](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[1+2+3]
```

```
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.13230,  0.05698]
                                    [   -1  ,  -1     ]
                          IDovf=[7], NHYDovf=["107"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[6+7+9]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[3.26](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
```

```
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.30240,  0.16307]
                                    [   -1  ,  -1     ]
                          IDovf=[5], NHYDovf=["105"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[2.40](ha),
                    XIMP=[0.46], TIMP=[0.46], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.78](%),
                                         LGP=[120](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+5+6]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
```

```
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08562,  0.04495]
                                    [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[2+3+5]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.023 ,  0.0003 ]
                                    [ 0.032 ,  0.0023 ]
                                    [ 0.039 ,  0.0082 ]
                                    [ 0.045 ,  0.0192 ]
                                    [ 0.050 ,  0.0336 ]
```

```
                                      E100Y3H
                                   [ 0.055 ,  0.0470 ]
                                   [ 0.060 ,  0.0548 ]
                                   [   -1  ,    -1   ]
                         IDovf=[5], NHYDovf=["105"]
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[3+5]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[3], NHYD=["TOTAL"], IDs to add=[8+4+1+7+6+9+2]
*
*%-----------------|------------------------------------------------------------|
FINISH
```

```
==================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                       9   9  9   9   # 3573794
        StormWater Management HYdrologic Model          999    999    =========

 *******************************************************************************
 ***************************** SWMHYMO Ver/4.05  ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                 OTTHYMO-83 and OTTHYMO-89.                  *********
 *******************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 *******************************************************************************


 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Morrison Hershfield Ltd.                     +++++++++
 +++++++++                Ottawa                 SERIAL#:3573794       +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 *******************************************************************************
 *********            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *********
 *********            Maximum value for ID numbers  :     10           *********
 *********            Max. number of rainfall points: 105408           *********
 *********            Max. number of flow points    : 105408           *********
 *******************************************************************************


 **********************   D E T A I L E D   O U T P U T   *********************
 *******************************************************************************
 *         DATE: 2018-10-19     TIME: 14:52:08     RUN COUNTER: 000308        *
 *******************************************************************************
 * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E100Y3H.DAT       *
 * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E100Y3H.out       *
 * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E100Y3H.sum       *
 * User comments:                                                             *
 * 1:_________________________________________________________________________*
 * 2:_________________________________________________________________________*
 * 3:_________________________________________________________________________*
 *******************************************************************************


--------------------------------------------------------------------------------
001:0001------------------------------------------------------------------------
*#******************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
*#                              October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#******************************************************************************
*
--------------------
| START             |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
```

```
     TZERO =    .00 hrs on        0
     METOUT=    2 (output = METRIC)
     NRUN  = 001
     NSTORM=    0
 ---------------------------------------------------------------------------------
 001:0002-------------------------------------------------------------------------
 *
 * 100 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
 *
 --------------------
 | CHICAGO STORM    |    IDF curve parameters: A=1735.688
 | Ptotal= 71.61 mm |                          B=   6.014
 --------------------                          C=    .820
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  3.00 hrs
                         Storm time step    = 15.00 min
                         Time to peak ratio =   .33

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .25   6.869 |   1.00 142.894 |   1.75  12.089 |   2.50   6.300
               .50  10.626 |   1.25  35.856 |   2.00   9.189 |   2.75   5.474
               .75  26.882 |   1.50  17.946 |   2.25   7.456 |   3.00   4.851

 ---------------------------------------------------------------------------------
 001:0003-------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 8: Building Z and Sport Field
 *
 *Total Building Area - Includes Building Z
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .05
 | 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .05           .00
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=        .50          2.00
      Length            (m)=      42.00         10.00
      Mannings n          =        .013          .200

      Max.eff.Inten.(mm/hr)=     142.89        112.47
                 over (min)        2.00          4.00
      Storage Coeff.  (min)=       1.62 (ii)     4.18 (ii)
      Unit Hyd. Tpeak (min)=       2.00          4.00
      Unit Hyd. peak  (cms)=        .64           .28
                                                               *TOTALS*
      PEAK FLOW       (cms)=        .02           .00            .020 (iii)
      TIME TO PEAK    (hrs)=       1.00          1.00           1.000
      RUNOFF VOLUME    (mm)=      70.04         29.57          69.633
      TOTAL RAINFALL   (mm)=      71.61         71.61          71.608
      RUNOFF COEFFICIENT   =        .98           .41            .972

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------------
 001:0004-------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
```

```
|  IN>01:(101    )   |
| OUT<02:(102    )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .009  .2660E-02

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )        .05      .020     1.000     69.633
     OUTFLOW<02: (102    )        .05      .006     1.083     69.633
    OVERFLOW<03: (103    )        .00      .000      .000       .000

                         TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                         CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                         PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                         PEAK   FLOW   REDUCTION [Qout/Qin](%)=   31.586
                         TIME SHIFT OF PEAK FLOW          (min)=     5.00
                         MAXIMUM  STORAGE   USED       (ha.m.)=.1760E-02

--------------------------------------------------------------------------------------
001:0005------------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.60
| 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .02         1.58
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=        2.03         1.76
     Length            (m)=       37.00        85.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      142.89       107.31
                over (min)         1.00        11.00
     Storage Coeff.  (min)=         .99 (ii)   10.79 (ii)
     Unit Hyd. Tpeak (min)=        1.00        11.00
     Unit Hyd. peak  (cms)=        1.08          .10
                                                               *TOTALS*
     PEAK FLOW       (cms)=         .01          .30             .300 (iii)
     TIME TO PEAK    (hrs)=         .98         1.08            1.083
     RUNOFF VOLUME    (mm)=       70.04        29.57           29.971
     TOTAL RAINFALL   (mm)=       71.61        71.61           71.608
     RUNOFF COEFFICIENT   =         .98          .41             .419
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------------
001:0006------------------------------------------------------------------------------
*
------------------------
| ADD HYD (105       ) | ID: NHYD        AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 02:102            .05      .006    1.08  69.63    .000
                    +ID2 03:103            .00      .000     .00    .00    .000  **DRY**
                    +ID3 04:104           1.60      .300    1.08  29.97    .000
                     ============================================================
                     SUM 05:105           1.65      .307    1.08  31.17    .000
```

```

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------
 001:0007--------------------------------------------------------------------
 *
 ----------------------
 | COMPUTE DUALHYD    |    Average inlet capacities   [CINLET] =    .096  (cms)
 | TotalHyd 05:105    |    Number of inlets in system [NINLET] =       1
 ----------------------    Total minor system capacity         =    .096  (cms)
                           Total major system storage [TMJSTO] =      70.(cu.m.)

                  ID: NHYD         AREA     QPEAK     TPEAK     R.V.      DWF
                                   (ha)     (cms)     (hrs)     (mm)    (cms)
      TOTAL HYD.  05:105           1.65      .307     1.083   31.173     .000
      ===================================================================
      MAJOR SYST  06:106            .48      .211     1.083   31.173     .000
      MINOR SYST  07:107           1.17      .096     1.817   31.564     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

      Maximum MAJOR SYSTEM storage used =      70.(cu.m.)

 ----------------------------------------------------------------------------
 001:0008--------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 7: North East Parking Lot
 *
 ----------------------
 | CALIB STANDHYD     |    Area    (ha)=     .67
 | 08:108    DT= 1.00 |    Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .60          .07
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=       2.00         4.03
      Length            (m)=      25.00        34.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       111.84
                 over (min)        1.00         5.00
      Storage Coeff.  (min)=        .78 (ii)     5.12 (ii)
      Unit Hyd. Tpeak (min)=       1.00         5.00
      Unit Hyd. peak  (cms)=       1.23          .22
                                                            *TOTALS*
      PEAK FLOW       (cms)=        .24          .02           .257 (iii)
      TIME TO PEAK    (hrs)=        .95         1.00          1.000
      RUNOFF VOLUME    (mm)=      70.04        29.57         65.991
      TOTAL RAINFALL   (mm)=      71.61        71.61         71.608
      RUNOFF COEFFICIENT   =        .98          .41           .922

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0009--------------------------------------------------------------------
 *
 *Combine Subcatchments 7 & 8
 *
 ------------------------
 | ADD HYD (109       ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
 ------------------------                  (ha)     (cms)    (hrs)    (mm)   (cms)
                      ID1 07:107           1.17      .096     1.82   31.56    .000
                     +ID2 08:108            .67      .257     1.00   65.99    .000
                      ============================================================
```

```
                      SUM 09:109            1.84     .353    1.00  44.10    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
001:0010----------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>09:(109    )   |
| OUT<01:(101    )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .096  .1750E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )       1.84      .353     1.000     44.103
     OUTFLOW<01: (101    )       1.38      .096      .933     44.103
    OVERFLOW<02: (102    )        .46      .257     1.000     44.103

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        2
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .88
                   PERCENTAGE OF TIME OVERFLOWING    (%)=     7.95


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   27.165
                   TIME SHIFT OF PEAK FLOW         (min)=    -4.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1754E-01

------------------------------------------------------------------------------
001:0011----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.08
| 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                   IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.05          .03
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.90          .01
     Length            (m)=     140.00        40.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89        37.74
                over (min)        2.00        47.00
     Storage Coeff.  (min)=       2.24 (ii)   46.91 (ii)
     Unit Hyd. Tpeak (min)=       2.00        47.00
     Unit Hyd. peak  (cms)=        .52          .02
                                                            *TOTALS*
     PEAK FLOW       (cms)=       1.21          .00          1.209 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.68          1.000
     RUNOFF VOLUME    (mm)=      70.04        29.57         69.633
     TOTAL RAINFALL   (mm)=      71.61        71.61         71.608
     RUNOFF COEFFICIENT   =        .98          .41           .972

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
001:0012----------------------------------------------------------------------
```

```
*
*Combine Subcatchment 6 and Overflows
*
------------------------
| ADD HYD (104        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 06:106             .48      .211     1.08  31.17    .000
                    +ID2 02:102             .46      .257     1.00  44.10    .000
                    +ID3 03:103            3.08     1.209     1.00  69.63    .000
                     ============================================================
                     SUM 04:104            4.02     1.466     1.00  62.13    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0013------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .09
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09           .00
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        112.47
                over (min)        2.00          4.00
     Storage Coeff.  (min)=       1.62 (ii)     4.18 (ii)
     Unit Hyd. Tpeak (min)=       2.00          4.00
     Unit Hyd. peak  (cms)=        .64           .27
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .04           .00            .036 (iii)
     TIME TO PEAK    (hrs)=       1.00          1.00           1.000
     RUNOFF VOLUME    (mm)=      70.04         29.57          69.633
     TOTAL RAINFALL   (mm)=      71.61         71.61          71.608
     RUNOFF COEFFICIENT   =        .98           .41            .972

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0014------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .008  .4690E-02

     ROUTING RESULTS               AREA      QPEAK      TPEAK        R.V.
     --------------------          (ha)      (cms)      (hrs)        (mm)
     INFLOW >08: (108    )          .09       .036      1.000      69.633
     OUTFLOW<09: (109    )          .09       .006      1.283      69.633
    OVERFLOW<02: (102    )          .00       .000       .000        .000
```

```
                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   17.548
                    TIME SHIFT OF PEAK FLOW          (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.3878E-02

---------------------------------------------------------------------------------------
001:0015--------------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.82
| 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=         .76          3.06
     Dep. Storage      (mm)=        1.57          4.67
     Average Slope      (%)=         .01          2.04
     Length             (m)=         .01        425.00
     Mannings n           =        .013          .200

     Max.eff.Inten.(mm/hr)=      142.89         54.76
                over (min)        1.00         32.00
     Storage Coeff.  (min)=         .04 (ii)   32.27 (ii)
     Unit Hyd. Tpeak (min)=        1.00         32.00
     Unit Hyd. peak  (cms)=        1.70           .04
                                                            *TOTALS*
     PEAK FLOW       (cms)=         .30           .26           .369 (iii)
     TIME TO PEAK    (hrs)=         .88          1.43          1.000
     RUNOFF VOLUME    (mm)=       70.04         29.57         37.661
     TOTAL RAINFALL   (mm)=       71.61         71.61         71.608
     RUNOFF COEFFICIENT   =         .98           .41           .526

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------------
001:0016--------------------------------------------------------------------------------
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 09:109            .09      .006    1.28   69.63    .000
                    +ID2 02:102            .00      .000     .00     .00    .000   **DRY**
                    +ID3 03:103           3.82      .369    1.00   37.66    .000
                     ============================================================
                     SUM 05:105           3.91      .374    1.00   38.40    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------------------
001:0017--------------------------------------------------------------------------------
*
*Combine Subcatchments 5, 6, 7 & 8
*
------------------------
| ADD HYD (108        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101           1.38      .096     .93   44.10    .000
                    +ID2 04:104           4.02     1.466    1.00   62.13    .000
```

```
                     +ID3 05:105            3.91      .374     1.00  38.40     .000
                      ===========================================================
                      SUM 08:108            9.31     1.936     1.00  49.49     .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ---------------------------------------------------------------------------------
 001:0018-------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7,
 *
 *Total Building Area - Includes Building N, P, S & Salt Storage Sheds
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    1.05
 | 09:109    DT= 1.00  |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       1.04          .01
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .50         2.00
      Length            (m)=      42.00        10.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       112.47
                 over (min)        2.00         4.00
      Storage Coeff.  (min)=       1.62 (ii)    4.18 (ii)
      Unit Hyd. Tpeak (min)=       2.00         4.00
      Unit Hyd. peak  (cms)=        .64          .27
                                                             *TOTALS*
      PEAK FLOW       (cms)=        .41          .00            .416 (iii)
      TIME TO PEAK    (hrs)=       1.00         1.00           1.000
      RUNOFF VOLUME    (mm)=      70.04        29.57          69.633
      TOTAL RAINFALL   (mm)=      71.61        71.61          71.608
      RUNOFF COEFFICIENT   =        .98          .41            .972

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------------
 001:0019-------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
 |  IN>09:(109   )    |
 | OUT<01:(101   )    |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)    (ha.m.)   |    (cms)    (ha.m.)
                              .000  .0000E+00   |     .085  .5115E-01

      ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
      --------------------         (ha)     (cms)     (hrs)       (mm)
      INFLOW >09: (109    )        1.05      .416     1.000     69.633
      OUTFLOW<01: (101    )        1.05      .075     1.283     69.633
     OVERFLOW<02: (102    )         .00      .000      .000       .000

                      TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                      CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                      PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                      PEAK   FLOW   REDUCTION [Qout/Qin](%)=   17.980
                      TIME SHIFT OF PEAK FLOW         (min)=    17.00
```

```
                     MAXIMUM  STORAGE   USED       (ha.m.)=.4494E-01

 ---------------------------------------------------------------------------------
 001:0020-------------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    4.36
 | 03:103    DT= 1.00  |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       3.23          1.13
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=       1.43         15.38
      Length            (m)=     116.00         13.00
      Mannings n          =        .013          .200

      Max.eff.Inten.(mm/hr)=     142.89        112.47
                 over (min)        2.00          4.00
      Storage Coeff.  (min)=       2.17 (ii)     3.80 (ii)
      Unit Hyd. Tpeak (min)=       2.00          4.00
      Unit Hyd. peak  (cms)=        .53           .29
                                                             *TOTALS*
      PEAK FLOW       (cms)=       1.28           .33          1.608 (iii)
      TIME TO PEAK    (hrs)=       1.00          1.00          1.000
      RUNOFF VOLUME    (mm)=      70.04         29.57         59.515
      TOTAL RAINFALL   (mm)=      71.61         71.61         71.608
      RUNOFF COEFFICIENT   =        .98           .41           .831

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------------
 001:0021-------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (104       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                      ID1 01:101           1.05      .075     1.28  69.63    .000
                     +ID2 02:102            .00      .000      .00    .00    .000   **DRY**
                     +ID3 03:103           4.36     1.608     1.00  59.52    .000
                      ===========================================================
                      SUM 04:104           5.41     1.671     1.00  61.48    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ---------------------------------------------------------------------------------
 001:0022-------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 1: Building B, K, M & T
 *
 *Total Building Area - Includes Building B, K, M & T
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    1.14
 | 05:105    DT= 1.00  |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       1.13           .01
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=        .50          2.00
      Length            (m)=      42.00         10.00
      Mannings n          =        .013          .200
```

```
     Max.eff.Inten.(mm/hr)=     142.89       112.47
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.18 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .27
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .45          .00            .451 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.00           1.000
     RUNOFF VOLUME    (mm)=      70.04        29.57          69.633
     TOTAL RAINFALL   (mm)=      71.61        71.61          71.608
     RUNOFF COEFFICIENT   =        .98          .41            .972

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------------
001:0023------------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(105    )  |
| OUT<06:(106    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .132  .5698E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >05: (105    )       1.14      .451     1.000     69.633
     OUTFLOW<06: (106    )       1.14      .104     1.267     69.633
    OVERFLOW<07: (107    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   23.070
                   TIME SHIFT OF PEAK FLOW          (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4483E-01

--------------------------------------------------------------------------------------
001:0024------------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.97
| 09:109    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.74         3.23
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.00         1.42
     Length            (m)=      57.00        57.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       108.16
                over (min)        2.00        10.00
     Storage Coeff.  (min)=       1.58 (ii)    9.78 (ii)
     Unit Hyd. Tpeak (min)=       2.00        10.00
     Unit Hyd. peak  (cms)=        .65          .11
                                                            *TOTALS*
```

```
     PEAK FLOW       (cms)=       .69          .65          1.257 (iii)
     TIME TO PEAK    (hrs)=      1.00         1.07          1.000
     RUNOFF VOLUME    (mm)=     70.04        29.57         43.731
     TOTAL RAINFALL   (mm)=     71.61        71.61         71.608
     RUNOFF COEFFICIENT   =       .98          .41           .611

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20      Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0025----------------------------------------------------------------------------
*
------------------------
| ADD HYD (101        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106           1.14     .104    1.27  69.63    .000
                    +ID2 07:107            .00     .000     .00    .00    .000   **DRY**
                    +ID3 09:109           4.97    1.257    1.00  43.73    .000
                     ==========================================================
                     SUM 01:101           6.11    1.348    1.00  48.56    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0026----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.26
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      3.23          .03
     Dep. Storage     (mm)=      1.57         4.67
     Average Slope     (%)=       .50         2.00
     Length            (m)=     42.00        10.00
     Mannings n          =       .013         .200

     Max.eff.Inten.(mm/hr)=    142.89       112.47
                over (min)       2.00         4.00
     Storage Coeff.  (min)=      1.62 (ii)    4.18 (ii)
     Unit Hyd. Tpeak (min)=      2.00         4.00
     Unit Hyd. peak  (cms)=       .64          .27
                                                          *TOTALS*
     PEAK FLOW       (cms)=      1.28          .01          1.290 (iii)
     TIME TO PEAK    (hrs)=      1.00         1.00          1.000
     RUNOFF VOLUME    (mm)=     70.04        29.57         69.633
     TOTAL RAINFALL   (mm)=     71.61        71.61         71.608
     RUNOFF COEFFICIENT   =       .98          .41           .972

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20      Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0027----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
```

```
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |      .302  .1631E+00

     ROUTING RESULTS              AREA      QPEAK      TPEAK        R.V.
     --------------------         (ha)      (cms)      (hrs)        (mm)
     INFLOW >02: (102    )        3.26      1.290      1.000      69.633
     OUTFLOW<03: (103    )        3.26       .252      1.283      69.633
    OVERFLOW<05: (105    )         .00       .000       .000        .000

                     TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                     CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                     PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                     PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.552
                     TIME SHIFT OF PEAK FLOW         (min)=    17.00
                     MAXIMUM  STORAGE   USED       (ha.m.)=.1361E+00

-----------------------------------------------------------------------------------
001:0028---------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots and Roads
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=    2.40
| 06:106    DT= 1.00 |   Total Imp(%)=   46.00   Dir. Conn.(%)=   46.00
---------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.10          1.30
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        1.92          2.78
     Length            (m)=      130.00        120.00
     Mannings n          =         .013          .200

     Max.eff.Inten.(mm/hr)=      142.89        105.49
                over (min)         2.00         13.00
     Storage Coeff.  (min)=        2.13 (ii)    12.71 (ii)
     Unit Hyd. Tpeak (min)=        2.00         13.00
     Unit Hyd. peak  (cms)=         .54           .09
                                                               *TOTALS*
     PEAK FLOW       (cms)=         .44           .22             .602 (iii)
     TIME TO PEAK    (hrs)=        1.00          1.12            1.000
     RUNOFF VOLUME    (mm)=       70.04         29.57           48.183
     TOTAL RAINFALL   (mm)=       71.61         71.61           71.608
     RUNOFF COEFFICIENT   =         .98           .41             .673

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------------
001:0029---------------------------------------------------------------------------
*
-----------------------
| ADD HYD (107       ) | ID: NHYD         AREA      QPEAK   TPEAK   R.V.     DWF
-----------------------                   (ha)      (cms)   (hrs)   (mm)    (cms)
                    ID1 03:103            3.26       .252    1.28  69.63     .000
                   +ID2 05:105             .00       .000     .00    .00     .000   **DRY**
                   +ID3 06:106            2.40       .602    1.00  48.18     .000
                    ============================================================
                    SUM 07:107            5.66       .815    1.00  60.54     .000
```

```
   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0030--------------------------------------------------------------------
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.01
| 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.00          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       112.47
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.18 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .27
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .40          .00            .400 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.00           1.000
     RUNOFF VOLUME    (mm)=      70.04        29.57          69.633
     TOTAL RAINFALL   (mm)=      71.61        71.61          71.608
     RUNOFF COEFFICIENT   =        .98          .41            .972

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0031--------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109   )   |
| OUT<02:(102   )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .086  .4495E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109   )        1.01      .400     1.000     69.633
     OUTFLOW<02: (102   )        1.01      .080     1.283     69.633
    OVERFLOW<03: (103   )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.951
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4189E-01

-----------------------------------------------------------------------------
001:0032--------------------------------------------------------------------
```

```
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.43
| 05:105    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        2.61          1.82
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        1.89          1.61
     Length            (m)=      103.00         36.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      142.89        109.74
                over (min)         2.00          8.00
     Storage Coeff.  (min)=        1.86 (ii)     7.82 (ii)
     Unit Hyd. Tpeak (min)=        2.00          8.00
     Unit Hyd. peak  (cms)=         .58           .14
                                                             *TOTALS*
     PEAK FLOW       (cms)=        1.04           .41          1.425 (iii)
     TIME TO PEAK    (hrs)=        1.00          1.05          1.000
     RUNOFF VOLUME    (mm)=       70.04         29.57         53.445
     TOTAL RAINFALL   (mm)=       71.61         71.61         71.608
     RUNOFF COEFFICIENT   =         .98           .41           .746

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0033----------------------------------------------------------------------------
*
------------------------
| ADD HYD (106       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 02:102           1.01      .080    1.28  69.63    .000
                    +ID2 03:103            .00      .000     .00    .00    .000   **DRY**
                    +ID3 05:105           4.43     1.425    1.00  53.44    .000
                     ==========================================================
                     SUM 06:106           5.44     1.492    1.00  56.45    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0034----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.67
| 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .95           .72
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=         .50          2.00
     Length            (m)=      113.00         10.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      142.89        111.17
                over (min)         3.00          6.00
     Storage Coeff.  (min)=        2.93 (ii)     5.51 (ii)
     Unit Hyd. Tpeak (min)=        3.00          6.00
```

```
     Unit Hyd. peak  (cms)=        .38          .20
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .38          .19             .561 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.02            1.000
     RUNOFF VOLUME    (mm)=      70.04        29.57           52.635
     TOTAL RAINFALL   (mm)=      71.61        71.61           71.608
     RUNOFF COEFFICIENT   =        .98          .41             .735

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20      Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
001:0035----------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .045  .1920E-01
                            .023  .3000E-03    |     .050  .3360E-01
                            .032  .2300E-02    |     .055  .4700E-01
                            .039  .8200E-02    |     .060  .5480E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )      1.67      .561     1.000     52.635
     OUTFLOW<03: (103    )      1.62      .060     1.250     52.635
    OVERFLOW<05: (105    )       .05      .087     1.250     52.635

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =          2
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=        .17
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       2.82


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   10.704
                   TIME SHIFT OF PEAK FLOW         (min)=    15.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.5479E-01

------------------------------------------------------------------------------
001:0036----------------------------------------------------------------------
*
------------------------
| ADD HYD (109       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 03:103            1.62      .060    1.25  52.64    .000
                    +ID2 05:105             .05      .087    1.25  52.64    .000
                     ============================================================
                     SUM 09:109            1.67      .147    1.25  52.64    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
001:0037----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.03
| 02:102    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .98          .05
     Dep. Storage     (mm)=       1.57         4.67
```

```
     Average Slope     (%)=       3.23         1.24
     Length            (m)=      35.00       200.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89        73.98
                over (min)        1.00        22.00
     Storage Coeff.  (min)=        .83 (ii)   21.94 (ii)
     Unit Hyd. Tpeak (min)=       1.00        22.00
     Unit Hyd. peak  (cms)=       1.19          .05
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .39          .01              .391 (iii)
     TIME TO PEAK    (hrs)=        .97         1.27             1.000
     RUNOFF VOLUME    (mm)=      70.04        29.57            68.014
     TOTAL RAINFALL   (mm)=      71.61        71.61            71.608
     RUNOFF COEFFICIENT   =        .98          .41              .950

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0038----------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 08:108            9.31    1.936    1.00  49.49    .000
                    +ID2 04:104            5.41    1.671    1.00  61.48    .000
                    +ID3 01:101            6.11    1.348    1.00  48.56    .000
                    +ID4 07:107            5.66     .815    1.00  60.54    .000
                    +ID5 06:106            5.44    1.492    1.00  56.45    .000
                    +ID6 09:109            1.67     .147    1.25  52.64    .000
                    +ID7 02:102            1.03     .391    1.00  68.01    .000
                     ==========================================================
                     SUM 03:TOTAL         34.63    7.704    1.00  54.80    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0039----------------------------------------------------------------------------
*
      FINISH
------------------------------------------------------------------------------------
************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                  20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 14:52:09
====================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
START                TIME = 0.0
*
* 100 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM        IUNITS=[2], TD=[6](hrs), TPRAT=[0.333], CSDT=[15](min)
                     ICASEcs=[1], A=[1735.688], B=[6.014], C=[0.820]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD       ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                     XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                     Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                             DCAY=[4.14](/hr), F=[0](mm),
                     Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                          LGP=[10](m), MNP=[0.2], SCP=[0](min),
                     Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                          LGI=[42](m), MNI=[0.013], SCI=[0](min),
                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR      IDout=[2],   NHYD=["102"],  IDin=[1],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                   [   0.0 ,  0.0    ]
                                   [0.00945,  0.00266]
                                   [   -1  ,  -1     ]
                           IDovf=[3], NHYDovf=["103"]
*
```

```
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.096 ,  0.0175 ]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
```

```
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.00756,  0.00469]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
```

```
                                   LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7, 8
(south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[4.36](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[1+2+3]
```

```
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.13230,  0.05698]
                                  [   -1  ,  -1     ]
                          IDovf=[7], NHYDovf=["107"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[6+7+9]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[3.26](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
```

```
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.30240,  0.16307]
                                    [   -1  ,  -1     ]
                          IDovf=[5], NHYDovf=["105"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[2.40](ha),
                    XIMP=[0.46], TIMP=[0.46], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.78](%),
                                         LGP=[120](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+5+6]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
```

```
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08562,  0.04495]
                                    [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[2+3+5]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.023 ,  0.0003 ]
                                    [ 0.032 ,  0.0023 ]
                                    [ 0.039 ,  0.0082 ]
                                    [ 0.045 ,  0.0192 ]
                                    [ 0.050 ,  0.0336 ]
```

```
                                              E100Y6H
                                           [ 0.055 ,  0.0470 ]
                                           [ 0.060 ,  0.0548 ]
                                           [   -1  ,    -1   ]
                                IDovf=[5], NHYDovf=["105"]
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[3+5]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[3], NHYD=["TOTAL"], IDs to add=[8+4+1+7+6+9+2]
*
*%-----------------|-----------------------------------------------------------|
FINISH
```

```
================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                       9   9  9   9   # 3573794
        StormWater Management HYdrologic Model          999    999    =========

 ******************************************************************************
 ***************************** SWMHYMO Ver/4.05  ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors     *********
 *********                 OTTHYMO-83 and OTTHYMO-89.                  *********
 ******************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ******************************************************************************


 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Morrison Hershfield Ltd.                    +++++++++
 +++++++++                Ottawa                 SERIAL#:3573794       +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ******************************************************************************
 *********           ++++++ PROGRAM ARRAY DIMENSIONS ++++++            *********
 *********           Maximum value for ID numbers  :     10            *********
 *********           Max. number of rainfall points: 105408            *********
 *********           Max. number of flow points    : 105408            *********
 ******************************************************************************



 *********************   D E T A I L E D   O U T P U T   *********************
 ******************************************************************************
 *         DATE: 2018-10-19     TIME: 14:52:20     RUN COUNTER: 000309        *
 ******************************************************************************
 * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E100Y6H.DAT       *
 * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E100Y6H.out       *
 * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E100Y6H.sum       *
 * User comments:                                                             *
 * 1:_________________________________________________________________________*
 * 2:_________________________________________________________________________*
 * 3:_________________________________________________________________________*
 ******************************************************************************

--------------------------------------------------------------------------------
001:0001------------------------------------------------------------------------
*#****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
*#                              October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#****************************************************************************
*
--------------------
| START             |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
```

```
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
--------------------------------------------------------------------------------
001:0002------------------------------------------------------------------------
*
* 100 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM     |     IDF curve parameters: A=1735.688
| Ptotal= 82.31 mm |                            B=   6.014
--------------------                            C=    .820
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  6.00 hrs
                        Storm time step    = 15.00 min
                        Time to peak ratio =   .33

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .25   3.051 |   1.75  26.882 |   3.25   7.456 |   4.75   3.653
               .50   3.514 |   2.00 142.894 |   3.50   6.300 |   5.00   3.383
               .75   4.164 |   2.25  35.856 |   3.75   5.474 |   5.25   3.154
              1.00   5.156 |   2.50  17.946 |   4.00   4.851 |   5.50   2.956
              1.25   6.869 |   2.75  12.089 |   4.25   4.365 |   5.75   2.784
              1.50  10.626 |   3.00   9.189 |   4.50   3.974 |   6.00   2.633

--------------------------------------------------------------------------------
001:0003------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       117.50
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.14 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .02          .00           .020 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.00          2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40         80.252
     TOTAL RAINFALL   (mm)=      82.31        82.31         82.305
     RUNOFF COEFFICIENT   =        .98          .39           .975

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
               Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
               Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0004------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
```

```
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(101    )   |
| OUT<02:(102    )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .009  .2660E-02

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )        .05      .020     2.000     80.252
     OUTFLOW<02: (102    )        .05      .006     2.083     80.251
    OVERFLOW<03: (103    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.429
                   TIME SHIFT OF PEAK FLOW         (min)=     5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1808E-02

-------------------------------------------------------------------------------------
001:0005----------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.60
| 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
----------------------
                                 IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .02          1.58
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        2.03          1.76
     Length            (m)=       37.00         85.00
     Mannings n           =        .013          .200

     Max.eff.Inten.(mm/hr)=      142.89        113.84
                over (min)         1.00         11.00
     Storage Coeff.  (min)=         .99 (ii)    10.56 (ii)
     Unit Hyd. Tpeak (min)=        1.00         11.00
     Unit Hyd. peak  (cms)=        1.08           .11
                                                                 *TOTALS*
     PEAK FLOW       (cms)=         .01           .32               .326 (iii)
     TIME TO PEAK    (hrs)=        1.95          2.08              2.083
     RUNOFF VOLUME    (mm)=       80.73         32.40             32.879
     TOTAL RAINFALL   (mm)=       82.31         82.31             82.305
     RUNOFF COEFFICIENT   =         .98           .39               .399
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0006----------------------------------------------------------------------------
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                   ID1 02:102               .05      .006    2.08  80.25    .000
                  +ID2 03:103               .00      .000     .00    .00    .000  **DRY**
```

```
                    +ID3 04:104           1.60     .326    2.08  32.88    .000
                     ============================================================
                     SUM 05:105           1.65     .332    2.08  34.31    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ---------------------------------------------------------------------------------
 001:0007-------------------------------------------------------------------------
 *
 ----------------------
 | COMPUTE DUALHYD     |   Average inlet capacities   [CINLET] =    .096  (cms)
 | TotalHyd 05:105     |   Number of inlets in system [NINLET] =       1
 ----------------------    Total minor system capacity         =    .096  (cms)
                           Total major system storage [TMJSTO] =      70.(cu.m.)

                   ID: NHYD         AREA     QPEAK     TPEAK     R.V.     DWF
                                    (ha)     (cms)     (hrs)     (mm)    (cms)
      TOTAL HYD.   05:105           1.65      .332     2.083   34.315     .000
      =======================================================================
      MAJOR SYST   06:106            .54      .236     2.083   34.315     .000
      MINOR SYST   07:107           1.11      .096     1.883   34.608     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

      Maximum MAJOR SYSTEM storage used =      70.(cu.m.)

 ---------------------------------------------------------------------------------
 001:0008-------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 7: North East Parking Lot
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=     .67
 | 08:108    DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .60           .07
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=       2.00          4.03
      Length            (m)=      25.00         34.00
      Mannings n          =        .013          .200

      Max.eff.Inten.(mm/hr)=     142.89        117.05
                 over (min)        1.00          5.00
      Storage Coeff.  (min)=        .78 (ii)     5.04 (ii)
      Unit Hyd. Tpeak (min)=       1.00          5.00
      Unit Hyd. peak  (cms)=       1.23           .22
                                                               *TOTALS*
      PEAK FLOW       (cms)=        .24           .02             .259 (iii)
      TIME TO PEAK    (hrs)=       1.95          2.00            2.000
      RUNOFF VOLUME    (mm)=      80.74         32.40           75.901
      TOTAL RAINFALL   (mm)=      82.31         82.31           82.305
      RUNOFF COEFFICIENT   =        .98           .39             .922

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------------
 001:0009-------------------------------------------------------------------------
 *
 *Combine Subcatchments 7 & 8
 *
 ------------------------
 | ADD HYD (109        ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
 ------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
```

```
                     ID1 07:107            1.11      .096    1.88  34.61    .000
                    +ID2 08:108             .67      .259    2.00  75.90    .000
                     ==========================================================
                     SUM 09:109            1.78      .355    2.00  50.19    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ---------------------------------------------------------------------------------
 001:0010-------------------------------------------------------------------------
 *
 *Flow Controlled to Pre-Development
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>09:(109    )  |
 | OUT<01:(101    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .096  .1750E-01

      ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
      --------------------          (ha)     (cms)     (hrs)       (mm)
      INFLOW >09: (109    )         1.78      .355     2.000     50.188
      OUTFLOW<01: (101    )         1.36      .096     1.917     50.188
     OVERFLOW<02: (102    )          .42      .258     2.000     50.188

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         3
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .90
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      6.78


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   27.070
                   TIME SHIFT OF PEAK FLOW         (min)=    -5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1752E-01

 ---------------------------------------------------------------------------------
 001:0011-------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    3.08
 | 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                                IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        3.05           .03
      Dep. Storage     (mm)=        1.57          4.67
      Average Slope     (%)=        1.90           .01
      Length            (m)=      140.00         40.00
      Mannings n          =         .013          .200

      Max.eff.Inten.(mm/hr)=      142.89         44.10
                 over (min)         2.00         44.00
      Storage Coeff.  (min)=        2.24 (ii)    44.22 (ii)
      Unit Hyd. Tpeak (min)=        2.00         44.00
      Unit Hyd. peak  (cms)=         .52           .03
                                                                *TOTALS*
      PEAK FLOW       (cms)=        1.21           .00           1.209 (iii)
      TIME TO PEAK    (hrs)=        2.00          2.63           2.000
      RUNOFF VOLUME    (mm)=       80.73         32.40          80.252
      TOTAL RAINFALL   (mm)=       82.31         82.31          82.305
      RUNOFF COEFFICIENT   =         .98           .39            .975

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
 ------------------------------------------------------------------------------
 001:0012----------------------------------------------------------------------
 *
 *Combine Subcatchment 6 and Overflows
 *
 ------------------------
 | ADD HYD (104        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                      ID1 06:106             .54      .236     2.08  34.31    .000
                     +ID2 02:102             .42      .258     2.00  50.19    .000
                     +ID3 03:103            3.08     1.209     2.00  80.25    .000
                      ==========================================================
                      SUM 04:104            4.04     1.467     2.00  70.95    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0013----------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 5: Building V and Snow Dump
 *
 *Total Building Area - Includes Building V
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=     .09
 | 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .09           .00
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=        .50          2.00
      Length            (m)=      42.00         10.00
      Mannings n          =        .013          .200

      Max.eff.Inten.(mm/hr)=     142.89        117.50
                 over (min)        2.00          4.00
      Storage Coeff.  (min)=       1.62 (ii)     4.14 (ii)
      Unit Hyd. Tpeak (min)=       2.00          4.00
      Unit Hyd. peak  (cms)=        .64           .28
                                                             *TOTALS*
      PEAK FLOW       (cms)=        .04           .00            .036 (iii)
      TIME TO PEAK    (hrs)=       2.00          2.00           2.000
      RUNOFF VOLUME    (mm)=      80.73         32.40          80.252
      TOTAL RAINFALL   (mm)=      82.31         82.31          82.305
      RUNOFF COEFFICIENT   =        .98           .39            .975

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0014----------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>08:(108    )  |
 | OUT<09:(109    )  |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .008  .4690E-02

      ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
      --------------------        (ha)     (cms)     (hrs)       (mm)
```

```
    INFLOW >08: (108    )        .09      .036     2.000     80.252
   OUTFLOW<09: (109    )        .09      .007     2.283     80.251
  OVERFLOW<02: (102    )        .00      .000      .000       .000

                 TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                 CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                 PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                 PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.286
                 TIME SHIFT OF PEAK FLOW         (min)=    17.00
                 MAXIMUM  STORAGE   USED       (ha.m.)=.4043E-02

---------------------------------------------------------------------------------
001:0015-------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.82
| 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=        .76         3.06
     Dep. Storage      (mm)=       1.57         4.67
     Average Slope      (%)=        .01         2.04
     Length             (m)=        .01       425.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89        61.58
                over (min)        1.00        31.00
     Storage Coeff.  (min)=        .04 (ii)   30.79 (ii)
     Unit Hyd. Tpeak (min)=       1.00        31.00
     Unit Hyd. peak  (cms)=       1.70          .04
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .30          .30            .380 (iii)
     TIME TO PEAK    (hrs)=       1.85         2.42           2.000
     RUNOFF VOLUME    (mm)=      80.74        32.39          42.064
     TOTAL RAINFALL   (mm)=      82.31        82.31          82.305
     RUNOFF COEFFICIENT   =        .98          .39            .511

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------
001:0016-------------------------------------------------------------------------
*
------------------------
| ADD HYD (105       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 09:109            .09      .007     2.28  80.25    .000
                    +ID2 02:102            .00      .000      .00    .00    .000  **DRY**
                    +ID3 03:103           3.82      .380     2.00  42.06    .000
                     ============================================================
                     SUM 05:105           3.91      .386     2.00  42.94    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------------
001:0017-------------------------------------------------------------------------
*
*Combine Subcatchments 5, 6, 7 & 8
*
------------------------
| ADD HYD (108       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
```

```
------------------------                         (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101             1.36      .096    1.92  50.19    .000
                    +ID2 04:104             4.04     1.467    2.00  70.95    .000
                    +ID3 05:105             3.91      .386    2.00  42.94    .000
                     ==========================================================
                     SUM 08:108             9.31     1.949    2.00  56.16    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0018-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7,
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.05
| 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.04           .01
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        117.50
                over (min)        2.00          4.00
     Storage Coeff.  (min)=       1.62 (ii)     4.14 (ii)
     Unit Hyd. Tpeak (min)=       2.00          4.00
     Unit Hyd. peak  (cms)=        .64           .28
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .41           .00             .416 (iii)
     TIME TO PEAK    (hrs)=       2.00          2.00            2.000
     RUNOFF VOLUME    (mm)=      80.73         32.40           80.252
     TOTAL RAINFALL   (mm)=      82.31         82.31           82.305
     RUNOFF COEFFICIENT   =        .98           .39             .975

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20      Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0019-----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .085  .5115E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )       1.05      .416     2.000     80.252
     OUTFLOW<01: (101    )       1.05      .078     2.283     80.252
    OVERFLOW<02: (102    )        .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=       .00
```

```
                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.723
                    TIME SHIFT OF PEAK FLOW          (min)=    17.00
                    MAXIMUM  STORAGE   USED        (ha.m.)=.4682E-01

 ----------------------------------------------------------------------------
 001:0020--------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    4.36
 | 03:103    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
 ----------------------
                                IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       3.23         1.13
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=       1.43        15.38
      Length            (m)=     116.00        13.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       117.50
                 over (min)        2.00         4.00
      Storage Coeff.  (min)=       2.17 (ii)    3.77 (ii)
      Unit Hyd. Tpeak (min)=       2.00         4.00
      Unit Hyd. peak  (cms)=        .53          .29
                                                              *TOTALS*
      PEAK FLOW       (cms)=       1.28          .35           1.628 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.00           2.000
      RUNOFF VOLUME    (mm)=      80.73        32.40          68.167
      TOTAL RAINFALL   (mm)=      82.31        82.31          82.305
      RUNOFF COEFFICIENT   =        .98          .39            .828

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0021--------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (104        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 01:101             1.05      .078    2.28  80.25    .000
                     +ID2 02:102              .00      .000     .00    .00    .000  **DRY**
                     +ID3 03:103             4.36     1.628    2.00  68.17    .000
                      ==========================================================
                      SUM 04:104             5.41     1.694    2.00  70.51    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------
 001:0022--------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 1: Building B, K, M & T
 *
 *Total Building Area - Includes Building B, K, M & T
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    1.14
 | 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                                IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       1.13          .01
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .50         2.00
```

```
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       117.50
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.14 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .45          .00              .451 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.00             2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40            80.252
     TOTAL RAINFALL   (mm)=      82.31        82.31            82.305
     RUNOFF COEFFICIENT   =        .98          .39              .975

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0023------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(105    )  |
| OUT<06:(106    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .132  .5698E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >05: (105    )      1.14      .451     2.000     80.252
     OUTFLOW<06: (106    )      1.14      .108     2.267     80.252
    OVERFLOW<07: (107    )       .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   23.841
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4636E-01

--------------------------------------------------------------------------------
001:0024------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.97
| 09:109    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.74         3.23
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.00         1.42
     Length            (m)=      57.00        57.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       114.44
                over (min)        2.00        10.00
     Storage Coeff.  (min)=       1.58 (ii)    9.60 (ii)
```

```
     Unit Hyd. Tpeak (min)=       2.00        10.00
     Unit Hyd. peak  (cms)=        .65          .12
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .69          .70             1.310 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.07             2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40            49.315
     TOTAL RAINFALL   (mm)=      82.31        82.31            82.305
     RUNOFF COEFFICIENT   =        .98          .39              .599

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0025------------------------------------------------------------------------
*
------------------------
| ADD HYD (101        ) | ID: NHYD          AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                    (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 06:106              1.14      .108     2.27  80.25    .000
                    +ID2 07:107               .00      .000      .00    .00    .000  **DRY**
                    +ID3 09:109              4.97     1.310     2.00  49.31    .000
                     ============================================================
                     SUM 01:101              6.11     1.405     2.00  55.09    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0026------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.26
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.23          .03
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       117.50
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.14 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                              *TOTALS*
     PEAK FLOW       (cms)=       1.28          .01             1.291 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.00             2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40            80.252
     TOTAL RAINFALL   (mm)=      82.31        82.31            82.305
     RUNOFF COEFFICIENT   =        .98          .39              .975

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0027------------------------------------------------------------------------
```

```
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |      .302  .1631E+00

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )       3.26     1.291     2.000     80.252
     OUTFLOW<03: (103    )       3.26      .262     2.283     80.252
    OVERFLOW<05: (105    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.309
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1415E+00

-------------------------------------------------------------------------------------
001:0028-----------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    2.40
| 06:106    DT= 1.00 |   Total Imp(%)=   46.00   Dir. Conn.(%)=   46.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.10         1.30
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.92         2.78
     Length            (m)=     130.00       120.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       113.21
                over (min)        2.00        12.00
     Storage Coeff.  (min)=       2.13 (ii)   12.42 (ii)
     Unit Hyd. Tpeak (min)=       2.00        12.00
     Unit Hyd. peak  (cms)=        .54          .09
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .44          .24              .630 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.10             2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40            54.632
     TOTAL RAINFALL   (mm)=      82.31        82.31            82.305
     RUNOFF COEFFICIENT   =        .98          .39              .664

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0029-----------------------------------------------------------------------------
*
------------------------
| ADD HYD (107        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                    ID1 03:103             3.26      .262    2.28  80.25    .000
                   +ID2 05:105              .00      .000     .00    .00    .000  **DRY**
                   +ID3 06:106             2.40      .630    2.00  54.63    .000
```

```
                         ============================================================
                         SUM 07:107            5.66     .856    2.00  69.39    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------------
 001:0030----------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
 *
 *Total Building Area - Includes Building F, G, R1, R2 & R3
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    1.01
 | 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       1.00          .01
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .50         2.00
      Length            (m)=      42.00        10.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       117.50
                 over (min)        2.00         4.00
      Storage Coeff.  (min)=       1.62 (ii)    4.14 (ii)
      Unit Hyd. Tpeak (min)=       2.00         4.00
      Unit Hyd. peak  (cms)=        .64          .28
                                                                *TOTALS*
      PEAK FLOW       (cms)=        .40          .00              .400 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.00             2.000
      RUNOFF VOLUME    (mm)=      80.73        32.40            80.252
      TOTAL RAINFALL   (mm)=      82.31        82.31            82.305
      RUNOFF COEFFICIENT   =        .98          .39              .975

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0031----------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estiamted
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>09:(109    )  |
 | OUT<02:(102    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .086  .4495E-01

      ROUTING RESULTS                AREA      QPEAK     TPEAK       R.V.
      --------------------           (ha)      (cms)     (hrs)       (mm)
      INFLOW >09: (109    )          1.01       .400     2.000     80.252
      OUTFLOW<02: (102    )          1.01       .083     2.267     80.252
     OVERFLOW<03: (103    )           .00       .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=    20.714
                   TIME SHIFT OF PEAK FLOW         (min)=     16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4351E-01
```

```
---------------------------------------------------------------------------------------
001:0032-------------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.43
| 05:105    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        2.61          1.82
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        1.89          1.61
     Length            (m)=      103.00         36.00
     Mannings n          =         .013          .200

     Max.eff.Inten.(mm/hr)=      142.89        115.56
                over (min)         2.00          8.00
     Storage Coeff.  (min)=        1.86 (ii)     7.70 (ii)
     Unit Hyd. Tpeak (min)=        2.00          8.00
     Unit Hyd. peak  (cms)=         .58           .15
                                                                *TOTALS*
     PEAK FLOW       (cms)=        1.04           .44             1.457 (iii)
     TIME TO PEAK    (hrs)=        2.00          2.03             2.000
     RUNOFF VOLUME    (mm)=       80.73         32.40            60.916
     TOTAL RAINFALL   (mm)=       82.31         82.31            82.305
     RUNOFF COEFFICIENT   =         .98           .39              .740

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------------
001:0033-------------------------------------------------------------------------------
*
------------------------
| ADD HYD (106       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 02:102           1.01      .083     2.27  80.25    .000
                    +ID2 03:103            .00      .000      .00    .00    .000  **DRY**
                    +ID3 05:105           4.43     1.457     2.00  60.92    .000
                     ==========================================================
                     SUM 06:106           5.44     1.529     2.00  64.51    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------------------
001:0034-------------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.67
| 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .95           .72
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=         .50          2.00
     Length            (m)=      113.00         10.00
     Mannings n          =         .013          .200

     Max.eff.Inten.(mm/hr)=      142.89        117.05
```

```
                   over (min)        3.00          5.00
      Storage Coeff.  (min)=       2.93 (ii)     5.46 (ii)
      Unit Hyd. Tpeak (min)=       3.00          5.00
      Unit Hyd. peak  (cms)=        .38           .21
                                                                *TOTALS*
      PEAK FLOW       (cms)=        .38           .20             .578 (iii)
      TIME TO PEAK    (hrs)=       2.00          2.02            2.000
      RUNOFF VOLUME    (mm)=      80.73         32.40           59.949
      TOTAL RAINFALL   (mm)=      82.31         82.31           82.305
      RUNOFF COEFFICIENT   =        .98           .39             .728

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

   ------------------------------------------------------------------------------------
   001:0035----------------------------------------------------------------------------
   *
   ---------------------
   | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
   |  IN>02:(102    )   |
   | OUT<03:(103    )   |    =========  OUTFLOW STORAGE TABLE  =========
   ---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                               (cms)    (ha.m.)    |    (cms)    (ha.m.)
                                .000  .0000E+00    |     .045  .1920E-01
                                .023  .3000E-03    |     .050  .3360E-01
                                .032  .2300E-02    |     .055  .4700E-01
                                .039  .8200E-02    |     .060  .5480E-01

      ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
      --------------------         (ha)     (cms)     (hrs)       (mm)
      INFLOW >02: (102    )        1.67      .578     2.000     59.949
      OUTFLOW<03: (103    )        1.60      .060     2.200     59.949
     OVERFLOW<05: (105    )         .07      .109     2.200     59.949

                    TOTAL NUMBER OF SIMULATED OVERFLOWS   =         3
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .23
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      3.20


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=    10.387
                    TIME SHIFT OF PEAK FLOW         (min)=     12.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.5479E-01

   ------------------------------------------------------------------------------------
   001:0036----------------------------------------------------------------------------
   *
   ------------------------
   | ADD HYD (109        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
   ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 03:103             1.60      .060    2.20  59.95    .000
                     +ID2 05:105              .07      .109    2.20  59.95    .000
                      ============================================================
                      SUM 09:109             1.67      .169    2.20  59.95    .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

   ------------------------------------------------------------------------------------
   001:0037----------------------------------------------------------------------------
   *
   *SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
   *
   ----------------------
   | CALIB STANDHYD      |   Area    (ha)=    1.03
   | 02:102    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
   ----------------------
```

```
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .98          .05
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=        3.23         1.24
     Length            (m)=       35.00       200.00
     Mannings n          =         .013         .200

     Max.eff.Inten.(mm/hr)=      142.89        83.37
                over (min)         1.00        21.00
     Storage Coeff.  (min)=         .83 (ii)   20.96 (ii)
     Unit Hyd. Tpeak (min)=        1.00        21.00
     Unit Hyd. peak  (cms)=        1.19          .05
                                                               *TOTALS*
     PEAK FLOW       (cms)=         .39          .01              .391 (iii)
     TIME TO PEAK    (hrs)=        1.97         2.25             2.000
     RUNOFF VOLUME    (mm)=       80.74        32.40            78.318
     TOTAL RAINFALL   (mm)=       82.31        82.31            82.305
     RUNOFF COEFFICIENT   =         .98          .39              .952

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0038------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 08:108            9.31    1.949    2.00  56.16    .000
                    +ID2 04:104            5.41    1.694    2.00  70.51    .000
                    +ID3 01:101            6.11    1.405    2.00  55.09    .000
                    +ID4 07:107            5.66     .856    2.00  69.39    .000
                    +ID5 06:106            5.44    1.529    2.00  64.51    .000
                    +ID6 09:109            1.67     .169    2.20  59.95    .000
                    +ID7 02:102            1.03     .391    2.00  78.32    .000
                     ============================================================
                     SUM 03:TOTAL         34.63    7.875    2.00  62.53    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0039------------------------------------------------------------------------
*
      FINISH
--------------------------------------------------------------------------------
********************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                  20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 14:52:21
================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
START               TIME = 0.0
*
* 100 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM       IUNITS=[2], TD=[12](hrs), TPRAT=[0.333], CSDT=[15](min)
                    ICASEcs=[1], A=[1735.688], B=[6.014], C=[0.820]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.00945,  0.00266]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
```

```
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                   [   0.0 ,  0.0    ]
                                   [ 0.096 ,  0.0175 ]
                                   [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
```

```
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.00756,  0.00469]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
```

```
                                  LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7, 8
(south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[4.36](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[1+2+3]
```

```
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.13230,  0.05698]
                                    [   -1  ,  -1     ]
                          IDovf=[7], NHYDovf=["107"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[6+7+9]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[3.26](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
```

```
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.30240,  0.16307]
                                    [   -1  ,  -1     ]
                          IDovf=[5], NHYDovf=["105"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[2.40](ha),
                    XIMP=[0.46], TIMP=[0.46], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.78](%),
                                         LGP=[120](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+5+6]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
```

```
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08562,  0.04495]
                                    [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[2+3+5]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.023 ,  0.0003 ]
                                    [ 0.032 ,  0.0023 ]
                                    [ 0.039 ,  0.0082 ]
                                    [ 0.045 ,  0.0192 ]
                                    [ 0.050 ,  0.0336 ]
```

```
                                             E100Y12H
                                           [ 0.055 ,  0.0470 ]
                                           [ 0.060 ,  0.0548 ]
                                           [   -1  ,    -1   ]
                                 IDovf=[5], NHYDovf=["105"]
*
ADD HYD              IDsum=[9], NHYD=["109"], IDs to add=[3+5]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD       ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.03](ha),
                     XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                     Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                             DCAY=[4.14](/hr), F=[0](mm),
                     Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                          LGP=[200](m), MNP=[0.2], SCP=[0](min),
                     Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                          LGI=[35](m), MNI=[0.013], SCI=[0](min),
                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD              IDsum=[3], NHYD=["TOTAL"], IDs to add=[8+4+1+7+6+9+2]
*
*%-----------------|-----------------------------------------------------------|
FINISH
```

```
==================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                       9   9  9   9   # 3573794
        StormWater Management HYdrologic Model          999    999    =========

 ********************************************************************************
 ***************************** SWMHYMO Ver/4.05  ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                 OTTHYMO-83 and OTTHYMO-89.                  *********
 ********************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ********************************************************************************

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Morrison Hershfield Ltd.                     +++++++++
 +++++++++                Ottawa                SERIAL#:3573794        +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ********************************************************************************
 *********             ++++++ PROGRAM ARRAY DIMENSIONS ++++++          *********
 *********             Maximum value for ID numbers  :     10          *********
 *********             Max. number of rainfall points: 105408          *********
 *********             Max. number of flow points    : 105408          *********
 ********************************************************************************


 *********************   D E T A I L E D   O U T P U T   *********************
 ********************************************************************************
 *         DATE: 2018-10-19     TIME: 14:52:38     RUN COUNTER: 000310         *
 ********************************************************************************
 * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E100Y12H.DAT       *
 * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E100Y12H.out       *
 * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E100Y12H.sum       *
 * User comments:                                                              *
 * 1:__________________________________________________________________________*
 * 2:__________________________________________________________________________*
 * 3:__________________________________________________________________________*
 ********************************************************************************

-----------------------------------------------------------------------------------
001:0001---------------------------------------------------------------------------
*#*******************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
*#                              October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*******************************************************************************
*
--------------------
| START             |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
```

```
     TZERO =   .00 hrs on        0
     METOUT=   2 (output = METRIC)
     NRUN  = 001
     NSTORM=   0
-----------------------------------------------------------------------------------
001:0002-----------------------------------------------------------------------------
*
* 100 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1735.688
| Ptotal= 93.90 mm |                          B=   6.014
--------------------                          C=    .820
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 12.00 hrs
                        Storm time step    = 15.00 min
                        Time to peak ratio =   .33

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .25   1.558 |   3.25   6.869 |   6.25   4.365 |   9.25   2.083
               .50   1.654 |   3.50  10.626 |   6.50   3.974 |   9.50   2.002
               .75   1.763 |   3.75  26.882 |   6.75   3.653 |   9.75   1.927
              1.00   1.890 |   4.00 142.894 |   7.00   3.383 |  10.00   1.858
              1.25   2.040 |   4.25  35.856 |   7.25   3.154 |  10.25   1.795
              1.50   2.218 |   4.50  17.946 |   7.50   2.956 |  10.50   1.736
              1.75   2.435 |   4.75  12.089 |   7.75   2.784 |  10.75   1.681
              2.00   2.705 |   5.00   9.189 |   8.00   2.633 |  11.00   1.630
              2.25   3.051 |   5.25   7.456 |   8.25   2.498 |  11.25   1.582
              2.50   3.514 |   5.50   6.300 |   8.50   2.378 |  11.50   1.538
              2.75   4.164 |   5.75   5.474 |   8.75   2.270 |  11.75   1.496
              3.00   5.156 |   6.00   4.851 |   9.00   2.172 |  12.00   1.456

-----------------------------------------------------------------------------------
001:0003-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       121.11
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.11 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .02          .00            .020 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.00           4.000
     RUNOFF VOLUME    (mm)=      92.33        34.43          91.748
     TOTAL RAINFALL   (mm)=      93.90        93.90          93.897
     RUNOFF COEFFICIENT   =        .98          .37            .977

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
```

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

--------------------------------------------------------------------------------
001:0004------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<02:(102    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |   (cms)    (ha.m.)
                            .000  .0000E+00   |    .009  .2660E-02

     ROUTING RESULTS                AREA     QPEAK     TPEAK       R.V.
     --------------------           (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )           .05      .020     4.000     91.748
     OUTFLOW<02: (102    )           .05      .006     4.083     91.747
    OVERFLOW<03: (103    )           .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.662
                   TIME SHIFT OF PEAK FLOW         (min)=     5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1822E-02

--------------------------------------------------------------------------------
001:0005------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.60
| 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .02         1.58
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=        2.03         1.76
     Length            (m)=       37.00        85.00
     Mannings n          =         .013         .200

     Max.eff.Inten.(mm/hr)=      142.89       118.96
                over (min)         1.00        10.00
     Storage Coeff.  (min)=         .99 (ii)   10.39 (ii)
     Unit Hyd. Tpeak (min)=        1.00        10.00
     Unit Hyd. peak  (cms)=        1.08          .11
                                                              *TOTALS*
     PEAK FLOW       (cms)=         .01          .35            .349 (iii)
     TIME TO PEAK    (hrs)=        3.93         4.07           4.067
     RUNOFF VOLUME    (mm)=       92.33        34.43          35.013
     TOTAL RAINFALL   (mm)=       93.90        93.90          93.897
     RUNOFF COEFFICIENT   =         .98          .37            .373
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0006------------------------------------------------------------------------
```

```
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 02:102            .05      .006     4.08   91.75     .000
                    +ID2 03:103            .00      .000      .00     .00     .000   **DRY**
                    +ID3 04:104           1.60      .349     4.07   35.01     .000
                     ==============================================================
                     SUM 05:105           1.65      .355     4.07   36.73     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0007------------------------------------------------------------------------
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .096  (cms)
| TotalHyd 05:105    |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity          =    .096  (cms)
                         Total major system storage [TMJSTO] =      70.(cu.m.)

                  ID: NHYD        AREA      QPEAK      TPEAK      R.V.       DWF
                                  (ha)      (cms)      (hrs)      (mm)     (cms)
     TOTAL HYD.   05:105          1.65       .355      4.067    36.732      .000
     =========================================================================
     MAJOR SYST   06:106           .59       .259      4.067    36.732      .000
     MINOR SYST   07:107          1.06       .096      3.867    36.963      .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

     Maximum MAJOR SYSTEM storage used =      70.(cu.m.)

--------------------------------------------------------------------------------
001:0008------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .67
| 08:108    DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .60          .07
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.00         4.03
     Length            (m)=      25.00        34.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       120.80
                over (min)        1.00         5.00
     Storage Coeff.  (min)=        .78 (ii)     4.99 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.23          .23
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .24          .02            .260 (iii)
     TIME TO PEAK    (hrs)=       3.95         4.00           4.000
     RUNOFF VOLUME    (mm)=      92.33        34.43          86.537
     TOTAL RAINFALL   (mm)=      93.90        93.90          93.897
     RUNOFF COEFFICIENT   =        .98          .37            .922

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0009------------------------------------------------------------------------
```

```
*
*Combine Subcatchments 7 & 8
*
------------------------
| ADD HYD (109        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.     DWF
------------------------                   (ha)     (cms)    (hrs)   (mm)    (cms)
                     ID1 07:107             1.06      .096     3.87  36.96     .000
                    +ID2 08:108              .67      .260     4.00  86.54     .000
                     ============================================================
                     SUM 09:109             1.73      .356     4.00  56.13     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0010-----------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE  |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)  |    (cms)    (ha.m.)
                            .000  .0000E+00  |     .096  .1750E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )       1.73      .356     4.000     56.132
     OUTFLOW<01: (101    )       1.35      .096     3.917     56.132
    OVERFLOW<02: (102    )        .38      .259     4.000     56.132

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         2
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .92
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      4.92


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   27.002
                   TIME SHIFT OF PEAK FLOW         (min)=    -5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1754E-01

-------------------------------------------------------------------------------------
001:0011-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.08
| 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        3.05           .03
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        1.90           .01
     Length            (m)=      140.00         40.00
     Mannings n           =        .013          .200

     Max.eff.Inten.(mm/hr)=      142.89         47.87
                over (min)         2.00         43.00
     Storage Coeff.  (min)=        2.24 (ii)    42.86 (ii)
     Unit Hyd. Tpeak (min)=        2.00         43.00
     Unit Hyd. peak  (cms)=         .52           .03
                                                              *TOTALS*
     PEAK FLOW       (cms)=        1.21           .00           1.209 (iii)
     TIME TO PEAK    (hrs)=        4.00          4.62           4.000
     RUNOFF VOLUME    (mm)=       92.32         34.43          91.748
     TOTAL RAINFALL   (mm)=       93.90         93.90          93.897
     RUNOFF COEFFICIENT   =         .98           .37            .977
```

```
        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------------------
 001:0012-------------------------------------------------------------------------------
 *
 *Combine Subcatchment 6 and Overflows
 *
 ------------------------
 | ADD HYD (104        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 06:106             .59      .259    4.07  36.73    .000
                     +ID2 02:102             .38      .259    4.00  56.13    .000
                     +ID3 03:103            3.08     1.209    4.00  91.75    .000
                      ============================================================
                      SUM 04:104            4.05     1.468    4.00  80.41    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ---------------------------------------------------------------------------------------
 001:0013-------------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 5: Building V and Snow Dump
 *
 *Total Building Area - Includes Building V
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .09
 | 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=         .09          .00
      Dep. Storage     (mm)=        1.57         4.67
      Average Slope     (%)=         .50         2.00
      Length            (m)=       42.00        10.00
      Mannings n          =         .013         .200

      Max.eff.Inten.(mm/hr)=      142.89       121.11
                 over (min)         2.00         4.00
      Storage Coeff.  (min)=        1.62 (ii)    4.11 (ii)
      Unit Hyd. Tpeak (min)=        2.00         4.00
      Unit Hyd. peak  (cms)=         .64          .28
                                                                *TOTALS*
      PEAK FLOW       (cms)=         .04          .00             .036 (iii)
      TIME TO PEAK    (hrs)=        4.00         4.00            4.000
      RUNOFF VOLUME    (mm)=       92.32        34.43           91.748
      TOTAL RAINFALL   (mm)=       93.90        93.90           93.897
      RUNOFF COEFFICIENT   =         .98          .37             .977

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------------------
 001:0014-------------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>08:(108    )  |
 | OUT<09:(109    )  |    =========  OUTFLOW STORAGE TABLE  =========
```

```
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |   (cms)    (ha.m.)
                            .000  .0000E+00    |    .008  .4690E-02

     ROUTING RESULTS            AREA      QPEAK      TPEAK        R.V.
     --------------------       (ha)      (cms)      (hrs)        (mm)
     INFLOW >08: (108    )       .09       .036      4.000      91.748
     OUTFLOW<09: (109    )       .09       .007      4.283      91.747
    OVERFLOW<02: (102    )       .00       .000       .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.693
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4135E-02

--------------------------------------------------------------------------------------
001:0015------------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.82
| 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .76         3.06
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=         .01         2.04
     Length            (m)=         .01       425.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      142.89        67.32
                over (min)        1.00        30.00
     Storage Coeff.  (min)=         .04 (ii)   29.72 (ii)
     Unit Hyd. Tpeak (min)=        1.00        30.00
     Unit Hyd. peak  (cms)=        1.70          .04
                                                               *TOTALS*
     PEAK FLOW       (cms)=         .30          .32             .390 (iii)
     TIME TO PEAK    (hrs)=        3.83         4.40            4.000
     RUNOFF VOLUME    (mm)=       92.33        34.43           46.013
     TOTAL RAINFALL   (mm)=       93.90        93.90           93.897
     RUNOFF COEFFICIENT   =         .98          .37             .490

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------------
001:0016------------------------------------------------------------------------------
*
------------------------
| ADD HYD (105       ) | ID: NHYD         AREA      QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)      (cms)    (hrs)   (mm)   (cms)
                    ID1 09:109             .09       .007     4.28  91.75    .000
                   +ID2 02:102             .00       .000      .00    .00    .000   **DRY**
                   +ID3 03:103            3.82       .390     4.00  46.01    .000
                    ============================================================
                    SUM 05:105            3.91       .396     4.00  47.07    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------------
```

```
001:0017---------------------------------------------------------------------------
*
*Combine Subcatchments 5, 6, 7 & 8
*
------------------------
| ADD HYD (108        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101             1.35      .096    3.92  56.13    .000
                    +ID2 04:104             4.05     1.468    4.00  80.41    .000
                    +ID3 05:105             3.91      .396    4.00  47.07    .000
                     ============================================================
                     SUM 08:108             9.31     1.960    4.00  62.88    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------------------
001:0018---------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7,
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.05
| 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.04          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       121.11
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.11 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .41          .00           .416 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.00          4.000
     RUNOFF VOLUME    (mm)=      92.32        34.43         91.748
     TOTAL RAINFALL   (mm)=      93.90        93.90         93.897
     RUNOFF COEFFICIENT   =        .98          .37           .977

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------------
001:0019---------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109   )   |
| OUT<01:(101   )   |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .085  .5115E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109   )         1.05      .416     4.000     91.748
     OUTFLOW<01: (101   )         1.05      .080     4.283     91.747
```

```
    OVERFLOW<02: (102   )        .00      .000      .000       .000

                       TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                       CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                       PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                       PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.125
                       TIME SHIFT OF PEAK FLOW         (min)=    17.00
                       MAXIMUM  STORAGE   USED       (ha.m.)=.4785E-01

 ----------------------------------------------------------------------------
 001:0020--------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    4.36
 | 03:103    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
 ----------------------
                                IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        3.23          1.13
      Dep. Storage     (mm)=        1.57          4.67
      Average Slope     (%)=        1.43         15.38
      Length            (m)=      116.00         13.00
      Mannings n          =         .013          .200

      Max.eff.Inten.(mm/hr)=      142.89        121.11
                 over (min)         2.00          4.00
      Storage Coeff.  (min)=        2.17 (ii)     3.75 (ii)
      Unit Hyd. Tpeak (min)=        2.00          4.00
      Unit Hyd. peak  (cms)=         .53           .29
                                                               *TOTALS*
      PEAK FLOW       (cms)=        1.28           .36           1.642 (iii)
      TIME TO PEAK    (hrs)=        4.00          4.00           4.000
      RUNOFF VOLUME    (mm)=       92.32         34.43          77.275
      TOTAL RAINFALL   (mm)=       93.90         93.90          93.897
      RUNOFF COEFFICIENT   =         .98           .37            .823

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0021--------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (104       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 01:101           1.05      .080    4.28  91.75    .000
                     +ID2 02:102            .00      .000     .00    .00    .000   **DRY**
                     +ID3 03:103           4.36     1.642    4.00  77.27    .000
                      ============================================================
                      SUM 04:104           5.41     1.710    4.00  80.08    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------
 001:0022--------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 1: Building B, K, M & T
 *
 *Total Building Area - Includes Building B, K, M & T
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.14
```

```
| 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                 IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.13           .01
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=         .50          2.00
     Length            (m)=       42.00         10.00
     Mannings n           =        .013          .200

     Max.eff.Inten.(mm/hr)=      142.89        121.11
                over (min)         2.00          4.00
     Storage Coeff.  (min)=        1.62 (ii)     4.11 (ii)
     Unit Hyd. Tpeak (min)=        2.00          4.00
     Unit Hyd. peak  (cms)=         .64           .28
                                                                *TOTALS*
     PEAK FLOW       (cms)=         .45           .00             .452 (iii)
     TIME TO PEAK    (hrs)=        4.00          4.00            4.000
     RUNOFF VOLUME    (mm)=       92.32         34.43           91.748
     TOTAL RAINFALL   (mm)=       93.90         93.90           93.897
     RUNOFF COEFFICIENT   =         .98           .37             .977

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0023------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(105   )   |
| OUT<06:(106   )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .132  .5698E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >05: (105    )        1.14      .452     4.000     91.748
     OUTFLOW<06: (106    )        1.14      .109     4.250     91.748
    OVERFLOW<07: (107    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =          0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=        .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=        .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   24.173
                   TIME SHIFT OF PEAK FLOW         (min)=    15.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4702E-01

--------------------------------------------------------------------------------
001:0024------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.97
| 09:109    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                                 IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.74          3.23
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        1.00          1.42
```

```
      Length            (m)=      57.00        57.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       119.37
                 over (min)        2.00         9.00
      Storage Coeff.  (min)=       1.58 (ii)    9.46 (ii)
      Unit Hyd. Tpeak (min)=       2.00         9.00
      Unit Hyd. peak  (cms)=        .65          .12
                                                           *TOTALS*
      PEAK FLOW       (cms)=        .69          .75          1.376 (iii)
      TIME TO PEAK    (hrs)=       4.00         4.05          4.000
      RUNOFF VOLUME    (mm)=      92.32        34.43         54.697
      TOTAL RAINFALL   (mm)=      93.90        93.90         93.897
      RUNOFF COEFFICIENT   =        .98          .37           .583

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0025------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (101       ) | ID: NHYD          AREA      QPEAK    TPEAK   R.V.    DWF
 ------------------------                   (ha)      (cms)    (hrs)   (mm)   (cms)
                      ID1 06:106            1.14      .109     4.25   91.75    .000
                     +ID2 07:107             .00      .000      .00     .00    .000   **DRY**
                     +ID3 09:109            4.97     1.376     4.00   54.70    .000
                      ============================================================
                      SUM 01:101            6.11     1.473     4.00   61.61    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0026------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 2: Building A, C, D, H & J
 *
 *Total Building Area - Includes Building A, C, D, H & J
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    3.26
 | 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       3.23          .03
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .50         2.00
      Length            (m)=      42.00        10.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       121.11
                 over (min)        2.00         4.00
      Storage Coeff.  (min)=       1.62 (ii)    4.11 (ii)
      Unit Hyd. Tpeak (min)=       2.00         4.00
      Unit Hyd. peak  (cms)=        .64          .28
                                                           *TOTALS*
      PEAK FLOW       (cms)=       1.28          .01          1.291 (iii)
      TIME TO PEAK    (hrs)=       4.00         4.00          4.000
      RUNOFF VOLUME    (mm)=      92.32        34.43         91.748
      TOTAL RAINFALL   (mm)=      93.90        93.90         93.897
      RUNOFF COEFFICIENT   =        .98          .37           .977

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
```

```
        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
             THAN THE STORAGE COEFFICIENT.
       (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0027------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estiamted
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>02:(102    )  |
 | OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .302  .1631E+00

      ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
      --------------------        (ha)     (cms)     (hrs)       (mm)
      INFLOW >02: (102    )       3.26     1.291     4.000     91.748
      OUTFLOW<03: (103    )       3.26      .267     4.267     91.747
     OVERFLOW<05: (105    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.694
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1442E+00

 --------------------------------------------------------------------------------
 001:0028------------------------------------------------------------------------
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    2.40
 | 06:106    DT= 1.00 |   Total Imp(%)=   46.00   Dir. Conn.(%)=   46.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       1.10         1.30
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=       1.92         2.78
      Length            (m)=     130.00       120.00
      Mannings n           =       .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       118.10
                 over (min)        2.00        12.00
      Storage Coeff.  (min)=       2.13 (ii)   12.25 (ii)
      Unit Hyd. Tpeak (min)=       2.00        12.00
      Unit Hyd. peak  (cms)=        .54          .09
                                                            *TOTALS*
      PEAK FLOW       (cms)=        .44          .26           .643 (iii)
      TIME TO PEAK    (hrs)=       4.00         4.10          4.000
      RUNOFF VOLUME    (mm)=      92.32        34.43         61.065
      TOTAL RAINFALL   (mm)=      93.90        93.90         93.897
      RUNOFF COEFFICIENT   =        .98          .37           .650

         (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
              Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
              Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
             THAN THE STORAGE COEFFICIENT.
       (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0029------------------------------------------------------------------------
 *
```

```
 ------------------------
 | ADD HYD (107         ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                      ID1 03:103             3.26      .267     4.27  91.75    .000
                     +ID2 05:105              .00      .000      .00    .00    .000  **DRY**
                     +ID3 06:106             2.40      .643     4.00  61.06    .000
                      ==============================================================
                      SUM 07:107             5.66      .874     4.00  78.74    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------------------
 001:0030--------------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
 *
 *Total Building Area - Includes Building F, G, R1, R2 & R3
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.01
 | 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        1.00          .01
      Dep. Storage     (mm)=        1.57         4.67
      Average Slope     (%)=         .50         2.00
      Length            (m)=       42.00        10.00
      Mannings n          =         .013         .200

      Max.eff.Inten.(mm/hr)=      142.89       121.11
                 over (min)         2.00         4.00
      Storage Coeff.  (min)=        1.62 (ii)    4.11 (ii)
      Unit Hyd. Tpeak (min)=        2.00         4.00
      Unit Hyd. peak  (cms)=         .64          .28
                                                                *TOTALS*
      PEAK FLOW       (cms)=         .40          .00              .400 (iii)
      TIME TO PEAK    (hrs)=        4.00         4.00             4.000
      RUNOFF VOLUME    (mm)=       92.32        34.43            91.748
      TOTAL RAINFALL   (mm)=       93.90        93.90            93.897
      RUNOFF COEFFICIENT   =         .98          .37              .977

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------------------
 001:0031--------------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estiamted
 *
 ---------------------
 | ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
 |  IN>09:(109    )  |
 | OUT<02:(102    )  |     =========  OUTFLOW STORAGE TABLE  =========
 ---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                             (cms)    (ha.m.)    |    (cms)    (ha.m.)
                              .000  .0000E+00    |     .086  .4495E-01

      ROUTING RESULTS                AREA     QPEAK     TPEAK       R.V.
      --------------------           (ha)     (cms)     (hrs)       (mm)
      INFLOW >09: (109    )          1.01      .400     4.000     91.748
      OUTFLOW<02: (102    )          1.01      .084     4.267     91.747
     OVERFLOW<03: (103    )           .00      .000      .000       .000

                         TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                         CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
```

```
                     PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                     PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.094
                     TIME SHIFT OF PEAK FLOW          (min)=    16.00
                     MAXIMUM  STORAGE   USED        (ha.m.)=.4432E-01

 ----------------------------------------------------------------------------
 001:0032--------------------------------------------------------------------
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    4.43
 | 05:105    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        2.61          1.82
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        1.89          1.61
     Length            (m)=      103.00         36.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      142.89        119.75
                over (min)         2.00          8.00
     Storage Coeff.  (min)=        1.86 (ii)     7.62 (ii)
     Unit Hyd. Tpeak (min)=        2.00          8.00
     Unit Hyd. peak  (cms)=         .58           .15
                                                              *TOTALS*
     PEAK FLOW       (cms)=        1.04           .46           1.481 (iii)
     TIME TO PEAK    (hrs)=        4.00          4.03           4.000
     RUNOFF VOLUME    (mm)=       92.32         34.43          68.591
     TOTAL RAINFALL   (mm)=       93.90         93.90          93.897
     RUNOFF COEFFICIENT   =         .98           .37            .730

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0033--------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (106        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                      ID1 02:102            1.01      .084     4.27  91.75    .000
                     +ID2 03:103             .00      .000      .00    .00    .000  **DRY**
                     +ID3 05:105            4.43     1.481     4.00  68.59    .000
                      ============================================================
                      SUM 06:106            5.44     1.554     4.00  72.89    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------
 001:0034--------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
 *
 *Area controlled to 60L/s to meet Pinecrest Creek Criteria
 *SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    1.67
 | 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .95           .72
```

```
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=     113.00         10.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        120.80
                over (min)        3.00          5.00
     Storage Coeff.  (min)=       2.93 (ii)     5.43 (ii)
     Unit Hyd. Tpeak (min)=       3.00          5.00
     Unit Hyd. peak  (cms)=        .38           .21
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .38           .21               .587 (iii)
     TIME TO PEAK    (hrs)=       4.00          4.00              4.000
     RUNOFF VOLUME    (mm)=      92.32         34.43             67.433
     TOTAL RAINFALL   (mm)=      93.90         93.90             93.897
     RUNOFF COEFFICIENT   =        .98           .37               .718

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0035------------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .045  .1920E-01
                            .023  .3000E-03    |     .050  .3360E-01
                            .032  .2300E-02    |     .055  .4700E-01
                            .039  .8200E-02    |     .060  .5480E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )       1.67      .587     4.000     67.433
     OUTFLOW<03: (103    )       1.58      .060     4.167     67.433
    OVERFLOW<05: (105    )        .09      .138     4.167     67.433

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         3
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .28
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      2.15


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   10.223
                   TIME SHIFT OF PEAK FLOW         (min)=    10.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.5479E-01

--------------------------------------------------------------------------------
001:0036------------------------------------------------------------------------
*
------------------------
| ADD HYD (109       ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)   (cms)
                      ID1 03:103          1.58      .060     4.17   67.43    .000
                     +ID2 05:105           .09      .138     4.17   67.43    .000
                      ============================================================
                      SUM 09:109          1.67      .198     4.17   67.43    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0037------------------------------------------------------------------------
*
```

```
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.03
| 02:102    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .98          .05
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       3.23         1.24
     Length            (m)=      35.00       200.00
     Mannings n          =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89        91.56
                over (min)        1.00        20.00
     Storage Coeff.  (min)=        .83 (ii)   20.22 (ii)
     Unit Hyd. Tpeak (min)=       1.00        20.00
     Unit Hyd. peak  (cms)=       1.19          .06
                                                         *TOTALS*
     PEAK FLOW       (cms)=        .39          .01           .392 (iii)
     TIME TO PEAK    (hrs)=       3.97         4.23          4.000
     RUNOFF VOLUME    (mm)=      92.33        34.43         89.432
     TOTAL RAINFALL   (mm)=      93.90        93.90         93.897
     RUNOFF COEFFICIENT   =        .98          .37           .952

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0038----------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 08:108            9.31    1.960    4.00  62.88    .000
                    +ID2 04:104            5.41    1.710    4.00  80.08    .000
                    +ID3 01:101            6.11    1.473    4.00  61.61    .000
                    +ID4 07:107            5.66     .874    4.00  78.74    .000
                    +ID5 06:106            5.44    1.554    4.00  72.89    .000
                    +ID6 09:109            1.67     .198    4.17  67.43    .000
                    +ID7 02:102            1.03     .392    4.00  89.43    .000
                     ===========================================================
                     SUM 03:TOTAL         34.63    8.015    4.00  70.52    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0039----------------------------------------------------------------------------
*
      FINISH
-------------------------------------------------------------------------------------
*************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 14:52:39
=====================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2017
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
START               TIME = 0.0
*
* 100 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM       IUNITS=[2], TD=[24](hrs), TPRAT=[0.333], CSDT=[15](min)
                    ICASEcs=[1], A=[1735.688], B=[6.014], C=[0.820]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                   [   0.0 ,  0.0    ]
                                   [0.00945,  0.00266]
                                   [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
```

```
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.096 ,  0.0175 ]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
```

```
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.00756,  0.00469]
                                    [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
```

```
                                 LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,   ,   ,   , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7, 8
(south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,   ,   ,   , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,   -1    ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[4.36](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,   ,   ,   , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[1+2+3]
```

```
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.13230,  0.05698]
                                  [   -1  ,  -1     ]
                          IDovf=[7], NHYDovf=["107"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[6+7+9]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[3.26](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
```

```
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.30240,  0.16307]
                                    [   -1  ,  -1     ]
                          IDovf=[5], NHYDovf=["105"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[2.40](ha),
                    XIMP=[0.46], TIMP=[0.46], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.78](%),
                                         LGP=[120](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+5+6]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
```

```
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.08562,  0.04495]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]

*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[2+3+5]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.023 ,  0.0003 ]
                                  [ 0.032 ,  0.0023 ]
                                  [ 0.039 ,  0.0082 ]
                                  [ 0.045 ,  0.0192 ]
                                  [ 0.050 ,  0.0336 ]
```

```
                                      E100Y24H
                                    [ 0.055 ,  0.0470 ]
                                    [ 0.060 ,  0.0548 ]
                                    [   -1  ,    -1   ]
                          IDovf=[5], NHYDovf=["105"]
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[3+5]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[3], NHYD=["TOTAL"], IDs to add=[8+4+1+7+6+9+2]
*
*%-----------------|-----------------------------------------------------------|
FINISH
```

```
================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                       9   9  9   9   # 3573794
        StormWater Management HYdrologic Model          999    999    =========

 ******************************************************************************
 ***************************** SWMHYMO Ver/4.05  *****************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                  OTTHYMO-83 and OTTHYMO-89.                 *********
 ******************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ******************************************************************************


 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Morrison Hershfield Ltd.                    +++++++++
 +++++++++                Ottawa                 SERIAL#:3573794      +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ******************************************************************************
 *********             ++++++ PROGRAM ARRAY DIMENSIONS ++++++          *********
 *********             Maximum value for ID numbers  :     10          *********
 *********             Max. number of rainfall points: 105408          *********
 *********             Max. number of flow points    : 105408          *********
 ******************************************************************************


 *********************   D E T A I L E D   O U T P U T   *********************
 ******************************************************************************
 *         DATE: 2018-10-19     TIME: 14:52:48     RUN COUNTER: 000311        *
 ******************************************************************************
 * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E100Y24H.DAT      *
 * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E100Y24H.out      *
 * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\E100Y24H.sum      *
 * User comments:                                                             *
 * 1:_________________________________________________________________________*
 * 2:_________________________________________________________________________*
 * 3:_________________________________________________________________________*
 ******************************************************************************

--------------------------------------------------------------------------------
001:0001------------------------------------------------------------------------
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 06-28-2017
*#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
*#                              October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
--------------------
| START            |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\Exs\
```

```
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
--------------------------------------------------------------------------------------
001:0002------------------------------------------------------------------------------
*
* 100 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM    |     IDF curve parameters: A=1735.688
| Ptotal=106.74 mm |                           B=   6.014
--------------------                           C=    .820
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 24.00 hrs
                        Storm time step    = 15.00 min
                        Time to peak ratio =   .33

              TIME    RAIN |    TIME    RAIN |    TIME    RAIN |    TIME    RAIN
               hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr
               .25    .841 |    6.25   3.051 |   12.25   2.498 |   18.25   1.182
               .50    .864 |    6.50   3.514 |   12.50   2.378 |   18.50   1.158
               .75    .889 |    6.75   4.164 |   12.75   2.270 |   18.75   1.135
              1.00    .916 |    7.00   5.156 |   13.00   2.172 |   19.00   1.114
              1.25    .945 |    7.25   6.869 |   13.25   2.083 |   19.25   1.093
              1.50    .975 |    7.50  10.626 |   13.50   2.002 |   19.50   1.073
              1.75   1.008 |    7.75  26.882 |   13.75   1.927 |   19.75   1.054
              2.00   1.043 |    8.00 142.894 |   14.00   1.858 |   20.00   1.035
              2.25   1.082 |    8.25  35.856 |   14.25   1.795 |   20.25   1.018
              2.50   1.123 |    8.50  17.946 |   14.50   1.736 |   20.50   1.001
              2.75   1.168 |    8.75  12.089 |   14.75   1.681 |   20.75    .984
              3.00   1.218 |    9.00   9.189 |   15.00   1.630 |   21.00    .968
              3.25   1.272 |    9.25   7.456 |   15.25   1.582 |   21.25    .953
              3.50   1.332 |    9.50   6.300 |   15.50   1.538 |   21.50    .938
              3.75   1.399 |    9.75   5.474 |   15.75   1.496 |   21.75    .924
              4.00   1.474 |   10.00   4.851 |   16.00   1.456 |   22.00    .910
              4.25   1.558 |   10.25   4.365 |   16.25   1.419 |   22.25    .897
              4.50   1.654 |   10.50   3.974 |   16.50   1.383 |   22.50    .884
              4.75   1.763 |   10.75   3.653 |   16.75   1.350 |   22.75    .871
              5.00   1.890 |   11.00   3.383 |   17.00   1.318 |   23.00    .859
              5.25   2.040 |   11.25   3.154 |   17.25   1.288 |   23.25    .848
              5.50   2.218 |   11.50   2.956 |   17.50   1.260 |   23.50    .836
              5.75   2.435 |   11.75   2.784 |   17.75   1.232 |   23.75    .825
              6.00   2.705 |   12.00   2.633 |   18.00   1.206 |   24.00    .814

--------------------------------------------------------------------------------------
001:0003------------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .05          .00
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=         .50         2.00
     Length            (m)=       42.00        10.00
     Mannings n          =         .013         .200

     Max.eff.Inten.(mm/hr)=      142.89       125.58
                over (min)         2.00         4.00
     Storage Coeff.  (min)=        1.62 (ii)    4.07 (ii)
     Unit Hyd. Tpeak (min)=        2.00         4.00
     Unit Hyd. peak  (cms)=         .64          .28
```

```
                                                                        *TOTALS*
     PEAK FLOW       (cms)=        .02          .00            .020 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.00           8.000
     RUNOFF VOLUME    (mm)=     105.17        37.09         104.491
     TOTAL RAINFALL   (mm)=     106.74       106.74         106.742
     RUNOFF COEFFICIENT   =        .99          .35            .979

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0004-----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<02:(102    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .009  .2660E-02

     ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
     --------------------          (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )          .05      .020     8.000    104.491
     OUTFLOW<02: (102    )          .05      .006     8.083    104.491
    OVERFLOW<03: (103    )          .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.683
                   TIME SHIFT OF PEAK FLOW         (min)=     5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1824E-02

-------------------------------------------------------------------------------------
001:0005-----------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.60
| 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02         1.58
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.03         1.76
     Length            (m)=      37.00        85.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       124.55
                over (min)        1.00        10.00
     Storage Coeff.  (min)=        .99 (ii)   10.22 (ii)
     Unit Hyd. Tpeak (min)=       1.00        10.00
     Unit Hyd. peak  (cms)=       1.08          .11
                                                                        *TOTALS*
     PEAK FLOW       (cms)=        .01          .37            .372 (iii)
     TIME TO PEAK    (hrs)=       7.93         8.07           8.067
     RUNOFF VOLUME    (mm)=     105.17        37.09          37.775
     TOTAL RAINFALL   (mm)=     106.74       106.74         106.742
     RUNOFF COEFFICIENT   =        .99          .35            .354
```

```
  *** WARNING: For areas with impervious ratios below
               20%, this routine may not be applicable.

   (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
        Fo    (mm/hr)= 76.20          K  (1/hr)=  4.14
        Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
  (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
       THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0006------------------------------------------------------------------------
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 02:102             .05      .006    8.08 104.49    .000
                    +ID2 03:103             .00      .000     .00    .00    .000  **DRY**
                    +ID3 04:104            1.60      .372    8.07  37.77    .000
                     ==============================================================
                     SUM 05:105            1.65      .379    8.07  39.80    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0007------------------------------------------------------------------------
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .096  (cms)
| TotalHyd 05:105    |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity         =    .096  (cms)
                         Total major system storage [TMJSTO] =      70.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   05:105          1.65      .379     8.067   39.797     .000
     ======================================================================
     MAJOR SYST   06:106           .63      .283     8.067   39.797     .000
     MINOR SYST   07:107          1.02      .096     8.850   40.066     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

     Maximum MAJOR SYSTEM storage used =      70.(cu.m.)

--------------------------------------------------------------------------------
001:0008------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .67
| 08:108    DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .60          .07
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.00         4.03
     Length            (m)=      25.00        34.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       125.43
                over (min)        1.00         5.00
     Storage Coeff.  (min)=        .78 (ii)     4.93 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.23          .23
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .24          .02           .261 (iii)
     TIME TO PEAK    (hrs)=       7.95         8.00          8.000
     RUNOFF VOLUME    (mm)=     105.17        37.09         98.364
```

```
    TOTAL RAINFALL   (mm)=     106.74       106.74        106.742
    RUNOFF COEFFICIENT   =        .99          .35           .922

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
           Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0009-----------------------------------------------------------------------------
*
*Combine Subcatchments 7 & 8
*
------------------------
| ADD HYD (109        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 07:107            1.02      .096    8.85  40.07    .000
                    +ID2 08:108             .67      .261    8.00  98.36    .000
                     ============================================================
                     SUM 09:109            1.69      .357    8.00  63.20    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0010-----------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .096  .1750E-01

    ROUTING RESULTS               AREA     QPEAK     TPEAK        R.V.
    --------------------          (ha)     (cms)     (hrs)        (mm)
    INFLOW >09: (109    )         1.69      .357     8.000      63.202
    OUTFLOW<01: (101    )         1.34      .096     7.917      63.203
   OVERFLOW<02: (102    )          .35      .260     8.000      63.202

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         2
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .93
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      3.10


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   26.917
                   TIME SHIFT OF PEAK FLOW         (min)=    -5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1753E-01

-------------------------------------------------------------------------------------
001:0011-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.08
| 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=        3.05          .03
    Dep. Storage     (mm)=        1.57         4.67
    Average Slope     (%)=        1.90          .01
    Length            (m)=      140.00        40.00
    Mannings n          =        .013         .200
```

```
          Max.eff.Inten.(mm/hr)=     142.89         53.67
                     over (min)        2.00         41.00
          Storage Coeff.  (min)=       2.24 (ii)    41.05 (ii)
          Unit Hyd. Tpeak (min)=       2.00         41.00
          Unit Hyd. peak  (cms)=        .52           .03
                                                                 *TOTALS*
          PEAK FLOW       (cms)=       1.21           .00          1.209 (iii)
          TIME TO PEAK    (hrs)=       8.00          8.58          8.000
          RUNOFF VOLUME    (mm)=     105.17         37.09        104.491
          TOTAL RAINFALL   (mm)=     106.74        106.74        106.742
          RUNOFF COEFFICIENT   =        .99           .35           .979

            (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
                 Fo    (mm/hr)= 76.20            K  (1/hr)=  4.14
                 Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
           (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
                THAN THE STORAGE COEFFICIENT.
          (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

     -------------------------------------------------------------------------------------
     001:0012-----------------------------------------------------------------------------
     *
     *Combine Subcatchment 6 and Overflows
     *
     ------------------------
     | ADD HYD (104        ) | ID: NHYD          AREA      QPEAK    TPEAK    R.V.     DWF
     ------------------------                    (ha)      (cms)    (hrs)    (mm)    (cms)
                          ID1 06:106              .63      .283     8.07   39.80     .000
                         +ID2 02:102              .35      .260     8.00   63.20     .000
                         +ID3 03:103             3.08     1.209     8.00  104.49     .000
                          ============================================================
                          SUM 04:104             4.06     1.528     8.02   90.90     .000

        NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

     -------------------------------------------------------------------------------------
     001:0013-----------------------------------------------------------------------------
     *
     *SUBCATCHMENT AREA 5: Building V and Snow Dump
     *
     *Total Building Area - Includes Building V
     *
     ----------------------
     | CALIB STANDHYD      |   Area    (ha)=     .09
     | 08:108    DT= 1.00  |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
     ----------------------
                                  IMPERVIOUS    PERVIOUS (i)
          Surface Area     (ha)=        .09           .00
          Dep. Storage     (mm)=       1.57          4.67
          Average Slope     (%)=        .50          2.00
          Length            (m)=      42.00         10.00
          Mannings n           =       .013          .200

          Max.eff.Inten.(mm/hr)=     142.89        125.58
                     over (min)        2.00          4.00
          Storage Coeff.  (min)=       1.62 (ii)     4.07 (ii)
          Unit Hyd. Tpeak (min)=       2.00          4.00
          Unit Hyd. peak  (cms)=        .64           .28
                                                                 *TOTALS*
          PEAK FLOW       (cms)=        .04           .00           .036 (iii)
          TIME TO PEAK    (hrs)=       8.00          8.00          8.000
          RUNOFF VOLUME    (mm)=     105.17         37.09        104.491
          TOTAL RAINFALL   (mm)=     106.74        106.74        106.742
          RUNOFF COEFFICIENT   =        .99           .35           .979

            (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
                 Fo    (mm/hr)= 76.20            K  (1/hr)=  4.14
                 Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
           (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0014--------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>08:(108    )  |
 | OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .008  .4690E-02

      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
      --------------------       (ha)     (cms)     (hrs)       (mm)
      INFLOW >08: (108   )        .09      .036     8.000    104.491
      OUTFLOW<09: (109   )        .09      .007     8.283    104.491
     OVERFLOW<02: (102   )        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.821
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.4165E-02

 ----------------------------------------------------------------------------
 001:0015--------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    3.82
 | 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .76         3.06
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .01         2.04
      Length            (m)=        .01       425.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=     142.89        73.67
                 over (min)        1.00        29.00
      Storage Coeff.  (min)=        .04 (ii)   28.66 (ii)
      Unit Hyd. Tpeak (min)=       1.00        29.00
      Unit Hyd. peak  (cms)=       1.70          .04
                                                               *TOTALS*
      PEAK FLOW       (cms)=        .30          .35             .404 (iii)
      TIME TO PEAK    (hrs)=       7.78         8.38            8.000
      RUNOFF VOLUME    (mm)=     105.17        37.09           50.710
      TOTAL RAINFALL   (mm)=     106.74       106.74          106.742
      RUNOFF COEFFICIENT   =        .99          .35             .475

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0016--------------------------------------------------------------------
 *
```

```
------------------------
| ADD HYD (105        ) | ID: NHYD          AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 09:109              .09      .007     8.28 104.49    .000
                    +ID2 02:102              .00      .000      .00    .00    .000   **DRY**
                    +ID3 03:103             3.82      .404     8.00  50.71    .000
                     ============================================================
                     SUM 05:105             3.91      .410     8.00  51.95    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0017-----------------------------------------------------------------------------
*
*Combine Subcatchments 5, 6, 7 & 8
*
------------------------
| ADD HYD (108        ) | ID: NHYD          AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 01:101             1.34      .096     7.92  63.20    .000
                    +ID2 04:104             4.06     1.528     8.02  90.90    .000
                    +ID3 05:105             3.91      .410     8.00  51.95    .000
                     ============================================================
                     SUM 08:108             9.31     2.034     8.00  70.55    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0018-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 4: Building N, P, S and Salt Storage Shed and Parking Lot 7,
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.05
| 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.04          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       125.58
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.07 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .41          .00             .416 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.00            8.000
     RUNOFF VOLUME    (mm)=     105.17        37.09          104.491
     TOTAL RAINFALL   (mm)=     106.74       106.74          106.742
     RUNOFF COEFFICIENT   =        .99          .35             .979

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0019-----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
```

```
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>09:(109    )   |
| OUT<01:(101    )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .085  .5115E-01

     ROUTING RESULTS                AREA     QPEAK     TPEAK       R.V.
     --------------------           (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )          1.05      .416     8.000    104.491
     OUTFLOW<01: (101    )          1.05      .080     8.283    104.491
    OVERFLOW<02: (102    )           .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.248
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4818E-01

--------------------------------------------------------------------------------
001:0020------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.36
| 03:103    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        3.23          1.13
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        1.43         15.38
     Length            (m)=      116.00         13.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      142.89        125.58
                over (min)         2.00          4.00
     Storage Coeff.  (min)=        2.17 (ii)     3.73 (ii)
     Unit Hyd. Tpeak (min)=        2.00          4.00
     Unit Hyd. peak  (cms)=         .53           .30
                                                             *TOTALS*
     PEAK FLOW       (cms)=        1.28           .38          1.660 (iii)
     TIME TO PEAK    (hrs)=        8.00          8.00          8.000
     RUNOFF VOLUME    (mm)=      105.17         37.09         87.472
     TOTAL RAINFALL   (mm)=      106.74        106.74        106.742
     RUNOFF COEFFICIENT   =         .99           .35           .819

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0021------------------------------------------------------------------------
*
------------------------
| ADD HYD (104       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101           1.05      .080    8.28 104.49    .000
                    +ID2 02:102            .00      .000     .00    .00    .000  **DRY**
                    +ID3 03:103           4.36     1.660    8.00  87.47    .000
                     ============================================================
                     SUM 04:104           5.41     1.728    8.00  90.77    .000
```

```

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0022------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.14
| 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.13          .01
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=         .50         2.00
     Length            (m)=       42.00        10.00
     Mannings n           =        .013         .200

     Max.eff.Inten.(mm/hr)=      142.89       125.58
                over (min)         2.00         4.00
     Storage Coeff.  (min)=        1.62 (ii)    4.07 (ii)
     Unit Hyd. Tpeak (min)=        2.00         4.00
     Unit Hyd. peak  (cms)=         .64          .28
                                                                *TOTALS*
     PEAK FLOW       (cms)=         .45          .00              .452 (iii)
     TIME TO PEAK    (hrs)=        8.00         8.00             8.000
     RUNOFF VOLUME    (mm)=      105.17        37.09           104.491
     TOTAL RAINFALL   (mm)=      106.74       106.74           106.742
     RUNOFF COEFFICIENT   =         .99          .35              .979

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0023------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(105    )  |
| OUT<06:(106    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .132  .5698E-01

     ROUTING RESULTS              AREA      QPEAK      TPEAK        R.V.
     --------------------         (ha)      (cms)      (hrs)        (mm)
     INFLOW >05: (105    )        1.14       .452      8.000     104.491
     OUTFLOW<06: (106    )        1.14       .109      8.250     104.491
    OVERFLOW<07: (107    )         .00       .000       .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   24.238
                   TIME SHIFT OF PEAK FLOW         (min)=    15.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4717E-01

--------------------------------------------------------------------------------
```

```
001:0024---------------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.97
| 09:109    DT= 1.00  |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.74          3.23
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.00          1.42
     Length            (m)=      57.00         57.00
     Mannings n          =       .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        124.74
                over (min)        2.00          9.00
     Storage Coeff.  (min)=       1.58 (ii)     9.33 (ii)
     Unit Hyd. Tpeak (min)=       2.00          9.00
     Unit Hyd. peak  (cms)=        .65           .12
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .69           .80            1.427 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.05            8.000
     RUNOFF VOLUME    (mm)=     105.17         37.09           60.921
     TOTAL RAINFALL   (mm)=     106.74        106.74          106.742
     RUNOFF COEFFICIENT   =        .99           .35             .571

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0025---------------------------------------------------------------------------------
*
------------------------
| ADD HYD (101        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106            1.14      .109    8.25 104.49    .000
                    +ID2 07:107             .00      .000     .00    .00    .000  **DRY**
                    +ID3 09:109            4.97     1.427    8.00  60.92    .000
                     ==========================================================
                     SUM 01:101            6.11     1.524    8.00  69.05    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0026---------------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building A, C, D, H & J
*
*Total Building Area - Includes Building A, C, D, H & J
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.26
| 02:102    DT= 1.00  |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.23           .03
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n          =       .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        125.58
                over (min)        2.00          4.00
     Storage Coeff.  (min)=       1.62 (ii)     4.07 (ii)
```

```
     Unit Hyd. Tpeak (min)=       2.00          4.00
     Unit Hyd. peak  (cms)=        .64           .28
                                                                 *TOTALS*
     PEAK FLOW       (cms)=       1.28           .01               1.292 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.00               8.000
     RUNOFF VOLUME    (mm)=     105.17         37.09             104.491
     TOTAL RAINFALL   (mm)=     106.74        106.74             106.742
     RUNOFF COEFFICIENT   =        .99           .35                .979

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0027----------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estiamted
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>02:(102    )  |
 | OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .302  .1631E+00

     ROUTING RESULTS             AREA      QPEAK      TPEAK        R.V.
     --------------------        (ha)      (cms)      (hrs)        (mm)
     INFLOW >02: (102    )       3.26      1.292      8.000     104.491
     OUTFLOW<03: (103    )       3.26       .269      8.267     104.491
    OVERFLOW<05: (105    )        .00       .000       .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =          0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=        .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=        .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.797
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1449E+00

 ------------------------------------------------------------------------------------
 001:0028----------------------------------------------------------------------------
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    2.40
 | 06:106    DT= 1.00 |   Total Imp(%)=   46.00   Dir. Conn.(%)=   46.00
 ----------------------
                                    IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.10          1.30
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.92          2.78
     Length            (m)=     130.00        120.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        124.13
                over (min)        2.00         12.00
     Storage Coeff.  (min)=       2.13 (ii)    12.05 (ii)
     Unit Hyd. Tpeak (min)=       2.00         12.00
     Unit Hyd. peak  (cms)=        .54           .09
                                                                 *TOTALS*
     PEAK FLOW       (cms)=        .44           .27                .660 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.10               8.000
     RUNOFF VOLUME    (mm)=     105.17         37.09              68.410
     TOTAL RAINFALL   (mm)=     106.74        106.74             106.742
```

```
     RUNOFF COEFFICIENT   =        .99          .35           .641

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0029------------------------------------------------------------------------
*
------------------------
| ADD HYD (107       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 03:103           3.26      .269    8.27 104.49    .000
                    +ID2 05:105            .00      .000     .00    .00    .000  **DRY**
                    +ID3 06:106           2.40      .660    8.00  68.41    .000
                     ============================================================
                     SUM 07:107           5.66      .893    8.00  89.19    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0030------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2 & R3 and Parking Lot 5, 8 (north), 9
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.01
| 09:109    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.00          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       125.58
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.07 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .40          .00           .400 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.00          8.000
     RUNOFF VOLUME    (mm)=     105.17        37.09        104.491
     TOTAL RAINFALL   (mm)=     106.74       106.74        106.742
     RUNOFF COEFFICIENT   =        .99          .35           .979

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0031------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<02:(102    )  |    =========  OUTLFOW STORAGE TABLE  =========
```

```
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)     |   (cms)    (ha.m.)
                           .000   .0000E+00    |    .086   .4495E-01

     ROUTING RESULTS              AREA      QPEAK      TPEAK       R.V.
     --------------------         (ha)      (cms)      (hrs)       (mm)
     INFLOW >09: (109    )        1.01       .400      8.000    104.491
     OUTFLOW<02: (102    )        1.01       .085      8.267    104.491
    OVERFLOW<03: (103    )         .00       .000       .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.192
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4454E-01

--------------------------------------------------------------------------------
001:0032------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.43
| 05:105    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.61          1.82
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.89          1.61
     Length            (m)=     103.00         36.00
     Mannings n          =       .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        124.93
                over (min)        2.00          8.00
     Storage Coeff.  (min)=       1.86 (ii)     7.52 (ii)
     Unit Hyd. Tpeak (min)=       2.00          8.00
     Unit Hyd. peak  (cms)=        .58           .15
                                                              *TOTALS*
     PEAK FLOW       (cms)=       1.04           .49           1.511 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.03           8.000
     RUNOFF VOLUME    (mm)=     105.17         37.09          77.260
     TOTAL RAINFALL   (mm)=     106.74        106.74         106.742
     RUNOFF COEFFICIENT   =        .99           .35            .724

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20            K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0033------------------------------------------------------------------------
*
------------------------
| ADD HYD (106       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 02:102           1.01      .085     8.27 104.49    .000
                    +ID2 03:103            .00      .000      .00    .00    .000  **DRY**
                    +ID3 05:105           4.43     1.511     8.00  77.26    .000
                     ============================================================
                     SUM 06:106           5.44     1.585     8.00  82.32    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0034------------------------------------------------------------------------
```

```
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.67
| 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .95           .72
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=         .50          2.00
     Length            (m)=      113.00         10.00
     Mannings n           =        .013          .200

     Max.eff.Inten.(mm/hr)=      142.89        125.43
                over (min)         3.00          5.00
     Storage Coeff.  (min)=        2.93 (ii)     5.39 (ii)
     Unit Hyd. Tpeak (min)=        3.00          5.00
     Unit Hyd. peak  (cms)=         .38           .21
                                                               *TOTALS*
     PEAK FLOW       (cms)=         .38           .22             .599 (iii)
     TIME TO PEAK    (hrs)=        8.00          8.00            8.000
     RUNOFF VOLUME    (mm)=      105.16         37.09           75.899
     TOTAL RAINFALL   (mm)=      106.74        106.74          106.742
     RUNOFF COEFFICIENT   =         .99           .35             .711

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0035----------------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .045  .1920E-01
                            .023  .3000E-03    |     .050  .3360E-01
                            .032  .2300E-02    |     .055  .4700E-01
                            .039  .8200E-02    |     .060  .5480E-01

     ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
     --------------------          (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )         1.67      .599     8.000     75.899
     OUTFLOW<03: (103    )         1.57      .060     8.150     75.899
    OVERFLOW<05: (105    )          .10      .162     8.150     75.899

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         2
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .32
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      1.26


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   10.023
                   TIME SHIFT OF PEAK FLOW         (min)=     9.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.5480E-01

-------------------------------------------------------------------------------------
001:0036----------------------------------------------------------------------------
*
------------------------
```

```
| ADD HYD (109         ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                       (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 03:103            1.57      .060    8.15   75.90    .000
                    +ID2 05:105             .10      .162    8.15   75.90    .000
                     ==========================================================
                     SUM 09:109            1.67      .222    8.15   75.90    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0037----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.03
| 02:102    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .98           .05
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        3.23          1.24
     Length            (m)=       35.00        200.00
     Mannings n           =        .013          .200

     Max.eff.Inten.(mm/hr)=      142.89         97.48
                over (min)         1.00         20.00
     Storage Coeff.  (min)=         .83 (ii)    19.74 (ii)
     Unit Hyd. Tpeak (min)=        1.00         20.00
     Unit Hyd. peak  (cms)=        1.19           .06
                                                              *TOTALS*
     PEAK FLOW       (cms)=         .39           .01            .392 (iii)
     TIME TO PEAK    (hrs)=        7.97          8.23           8.000
     RUNOFF VOLUME    (mm)=      105.17         37.09         101.768
     TOTAL RAINFALL   (mm)=      106.74        106.74         106.742
     RUNOFF COEFFICIENT   =         .99           .35            .953

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0038----------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                       (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 08:108            9.31     2.034    8.00   70.55    .000
                    +ID2 04:104            5.41     1.728    8.00   90.77    .000
                    +ID3 01:101            6.11     1.524    8.00   69.05    .000
                    +ID4 07:107            5.66      .893    8.00   89.19    .000
                    +ID5 06:106            5.44     1.585    8.00   82.32    .000
                    +ID6 09:109            1.67      .222    8.15   75.90    .000
                    +ID7 02:102            1.03      .392    8.00  101.77    .000
                     ==========================================================
                     SUM 03:TOTAL         34.63     8.207    8.00   79.53    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0039----------------------------------------------------------------------------
*
      FINISH
------------------------------------------------------------------------------------
```

```
*************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 14:52:49
=====================================================================================
```

Appendix B-IV

CONTENTS

Pinecrest Creek Criteria - Existing Shortfall Projects	1 pages
Short Term Development 100 Year Storage Volume Requirement	1 pages

Algonquin College
Stormwater Management - Pond Design Report
Appendix B-IV: Pinecrest Creek Existing Shortfall Projects

Drainage Area - Proposed SWM Facility (ha) = 9.31

Water Quality Storage Requirement (m^3/ha) = 92.5 — Based on Table 3.2 MOE SWM Manual: Protection Level = 80%, Imp. Level = 45%, SWMP Type = Wetland
Water Quality Storage Volume (m^3) = 861
Extended Detention Storage Requirement (m^3/ha) = 40 — Based on MOE Stormwater Management Design Manual
Extended Detention Storage Volume (m^3) = 372
Permanent Pool Volume (m^3) = 489

Runoff Volume Reduction

10mm Event Runoff Volume (m^3) = 59.23 — For NE Parking Lot, Building C Expansion, Building S Expansion

Water Quality - TSS Removal

Impervious Level (%) = 45.00
Storage Volume for Impervious Level (m^3/ha) = 92.50
Storage Volume (m^3) = 861.18

Water Quantity - Flood Management

Allowable Release Rate (L/s/ha) = 33.50
Release Rate (L/s) = 311.89

Water Quantity - Erosion Control

Allowable Release Rate (L/s/ha) = 5.80
Release Rate (L/s) = 54.00
25mm Volume Runoff SWMHYMO (mm) = 11.69 — For 9.31ha, from SWMMHYMO
25mm Event Runoff Volume (m^3) = 1029 — For 9.31ha, from SWMMHYMO

	North East Parking Lot	***Building C Expansion***	***Building S Expansion***	***TOTAL***
Site Area (ha) =	0.67	0.23 (2)	0.03 (4)	0.94
Runoff Volume Reduction				
10mm Volume Runoff SWMHYMO (mm) =	7.58	2.28	8.34	
10mm Event Runoff Volume SWMHYMO (m3) =	51.13	5.24	2.85	**59.23**
Water Quality - TSS Removal				
Impervious Level (%) =	90.10	27.00	99.00	
Storage Volume for Impervious Level (m^3/ha) =	140.00 (1)	80.00 (3)	140.00 (5)	
Storage Volume (m^3) =	94.44	18.40	4.79	117.63
Extended Detention Storage Requirement (m^3/ha) =	40.00	40.00	40.00	40.00
Extended Detention Storage Volume (m^3) =	27.0	9.2	1.4	37.6
Permanent Pool Volume (m^3) =	67.5	9.2	3.4	**80.1**
Water Quantity - Flood Management				
Allowable Release Rate (L/s/ha) =	33.50	33.50	33.50	33.5
Release Rate (L/s) =	22.60	7.71	1.15	**31.45**
100yr Runoff Volume from Mod. Rational Method (m^3) =	273.07	43.27	15.07	**331.41**
Water Quantity - Erosion Control				
Allowable Release Rate (L/s/ha) =	5.80	5.80	5.80	5.8
Release Rate (L/s) =	3.91	1.33	0.20	**5.44**
25mm Volume Runoff SWMHYMO (mm) =	21.12	6.60	23.20	
*25mm Event Runoff Volume (m^3) =	91.34	9.94	5.08	**106.36**

Notes

(1) Based on Table 3.2 MOE Stormwater Management Design Manual: Protection Level = 80%, Impervious Level = 85%, SWMP Type = Wetland
(2) Considered courtyard area only (0.23ha)
(3) Based on Table 3.2 MOE Stormwater Management Design Manual: Protection Level = 80%, Impervious Level = 35%, SWMP Type = Wetland
(4) Includes Phase 1
(5) Based on Table 3.2 MOE Stormwater Management Design Manual: Protection Level = 80%, Impervious Level = 85%, SWMP Type = Wetland
(6) Based on Modified Rational Method (100yr controlled to 33.5 L/s/ha)
* 25mm is the difference between 25mm and 10mm events.

Appendix B-V

CONTENTS

Pond Design Requirements	1 pages
Pond Volume Required to Address Shortfall	1 pages
Pond Reserve Capacity Calculation	1 pages
Pond Stage Storage Discharge (Orifice & Weir)	1 pages
Pond Sediment Forebay	1 pages
Pond Drawdown Time	2 pages

Algonquin College
Stormwater Management - Pond Design Report
Appendix B-V: Pond Design Requirements

			Notes
Flood Management	100 Year Storage Volume (m^3) =	3755	(1) From the SWMHYMO model. For the 9.31ha drainage area.
	100 Year Release Rate (L/s) =	312	(2) Based on an allowable release rate of 33.5L/s/ha for the 9.31ha drainage area
Runoff Volume Reduction	10mm Event Runoff Volume (m^3) =	59.2	(3) Includes the three (3) projects outlined below
Erosion Control	25mm Event Runoff Volume (m^3) =	1029	(4) For the 9.31ha drainage area
	25mm Release Rate (L/s) =	23	(5) Based on an allowable release rate of 5.8L/s/ha for the 9.31ha drainage area a release rate of 54L/s is required. **The draw-down time required to meet MOE criteria exceeds the Pinecrest Creek criteria. The 25mm volume will be released @ 23L/s to ensure a draw-down time greater than 24 hours.**
Water Quality	Extended Detention Storage Volume (m^3) =	372	(6) For the 9.31ha drainage area **this volume has not been specifically incorporated into the total volume since the Pinecrest Creek criteria requirements govern/exceeds the volume of required extended detention**
	Permanent Pool Volume (m^3) =	489	(7) For the 9.31ha drainage area
	Permanent Pool Volume (m^3) =	**548**	(3) + (7)
	Extended Detention/Active Storage Volume (m^3) =	**4784**	(1) + (4)
	Total Pond Volume Required (m^3) =	**5332**	(1) + (3) + (5) + (7)

1. Student Commons Building Displaced Parking Lot (NE Parking Lot)
2. Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) Building
3. Building S Automotive Welding Shop Addition (Phase 1)

Drainage area to pond (9.31ha) includes Catchments 5, 6, 7, 8

Algonquin College
Stormwater Management - Pond Design Report
Appendix B-V: Pond Forebay Design Calculations

Variable	Value	Source
Forebay Dimensions		
Forebay Area at Permanent Pool Elevation (m^2) =	348	*from design drawings*
Total Permanent Pool Area (m^2) =	2420	*from design drawings*
Maximum Bottom Width (m) =	7	*from design drawings*
Minimum Bottom Width (m) =	3	*from design drawings*
Average Bottom Width (m) =	5	*calculated*
Maximum Width at Permanent Pool Elevation (m) =	13	*from design drawings*
Minimum Width at Permanent Pool Elevation (m) =	12	*from design drawings*
Average Width at Permanent Pool Elevation (m) =	13	*calculated*
Average Width at Narrowest Point (m) =	8	*calculated*
Length, at Permanent Pool Elevation (m) =	25	*from design drawings*
d, Depth of permanent pool in Forebay (m) =	1.0	*from design drawings (note: MOECC requires min. 1.0m)*
d_{peak}, Depth During Peak Flow Rate (m) =	1.4	*from design drawings (depth during 25mm event)*
r, Average Length to Width Ratio (:1) =	2.0	*calculated*
Design Flows		
Q_P, Peak Flow, Design Quality Storm (m^3/s) =	0.019	*Peak outflow during 25mm storm*
Q, Inlet Peak Flowrate (m^3/s) =	1.28	*Peak inflow during 10-year storm (Rational Method calc)*
Length:Width Ratio		
Length, at Permanent Pool Elevation (m) =	25	*determined above*
Average Width at Permanent Pool Elevation (m) =	13	*determined above*
Length:Width Ratio (:1) =	2.0	*calculated. MOECC requires 2:1 minimum.*
Area Ratio		
Forebay Area at Permanent Pool Elevation (m^2) =	348	*determined above*
Total Permanent Pool Area (m^2) =	2420	*determined above*
Forebay as Percentage of Permanent Pool (%) =	14	*calculated. MOECC requires 20% maximum.*
Settling Length Criteria		
r =	2.0	*determined above*
Q_P (m^3/s) =	0.019	*determined above*
V_S, Settling Velocity (m/s) =	0.0003	*recommended by MOECC Manual*
Dist, Minimum Forebay Length (m) =	11.3	*calculated*
Dispersion Length		
Q (m^3/s) =	1.28	*determined above*
d (m) =	1.0	*determined above*
V_f, Desired Velocity at Forebay Berm (m/s) =	0.5	*recommended by MOECC Manual*
Dist, Minimum Length of Deep Section (m) =	20.5	*calculated*
Minimum Width		
Dist, Maximum Required Forebay Length (m) =	20.5	*maximum of Settling Length and Dispersion Length*
Width, Minimum Forebay Deep Zone Bottom Width (m) =	2.6	*calculated*
Average Forebay Velocity		
Q (m^3/s) =	1.28	*determined above*
d_{peak} (m)	1.4	*determined above*
Average Width at Narrowest Point (m) =	8	*determined above*
V_{avg} (m/s) =	0.12	*calculated, MOECC recommends < 0.15 m/s*

Algonquin College
Stormwater Management - Pond Design Report
Appendix B-V: Pond Reserve Capacity Calculation

		Pond Capacity Provided	Capacity Needed for 3 Shortfall Projects	Reserve Pond Capacity
Permanent Pool Volume	m^3	780	139	**641**
Extended Detention/Active Storage Volume	m^3	4,867	205	**4,662**
Total	m^3	5,647	345	**5,302**

Shortfall Projects:
1. Student Commons Building Displaced Parking Lot (NE Parking Lot)
2. Innovation and Entrepreneurship and Learning Centre and Institute of Indigenous Entrepreneurship (IELCIIE) Building
3. Building S Automotive Welding Shop Addition (Phase 1)

Appendix B-VI

CONTENTS

Short Term Development Subcatchment Areas and Hydrological Parameters	1 pages
Short Term Development Building Roof Characteristics	1 pages

Algonquin College
Stormwater Management - Pond Design Report
Appendix B-VI: Short Term Development Subcatchment Areas & Hydrological Parameters

Subcatchments	Area (ha)	Building			Grass Area (ha)	Asphalt/Concrete Area (ha)	Gravel Area (ha)	CN	Pervious				Impervious			
		Name	Area (ha)	Total Area (ha)					Area (ha)	Ratio	Length (m)	Slope (%)	Area (ha)	Ratio	Length (m)	Slope (%)
1	6.11	B	0.51	1.14	3.21	1.76	0.00	85.39	3.21	0.53	57.00	1.42	2.90	0.47	57.00	1.00
		K	0.11													
		M	0.14													
		T	0.37													
2	5.17	A	1.76	3.00	0.57	1.60	0.00	95.34	0.57	0.11	30.00	2.00	4.60	0.89	130.00	1.92
		C	0.30													
		D	0.33													
		H	0.42													
		J	0.19													
2a	0.49	Building C Expansion	0.30	0.30	0.17	0.02	0.00	89.79	0.17	0.34	30.00	3.30	0.32	0.66	7.50	2.00
3	5.44	F	0.13	1.01	1.83	2.60	0.00	89.93	1.83	0.34	36.00	1.61	3.61	0.66	103.00	1.89
		G	0.09													
		R1	0.28													
		R2	0.28													
		R3	0.24													
4	5.41	N	0.25	1.11	0.70	3.17	0.43	94.18	1.13	0.21	13.00	15.38	4.28	0.79	116.00	1.43
		P	0.48													
		S	0.29													
		Building S Expansion	0.06													
		Salt Storage Sheds	0.02													
5	3.91	V	0.09	0.09	3.73	0.08	0.00	75.10	3.73	0.95	425.00	2.04	0.18	0.05	0.00	0.00
6	3.08	-	0.00	0.00	0.00	3.08	0.00	98.00	0.00	0.00	0.00	0.00	3.08	1.00	140.00	1.90
7	0.67	-	0.00	0.00	0.07	0.61	0.00	95.62	0.07	0.10	34.00	4.03	0.61	0.90	25.00	2.00
8	1.65	Z	0.05	0.05	1.39	0.21	0.00	77.77	1.39	0.84	85.00	1.76	0.26	0.16	37.00	2.03
9	1.67	E	0.56	0.56	0.72	0.39	0.00	71.00	0.72	0.43	10.00	2.00	0.95	0.57	113.00	0.50
10	1.03	-	0.00	0.00	0.05	0.98	0.00	96.85	0.05	0.05	200.00	1.24	0.98	0.95	35.00	3.23

Runoff Coefficients		CN Values (Soil Type C)	
Asphalt/Concrete=	0.9	Asphalt/Concrete=	98
Building =	0.9	Building =	98
Gravel =	0.7	Gravel =	89
Grass =	0.5	Grass =	74

Algonquin College
Stormwater Management - Pond Design Report
Appendix B-VI: Short Term Development Building Roof Characteristics

Catchment	Building										
	Name	Area (ha)	Number of Roof Drains[4]	Approximate Drainage Length per Drain (m)	Approximate Drainage Slope per Drain (%)	Maximum Ponding Depth (m)	Approximate Volume		Approximate Release Rate		
							(m^3)	(ha-m)	(m^3/s)	(L/s)	(mm/hr)
1	B	0.51	38			0.15	256	0.02559	0.07182	71.82	41.80
	K	0.11	8			0.15	57	0.00570	0.01512	15.12	
	M	0.14	6			0.15	70	0.00695	0.01134	11.34	
	T	0.37	18			0.15	187	0.01873	0.03402	34.02	
2	A	1.76	64			0.15	881	0.08812	0.12096	120.96	34.22
	C	0.30	21			0.15	149	0.01495	0.03969	39.69	
	D	0.33	9			0.15	166	0.01656	0.01701	17.01	
	H	0.42	42			0.15	211	0.02114	0.07938	79.38	
	J	0.19	15			0.15	94	0.00937	0.02835	28.35	
2a	Building C Expansion	0.30	ROOF STORAGE CURRENTLY NOT CONSIDERED IN SHORT TERM FUTURE CONDITIONS MODEL - TOO MANY UNKNOWNS AT PRESENT TIME								
3	F	0.13	7			0.15	65	0.00653	0.01323	13.23	33.37
	G	0.09	-	-	-	-	-	-	-	-	
	R1	0.28	13			0.15	138	0.01376	0.02457	24.57	
	R2	0.28	9			0.15	141	0.01406	0.01701	17.01	
	R3[2]	0.24	13			0.13	106	0.01061	0.03081	30.81	
4	N	0.25	14			0.15	123	0.01231	0.02646	26.46	29.93
	P	0.48	19			0.15	242	0.02424	0.03591	35.91	
	S	0.29	12			0.15	146	0.01461	0.02268	22.68	
	Building S Expansion	0.06	ROOF STORAGE CURRENTLY NOT CONSIDERED IN SHORT TERM FUTURE CONDITIONS MODEL - TOO MANY UNKNOWNS AT PRESENT TIME								
	Salt Storage Sheds	0.02	-	-	-	-	-	-	-	-	
5	V	0.09	4			0.15	47	0.00469	0.00756	7.56	29.02
6	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-
8	Z	0.05	5			0.15	27	0.00266	0.00945	9.45	63.92
9	-	-	-	-	-	-	-	-	-	-	-
10	E[1]	0.56	17	113	0.5	0.15	307	0.03072	0.00553	5.53	3.54

(1) Stormwater Management Servicing Report Student Commons Building, May 2011
(2) Algonquin College - Phase III Residence Stormwater Management Report, January 2003
(3) Stormwater Management Report Algonquin College - Centre for Construction Trades and Building Sciences Building, December 2008
(4) Preventative Roof Maintenance, July 2013

Appendix B-VII

CONTENTS

SWMHYMO Model – Short Term Development Schematic	1 pages
SWMHYMO Model – Short Term Development (Pond + Shortfall Projects)	418 pages

```
                                      F5Y3H
2     Metric units
*#*******************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 02-13-2018
*#  Revised         : 06-28-2018
*#  Revised         : 07-04-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*******************************************************************************
*
* Future Building S, Building C, Deficit
* Short Term Development  (Future HLE, Sports Complex Removed)
*
START                TIME = 0.0
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM        IUNITS=[2], TD=[3](hrs), TPRAT=[0.333], CSDT=[15](min)
                     ICASEcs=[1], A=[998.071], B=[6.053], C=[0.814]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD       ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                     XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                     Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                             DCAY=[4.14](/hr), F=[0](mm),
                     Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                          LGP=[10](m), MNP=[0.2], SCP=[0](min),
                     Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                          LGI=[42](m), MNI=[0.013], SCI=[0](min),
                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR      IDout=[2],   NHYD=["102"],  IDin=[1],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                       (cms) - (ha-m)
```

```
                                        F5Y3H
                                     [   0.0 ,  0.0    ]
                                     [0.00945,  0.00266]
                                     [   -1  ,  -1     ]
                           IDovf=[3], NHYDovf=["103"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                     [   0.0 ,  0.0    ]
                                     [ 0.096 ,  0.0175 ]
```

```
                                   [   -1  ,  -1     ]
                         IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40.](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.00756,  0.00469]
                                  [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
                                         LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [ 0.000 ,  0.0000 ]
                                    [ 0.023 ,  0.1100 ]
                                    [ 0.312 ,  0.3830 ]
                                    [   -1  ,  -1     ]
                          IDovf=[1], NHYDovf=["101"]
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S
Expansion and Parking Lot 7, 8 (south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
```

```
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,  -1     ]
                          IDovf=[4], NHYDovf=["104"]
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S
Expansion
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.30](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[3+4+5]
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[9+1+6]
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
```

```
                               F5Y3H
                            [0.13230,  0.05698]
                            [   -1  ,  -1     ]
                      IDovf=[1], NHYDovf=["101"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[3], NHYD=["103"], IDs to add=[9+1+2]
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[7+3]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[3.00](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.28539,  0.15012]
                                  [   -1  ,  -1     ]
                          IDovf=[7], NHYDovf=["107"]

*Remaining Area - Includes Grass, Parking Lots, Road
```

```
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[2.17](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.00](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[6+7+8]
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.49](ha),
                    XIMP=[0.66], TIMP=[0.66], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[3.30](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[7.5](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.079 ,  0.0065 ]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and
Courtyard
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[7],   NHYD=["107"],  IDin=[6],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08562,  0.04495]
                                    [   -1  ,  -1     ]
                          IDovf=[8], NHYDovf=["108"]

*Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[7+8+9]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
```

```
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.023 ,  0.0003 ]
                                  [ 0.032 ,  0.0023 ]
                                  [ 0.039 ,  0.0082 ]
                                  [ 0.045 ,  0.0192 ]
                                  [ 0.050 ,  0.0336 ]
                                  [ 0.055 ,  0.0470 ]
                                  [ 0.060 ,  0.0548 ]
                                  [   -1  ,    -1   ]
                          IDovf=[6], NHYDovf=["106"]
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+6]
*
*Combine Subcatchment 3 & 9
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+7]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[1], NHYD=["TOTAL"], IDs to add=[4+5+8+9]
*
*%-----------------|------------------------------------------------------------|
FINISH
```

```
=====================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                       9   9  9   9   # 3573794
        StormWater Management HYdrologic Model          999    999    =========

    ********************************************************************************
    ***************************** SWMHYMO Ver/4.05  ******************************
    *********  A single event and continuous hydrologic simulation model  *********
    *********     based on the principles of HYMO and its successors      *********
    *********                 OTTHYMO-83 and OTTHYMO-89.                  *********
    ********************************************************************************
    ********* Distributed by:  J.F. Sabourin and Associates Inc.           *********
    *********                  Ottawa,  Ontario: (613) 836-3884           *********
    *********                  Gatineau, Quebec: (819) 243-6858           *********
    *********                  E-Mail: swmhymo@jfsa.Com                   *********
    ********************************************************************************


    ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
    +++++++++ Licensed user: Morrison Hershfield Ltd.                     +++++++++
    +++++++++                Ottawa                 SERIAL#:3573794       +++++++++
    ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

    ********************************************************************************
    *********            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *********
    *********            Maximum value for ID numbers  :     10           *********
    *********            Max. number of rainfall points: 105408           *********
    *********            Max. number of flow points    : 105408           *********
    ********************************************************************************



    *********************   D E T A I L E D   O U T P U T   *********************
    ********************************************************************************
    *         DATE: 2018-10-19     TIME: 12:09:36     RUN COUNTER: 000293         *
    ********************************************************************************
    * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F5Y3H.DAT              *
    * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F5Y3H.out              *
    * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F5Y3H.sum              *
    * User comments:                                                              *
    * 1:__________________________________________________________________________*
    * 2:__________________________________________________________________________*
    * 3:__________________________________________________________________________*
    ********************************************************************************

   ------------------------------------------------------------------------------------
   001:0001----------------------------------------------------------------------------
   *#******************************************************************************
   *#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
   *#  Project Number : [2085345.16]
   *#  Date           : 02-07-2014
   *#  Revised        : 01-20-2015
   *#  Revised        : 01-03-2017
   *#  Revised        : 02-13-2018
   *#  Revised     : 06-28-2018
   *#  Revised         : 07-04-2018
   *#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
   *#                                October 2018
   *#  Modeller       : [SM]
   *#  Company        : Morrison Hershfield Ltd
   *#  License #      : 3573794
   *#******************************************************************************
   *
   * Future Building S, Building C, Deficit
   * Short Term Development  (Future HLE, Sports Complex Removed)
   *
```

```
--------------------
| START             |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
-------------------------------------------------------------------------------
001:0002-----------------------------------------------------------------------
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 998.071
| Ptotal= 42.48 mm |                          B=   6.053
--------------------                          C=    .814
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 15.00 min
                        Time to peak ratio =   .33

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .25   4.178 |   1.00  83.557 |   1.75   7.304 |   2.50   3.836
               .50   6.429 |   1.25  21.363 |   2.00   5.570 |   2.75   3.337
               .75  16.065 |   1.50  10.789 |   2.25   4.530 |   3.00   2.962

-------------------------------------------------------------------------------
001:0003-----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        45.57
                over (min)        2.00         6.00
     Storage Coeff.  (min)=       2.01 (ii)    5.69 (ii)
     Unit Hyd. Tpeak (min)=       2.00         6.00
     Unit Hyd. peak  (cms)=        .56          .20
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .01          .00            .012 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.03           1.000
     RUNOFF VOLUME    (mm)=      40.91         8.82          40.589
     TOTAL RAINFALL   (mm)=      42.48        42.48          42.480
     RUNOFF COEFFICIENT   =        .96          .21            .955

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0004-----------------------------------------------------------------------
```

```
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(101    )   |
| OUT<02:(102    )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |      .009  .2660E-02

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )        .05      .012     1.000     40.589
     OUTFLOW<02: (102    )        .05      .004     1.100     40.588
    OVERFLOW<03: (103    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   31.285
                   TIME SHIFT OF PEAK FLOW         (min)=     6.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1015E-02

-------------------------------------------------------------------------------------
001:0005-----------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.60
| 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02         1.58
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.03         1.76
     Length            (m)=      37.00        85.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        31.12
                over (min)        1.00        17.00
     Storage Coeff.  (min)=       1.22 (ii)   17.31 (ii)
     Unit Hyd. Tpeak (min)=       1.00        17.00
     Unit Hyd. peak  (cms)=        .95          .07
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .00          .07            .075 (iii)
     TIME TO PEAK    (hrs)=        .95         1.20           1.200
     RUNOFF VOLUME    (mm)=      40.91         8.82           9.139
     TOTAL RAINFALL   (mm)=      42.48        42.48          42.480
     RUNOFF COEFFICIENT   =        .96          .21            .215
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0006-----------------------------------------------------------------------------
*
------------------------
| ADD HYD (105       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
```

```
                        ID1 02:102             .05     .004    1.10  40.59    .000
                       +ID2 03:103             .00     .000     .00    .00    .000  **DRY**
                       +ID3 04:104            1.60     .075    1.20   9.14    .000
                        ============================================================
                        SUM 05:105            1.65     .078    1.18  10.09    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0007----------------------------------------------------------------------------
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .096  (cms)
| TotalHyd 05:105    |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity          =    .096  (cms)
                         Total major system storage [TMJSTO] =      70.(cu.m.)

                   ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                   (ha)     (cms)     (hrs)     (mm)     (cms)
     TOTAL HYD.    05:105          1.65      .078     1.183   10.092      .000
     ==========================================================================
     MAJOR SYST    06:106           .00      .000      .000     .000      .000
     MINOR SYST    07:107          1.65      .078     1.183   10.092      .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

     Maximum MAJOR SYSTEM storage used =       0.(cu.m.)

------------------------------------------------------------------------------------
001:0008----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .67
| 08:108    DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .60          .07
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=        2.00         4.03
     Length            (m)=       25.00        34.00
     Mannings n          =         .013         .200

     Max.eff.Inten.(mm/hr)=       83.56        44.64
                over (min)         1.00         7.00
     Storage Coeff.  (min)=         .97 (ii)     7.24 (ii)
     Unit Hyd. Tpeak (min)=        1.00         7.00
     Unit Hyd. peak  (cms)=        1.09          .16
                                                                  *TOTALS*
     PEAK FLOW       (cms)=         .14          .01               .145 (iii)
     TIME TO PEAK    (hrs)=         .98         1.05              1.000
     RUNOFF VOLUME    (mm)=       40.91         8.82             37.701
     TOTAL RAINFALL   (mm)=       42.48        42.48             42.480
     RUNOFF COEFFICIENT   =         .96          .21               .887

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0009----------------------------------------------------------------------------
*
*Combine Subcatchments 7 & 8
*
------------------------
```

```
| ADD HYD (109        ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
-------------------------                    (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 07:107              1.65      .078     1.18   10.09     .000
                    +ID2 08:108               .67      .145     1.00   37.70     .000
                     ===============================================================
                     SUM 09:109              2.32      .188     1.00   18.07     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

----------------------------------------------------------------------------------------
001:0010--------------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW     STORAGE    |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00     |     .096  .1750E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK        R.V.
     --------------------         (ha)     (cms)     (hrs)        (mm)
     INFLOW >09: (109    )        2.32      .188     1.000      18.065
     OUTFLOW<01: (101    )        2.32      .086     1.283      18.065
    OVERFLOW<02: (102    )         .00      .000      .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   46.024
                   TIME SHIFT OF PEAK FLOW          (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1577E-01

----------------------------------------------------------------------------------------
001:0011--------------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.08
| 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.05          .03
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.90          .01
     Length            (m)=     140.00        40.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        35.27
                over (min)        3.00        49.00
     Storage Coeff.  (min)=       2.77 (ii)   48.67 (ii)
     Unit Hyd. Tpeak (min)=       3.00        49.00
     Unit Hyd. peak  (cms)=        .40          .02
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .70          .00             .704 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.72            1.000
     RUNOFF VOLUME    (mm)=      40.91         8.82           40.589
     TOTAL RAINFALL   (mm)=      42.48        42.48           42.480
     RUNOFF COEFFICIENT   =        .96          .21             .955

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0012----------------------------------------------------------------------------
*
*Combine Subcatchment 6 and Overflows
*
------------------------
| ADD HYD (104       ) | ID: NHYD          AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 06:106             .00      .000      .00     .00     .000   **DRY**
                    +ID2 02:102             .00      .000      .00     .00     .000   **DRY**
                    +ID3 03:103            3.08      .704     1.00   40.59     .000
                     ==========================================================
                     SUM 04:104            3.08      .704     1.00   40.59     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0013----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .09
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .09           .00
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=         .50          2.00
     Length            (m)=       42.00         10.00
     Mannings n          =         .013          .200

     Max.eff.Inten.(mm/hr)=       83.56         45.57
                over (min)         2.00          6.00
     Storage Coeff.  (min)=        2.01 (ii)     5.69 (ii)
     Unit Hyd. Tpeak (min)=        2.00          6.00
     Unit Hyd. peak  (cms)=         .56           .20
                                                               *TOTALS*
     PEAK FLOW       (cms)=         .02           .00             .021 (iii)
     TIME TO PEAK    (hrs)=        1.00          1.03            1.000
     RUNOFF VOLUME    (mm)=       40.91          8.82           40.589
     TOTAL RAINFALL   (mm)=       42.48         42.48           42.480
     RUNOFF COEFFICIENT   =         .96           .21             .955

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0014----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |     =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |   (cms)    (ha.m.)
                            .000  .0000E+00    |     .008  .4690E-02
```

```
      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
      --------------------       (ha)     (cms)     (hrs)       (mm)
      INFLOW >08: (108    )       .09      .021     1.000     40.589
      OUTFLOW<09: (109    )       .09      .004     1.300     40.588
     OVERFLOW<02: (102    )       .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   17.437
                    TIME SHIFT OF PEAK FLOW          (min)=    18.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2245E-02

 -----------------------------------------------------------------------------
 001:0015---------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    3.82
 | 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .76         3.06
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .01         2.04
      Length            (m)=        .01       425.00
      Mannings n          =       .013         .200

      Max.eff.Inten.(mm/hr)=      83.56        35.27
                 over (min)        1.00        38.00
      Storage Coeff.  (min)=        .04 (ii)   38.48 (ii)
      Unit Hyd. Tpeak (min)=       1.00        38.00
      Unit Hyd. peak  (cms)=       1.70          .03
                                                               *TOTALS*
      PEAK FLOW       (cms)=        .18          .07             .191 (iii)
      TIME TO PEAK    (hrs)=        .78         1.53            1.000
      RUNOFF VOLUME    (mm)=      40.91         8.82           15.237
      TOTAL RAINFALL   (mm)=      42.48        42.48           42.480
      RUNOFF COEFFICIENT   =        .96          .21             .359

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -----------------------------------------------------------------------------
 001:0016---------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (105       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 09:109             .09      .004    1.30  40.59    .000
                    +ID2 02:102             .00      .000     .00    .00    .000  **DRY**
                    +ID3 03:103            3.82      .191    1.00  15.24    .000
                     ============================================================
                     SUM 05:105            3.91      .194    1.00  15.82    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -----------------------------------------------------------------------------
 001:0017---------------------------------------------------------------------
 *
 *Combine Subcatchments 5, 6, 7 & 8
 *
```

```
------------------------
| ADD HYD (108        ) | ID: NHYD          AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                    (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 01:101              2.32      .086     1.28   18.07     .000
                    +ID2 04:104              3.08      .704     1.00   40.59     .000
                    +ID3 05:105              3.91      .194     1.00   15.82     .000
                     ============================================================
                     SUM 08:108              9.31      .965     1.00   24.57     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0018----------------------------------------------------------------------------
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .312  .3830E+00
                            .023  .1100E+00    |     .000  .0000E+00

     ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
     --------------------          (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )         9.31      .965     1.000     24.574
     OUTFLOW<09: (109    )         9.31      .089     2.417     24.573
    OVERFLOW<01: (101    )          .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=     9.251
                   TIME SHIFT OF PEAK FLOW         (min)=     85.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1726E+00

------------------------------------------------------------------------------------
001:0019----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S E
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.04          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        45.57
                over (min)       2.00         6.00
     Storage Coeff.  (min)=       2.01 (ii)    5.69 (ii)
     Unit Hyd. Tpeak (min)=       2.00         6.00
     Unit Hyd. peak  (cms)=        .56          .20
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .24          .00             .242 (iii)
```

```
     TIME TO PEAK    (hrs)=       1.00          1.03          1.000
     RUNOFF VOLUME    (mm)=      40.91          8.82         40.589
     TOTAL RAINFALL   (mm)=      42.48         42.48         42.480
     RUNOFF COEFFICIENT   =        .96           .21           .955

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20      Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0020----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)   |    (cms)     (ha.m.)
                            .000  .0000E+00   |     .085  .5115E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )        1.05      .242     1.000     40.589
     OUTFLOW<03: (103    )        1.05      .043     1.300     40.589
    OVERFLOW<04: (104    )         .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   17.866
                  TIME SHIFT OF PEAK FLOW         (min)=    18.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.2602E-01

-------------------------------------------------------------------------------------
001:0021----------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S Expa
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.30
| 05:105    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.18          1.12
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.43         15.38
     Length            (m)=     116.00         13.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         46.47
                over (min)        3.00          5.00
     Storage Coeff.  (min)=       2.70 (ii)     5.01 (ii)
     Unit Hyd. Tpeak (min)=       3.00          5.00
     Unit Hyd. peak  (cms)=        .40           .23
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .73           .11           .846 (iii)
     TIME TO PEAK    (hrs)=       1.00          1.02          1.000
     RUNOFF VOLUME    (mm)=      40.91          8.82         32.566
     TOTAL RAINFALL   (mm)=      42.48         42.48         42.480
     RUNOFF COEFFICIENT   =        .96           .21           .767

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
```

```
              Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
              Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
             THAN THE STORAGE COEFFICIENT.
       (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -----------------------------------------------------------------------------------
 001:0022---------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (106        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 03:103            1.05      .043    1.30  40.59    .000
                     +ID2 04:104             .00      .000     .00    .00    .000  **DRY**
                     +ID3 05:105            4.30      .846    1.00  32.57    .000
                      ============================================================
                      SUM 06:106            5.35      .881    1.00  34.14    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -----------------------------------------------------------------------------------
 001:0023---------------------------------------------------------------------------
 *
 *Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
 *
 ------------------------
 | ADD HYD (107        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 09:109            9.31      .089    2.42  24.57    .000
                     +ID2 01:101             .00      .000     .00    .00    .000  **DRY**
                     +ID3 06:106            5.35      .881    1.00  34.14    .000
                      ============================================================
                      SUM 07:107           14.66      .899    1.00  28.06    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -----------------------------------------------------------------------------------
 001:0024---------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 1: Building B, K, M & T
 *
 *Total Building Area - Includes Building B, K, M & T
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    1.14
 | 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                                   IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        1.13           .01
      Dep. Storage     (mm)=        1.57          4.67
      Average Slope     (%)=         .50          2.00
      Length            (m)=       42.00         10.00
      Mannings n          =         .013          .200

      Max.eff.Inten.(mm/hr)=       83.56         45.57
                 over (min)         2.00          6.00
      Storage Coeff.  (min)=        2.01 (ii)     5.69 (ii)
      Unit Hyd. Tpeak (min)=        2.00          6.00
      Unit Hyd. peak  (cms)=         .56           .20
                                                                 *TOTALS*
      PEAK FLOW       (cms)=         .26           .00              .263 (iii)
      TIME TO PEAK    (hrs)=        1.00          1.03             1.000
      RUNOFF VOLUME    (mm)=       40.91          8.82            40.589
      TOTAL RAINFALL   (mm)=       42.48         42.48            42.480
      RUNOFF COEFFICIENT   =         .96           .21              .955

         (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
              Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
              Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
```

```
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
001:0025----------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |     =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW     STORAGE   |  OUTFLOW     STORAGE
                            (cms)     (ha.m.)   |    (cms)     (ha.m.)
                             .000  .0000E+00    |     .132  .5698E-01

     ROUTING RESULTS             AREA      QPEAK      TPEAK        R.V.
     --------------------        (ha)      (cms)      (hrs)        (mm)
     INFLOW >08: (108    )       1.14       .263      1.000      40.589
     OUTFLOW<09: (109    )       1.14       .060      1.267      40.589
    OVERFLOW<01: (101    )        .00       .000       .000        .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   22.969
                    TIME SHIFT OF PEAK FLOW         (min)=    16.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2600E-01

------------------------------------------------------------------------------
001:0026----------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.97
| 02:102    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.74          3.23
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.00          1.42
     Length            (m)=      57.00         57.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         35.27
                over (min)        2.00         15.00
     Storage Coeff.  (min)=       1.96 (ii)   14.80 (ii)
     Unit Hyd. Tpeak (min)=       2.00         15.00
     Unit Hyd. peak  (cms)=        .57           .08
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .40           .17             .499 (iii)
     TIME TO PEAK    (hrs)=       1.00          1.17            1.000
     RUNOFF VOLUME    (mm)=      40.91          8.82           20.050
     TOTAL RAINFALL   (mm)=      42.48         42.48           42.480
     RUNOFF COEFFICIENT   =        .96           .21             .472

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
001:0027----------------------------------------------------------------------
```

```
*
 ------------------------
 | ADD HYD (103        ) | ID: NHYD          AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                    (ha)     (cms)    (hrs)   (mm)   (cms)
                       ID1 09:109            1.14      .060     1.27  40.59    .000
                      +ID2 01:101             .00      .000      .00    .00    .000  **DRY**
                      +ID3 02:102            4.97      .499     1.00  20.05    .000
                       ============================================================
                       SUM 03:103            6.11      .550     1.00  23.88    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -----------------------------------------------------------------------------------
 001:0028---------------------------------------------------------------------------
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
 ------------------------
 | ADD HYD (104        ) | ID: NHYD          AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                    (ha)     (cms)    (hrs)   (mm)   (cms)
                       ID1 07:107           14.66      .899     1.00  28.06    .000
                      +ID2 03:103            6.11      .550     1.00  23.88    .000
                       ============================================================
                       SUM 04:104           20.77     1.449     1.00  26.83    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -----------------------------------------------------------------------------------
 001:0029---------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    3.00
 | 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                                   IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        2.97           .03
      Dep. Storage     (mm)=        1.57          4.67
      Average Slope     (%)=         .50          2.00
      Length            (m)=       42.00         10.00
      Mannings n          =         .013          .200

      Max.eff.Inten.(mm/hr)=       83.56         45.57
                 over (min)         2.00          6.00
      Storage Coeff.  (min)=        2.01 (ii)     5.69 (ii)
      Unit Hyd. Tpeak (min)=        2.00          6.00
      Unit Hyd. peak  (cms)=         .56           .20
                                                                *TOTALS*
      PEAK FLOW       (cms)=         .69           .00            .692 (iii)
      TIME TO PEAK    (hrs)=        1.00          1.03           1.000
      RUNOFF VOLUME    (mm)=       40.91          8.82          40.589
      TOTAL RAINFALL   (mm)=       42.48         42.48          42.480
      RUNOFF COEFFICIENT   =         .96           .21            .955

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -----------------------------------------------------------------------------------
 001:0030---------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
```

```
 --------------------
 | ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
 |  IN>05:(105    )  |
 | OUT<06:(106    )  |     =========  OUTLFOW STORAGE TABLE  =========
 --------------------      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)    (ha.m.)   |    (cms)    (ha.m.)
                              .000  .0000E+00   |      .285  .1501E+00

      ROUTING RESULTS                AREA     QPEAK     TPEAK       R.V.
      --------------------           (ha)     (cms)     (hrs)       (mm)
      INFLOW >05: (105    )          3.00      .692     1.000     40.589
      OUTFLOW<06: (106    )          3.00      .137     1.283     40.589
     OVERFLOW<07: (107    )           .00      .000      .000       .000

                       TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                       CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                       PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                       PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.813
                       TIME SHIFT OF PEAK FLOW         (min)=    17.00
                       MAXIMUM  STORAGE   USED       (ha.m.)=.7209E-01

 --------------------------------------------------------------------------------
 001:0031------------------------------------------------------------------------
 *Remaining Area - Includes Grass, Parking Lots, Road
 *
 ---------------------
 | CALIB STANDHYD     |    Area    (ha)=    2.17
 | 08:108    DT= 1.00 |    Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
 ---------------------
                                  IMPERVIOUS    PERVIOUS (i)
      Surface Area      (ha)=        1.61           .56
      Dep. Storage      (mm)=        1.57          4.67
      Average Slope      (%)=        1.92          2.00
      Length             (m)=      130.00         30.00
      Mannings n           =         .013          .200

      Max.eff.Inten.(mm/hr)=        83.56         41.55
                 over (min)          3.00         10.00
      Storage Coeff.   (min)=        2.64 (ii)    10.02 (ii)
      Unit Hyd. Tpeak  (min)=        3.00         10.00
      Unit Hyd. peak   (cms)=         .41           .11
                                                                  *TOTALS*
      PEAK FLOW        (cms)=         .37           .04              .402 (iii)
      TIME TO PEAK     (hrs)=        1.00          1.08             1.000
      RUNOFF VOLUME     (mm)=       40.91          8.82            32.566
      TOTAL RAINFALL    (mm)=       42.48         42.48            42.480
      RUNOFF COEFFICIENT   =          .96           .21              .767

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20      Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0032------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (109       ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106            3.00      .137    1.28  40.59    .000
                    +ID2 07:107             .00      .000     .00    .00    .000   **DRY**
                    +ID3 08:108            2.17      .402    1.00  32.57    .000
                     ============================================================
                     SUM 09:109            5.17      .515    1.00  37.22    .000

```

```
   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0033-----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .49
| 01:101    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .32          .17
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.00         3.30
     Length            (m)=       7.50        30.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        44.64
                over (min)        1.00         7.00
     Storage Coeff.  (min)=        .47 (ii)    6.64 (ii)
     Unit Hyd. Tpeak (min)=       1.00         7.00
     Unit Hyd. peak  (cms)=       1.50          .17
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .08          .01            .089 (iii)
     TIME TO PEAK    (hrs)=        .87         1.03           1.000
     RUNOFF VOLUME    (mm)=      40.91         8.82          29.999
     TOTAL RAINFALL   (mm)=      42.48        42.48          42.480
     RUNOFF COEFFICIENT   =        .96          .21            .706

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0034-----------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<02:(102    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .079  .6500E-02

     ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
     --------------------          (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )          .49      .089     1.000     29.999
     OUTFLOW<02: (102    )          .49      .057     1.017     29.999
    OVERFLOW<03: (103    )          .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   64.816
                   TIME SHIFT OF PEAK FLOW         (min)=     1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4779E-02

-------------------------------------------------------------------------------
001:0035-----------------------------------------------------------------------
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and C
```

```
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 09:109             5.17     .515    1.00  37.22    .000
                    +ID2 02:102              .49     .057    1.02  30.00    .000
                    +ID3 03:103              .00     .000     .00    .00    .000  **DRY**
                     ===========================================================
                     SUM 05:105             5.66     .572    1.00  36.60    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0036-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.01
| 06:106    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.00          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        45.57
                over (min)        2.00         6.00
     Storage Coeff.  (min)=       2.01 (ii)    5.69 (ii)
     Unit Hyd. Tpeak (min)=       2.00         6.00
     Unit Hyd. peak  (cms)=        .56          .20
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .23          .00            .233 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.03           1.000
     RUNOFF VOLUME    (mm)=      40.91         8.82          40.589
     TOTAL RAINFALL   (mm)=      42.48        42.48          42.480
     RUNOFF COEFFICIENT   =        .96          .21            .955

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0037-----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>06:(106    )   |
| OUT<07:(107    )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |   (cms)     (ha.m.)
                             .000  .0000E+00   |    .086  .4495E-01

     ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
     --------------------          (ha)     (cms)     (hrs)       (mm)
     INFLOW >06: (106    )        1.01      .233     1.000     40.589
     OUTFLOW<07: (107    )        1.01      .046     1.283     40.589
    OVERFLOW<08: (108    )         .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
```

```
                     CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                     PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                     PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.843
                     TIME SHIFT OF PEAK FLOW         (min)=    17.00
                     MAXIMUM  STORAGE   USED       (ha.m.)=.2426E-01

 ---------------------------------------------------------------------------------
 001:0038------------------------------------------------------------------------
 *Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    4.43
 | 09:109    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       2.61          1.82
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=       1.89          1.61
      Length            (m)=     103.00         36.00
      Mannings n          =        .013          .200

      Max.eff.Inten.(mm/hr)=      83.56         40.41
                 over (min)        2.00         11.00
      Storage Coeff.  (min)=       2.31 (ii)    11.19 (ii)
      Unit Hyd. Tpeak (min)=       2.00         11.00
      Unit Hyd. peak  (cms)=        .51           .10
                                                               *TOTALS*
      PEAK FLOW       (cms)=        .61           .12            .694 (iii)
      TIME TO PEAK    (hrs)=       1.00          1.10           1.000
      RUNOFF VOLUME    (mm)=      40.91          8.82          27.752
      TOTAL RAINFALL   (mm)=      42.48         42.48          42.480
      RUNOFF COEFFICIENT   =        .96           .21            .653

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------------
 001:0039------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (101       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 07:107           1.01      .046    1.28  40.59    .000
                     +ID2 08:108            .00      .000     .00    .00    .000  **DRY**
                     +ID3 09:109           4.43      .694    1.00  27.75    .000
                      ============================================================
                      SUM 01:101           5.44      .732    1.00  30.14    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ---------------------------------------------------------------------------------
 001:0040------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
 *
 *Area controlled to 60L/s to meet Pinecrest Creek Criteria
 *SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.67
 | 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
```

```
    Surface Area      (ha)=        .95          .72
    Dep. Storage      (mm)=       1.57         4.67
    Average Slope      (%)=        .50         2.00
    Length             (m)=     113.00        10.00
    Mannings n            =       .013         .200

    Max.eff.Inten.(mm/hr)=       83.56        44.64
               over (min)         4.00         7.00
    Storage Coeff.  (min)=        3.64 (ii)    7.35 (ii)
    Unit Hyd. Tpeak (min)=        4.00         7.00
    Unit Hyd. peak  (cms)=         .30          .16
                                                            *TOTALS*
    PEAK FLOW       (cms)=         .22          .06           .272 (iii)
    TIME TO PEAK    (hrs)=        1.00         1.05          1.000
    RUNOFF VOLUME    (mm)=       40.91         8.82         27.111
    TOTAL RAINFALL   (mm)=       42.48        42.48         42.480
    RUNOFF COEFFICIENT   =         .96          .21           .638

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
           Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0041-----------------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .045  .1920E-01
                            .023  .3000E-03    |     .050  .3360E-01
                            .032  .2300E-02    |     .055  .4700E-01
                            .039  .8200E-02    |     .060  .5480E-01

    ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
    --------------------         (ha)     (cms)     (hrs)       (mm)
    INFLOW >02: (102    )        1.67      .272     1.000     27.111
    OUTFLOW<03: (103    )        1.67      .047     1.350     27.111
   OVERFLOW<06: (106    )         .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   17.220
                  TIME SHIFT OF PEAK FLOW         (min)=    21.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.2448E-01

-------------------------------------------------------------------------------------
001:0042-----------------------------------------------------------------------------
*
------------------------
| ADD HYD (107       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 03:103           1.67      .047    1.35  27.11    .000
                    +ID2 06:106            .00      .000     .00    .00    .000  **DRY**
                     ============================================================
                     SUM 07:107           1.67      .047    1.35  27.11    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0043-----------------------------------------------------------------------------
```

```
*
*Combine Subcatchment 3 & 9
*
------------------------
| ADD HYD (108        ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 01:101            5.44      .732     1.00   30.14     .000
                    +ID2 07:107            1.67      .047     1.35   27.11     .000
                     ==========================================================
                     SUM 08:108            7.11      .774     1.00   29.43     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0044------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.03
| 09:109    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .98           .05
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       3.23          1.24
     Length            (m)=      35.00        200.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         11.76
                over (min)        1.00         45.00
     Storage Coeff.  (min)=       1.03 (ii)    45.09 (ii)
     Unit Hyd. Tpeak (min)=       1.00         45.00
     Unit Hyd. peak  (cms)=       1.06           .03
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .23           .00             .227 (iii)
     TIME TO PEAK    (hrs)=        .98          1.65            1.000
     RUNOFF VOLUME    (mm)=      40.91          8.82           39.305
     TOTAL RAINFALL   (mm)=      42.48         42.48           42.480
     RUNOFF COEFFICIENT   =        .96           .21             .925

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0045------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL      ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 04:104           20.77     1.449     1.00   26.83     .000
                    +ID2 05:105            5.66      .572     1.00   36.60     .000
                    +ID3 08:108            7.11      .774     1.00   29.43     .000
                    +ID4 09:109            1.03      .227     1.00   39.31     .000
                     ==========================================================
                     SUM 01:TOTAL         34.57     3.023     1.00   29.34     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0046------------------------------------------------------------------------
*
      FINISH
```

```
-------------------------------------------------------------------------------------
*************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 12:09:38
=====================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 02-13-2018
*#  Revised         : 06-28-2018
*#  Revised         : 07-04-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
* Future Building S, Building C, Deficit
* Short Term Development  (Future HLE, Sports Complex Removed)
*
START                TIME = 0.0
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM        IUNITS=[2], TD=[6](hrs), TPRAT=[0.333], CSDT=[15](min)
                     ICASEcs=[1], A=[998.071], B=[6.053], C=[0.814]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD       ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                     XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                     Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                             DCAY=[4.14](/hr), F=[0](mm),
                     Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                          LGP=[10](m), MNP=[0.2], SCP=[0](min),
                     Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                          LGI=[42](m), MNI=[0.013], SCI=[0](min),
                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR      IDout=[2],   NHYD=["102"],  IDin=[1],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
```

```
                                F5Y6H
                             [   0.0 ,  0.0    ]
                             [0.00945,  0.00266]
                             [   -1  ,  -1     ]
                       IDovf=[3], NHYDovf=["103"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                   [   0.0 ,  0.0    ]
                                   [ 0.096 ,  0.0175 ]
```

```
                                         F5Y6H
                                      [    -1  ,  -1     ]
                            IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40.](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [    0.0 ,  0.0    ]
                                  [0.00756,  0.00469]
                                  [    -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
                                         LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [ 0.000 ,  0.0000 ]
                                    [ 0.023 ,  0.1100 ]
                                    [ 0.312 ,  0.3830 ]
                                    [   -1  ,  -1     ]
                          IDovf=[1], NHYDovf=["101"]
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S
Expansion and Parking Lot 7, 8 (south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
```

```
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,  -1     ]
                          IDovf=[4], NHYDovf=["104"]
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S
Expansion
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.30](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[3+4+5]
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[9+1+6]
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
```

```
                                 F5Y6H
                              [0.13230,  0.05698]
                              [   -1  ,  -1     ]
                        IDovf=[1], NHYDovf=["101"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[3], NHYD=["103"], IDs to add=[9+1+2]
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[7+3]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[3.00](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                              [   0.0 ,  0.0    ]
                              [0.28539,  0.15012]
                              [   -1  ,  -1     ]
                        IDovf=[7], NHYDovf=["107"]

*Remaining Area - Includes Grass, Parking Lots, Road
```

```
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[2.17](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.00](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[6+7+8]
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.49](ha),
                    XIMP=[0.66], TIMP=[0.66], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[3.30](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[7.5](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.079 ,  0.0065 ]
                                    [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and
Courtyard
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[7],   NHYD=["107"],  IDin=[6],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08562,  0.04495]
                                    [   -1  ,  -1     ]
                          IDovf=[8], NHYDovf=["108"]

*Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[7+8+9]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
```

```
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.023 ,  0.0003 ]
                                  [ 0.032 ,  0.0023 ]
                                  [ 0.039 ,  0.0082 ]
                                  [ 0.045 ,  0.0192 ]
                                  [ 0.050 ,  0.0336 ]
                                  [ 0.055 ,  0.0470 ]
                                  [ 0.060 ,  0.0548 ]
                                  [   -1  ,    -1   ]
                          IDovf=[6], NHYDovf=["106"]
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+6]
*
*Combine Subcatchment 3 & 9
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+7]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[1], NHYD=["TOTAL"], IDs to add=[4+5+8+9]
*
*%-----------------|------------------------------------------------------------|
FINISH
```

```
==================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                       9   9  9   9   # 3573794
        StormWater Management HYdrologic Model          999    999    =========

  *******************************************************************************
  ***************************** SWMHYMO Ver/4.05  ******************************
  *********  A single event and continuous hydrologic simulation model  *********
  *********     based on the principles of HYMO and its successors      *********
  *********                 OTTHYMO-83 and OTTHYMO-89.                  *********
  *******************************************************************************
  ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
  *********                  Ottawa,  Ontario: (613) 836-3884          *********
  *********                  Gatineau, Quebec: (819) 243-6858          *********
  *********                  E-Mail: swmhymo@jfsa.Com                  *********
  *******************************************************************************

  +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  +++++++++ Licensed user: Morrison Hershfield Ltd.                    +++++++++
  +++++++++                Ottawa                  SERIAL#:3573794     +++++++++
  +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

  *******************************************************************************
  *********           ++++++ PROGRAM ARRAY DIMENSIONS ++++++            *********
  *********           Maximum value for ID numbers  :     10           *********
  *********           Max. number of rainfall points: 105408           *********
  *********           Max. number of flow points    : 105408           *********
  *******************************************************************************


  **********************   D E T A I L E D   O U T P U T   *********************
  *******************************************************************************
  *         DATE: 2018-10-19     TIME: 12:09:46     RUN COUNTER: 000294          *
  *******************************************************************************
  * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F5Y6H.DAT              *
  * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F5Y6H.out              *
  * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F5Y6H.sum              *
  * User comments:                                                              *
  * 1:__________________________________________________________________________*
  * 2:__________________________________________________________________________*
  * 3:__________________________________________________________________________*
  *******************************************************************************

 ----------------------------------------------------------------------------------
 001:0001--------------------------------------------------------------------------
 *#*****************************************************************************
 *#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
 *#  Project Number : [2085345.16]
 *#  Date           : 02-07-2014
 *#  Revised        : 01-20-2015
 *#  Revised        : 01-03-2017
 *#  Revised        : 02-13-2018
 *#  Revised     : 06-28-2018
 *#  Revised     : 07-04-2018
 *#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
 *#                                 October 2018
 *#  Modeller       : [SM]
 *#  Company        : Morrison Hershfield Ltd
 *#  License #      : 3573794
 *#*****************************************************************************
 *
 * Future Building S, Building C, Deficit
 * Short Term Development  (Future HLE, Sports Complex Removed)
 *
```

```
--------------------
| START              |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN   = 001
    NSTORM=    0
--------------------------------------------------------------------------------
001:0002------------------------------------------------------------------------
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM    |     IDF curve parameters: A= 998.071
| Ptotal= 49.03 mm |                           B=   6.053
--------------------                           C=    .814
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm   =  6.00 hrs
                        Storm time step     = 15.00 min
                        Time to peak ratio =   .33

              TIME    RAIN |    TIME    RAIN |    TIME    RAIN |    TIME    RAIN
               hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr
               .25   1.872 |    1.75  16.065 |    3.25   4.530 |    4.75   2.236
               .50   2.152 |    2.00  83.557 |    3.50   3.836 |    5.00   2.073
               .75   2.546 |    2.25  21.363 |    3.75   3.337 |    5.25   1.934
              1.00   3.146 |    2.50  10.789 |    4.00   2.962 |    5.50   1.814
              1.25   4.178 |    2.75   7.304 |    4.25   2.668 |    5.75   1.709
              1.50   6.429 |    3.00   5.570 |    4.50   2.431 |    6.00   1.617

--------------------------------------------------------------------------------
001:0003------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05           .00
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         49.09
                over (min)        2.00          6.00
     Storage Coeff.  (min)=       2.01 (ii)     5.58 (ii)
     Unit Hyd. Tpeak (min)=       2.00          6.00
     Unit Hyd. peak  (cms)=        .56           .20
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .01           .00               .012 (iii)
     TIME TO PEAK    (hrs)=       2.00          2.02              2.000
     RUNOFF VOLUME    (mm)=      47.46         10.09             47.086
     TOTAL RAINFALL   (mm)=      49.03         49.03             49.029
     RUNOFF COEFFICIENT   =        .97           .21               .960

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```

 -----------------------------------------------------------------------------
 001:0004--------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
 |  IN>01:(101    )   |
 | OUT<02:(102    )   |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)    (ha.m.)   |    (cms)    (ha.m.)
                              .000  .0000E+00   |     .009  .2660E-02

      ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
      --------------------         (ha)     (cms)     (hrs)       (mm)
      INFLOW >01: (101    )         .05      .012     2.000     47.086
      OUTFLOW<02: (102    )         .05      .004     2.100     47.085
     OVERFLOW<03: (103    )         .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.357
                    TIME SHIFT OF PEAK FLOW         (min)=     6.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1051E-02

 -----------------------------------------------------------------------------
 001:0005--------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    1.60
 | 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
 ----------------------
                                IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=         .02         1.58
      Dep. Storage     (mm)=        1.57         4.67
      Average Slope     (%)=        2.03         1.76
      Length            (m)=       37.00        85.00
      Mannings n          =         .013         .200

      Max.eff.Inten.(mm/hr)=       83.56        37.74
                 over (min)        1.00        16.00
      Storage Coeff.  (min)=        1.22 (ii)   16.11 (ii)
      Unit Hyd. Tpeak (min)=        1.00        16.00
      Unit Hyd. peak  (cms)=         .95          .07
                                                                 *TOTALS*
      PEAK FLOW       (cms)=         .00          .09            .089 (iii)
      TIME TO PEAK    (hrs)=        1.95         2.17           2.167
      RUNOFF VOLUME    (mm)=       47.46        10.09          10.459
      TOTAL RAINFALL   (mm)=       49.03        49.03          49.029
      RUNOFF COEFFICIENT   =         .97          .21            .213
       *** WARNING: For areas with impervious ratios below
                    20%, this routine may not be applicable.

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -----------------------------------------------------------------------------
 001:0006--------------------------------------------------------------------
 *
```

```
 -----------------------
 | ADD HYD (105       ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
 -----------------------                   (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 02:102             .05      .004     2.10   47.09     .000
                    +ID2 03:103             .00      .000      .00     .00     .000   **DRY**
                    +ID3 04:104            1.60      .089     2.17   10.46     .000
                     ============================================================
                     SUM 05:105            1.65      .093     2.17   11.57     .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ---------------------------------------------------------------------------------
 001:0007-------------------------------------------------------------------------
 *
 ---------------------
 | COMPUTE DUALHYD     |   Average inlet capacities   [CINLET] =    .096  (cms)
 | TotalHyd 05:105     |   Number of inlets in system [NINLET] =       1
 ---------------------     Total minor system capacity         =    .096  (cms)
                           Total major system storage [TMJSTO] =      70.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)     (cms)
      TOTAL HYD.  05:105          1.65      .093     2.167   11.569      .000
      =================================================================
      MAJOR SYST  06:106           .00      .000      .000     .000      .000
      MINOR SYST  07:107          1.65      .093     2.167   11.569      .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

      Maximum MAJOR SYSTEM storage used =       0.(cu.m.)

 ---------------------------------------------------------------------------------
 001:0008-------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 7: North East Parking Lot
 *
 ---------------------
 | CALIB STANDHYD      |   Area    (ha)=     .67
 | 08:108    DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
 ---------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       .60          .07
      Dep. Storage     (mm)=      1.57         4.67
      Average Slope     (%)=      2.00         4.03
      Length            (m)=     25.00        34.00
      Mannings n          =       .013         .200

      Max.eff.Inten.(mm/hr)=     83.56        48.29
                 over (min)       1.00         7.00
      Storage Coeff.  (min)=       .97 (ii)    7.04 (ii)
      Unit Hyd. Tpeak (min)=      1.00         7.00
      Unit Hyd. peak  (cms)=      1.09          .16
                                                            *TOTALS*
      PEAK FLOW       (cms)=       .14          .01           .146 (iii)
      TIME TO PEAK    (hrs)=      1.98         2.03          2.000
      RUNOFF VOLUME    (mm)=     47.46        10.09         43.722
      TOTAL RAINFALL   (mm)=     49.03        49.03         49.029
      RUNOFF COEFFICIENT   =       .97          .21           .892

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------------
 001:0009-------------------------------------------------------------------------
 *
```

```
*Combine Subcatchments 7 & 8
*
------------------------
| ADD HYD (109         ) | ID: NHYD          AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                   (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 07:107            1.65      .093     2.17   11.57     .000
                    +ID2 08:108             .67      .146     2.00   43.72     .000
                     ===========================================================
                     SUM 09:109            2.32      .202     2.00   20.85     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0010----------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>09:(109    )   |
| OUT<01:(101    )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW     STORAGE    |  OUTFLOW     STORAGE
                            (cms)     (ha.m.)    |    (cms)     (ha.m.)
                             .000  .0000E+00     |     .096  .1750E-01

     ROUTING RESULTS              AREA     QPEAK      TPEAK       R.V.
     --------------------         (ha)     (cms)      (hrs)       (mm)
     INFLOW >09: (109    )        2.32      .202      2.000     20.855
     OUTFLOW<01: (101    )        2.32      .095      2.283     20.855
    OVERFLOW<02: (102    )         .00      .000       .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   46.911
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1724E-01

------------------------------------------------------------------------------------
001:0011----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.08
| 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.05          .03
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.90          .01
     Length            (m)=     140.00        40.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        40.25
                over (min)        3.00        46.00
     Storage Coeff.  (min)=       2.77 (ii)   46.31 (ii)
     Unit Hyd. Tpeak (min)=       3.00        46.00
     Unit Hyd. peak  (cms)=        .40          .02
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .70          .00             .704 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.67            2.000
     RUNOFF VOLUME    (mm)=      47.46        10.09           47.086
     TOTAL RAINFALL   (mm)=      49.03        49.03           49.029
     RUNOFF COEFFICIENT   =        .97          .21             .960

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
```

```
              Fo    (mm/hr)= 76.20            K  (1/hr)=  4.14
              Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
             THAN THE STORAGE COEFFICIENT.
       (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0012----------------------------------------------------------------------------
 *
 *Combine Subcatchment 6 and Overflows
 *
 ------------------------
 | ADD HYD (104        ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
 ------------------------                   (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 06:106              .00      .000      .00     .00     .000   **DRY**
                    +ID2 02:102              .00      .000      .00     .00     .000   **DRY**
                    +ID3 03:103             3.08      .704     2.00   47.09     .000
                     ============================================================
                     SUM 04:104             3.08      .704     2.00   47.09     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------------
 001:0013----------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 5: Building V and Snow Dump
 *
 *Total Building Area - Includes Building V
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .09
 | 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=         .09          .00
      Dep. Storage     (mm)=        1.57         4.67
      Average Slope     (%)=         .50         2.00
      Length            (m)=       42.00        10.00
      Mannings n           =        .013         .200

      Max.eff.Inten.(mm/hr)=       83.56        49.09
                 over (min)         2.00         6.00
      Storage Coeff.  (min)=        2.01 (ii)    5.58 (ii)
      Unit Hyd. Tpeak (min)=        2.00         6.00
      Unit Hyd. peak  (cms)=         .56          .20
                                                                *TOTALS*
      PEAK FLOW       (cms)=         .02          .00              .021 (iii)
      TIME TO PEAK    (hrs)=        2.00         2.02             2.000
      RUNOFF VOLUME    (mm)=       47.46        10.09            47.086
      TOTAL RAINFALL   (mm)=       49.03        49.03            49.029
      RUNOFF COEFFICIENT   =         .97          .21              .960

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
              Fo    (mm/hr)= 76.20            K  (1/hr)=  4.14
              Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
             THAN THE STORAGE COEFFICIENT.
       (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0014----------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>08:(108    )  |
 | OUT<09:(109    )  |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
```

```
                              (cms)    (ha.m.)   |    (cms)    (ha.m.)
                               .000  .0000E+00   |     .008  .4690E-02

     ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
     --------------------          (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )          .09      .021     2.000     47.086
     OUTFLOW<09: (109    )          .09      .004     2.283     47.085
    OVERFLOW<02: (102    )          .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.285
                   TIME SHIFT OF PEAK FLOW          (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2356E-02

--------------------------------------------------------------------------------
001:0015------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.82
| 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .76          3.06
     Dep. Storage     (mm)=         1.57          4.67
     Average Slope     (%)=          .01          2.04
     Length            (m)=          .01        425.00
     Mannings n           =         .013          .200

     Max.eff.Inten.(mm/hr)=        83.56          9.17
                over (min)          1.00         66.00
     Storage Coeff.  (min)=          .04 (ii)    65.93 (ii)
     Unit Hyd. Tpeak (min)=         1.00         66.00
     Unit Hyd. peak  (cms)=         1.70           .02
                                                              *TOTALS*
     PEAK FLOW       (cms)=          .18           .05           .183 (iii)
     TIME TO PEAK    (hrs)=         1.77          3.00          2.000
     RUNOFF VOLUME    (mm)=        47.46         10.09         17.560
     TOTAL RAINFALL   (mm)=        49.03         49.03         49.029
     RUNOFF COEFFICIENT   =          .97           .21           .358

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0016------------------------------------------------------------------------
*
------------------------
| ADD HYD (105       ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 09:109            .09      .004     2.28   47.09     .000
                    +ID2 02:102            .00      .000      .00     .00     .000  **DRY**
                    +ID3 03:103           3.82      .183     2.00   17.56     .000
                     ============================================================
                     SUM 05:105           3.91      .186     2.00   18.24     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0017------------------------------------------------------------------------
```

```
*
*Combine Subcatchments 5, 6, 7 & 8
*
------------------------
| ADD HYD (108       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.     DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)    (cms)
                     ID1 01:101            2.32      .095     2.28  20.85     .000
                    +ID2 04:104            3.08      .704     2.00  47.09     .000
                    +ID3 05:105            3.91      .186     2.00  18.24     .000
                     ============================================================
                     SUM 08:108            9.31      .961     2.00  28.43     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------------------
001:0018----------------------------------------------------------------------------------------
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .312  .3830E+00
                            .023  .1100E+00   |     .000  .0000E+00

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )        9.31      .961     2.000     28.434
     OUTFLOW<09: (109    )        9.31      .094     3.550     28.434
    OVERFLOW<01: (101    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=    9.825
                   TIME SHIFT OF PEAK FLOW          (min)=    93.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1775E+00

------------------------------------------------------------------------------------------------
001:0019----------------------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S E
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.04          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        49.09
                over (min)       2.00         6.00
     Storage Coeff.  (min)=       2.01 (ii)    5.58 (ii)
     Unit Hyd. Tpeak (min)=       2.00         6.00
```

```
     Unit Hyd. peak  (cms)=        .56          .20
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .24          .00               .242 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.02              2.000
     RUNOFF VOLUME    (mm)=      47.46        10.09             47.086
     TOTAL RAINFALL   (mm)=      49.03        49.03             49.029
     RUNOFF COEFFICIENT   =        .97          .21               .960

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20      Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------------
001:0020------------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .085  .5115E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )       1.05      .242     2.000     47.086
     OUTFLOW<03: (103    )       1.05      .045     2.283     47.086
    OVERFLOW<04: (104    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.727
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2728E-01

--------------------------------------------------------------------------------------
001:0021------------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S Expa
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.30
| 05:105    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.18         1.12
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.43        15.38
     Length            (m)=     116.00        13.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        49.86
                over (min)        3.00         5.00
     Storage Coeff.  (min)=       2.70 (ii)    4.95 (ii)
     Unit Hyd. Tpeak (min)=       3.00         5.00
     Unit Hyd. peak  (cms)=        .40          .23
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .73          .13               .859 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.02              2.000
     RUNOFF VOLUME    (mm)=      47.46        10.09             37.742
     TOTAL RAINFALL   (mm)=      49.03        49.03             49.029
```

```
    RUNOFF COEFFICIENT   =        .97          .21           .770

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
           Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0022-----------------------------------------------------------------------
*
------------------------
| ADD HYD (106        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 03:103            1.05      .045    2.28  47.09    .000
                    +ID2 04:104             .00      .000     .00    .00    .000  **DRY**
                    +ID3 05:105            4.30      .859    2.00  37.74    .000
                     ===========================================================
                     SUM 06:106            5.35      .897    2.00  39.58    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0023-----------------------------------------------------------------------
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
------------------------
| ADD HYD (107        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 09:109            9.31      .094    3.55  28.43    .000
                    +ID2 01:101             .00      .000     .00    .00    .000  **DRY**
                    +ID3 06:106            5.35      .897    2.00  39.58    .000
                     ===========================================================
                     SUM 07:107           14.66      .916    2.00  32.50    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0024-----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.14
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=       1.13          .01
    Dep. Storage     (mm)=       1.57         4.67
    Average Slope     (%)=        .50         2.00
    Length            (m)=      42.00        10.00
    Mannings n          =        .013         .200

    Max.eff.Inten.(mm/hr)=      83.56        49.09
               over (min)        2.00         6.00
    Storage Coeff.  (min)=       2.01 (ii)    5.58 (ii)
    Unit Hyd. Tpeak (min)=       2.00         6.00
    Unit Hyd. peak  (cms)=        .56          .20
                                                         *TOTALS*
    PEAK FLOW       (cms)=        .26          .00          .263 (iii)
    TIME TO PEAK    (hrs)=       2.00         2.02         2.000
    RUNOFF VOLUME    (mm)=      47.46        10.09        47.086
    TOTAL RAINFALL   (mm)=      49.03        49.03        49.029
    RUNOFF COEFFICIENT   =        .97          .21          .960
```

```
       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0025-----------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .132  .5698E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK        R.V.
     --------------------         (ha)     (cms)     (hrs)        (mm)
     INFLOW >08: (108    )        1.14      .263     2.000      47.086
     OUTFLOW<09: (109    )        1.14      .063     2.267      47.086
    OVERFLOW<01: (101    )         .00      .000      .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =          0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=        .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=        .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   23.899
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2707E-01

-------------------------------------------------------------------------------
001:0026-----------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.97
| 02:102    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.74          3.23
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        1.00          1.42
     Length            (m)=       57.00         57.00
     Mannings n          =         .013          .200

     Max.eff.Inten.(mm/hr)=       83.56         41.44
                over (min)        2.00         14.00
     Storage Coeff.  (min)=        1.96 (ii)    13.99 (ii)
     Unit Hyd. Tpeak (min)=        2.00         14.00
     Unit Hyd. peak  (cms)=         .57           .08
                                                               *TOTALS*
     PEAK FLOW       (cms)=         .40           .20            .532 (iii)
     TIME TO PEAK    (hrs)=        2.00          2.13           2.000
     RUNOFF VOLUME    (mm)=       47.46         10.09          23.167
     TOTAL RAINFALL   (mm)=       49.03         49.03          49.029
     RUNOFF COEFFICIENT   =         .97           .21            .473

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
 ----------------------------------------------------------------------------
 001:0027--------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (103       ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
 ------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
                      ID1 09:109            1.14      .063     2.27   47.09     .000
                     +ID2 01:101             .00      .000      .00     .00     .000  **DRY**
                     +ID3 02:102            4.97      .532     2.00   23.17     .000
                      =======================================================
                      SUM 03:103            6.11      .586     2.00   27.63     .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------
 001:0028--------------------------------------------------------------------
 *
 *Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
 *
 ------------------------
 | ADD HYD (104       ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
 ------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
                      ID1 07:107           14.66      .916     2.00   32.50     .000
                     +ID2 03:103            6.11      .586     2.00   27.63     .000
                      =======================================================
                      SUM 04:104           20.77     1.503     2.00   31.07     .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------
 001:0029--------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 2: Building A, C, D, H, J
 *
 *Total Building Area - Includes Building A, C, D, H & J
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    3.00
 | 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       2.97          .03
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .50         2.00
      Length            (m)=      42.00        10.00
      Mannings n          =       .013         .200

      Max.eff.Inten.(mm/hr)=      83.56        49.09
                 over (min)        2.00         6.00
      Storage Coeff.  (min)=       2.01 (ii)    5.58 (ii)
      Unit Hyd. Tpeak (min)=       2.00         6.00
      Unit Hyd. peak  (cms)=        .56          .20
                                                            *TOTALS*
      PEAK FLOW       (cms)=        .69          .00           .692 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.02          2.000
      RUNOFF VOLUME    (mm)=      47.46        10.09         47.086
      TOTAL RAINFALL   (mm)=      49.03        49.03         49.029
      RUNOFF COEFFICIENT  =        .97          .21           .960

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0030--------------------------------------------------------------------
```

```
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>05:(105    )   |
| OUT<06:(106    )   |    =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |      .285  .1501E+00

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >05: (105    )        3.00      .692     2.000     47.086
     OUTFLOW<06: (106    )        3.00      .143     2.283     47.086
    OVERFLOW<07: (107    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.707
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.7540E-01

--------------------------------------------------------------------------------
001:0031------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots, Road
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    2.17
| 08:108    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.61          .56
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.92         2.00
     Length            (m)=     130.00        30.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        45.64
                over (min)        3.00        10.00
     Storage Coeff.  (min)=       2.64 (ii)    9.75 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .41          .12
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .37          .04             .408 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.08            2.000
     RUNOFF VOLUME    (mm)=      47.46        10.09           37.742
     TOTAL RAINFALL   (mm)=      49.03        49.03           49.029
     RUNOFF COEFFICIENT   =        .97          .21             .770

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0032------------------------------------------------------------------------
*
------------------------
| ADD HYD (109       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 06:106            3.00      .143     2.28  47.09    .000
                    +ID2 07:107             .00      .000      .00    .00    .000  **DRY**
                    +ID3 08:108            2.17      .408     2.00  37.74    .000
```

```
                    ============================================================
                    SUM 09:109            5.17     .529    2.00  43.16    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0033----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .49
| 01:101    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .32           .17
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       2.00          3.30
     Length            (m)=       7.50         30.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         49.09
                over (min)        1.00          6.00
     Storage Coeff.  (min)=        .47 (ii)     6.41 (ii)
     Unit Hyd. Tpeak (min)=       1.00          6.00
     Unit Hyd. peak  (cms)=       1.50           .18
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .08           .02              .091 (iii)
     TIME TO PEAK    (hrs)=       1.87          2.03             2.000
     RUNOFF VOLUME    (mm)=      47.46         10.09            34.752
     TOTAL RAINFALL   (mm)=      49.03         49.03            49.029
     RUNOFF COEFFICIENT   =        .97           .21              .709

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0034----------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<02:(102    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .079  .6500E-02

     ROUTING RESULTS              AREA      QPEAK     TPEAK       R.V.
     --------------------         (ha)      (cms)     (hrs)       (mm)
     INFLOW >01: (101    )         .49       .091     2.000     34.752
     OUTFLOW<02: (102    )         .49       .059     2.017     34.752
    OVERFLOW<03: (103    )         .00       .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   64.757
                   TIME SHIFT OF PEAK FLOW         (min)=     1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4917E-02

------------------------------------------------------------------------------------
```

```
001:0035---------------------------------------------------------------------------
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and C
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA      QPEAK    TPEAK    R.V.     DWF
------------------------                   (ha)      (cms)    (hrs)    (mm)    (cms)
                    ID1 09:109             5.17      .529     2.00   43.16     .000
                   +ID2 02:102              .49      .059     2.02   34.75     .000
                   +ID3 03:103              .00      .000      .00     .00     .000  **DRY**
                    ==========================================================
                    SUM 05:105             5.66      .587     2.00   42.44     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------
001:0036---------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.01
| 06:106    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.00          .01
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=         .50         2.00
     Length            (m)=       42.00        10.00
     Mannings n          =         .013         .200

     Max.eff.Inten.(mm/hr)=       83.56        49.09
                over (min)         2.00         6.00
     Storage Coeff.  (min)=        2.01 (ii)    5.58 (ii)
     Unit Hyd. Tpeak (min)=        2.00         6.00
     Unit Hyd. peak  (cms)=         .56          .20
                                                              *TOTALS*
     PEAK FLOW       (cms)=         .23          .00             .233 (iii)
     TIME TO PEAK    (hrs)=        2.00         2.02            2.000
     RUNOFF VOLUME    (mm)=       47.46        10.09           47.086
     TOTAL RAINFALL   (mm)=       49.03        49.03           49.029
     RUNOFF COEFFICIENT   =         .97          .21             .960

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------
001:0037---------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>06:(106    )  |
| OUT<07:(107    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .086  .4495E-01

     ROUTING RESULTS              AREA      QPEAK      TPEAK        R.V.
     --------------------         (ha)      (cms)      (hrs)        (mm)
     INFLOW >06: (106    )        1.01       .233      2.000      47.086
     OUTFLOW<07: (107    )        1.01       .048      2.283      47.086
```

```
     OVERFLOW<08: (108    )        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.737
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2537E-01

 ------------------------------------------------------------------------------------
 001:0038----------------------------------------------------------------------------
 *Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    4.43
 | 09:109    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       2.61          1.82
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=       1.89          1.61
      Length            (m)=     103.00         36.00
      Mannings n          =       .013          .200

      Max.eff.Inten.(mm/hr)=      83.56         44.66
                 over (min)        2.00         11.00
      Storage Coeff.  (min)=       2.31 (ii)    10.85 (ii)
      Unit Hyd. Tpeak (min)=       2.00         11.00
      Unit Hyd. peak  (cms)=        .51           .10
                                                              *TOTALS*
      PEAK FLOW       (cms)=        .61           .13            .711 (iii)
      TIME TO PEAK    (hrs)=       2.00          2.10           2.000
      RUNOFF VOLUME    (mm)=      47.46         10.09          32.136
      TOTAL RAINFALL   (mm)=      49.03         49.03          49.029
      RUNOFF COEFFICIENT   =        .97           .21            .655

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0039----------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (101       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 07:107            1.01      .048    2.28  47.09    .000
                    +ID2 08:108             .00      .000     .00    .00    .000  **DRY**
                    +ID3 09:109            4.43      .711    2.00  32.14    .000
                     ============================================================
                     SUM 01:101            5.44      .752    2.00  34.91    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------------
 001:0040----------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
 *
 *Area controlled to 60L/s to meet Pinecrest Creek Criteria
 *SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.67
```

```
| 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .95          .72
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=         .50         2.00
     Length             (m)=      113.00        10.00
     Mannings n            =        .013         .200

     Max.eff.Inten.(mm/hr)=       83.56        48.29
                over (min)        4.00         7.00
     Storage Coeff.  (min)=        3.64 (ii)    7.23 (ii)
     Unit Hyd. Tpeak (min)=        4.00         7.00
     Unit Hyd. peak  (cms)=         .30          .16
                                                           *TOTALS*
     PEAK FLOW       (cms)=         .22          .07             .280 (iii)
     TIME TO PEAK    (hrs)=        2.00         2.03            2.000
     RUNOFF VOLUME    (mm)=       47.46        10.09           31.389
     TOTAL RAINFALL   (mm)=       49.03        49.03           49.029
     RUNOFF COEFFICIENT   =         .97          .21             .640

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------------
001:0041------------------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |      .045  .1920E-01
                            .023  .3000E-03   |      .050  .3360E-01
                            .032  .2300E-02   |      .055  .4700E-01
                            .039  .8200E-02   |      .060  .5480E-01

     ROUTING RESULTS            AREA      QPEAK      TPEAK        R.V.
     --------------------       (ha)      (cms)      (hrs)        (mm)
     INFLOW >02: (102    )      1.67       .280      2.000      31.389
     OUTFLOW<03: (103    )      1.67       .047      2.350      31.389
    OVERFLOW<06: (106    )       .00       .000       .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   16.821
                   TIME SHIFT OF PEAK FLOW         (min)=    21.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2533E-01

--------------------------------------------------------------------------------------
001:0042------------------------------------------------------------------------------
*
------------------------
| ADD HYD (107        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                    ID1 03:103            1.67      .047    2.35  31.39    .000
                   +ID2 06:106             .00      .000     .00    .00    .000  **DRY**
                    ===========================================================
                    SUM 07:107            1.67      .047    2.35  31.39    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

```
--------------------------------------------------------------------------------
001:0043------------------------------------------------------------------------
*
*Combine Subcatchment 3 & 9
*
------------------------
| ADD HYD (108        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 01:101            5.44      .752     2.00  34.91    .000
                    +ID2 07:107            1.67      .047     2.35  31.39    .000
                     ============================================================
                     SUM 08:108            7.11      .794     2.00  34.08    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0044------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.03
| 09:109    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .98           .05
     Dep. Storage     (mm)=         1.57          4.67
     Average Slope     (%)=         3.23          1.24
     Length            (m)=        35.00        200.00
     Mannings n           =         .013          .200

     Max.eff.Inten.(mm/hr)=        83.56         14.76
                over (min)          1.00         41.00
     Storage Coeff.  (min)=         1.03 (ii)    41.26 (ii)
     Unit Hyd. Tpeak (min)=         1.00         41.00
     Unit Hyd. peak  (cms)=         1.06           .03
                                                                *TOTALS*
     PEAK FLOW       (cms)=          .23           .00             .227 (iii)
     TIME TO PEAK    (hrs)=         2.00          2.58            2.000
     RUNOFF VOLUME    (mm)=        47.46         10.09           45.591
     TOTAL RAINFALL   (mm)=        49.03         49.03           49.029
     RUNOFF COEFFICIENT   =          .97           .21             .930

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0045------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL      ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 04:104           20.77     1.503     2.00  31.07    .000
                    +ID2 05:105            5.66      .587     2.00  42.44    .000
                    +ID3 08:108            7.11      .794     2.00  34.08    .000
                    +ID4 09:109            1.03      .227     2.00  45.59    .000
                     ============================================================
                     SUM 01:TOTAL         34.57     3.112     2.00  33.98    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
```

```
001:0046------------------------------------------------------------------------
*
      FINISH
--------------------------------------------------------------------------------
********************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 12:09:47
================================================================================
```

```
2     Metric units
*#****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 02-13-2018
*#  Revised         : 06-28-2018
*#  Revised         : 07-04-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#****************************************************************************
*
* Future Building S, Building C, Deficit
* Short Term Development  (Future HLE, Sports Complex Removed)
*
START               TIME = 0.0
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM       IUNITS=[2], TD=[12](hrs), TPRAT=[0.333], CSDT=[15](min)
                    ICASEcs=[1], A=[998.071], B=[6.053], C=[0.814]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
```

```
                           [   0.0 ,  0.0    ]
                           [0.00945,  0.00266]
                           [   -1  ,  -1     ]
                    IDovf=[3], NHYDovf=["103"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                   [   0.0 ,  0.0    ]
                                   [ 0.096 ,  0.0175 ]
```

```
                                [    -1  ,  -1     ]
                      IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40.](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.00756,  0.00469]
                                  [    -1  ,  -1     ]
                      IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
                                         LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [ 0.000 ,  0.0000 ]
                                    [ 0.023 ,  0.1100 ]
                                    [ 0.312 ,  0.3830 ]
                                    [   -1  ,  -1     ]
                          IDovf=[1], NHYDovf=["101"]
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S
Expansion and Parking Lot 7, 8 (south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
```

```
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.08505,  0.05115]
                                  [   -1  ,   -1    ]
                          IDovf=[4], NHYDovf=["104"]
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S
Expansion
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.30](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[3+4+5]
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[9+1+6]
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
```

```
                        [0.13230,  0.05698]
                        [   -1  ,   -1     ]
              IDovf=[1], NHYDovf=["101"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[3], NHYD=["103"], IDs to add=[9+1+2]
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[7+3]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[3.00](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.28539,  0.15012]
                                  [   -1  ,   -1     ]
                          IDovf=[7], NHYDovf=["107"]

*Remaining Area - Includes Grass, Parking Lots, Road
```

```
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[2.17](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.00](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[6+7+8]
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.49](ha),
                    XIMP=[0.66], TIMP=[0.66], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[3.30](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[7.5](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.079 ,  0.0065 ]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and
Courtyard
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[7],   NHYD=["107"],  IDin=[6],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08562,  0.04495]
                                    [   -1  ,  -1     ]
                          IDovf=[8], NHYDovf=["108"]

*Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[7+8+9]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
```

```
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.023 ,  0.0003 ]
                                    [ 0.032 ,  0.0023 ]
                                    [ 0.039 ,  0.0082 ]
                                    [ 0.045 ,  0.0192 ]
                                    [ 0.050 ,  0.0336 ]
                                    [ 0.055 ,  0.0470 ]
                                    [ 0.060 ,  0.0548 ]
                                    [   -1  ,    -1   ]
                          IDovf=[6], NHYDovf=["106"]
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+6]
*
*Combine Subcatchment 3 & 9
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+7]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[1], NHYD=["TOTAL"], IDs to add=[4+5+8+9]
*
*%-----------------|-----------------------------------------------------------|
FINISH
```

```
=================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                     9   9  9   9   # 3573794
        StormWater Management HYdrologic Model           999    999    =========

 ********************************************************************************
 ***************************** SWMHYMO Ver/4.05  ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                  OTTHYMO-83 and OTTHYMO-89.                 *********
 ********************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ********************************************************************************

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Morrison Hershfield Ltd.                     +++++++++
 +++++++++                Ottawa                 SERIAL#:3573794       +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ********************************************************************************
 *********           ++++++ PROGRAM ARRAY DIMENSIONS ++++++            *********
 *********           Maximum value for ID numbers  :     10            *********
 *********           Max. number of rainfall points: 105408            *********
 *********           Max. number of flow points    : 105408            *********
 ********************************************************************************


 *********************   D E T A I L E D   O U T P U T   *********************
 ********************************************************************************
 *         DATE: 2018-10-19     TIME: 12:09:55     RUN COUNTER: 000295          *
 ********************************************************************************
 * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F5Y12H.DAT              *
 * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F5Y12H.out              *
 * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F5Y12H.sum              *
 * User comments:                                                               *
 * 1:___________________________________________________________________________*
 * 2:___________________________________________________________________________*
 * 3:___________________________________________________________________________*
 ********************************************************************************

-------------------------------------------------------------------------------------
001:0001----------------------------------------------------------------------------
*#******************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 02-13-2018
*#  Revised         : 06-28-2018
*#  Revised     : 07-04-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
*#                                 October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#******************************************************************************
*
* Future Building S, Building C, Deficit
* Short Term Development  (Future HLE, Sports Complex Removed)
*
```

```
--------------------
| START             |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
-----------------------------------------------------------------------------------
001:0002---------------------------------------------------------------------------
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM     |     IDF curve parameters: A= 998.071
| Ptotal= 56.17 mm |                           B=   6.053
--------------------                           C=    .814
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm   = 12.00 hrs
                        Storm time step     = 15.00 min
                        Time to peak ratio =   .33

              TIME    RAIN |    TIME    RAIN |    TIME    RAIN |    TIME    RAIN
               hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr
               .25    .961 |    3.25   4.178 |    6.25   2.668 |    9.25   1.282
               .50   1.020 |    3.50   6.429 |    6.50   2.431 |    9.50   1.232
               .75   1.087 |    3.75  16.065 |    6.75   2.236 |    9.75   1.187
              1.00   1.165 |    4.00  83.557 |    7.00   2.073 |   10.00   1.145
              1.25   1.256 |    4.25  21.363 |    7.25   1.934 |   10.25   1.106
              1.50   1.364 |    4.50  10.789 |    7.50   1.814 |   10.50   1.070
              1.75   1.497 |    4.75   7.304 |    7.75   1.709 |   10.75   1.037
              2.00   1.661 |    5.00   5.570 |    8.00   1.617 |   11.00   1.006
              2.25   1.872 |    5.25   4.530 |    8.25   1.535 |   11.25    .976
              2.50   2.152 |    5.50   3.836 |    8.50   1.462 |   11.50    .949
              2.75   2.546 |    5.75   3.337 |    8.75   1.396 |   11.75    .923
              3.00   3.146 |    6.00   2.962 |    9.00   1.336 |   12.00    .899

-----------------------------------------------------------------------------------
001:0003---------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        52.62
                over (min)        2.00         5.00
     Storage Coeff.  (min)=       2.01 (ii)    5.48 (ii)
     Unit Hyd. Tpeak (min)=       2.00         5.00
     Unit Hyd. peak  (cms)=        .56          .21
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .01          .00             .012 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.02            4.000
     RUNOFF VOLUME    (mm)=      54.60        11.19           54.164
     TOTAL RAINFALL   (mm)=      56.17        56.17           56.168
     RUNOFF COEFFICIENT   =        .97          .20             .964
```

```
        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0004------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>01:(101    )  |
 | OUT<02:(102    )  |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .009  .2660E-02

      ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
      --------------------        (ha)     (cms)     (hrs)       (mm)
      INFLOW >01: (101    )        .05      .012     4.000     54.164
      OUTFLOW<02: (102    )        .05      .004     4.083     54.163
     OVERFLOW<03: (103    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.721
                   TIME SHIFT OF PEAK FLOW         (min)=     5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1064E-02

 --------------------------------------------------------------------------------
 001:0005------------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    1.60
 | 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
 ----------------------
                                 IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=          .02         1.58
      Dep. Storage     (mm)=         1.57         4.67
      Average Slope     (%)=         2.03         1.76
      Length            (m)=        37.00        85.00
      Mannings n          =         .013         .200

      Max.eff.Inten.(mm/hr)=        83.56        44.30
                 over (min)         1.00        15.00
      Storage Coeff.  (min)=         1.22 (ii)   15.19 (ii)
      Unit Hyd. Tpeak (min)=         1.00        15.00
      Unit Hyd. peak  (cms)=          .95          .07
                                                               *TOTALS*
      PEAK FLOW       (cms)=          .00          .10           .102 (iii)
      TIME TO PEAK    (hrs)=         3.97         4.15          4.150
      RUNOFF VOLUME    (mm)=        54.60        11.19         11.620
      TOTAL RAINFALL   (mm)=        56.17        56.17         56.168
      RUNOFF COEFFICIENT   =          .97          .20           .207
       *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
               THAN THE STORAGE COEFFICIENT.
         (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

    --------------------------------------------------------------------------------
    001:0006------------------------------------------------------------------------
    *
    ------------------------
    | ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
    ------------------------                 (ha)     (cms)    (hrs)   (mm)   (cms)
                         ID1 02:102            .05      .004     4.08  54.16    .000
                        +ID2 03:103            .00      .000      .00    .00    .000  **DRY**
                        +ID3 04:104           1.60      .102     4.15  11.62    .000
                         ============================================================
                         SUM 05:105           1.65      .106     4.15  12.91    .000

       NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

    --------------------------------------------------------------------------------
    001:0007------------------------------------------------------------------------
    *
    ----------------------
    | COMPUTE DUALHYD     |   Average inlet capacities   [CINLET] =    .096  (cms)
    | TotalHyd 05:105     |   Number of inlets in system [NINLET] =       1
    ----------------------    Total minor system capacity         =    .096  (cms)
                              Total major system storage [TMJSTO] =      70.(cu.m.)

                      ID: NHYD         AREA     QPEAK     TPEAK      R.V.      DWF
                                       (ha)     (cms)     (hrs)      (mm)     (cms)
         TOTAL HYD.   05:105           1.65      .106     4.150    12.909      .000
         ======================================================================
         MAJOR SYST   06:106            .00      .000      .000      .000      .000
         MINOR SYST   07:107           1.65      .096     4.083    12.937      .000

         NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

         Maximum MAJOR SYSTEM storage used =       4.(cu.m.)

    --------------------------------------------------------------------------------
    001:0008------------------------------------------------------------------------
    *
    *SUBCATCHMENT AREA 7: North East Parking Lot
    *
    ----------------------
    | CALIB STANDHYD      |   Area     (ha)=     .67
    | 08:108    DT= 1.00  |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
    ----------------------
                                   IMPERVIOUS    PERVIOUS (i)
         Surface Area     (ha)=        .60           .07
         Dep. Storage     (mm)=       1.57          4.67
         Average Slope     (%)=       2.00          4.03
         Length            (m)=      25.00         34.00
         Mannings n          =        .013          .200

         Max.eff.Inten.(mm/hr)=      83.56         51.26
                    over (min)        1.00          7.00
         Storage Coeff.  (min)=        .97 (ii)     6.90 (ii)
         Unit Hyd. Tpeak (min)=       1.00          7.00
         Unit Hyd. peak  (cms)=       1.09           .16
                                                                *TOTALS*
         PEAK FLOW       (cms)=        .14           .01           .147 (iii)
         TIME TO PEAK    (hrs)=       3.98          4.03          4.000
         RUNOFF VOLUME    (mm)=      54.60         11.19         50.256
         TOTAL RAINFALL   (mm)=      56.17         56.17         56.168
         RUNOFF COEFFICIENT  =         .97           .20           .895

           (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
                Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
                Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
          (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
              THAN THE STORAGE COEFFICIENT.
        (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0009------------------------------------------------------------------------
 *
 *Combine Subcatchments 7 & 8
 *
 ------------------------
 | ADD HYD (109        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                      ID1 07:107           1.65      .096     4.08  12.94    .000
                     +ID2 08:108            .67      .147     4.00  50.26    .000
                      ===========================================================
                      SUM 09:109           2.32      .216     4.00  23.71    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0010------------------------------------------------------------------------
 *
 *Flow Controlled to Pre-Development
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>09:(109    )  |
 | OUT<01:(101    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .096   .1750E-01

      ROUTING RESULTS              AREA      QPEAK      TPEAK        R.V.
      --------------------         (ha)      (cms)      (hrs)        (mm)
      INFLOW >09: (109    )        2.32       .216      4.000      23.715
      OUTFLOW<01: (101    )        2.27       .096      4.217      23.715
     OVERFLOW<02: (102    )         .05       .038      4.217      23.715

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         1
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .10
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .55


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=    44.419
                    TIME SHIFT OF PEAK FLOW         (min)=     13.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1748E-01

 --------------------------------------------------------------------------------
 001:0011------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    3.08
 | 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                                 IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=         3.05           .03
      Dep. Storage     (mm)=         1.57          4.67
      Average Slope     (%)=         1.90           .01
      Length            (m)=       140.00         40.00
      Mannings n          =          .013          .200

      Max.eff.Inten.(mm/hr)=        83.56         44.30
                 over (min)         3.00          45.00
      Storage Coeff.  (min)=        2.77 (ii)     44.67 (ii)
      Unit Hyd. Tpeak (min)=        3.00          45.00
      Unit Hyd. peak  (cms)=         .40            .03
                                                               *TOTALS*
      PEAK FLOW       (cms)=         .70            .00            .704 (iii)
```

```
    TIME TO PEAK    (hrs)=       4.00          4.63           4.000
    RUNOFF VOLUME    (mm)=      54.60         11.19          54.164
    TOTAL RAINFALL   (mm)=      56.17         56.17          56.168
    RUNOFF COEFFICIENT   =        .97           .20            .964

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
           Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0012----------------------------------------------------------------------------
*
*Combine Subcatchment 6 and Overflows
*
------------------------
| ADD HYD (104        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106             .00      .000     .00    .00    .000  **DRY**
                    +ID2 02:102             .05      .038    4.22  23.71    .000
                    +ID3 03:103            3.08      .704    4.00  54.16    .000
                     ===========================================================
                     SUM 04:104            3.13      .704    4.00  53.70    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0013----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .09
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=        .09           .00
    Dep. Storage     (mm)=       1.57          4.67
    Average Slope     (%)=        .50          2.00
    Length            (m)=      42.00         10.00
    Mannings n           =       .013          .200

    Max.eff.Inten.(mm/hr)=      83.56         52.62
               over (min)        2.00          5.00
    Storage Coeff.  (min)=       2.01 (ii)     5.48 (ii)
    Unit Hyd. Tpeak (min)=       2.00          5.00
    Unit Hyd. peak  (cms)=        .56           .21
                                                            *TOTALS*
    PEAK FLOW       (cms)=        .02           .00            .021 (iii)
    TIME TO PEAK    (hrs)=       4.00          4.02           4.000
    RUNOFF VOLUME    (mm)=      54.60         11.19          54.163
    TOTAL RAINFALL   (mm)=      56.17         56.17          56.168
    RUNOFF COEFFICIENT   =        .97           .20            .964

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
           Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0014----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
```

```
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>08:(108     )  |
| OUT<09:(109     )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .008  .4690E-02

     ROUTING RESULTS              AREA      QPEAK      TPEAK        R.V.
     --------------------         (ha)      (cms)      (hrs)        (mm)
     INFLOW >08: (108    )         .09       .021      4.000      54.163
     OUTFLOW<09: (109    )         .09       .004      4.283      54.163
    OVERFLOW<02: (102    )         .00       .000       .000        .000

                         TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                         CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                         PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                         PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.803
                         TIME SHIFT OF PEAK FLOW         (min)=    17.00
                         MAXIMUM  STORAGE   USED       (ha.m.)=.2423E-02

--------------------------------------------------------------------------------
001:0015------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.82
| 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
----------------------
                                     IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .76          3.06
     Dep. Storage     (mm)=         1.57          4.67
     Average Slope     (%)=          .01          2.04
     Length            (m)=          .01        425.00
     Mannings n          =          .013          .200

     Max.eff.Inten.(mm/hr)=        83.56         11.00
                over (min)         1.00         61.00
     Storage Coeff.  (min)=          .04 (ii)   61.30 (ii)
     Unit Hyd. Tpeak (min)=         1.00         61.00
     Unit Hyd. peak  (cms)=         1.70           .02
                                                                *TOTALS*
     PEAK FLOW       (cms)=          .18           .06             .185 (iii)
     TIME TO PEAK    (hrs)=         3.77          4.90            4.000
     RUNOFF VOLUME    (mm)=        54.60         11.19           19.868
     TOTAL RAINFALL   (mm)=        56.17         56.17           56.168
     RUNOFF COEFFICIENT  =           .97           .20             .354

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20      Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0016------------------------------------------------------------------------
*
------------------------
| ADD HYD (105       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 09:109            .09      .004     4.28  54.16    .000
                    +ID2 02:102            .00      .000      .00    .00    .000  **DRY**
                    +ID3 03:103           3.82      .185     4.00  19.87    .000
                     ============================================================
```

```
                        SUM 05:105            3.91      .188    4.00  20.66    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0017------------------------------------------------------------------------
*
*Combine Subcatchments 5, 6, 7 & 8
*
------------------------
| ADD HYD (108       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 01:101        2.27      .096    4.22  23.71    .000
                       +ID2 04:104        3.13      .704    4.00  53.70    .000
                       +ID3 05:105        3.91      .188    4.00  20.66    .000
                        ============================================================
                        SUM 08:108        9.31      .966    4.00  32.50    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0018------------------------------------------------------------------------
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .312  .3830E+00
                            .023  .1100E+00    |     .000  .0000E+00

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )        9.31      .966     4.000     32.504
     OUTFLOW<09: (109    )        9.31      .104     5.483     32.503
    OVERFLOW<01: (101    )         .00      .000      .000       .000

                      TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                      CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                      PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                      PEAK   FLOW   REDUCTION [Qout/Qin](%)=   10.821
                      TIME SHIFT OF PEAK FLOW         (min)=    89.00
                      MAXIMUM  STORAGE   USED       (ha.m.)=.1870E+00

--------------------------------------------------------------------------------
001:0019------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S E
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.04           .01
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
```

```
     Mannings n            =         .013         .200

     Max.eff.Inten.(mm/hr)=        83.56        52.62
                over (min)          2.00         5.00
     Storage Coeff.  (min)=         2.01 (ii)    5.48 (ii)
     Unit Hyd. Tpeak (min)=         2.00         5.00
     Unit Hyd. peak  (cms)=          .56          .21
                                                               *TOTALS*
     PEAK FLOW       (cms)=          .24          .00             .242 (iii)
     TIME TO PEAK    (hrs)=         4.00         4.02            4.000
     RUNOFF VOLUME    (mm)=        54.60        11.19           54.164
     TOTAL RAINFALL   (mm)=        56.17        56.17           56.168
     RUNOFF COEFFICIENT    =          .97          .20             .964

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0020------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>02:(102    )   |
| OUT<03:(103    )   |    =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .085  .5115E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )       1.05      .242     4.000     54.164
     OUTFLOW<03: (103    )       1.05      .047     4.283     54.163
    OVERFLOW<04: (104    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=    19.241
                   TIME SHIFT OF PEAK FLOW         (min)=     17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2804E-01

--------------------------------------------------------------------------------
001:0021------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S Expa
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.30
| 05:105    DT= 1.00  |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                                 IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         3.18         1.12
     Dep. Storage     (mm)=         1.57         4.67
     Average Slope     (%)=         1.43        15.38
     Length            (m)=       116.00        13.00
     Mannings n            =         .013         .200

     Max.eff.Inten.(mm/hr)=        83.56        52.62
                over (min)          3.00         5.00
     Storage Coeff.  (min)=         2.70 (ii)    4.90 (ii)
     Unit Hyd. Tpeak (min)=         3.00         5.00
```

```
     Unit Hyd. peak  (cms)=        .40          .23
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .73          .14             .870 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.02            4.000
     RUNOFF VOLUME    (mm)=      54.60        11.19           43.311
     TOTAL RAINFALL   (mm)=      56.17        56.17           56.168
     RUNOFF COEFFICIENT   =        .97          .20             .771

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0022------------------------------------------------------------------------
*
------------------------
| ADD HYD (106        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                    ID1 03:103             1.05      .047     4.28  54.16    .000
                   +ID2 04:104              .00      .000      .00    .00    .000  **DRY**
                   +ID3 05:105             4.30      .870     4.00  43.31    .000
                    ============================================================
                    SUM 06:106             5.35      .909     4.00  45.44    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0023------------------------------------------------------------------------
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
------------------------
| ADD HYD (107        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                    ID1 09:109             9.31      .104     5.48  32.50    .000
                   +ID2 01:101              .00      .000      .00    .00    .000  **DRY**
                   +ID3 06:106             5.35      .909     4.00  45.44    .000
                    ============================================================
                    SUM 07:107            14.66      .931     4.00  37.22    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0024------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.14
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.13          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        52.62
                over (min)        2.00         5.00
     Storage Coeff.  (min)=       2.01 (ii)    5.48 (ii)
     Unit Hyd. Tpeak (min)=       2.00         5.00
     Unit Hyd. peak  (cms)=        .56          .21
                                                              *TOTALS*
```

```
    PEAK FLOW       (cms)=        .26           .00           .263 (iii)
    TIME TO PEAK    (hrs)=       4.00          4.02          4.000
    RUNOFF VOLUME    (mm)=      54.60         11.19         54.163
    TOTAL RAINFALL   (mm)=      56.17         56.17         56.168
    RUNOFF COEFFICIENT   =        .97           .20           .964

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
           Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0025----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)   |    (cms)     (ha.m.)
                            .000  .0000E+00    |     .132  .5698E-01

    ROUTING RESULTS                AREA     QPEAK     TPEAK       R.V.
    --------------------           (ha)     (cms)     (hrs)       (mm)
    INFLOW >08: (108    )          1.14      .263     4.000     54.163
    OUTFLOW<09: (109    )          1.14      .064     4.267     54.163
   OVERFLOW<01: (101    )           .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   24.349
                  TIME SHIFT OF PEAK FLOW         (min)=    16.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.2760E-01

-------------------------------------------------------------------------------------
001:0026----------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.97
| 02:102    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=       1.74          3.23
    Dep. Storage     (mm)=       1.57          4.67
    Average Slope     (%)=       1.00          1.42
    Length            (m)=      57.00         57.00
    Mannings n          =        .013          .200

    Max.eff.Inten.(mm/hr)=      83.56         45.33
               over (min)        2.00         14.00
    Storage Coeff.  (min)=       1.96 (ii)    13.57 (ii)
    Unit Hyd. Tpeak (min)=       2.00         14.00
    Unit Hyd. peak  (cms)=        .57           .08
                                                          *TOTALS*
    PEAK FLOW       (cms)=        .40           .22           .552 (iii)
    TIME TO PEAK    (hrs)=       4.00          4.13          4.000
    RUNOFF VOLUME    (mm)=      54.60         11.19         26.380
    TOTAL RAINFALL   (mm)=      56.17         56.17         56.168
    RUNOFF COEFFICIENT   =        .97           .20           .470
```

```
        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0027----------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (103       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 09:109           1.14      .064    4.27  54.16    .000
                     +ID2 01:101            .00      .000     .00    .00    .000  **DRY**
                     +ID3 02:102           4.97      .552    4.00  26.38    .000
                      ============================================================
                      SUM 03:103           6.11      .608    4.00  31.56    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------------
 001:0028----------------------------------------------------------------------------
 *
 *Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
 *
 ------------------------
 | ADD HYD (104       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 07:107          14.66      .931    4.00  37.22    .000
                     +ID2 03:103           6.11      .608    4.00  31.56    .000
                      ============================================================
                      SUM 04:104          20.77     1.539    4.00  35.56    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------------
 001:0029----------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 2: Building A, C, D, H, J
 *
 *Total Building Area - Includes Building A, C, D, H & J
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    3.00
 | 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       2.97          .03
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .50         2.00
      Length            (m)=      42.00        10.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=      83.56        52.62
                 over (min)        2.00         5.00
      Storage Coeff.  (min)=       2.01 (ii)    5.48 (ii)
      Unit Hyd. Tpeak (min)=       2.00         5.00
      Unit Hyd. peak  (cms)=        .56          .21
                                                             *TOTALS*
      PEAK FLOW       (cms)=        .69          .00            .692 (iii)
      TIME TO PEAK    (hrs)=       4.00         4.02           4.000
      RUNOFF VOLUME    (mm)=      54.60        11.19          54.164
      TOTAL RAINFALL   (mm)=      56.17        56.17          56.168
      RUNOFF COEFFICIENT   =        .97          .20            .964

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
```

```
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0030----------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estiamted
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>05:(105    )  |
 | OUT<06:(106    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .285  .1501E+00

      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
      --------------------       (ha)     (cms)     (hrs)       (mm)
      INFLOW >05: (105    )       3.00      .692     4.000     54.164
      OUTFLOW<06: (106    )       3.00      .147     4.283     54.163
     OVERFLOW<07: (107    )        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.201
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.7726E-01

 ------------------------------------------------------------------------------------
 001:0031----------------------------------------------------------------------------
 *Remaining Area - Includes Grass, Parking Lots, Road
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    2.17
 | 08:108    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       1.61          .56
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=       1.92         2.00
      Length            (m)=     130.00        30.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=      83.56        48.96
                 over (min)        3.00        10.00
      Storage Coeff.  (min)=       2.64 (ii)    9.55 (ii)
      Unit Hyd. Tpeak (min)=       3.00        10.00
      Unit Hyd. peak  (cms)=        .41          .12
                                                             *TOTALS*
      PEAK FLOW       (cms)=        .37          .05            .413 (iii)
      TIME TO PEAK    (hrs)=       4.00         4.07           4.000
      RUNOFF VOLUME    (mm)=      54.60        11.19          43.311
      TOTAL RAINFALL   (mm)=      56.17        56.17          56.168
      RUNOFF COEFFICIENT   =        .97          .20            .771

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0032----------------------------------------------------------------------------
 *
```

```
------------------------
| ADD HYD (109        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 06:106           3.00      .147     4.28  54.16    .000
                    +ID2 07:107            .00      .000      .00    .00    .000  **DRY**
                    +ID3 08:108           2.17      .413     4.00  43.31    .000
                     ============================================================
                     SUM 09:109           5.17      .538     4.00  49.61    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0033-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .49
| 01:101    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .32          .17
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.00         3.30
     Length            (m)=       7.50        30.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        51.95
                over (min)        1.00         6.00
     Storage Coeff.  (min)=        .47 (ii)    6.28 (ii)
     Unit Hyd. Tpeak (min)=       1.00         6.00
     Unit Hyd. peak  (cms)=       1.50          .18
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .08          .02              .093 (iii)
     TIME TO PEAK    (hrs)=       3.87         4.02             4.000
     RUNOFF VOLUME    (mm)=      54.60        11.19            39.838
     TOTAL RAINFALL   (mm)=      56.17        56.17            56.168
     RUNOFF COEFFICIENT   =        .97          .20              .709

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0034-----------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<02:(102    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .079  .6500E-02

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )        .49      .093     4.000     39.838
     OUTFLOW<02: (102    )        .49      .060     4.017     39.838
    OVERFLOW<03: (103    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00
```

```
                     PEAK   FLOW   REDUCTION [Qout/Qin](%)=   64.576
                     TIME SHIFT OF PEAK FLOW         (min)=     1.00
                     MAXIMUM  STORAGE   USED       (ha.m.)=.4990E-02

 -----------------------------------------------------------------------------
 001:0035--------------------------------------------------------------------
 *
 *Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and C
 *
 ------------------------
 | ADD HYD (105         ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                       ID1 09:109            5.17      .538    4.00  49.61    .000
                      +ID2 02:102             .49      .060    4.02  39.84    .000
                      +ID3 03:103             .00      .000     .00    .00    .000  **DRY**
                       ============================================================
                       SUM 05:105            5.66      .597    4.00  48.76    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -----------------------------------------------------------------------------
 001:0036--------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
 *
 *Total Building Area - Includes Building F, G, R1, R2 & R3
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.01
 | 06:106    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                                IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       1.00          .01
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .50         2.00
      Length            (m)=      42.00        10.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=      83.56        52.62
                 over (min)        2.00         5.00
      Storage Coeff.  (min)=       2.01 (ii)    5.48 (ii)
      Unit Hyd. Tpeak (min)=       2.00         5.00
      Unit Hyd. peak  (cms)=        .56          .21
                                                          *TOTALS*
      PEAK FLOW       (cms)=        .23          .00          .233 (iii)
      TIME TO PEAK    (hrs)=       4.00         4.02         4.000
      RUNOFF VOLUME    (mm)=      54.60        11.19        54.163
      TOTAL RAINFALL   (mm)=      56.17        56.17        56.168
      RUNOFF COEFFICIENT   =        .97          .20          .964

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -----------------------------------------------------------------------------
 001:0037--------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estiamted
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>06:(106    )  |
 | OUT<07:(107    )  |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
```

```
                               .000  .0000E+00    |     .086  .4495E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >06: (106    )       1.01      .233     4.000     54.163
     OUTFLOW<07: (107    )       1.01      .049     4.283     54.163
    OVERFLOW<08: (108    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.230
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2600E-01

--------------------------------------------------------------------------------
001:0038------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.43
| 09:109    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.61         1.82
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.89         1.61
     Length            (m)=     103.00        36.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        48.12
                over (min)        2.00        11.00
     Storage Coeff.  (min)=       2.31 (ii)   10.60 (ii)
     Unit Hyd. Tpeak (min)=       2.00        11.00
     Unit Hyd. peak  (cms)=        .51          .11
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .61          .15            .725 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.08           4.000
     RUNOFF VOLUME    (mm)=      54.60        11.19          36.799
     TOTAL RAINFALL   (mm)=      56.17        56.17          56.168
     RUNOFF COEFFICIENT   =        .97          .20            .655

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0039------------------------------------------------------------------------
*
------------------------
| ADD HYD (101       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 07:107           1.01      .049    4.28  54.16    .000
                    +ID2 08:108            .00      .000     .00    .00    .000  **DRY**
                    +ID3 09:109           4.43      .725    4.00  36.80    .000
                     ============================================================
                     SUM 01:101           5.44      .767    4.00  40.02    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0040------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
```

```
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.67
| 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .95          .72
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=         .50         2.00
     Length            (m)=      113.00        10.00
     Mannings n           =        .013         .200

     Max.eff.Inten.(mm/hr)=       83.56        51.26
                over (min)         4.00         7.00
     Storage Coeff.  (min)=        3.64 (ii)    7.15 (ii)
     Unit Hyd. Tpeak (min)=        4.00         7.00
     Unit Hyd. peak  (cms)=         .30          .16
                                                              *TOTALS*
     PEAK FLOW       (cms)=         .22          .07             .287 (iii)
     TIME TO PEAK    (hrs)=        4.00         4.03            4.000
     RUNOFF VOLUME    (mm)=       54.60        11.19           35.931
     TOTAL RAINFALL   (mm)=       56.17        56.17           56.168
     RUNOFF COEFFICIENT   =         .97          .20             .640

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0041----------------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>02:(102    )   |
| OUT<03:(103    )   |    =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .045  .1920E-01
                             .023  .3000E-03    |     .050  .3360E-01
                             .032  .2300E-02    |     .055  .4700E-01
                             .039  .8200E-02    |     .060  .5480E-01

     ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
     --------------------          (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )         1.67      .287     4.000     35.931
     OUTFLOW<03: (103    )         1.67      .047     4.350     35.931
    OVERFLOW<06: (106    )          .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   16.514
                   TIME SHIFT OF PEAK FLOW         (min)=    21.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2604E-01

------------------------------------------------------------------------------------
001:0042----------------------------------------------------------------------------
*
------------------------
| ADD HYD (107       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
```

```
                     ID1 03:103            1.67      .047     4.35  35.93     .000
                    +ID2 06:106             .00      .000      .00    .00     .000  **DRY**
                     ============================================================
                     SUM 07:107            1.67      .047     4.35  35.93     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0043------------------------------------------------------------------------
*
*Combine Subcatchment 3 & 9
*
------------------------
| ADD HYD (108        ) | ID: NHYD          AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                    (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 01:101            5.44      .767     4.00  40.02     .000
                    +ID2 07:107            1.67      .047     4.35  35.93     .000
                     ============================================================
                     SUM 08:108            7.11      .810     4.00  39.06     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0044------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.03
| 09:109    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=        .98          .05
     Dep. Storage      (mm)=       1.57         4.67
     Average Slope      (%)=       3.23         1.24
     Length             (m)=      35.00       200.00
     Mannings n           =        .013         .200

     Max.eff.Inten.(mm/hr)=       83.56        17.21
                over (min)         1.00        39.00
     Storage Coeff.  (min)=        1.03 (ii)   38.86 (ii)
     Unit Hyd. Tpeak (min)=        1.00        39.00
     Unit Hyd. peak  (cms)=        1.06          .03
                                                             *TOTALS*
     PEAK FLOW       (cms)=         .23          .00            .227 (iii)
     TIME TO PEAK    (hrs)=        4.00         4.53           4.000
     RUNOFF VOLUME    (mm)=       54.60        11.19          52.427
     TOTAL RAINFALL   (mm)=       56.17        56.17          56.168
     RUNOFF COEFFICIENT   =         .97          .20            .933

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0045------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL      ) | ID: NHYD          AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                    (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 04:104           20.77     1.539     4.00  35.56     .000
                    +ID2 05:105            5.66      .597     4.00  48.76     .000
                    +ID3 08:108            7.11      .810     4.00  39.06     .000
                    +ID4 09:109            1.03      .227     4.00  52.43     .000
```

```
                     ============================================================
                     SUM 01:TOTAL         34.57    3.173    4.00  38.94    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0046-----------------------------------------------------------------------------
*
      FINISH
-------------------------------------------------------------------------------------
*************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 12:09:56
=====================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 02-13-2018
*#  Revised         : 06-28-2018
*#  Revised         : 07-04-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
* Future Building S, Building C, Deficit
* Short Term Development  (Future HLE, Sports Complex Removed)
*
START               TIME = 0.0
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM       IUNITS=[2], TD=[24](hrs), TPRAT=[0.333], CSDT=[15](min)
                    ICASEcs=[1], A=[998.071], B=[6.053], C=[0.814]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
```

```
                        [   0.0 ,  0.0    ]
                        [0.00945,  0.00266]
                        [   -1  ,  -1     ]
               IDovf=[3], NHYDovf=["103"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                 [   0.0 ,  0.0    ]
                                 [ 0.096 ,  0.0175 ]
```

```
                                 [    -1  ,  -1     ]
                       IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40.](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.00756,  0.00469]
                                  [    -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
                                         LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [ 0.000 ,  0.0000 ]
                                    [ 0.023 ,  0.1100 ]
                                    [ 0.312 ,  0.3830 ]
                                    [   -1  ,  -1     ]
                          IDovf=[1], NHYDovf=["101"]
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S
Expansion and Parking Lot 7, 8 (south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
```

```
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,   -1    ]
                          IDovf=[4], NHYDovf=["104"]
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S
Expansion
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.30](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                          LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                          LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[3+4+5]
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[9+1+6]
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                          LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                          LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
```

```
                                [0.13230,  0.05698]
                                [   -1  ,   -1     ]
                          IDovf=[1], NHYDovf=["101"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[3], NHYD=["103"], IDs to add=[9+1+2]
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[7+3]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[3.00](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                [   0.0 ,  0.0    ]
                                [0.28539,  0.15012]
                                [   -1  ,   -1     ]
                          IDovf=[7], NHYDovf=["107"]

*Remaining Area - Includes Grass, Parking Lots, Road
```

```
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[2.17](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.00](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[6+7+8]
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.49](ha),
                    XIMP=[0.66], TIMP=[0.66], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[3.30](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[7.5](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.079 ,  0.0065 ]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and
Courtyard
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[7],   NHYD=["107"],  IDin=[6],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08562,  0.04495]
                                    [   -1  ,  -1     ]
                          IDovf=[8], NHYDovf=["108"]

*Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[7+8+9]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
```

```
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.023 ,  0.0003 ]
                                    [ 0.032 ,  0.0023 ]
                                    [ 0.039 ,  0.0082 ]
                                    [ 0.045 ,  0.0192 ]
                                    [ 0.050 ,  0.0336 ]
                                    [ 0.055 ,  0.0470 ]
                                    [ 0.060 ,  0.0548 ]
                                    [   -1  ,    -1   ]
                          IDovf=[6], NHYDovf=["106"]
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+6]
*
*Combine Subcatchment 3 & 9
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+7]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[1], NHYD=["TOTAL"], IDs to add=[4+5+8+9]
*
*%-----------------|-----------------------------------------------------------|
FINISH
```

```
==================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                       9   9  9   9   # 3573794
        StormWater Management HYdrologic Model          999    999    =========

    ******************************************************************************
    *****************************  SWMHYMO Ver/4.05  ******************************
    *********  A single event and continuous hydrologic simulation model  *********
    *********     based on the principles of HYMO and its successors      *********
    *********                  OTTHYMO-83 and OTTHYMO-89.                 *********
    ******************************************************************************
    ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
    *********                  Ottawa,  Ontario: (613) 836-3884           *********
    *********                  Gatineau, Quebec: (819) 243-6858           *********
    *********                  E-Mail: swmhymo@jfsa.Com                   *********
    ******************************************************************************

    ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
    +++++++++ Licensed user: Morrison Hershfield Ltd.                    +++++++++
    +++++++++                Ottawa                SERIAL#:3573794       +++++++++
    ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

    ******************************************************************************
    *********              ++++++ PROGRAM ARRAY DIMENSIONS ++++++         *********
    *********              Maximum value for ID numbers  :     10         *********
    *********              Max. number of rainfall points: 105408         *********
    *********              Max. number of flow points    : 105408         *********
    ******************************************************************************


    *********************   D E T A I L E D   O U T P U T   *********************
    ******************************************************************************
    *         DATE: 2018-10-19     TIME: 12:10:04     RUN COUNTER: 000296        *
    ******************************************************************************
    * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F5Y24H.DAT            *
    * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F5Y24H.out            *
    * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F5Y24H.sum            *
    * User comments:                                                             *
    * 1:_________________________________________________________________________*
    * 2:_________________________________________________________________________*
    * 3:_________________________________________________________________________*
    ******************************************************************************

   --------------------------------------------------------------------------------
   001:0001------------------------------------------------------------------------
   *#****************************************************************************
   *#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
   *#  Project Number : [2085345.16]
   *#  Date           : 02-07-2014
   *#  Revised        : 01-20-2015
   *#  Revised        : 01-03-2017
   *#  Revised        : 02-13-2018
   *#  Revised         : 06-28-2018
   *#  Revised     : 07-04-2018
   *#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
   *#                             October 2018
   *#  Modeller       : [SM]
   *#  Company        : Morrison Hershfield Ltd
   *#  License #      : 3573794
   *#****************************************************************************
   *
   * Future Building S, Building C, Deficit
   * Short Term Development  (Future HLE, Sports Complex Removed)
   *
```

```
--------------------
| START            |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
-------------------------------------------------------------------------------------
001:0002-----------------------------------------------------------------------------
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 998.071
| Ptotal= 64.12 mm |                          B=   6.053
--------------------                          C=    .814
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 24.00 hrs
                        Storm time step    = 15.00 min
                        Time to peak ratio =   .33

              TIME    RAIN |    TIME    RAIN |    TIME    RAIN |    TIME    RAIN
               hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr
               .25    .521 |    6.25   1.872 |   12.25   1.535 |   18.25    .731
               .50    .536 |    6.50   2.152 |   12.50   1.462 |   18.50    .716
               .75    .551 |    6.75   2.546 |   12.75   1.396 |   18.75    .702
              1.00    .568 |    7.00   3.146 |   13.00   1.336 |   19.00    .689
              1.25    .585 |    7.25   4.178 |   13.25   1.282 |   19.25    .676
              1.50    .604 |    7.50   6.429 |   13.50   1.232 |   19.50    .664
              1.75    .624 |    7.75  16.065 |   13.75   1.187 |   19.75    .652
              2.00    .646 |    8.00  83.557 |   14.00   1.145 |   20.00    .641
              2.25    .669 |    8.25  21.363 |   14.25   1.106 |   20.25    .630
              2.50    .695 |    8.50  10.789 |   14.50   1.070 |   20.50    .620
              2.75    .723 |    8.75   7.304 |   14.75   1.037 |   20.75    .610
              3.00    .753 |    9.00   5.570 |   15.00   1.006 |   21.00    .600
              3.25    .786 |    9.25   4.530 |   15.25    .976 |   21.25    .590
              3.50    .823 |    9.50   3.836 |   15.50    .949 |   21.50    .581
              3.75    .864 |    9.75   3.337 |   15.75    .923 |   21.75    .573
              4.00    .910 |   10.00   2.962 |   16.00    .899 |   22.00    .564
              4.25    .961 |   10.25   2.668 |   16.25    .876 |   22.25    .556
              4.50   1.020 |   10.50   2.431 |   16.50    .854 |   22.50    .548
              4.75   1.087 |   10.75   2.236 |   16.75    .834 |   22.75    .540
              5.00   1.165 |   11.00   2.073 |   17.00    .815 |   23.00    .533
              5.25   1.256 |   11.25   1.934 |   17.25    .796 |   23.25    .526
              5.50   1.364 |   11.50   1.814 |   17.50    .779 |   23.50    .519
              5.75   1.497 |   11.75   1.709 |   17.75    .762 |   23.75    .512
              6.00   1.661 |   12.00   1.617 |   18.00    .746 |   24.00    .505

-------------------------------------------------------------------------------------
001:0003-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200
```

```
     Max.eff.Inten.(mm/hr)=      83.56        57.01
                over (min)        2.00         5.00
     Storage Coeff.  (min)=       2.01 (ii)    5.37 (ii)
     Unit Hyd. Tpeak (min)=       2.00         5.00
     Unit Hyd. peak  (cms)=        .56          .22
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .01          .00              .012 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.02             8.000
     RUNOFF VOLUME    (mm)=      62.54        13.08            62.053
     TOTAL RAINFALL   (mm)=      64.12        64.12            64.117
     RUNOFF COEFFICIENT   =        .98          .20              .968

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------------
001:0004-------------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<02:(102    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .009  .2660E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )       .05      .012     8.000     62.053
     OUTFLOW<02: (102    )       .05      .004     8.083     62.052
    OVERFLOW<03: (103    )       .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.762
                   TIME SHIFT OF PEAK FLOW         (min)=     5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1066E-02

--------------------------------------------------------------------------------------
001:0005-------------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.60
| 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
----------------------
                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02          1.58
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       2.03          1.76
     Length            (m)=      37.00         85.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         51.53
                over (min)        1.00         14.00
     Storage Coeff.  (min)=       1.22 (ii)   14.37 (ii)
     Unit Hyd. Tpeak (min)=       1.00         14.00
     Unit Hyd. peak  (cms)=        .95           .08
                                                              *TOTALS*
```

```
     PEAK FLOW       (cms)=       .00          .12           .121 (iii)
     TIME TO PEAK    (hrs)=      7.97         8.13          8.133
     RUNOFF VOLUME    (mm)=     62.54        13.08         13.573
     TOTAL RAINFALL   (mm)=     64.12        64.12         64.117
     RUNOFF COEFFICIENT   =       .98          .20           .212
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
001:0006----------------------------------------------------------------------
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 02:102             .05      .004     8.08  62.05    .000
                    +ID2 03:103             .00      .000      .00    .00    .000  **DRY**
                    +ID3 04:104            1.60      .121     8.13  13.57    .000
                     ==========================================================
                     SUM 05:105            1.65      .125     8.13  15.04    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
001:0007----------------------------------------------------------------------
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .096  (cms)
| TotalHyd 05:105    |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity          =    .096  (cms)
                         Total major system storage [TMJSTO] =      70.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)     (cms)
     TOTAL HYD.   05:105          1.65      .125     8.133   15.042      .000
     =======================================================================
     MAJOR SYST   06:106           .00      .000      .000     .000      .000
     MINOR SYST   07:107          1.65      .096     8.433   15.159      .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

     Maximum MAJOR SYSTEM storage used =      16.(cu.m.)

------------------------------------------------------------------------------
001:0008----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .67
| 08:108    DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .60          .07
     Dep. Storage     (mm)=      1.57         4.67
     Average Slope     (%)=      2.00         4.03
     Length            (m)=     25.00        34.00
     Mannings n           =      .013         .200

     Max.eff.Inten.(mm/hr)=     83.56        55.99
                over (min)      1.00         7.00
     Storage Coeff.  (min)=       .97 (ii)     6.69 (ii)
     Unit Hyd. Tpeak (min)=      1.00         7.00
```

```
     Unit Hyd. peak  (cms)=      1.09          .17
                                                        *TOTALS*
     PEAK FLOW       (cms)=       .14          .01           .148 (iii)
     TIME TO PEAK    (hrs)=      7.98         8.03          8.000
     RUNOFF VOLUME    (mm)=     62.55        13.08         57.600
     TOTAL RAINFALL   (mm)=     64.12        64.12         64.117
     RUNOFF COEFFICIENT   =       .98          .20           .898

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0009------------------------------------------------------------------------
*
*Combine Subcatchments 7 & 8
*
------------------------
| ADD HYD (109        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 07:107             1.65     .096     8.43  15.16    .000
                    +ID2 08:108              .67     .148     8.00  57.60    .000
                     ============================================================
                     SUM 09:109             2.32     .238     8.00  27.42    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0010------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .096  .1750E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )        2.32      .238     8.000     27.416
     OUTFLOW<01: (101    )        2.22      .096     8.167     27.416
    OVERFLOW<02: (102    )         .10      .040     8.167     27.416

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         1
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .28
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .95


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   40.370
                   TIME SHIFT OF PEAK FLOW         (min)=    10.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1751E-01

--------------------------------------------------------------------------------
001:0011------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.08
| 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      3.05          .03
```

```
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.90           .01
     Length            (m)=     140.00         40.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         50.76
                over (min)        3.00         42.00
     Storage Coeff.  (min)=       2.77 (ii)    42.46 (ii)
     Unit Hyd. Tpeak (min)=       3.00         42.00
     Unit Hyd. peak  (cms)=        .40           .03
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .70           .00            .704 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.58           8.000
     RUNOFF VOLUME    (mm)=      62.54         13.08          62.053
     TOTAL RAINFALL   (mm)=      64.12         64.12          64.117
     RUNOFF COEFFICIENT   =        .98           .20            .968

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0012----------------------------------------------------------------------------
*
*Combine Subcatchment 6 and Overflows
*
-------------------------
| ADD HYD (104        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
-------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 06:106             .00      .000      .00    .00    .000  **DRY**
                    +ID2 02:102             .10      .040     8.17  27.42    .000
                    +ID3 03:103            3.08      .704     8.00  62.05    .000
                     ==============================================================
                     SUM 04:104            3.18      .704     8.00  60.95    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0013----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .09
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09           .00
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         57.01
                over (min)        2.00          5.00
     Storage Coeff.  (min)=       2.01 (ii)     5.37 (ii)
     Unit Hyd. Tpeak (min)=       2.00          5.00
     Unit Hyd. peak  (cms)=        .56           .22
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .02           .00            .021 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.02           8.000
     RUNOFF VOLUME    (mm)=      62.55         13.08          62.053
     TOTAL RAINFALL   (mm)=      64.12         64.12          64.117
     RUNOFF COEFFICIENT   =        .98           .20            .968
```

```
        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0014------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .008  .4690E-02

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )         .09      .021     8.000     62.053
     OUTFLOW<09: (109    )         .09      .004     8.283     62.052
    OVERFLOW<02: (102    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.994
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2450E-02

--------------------------------------------------------------------------------
001:0015------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.82
| 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .76          3.06
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=         .01          2.04
     Length            (m)=         .01        425.00
     Mannings n           =        .013          .200

     Max.eff.Inten.(mm/hr)=       83.56         14.27
                over (min)        1.00         55.00
     Storage Coeff.  (min)=         .04 (ii)   55.25 (ii)
     Unit Hyd. Tpeak (min)=        1.00         55.00
     Unit Hyd. peak  (cms)=        1.70           .02
                                                               *TOTALS*
     PEAK FLOW       (cms)=         .18           .07            .188 (iii)
     TIME TO PEAK    (hrs)=        7.77          8.80           8.000
     RUNOFF VOLUME    (mm)=       62.55         13.08          22.972
     TOTAL RAINFALL   (mm)=       64.12         64.12          64.117
     RUNOFF COEFFICIENT   =         .98           .20            .358

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
```

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

------------------------------------------------------------------------------------------
001:0016----------------------------------------------------------------------------------
*
------------------------
| ADD HYD (105       ) | ID: NHYD          AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                    (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 09:109              .09      .004     8.28   62.05     .000
                    +ID2 02:102              .00      .000      .00     .00     .000   **DRY**
                    +ID3 03:103             3.82      .188     8.00   22.97     .000
                     ============================================================
                     SUM 05:105             3.91      .191     8.00   23.87     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------------
001:0017----------------------------------------------------------------------------------
*
*Combine Subcatchments 5, 6, 7 & 8
*
------------------------
| ADD HYD (108       ) | ID: NHYD          AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                    (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 01:101             2.22      .096     8.17   27.42     .000
                    +ID2 04:104             3.18      .704     8.00   60.95     .000
                    +ID3 05:105             3.91      .191     8.00   23.87     .000
                     ============================================================
                     SUM 08:108             9.31      .973     8.00   37.39     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------------
001:0018----------------------------------------------------------------------------------
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .312  .3830E+00
                            .023  .1100E+00    |     .000  .0000E+00

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )       9.31      .973     8.000     37.386
     OUTFLOW<09: (109    )       9.31      .117     9.383     37.385
    OVERFLOW<01: (101    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   12.055
                   TIME SHIFT OF PEAK FLOW          (min)=    83.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1990E+00

------------------------------------------------------------------------------------------
001:0019----------------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S E
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
```

```
*
*No roof storage was assumed for the Future Building S Expansion
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.04           .01
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         57.01
                over (min)        2.00          5.00
     Storage Coeff.  (min)=       2.01 (ii)     5.37 (ii)
     Unit Hyd. Tpeak (min)=       2.00          5.00
     Unit Hyd. peak  (cms)=        .56           .22
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .24           .00           .243 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.02          8.000
     RUNOFF VOLUME    (mm)=      62.54         13.08         62.053
     TOTAL RAINFALL   (mm)=      64.12         64.12         64.117
     RUNOFF COEFFICIENT   =        .98           .20           .968

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0020----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .085  .5115E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )       1.05      .243     8.000     62.053
     OUTFLOW<03: (103    )       1.05      .047     8.283     62.052
    OVERFLOW<04: (104    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.425
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2833E-01

-------------------------------------------------------------------------------------
001:0021----------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S Expa
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.30
| 05:105    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
```

```
---------------------
                              IMPERVIOUS   PERVIOUS (i)
     Surface Area     (ha)=       3.18         1.12
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.43        15.38
     Length            (m)=     116.00        13.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        57.01
                over (min)        3.00         5.00
     Storage Coeff.  (min)=       2.70 (ii)    4.83 (ii)
     Unit Hyd. Tpeak (min)=       3.00         5.00
     Unit Hyd. peak  (cms)=        .40          .23
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .73          .15           .887 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.02          8.000
     RUNOFF VOLUME    (mm)=      62.54        13.08         49.685
     TOTAL RAINFALL   (mm)=      64.12        64.12         64.117
     RUNOFF COEFFICIENT   =        .98          .20           .775

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0022------------------------------------------------------------------------
*
-----------------------
| ADD HYD (106       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
-----------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 03:103           1.05      .047     8.28  62.05    .000
                    +ID2 04:104            .00      .000      .00    .00    .000  **DRY**
                    +ID3 05:105           4.30      .887     8.00  49.69    .000
                     =======================================================
                     SUM 06:106           5.35      .926     8.00  52.11    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0023------------------------------------------------------------------------
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
-----------------------
| ADD HYD (107       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
-----------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 09:109           9.31      .117     9.38  37.38    .000
                    +ID2 01:101            .00      .000      .00    .00    .000  **DRY**
                    +ID3 06:106           5.35      .926     8.00  52.11    .000
                     =======================================================
                     SUM 07:107          14.66      .955     8.00  42.76    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0024------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=    1.14
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                              IMPERVIOUS   PERVIOUS (i)
```

```
     Surface Area     (ha)=       1.13          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        57.01
                over (min)        2.00         5.00
     Storage Coeff.  (min)=       2.01 (ii)    5.37 (ii)
     Unit Hyd. Tpeak (min)=       2.00         5.00
     Unit Hyd. peak  (cms)=        .56          .22
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .26          .00              .263 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.02             8.000
     RUNOFF VOLUME    (mm)=      62.54        13.08            62.053
     TOTAL RAINFALL   (mm)=      64.12        64.12            64.117
     RUNOFF COEFFICIENT   =        .98          .20              .968

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0025------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .132  .5698E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )        1.14      .263     8.000     62.053
     OUTFLOW<09: (109    )        1.14      .064     8.267     62.053
    OVERFLOW<01: (101    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   24.457
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2774E-01

--------------------------------------------------------------------------------
001:0026------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.97
| 02:102    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.74         3.23
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.00         1.42
     Length            (m)=      57.00        57.00
     Mannings n          =        .013         .200

```

```
     Max.eff.Inten.(mm/hr)=      83.56        52.26
                over (min)        2.00        13.00
     Storage Coeff.  (min)=       1.96 (ii)   12.93 (ii)
     Unit Hyd. Tpeak (min)=       2.00        13.00
     Unit Hyd. peak  (cms)=        .57          .09
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .40          .26              .598 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.12             8.000
     RUNOFF VOLUME    (mm)=      62.54        13.08            30.392
     TOTAL RAINFALL   (mm)=      64.12        64.12            64.117
     RUNOFF COEFFICIENT   =        .98          .20              .474

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------------
001:0027------------------------------------------------------------------------------
*
------------------------
| ADD HYD (103       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 09:109           1.14      .064     8.27  62.05    .000
                    +ID2 01:101            .00      .000      .00    .00    .000  **DRY**
                    +ID3 02:102           4.97      .598     8.00  30.39    .000
                     ============================================================
                     SUM 03:103           6.11      .655     8.00  36.30    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------------
001:0028------------------------------------------------------------------------------
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
------------------------
| ADD HYD (104       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 07:107          14.66      .955     8.00  42.76    .000
                    +ID2 03:103           6.11      .655     8.00  36.30    .000
                     ============================================================
                     SUM 04:104          20.77     1.609     8.00  40.86    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------------
001:0029------------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.00
| 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.97          .03
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=      83.56        57.01
                over (min)        2.00         5.00
     Storage Coeff.  (min)=       2.01 (ii)    5.37 (ii)
```

```
     Unit Hyd. Tpeak (min)=        2.00          5.00
     Unit Hyd. peak  (cms)=         .56           .22
                                                                 *TOTALS*
     PEAK FLOW       (cms)=         .69           .00              .693 (iii)
     TIME TO PEAK    (hrs)=        8.00          8.02             8.000
     RUNOFF VOLUME    (mm)=       62.54         13.08            62.053
     TOTAL RAINFALL   (mm)=       64.12         64.12            64.117
     RUNOFF COEFFICIENT   =         .98           .20              .968

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

----------------------------------------------------------------------------------------
001:0030--------------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(105    )  |
| OUT<06:(106    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .285  .1501E+00

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >05: (105    )        3.00      .693     8.000     62.053
     OUTFLOW<06: (106    )        3.00      .148     8.283     62.053
    OVERFLOW<07: (107    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.353
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.7787E-01

----------------------------------------------------------------------------------------
001:0031--------------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots, Road
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    2.17
| 08:108    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                                 IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.61           .56
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        1.92          2.00
     Length            (m)=      130.00         30.00
     Mannings n           =        .013          .200

     Max.eff.Inten.(mm/hr)=       83.56         54.86
                over (min)        3.00          9.00
     Storage Coeff.  (min)=        2.64 (ii)     9.25 (ii)
     Unit Hyd. Tpeak (min)=        3.00          9.00
     Unit Hyd. peak  (cms)=         .41           .12
                                                                 *TOTALS*
     PEAK FLOW       (cms)=         .37           .06              .423 (iii)
     TIME TO PEAK    (hrs)=        8.00          8.05             8.000
     RUNOFF VOLUME    (mm)=       62.54         13.08            49.685
     TOTAL RAINFALL   (mm)=       64.12         64.12            64.117
```

```
    RUNOFF COEFFICIENT   =        .98          .20           .775

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
           Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0032-----------------------------------------------------------------------
*
------------------------
| ADD HYD (109        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106            3.00      .148    8.28  62.05    .000
                    +ID2 07:107             .00      .000     .00    .00    .000  **DRY**
                    +ID3 08:108            2.17      .423    8.00  49.69    .000
                     ==============================================================
                     SUM 09:109            5.17      .549    8.00  56.86    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0033-----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .49
| 01:101    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=        .32          .17
    Dep. Storage     (mm)=       1.57         4.67
    Average Slope     (%)=       2.00         3.30
    Length            (m)=       7.50        30.00
    Mannings n          =        .013         .200

    Max.eff.Inten.(mm/hr)=      83.56        56.51
               over (min)        1.00         6.00
    Storage Coeff.  (min)=        .47 (ii)    6.09 (ii)
    Unit Hyd. Tpeak (min)=       1.00         6.00
    Unit Hyd. peak  (cms)=       1.50          .19
                                                             *TOTALS*
    PEAK FLOW       (cms)=        .08          .02              .096 (iii)
    TIME TO PEAK    (hrs)=       7.87         8.02             8.000
    RUNOFF VOLUME    (mm)=      62.55        13.08            45.728
    TOTAL RAINFALL   (mm)=      64.12        64.12            64.117
    RUNOFF COEFFICIENT   =        .98          .20              .713

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
           Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0034-----------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<02:(102    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
```

```
                              .000  .0000E+00   |     .079  .6500E-02

      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
      --------------------       (ha)     (cms)     (hrs)       (mm)
      INFLOW >01: (101    )       .49      .096     8.000     45.728
      OUTFLOW<02: (102    )       .49      .062     8.017     45.728
     OVERFLOW<03: (103    )       .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   64.302
                    TIME SHIFT OF PEAK FLOW         (min)=     1.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.5105E-02

 ---------------------------------------------------------------------------------
 001:0035--------------------------------------------------------------------------
 *
 *Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and C
 *
 ------------------------
 | ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                      ID1 09:109            5.17      .549     8.00  56.86    .000
                     +ID2 02:102             .49      .062     8.02  45.73    .000
                     +ID3 03:103             .00      .000      .00    .00    .000  **DRY**
                      ============================================================
                      SUM 05:105            5.66      .610     8.00  55.90    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ---------------------------------------------------------------------------------
 001:0036--------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
 *
 *Total Building Area - Includes Building F, G, R1, R2 & R3
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.01
 | 06:106    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       1.00           .01
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=        .50          2.00
      Length            (m)=      42.00         10.00
      Mannings n          =        .013          .200

      Max.eff.Inten.(mm/hr)=      83.56         57.01
                 over (min)        2.00          5.00
      Storage Coeff.  (min)=       2.01 (ii)     5.37 (ii)
      Unit Hyd. Tpeak (min)=       2.00          5.00
      Unit Hyd. peak  (cms)=        .56           .22
                                                              *TOTALS*
      PEAK FLOW       (cms)=        .23           .00           .233 (iii)
      TIME TO PEAK    (hrs)=       8.00          8.02          8.000
      RUNOFF VOLUME    (mm)=      62.54         13.08         62.053
      TOTAL RAINFALL   (mm)=      64.12         64.12         64.117
      RUNOFF COEFFICIENT   =        .98           .20           .968

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```

 ---------------------------------------------------------------------------------
 001:0037-------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estiamted
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>06:(106    )  |
 | OUT<07:(107    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .086  .4495E-01

      ROUTING RESULTS                AREA     QPEAK     TPEAK       R.V.
      --------------------           (ha)     (cms)     (hrs)       (mm)
      INFLOW >06: (106    )          1.01      .233     8.000     62.053
      OUTFLOW<07: (107    )          1.01      .050     8.283     62.053
     OVERFLOW<08: (108    )           .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.382
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2620E-01

 ---------------------------------------------------------------------------------
 001:0038-------------------------------------------------------------------------
 *Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    4.43
 | 09:109    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
 ----------------------
                                   IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       2.61         1.82
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=       1.89         1.61
      Length            (m)=     103.00        36.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=      83.56        54.26
                 over (min)       2.00        10.00
      Storage Coeff.  (min)=       2.31 (ii)   10.21 (ii)
      Unit Hyd. Tpeak (min)=       2.00        10.00
      Unit Hyd. peak  (cms)=        .51          .11
                                                               *TOTALS*
      PEAK FLOW       (cms)=        .61          .17             .757 (iii)
      TIME TO PEAK    (hrs)=       8.00         8.07            8.000
      RUNOFF VOLUME    (mm)=      62.54        13.08           42.265
      TOTAL RAINFALL   (mm)=      64.12        64.12           64.117
      RUNOFF COEFFICIENT   =        .98          .20             .659

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------------
 001:0039-------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (101       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
```

```
                        ID1 07:107            1.01      .050    8.28  62.05    .000
                       +ID2 08:108             .00      .000     .00    .00    .000  **DRY**
                       +ID3 09:109            4.43      .757    8.00  42.26    .000
                        ============================================================
                        SUM 01:101            5.44      .799    8.00  45.94    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0040-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.67
| 02:102    DT= 1.00  |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .95           .72
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=     113.00         10.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=      83.56         55.99
                over (min)        4.00          7.00
     Storage Coeff.  (min)=       3.64 (ii)     7.03 (ii)
     Unit Hyd. Tpeak (min)=       4.00          7.00
     Unit Hyd. peak  (cms)=        .30           .16
                                                                 *TOTALS*
     PEAK FLOW       (cms)=        .22           .08               .298 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.03              8.000
     RUNOFF VOLUME    (mm)=      62.54         13.08             41.276
     TOTAL RAINFALL   (mm)=      64.12         64.12             64.117
     RUNOFF COEFFICIENT   =        .98           .20               .644

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0041-----------------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>02:(102    )   |
| OUT<03:(103    )   |    =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .045  .1920E-01
                             .023  .3000E-03    |     .050  .3360E-01
                             .032  .2300E-02    |     .055  .4700E-01
                             .039  .8200E-02    |     .060  .5480E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )       1.67      .298     8.000     41.276
     OUTFLOW<03: (103    )       1.67      .048     8.350     41.276
    OVERFLOW<06: (106    )        .00      .000      .000       .000

                     TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                     CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                     PERCENTAGE OF TIME OVERFLOWING    (%)=       .00
```

```

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   16.059
                  TIME SHIFT OF PEAK FLOW         (min)=    21.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.2724E-01

 --------------------------------------------------------------------------------
 001:0042------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (107        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 03:103            1.67      .048     8.35  41.28    .000
                    +ID2 06:106             .00      .000      .00    .00    .000  **DRY**
                     ==============================================================
                     SUM 07:107            1.67      .048     8.35  41.28    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0043------------------------------------------------------------------------
 *
 *Combine Subcatchment 3 & 9
 *
 ------------------------
 | ADD HYD (108        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 01:101            5.44      .799     8.00  45.94    .000
                    +ID2 07:107            1.67      .048     8.35  41.28    .000
                     ==============================================================
                     SUM 08:108            7.11      .842     8.00  44.84    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0044------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.03
 | 09:109    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .98          .05
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=       3.23         1.24
      Length            (m)=      35.00       200.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=      83.56        22.42
                 over (min)        1.00        35.00
      Storage Coeff.  (min)=       1.03 (ii)   35.06 (ii)
      Unit Hyd. Tpeak (min)=       1.00        35.00
      Unit Hyd. peak  (cms)=       1.06          .03
                                                           *TOTALS*
      PEAK FLOW       (cms)=        .23          .00           .228 (iii)
      TIME TO PEAK    (hrs)=       8.00         8.47          8.000
      RUNOFF VOLUME    (mm)=      62.55        13.08         60.074
      TOTAL RAINFALL   (mm)=      64.12        64.12         64.117
      RUNOFF COEFFICIENT   =        .98          .20           .937

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

```
--------------------------------------------------------------------------------
001:0045------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 04:104          20.77     1.609    8.00  40.86    .000
                    +ID2 05:105           5.66      .610    8.00  55.90    .000
                    +ID3 08:108           7.11      .842    8.00  44.84    .000
                    +ID4 09:109           1.03      .228    8.00  60.07    .000
                     ============================================================
                     SUM 01:TOTAL        34.57     3.289    8.00  44.71    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0046------------------------------------------------------------------------
*
      FINISH
--------------------------------------------------------------------------------
********************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 12:10:05
================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 02-13-2018
*#  Revised         : 06-28-2018
*#  Revised         : 07-04-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
* Future Building S, Building C, Deficit
* Short Term Development  (Future HLE, Sports Complex Removed)
*
START               TIME = 0.0
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM       IUNITS=[2], TD=[3](hrs), TPRAT=[0.333], CSDT=[15](min)
                    ICASEcs=[1], A=[1735.688], B=[6.014], C=[0.820]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
```

```
                                [   0.0 ,  0.0    ]
                                [0.00945,  0.00266]
                                [   -1  ,  -1     ]
                      IDovf=[3], NHYDovf=["103"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                [   0.0 ,  0.0    ]
                                [ 0.096 ,  0.0175 ]
```

```
                      [   -1  ,  -1     ]
             IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40.](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.00756,  0.00469]
                                  [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
                                         LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [ 0.000 ,  0.0000 ]
                                    [ 0.023 ,  0.1100 ]
                                    [ 0.312 ,  0.3830 ]
                                    [   -1  ,  -1     ]
                          IDovf=[1], NHYDovf=["101"]
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S
Expansion and Parking Lot 7, 8 (south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
```

```
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,  -1     ]
                          IDovf=[4], NHYDovf=["104"]
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S
Expansion
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.30](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[3+4+5]
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[9+1+6]
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
```

```
                              [0.13230,  0.05698]
                              [   -1  ,   -1     ]
                    IDovf=[1], NHYDovf=["101"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[3], NHYD=["103"], IDs to add=[9+1+2]
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[7+3]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[3.00](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                              [   0.0 ,  0.0    ]
                              [0.28539,  0.15012]
                              [   -1  ,   -1     ]
                    IDovf=[7], NHYDovf=["107"]

*Remaining Area - Includes Grass, Parking Lots, Road
```

```
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[2.17](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.00](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[6+7+8]
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.49](ha),
                    XIMP=[0.66], TIMP=[0.66], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[3.30](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[7.5](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.079 ,  0.0065 ]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and
Courtyard
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[7],   NHYD=["107"],  IDin=[6],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                   [   0.0 ,  0.0    ]
                                   [0.08562,  0.04495]
                                   [   -1  ,  -1     ]
                          IDovf=[8], NHYDovf=["108"]

*Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[7+8+9]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
```

```
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.023 ,  0.0003 ]
                                    [ 0.032 ,  0.0023 ]
                                    [ 0.039 ,  0.0082 ]
                                    [ 0.045 ,  0.0192 ]
                                    [ 0.050 ,  0.0336 ]
                                    [ 0.055 ,  0.0470 ]
                                    [ 0.060 ,  0.0548 ]
                                    [   -1  ,    -1   ]
                          IDovf=[6], NHYDovf=["106"]
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+6]
*
*Combine Subcatchment 3 & 9
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+7]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[1], NHYD=["TOTAL"], IDs to add=[4+5+8+9]
*
*%-----------------|------------------------------------------------------------|
FINISH
```

```
 ===================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9   =========
                                                        9   9  9   9   # 3573794
        StormWater Management HYdrologic Model           999    999    =========

  *******************************************************************************
  ***************************** SWMHYMO Ver/4.05  ******************************
  *********  A single event and continuous hydrologic simulation model  *********
  *********     based on the principles of HYMO and its successors      *********
  *********                  OTTHYMO-83 and OTTHYMO-89.                 *********
  *******************************************************************************
  ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
  *********                  Ottawa,  Ontario: (613) 836-3884           *********
  *********                  Gatineau, Quebec: (819) 243-6858           *********
  *********                  E-Mail: swmhymo@jfsa.Com                   *********
  *******************************************************************************

  +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  +++++++++ Licensed user: Morrison Hershfield Ltd.                     +++++++++
  +++++++++                Ottawa                SERIAL#:3573794        +++++++++
  +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

  *******************************************************************************
  *********            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *********
  *********            Maximum value for ID numbers  :     10           *********
  *********            Max. number of rainfall points: 105408           *********
  *********            Max. number of flow points    : 105408           *********
  *******************************************************************************


  *********************   D E T A I L E D   O U T P U T   *********************
  *******************************************************************************
  *         DATE: 2018-10-19     TIME: 12:10:13     RUN COUNTER: 000297         *
  *******************************************************************************
  * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F100Y3H.DAT          *
  * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F100Y3H.out          *
  * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F100Y3H.sum          *
  * User comments:                                                             *
  * 1:_________________________________________________________________________*
  * 2:_________________________________________________________________________*
  * 3:_________________________________________________________________________*
  *******************************************************************************

 ----------------------------------------------------------------------------------
 001:0001--------------------------------------------------------------------------
 *#*****************************************************************************
 *#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
 *#  Project Number : [2085345.16]
 *#  Date           : 02-07-2014
 *#  Revised        : 01-20-2015
 *#  Revised        : 01-03-2017
 *#  Revised        : 02-13-2018
 *#  Revised     : 06-28-2018
 *#  Revised         : 07-04-2018
 *#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
 *#                                 October 2018
 *#  Modeller       : [SM]
 *#  Company        : Morrison Hershfield Ltd
 *#  License #      : 3573794
 *#*****************************************************************************
 *
 * Future Building S, Building C, Deficit
 * Short Term Development  (Future HLE, Sports Complex Removed)
 *
```

```
--------------------
| START             |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
--------------------------------------------------------------------------------
001:0002------------------------------------------------------------------------
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM     |     IDF curve parameters: A=1735.688
| Ptotal= 71.61 mm |                           B=    6.014
--------------------                           C=     .820
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm   =  3.00 hrs
                        Storm time step     = 15.00 min
                        Time to peak ratio =    .33

              TIME    RAIN |    TIME    RAIN |    TIME    RAIN |    TIME    RAIN
               hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr
               .25   6.869 |    1.00 142.894 |    1.75  12.089 |    2.50   6.300
               .50  10.626 |    1.25  35.856 |    2.00   9.189 |    2.75   5.474
               .75  26.882 |    1.50  17.946 |    2.25   7.456 |    3.00   4.851

--------------------------------------------------------------------------------
001:0003------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       112.47
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.18 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .02          .00            .020 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.00           1.000
     RUNOFF VOLUME    (mm)=      70.04        29.57          69.633
     TOTAL RAINFALL   (mm)=      71.61        71.61          71.608
     RUNOFF COEFFICIENT   =        .98          .41            .972

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0004------------------------------------------------------------------------
```

```
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(101    )   |
| OUT<02:(102    )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |   (cms)    (ha.m.)
                             .000  .0000E+00   |     .009  .2660E-02

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )        .05      .020     1.000     69.633
     OUTFLOW<02: (102    )        .05      .006     1.083     69.633
    OVERFLOW<03: (103    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   31.586
                   TIME SHIFT OF PEAK FLOW         (min)=     5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1760E-02

--------------------------------------------------------------------------------
001:0005------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.60
| 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02         1.58
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.03         1.76
     Length            (m)=      37.00        85.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       107.31
                over (min)       1.00        11.00
     Storage Coeff.  (min)=        .99 (ii)   10.79 (ii)
     Unit Hyd. Tpeak (min)=       1.00        11.00
     Unit Hyd. peak  (cms)=       1.08          .10
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .01          .30            .300 (iii)
     TIME TO PEAK    (hrs)=        .98         1.08           1.083
     RUNOFF VOLUME    (mm)=      70.04        29.57          29.971
     TOTAL RAINFALL   (mm)=      71.61        71.61          71.608
     RUNOFF COEFFICIENT   =        .98          .41            .419
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20      Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0006------------------------------------------------------------------------
*
-------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
```

```
                        ID1 02:102            .05     .006    1.08  69.63    .000
                       +ID2 03:103            .00     .000     .00    .00    .000  **DRY**
                       +ID3 04:104           1.60     .300    1.08  29.97    .000
                        =======================================================
                        SUM 05:105           1.65     .307    1.08  31.17    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0007------------------------------------------------------------------------
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .096  (cms)
| TotalHyd 05:105    |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity          =    .096  (cms)
                         Total major system storage [TMJSTO] =      70.(cu.m.)

                     ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                     (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.    05:105            1.65      .307     1.083   31.173     .000
     ========================================================================
     MAJOR SYST    06:106             .48      .211     1.083   31.173     .000
     MINOR SYST    07:107            1.17      .096     1.817   31.564     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

     Maximum MAJOR SYSTEM storage used =      70.(cu.m.)

--------------------------------------------------------------------------------
001:0008------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .67
| 08:108    DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .60           .07
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=        2.00          4.03
     Length            (m)=       25.00         34.00
     Mannings n          =         .013          .200

     Max.eff.Inten.(mm/hr)=      142.89        111.84
                over (min)         1.00          5.00
     Storage Coeff.  (min)=         .78 (ii)     5.12 (ii)
     Unit Hyd. Tpeak (min)=        1.00          5.00
     Unit Hyd. peak  (cms)=        1.23           .22
                                                              *TOTALS*
     PEAK FLOW       (cms)=         .24           .02            .257 (iii)
     TIME TO PEAK    (hrs)=         .95          1.00           1.000
     RUNOFF VOLUME    (mm)=       70.04         29.57          65.991
     TOTAL RAINFALL   (mm)=       71.61         71.61          71.608
     RUNOFF COEFFICIENT   =         .98           .41            .922

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20      Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0009------------------------------------------------------------------------
*
*Combine Subcatchments 7 & 8
*
------------------------
```

```
| ADD HYD (109        ) | ID: NHYD          AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                    (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 07:107              1.17      .096     1.82   31.56    .000
                    +ID2 08:108               .67      .257     1.00   65.99    .000
                     ==============================================================
                     SUM 09:109              1.84      .353     1.00   44.10    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0010-----------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .096  .1750E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK        R.V.
     --------------------         (ha)     (cms)     (hrs)        (mm)
     INFLOW >09: (109    )        1.84      .353     1.000      44.103
     OUTFLOW<01: (101    )        1.38      .096      .933      44.103
    OVERFLOW<02: (102    )         .46      .257     1.000      44.103

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         2
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .88
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      7.95


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   27.165
                   TIME SHIFT OF PEAK FLOW         (min)=    -4.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1754E-01

-------------------------------------------------------------------------------------
001:0011-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.08
| 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.05           .03
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.90           .01
     Length            (m)=     140.00         40.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=     142.89         37.74
                over (min)        2.00         47.00
     Storage Coeff.  (min)=       2.24 (ii)    46.91 (ii)
     Unit Hyd. Tpeak (min)=       2.00         47.00
     Unit Hyd. peak  (cms)=        .52           .02
                                                            *TOTALS*
     PEAK FLOW       (cms)=       1.21           .00          1.209 (iii)
     TIME TO PEAK    (hrs)=       1.00          1.68          1.000
     RUNOFF VOLUME    (mm)=      70.04         29.57         69.633
     TOTAL RAINFALL   (mm)=      71.61         71.61         71.608
     RUNOFF COEFFICIENT   =        .98           .41           .972

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0012------------------------------------------------------------------------
*
*Combine Subcatchment 6 and Overflows
*
------------------------
| ADD HYD (104       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106             .48      .211    1.08  31.17    .000
                    +ID2 02:102             .46      .257    1.00  44.10    .000
                    +ID3 03:103            3.08     1.209    1.00  69.63    .000
                     ============================================================
                     SUM 04:104            4.02     1.466    1.00  62.13    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0013------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .09
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       112.47
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.18 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .27
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .04          .00             .036 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.00            1.000
     RUNOFF VOLUME    (mm)=      70.04        29.57           69.633
     TOTAL RAINFALL   (mm)=      71.61        71.61           71.608
     RUNOFF COEFFICIENT   =        .98          .41             .972

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0014------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |      .008  .4690E-02
```

```
     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108   )        .09      .036     1.000     69.633
     OUTFLOW<09: (109   )        .09      .006     1.283     69.633
    OVERFLOW<02: (102   )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   17.548
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3878E-02

--------------------------------------------------------------------------------
001:0015------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.82
| 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
----------------------
                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .76          3.06
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=         .01          2.04
     Length            (m)=         .01        425.00
     Mannings n          =         .013          .200

     Max.eff.Inten.(mm/hr)=      142.89         54.76
                over (min)         1.00         32.00
     Storage Coeff.  (min)=         .04 (ii)    32.27 (ii)
     Unit Hyd. Tpeak (min)=        1.00         32.00
     Unit Hyd. peak  (cms)=        1.70           .04
                                                               *TOTALS*
     PEAK FLOW       (cms)=         .30           .26             .369 (iii)
     TIME TO PEAK    (hrs)=         .88          1.43            1.000
     RUNOFF VOLUME    (mm)=       70.04         29.57           37.661
     TOTAL RAINFALL   (mm)=       71.61         71.61           71.608
     RUNOFF COEFFICIENT   =         .98           .41             .526

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0016------------------------------------------------------------------------
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                    ID1 09:109             .09      .006    1.28   69.63    .000
                   +ID2 02:102             .00      .000     .00     .00    .000  **DRY**
                   +ID3 03:103            3.82      .369    1.00   37.66    .000
                    ========================================================
                    SUM 05:105            3.91      .374    1.00   38.40    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0017------------------------------------------------------------------------
*
*Combine Subcatchments 5, 6, 7 & 8
*
```

```
 ------------------------
 | ADD HYD (108        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101             1.38      .096     .93  44.10    .000
                    +ID2 04:104             4.02     1.466    1.00  62.13    .000
                    +ID3 05:105             3.91      .374    1.00  38.40    .000
                     ============================================================
                     SUM 08:108             9.31     1.936    1.00  49.49    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------------
 001:0018--------------------------------------------------------------------------
 *
 *Wetland Storage
 *
 *Controlled @ Proposed Outlet Structure
 *
 ---------------------
 | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
 |  IN>08:(108    )   |
 | OUT<09:(109    )   |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                             (cms)    (ha.m.)    |   (cms)     (ha.m.)
                              .000  .0000E+00    |     .312  .3830E+00
                              .023  .1100E+00    |     .000  .0000E+00

      ROUTING RESULTS                 AREA     QPEAK     TPEAK       R.V.
      --------------------            (ha)     (cms)     (hrs)       (mm)
      INFLOW >08: (108    )           9.31     1.936     1.000     49.485
      OUTFLOW<09: (109    )           9.31      .244     2.117     49.484
     OVERFLOW<01: (101    )            .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   12.602
                   TIME SHIFT OF PEAK FLOW          (min)=    67.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3188E+00

 ----------------------------------------------------------------------------------
 001:0019--------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S E
 *
 *Total Building Area - Includes Building N, P, S & Salt Storage Sheds
 *
 *No roof storage was assumed for the Future Building S Expansion
 *
 ----------------------
 | CALIB STANDHYD     |    Area    (ha)=    1.05
 | 02:102    DT= 1.00 |    Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                                 IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        1.04           .01
      Dep. Storage     (mm)=        1.57          4.67
      Average Slope     (%)=         .50          2.00
      Length            (m)=       42.00         10.00
      Mannings n          =         .013          .200

      Max.eff.Inten.(mm/hr)=      142.89        112.47
                 over (min)         2.00          4.00
      Storage Coeff.  (min)=        1.62 (ii)     4.18 (ii)
      Unit Hyd. Tpeak (min)=        2.00          4.00
      Unit Hyd. peak  (cms)=         .64           .27
                                                               *TOTALS*
      PEAK FLOW       (cms)=         .41           .00            .416 (iii)
```

```
     TIME TO PEAK    (hrs)=      1.00         1.00          1.000
     RUNOFF VOLUME    (mm)=     70.04        29.57         69.633
     TOTAL RAINFALL   (mm)=     71.61        71.61         71.608
     RUNOFF COEFFICIENT   =       .98          .41           .972

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0020------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .085  .5115E-01

     ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
     --------------------          (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )         1.05      .416     1.000     69.633
     OUTFLOW<03: (103    )         1.05      .075     1.283     69.633
    OVERFLOW<04: (104    )          .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   17.980
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4494E-01

--------------------------------------------------------------------------------
001:0021------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S Expa
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.30
| 05:105    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      3.18         1.12
     Dep. Storage     (mm)=      1.57         4.67
     Average Slope     (%)=      1.43        15.38
     Length            (m)=    116.00        13.00
     Mannings n           =      .013         .200

     Max.eff.Inten.(mm/hr)=    142.89       112.47
                over (min)       2.00         4.00
     Storage Coeff.  (min)=      2.17 (ii)    3.80 (ii)
     Unit Hyd. Tpeak (min)=      2.00         4.00
     Unit Hyd. peak  (cms)=       .53          .29
                                                            *TOTALS*
     PEAK FLOW       (cms)=      1.26          .32          1.586 (iii)
     TIME TO PEAK    (hrs)=      1.00         1.00          1.000
     RUNOFF VOLUME    (mm)=     70.04        29.57         59.515
     TOTAL RAINFALL   (mm)=     71.61        71.61         71.608
     RUNOFF COEFFICIENT   =       .98          .41           .831

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
```

```
                Fo    (mm/hr)= 76.20            K  (1/hr)=  4.14
                Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
          (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
               THAN THE STORAGE COEFFICIENT.
         (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

    ------------------------------------------------------------------------------------
    001:0022----------------------------------------------------------------------------
    *
    ------------------------
    | ADD HYD (106        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
    ------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                         ID1 03:103            1.05      .075    1.28  69.63    .000
                        +ID2 04:104             .00      .000     .00    .00    .000  **DRY**
                        +ID3 05:105            4.30     1.586    1.00  59.52    .000
                         ============================================================
                         SUM 06:106            5.35     1.648    1.00  61.50    .000

       NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

    ------------------------------------------------------------------------------------
    001:0023----------------------------------------------------------------------------
    *
    *Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
    *
    ------------------------
    | ADD HYD (107        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
    ------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                         ID1 09:109            9.31      .244    2.12  49.48    .000
                        +ID2 01:101             .00      .000     .00    .00    .000  **DRY**
                        +ID3 06:106            5.35     1.648    1.00  61.50    .000
                         ============================================================
                         SUM 07:107           14.66     1.730    1.00  53.87    .000

       NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

    ------------------------------------------------------------------------------------
    001:0024----------------------------------------------------------------------------
    *
    *SUBCATCHMENT AREA 1: Building B, K, M & T
    *
    *Total Building Area - Includes Building B, K, M & T
    *
    ----------------------
    | CALIB STANDHYD     |   Area    (ha)=    1.14
    | 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
    ----------------------
                                      IMPERVIOUS    PERVIOUS (i)
         Surface Area     (ha)=        1.13           .01
         Dep. Storage     (mm)=        1.57          4.67
         Average Slope     (%)=         .50          2.00
         Length            (m)=       42.00         10.00
         Mannings n           =        .013          .200

         Max.eff.Inten.(mm/hr)=      142.89        112.47
                    over (min)         2.00          4.00
         Storage Coeff.  (min)=        1.62 (ii)     4.18 (ii)
         Unit Hyd. Tpeak (min)=        2.00          4.00
         Unit Hyd. peak  (cms)=         .64           .27
                                                                *TOTALS*
         PEAK FLOW       (cms)=         .45           .00          .451 (iii)
         TIME TO PEAK    (hrs)=        1.00          1.00         1.000
         RUNOFF VOLUME    (mm)=       70.04         29.57        69.633
         TOTAL RAINFALL   (mm)=       71.61         71.61        71.608
         RUNOFF COEFFICIENT   =         .98           .41          .972

           (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
                Fo    (mm/hr)= 76.20            K  (1/hr)=  4.14
                Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
```

```
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0025---------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>08:(108    )   |
| OUT<09:(109    )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .132  .5698E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )       1.14      .451     1.000     69.633
     OUTFLOW<09: (109    )       1.14      .104     1.267     69.633
    OVERFLOW<01: (101    )        .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   23.070
                  TIME SHIFT OF PEAK FLOW         (min)=    16.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.4483E-01

-----------------------------------------------------------------------------
001:0026---------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.97
| 02:102    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.74          3.23
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.00          1.42
     Length            (m)=      57.00         57.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        108.16
                over (min)        2.00         10.00
     Storage Coeff.  (min)=       1.58 (ii)     9.78 (ii)
     Unit Hyd. Tpeak (min)=       2.00         10.00
     Unit Hyd. peak  (cms)=        .65           .11
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .69           .65           1.257 (iii)
     TIME TO PEAK    (hrs)=       1.00          1.07           1.000
     RUNOFF VOLUME    (mm)=      70.04         29.57          43.731
     TOTAL RAINFALL   (mm)=      71.61         71.61          71.608
     RUNOFF COEFFICIENT   =        .98           .41            .611

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0027---------------------------------------------------------------------
```

```
*
------------------------
| ADD HYD (103        ) | ID: NHYD          AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                    (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 09:109             1.14      .104     1.27  69.63    .000
                    +ID2 01:101              .00      .000      .00    .00    .000  **DRY**
                    +ID3 02:102             4.97     1.257     1.00  43.73    .000
                     ============================================================
                     SUM 03:103             6.11     1.348     1.00  48.56    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0028----------------------------------------------------------------------------
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
------------------------
| ADD HYD (104        ) | ID: NHYD          AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                    (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 07:107            14.66     1.730     1.00  53.87    .000
                    +ID2 03:103             6.11     1.348     1.00  48.56    .000
                     ============================================================
                     SUM 04:104            20.77     3.078     1.00  52.31    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0029----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.00
| 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.97           .03
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        112.47
                over (min)        2.00          4.00
     Storage Coeff.  (min)=       1.62 (ii)     4.18 (ii)
     Unit Hyd. Tpeak (min)=       2.00          4.00
     Unit Hyd. peak  (cms)=        .64           .27
                                                              *TOTALS*
     PEAK FLOW       (cms)=       1.18           .01           1.187 (iii)
     TIME TO PEAK    (hrs)=       1.00          1.00           1.000
     RUNOFF VOLUME    (mm)=      70.04         29.57          69.633
     TOTAL RAINFALL   (mm)=      71.61         71.61          71.608
     RUNOFF COEFFICIENT   =        .98           .41            .972

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0030----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
```

```
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>05:(105    )  |
 | OUT<06:(106    )  |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .285  .1501E+00

      ROUTING RESULTS             AREA      QPEAK      TPEAK        R.V.
      --------------------        (ha)      (cms)      (hrs)        (mm)
      INFLOW >05: (105    )       3.00      1.187      1.000      69.633
      OUTFLOW<06: (106    )       3.00       .237      1.283      69.633
     OVERFLOW<07: (107    )        .00       .000       .000        .000

                       TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                       CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                       PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                       PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.922
                       TIME SHIFT OF PEAK FLOW         (min)=    17.00
                       MAXIMUM  STORAGE   USED       (ha.m.)=.1245E+00

 --------------------------------------------------------------------------------
 001:0031------------------------------------------------------------------------
 *Remaining Area - Includes Grass, Parking Lots, Road
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    2.17
 | 08:108    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
 ----------------------
                                IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       1.61           .56
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=       1.92          2.00
      Length            (m)=     130.00         30.00
      Mannings n          =       .013          .200

      Max.eff.Inten.(mm/hr)=     142.89        110.47
                 over (min)        2.00          7.00
      Storage Coeff.  (min)=       2.13 (ii)     7.12 (ii)
      Unit Hyd. Tpeak (min)=       2.00          7.00
      Unit Hyd. peak  (cms)=        .54           .16
                                                                *TOTALS*
      PEAK FLOW       (cms)=        .64           .13             .766 (iii)
      TIME TO PEAK    (hrs)=       1.00          1.03            1.000
      RUNOFF VOLUME    (mm)=      70.04         29.57           59.515
      TOTAL RAINFALL   (mm)=      71.61         71.61           71.608
      RUNOFF COEFFICIENT   =        .98           .41             .831

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0032------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (109       ) | ID: NHYD         AREA      QPEAK   TPEAK   R.V.    DWF
 ------------------------                  (ha)      (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106            3.00       .237    1.28  69.63    .000
                    +ID2 07:107             .00       .000     .00    .00    .000  **DRY**
                    +ID3 08:108            2.17       .766    1.00  59.52    .000
                     ============================================================
                     SUM 09:109            5.17       .967    1.00  65.39    .000
```

```
   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0033-----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .49
| 01:101    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .32          .17
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=        2.00         3.30
     Length            (m)=        7.50        30.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      142.89       111.84
                over (min)        1.00         5.00
     Storage Coeff.  (min)=         .38 (ii)     4.65 (ii)
     Unit Hyd. Tpeak (min)=        1.00         5.00
     Unit Hyd. peak  (cms)=        1.58          .24
                                                            *TOTALS*
     PEAK FLOW       (cms)=         .13          .05           .174 (iii)
     TIME TO PEAK    (hrs)=         .90         1.00          1.000
     RUNOFF VOLUME    (mm)=       70.04        29.57         56.278
     TOTAL RAINFALL   (mm)=       71.61        71.61         71.608
     RUNOFF COEFFICIENT   =         .98          .41           .786

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0034-----------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<02:(102    )  |     =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .079  .6500E-02

     ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
     --------------------          (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101   )           .49      .174     1.000     56.278
     OUTFLOW<02: (102   )           .43      .079      .917     56.278
    OVERFLOW<03: (103   )           .06      .095     1.000     56.278

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         1
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .12
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      2.12


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   45.333
                   TIME SHIFT OF PEAK FLOW         (min)=    -5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.6378E-02

-------------------------------------------------------------------------------
001:0035-----------------------------------------------------------------------
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and C
```

```
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)   (cms)
                     ID1 09:109            5.17      .967     1.00   65.39    .000
                    +ID2 02:102             .43      .079      .92   56.28    .000
                    +ID3 03:103             .06      .095     1.00   56.28    .000
                     ==========================================================
                     SUM 05:105            5.66     1.141     1.00   64.60    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0036------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.01
| 06:106    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.00           .01
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        112.47
                over (min)        2.00          4.00
     Storage Coeff.  (min)=       1.62 (ii)     4.18 (ii)
     Unit Hyd. Tpeak (min)=       2.00          4.00
     Unit Hyd. peak  (cms)=        .64           .27
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .40           .00             .400 (iii)
     TIME TO PEAK    (hrs)=       1.00          1.00            1.000
     RUNOFF VOLUME    (mm)=      70.04         29.57           69.633
     TOTAL RAINFALL   (mm)=      71.61         71.61           71.608
     RUNOFF COEFFICIENT   =        .98           .41             .972

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0037------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>06:(106    )  |
| OUT<07:(107    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .086  .4495E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >06: (106    )        1.01      .400     1.000     69.633
     OUTFLOW<07: (107    )        1.01      .080     1.283     69.633
    OVERFLOW<08: (108    )         .00      .000      .000       .000

                      TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
```

```
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.951
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.4189E-01

 ----------------------------------------------------------------------------
 001:0038--------------------------------------------------------------------
 *Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    4.43
 | 09:109    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       2.61         1.82
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=       1.89         1.61
      Length            (m)=     103.00        36.00
      Mannings n          =       .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       109.74
                 over (min)        2.00         8.00
      Storage Coeff.  (min)=       1.86 (ii)    7.82 (ii)
      Unit Hyd. Tpeak (min)=       2.00         8.00
      Unit Hyd. peak  (cms)=        .58          .14
                                                             *TOTALS*
      PEAK FLOW       (cms)=       1.04          .41           1.425 (iii)
      TIME TO PEAK    (hrs)=       1.00         1.05           1.000
      RUNOFF VOLUME    (mm)=      70.04        29.57          53.445
      TOTAL RAINFALL   (mm)=      71.61        71.61          71.608
      RUNOFF COEFFICIENT   =        .98          .41            .746

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0039--------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (101       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 07:107            1.01      .080    1.28  69.63    .000
                    +ID2 08:108             .00      .000     .00    .00    .000  **DRY**
                    +ID3 09:109            4.43     1.425    1.00  53.44    .000
                     ============================================================
                     SUM 01:101            5.44     1.492    1.00  56.45    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------
 001:0040--------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
 *
 *Area controlled to 60L/s to meet Pinecrest Creek Criteria
 *SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    1.67
 | 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
```

```
     Surface Area     (ha)=       .95          .72
     Dep. Storage     (mm)=      1.57         4.67
     Average Slope     (%)=       .50         2.00
     Length            (m)=    113.00        10.00
     Mannings n          =      .013         .200

     Max.eff.Inten.(mm/hr)=    142.89       111.17
                over (min)       3.00         6.00
     Storage Coeff.  (min)=      2.93 (ii)    5.51 (ii)
     Unit Hyd. Tpeak (min)=      3.00         6.00
     Unit Hyd. peak  (cms)=       .38          .20
                                                          *TOTALS*
     PEAK FLOW       (cms)=       .38          .19           .561 (iii)
     TIME TO PEAK    (hrs)=      1.00         1.02          1.000
     RUNOFF VOLUME    (mm)=     70.04        29.57         52.635
     TOTAL RAINFALL   (mm)=     71.61        71.61         71.608
     RUNOFF COEFFICIENT   =       .98          .41           .735

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0041------------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .045  .1920E-01
                            .023  .3000E-03    |     .050  .3360E-01
                            .032  .2300E-02    |     .055  .4700E-01
                            .039  .8200E-02    |     .060  .5480E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )      1.67      .561     1.000     52.635
     OUTFLOW<03: (103    )      1.62      .060     1.250     52.635
    OVERFLOW<06: (106    )       .05      .087     1.250     52.635

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         2
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .17
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      2.82


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   10.704
                   TIME SHIFT OF PEAK FLOW         (min)=    15.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.5479E-01

--------------------------------------------------------------------------------
001:0042------------------------------------------------------------------------
*
------------------------
| ADD HYD (107       ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 03:103            1.62      .060     1.25  52.64    .000
                    +ID2 06:106             .05      .087     1.25  52.64    .000
                     ============================================================
                     SUM 07:107            1.67      .147     1.25  52.64    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0043------------------------------------------------------------------------
```

```
*
*Combine Subcatchment 3 & 9
*
------------------------
| ADD HYD (108        ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 01:101            5.44     1.492     1.00   56.45     .000
                    +ID2 07:107            1.67      .147     1.25   52.64     .000
                     ==============================================================
                     SUM 08:108            7.11     1.543     1.00   55.55     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------------
001:0044---------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.03
| 09:109    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .98           .05
     Dep. Storage     (mm)=         1.57          4.67
     Average Slope     (%)=         3.23          1.24
     Length            (m)=        35.00        200.00
     Mannings n           =         .013          .200

     Max.eff.Inten.(mm/hr)=       142.89         73.98
                over (min)          1.00         22.00
     Storage Coeff.  (min)=          .83 (ii)    21.94 (ii)
     Unit Hyd. Tpeak (min)=         1.00         22.00
     Unit Hyd. peak  (cms)=         1.19           .05
                                                                *TOTALS*
     PEAK FLOW       (cms)=          .39           .01              .391 (iii)
     TIME TO PEAK    (hrs)=          .97          1.27             1.000
     RUNOFF VOLUME    (mm)=        70.04         29.57            68.014
     TOTAL RAINFALL   (mm)=        71.61         71.61            71.608
     RUNOFF COEFFICIENT   =          .98           .41              .950

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20      Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------------
001:0045---------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL      ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 04:104           20.77     3.078     1.00   52.31     .000
                    +ID2 05:105            5.66     1.141     1.00   64.60     .000
                    +ID3 08:108            7.11     1.543     1.00   55.55     .000
                    +ID4 09:109            1.03      .391     1.00   68.01     .000
                     ==============================================================
                     SUM 01:TOTAL         34.57     6.152     1.00   55.46     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------------
001:0046---------------------------------------------------------------------------
*
      FINISH
```

```
---------------------------------------------------------------------------------------
***************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 12:10:14
=======================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 02-13-2018
*#  Revised         : 06-28-2018
*#  Revised         : 07-04-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
* Future Building S, Building C, Deficit
* Short Term Development  (Future HLE, Sports Complex Removed)
*
START               TIME = 0.0
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM       IUNITS=[2], TD=[6](hrs), TPRAT=[0.333], CSDT=[15](min)
                    ICASEcs=[1], A=[1735.688], B=[6.014], C=[0.820]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
```

```
                                      F100Y6H
                                   [   0.0 ,  0.0    ]
                                   [0.00945,  0.00266]
                                   [   -1  ,  -1     ]
                         IDovf=[3], NHYDovf=["103"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],  NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                   [   0.0 ,  0.0    ]
                                   [ 0.096 ,  0.0175 ]
```

```
                          [   -1  ,  -1     ]
                    IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40.](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.00756,  0.00469]
                                  [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
```

```
                     Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                             DCAY=[4.14](/hr), F=[0](mm),
                     Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                          LGP=[425](m), MNP=[0.2], SCP=[0](min),
                     Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
                                          LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD              IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD              IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
ROUTE RESERVOIR      IDout=[9],   NHYD=["109"],  IDin=[8],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                       (cms) - (ha-m)
                                     [ 0.000 ,  0.0000 ]
                                     [ 0.023 ,  0.1100 ]
                                     [ 0.312 ,  0.3830 ]
                                     [   -1  ,  -1     ]
                           IDovf=[1], NHYDovf=["101"]
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S
Expansion and Parking Lot 7, 8 (south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
CALIB STANDHYD       ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.05](ha),
                     XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                     Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                             DCAY=[4.14](/hr), F=[0](mm),
                     Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                          LGP=[10](m), MNP=[0.2], SCP=[0](min),
                     Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                          LGI=[42](m), MNI=[0.013], SCI=[0](min),
                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR      IDout=[3],   NHYD=["103"],  IDin=[2],
```

```
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,  -1     ]
                          IDovf=[4], NHYDovf=["104"]
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S
Expansion
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.30](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[3+4+5]
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[9+1+6]
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
```

```
                               [0.13230,  0.05698]
                               [   -1  ,   -1     ]
                     IDovf=[1], NHYDovf=["101"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[3], NHYD=["103"], IDs to add=[9+1+2]
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[7+3]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[3.00](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                               [   0.0 ,  0.0    ]
                               [0.28539,  0.15012]
                               [   -1  ,   -1     ]
                     IDovf=[7], NHYDovf=["107"]

*Remaining Area - Includes Grass, Parking Lots, Road
```

```
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[2.17](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.00](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[6+7+8]
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.49](ha),
                    XIMP=[0.66], TIMP=[0.66], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[3.30](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[7.5](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [ 0.079 ,  0.0065 ]
                                    [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and
Courtyard
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[7],   NHYD=["107"],  IDin=[6],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08562,  0.04495]
                                    [   -1  ,  -1     ]
                          IDovf=[8], NHYDovf=["108"]

*Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[7+8+9]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
```

```
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.023 ,  0.0003 ]
                                  [ 0.032 ,  0.0023 ]
                                  [ 0.039 ,  0.0082 ]
                                  [ 0.045 ,  0.0192 ]
                                  [ 0.050 ,  0.0336 ]
                                  [ 0.055 ,  0.0470 ]
                                  [ 0.060 ,  0.0548 ]
                                  [   -1  ,    -1   ]
                          IDovf=[6], NHYDovf=["106"]
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+6]
*
*Combine Subcatchment 3 & 9
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+7]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[1], NHYD=["TOTAL"], IDs to add=[4+5+8+9]
*
*%-----------------|-----------------------------------------------------------|
FINISH
```

```
================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                       9   9  9   9   # 3573794
        StormWater Management HYdrologic Model          999    999    =========

 ******************************************************************************
 ***************************** SWMHYMO Ver/4.05  ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                 OTTHYMO-83 and OTTHYMO-89.                  *********
 ******************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.           *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ******************************************************************************

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Morrison Hershfield Ltd.                    +++++++++
 +++++++++                Ottawa                SERIAL#:3573794       +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ******************************************************************************
 *********              ++++++ PROGRAM ARRAY DIMENSIONS ++++++         *********
 *********              Maximum value for ID numbers  :     10         *********
 *********              Max. number of rainfall points: 105408         *********
 *********              Max. number of flow points    : 105408         *********
 ******************************************************************************


 **********************   D E T A I L E D   O U T P U T   *********************
 ******************************************************************************
 *         DATE: 2018-10-19     TIME: 12:10:38     RUN COUNTER: 000299        *
 ******************************************************************************
 * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F100Y6H.DAT           *
 * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F100Y6H.out           *
 * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F100Y6H.sum           *
 * User comments:                                                             *
 * 1:_________________________________________________________________________*
 * 2:_________________________________________________________________________*
 * 3:_________________________________________________________________________*
 ******************************************************************************

--------------------------------------------------------------------------------
001:0001------------------------------------------------------------------------
*#****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 02-13-2018
*#  Revised     : 06-28-2018
*#  Revised     : 07-04-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
*#                              October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#****************************************************************************
*
* Future Building S, Building C, Deficit
* Short Term Development  (Future HLE, Sports Complex Removed)
*
```

```
--------------------
| START             |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 001
    NSTORM=    0
-----------------------------------------------------------------------------
001:0002--------------------------------------------------------------------
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM     |     IDF curve parameters: A=1735.688
| Ptotal= 82.31 mm |                            B=    6.014
--------------------                            C=     .820
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm   =  6.00 hrs
                        Storm time step     = 15.00 min
                        Time to peak ratio =    .33

              TIME    RAIN |    TIME    RAIN |    TIME    RAIN |    TIME    RAIN
               hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr
               .25   3.051 |    1.75  26.882 |    3.25   7.456 |    4.75   3.653
               .50   3.514 |    2.00 142.894 |    3.50   6.300 |    5.00   3.383
               .75   4.164 |    2.25  35.856 |    3.75   5.474 |    5.25   3.154
              1.00   5.156 |    2.50  17.946 |    4.00   4.851 |    5.50   2.956
              1.25   6.869 |    2.75  12.089 |    4.25   4.365 |    5.75   2.784
              1.50  10.626 |    3.00   9.189 |    4.50   3.974 |    6.00   2.633

-----------------------------------------------------------------------------
001:0003--------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       117.50
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.14 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .02          .00            .020 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.00           2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40          80.252
     TOTAL RAINFALL   (mm)=      82.31        82.31          82.305
     RUNOFF COEFFICIENT   =        .98          .39            .975

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```

 ---------------------------------------------------------------------------------------
 001:0004-------------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>01:(101    )  |
 | OUT<02:(102    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .009  .2660E-02

      ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
      --------------------         (ha)     (cms)     (hrs)       (mm)
      INFLOW >01: (101    )         .05      .020     2.000     80.252
      OUTFLOW<02: (102    )         .05      .006     2.083     80.251
     OVERFLOW<03: (103    )         .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.429
                    TIME SHIFT OF PEAK FLOW         (min)=     5.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1808E-02

 ---------------------------------------------------------------------------------------
 001:0005-------------------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.60
 | 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .02         1.58
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=       2.03         1.76
      Length            (m)=      37.00        85.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       113.84
                 over (min)        1.00        11.00
      Storage Coeff.  (min)=        .99 (ii)   10.56 (ii)
      Unit Hyd. Tpeak (min)=       1.00        11.00
      Unit Hyd. peak  (cms)=       1.08          .11
                                                              *TOTALS*
      PEAK FLOW       (cms)=        .01          .32            .326 (iii)
      TIME TO PEAK    (hrs)=       1.95         2.08           2.083
      RUNOFF VOLUME    (mm)=      80.73        32.40          32.879
      TOTAL RAINFALL   (mm)=      82.31        82.31          82.305
      RUNOFF COEFFICIENT   =        .98          .39            .399
       *** WARNING: For areas with impervious ratios below
                    20%, this routine may not be applicable.

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------------------
 001:0006-------------------------------------------------------------------------------
 *
```

```
-----------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
-----------------------                    (ha)     (cms)    (hrs)    (mm)    (cms)
                     ID1 02:102             .05      .006     2.08   80.25     .000
                    +ID2 03:103             .00      .000      .00     .00     .000  **DRY**
                    +ID3 04:104            1.60      .326     2.08   32.88     .000
                     ============================================================
                     SUM 05:105            1.65      .332     2.08   34.31     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0007------------------------------------------------------------------------
*
---------------------
| COMPUTE DUALHYD     |   Average inlet capacities   [CINLET] =    .096  (cms)
| TotalHyd 05:105     |   Number of inlets in system [NINLET] =       1
---------------------     Total minor system capacity         =    .096  (cms)
                          Total major system storage [TMJSTO] =      70.(cu.m.)

                  ID: NHYD         AREA     QPEAK     TPEAK     R.V.      DWF
                                   (ha)     (cms)     (hrs)     (mm)     (cms)
     TOTAL HYD.   05:105           1.65      .332     2.083    34.315     .000
     ========================================================================
     MAJOR SYST   06:106            .54      .236     2.083    34.315     .000
     MINOR SYST   07:107           1.11      .096     1.883    34.608     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

     Maximum MAJOR SYSTEM storage used =      70.(cu.m.)

--------------------------------------------------------------------------------
001:0008------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
---------------------
| CALIB STANDHYD      |   Area    (ha)=     .67
| 08:108    DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .60          .07
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.00         4.03
     Length            (m)=      25.00        34.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       117.05
                over (min)        1.00         5.00
     Storage Coeff.  (min)=        .78 (ii)    5.04 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.23          .22
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .24          .02             .259 (iii)
     TIME TO PEAK    (hrs)=       1.95         2.00            2.000
     RUNOFF VOLUME    (mm)=      80.74        32.40           75.901
     TOTAL RAINFALL   (mm)=      82.31        82.31           82.305
     RUNOFF COEFFICIENT   =        .98          .39             .922

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0009------------------------------------------------------------------------
*
```

```
*Combine Subcatchments 7 & 8
*
------------------------
| ADD HYD (109        ) | ID: NHYD          AREA     QPEAK    TPEAK    R.V.    DWF
------------------------                    (ha)     (cms)    (hrs)    (mm)   (cms)
                      ID1 07:107             1.11      .096     1.88   34.61    .000
                     +ID2 08:108              .67      .259     2.00   75.90    .000
                      ===========================================================
                      SUM 09:109             1.78      .355     2.00   50.19    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0010----------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(109    )  |
| OUT<01:(101    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |      .096  .1750E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (109    )        1.78      .355     2.000     50.188
     OUTFLOW<01: (101    )        1.36      .096     1.917     50.188
    OVERFLOW<02: (102    )         .42      .258     2.000     50.188

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         3
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .90
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      6.78


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   27.070
                   TIME SHIFT OF PEAK FLOW         (min)=    -5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1752E-01

------------------------------------------------------------------------------------
001:0011----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.08
| 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.05          .03
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.90          .01
     Length            (m)=     140.00        40.00
     Mannings n          =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89        44.10
                over (min)        2.00        44.00
     Storage Coeff.  (min)=       2.24 (ii)   44.22 (ii)
     Unit Hyd. Tpeak (min)=       2.00        44.00
     Unit Hyd. peak  (cms)=        .52          .03
                                                              *TOTALS*
     PEAK FLOW       (cms)=       1.21          .00            1.209 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.63            2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40           80.252
     TOTAL RAINFALL   (mm)=      82.31        82.31           82.305
     RUNOFF COEFFICIENT   =        .98          .39             .975

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
```

```
                Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
                Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
          (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
               THAN THE STORAGE COEFFICIENT.
         (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

   ------------------------------------------------------------------------------------
   001:0012----------------------------------------------------------------------------
   *
   *Combine Subcatchment 6 and Overflows
   *
   ------------------------
   | ADD HYD (104        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
   ------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106             .54      .236    2.08  34.31    .000
                    +ID2 02:102             .42      .258    2.00  50.19    .000
                    +ID3 03:103            3.08     1.209    2.00  80.25    .000
                     ============================================================
                     SUM 04:104            4.04     1.467    2.00  70.95    .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

   ------------------------------------------------------------------------------------
   001:0013----------------------------------------------------------------------------
   *
   *SUBCATCHMENT AREA 5: Building V and Snow Dump
   *
   *Total Building Area - Includes Building V
   *
   ----------------------
   | CALIB STANDHYD      |   Area    (ha)=     .09
   | 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
   ----------------------
                              IMPERVIOUS    PERVIOUS (i)
        Surface Area     (ha)=        .09          .00
        Dep. Storage     (mm)=       1.57         4.67
        Average Slope     (%)=        .50         2.00
        Length            (m)=      42.00        10.00
        Mannings n          =       .013         .200

        Max.eff.Inten.(mm/hr)=     142.89       117.50
                   over (min)        2.00         4.00
        Storage Coeff.  (min)=       1.62 (ii)    4.14 (ii)
        Unit Hyd. Tpeak (min)=       2.00         4.00
        Unit Hyd. peak  (cms)=        .64          .28
                                                               *TOTALS*
        PEAK FLOW       (cms)=        .04          .00            .036 (iii)
        TIME TO PEAK    (hrs)=       2.00         2.00           2.000
        RUNOFF VOLUME    (mm)=      80.73        32.40          80.252
        TOTAL RAINFALL   (mm)=      82.31        82.31          82.305
        RUNOFF COEFFICIENT   =        .98          .39            .975

           (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
                Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
                Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
          (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
               THAN THE STORAGE COEFFICIENT.
         (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

   ------------------------------------------------------------------------------------
   001:0014----------------------------------------------------------------------------
   *
   *Roof storage volume and release rate were estimated
   *
   ---------------------
   | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
   |  IN>08:(108    )  |
   | OUT<09:(109    )  |    =========  OUTFLOW STORAGE TABLE  =========
   ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
```

```
                              (cms)    (ha.m.)   |    (cms)    (ha.m.)
                               .000  .0000E+00   |     .008  .4690E-02

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )        .09      .036     2.000     80.252
     OUTFLOW<09: (109    )        .09      .007     2.283     80.251
    OVERFLOW<02: (102    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.286
                   TIME SHIFT OF PEAK FLOW          (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4043E-02

-------------------------------------------------------------------------------------
001:0015-----------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.82
| 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .76          3.06
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=         .01          2.04
     Length            (m)=         .01        425.00
     Mannings n           =        .013          .200

     Max.eff.Inten.(mm/hr)=      142.89         61.58
                over (min)         1.00         31.00
     Storage Coeff.  (min)=         .04 (ii)    30.79 (ii)
     Unit Hyd. Tpeak (min)=        1.00         31.00
     Unit Hyd. peak  (cms)=        1.70           .04
                                                            *TOTALS*
     PEAK FLOW       (cms)=         .30           .30           .380 (iii)
     TIME TO PEAK    (hrs)=        1.85          2.42          2.000
     RUNOFF VOLUME    (mm)=       80.74         32.39         42.064
     TOTAL RAINFALL   (mm)=       82.31         82.31         82.305
     RUNOFF COEFFICIENT   =         .98           .39           .511

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0016-----------------------------------------------------------------------------
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                          ID1 09:109          .09      .007     2.28  80.25    .000
                         +ID2 02:102          .00      .000      .00    .00    .000  **DRY**
                         +ID3 03:103         3.82      .380     2.00  42.06    .000
                          ============================================================
                          SUM 05:105         3.91      .386     2.00  42.94    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0017-----------------------------------------------------------------------------
```

```
*
*Combine Subcatchments 5, 6, 7 & 8
*
------------------------
| ADD HYD (108       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101            1.36      .096    1.92  50.19    .000
                    +ID2 04:104            4.04     1.467    2.00  70.95    .000
                    +ID3 05:105            3.91      .386    2.00  42.94    .000
                     ============================================================
                     SUM 08:108            9.31     1.949    2.00  56.16    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0018-----------------------------------------------------------------------------
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .312  .3830E+00
                            .023  .1100E+00   |     .000  .0000E+00

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )        9.31     1.949     2.000     56.163
     OUTFLOW<09: (109    )        9.31      .266     3.067     56.162
    OVERFLOW<01: (101    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   13.630
                   TIME SHIFT OF PEAK FLOW          (min)=    64.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3392E+00

-------------------------------------------------------------------------------------
001:0019-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S E
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.04          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       117.50
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.14 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
```

```
      Unit Hyd. peak  (cms)=        .64          .28
                                                              *TOTALS*
      PEAK FLOW       (cms)=        .41          .00            .416 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.00           2.000
      RUNOFF VOLUME    (mm)=      80.73        32.40          80.252
      TOTAL RAINFALL   (mm)=      82.31        82.31          82.305
      RUNOFF COEFFICIENT   =        .98          .39            .975

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0020----------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>02:(102    )  |
 | OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .085  .5115E-01

      ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
      --------------------        (ha)     (cms)     (hrs)       (mm)
      INFLOW >02: (102    )       1.05      .416     2.000     80.252
      OUTFLOW<03: (103    )       1.05      .078     2.283     80.252
     OVERFLOW<04: (104    )        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.723
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.4682E-01

 ------------------------------------------------------------------------------
 001:0021----------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S Expa
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    4.30
 | 05:105    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       3.18         1.12
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=       1.43        15.38
      Length            (m)=     116.00        13.00
      Mannings n           =       .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       117.50
                 over (min)        2.00         4.00
      Storage Coeff.  (min)=       2.17 (ii)    3.77 (ii)
      Unit Hyd. Tpeak (min)=       2.00         4.00
      Unit Hyd. peak  (cms)=        .53          .29
                                                              *TOTALS*
      PEAK FLOW       (cms)=       1.26          .34           1.606 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.00           2.000
      RUNOFF VOLUME    (mm)=      80.73        32.40          68.167
      TOTAL RAINFALL   (mm)=      82.31        82.31          82.305
```

```
     RUNOFF COEFFICIENT   =        .98          .39           .828

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

----------------------------------------------------------------------------------
001:0022--------------------------------------------------------------------------
*
------------------------
| ADD HYD (106        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 03:103            1.05      .078     2.28   80.25    .000
                    +ID2 04:104             .00      .000      .00     .00    .000  **DRY**
                    +ID3 05:105            4.30     1.606     2.00   68.17    .000
                     ==========================================================
                     SUM 06:106            5.35     1.672     2.00   70.54    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

----------------------------------------------------------------------------------
001:0023--------------------------------------------------------------------------
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
------------------------
| ADD HYD (107        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 09:109            9.31      .266     3.07   56.16    .000
                    +ID2 01:101             .00      .000      .00     .00    .000  **DRY**
                    +ID3 06:106            5.35     1.672     2.00   70.54    .000
                     ==========================================================
                     SUM 07:107           14.66     1.772     2.00   61.41    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

----------------------------------------------------------------------------------
001:0024--------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.14
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.13          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       117.50
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.14 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .45          .00           .451 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.00          2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40         80.252
     TOTAL RAINFALL   (mm)=      82.31        82.31         82.305
     RUNOFF COEFFICIENT   =        .98          .39           .975
```

```
          (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
               Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
               Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
         (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
              THAN THE STORAGE COEFFICIENT.
        (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0025------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .132  .5698E-01

     ROUTING RESULTS               AREA     QPEAK     TPEAK       R.V.
     --------------------          (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )         1.14      .451     2.000     80.252
     OUTFLOW<09: (109    )         1.14      .108     2.267     80.252
    OVERFLOW<01: (101    )          .00      .000      .000       .000

                      TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                      CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                      PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                      PEAK   FLOW   REDUCTION [Qout/Qin](%)=   23.841
                      TIME SHIFT OF PEAK FLOW          (min)=    16.00
                      MAXIMUM  STORAGE   USED       (ha.m.)=.4636E-01

--------------------------------------------------------------------------------
001:0026------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.97
| 02:102    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.74         3.23
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.00         1.42
     Length            (m)=      57.00        57.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       114.44
                over (min)       2.00        10.00
     Storage Coeff.  (min)=       1.58 (ii)     9.60 (ii)
     Unit Hyd. Tpeak (min)=       2.00        10.00
     Unit Hyd. peak  (cms)=        .65          .12
                                                                 *TOTALS*
     PEAK FLOW       (cms)=        .69          .70            1.310 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.07            2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40           49.315
     TOTAL RAINFALL   (mm)=      82.31        82.31           82.305
     RUNOFF COEFFICIENT  =         .98          .39             .599

          (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
               Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
               Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
         (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
              THAN THE STORAGE COEFFICIENT.
        (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
--------------------------------------------------------------------------------
001:0027------------------------------------------------------------------------
*
------------------------
| ADD HYD (103        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 09:109           1.14      .108     2.27   80.25    .000
                    +ID2 01:101            .00      .000      .00     .00    .000  **DRY**
                    +ID3 02:102           4.97     1.310     2.00   49.31    .000
                     ==========================================================
                     SUM 03:103           6.11     1.405     2.00   55.09    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0028------------------------------------------------------------------------
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
------------------------
| ADD HYD (104        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 07:107          14.66     1.772     2.00   61.41    .000
                    +ID2 03:103           6.11     1.405     2.00   55.09    .000
                     ==========================================================
                     SUM 04:104          20.77     3.177     2.00   59.55    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0029------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.00
| 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.97          .03
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       117.50
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.14 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                            *TOTALS*
     PEAK FLOW       (cms)=       1.18          .01           1.188 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.00           2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40          80.252
     TOTAL RAINFALL   (mm)=      82.31        82.31          82.305
     RUNOFF COEFFICIENT   =        .98          .39            .975

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0030------------------------------------------------------------------------
```

```
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(105    )  |
| OUT<06:(106    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |      .285  .1501E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >05: (105    )      3.00     1.188     2.000     80.252
     OUTFLOW<06: (106    )      3.00      .246     2.267     80.252
    OVERFLOW<07: (107    )       .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.684
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1293E+00

-----------------------------------------------------------------------------------------
001:0031---------------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots, Road
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    2.17
| 08:108    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.61          .56
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.92         2.00
     Length            (m)=     130.00        30.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       116.08
                over (min)        2.00         7.00
     Storage Coeff.  (min)=       2.13 (ii)    7.03 (ii)
     Unit Hyd. Tpeak (min)=       2.00         7.00
     Unit Hyd. peak  (cms)=        .54          .16
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .64          .14             .777 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.03            2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40           68.167
     TOTAL RAINFALL   (mm)=      82.31        82.31           82.305
     RUNOFF COEFFICIENT   =        .98          .39             .828

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------------------
001:0032---------------------------------------------------------------------------------
*
------------------------
| ADD HYD (109       ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.    DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)   (cms)
                     ID1 06:106           3.00      .246     2.27   80.25    .000
                    +ID2 07:107            .00      .000      .00     .00    .000  **DRY**
                    +ID3 08:108           2.17      .777     2.00   68.17    .000
```

```
                     ============================================================
                     SUM 09:109            5.17     .988    2.00  75.18    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0033----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .49
| 01:101    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
----------------------
                                    IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .32            .17
     Dep. Storage     (mm)=         1.57           4.67
     Average Slope     (%)=         2.00           3.30
     Length            (m)=         7.50          30.00
     Mannings n          =          .013           .200

     Max.eff.Inten.(mm/hr)=       142.89         117.05
                over (min)          1.00           5.00
     Storage Coeff.  (min)=          .38 (ii)      4.58 (ii)
     Unit Hyd. Tpeak (min)=         1.00           5.00
     Unit Hyd. peak  (cms)=         1.58            .24
                                                                *TOTALS*
     PEAK FLOW       (cms)=          .13            .05            .177 (iii)
     TIME TO PEAK    (hrs)=         1.87           2.00           2.000
     RUNOFF VOLUME    (mm)=        80.73          32.40          64.300
     TOTAL RAINFALL   (mm)=        82.31          82.31          82.305
     RUNOFF COEFFICIENT   =          .98            .39            .781

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0034----------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<02:(102    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .079  .6500E-02

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )         .49      .177     2.000     64.300
     OUTFLOW<02: (102    )         .43      .079     1.917     64.300
    OVERFLOW<03: (103    )         .06      .098     2.000     64.300

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         1
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .12
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      1.40


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   44.540
                   TIME SHIFT OF PEAK FLOW         (min)=    -5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.6493E-02

------------------------------------------------------------------------------------
```

```
001:0035------------------------------------------------------------------------------
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and C
*
------------------------
| ADD HYD (105       ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                  (ha)     (cms)    (hrs)    (mm)    (cms)
                    ID1 09:109            5.17      .988     2.00   75.18     .000
                   +ID2 02:102             .43      .079     1.92   64.30     .000
                   +ID3 03:103             .06      .098     2.00   64.30     .000
                    ============================================================
                    SUM 05:105            5.66     1.165     2.00   74.24     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0036------------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.01
| 06:106    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.00          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       117.50
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.14 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .40          .00            .400 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.00           2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40          80.252
     TOTAL RAINFALL   (mm)=      82.31        82.31          82.305
     RUNOFF COEFFICIENT   =        .98          .39            .975

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0037------------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>06:(106   )   |
| OUT<07:(107   )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .086  .4495E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >06: (106   )         1.01      .400     2.000     80.252
     OUTFLOW<07: (107   )         1.01      .083     2.267     80.252
```

```
    OVERFLOW<08: (108    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.714
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4351E-01

--------------------------------------------------------------------------------
001:0038------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.43
| 09:109    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.61         1.82
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.89         1.61
     Length            (m)=     103.00        36.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       115.56
                over (min)        2.00         8.00
     Storage Coeff.  (min)=       1.86 (ii)    7.70 (ii)
     Unit Hyd. Tpeak (min)=       2.00         8.00
     Unit Hyd. peak  (cms)=        .58          .15
                                                           *TOTALS*
     PEAK FLOW       (cms)=       1.04          .44          1.457 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.03          2.000
     RUNOFF VOLUME    (mm)=      80.73        32.40         60.916
     TOTAL RAINFALL   (mm)=      82.31        82.31         82.305
     RUNOFF COEFFICIENT   =        .98          .39           .740

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0039------------------------------------------------------------------------
*
------------------------
| ADD HYD (101       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 07:107           1.01      .083    2.27  80.25    .000
                    +ID2 08:108            .00      .000     .00    .00    .000  **DRY**
                    +ID3 09:109           4.43     1.457    2.00  60.92    .000
                     ============================================================
                     SUM 01:101           5.44     1.529    2.00  64.51    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0040------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.67
```

```
| 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .95           .72
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=     113.00         10.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        117.05
                over (min)        3.00          5.00
     Storage Coeff.  (min)=       2.93 (ii)     5.46 (ii)
     Unit Hyd. Tpeak (min)=       3.00          5.00
     Unit Hyd. peak  (cms)=        .38           .21
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .38           .20            .578 (iii)
     TIME TO PEAK    (hrs)=       2.00          2.02           2.000
     RUNOFF VOLUME    (mm)=      80.73         32.40          59.949
     TOTAL RAINFALL   (mm)=      82.31         82.31          82.305
     RUNOFF COEFFICIENT   =        .98           .39            .728

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0041------------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .045  .1920E-01
                            .023  .3000E-03   |     .050  .3360E-01
                            .032  .2300E-02   |     .055  .4700E-01
                            .039  .8200E-02   |     .060  .5480E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK        R.V.
     --------------------         (ha)     (cms)     (hrs)        (mm)
     INFLOW >02: (102    )        1.67      .578     2.000      59.949
     OUTFLOW<03: (103    )        1.60      .060     2.200      59.949
    OVERFLOW<06: (106    )         .07      .109     2.200      59.949

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         3
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .23
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      3.20


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   10.387
                   TIME SHIFT OF PEAK FLOW         (min)=    12.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.5479E-01

--------------------------------------------------------------------------------
001:0042------------------------------------------------------------------------
*
------------------------
| ADD HYD (107        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 03:103           1.60      .060    2.20  59.95    .000
                    +ID2 06:106            .07      .109    2.20  59.95    .000
                     ============================================================
                     SUM 07:107           1.67      .169    2.20  59.95    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

```
 ---------------------------------------------------------------------------------
 001:0043------------------------------------------------------------------------
 *
 *Combine Subcatchment 3 & 9
 *
 ------------------------
 | ADD HYD (108        ) | ID: NHYD          AREA     QPEAK    TPEAK    R.V.     DWF
 ------------------------                    (ha)     (cms)    (hrs)    (mm)    (cms)
                      ID1 01:101              5.44    1.529     2.00   64.51    .000
                     +ID2 07:107              1.67     .169     2.20   59.95    .000
                      ============================================================
                      SUM 08:108              7.11    1.580     2.00   63.44    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ---------------------------------------------------------------------------------
 001:0044------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    1.03
 | 09:109    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .98           .05
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=       3.23          1.24
      Length            (m)=      35.00        200.00
      Mannings n           =       .013          .200

      Max.eff.Inten.(mm/hr)=     142.89         83.37
                 over (min)        1.00         21.00
      Storage Coeff.  (min)=        .83 (ii)    20.96 (ii)
      Unit Hyd. Tpeak (min)=       1.00         21.00
      Unit Hyd. peak  (cms)=       1.19           .05
                                                               *TOTALS*
      PEAK FLOW       (cms)=        .39           .01             .391 (iii)
      TIME TO PEAK    (hrs)=       1.97          2.25            2.000
      RUNOFF VOLUME    (mm)=      80.74         32.40           78.318
      TOTAL RAINFALL   (mm)=      82.31         82.31           82.305
      RUNOFF COEFFICIENT   =        .98           .39             .952

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------------
 001:0045------------------------------------------------------------------------
 *
 *Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
 *
 ------------------------
 | ADD HYD (TOTAL      ) | ID: NHYD          AREA     QPEAK    TPEAK    R.V.     DWF
 ------------------------                    (ha)     (cms)    (hrs)    (mm)    (cms)
                      ID1 04:104             20.77    3.177     2.00   59.55    .000
                     +ID2 05:105              5.66    1.165     2.00   74.24    .000
                     +ID3 08:108              7.11    1.580     2.00   63.44    .000
                     +ID4 09:109              1.03     .391     2.00   78.32    .000
                      ============================================================
                      SUM 01:TOTAL           34.57    6.313     2.00   63.31    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ---------------------------------------------------------------------------------
```

```
001:0046---------------------------------------------------------------------------------
*
      FINISH
---------------------------------------------------------------------------------------
***************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 12:10:39
=======================================================================================
```

```
2     Metric units
*#*****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 02-13-2018
*#  Revised         : 06-28-2018
*#  Revised         : 07-04-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                  October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#*****************************************************************************
*
* Future Building S, Building C, Deficit
* Short Term Development  (Future HLE, Sports Complex Removed)
*
START                TIME = 0.0
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM        IUNITS=[2], TD=[12](hrs), TPRAT=[0.333], CSDT=[15](min)
                     ICASEcs=[1], A=[1735.688], B=[6.014], C=[0.820]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD       ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                     XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                     Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                             DCAY=[4.14](/hr), F=[0](mm),
                     Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                          LGP=[10](m), MNP=[0.2], SCP=[0](min),
                     Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                          LGI=[42](m), MNI=[0.013], SCI=[0](min),
                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR      IDout=[2],   NHYD=["102"],  IDin=[1],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
```

```
                                  F100Y12H
                                [   0.0 ,  0.0    ]
                                [0.00945,  0.00266]
                                [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                  (cms) - (ha-m)
                                [   0.0 ,  0.0    ]
                                [ 0.096 ,  0.0175 ]
```

```
                                   [    -1  ,  -1     ]
                         IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40.](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [    0.0 ,  0.0     ]
                                  [0.00756,  0.00469]
                                  [    -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
                                         LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [ 0.000 ,  0.0000 ]
                                    [ 0.023 ,  0.1100 ]
                                    [ 0.312 ,  0.3830 ]
                                    [   -1  ,  -1     ]
                          IDovf=[1], NHYDovf=["101"]
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S
Expansion and Parking Lot 7, 8 (south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
```

```
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,   -1    ]
                          IDovf=[4], NHYDovf=["104"]
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S
Expansion
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.30](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[3+4+5]
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[9+1+6]
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
```

```
                                   F100Y12H
                                 [0.13230,  0.05698]
                                 [   -1  ,   -1     ]
                          IDovf=[1], NHYDovf=["101"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[3], NHYD=["103"], IDs to add=[9+1+2]
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[7+3]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[3.00](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                   (cms) - (ha-m)
                                 [   0.0 ,  0.0    ]
                                 [0.28539,  0.15012]
                                 [   -1  ,   -1     ]
                          IDovf=[7], NHYDovf=["107"]

*Remaining Area - Includes Grass, Parking Lots, Road
```

```
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[2.17](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.00](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[6+7+8]
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.49](ha),
                    XIMP=[0.66], TIMP=[0.66], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[3.30](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[7.5](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.079 ,  0.0065 ]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and
Courtyard
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[7],   NHYD=["107"],  IDin=[6],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08562,  0.04495]
                                    [   -1  ,  -1     ]
                          IDovf=[8], NHYDovf=["108"]

*Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[7+8+9]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
```

```
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.023 ,  0.0003 ]
                                  [ 0.032 ,  0.0023 ]
                                  [ 0.039 ,  0.0082 ]
                                  [ 0.045 ,  0.0192 ]
                                  [ 0.050 ,  0.0336 ]
                                  [ 0.055 ,  0.0470 ]
                                  [ 0.060 ,  0.0548 ]
                                  [   -1  ,    -1   ]
                          IDovf=[6], NHYDovf=["106"]
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+6]
*
*Combine Subcatchment 3 & 9
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+7]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[1], NHYD=["TOTAL"], IDs to add=[4+5+8+9]
*
*%-----------------|-----------------------------------------------------------|
FINISH
```

```
==================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999     =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9    Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999    Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                        9   9  9   9    # 3573794
        StormWater Management HYdrologic Model           999    999     =========

    ********************************************************************************
    ***************************** SWMHYMO Ver/4.05  ******************************
    *********  A single event and continuous hydrologic simulation model  *********
    *********     based on the principles of HYMO and its successors      *********
    *********                  OTTHYMO-83 and OTTHYMO-89.                 *********
    ********************************************************************************
    ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
    *********                  Ottawa,  Ontario: (613) 836-3884           *********
    *********                  Gatineau, Quebec: (819) 243-6858           *********
    *********                  E-Mail: swmhymo@jfsa.Com                   *********
    ********************************************************************************


    ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
    +++++++++ Licensed user: Morrison Hershfield Ltd.                     +++++++++
    +++++++++                Ottawa                 SERIAL#:3573794       +++++++++
    ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

    ********************************************************************************
    *********           ++++++ PROGRAM ARRAY DIMENSIONS ++++++            *********
    *********           Maximum value for ID numbers  :     10            *********
    *********           Max. number of rainfall points: 105408            *********
    *********           Max. number of flow points    : 105408            *********
    ********************************************************************************



    **********************   D E T A I L E D   O U T P U T   **********************
    ********************************************************************************
    *         DATE: 2018-10-19     TIME: 12:10:54     RUN COUNTER: 000300          *
    ********************************************************************************
    * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F100Y12H.DAT            *
    * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F100Y12H.out            *
    * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F100Y12H.sum            *
    * User comments:                                                               *
    * 1:___________________________________________________________________________*
    * 2:___________________________________________________________________________*
    * 3:___________________________________________________________________________*
    ********************************************************************************

   -------------------------------------------------------------------------------------
   001:0001----------------------------------------------------------------------------
   *#*******************************************************************************
   *#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
   *#  Project Number : [2085345.16]
   *#  Date           : 02-07-2014
   *#  Revised        : 01-20-2015
   *#  Revised        : 01-03-2017
   *#  Revised        : 02-13-2018
   *#  Revised         : 06-28-2018
   *#  Revised     : 07-04-2018
   *#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
   *#                                 October 2018
   *#  Modeller       : [SM]
   *#  Company        : Morrison Hershfield Ltd
   *#  License #      : 3573794
   *#*******************************************************************************
   *
   * Future Building S, Building C, Deficit
   * Short Term Development  (Future HLE, Sports Complex Removed)
   *
```

```
--------------------
| START              |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
--------------------------------------------------------------------------------
001:0002------------------------------------------------------------------------
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM     |     IDF curve parameters: A=1735.688
| Ptotal= 93.90 mm |                           B=   6.014
--------------------                           C=    .820
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm   = 12.00 hrs
                        Storm time step     = 15.00 min
                        Time to peak ratio =    .33

              TIME    RAIN |    TIME    RAIN |    TIME    RAIN |    TIME    RAIN
               hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr |     hrs   mm/hr
               .25   1.558 |    3.25   6.869 |    6.25   4.365 |    9.25   2.083
               .50   1.654 |    3.50  10.626 |    6.50   3.974 |    9.50   2.002
               .75   1.763 |    3.75  26.882 |    6.75   3.653 |    9.75   1.927
              1.00   1.890 |    4.00 142.894 |    7.00   3.383 |   10.00   1.858
              1.25   2.040 |    4.25  35.856 |    7.25   3.154 |   10.25   1.795
              1.50   2.218 |    4.50  17.946 |    7.50   2.956 |   10.50   1.736
              1.75   2.435 |    4.75  12.089 |    7.75   2.784 |   10.75   1.681
              2.00   2.705 |    5.00   9.189 |    8.00   2.633 |   11.00   1.630
              2.25   3.051 |    5.25   7.456 |    8.25   2.498 |   11.25   1.582
              2.50   3.514 |    5.50   6.300 |    8.50   2.378 |   11.50   1.538
              2.75   4.164 |    5.75   5.474 |    8.75   2.270 |   11.75   1.496
              3.00   5.156 |    6.00   4.851 |    9.00   2.172 |   12.00   1.456

--------------------------------------------------------------------------------
001:0003------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .00
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       121.11
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.11 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .02          .00           .020 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.00          4.000
     RUNOFF VOLUME    (mm)=      92.33        34.43         91.748
     TOTAL RAINFALL   (mm)=      93.90        93.90         93.897
     RUNOFF COEFFICIENT   =        .98          .37           .977
```

```
         (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
              Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
              Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
             THAN THE STORAGE COEFFICIENT.
       (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------------
 001:0004--------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>01:(101    )  |
 | OUT<02:(102    )  |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .009  .2660E-02

      ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
      --------------------        (ha)     (cms)     (hrs)       (mm)
      INFLOW >01: (101    )        .05      .020     4.000     91.748
      OUTFLOW<02: (102    )        .05      .006     4.083     91.747
     OVERFLOW<03: (103    )        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.662
                    TIME SHIFT OF PEAK FLOW         (min)=     5.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1822E-02

 ----------------------------------------------------------------------------------
 001:0005--------------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.60
 | 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
 ----------------------
                                  IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=          .02         1.58
      Dep. Storage     (mm)=         1.57         4.67
      Average Slope     (%)=         2.03         1.76
      Length            (m)=        37.00        85.00
      Mannings n          =          .013         .200

      Max.eff.Inten.(mm/hr)=       142.89       118.96
                 over (min)          1.00        10.00
      Storage Coeff.  (min)=          .99 (ii)   10.39 (ii)
      Unit Hyd. Tpeak (min)=         1.00        10.00
      Unit Hyd. peak  (cms)=         1.08          .11
                                                               *TOTALS*
      PEAK FLOW       (cms)=          .01          .35            .349 (iii)
      TIME TO PEAK    (hrs)=         3.93         4.07           4.067
      RUNOFF VOLUME    (mm)=        92.33        34.43          35.013
      TOTAL RAINFALL   (mm)=        93.90        93.90          93.897
      RUNOFF COEFFICIENT   =          .98          .37            .373
       *** WARNING: For areas with impervious ratios below
                    20%, this routine may not be applicable.

         (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
              Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
              Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
             THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------------
 001:0006--------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 02:102               .05      .006     4.08  91.75    .000
                    +ID2 03:103               .00      .000      .00    .00    .000  **DRY**
                    +ID3 04:104              1.60      .349     4.07  35.01    .000
                     ==========================================================
                     SUM 05:105              1.65      .355     4.07  36.73    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------------
 001:0007--------------------------------------------------------------------------
 *
 ----------------------
 | COMPUTE DUALHYD    |    Average inlet capacities   [CINLET] =    .096  (cms)
 | TotalHyd 05:105    |    Number of inlets in system [NINLET] =       1
 ----------------------    Total minor system capacity         =    .096  (cms)
                           Total major system storage [TMJSTO] =      70.(cu.m.)

                  ID: NHYD         AREA      QPEAK     TPEAK      R.V.      DWF
                                   (ha)      (cms)     (hrs)      (mm)     (cms)
      TOTAL HYD.  05:105           1.65       .355     4.067    36.732     .000
      =====================================================================
      MAJOR SYST  06:106            .59       .259     4.067    36.732     .000
      MINOR SYST  07:107           1.06       .096     3.867    36.963     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

      Maximum MAJOR SYSTEM storage used =      70.(cu.m.)

 ----------------------------------------------------------------------------------
 001:0008--------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 7: North East Parking Lot
 *
 ----------------------
 | CALIB STANDHYD     |    Area    (ha)=     .67
 | 08:108    DT= 1.00 |    Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
 ----------------------
                                 IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=         .60           .07
      Dep. Storage     (mm)=        1.57          4.67
      Average Slope     (%)=        2.00          4.03
      Length            (m)=       25.00         34.00
      Mannings n           =        .013          .200

      Max.eff.Inten.(mm/hr)=      142.89        120.80
                 over (min)         1.00          5.00
      Storage Coeff.  (min)=         .78 (ii)     4.99 (ii)
      Unit Hyd. Tpeak (min)=        1.00          5.00
      Unit Hyd. peak  (cms)=        1.23           .23
                                                              *TOTALS*
      PEAK FLOW       (cms)=         .24           .02            .260 (iii)
      TIME TO PEAK    (hrs)=        3.95          4.00           4.000
      RUNOFF VOLUME    (mm)=       92.33         34.43          86.537
      TOTAL RAINFALL   (mm)=       93.90         93.90          93.897
      RUNOFF COEFFICIENT   =         .98           .37            .922

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0009--------------------------------------------------------------------
 *
 *Combine Subcatchments 7 & 8
 *
 ------------------------
 | ADD HYD (109        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 07:107              1.06      .096     3.87  36.96    .000
                    +ID2 08:108               .67      .260     4.00  86.54    .000
                     =========================================================
                     SUM 09:109              1.73      .356     4.00  56.13    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------
 001:0010--------------------------------------------------------------------
 *
 *Flow Controlled to Pre-Development
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>09:(109    )  |
 | OUT<01:(101    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .096  .1750E-01

      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
      --------------------       (ha)     (cms)     (hrs)       (mm)
      INFLOW >09: (109    )      1.73      .356     4.000     56.132
      OUTFLOW<01: (101    )      1.35      .096     3.917     56.132
     OVERFLOW<02: (102    )       .38      .259     4.000     56.132

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        2
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .92
                    PERCENTAGE OF TIME OVERFLOWING    (%)=     4.92


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   27.002
                    TIME SHIFT OF PEAK FLOW         (min)=    -5.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1754E-01

 ----------------------------------------------------------------------------
 001:0011--------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    3.08
 | 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       3.05           .03
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=       1.90           .01
      Length            (m)=     140.00         40.00
      Mannings n          =        .013          .200

      Max.eff.Inten.(mm/hr)=     142.89         47.87
                 over (min)        2.00         43.00
      Storage Coeff.  (min)=       2.24 (ii)    42.86 (ii)
      Unit Hyd. Tpeak (min)=       2.00         43.00
      Unit Hyd. peak  (cms)=        .52           .03
                                                               *TOTALS*
      PEAK FLOW       (cms)=       1.21           .00            1.209 (iii)
```

```
     TIME TO PEAK    (hrs)=       4.00          4.62           4.000
     RUNOFF VOLUME    (mm)=      92.32         34.43          91.748
     TOTAL RAINFALL   (mm)=      93.90         93.90          93.897
     RUNOFF COEFFICIENT   =        .98           .37            .977

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0012----------------------------------------------------------------------------
*
*Combine Subcatchment 6 and Overflows
*
------------------------
| ADD HYD (104        ) | ID: NHYD         AREA      QPEAK    TPEAK   R.V.    DWF
------------------------                  (ha)      (cms)    (hrs)   (mm)   (cms)
                     ID1 06:106              .59      .259     4.07  36.73    .000
                    +ID2 02:102              .38      .259     4.00  56.13    .000
                    +ID3 03:103             3.08     1.209     4.00  91.75    .000
                     ============================================================
                     SUM 04:104             4.05     1.468     4.00  80.41    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0013----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .09
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09           .00
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        121.11
                over (min)        2.00          4.00
     Storage Coeff.  (min)=       1.62 (ii)     4.11 (ii)
     Unit Hyd. Tpeak (min)=       2.00          4.00
     Unit Hyd. peak  (cms)=        .64           .28
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .04           .00            .036 (iii)
     TIME TO PEAK    (hrs)=       4.00          4.00           4.000
     RUNOFF VOLUME    (mm)=      92.32         34.43          91.748
     TOTAL RAINFALL   (mm)=      93.90         93.90          93.897
     RUNOFF COEFFICIENT   =        .98           .37            .977

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0014----------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
```

```
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>08:(108    )   |
| OUT<09:(109    )   |    =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |      .008  .4690E-02

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )         .09      .036     4.000     91.748
     OUTFLOW<09: (109    )         .09      .007     4.283     91.747
    OVERFLOW<02: (102    )         .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =          0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=        .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=        .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.693
                  TIME SHIFT OF PEAK FLOW         (min)=    17.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.4135E-02

--------------------------------------------------------------------------------
001:0015------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    3.82
| 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
----------------------
                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .76          3.06
     Dep. Storage     (mm)=         1.57          4.67
     Average Slope     (%)=          .01          2.04
     Length            (m)=          .01        425.00
     Mannings n          =          .013          .200

     Max.eff.Inten.(mm/hr)=       142.89         67.32
                over (min)          1.00         30.00
     Storage Coeff.  (min)=          .04 (ii)    29.72 (ii)
     Unit Hyd. Tpeak (min)=         1.00         30.00
     Unit Hyd. peak  (cms)=         1.70           .04
                                                                *TOTALS*
     PEAK FLOW       (cms)=          .30           .32            .390 (iii)
     TIME TO PEAK    (hrs)=         3.83          4.40           4.000
     RUNOFF VOLUME    (mm)=        92.33         34.43          46.013
     TOTAL RAINFALL   (mm)=        93.90         93.90          93.897
     RUNOFF COEFFICIENT   =          .98           .37            .490

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0016------------------------------------------------------------------------
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.     DWF
------------------------                 (ha)     (cms)    (hrs)   (mm)    (cms)
                     ID1 09:109            .09      .007     4.28  91.75     .000
                    +ID2 02:102            .00      .000      .00    .00     .000  **DRY**
                    +ID3 03:103           3.82      .390     4.00  46.01     .000
                     ============================================================
```

```
                     SUM 05:105            3.91     .396    4.00  47.07    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0017-----------------------------------------------------------------------
*
*Combine Subcatchments 5, 6, 7 & 8
*
------------------------
| ADD HYD (108        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101            1.35     .096    3.92  56.13    .000
                    +ID2 04:104            4.05    1.468    4.00  80.41    .000
                    +ID3 05:105            3.91     .396    4.00  47.07    .000
                     ============================================================
                     SUM 08:108            9.31    1.960    4.00  62.88    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0018-----------------------------------------------------------------------
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108   )   |
| OUT<09:(109   )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .312  .3830E+00
                            .023  .1100E+00   |     .000  .0000E+00

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )       9.31     1.960     4.000     62.883
     OUTFLOW<09: (109    )       9.31      .284     5.033     62.882
    OVERFLOW<01: (101    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   14.498
                   TIME SHIFT OF PEAK FLOW         (min)=    62.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3568E+00

-------------------------------------------------------------------------------
001:0019-----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S E
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.04          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
```

```
    Mannings n          =        .013          .200

    Max.eff.Inten.(mm/hr)=     142.89        121.11
               over (min)        2.00          4.00
    Storage Coeff.  (min)=       1.62 (ii)     4.11 (ii)
    Unit Hyd. Tpeak (min)=       2.00          4.00
    Unit Hyd. peak  (cms)=        .64           .28
                                                           *TOTALS*
    PEAK FLOW       (cms)=        .41           .00           .416 (iii)
    TIME TO PEAK    (hrs)=       4.00          4.00          4.000
    RUNOFF VOLUME    (mm)=      92.32         34.43         91.748
    TOTAL RAINFALL   (mm)=      93.90         93.90         93.897
    RUNOFF COEFFICIENT   =        .98           .37           .977

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
           Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0020-----------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .085  .5115E-01

    ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
    --------------------        (ha)     (cms)     (hrs)       (mm)
    INFLOW >02: (102    )       1.05      .416     4.000     91.748
    OUTFLOW<03: (103    )       1.05      .080     4.283     91.747
   OVERFLOW<04: (104    )        .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.125
                  TIME SHIFT OF PEAK FLOW         (min)=    17.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.4785E-01

-------------------------------------------------------------------------------
001:0021-----------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S Expa
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.30
| 05:105    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=       3.18          1.12
    Dep. Storage     (mm)=       1.57          4.67
    Average Slope     (%)=       1.43         15.38
    Length            (m)=     116.00         13.00
    Mannings n          =        .013          .200

    Max.eff.Inten.(mm/hr)=     142.89        121.11
               over (min)        2.00          4.00
    Storage Coeff.  (min)=       2.17 (ii)     3.75 (ii)
    Unit Hyd. Tpeak (min)=       2.00          4.00
```

```
     Unit Hyd. peak  (cms)=        .53          .29
                                                               *TOTALS*
     PEAK FLOW       (cms)=       1.26          .36              1.620 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.00              4.000
     RUNOFF VOLUME    (mm)=      92.32        34.43             77.275
     TOTAL RAINFALL   (mm)=      93.90        93.90             93.897
     RUNOFF COEFFICIENT   =        .98          .37               .823

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
001:0022----------------------------------------------------------------------
*
------------------------
| ADD HYD (106        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 03:103            1.05      .080    4.28  91.75    .000
                    +ID2 04:104             .00      .000     .00    .00    .000  **DRY**
                    +ID3 05:105            4.30     1.620    4.00  77.27    .000
                     ============================================================
                     SUM 06:106            5.35     1.688    4.00  80.11    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
001:0023----------------------------------------------------------------------
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
------------------------
| ADD HYD (107        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 09:109            9.31      .284    5.03  62.88    .000
                    +ID2 01:101             .00      .000     .00    .00    .000  **DRY**
                    +ID3 06:106            5.35     1.688    4.00  80.11    .000
                     ============================================================
                     SUM 07:107           14.66     1.804    4.00  69.17    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
001:0024----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.14
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=       1.13          .01
     Dep. Storage      (mm)=       1.57         4.67
     Average Slope      (%)=        .50         2.00
     Length             (m)=      42.00        10.00
     Mannings n            =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       121.11
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.11 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                               *TOTALS*
```

```
     PEAK FLOW       (cms)=        .45          .00           .452 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.00          4.000
     RUNOFF VOLUME    (mm)=      92.32        34.43         91.748
     TOTAL RAINFALL   (mm)=      93.90        93.90         93.897
     RUNOFF COEFFICIENT   =        .98          .37           .977

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0025------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)    |    (cms)     (ha.m.)
                            .000  .0000E+00    |     .132  .5698E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >08: (108    )        1.14      .452     4.000     91.748
     OUTFLOW<09: (109    )        1.14      .109     4.250     91.748
    OVERFLOW<01: (101    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   24.173
                   TIME SHIFT OF PEAK FLOW         (min)=    15.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4702E-01

--------------------------------------------------------------------------------
001:0026------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.97
| 02:102    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.74         3.23
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.00         1.42
     Length            (m)=      57.00        57.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       119.37
                over (min)        2.00         9.00
     Storage Coeff.  (min)=       1.58 (ii)    9.46 (ii)
     Unit Hyd. Tpeak (min)=       2.00         9.00
     Unit Hyd. peak  (cms)=        .65          .12
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .69          .75          1.376 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.05          4.000
     RUNOFF VOLUME    (mm)=      92.32        34.43         54.697
     TOTAL RAINFALL   (mm)=      93.90        93.90         93.897
     RUNOFF COEFFICIENT   =        .98          .37           .583
```

```
          (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
               Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
               Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
         (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
              THAN THE STORAGE COEFFICIENT.
        (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0027------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (103        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 09:109            1.14      .109    4.25  91.75    .000
                     +ID2 01:101             .00      .000     .00    .00    .000  **DRY**
                     +ID3 02:102            4.97     1.376    4.00  54.70    .000
                      ==========================================================
                      SUM 03:103            6.11     1.473    4.00  61.61    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0028------------------------------------------------------------------------
 *
 *Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
 *
 ------------------------
 | ADD HYD (104        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 07:107           14.66     1.804    4.00  69.17    .000
                     +ID2 03:103            6.11     1.473    4.00  61.61    .000
                      ==========================================================
                      SUM 04:104           20.77     3.277    4.00  66.95    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0029------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 2: Building A, C, D, H, J
 *
 *Total Building Area - Includes Building A, C, D, H & J
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=    3.00
 | 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                                IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        2.97          .03
      Dep. Storage     (mm)=        1.57         4.67
      Average Slope     (%)=         .50         2.00
      Length            (m)=       42.00        10.00
      Mannings n          =         .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       121.11
                 over (min)        2.00         4.00
      Storage Coeff.  (min)=        1.62 (ii)    4.11 (ii)
      Unit Hyd. Tpeak (min)=        2.00         4.00
      Unit Hyd. peak  (cms)=         .64          .28
                                                               *TOTALS*
      PEAK FLOW       (cms)=        1.18          .01           1.188 (iii)
      TIME TO PEAK    (hrs)=        4.00         4.00           4.000
      RUNOFF VOLUME    (mm)=       92.33        34.43          91.748
      TOTAL RAINFALL   (mm)=       93.90        93.90          93.897
      RUNOFF COEFFICIENT   =         .98          .37            .977

          (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
               Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
               Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
```

```
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0030------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(105    )  |
| OUT<06:(106    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .285  .1501E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >05: (105    )      3.00     1.188     4.000     91.748
     OUTFLOW<06: (106    )      3.00      .250     4.267     91.748
    OVERFLOW<07: (107    )       .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.065
                  TIME SHIFT OF PEAK FLOW         (min)=    16.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.1317E+00

--------------------------------------------------------------------------------
001:0031------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots, Road
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    2.17
| 08:108    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.61          .56
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.92         2.00
     Length            (m)=     130.00        30.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       120.11
                over (min)        2.00         7.00
     Storage Coeff.  (min)=       2.13 (ii)    6.96 (ii)
     Unit Hyd. Tpeak (min)=       2.00         7.00
     Unit Hyd. peak  (cms)=        .54          .16
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .64          .15               .784 (iii)
     TIME TO PEAK    (hrs)=       4.00         4.03              4.000
     RUNOFF VOLUME    (mm)=      92.32        34.43             77.275
     TOTAL RAINFALL   (mm)=      93.90        93.90             93.897
     RUNOFF COEFFICIENT   =        .98          .37               .823

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0032------------------------------------------------------------------------
*
```

```
------------------------
| ADD HYD (109        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:106            3.00      .250    4.27  91.75    .000
                    +ID2 07:107             .00      .000     .00    .00    .000   **DRY**
                    +ID3 08:108            2.17      .784    4.00  77.27    .000
                     ============================================================
                     SUM 09:109            5.17     1.001    4.00  85.67    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0033-----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .49
| 01:101    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .32          .17
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.00         3.30
     Length            (m)=       7.50        30.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       120.80
                over (min)        1.00         5.00
     Storage Coeff.  (min)=        .38 (ii)    4.52 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.58          .24
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .13          .05            .180 (iii)
     TIME TO PEAK    (hrs)=       3.85         4.00           4.000
     RUNOFF VOLUME    (mm)=      92.33        34.43          72.643
     TOTAL RAINFALL   (mm)=      93.90        93.90          93.897
     RUNOFF COEFFICIENT   =        .98          .37            .774

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20      Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0034-----------------------------------------------------------------------------
*
*Flow Controlled to Pre-Development
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(101    )   |
| OUT<02:(102    )   |    =========  OUTFLOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)     (ha.m.)   |    (cms)     (ha.m.)
                             .000  .0000E+00    |     .079  .6500E-02

     ROUTING RESULTS              AREA     QPEAK      TPEAK        R.V.
     --------------------         (ha)     (cms)      (hrs)        (mm)
     INFLOW >01: (101    )         .49      .180      4.000      72.643
     OUTFLOW<02: (102    )         .44      .079      3.900      72.643
    OVERFLOW<03: (103    )         .05      .100      4.000      72.643

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =          1
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=        .12
                   PERCENTAGE OF TIME OVERFLOWING    (%)=        .82

```

```
                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   43.988
                   TIME SHIFT OF PEAK FLOW         (min)=    -6.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.6398E-02

--------------------------------------------------------------------------------
001:0035------------------------------------------------------------------------
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and C
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 09:109           5.17     1.001    4.00  85.67    .000
                    +ID2 02:102            .44      .079    3.90  72.64    .000
                    +ID3 03:103            .05      .100    4.00  72.64    .000
                     ============================================================
                     SUM 05:105           5.66     1.180    4.00  84.54    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0036------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.01
| 06:106    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                 IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.00           .01
     Dep. Storage     (mm)=        1.57          4.67
     Average Slope     (%)=         .50          2.00
     Length            (m)=       42.00         10.00
     Mannings n           =        .013          .200

     Max.eff.Inten.(mm/hr)=      142.89        121.11
                over (min)         2.00          4.00
     Storage Coeff.  (min)=        1.62 (ii)     4.11 (ii)
     Unit Hyd. Tpeak (min)=        2.00          4.00
     Unit Hyd. peak  (cms)=         .64           .28
                                                              *TOTALS*
     PEAK FLOW       (cms)=         .40           .00            .400 (iii)
     TIME TO PEAK    (hrs)=        4.00          4.00           4.000
     RUNOFF VOLUME    (mm)=       92.32         34.43          91.748
     TOTAL RAINFALL   (mm)=       93.90         93.90          93.897
     RUNOFF COEFFICIENT   =         .98           .37            .977

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0037------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>06:(106    )  |
| OUT<07:(107    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
```

```
                              .000  .0000E+00   |     .086  .4495E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >06: (106    )        1.01      .400     4.000     91.748
     OUTFLOW<07: (107    )        1.01      .084     4.267     91.747
    OVERFLOW<08: (108    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.094
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4432E-01

--------------------------------------------------------------------------------
001:0038------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.43
| 09:109    DT= 1.00  |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.61          1.82
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.89          1.61
     Length            (m)=     103.00         36.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        119.75
                over (min)        2.00          8.00
     Storage Coeff.  (min)=       1.86 (ii)     7.62 (ii)
     Unit Hyd. Tpeak (min)=       2.00          8.00
     Unit Hyd. peak  (cms)=        .58           .15
                                                             *TOTALS*
     PEAK FLOW       (cms)=       1.04           .46           1.481 (iii)
     TIME TO PEAK    (hrs)=       4.00          4.03           4.000
     RUNOFF VOLUME    (mm)=      92.32         34.43          68.591
     TOTAL RAINFALL   (mm)=      93.90         93.90          93.897
     RUNOFF COEFFICIENT   =        .98           .37            .730

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0039------------------------------------------------------------------------
*
------------------------
| ADD HYD (101       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 07:107           1.01      .084    4.27  91.75    .000
                    +ID2 08:108            .00      .000     .00    .00    .000  **DRY**
                    +ID3 09:109           4.43     1.481    4.00  68.59    .000
                     ============================================================
                     SUM 01:101           5.44     1.554    4.00  72.89    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0040------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
```

```
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.67
| 02:102    DT= 1.00 |   Total Imp(%)=   57.00   Dir. Conn.(%)=   57.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .95          .72
     Dep. Storage     (mm)=        1.57         4.67
     Average Slope     (%)=         .50         2.00
     Length            (m)=      113.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=      142.89       120.80
                over (min)         3.00         5.00
     Storage Coeff.  (min)=        2.93 (ii)    5.43 (ii)
     Unit Hyd. Tpeak (min)=        3.00         5.00
     Unit Hyd. peak  (cms)=         .38          .21
                                                                *TOTALS*
     PEAK FLOW       (cms)=         .38          .21             .587 (iii)
     TIME TO PEAK    (hrs)=        4.00         4.00            4.000
     RUNOFF VOLUME    (mm)=       92.32        34.43           67.433
     TOTAL RAINFALL   (mm)=       93.90        93.90           93.897
     RUNOFF COEFFICIENT   =         .98          .37             .718

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
001:0041-----------------------------------------------------------------------------
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .045  .1920E-01
                            .023  .3000E-03    |     .050  .3360E-01
                            .032  .2300E-02    |     .055  .4700E-01
                            .039  .8200E-02    |     .060  .5480E-01

     ROUTING RESULTS              AREA      QPEAK      TPEAK       R.V.
     --------------------         (ha)      (cms)      (hrs)       (mm)
     INFLOW >02: (102    )        1.67       .587      4.000     67.433
     OUTFLOW<03: (103    )        1.58       .060      4.167     67.433
    OVERFLOW<06: (106    )         .09       .138      4.167     67.433

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         3
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .28
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      2.15


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   10.223
                   TIME SHIFT OF PEAK FLOW         (min)=    10.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.5479E-01

-------------------------------------------------------------------------------------
001:0042-----------------------------------------------------------------------------
*
------------------------
| ADD HYD (107       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
```

```
                     ID1 03:103            1.58      .060    4.17   67.43     .000
                    +ID2 06:106             .09      .138    4.17   67.43     .000
                     ==========================================================
                     SUM 07:107            1.67      .198    4.17   67.43     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0043----------------------------------------------------------------------------
*
*Combine Subcatchment 3 & 9
*
------------------------
| ADD HYD (108        ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101            5.44     1.554    4.00   72.89     .000
                    +ID2 07:107            1.67      .198    4.17   67.43     .000
                     ==========================================================
                     SUM 08:108            7.11     1.605    4.00   71.61     .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------------
001:0044----------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.03
| 09:109    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .98          .05
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       3.23         1.24
     Length            (m)=      35.00       200.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89        91.56
                over (min)        1.00        20.00
     Storage Coeff.  (min)=        .83 (ii)   20.22 (ii)
     Unit Hyd. Tpeak (min)=       1.00        20.00
     Unit Hyd. peak  (cms)=       1.19          .06
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .39          .01           .392 (iii)
     TIME TO PEAK    (hrs)=       3.97         4.23          4.000
     RUNOFF VOLUME    (mm)=      92.33        34.43         89.432
     TOTAL RAINFALL   (mm)=      93.90        93.90         93.897
     RUNOFF COEFFICIENT   =        .98          .37           .952

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
001:0045----------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL      ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 04:104           20.77     3.277    4.00   66.95     .000
                    +ID2 05:105            5.66     1.180    4.00   84.54     .000
                    +ID3 08:108            7.11     1.605    4.00   71.61     .000
                    +ID4 09:109            1.03      .392    4.00   89.43     .000
```

```
                    ============================================================
                    SUM 01:TOTAL         34.57    6.454    4.00  71.46    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0046-----------------------------------------------------------------------------
*
      FINISH
-------------------------------------------------------------------------------------
*************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 12:10:55
=====================================================================================
```

```
2     Metric units
*#****************************************************************************
*#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
*#  Project Number : [2085345.16]
*#  Date           : 02-07-2014
*#  Revised        : 01-20-2015
*#  Revised        : 01-03-2017
*#  Revised        : 02-13-2018
*#  Revised         : 06-28-2018
*#  Revised         : 07-04-2018
*#  Revised         : 10-16-2018 - Revised as per the comments received from the
City
*#                                October 2018
*#  Modeller       : [SM]
*#  Company        : Morrison Hershfield Ltd
*#  License #      : 3573794
*#****************************************************************************
*
* Future Building S, Building C, Deficit
* Short Term Development  (Future HLE, Sports Complex Removed)
*
START               TIME = 0.0
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
CHICAGO STORM       IUNITS=[2], TD=[24](hrs), TPRAT=[0.333], CSDT=[15](min)
                    ICASEcs=[1], A=[1735.688], B=[6.014], C=[0.820]
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
```

```
                              F100Y24H
                            [   0.0 ,  0.0    ]
                            [0.00945,  0.00266]
                            [   -1  ,  -1     ]
                  IDovf=[3], NHYDovf=["103"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[4], NHYD=["104"], DT=[1](min), AREA=[1.60](ha),
                    XIMP=[0.01], TIMP=[0.01], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.76](%),
                                         LGP=[85](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.03](%),
                                         LGI=[37](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[2+3+4]
*
COMPUTE DUALHYD     IDin=[5], CINLET=[0.096](cms), NINLET=[1],
                    MAJID=[6], MajNHYD=["106"],
                    MINID=[7], MinNHYD=["107"],
                    TMJSTO=[70](cu-m)
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.67](ha),
                    XIMP=[0.90], TIMP=[0.90], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[4.03](%),
                                         LGP=[34](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchments 7 & 8
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[7+8]
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["101"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                            [   0.0 ,  0.0    ]
                            [ 0.096 ,  0.0175 ]
```

```
                              [   -1  ,  -1     ]
                    IDovf=[2], NHYDovf=["102"]
*
*SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.08](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[0.01](%),
                                         LGP=[40.](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.90](%),
                                         LGI=[140](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 6 and Overflows
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[6+2+3]
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                (cms) - (ha-m)
                              [   0.0 ,  0.0    ]
                              [0.00756,  0.00469]
                              [   -1  ,  -1     ]
                          IDovf=[2], NHYDovf=["102"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[3], NHYD=["103"], DT=[1](min), AREA=[3.82](ha),
                    XIMP=[0.20], TIMP=[0.20], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.04](%),
                                         LGP=[425](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.01](%),
                                         LGI=[0.01](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*Combine Subcatchments 5, 6, 7 & 8
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+4+5]
*
*Wetland Storage
*
*Controlled @ Proposed Outlet Structure
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [ 0.000 ,  0.0000 ]
                                    [ 0.023 ,  0.1100 ]
                                    [ 0.312 ,  0.3830 ]
                                    [   -1  ,  -1     ]
                          IDovf=[1], NHYDovf=["101"]
*
*SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S
Expansion and Parking Lot 7, 8 (south), 9 (southeast)
*
*Total Building Area - Includes Building N, P, S & Salt Storage Sheds
*
*No roof storage was assumed for the Future Building S Expansion
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.05](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estimated
*
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
```

```
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08505,  0.05115]
                                    [   -1  ,  -1     ]
                          IDovf=[4], NHYDovf=["104"]
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S
Expansion
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[4.30](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[15.38](%),
                                         LGP=[13](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.43](%),
                                         LGI=[116](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[6], NHYD=["106"], IDs to add=[3+4+5]
*
*Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[9+1+6]
*
*SUBCATCHMENT AREA 1: Building B, K, M & T
*
*Total Building Area - Includes Building B, K, M & T
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[1.14](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[9],   NHYD=["109"],  IDin=[8],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
```

```
                              F100Y24H
                          [0.13230,  0.05698]
                          [   -1  ,   -1     ]
                    IDovf=[1], NHYDovf=["101"]
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[4.97](ha),
                    XIMP=[0.35], TIMP=[0.35], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.42](%),
                                         LGP=[57](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.00](%),
                                         LGI=[57](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[3], NHYD=["103"], IDs to add=[9+1+2]
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
ADD HYD             IDsum=[4], NHYD=["104"], IDs to add=[7+3]
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
CALIB STANDHYD      ID=[5], NHYD=["105"], DT=[1](min), AREA=[3.00](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[6],   NHYD=["106"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [0.28539,  0.15012]
                                  [   -1  ,   -1     ]
                          IDovf=[7], NHYDovf=["107"]

*Remaining Area - Includes Grass, Parking Lots, Road
```

```
*
CALIB STANDHYD      ID=[8], NHYD=["108"], DT=[1](min), AREA=[2.17](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2.00](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.92](%),
                                         LGI=[130](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[9], NHYD=["109"], IDs to add=[6+7+8]
*
*SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.49](ha),
                    XIMP=[0.66], TIMP=[0.66], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[3.30](%),
                                         LGP=[30](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[2.00](%),
                                         LGI=[7.5](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Flow Controlled to Pre-Development
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["102"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.079 ,  0.0065 ]
                                  [   -1  ,  -1     ]
                          IDovf=[3], NHYDovf=["103"]
*
*Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and
Courtyard
*
ADD HYD             IDsum=[5], NHYD=["105"], IDs to add=[9+2+3]
*
*SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
(northwest) & 11
*
*Total Building Area - Includes Building F, G, R1, R2 & R3
*
CALIB STANDHYD      ID=[6], NHYD=["106"], DT=[1](min), AREA=[1.01](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[1],
```

```
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[42](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Roof storage volume and release rate were estiamted
*
ROUTE RESERVOIR     IDout=[7],   NHYD=["107"],  IDin=[6],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0 ,  0.0    ]
                                    [0.08562,  0.04495]
                                    [   -1  ,  -1     ]
                          IDovf=[8], NHYDovf=["108"]

*Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[4.43](ha),
                    XIMP=[0.59], TIMP=[0.59], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.61](%),
                                         LGP=[36](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[1.89](%),
                                         LGI=[103](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
ADD HYD             IDsum=[1], NHYD=["101"], IDs to add=[7+8+9]
*
*SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
*
*Area controlled to 60L/s to meet Pinecrest Creek Criteria
*SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
*
CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[1.67](ha),
                    XIMP=[0.57], TIMP=[0.57], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[2](%),
                                         LGP=[10](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[0.5](%),
                                         LGI=[113](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
```

```
ROUTE RESERVOIR     IDout=[3],   NHYD=["103"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0    ]
                                  [ 0.023 ,  0.0003 ]
                                  [ 0.032 ,  0.0023 ]
                                  [ 0.039 ,  0.0082 ]
                                  [ 0.045 ,  0.0192 ]
                                  [ 0.050 ,  0.0336 ]
                                  [ 0.055 ,  0.0470 ]
                                  [ 0.060 ,  0.0548 ]
                                  [   -1  ,    -1   ]
                          IDovf=[6], NHYDovf=["106"]
*
ADD HYD             IDsum=[7], NHYD=["107"], IDs to add=[3+6]
*
*Combine Subcatchment 3 & 9
*
ADD HYD             IDsum=[8], NHYD=["108"], IDs to add=[1+7]
*
*SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
*
CALIB STANDHYD      ID=[9], NHYD=["109"], DT=[1](min), AREA=[1.03](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[1],
                    Horton: Fo=[76.2](mm/hr), Fc=[13.2](mm/hr),
                            DCAY=[4.14](/hr), F=[0](mm),
                    Pervious   surfaces: IAper=[4.67](mm), SLPP=[1.24](%),
                                         LGP=[200](m), MNP=[0.2], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.57](mm), SLPI=[3.23](%),
                                         LGI=[35](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
ADD HYD             IDsum=[1], NHYD=["TOTAL"], IDs to add=[4+5+8+9]
*
*%-----------------|-----------------------------------------------------------|
FINISH
```

```
 =================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S       W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9    =========
                                                       9   9  9   9   # 3573794
        StormWater Management HYdrologic Model           999    999    =========

  *******************************************************************************
  ***************************** SWMHYMO Ver/4.05  ******************************
  *********  A single event and continuous hydrologic simulation model  *********
  *********     based on the principles of HYMO and its successors     *********
  *********                  OTTHYMO-83 and OTTHYMO-89.                *********
  *******************************************************************************
  ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
  *********                  Ottawa,  Ontario: (613) 836-3884          *********
  *********                  Gatineau, Quebec: (819) 243-6858          *********
  *********                  E-Mail: swmhymo@jfsa.Com                  *********
  *******************************************************************************

  +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  +++++++++ Licensed user: Morrison Hershfield Ltd.                     +++++++++
  +++++++++                Ottawa                SERIAL#:3573794        +++++++++
  +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

  *******************************************************************************
  *********            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *********
  *********            Maximum value for ID numbers  :     10          *********
  *********            Max. number of rainfall points: 105408          *********
  *********            Max. number of flow points    : 105408          *********
  *******************************************************************************


  *********************   D E T A I L E D   O U T P U T   *********************
  *******************************************************************************
  *         DATE: 2018-10-19     TIME: 12:11:02     RUN COUNTER: 000301         *
  *******************************************************************************
  * Input   filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F100Y24H.DAT          *
  * Output  filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F100Y24H.out          *
  * Summary filename: C:\SWMHYMO\Projects\Algon\OCTOBE~1\F100Y24H.sum          *
  * User comments:                                                              *
  * 1:__________________________________________________________________________*
  * 2:__________________________________________________________________________*
  * 3:__________________________________________________________________________*
  *******************************************************************************

 ----------------------------------------------------------------------------------
 001:0001--------------------------------------------------------------------------
 *#******************************************************************************
 *#  Project Name   : [Algonquin Woodroffe Campus SWM Master Plan]
 *#  Project Number : [2085345.16]
 *#  Date           : 02-07-2014
 *#  Revised        : 01-20-2015
 *#  Revised        : 01-03-2017
 *#  Revised        : 02-13-2018
 *#  Revised         : 06-28-2018
 *#  Revised     : 07-04-2018
 *#  Revised         : 10-16-2018 - Revised as per the comments received from the Ci
 *#                                 October 2018
 *#  Modeller       : [SM]
 *#  Company        : Morrison Hershfield Ltd
 *#  License #      : 3573794
 *#******************************************************************************
 *
 * Future Building S, Building C, Deficit
 * Short Term Development  (Future HLE, Sports Complex Removed)
 *
```

```
--------------------
| START            |  Project  dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
--------------------  Rainfall dir.:
C:\SWMHYMO\Projects\Algon\OCTOBE~1\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
--------------------------------------------------------------------------------
001:0002------------------------------------------------------------------------
*
* 5 Year Storm IDF Curve (City of Ottawa Sewer Design Guidelines, 2012)
*
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1735.688
| Ptotal=106.74 mm |                          B=   6.014
--------------------                          C=    .820
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 24.00 hrs
                        Storm time step    = 15.00 min
                        Time to peak ratio =   .33

              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .25    .841 |   6.25   3.051 |  12.25   2.498 |  18.25   1.182
               .50    .864 |   6.50   3.514 |  12.50   2.378 |  18.50   1.158
               .75    .889 |   6.75   4.164 |  12.75   2.270 |  18.75   1.135
              1.00    .916 |   7.00   5.156 |  13.00   2.172 |  19.00   1.114
              1.25    .945 |   7.25   6.869 |  13.25   2.083 |  19.25   1.093
              1.50    .975 |   7.50  10.626 |  13.50   2.002 |  19.50   1.073
              1.75   1.008 |   7.75  26.882 |  13.75   1.927 |  19.75   1.054
              2.00   1.043 |   8.00 142.894 |  14.00   1.858 |  20.00   1.035
              2.25   1.082 |   8.25  35.856 |  14.25   1.795 |  20.25   1.018
              2.50   1.123 |   8.50  17.946 |  14.50   1.736 |  20.50   1.001
              2.75   1.168 |   8.75  12.089 |  14.75   1.681 |  20.75    .984
              3.00   1.218 |   9.00   9.189 |  15.00   1.630 |  21.00    .968
              3.25   1.272 |   9.25   7.456 |  15.25   1.582 |  21.25    .953
              3.50   1.332 |   9.50   6.300 |  15.50   1.538 |  21.50    .938
              3.75   1.399 |   9.75   5.474 |  15.75   1.496 |  21.75    .924
              4.00   1.474 |  10.00   4.851 |  16.00   1.456 |  22.00    .910
              4.25   1.558 |  10.25   4.365 |  16.25   1.419 |  22.25    .897
              4.50   1.654 |  10.50   3.974 |  16.50   1.383 |  22.50    .884
              4.75   1.763 |  10.75   3.653 |  16.75   1.350 |  22.75    .871
              5.00   1.890 |  11.00   3.383 |  17.00   1.318 |  23.00    .859
              5.25   2.040 |  11.25   3.154 |  17.25   1.288 |  23.25    .848
              5.50   2.218 |  11.50   2.956 |  17.50   1.260 |  23.50    .836
              5.75   2.435 |  11.75   2.784 |  17.75   1.232 |  23.75    .825
              6.00   2.705 |  12.00   2.633 |  18.00   1.206 |  24.00    .814

--------------------------------------------------------------------------------
001:0003------------------------------------------------------------------------
*
*SUBCATCHMENT AREA 8: Building Z and Sport Field
*
*Total Building Area - Includes Building Z
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .05
| 01:101    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05           .00
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n          =        .013          .200
```

```
     Max.eff.Inten.(mm/hr)=     142.89       125.58
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.07 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .02          .00           .020 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.00          8.000
     RUNOFF VOLUME    (mm)=     105.17        37.09        104.491
     TOTAL RAINFALL   (mm)=     106.74       106.74        106.742
     RUNOFF COEFFICIENT   =        .99          .35           .979

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0004------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(101    )  |
| OUT<02:(102    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .009  .2660E-02

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (101    )        .05      .020     8.000    104.491
     OUTFLOW<02: (102    )        .05      .006     8.083    104.491
    OVERFLOW<03: (103    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.683
                   TIME SHIFT OF PEAK FLOW         (min)=     5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1824E-02

--------------------------------------------------------------------------------
001:0005------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    1.60
| 04:104    DT= 1.00 |   Total Imp(%)=    1.00   Dir. Conn.(%)=    1.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02         1.58
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.03         1.76
     Length            (m)=      37.00        85.00
     Mannings n          =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       124.55
                over (min)        1.00        10.00
     Storage Coeff.  (min)=        .99 (ii)   10.22 (ii)
     Unit Hyd. Tpeak (min)=       1.00        10.00
     Unit Hyd. peak  (cms)=       1.08          .11
                                                           *TOTALS*
```

```
     PEAK FLOW       (cms)=        .01          .37           .372 (iii)
     TIME TO PEAK    (hrs)=       7.93         8.07          8.067
     RUNOFF VOLUME    (mm)=     105.17        37.09         37.775
     TOTAL RAINFALL   (mm)=     106.74       106.74        106.742
     RUNOFF COEFFICIENT   =        .99          .35           .354
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

----------------------------------------------------------------------------
001:0006--------------------------------------------------------------------
*
------------------------
| ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 02:102            .05      .006     8.08 104.49    .000
                    +ID2 03:103            .00      .000      .00    .00    .000  **DRY**
                    +ID3 04:104           1.60      .372     8.07  37.77    .000
                     ============================================================
                     SUM 05:105           1.65      .379     8.07  39.80    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

----------------------------------------------------------------------------
001:0007--------------------------------------------------------------------
*
----------------------
| COMPUTE DUALHYD    |    Average inlet capacities   [CINLET] =    .096  (cms)
| TotalHyd 05:105    |    Number of inlets in system [NINLET] =      1
----------------------    Total minor system capacity         =    .096  (cms)
                          Total major system storage [TMJSTO] =      70.(cu.m.)

                  ID: NHYD         AREA     QPEAK     TPEAK     R.V.      DWF
                                   (ha)     (cms)     (hrs)     (mm)     (cms)
     TOTAL HYD.   05:105           1.65      .379     8.067   39.797     .000
     ======================================================================
     MAJOR SYST   06:106            .63      .283     8.067   39.797     .000
     MINOR SYST   07:107           1.02      .096     8.850   40.066     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

     Maximum MAJOR SYSTEM storage used =      70.(cu.m.)

----------------------------------------------------------------------------
001:0008--------------------------------------------------------------------
*
*SUBCATCHMENT AREA 7: North East Parking Lot
*
----------------------
| CALIB STANDHYD     |    Area    (ha)=     .67
| 08:108    DT= 1.00 |    Total Imp(%)=   90.00   Dir. Conn.(%)=   90.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .60          .07
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.00         4.03
     Length            (m)=      25.00        34.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       125.43
                over (min)        1.00         5.00
     Storage Coeff.  (min)=        .78 (ii)     4.93 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
```

```
      Unit Hyd. peak  (cms)=       1.23          .23
                                                           *TOTALS*
      PEAK FLOW       (cms)=        .24          .02           .261 (iii)
      TIME TO PEAK    (hrs)=       7.95         8.00          8.000
      RUNOFF VOLUME    (mm)=     105.17        37.09         98.364
      TOTAL RAINFALL   (mm)=     106.74       106.74        106.742
      RUNOFF COEFFICIENT   =        .99          .35           .922

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0009------------------------------------------------------------------------
 *
 *Combine Subcatchments 7 & 8
 *
 ------------------------
 | ADD HYD (109        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                      ID1 07:107             1.02      .096     8.85  40.07    .000
                     +ID2 08:108              .67      .261     8.00  98.36    .000
                      ============================================================
                      SUM 09:109             1.69      .357     8.00  63.20    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0010------------------------------------------------------------------------
 *
 *Flow Controlled to Pre-Development
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>09:(109    )  |
 | OUT<01:(101    )  |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .096  .1750E-01

      ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
      --------------------         (ha)     (cms)     (hrs)       (mm)
      INFLOW >09: (109    )        1.69      .357     8.000     63.202
      OUTFLOW<01: (101    )        1.34      .096     7.917     63.203
     OVERFLOW<02: (102    )         .35      .260     8.000     63.202

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         2
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .93
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      3.10


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   26.917
                    TIME SHIFT OF PEAK FLOW          (min)=    -5.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1753E-01

 --------------------------------------------------------------------------------
 001:0011------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 6: Existing Parking Lot 9 & 12
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    3.08
 | 03:103    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                                IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       3.05          .03
```

```
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.90           .01
     Length            (m)=     140.00         40.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=     142.89         53.67
                over (min)        2.00         41.00
     Storage Coeff.  (min)=       2.24 (ii)    41.05 (ii)
     Unit Hyd. Tpeak (min)=       2.00         41.00
     Unit Hyd. peak  (cms)=        .52           .03
                                                                *TOTALS*
     PEAK FLOW       (cms)=       1.21           .00              1.209 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.58              8.000
     RUNOFF VOLUME    (mm)=     105.17         37.09            104.491
     TOTAL RAINFALL   (mm)=     106.74        106.74            106.742
     RUNOFF COEFFICIENT  =         .99           .35               .979

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20      Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0012-----------------------------------------------------------------------
*
*Combine Subcatchment 6 and Overflows
*
------------------------
| ADD HYD (104        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)    (hrs)   (mm)   (cms)
                     ID1 06:106             .63      .283     8.07  39.80    .000
                    +ID2 02:102             .35      .260     8.00  63.20    .000
                    +ID3 03:103            3.08     1.209     8.00 104.49    .000
                     ============================================================
                     SUM 04:104            4.06     1.528     8.02  90.90    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0013-----------------------------------------------------------------------
*
*SUBCATCHMENT AREA 5: Building V and Snow Dump
*
*Total Building Area - Includes Building V
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .09
| 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09           .00
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=        .50          2.00
     Length            (m)=      42.00         10.00
     Mannings n          =        .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        125.58
                over (min)        2.00          4.00
     Storage Coeff.  (min)=       1.62 (ii)     4.07 (ii)
     Unit Hyd. Tpeak (min)=       2.00          4.00
     Unit Hyd. peak  (cms)=        .64           .28
                                                                *TOTALS*
     PEAK FLOW       (cms)=        .04           .00               .036 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.00              8.000
     RUNOFF VOLUME    (mm)=     105.17         37.09            104.491
     TOTAL RAINFALL   (mm)=     106.74        106.74            106.742
     RUNOFF COEFFICIENT  =         .99           .35               .979
```

```
        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------------------
 001:0014--------------------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estimated
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>08:(108    )  |
 | OUT<09:(109    )  |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .008  .4690E-02

      ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
      --------------------         (ha)     (cms)     (hrs)       (mm)
      INFLOW >08: (108    )         .09      .036     8.000    104.491
      OUTFLOW<09: (109    )         .09      .007     8.283    104.491
     OVERFLOW<02: (102    )         .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   18.821
                    TIME SHIFT OF PEAK FLOW         (min)=    17.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.4165E-02

 ----------------------------------------------------------------------------------------
 001:0015--------------------------------------------------------------------------------
 *
 *Remaining Area - Includes Grass, Parking Lots and Roads
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    3.82
 | 03:103    DT= 1.00 |   Total Imp(%)=   20.00   Dir. Conn.(%)=   20.00
 ----------------------
                                   IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=          .76          3.06
      Dep. Storage     (mm)=         1.57          4.67
      Average Slope     (%)=          .01          2.04
      Length            (m)=          .01        425.00
      Mannings n          =          .013          .200

      Max.eff.Inten.(mm/hr)=       142.89         73.67
                 over (min)         1.00         29.00
      Storage Coeff.  (min)=          .04 (ii)    28.66 (ii)
      Unit Hyd. Tpeak (min)=         1.00         29.00
      Unit Hyd. peak  (cms)=         1.70           .04
                                                                *TOTALS*
      PEAK FLOW       (cms)=          .30           .35            .404 (iii)
      TIME TO PEAK    (hrs)=         7.78          8.38           8.000
      RUNOFF VOLUME    (mm)=       105.17         37.09          50.710
      TOTAL RAINFALL   (mm)=       106.74        106.74         106.742
      RUNOFF COEFFICIENT   =          .99           .35            .475

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
```

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

 --------------------------------------------------------------------------------
 001:0016------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (105        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.     DWF
 ------------------------                   (ha)     (cms)    (hrs)   (mm)    (cms)
                      ID1 09:109             .09      .007     8.28 104.49     .000
                     +ID2 02:102             .00      .000      .00    .00     .000   **DRY**
                     +ID3 03:103            3.82      .404     8.00  50.71     .000
                      ===========================================================
                      SUM 05:105            3.91      .410     8.00  51.95     .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0017------------------------------------------------------------------------
 *
 *Combine Subcatchments 5, 6, 7 & 8
 *
 ------------------------
 | ADD HYD (108        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.     DWF
 ------------------------                   (ha)     (cms)    (hrs)   (mm)    (cms)
                      ID1 01:101            1.34      .096     7.92  63.20     .000
                     +ID2 04:104            4.06     1.528     8.02  90.90     .000
                     +ID3 05:105            3.91      .410     8.00  51.95     .000
                      ===========================================================
                      SUM 08:108            9.31     2.034     8.00  70.55     .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0018------------------------------------------------------------------------
 *
 *Wetland Storage
 *
 *Controlled @ Proposed Outlet Structure
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>08:(108    )  |
 | OUT<09:(109    )  |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .312  .3830E+00
                             .023  .1100E+00    |     .000  .0000E+00

      ROUTING RESULTS              AREA     QPEAK     TPEAK        R.V.
      --------------------         (ha)     (cms)     (hrs)        (mm)
      INFLOW >08: (108    )        9.31     2.034     8.000      70.547
      OUTFLOW<09: (109    )        9.31      .304     9.017      70.546
     OVERFLOW<01: (101    )         .00      .000      .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   14.948
                   TIME SHIFT OF PEAK FLOW         (min)=    61.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3755E+00

 --------------------------------------------------------------------------------
 001:0019------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 4: Building N, P, S, Salt Storage Shed, & Future Building S E
 *
 *Total Building Area - Includes Building N, P, S & Salt Storage Sheds
```

```
*
*No roof storage was assumed for the Future Building S Expansion
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    1.05
| 02:102    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.04          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =        .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       125.58
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.07 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .41          .00            .416 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.00           8.000
     RUNOFF VOLUME    (mm)=     105.17        37.09         104.491
     TOTAL RAINFALL   (mm)=     106.74       106.74         106.742
     RUNOFF COEFFICIENT   =        .99          .35            .979

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20      Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0020------------------------------------------------------------------------
*
*Roof storage volume and release rate were estimated
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(102    )  |
| OUT<03:(103    )  |    =========  OUTFLOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .085  .5115E-01

     ROUTING RESULTS              AREA     QPEAK     TPEAK       R.V.
     --------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (102    )        1.05      .416     8.000    104.491
     OUTFLOW<03: (103    )        1.05      .080     8.283    104.491
    OVERFLOW<04: (104    )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.248
                   TIME SHIFT OF PEAK FLOW         (min)=    17.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4818E-01

--------------------------------------------------------------------------------
001:0021------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots, Roads and Future Building S Expa
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=    4.30
| 05:105    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
```

```
 ----------------------
                                    IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        3.18          1.12
      Dep. Storage     (mm)=        1.57          4.67
      Average Slope     (%)=        1.43         15.38
      Length            (m)=      116.00         13.00
      Mannings n          =         .013          .200

      Max.eff.Inten.(mm/hr)=      142.89        125.58
                 over (min)         2.00          4.00
      Storage Coeff.  (min)=        2.17 (ii)     3.73 (ii)
      Unit Hyd. Tpeak (min)=        2.00          4.00
      Unit Hyd. peak  (cms)=         .53           .30
                                                          *TOTALS*
      PEAK FLOW       (cms)=        1.26           .38       1.637 (iii)
      TIME TO PEAK    (hrs)=        8.00          8.00       8.000
      RUNOFF VOLUME    (mm)=      105.17         37.09      87.472
      TOTAL RAINFALL   (mm)=      106.74        106.74     106.742
      RUNOFF COEFFICIENT   =         .99           .35        .819

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------------
 001:0022--------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (106        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 03:103            1.05      .080    8.28 104.49    .000
                     +ID2 04:104             .00      .000     .00    .00    .000  **DRY**
                     +ID3 05:105            4.30     1.637    8.00  87.47    .000
                      ============================================================
                      SUM 06:106            5.35     1.706    8.00  90.81    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------------
 001:0023--------------------------------------------------------------------------
 *
 *Combine Subcatchment 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
 *
 ------------------------
 | ADD HYD (107        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 09:109            9.31      .304    9.02  70.55    .000
                     +ID2 01:101             .00      .000     .00    .00    .000  **DRY**
                     +ID3 06:106            5.35     1.706    8.00  90.81    .000
                      ============================================================
                      SUM 07:107           14.66     1.837    8.00  77.94    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------------
 001:0024--------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 1: Building B, K, M & T
 *
 *Total Building Area - Includes Building B, K, M & T
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.14
 | 08:108    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                                    IMPERVIOUS    PERVIOUS (i)
```

```
     Surface Area     (ha)=       1.13          .01
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=        .50         2.00
     Length            (m)=      42.00        10.00
     Mannings n          =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       125.58
                over (min)        2.00         4.00
     Storage Coeff.  (min)=       1.62 (ii)    4.07 (ii)
     Unit Hyd. Tpeak (min)=       2.00         4.00
     Unit Hyd. peak  (cms)=        .64          .28
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .45          .00           .452 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.00          8.000
     RUNOFF VOLUME    (mm)=     105.17        37.09        104.491
     TOTAL RAINFALL   (mm)=     106.74       106.74        106.742
     RUNOFF COEFFICIENT   =        .99          .35           .979

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=    .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0025------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>08:(108    )  |
| OUT<09:(109    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)  |    (cms)     (ha.m.)
                            .000  .0000E+00   |     .132  .5698E-01

     ROUTING RESULTS              AREA      QPEAK     TPEAK        R.V.
     --------------------         (ha)      (cms)     (hrs)        (mm)
     INFLOW >08: (108    )        1.14       .452     8.000     104.491
     OUTFLOW<09: (109    )        1.14       .109     8.250     104.491
    OVERFLOW<01: (101    )         .00       .000      .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   24.238
                   TIME SHIFT OF PEAK FLOW         (min)=    15.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.4717E-01

--------------------------------------------------------------------------------
001:0026------------------------------------------------------------------------
*
*Remaining Area - Includes Grass, Parking Lots and Roads
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    4.97
| 02:102    DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.74         3.23
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.00         1.42
     Length            (m)=      57.00        57.00
     Mannings n          =       .013         .200
```

```
    Max.eff.Inten.(mm/hr)=     142.89       124.74
               over (min)        2.00         9.00
    Storage Coeff.  (min)=       1.58 (ii)    9.33 (ii)
    Unit Hyd. Tpeak (min)=       2.00         9.00
    Unit Hyd. peak  (cms)=        .65          .12
                                                          *TOTALS*
    PEAK FLOW       (cms)=        .69          .80          1.427 (iii)
    TIME TO PEAK    (hrs)=       8.00         8.05          8.000
    RUNOFF VOLUME    (mm)=     105.17        37.09         60.921
    TOTAL RAINFALL   (mm)=     106.74       106.74        106.742
    RUNOFF COEFFICIENT   =        .99          .35           .571

      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
           Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0027---------------------------------------------------------------------
*
------------------------
| ADD HYD (103       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.     DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 09:109           1.14      .109    8.25 104.49    .000
                    +ID2 01:101            .00      .000     .00    .00    .000  **DRY**
                    +ID3 02:102           4.97     1.427    8.00  60.92    .000
                     ============================================================
                     SUM 03:103           6.11     1.524    8.00  69.05    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0028---------------------------------------------------------------------
*
*Combine Subcatchments 1, 4 and Wetland Subcatchemnts (5, 6, 7 & 8)
*
------------------------
| ADD HYD (104       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.     DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 07:107          14.66     1.837    8.00  77.94    .000
                    +ID2 03:103           6.11     1.524    8.00  69.05    .000
                     ============================================================
                     SUM 04:104          20.77     3.361    8.00  75.32    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0029---------------------------------------------------------------------
*
*SUBCATCHMENT AREA 2: Building A, C, D, H, J
*
*Total Building Area - Includes Building A, C, D, H & J
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.00
| 05:105    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=       2.97          .03
    Dep. Storage     (mm)=       1.57         4.67
    Average Slope     (%)=        .50         2.00
    Length            (m)=      42.00        10.00
    Mannings n          =       .013         .200

    Max.eff.Inten.(mm/hr)=     142.89       125.58
               over (min)        2.00         4.00
    Storage Coeff.  (min)=       1.62 (ii)    4.07 (ii)
```

```
     Unit Hyd. Tpeak (min)=       2.00          4.00
     Unit Hyd. peak  (cms)=        .64           .28
                                                              *TOTALS*
     PEAK FLOW       (cms)=       1.18           .01            1.189 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.00            8.000
     RUNOFF VOLUME    (mm)=     105.17         37.09          104.491
     TOTAL RAINFALL   (mm)=     106.74        106.74          106.742
     RUNOFF COEFFICIENT   =        .99           .35             .979

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0030------------------------------------------------------------------------
*
*Roof storage volume and release rate were estiamted
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(105    )  |
| OUT<06:(106    )  |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00    |     .285  .1501E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >05: (105    )       3.00     1.189     8.000    104.491
     OUTFLOW<06: (106    )       3.00      .252     8.267    104.491
    OVERFLOW<07: (107    )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.163
                   TIME SHIFT OF PEAK FLOW         (min)=    16.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1324E+00

--------------------------------------------------------------------------------
001:0031------------------------------------------------------------------------
*Remaining Area - Includes Grass, Parking Lots, Road
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    2.17
| 08:108    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.61           .56
     Dep. Storage     (mm)=       1.57          4.67
     Average Slope     (%)=       1.92          2.00
     Length            (m)=     130.00         30.00
     Mannings n           =       .013          .200

     Max.eff.Inten.(mm/hr)=     142.89        125.10
                over (min)        2.00          7.00
     Storage Coeff.  (min)=       2.13 (ii)     6.88 (ii)
     Unit Hyd. Tpeak (min)=       2.00          7.00
     Unit Hyd. peak  (cms)=        .54           .16
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .64           .16             .793 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.03            8.000
     RUNOFF VOLUME    (mm)=     105.17         37.09           87.472
     TOTAL RAINFALL   (mm)=     106.74        106.74          106.742
```

```
     RUNOFF COEFFICIENT   =        .99          .35           .819

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0032---------------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (109        ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 06:106          3.00      .252    8.27 104.49    .000
                     +ID2 07:107           .00      .000     .00    .00    .000  **DRY**
                     +ID3 08:108          2.17      .793    8.00  87.47    .000
                      ============================================================
                      SUM 09:109          5.17     1.012    8.00  97.35    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------------
 001:0033---------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 2: Building C Expansion and Courtyard
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=     .49
 | 01:101    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .32          .17
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       2.00         3.30
     Length            (m)=       7.50        30.00
     Mannings n           =       .013         .200

     Max.eff.Inten.(mm/hr)=     142.89       125.58
                over (min)        1.00         4.00
     Storage Coeff.  (min)=        .38 (ii)    4.46 (ii)
     Unit Hyd. Tpeak (min)=       1.00         4.00
     Unit Hyd. peak  (cms)=       1.58          .26
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .13          .05           .183 (iii)
     TIME TO PEAK    (hrs)=       7.87         8.00          8.000
     RUNOFF VOLUME    (mm)=     105.17        37.09         82.026
     TOTAL RAINFALL   (mm)=     106.74       106.74        106.742
     RUNOFF COEFFICIENT   =        .99          .35           .768

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0034---------------------------------------------------------------------------
 *
 *Flow Controlled to Pre-Development
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>01:(101    )  |
 | OUT<02:(102    )  |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
```

```
                                .000  .0000E+00   |     .079  .6500E-02

      ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
      --------------------        (ha)     (cms)     (hrs)       (mm)
      INFLOW >01: (101    )        .49      .183     8.000     82.026
      OUTFLOW<02: (102    )        .43      .079     7.900     82.025
     OVERFLOW<03: (103    )        .06      .104     8.000     82.026

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        1
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .13
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .51


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   43.182
                    TIME SHIFT OF PEAK FLOW          (min)=    -6.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.6264E-02

 --------------------------------------------------------------------------------
 001:0035--------------------------------------------------------------------------
 *
 *Combine Subcatchment 2: Building A, C, D, H, & J and Building C Expansion and C
 *
 ------------------------
 | ADD HYD (105       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 09:109          5.17     1.012    8.00  97.35    .000
                     +ID2 02:102           .43      .079    7.90  82.03    .000
                     +ID3 03:103           .06      .104    8.00  82.03    .000
                      ============================================================
                      SUM 05:105          5.66     1.195    8.00  96.02    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0036--------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 3: Building F, G, R1, R2, R3 and Parking Lot 5, 8 (north), 9
 *
 *Total Building Area - Includes Building F, G, R1, R2 & R3
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.01
 | 06:106    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
 ----------------------
                                IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       1.00          .01
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=        .50         2.00
      Length            (m)=      42.00        10.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       125.58
                 over (min)        2.00         4.00
      Storage Coeff.  (min)=       1.62 (ii)    4.07 (ii)
      Unit Hyd. Tpeak (min)=       2.00         4.00
      Unit Hyd. peak  (cms)=        .64          .28
                                                             *TOTALS*
      PEAK FLOW       (cms)=        .40          .00            .400 (iii)
      TIME TO PEAK    (hrs)=       8.00         8.00           8.000
      RUNOFF VOLUME    (mm)=     105.17        37.09         104.491
      TOTAL RAINFALL   (mm)=     106.74       106.74         106.742
      RUNOFF COEFFICIENT  =         .99          .35            .979

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```

 ------------------------------------------------------------------------------
 001:0037----------------------------------------------------------------------
 *
 *Roof storage volume and release rate were estiamted
 *
 ---------------------
 | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
 |  IN>06:(106    )  |
 | OUT<07:(107    )  |    =========  OUTLFOW STORAGE TABLE  =========
 ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .086  .4495E-01

      ROUTING RESULTS                AREA     QPEAK     TPEAK       R.V.
      --------------------           (ha)     (cms)     (hrs)       (mm)
      INFLOW >06: (106    )          1.01      .400     8.000    104.491
      OUTFLOW<07: (107    )          1.01      .085     8.267    104.491
     OVERFLOW<08: (108    )           .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.192
                    TIME SHIFT OF PEAK FLOW          (min)=    16.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.4454E-01

 ------------------------------------------------------------------------------
 001:0038----------------------------------------------------------------------
 *Remaining Area - Includes Grass, Parking Lots, Roads and Future Sports Complex
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    4.43
 | 09:109    DT= 1.00 |   Total Imp(%)=   59.00   Dir. Conn.(%)=   59.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       2.61         1.82
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=       1.89         1.61
      Length            (m)=     103.00        36.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=     142.89       124.93
                 over (min)        2.00         8.00
      Storage Coeff.  (min)=       1.86 (ii)    7.52 (ii)
      Unit Hyd. Tpeak (min)=       2.00         8.00
      Unit Hyd. peak  (cms)=        .58          .15
                                                               *TOTALS*
      PEAK FLOW       (cms)=       1.04          .49          1.511 (iii)
      TIME TO PEAK    (hrs)=       8.00         8.03          8.000
      RUNOFF VOLUME    (mm)=     105.17        37.09         77.260
      TOTAL RAINFALL   (mm)=     106.74       106.74        106.742
      RUNOFF COEFFICIENT   =        .99          .35           .724

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0039----------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (101       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
```

```
                      ID1 07:107            1.01      .085     8.27 104.49     .000
                     +ID2 08:108             .00      .000      .00    .00     .000  **DRY**
                     +ID3 09:109            4.43     1.511     8.00  77.26     .000
                      ===========================================================
                      SUM 01:101            5.44     1.585     8.00  82.32     .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------------
 001:0040----------------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 9: Student Commons Building Site (Building E)
 *
 *Area controlled to 60L/s to meet Pinecrest Creek Criteria
 *SWM Servicing Report Student Commons Building prepared by IBI Group May 2011
 *
 ----------------------
 | CALIB STANDHYD      |    Area     (ha)=     1.67
 | 02:102    DT= 1.00 |    Total Imp(%)=    57.00   Dir. Conn.(%)=   57.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=          .95           .72
      Dep. Storage     (mm)=         1.57          4.67
      Average Slope     (%)=          .50          2.00
      Length            (m)=       113.00         10.00
      Mannings n          =          .013          .200

      Max.eff.Inten.(mm/hr)=       142.89        125.43
                 over (min)          3.00          5.00
      Storage Coeff.  (min)=         2.93 (ii)     5.39 (ii)
      Unit Hyd. Tpeak (min)=         3.00          5.00
      Unit Hyd. peak  (cms)=          .38           .21
                                                                *TOTALS*
      PEAK FLOW       (cms)=          .38           .22            .599 (iii)
      TIME TO PEAK    (hrs)=         8.00          8.00           8.000
      RUNOFF VOLUME    (mm)=       105.16         37.09          75.899
      TOTAL RAINFALL   (mm)=       106.74        106.74         106.742
      RUNOFF COEFFICIENT   =          .99           .35            .711

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------------
 001:0041----------------------------------------------------------------------------
 *
 ---------------------
 | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
 |  IN>02:(102    )   |
 | OUT<03:(103    )   |    =========  OUTFLOW STORAGE TABLE  =========
 ---------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)    (ha.m.)   |    (cms)    (ha.m.)
                              .000  .0000E+00   |     .045  .1920E-01
                              .023  .3000E-03   |     .050  .3360E-01
                              .032  .2300E-02   |     .055  .4700E-01
                              .039  .8200E-02   |     .060  .5480E-01

      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
      --------------------       (ha)     (cms)     (hrs)       (mm)
      INFLOW >02: (102    )      1.67      .599     8.000     75.899
      OUTFLOW<03: (103    )      1.57      .060     8.150     75.899
     OVERFLOW<06: (106    )       .10      .162     8.150     75.899

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         2
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .32
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      1.26
```

```
                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   10.023
                  TIME SHIFT OF PEAK FLOW        (min)=     9.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.5480E-01

 ---------------------------------------------------------------------------
 001:0042-------------------------------------------------------------------
 *
 ------------------------
 | ADD HYD (107        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                    ID1 03:103              1.57      .060     8.15  75.90    .000
                   +ID2 06:106               .10      .162     8.15  75.90    .000
                    ===========================================================
                    SUM 07:107              1.67      .222     8.15  75.90    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ---------------------------------------------------------------------------
 001:0043-------------------------------------------------------------------
 *
 *Combine Subcatchment 3 & 9
 *
 ------------------------
 | ADD HYD (108        ) | ID: NHYD         AREA     QPEAK    TPEAK   R.V.    DWF
 ------------------------                  (ha)     (cms)    (hrs)   (mm)   (cms)
                    ID1 01:101              5.44     1.585     8.00  82.32    .000
                   +ID2 07:107              1.67      .222     8.15  75.90    .000
                    ===========================================================
                    SUM 08:108              7.11     1.636     8.00  80.81    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ---------------------------------------------------------------------------
 001:0044-------------------------------------------------------------------
 *
 *SUBCATCHMENT AREA 10: Area to the North of the North East Parking Lot
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=    1.03
 | 09:109    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .98          .05
      Dep. Storage     (mm)=       1.57         4.67
      Average Slope     (%)=       3.23         1.24
      Length            (m)=      35.00       200.00
      Mannings n          =        .013         .200

      Max.eff.Inten.(mm/hr)=     142.89        97.48
                 over (min)        1.00        20.00
      Storage Coeff.  (min)=        .83 (ii)   19.74 (ii)
      Unit Hyd. Tpeak (min)=       1.00        20.00
      Unit Hyd. peak  (cms)=       1.19          .06
                                                            *TOTALS*
      PEAK FLOW       (cms)=        .39          .01           .392 (iii)
      TIME TO PEAK    (hrs)=       7.97         8.23          8.000
      RUNOFF VOLUME    (mm)=     105.17        37.09        101.768
      TOTAL RAINFALL   (mm)=     106.74       106.74        106.742
      RUNOFF COEFFICIENT   =        .99          .35           .953

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo    (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc    (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
-------------------------------------------------------------------------------------
001:0045----------------------------------------------------------------------------
*
*Combine Subcatchment 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10
*
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 04:104          20.77     3.361    8.00  75.32    .000
                    +ID2 05:105           5.66     1.195    8.00  96.02    .000
                    +ID3 08:108           7.11     1.636    8.00  80.81    .000
                    +ID4 09:109           1.03      .392    8.00 101.77    .000
                     =========================================================
                     SUM 01:TOTAL        34.57     6.584    8.00  80.63    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
001:0046----------------------------------------------------------------------------
*
      FINISH
-------------------------------------------------------------------------------------
*************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0005 CALIB STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2018-10-19     at 12:11:03
=====================================================================================
```

Appendix B-VIII

CONTENTS

Storm Sewer Design Sheet 1 pages

Algonquin College
Stormwater Management - Pond Design Report

Appendix B-VIII: Storm Sewer Design Calculations

Q = RAIN, where

Q = Peak runoff flow (L/s)	Asphalt Area:	R = 0.95	$I = \frac{A}{(T_d + C)^B}$	where I = Rainfall Intensity (mm/hr) for 5 year storm	
R = Runoff coefficient	Lawn Area:	R = 0.20		T_d = Time of Concentration (min)	
A = Area (ha)	Building Area:	R = 0.90		A = 998.071	
I = Rainfall intensity (mm/hr)	Gravel Area:	R = 0.60		B = 0.814	
N = 2.78	Other:	R = 0.40		C = 6.053	

Time of Concentration, tc = ti + tf (minutes)
Where: ti = inlet time before pipe (minutes) = 10
tf = time of flow in pipe (minutes)
tf = L/(60V) (minutes)

Manning Equation: Qcap = (D/1000)^2.667*(S/100)^0.5/(3.211*n)*1000 (L/s)
Where: D = pipe size (mm)
S = Slope (grade) of pipe (%)
n = roughness coefficient = 0.013

LOCATION			INDIVIDUAL							CUMULATIVE		DESIGN			PROPOSED SEWER													
Street / Areas	From	To	Drainage Areas	Asphalt Area	Lawn Areas	Bldg. Area	Gravel Area	Other	R*A*N	Area, A	R*A*I*N	Time of Conc., tc	Rainfall Intensity, I	Peak Flow, Q	Length, L	Size, D	Grade, S (Hyd Grade where surcharged)	Full Capacity, Qcap	Full Velocity	Time of Flow, tf	Q / Qcap	Upstream Top of Grate	Downstream Top of Grate	Upstream Cover	Downstream Cover	Upstream Water Level (where surcharged)	Upstream Invert	Downstream Invert
				(ha)	(ha)	(ha)	(ha)	(ha)		(ha)		(min.)	(mm/hr)	(L/s)	(m)	(mm)	(%)	(L/s)	(m/s)	(min)		(m)	(m)	(m)	(m)	(m)	(m)	(m)
	DICB1	STMH1	5	0.08	3.73	0.09			2.51	3.90	2.51	10.00	104.19	262	12.3	375	3.66	335	3.04	0.07	0.8	86.43	86.30	0.95	1.27		85.11	84.66
	STMH1	CBMH1	6,7,8	3.90	1.46	0.05			11.24	9.31	13.75	15.56	81.80	1125	44.4	450	0.50	201	1.26	0.59	5.6	86.30	85.90	1.25	1.07		84.60	84.38
	CBMH1	Pond Inlet								9.31	13.75	16.14	80.04	1100	19.3	450	0.52	205	1.29	0.25	5.4	85.90	84.95	1.30	0.45		84.15	84.05

Refer to Appendix B-I for breakdown of catchment areas.

Time of concentration upstream of STMH1 conservatively estimated at 15.56 minutes: 10 mins + 500m of storm sewers / assumed 1.5m/s velocity

Designed; **Sarah Mitchelson**	Project: **Algonquin College, Stormwater Management Pond**	
Checked **J Fookes**	Location: **Ottawa, ON**	
	File Ref: **2085345.47**	Date: **Oct 17, 2018**

Appendix C

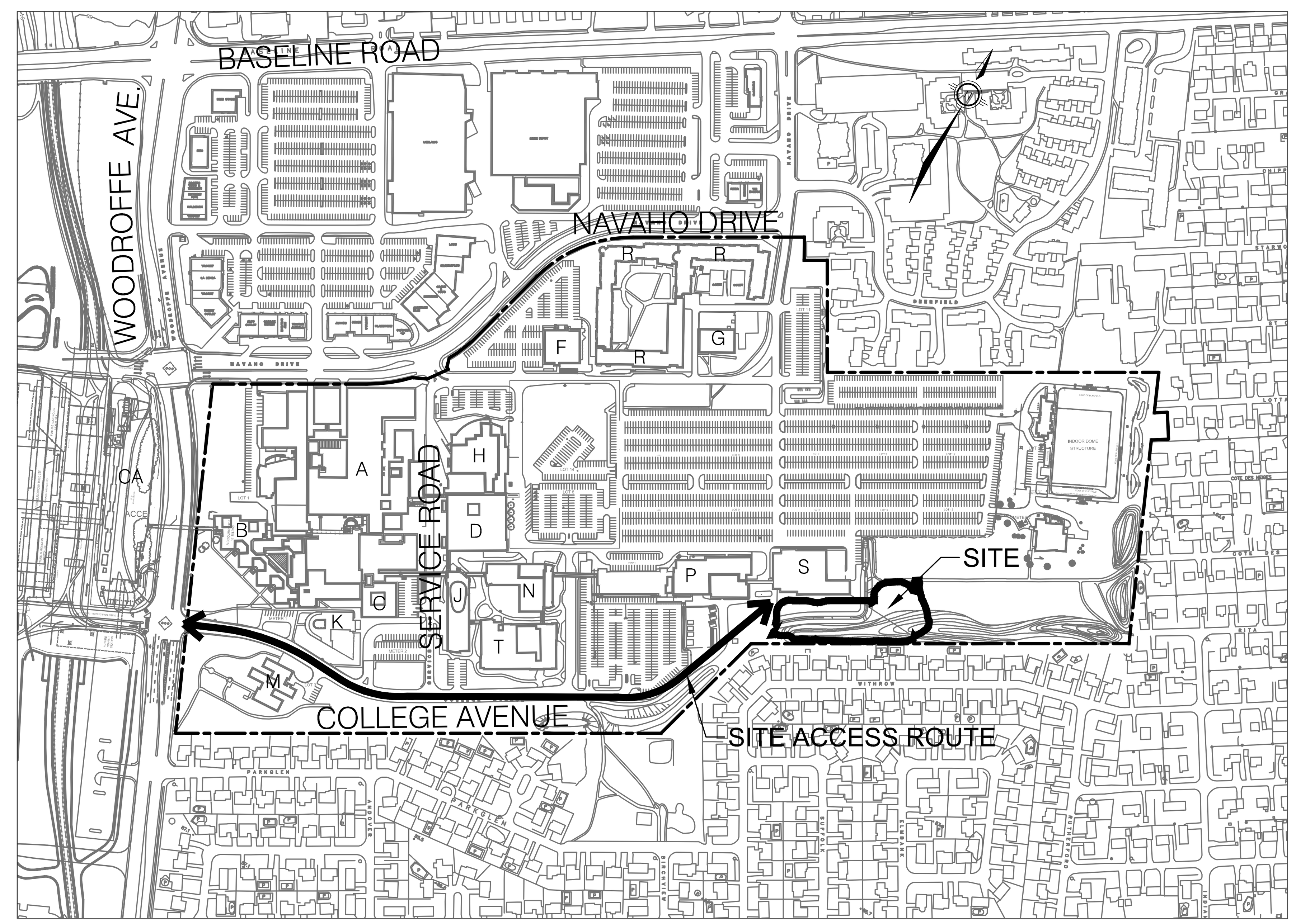
CONTENTS

Pond Design Drawings	6 pages

ALGONQUIN
COLLEGE

WOODROFFE CAMPUS

MORRISON HERSHFIELD



KEY PLAN

INDEX

DWG	DESCRIPTION	REVISION
000	COVER	06
001	LEGEND	06
002	REMOVALS	06
003	SITE SERVICING PLAN	06
004	GRADING AND DRAINAGE	06
005	CROSS SECTIONS AND DETAILS	06
006	EROSION AND SEDIMENT CONTROL	02
007	POST-DEVELOPMENT PLAN	01

ALGONQUIN COLLEGE
STORMWATER MANAGEMENT POND
CONTRACT # 17047

REISSUED FOR SITE PLAN APPLICATION
17/10/2018

D07-12-18-0036

#17611

\\mh.local\data\Offices\Ottawa\proj\2085345\2085345.47 Integrated College SWM Pond Design & Construction\300 - Engineering\03 Drawings\10 Site Plan Control - Oct2018\000-cov.dwg Last Saved: 10/17/2018 11:00 AM by nionita Plotted: 10/17/2018 2:54 PM by Nadia Ionita

SYMBOLS

UTILITIES	EXISTING	PROPOSED
WATER - WATERMAIN	203mm WATERMAIN	203mm WM
PROFILE WATERMAIN		203mm WM (IN PROFILE)
VALVE BOX		
VALVE CHAMBER		
STAND PIPE		
WATERMAIN LEADS		
REDUCER		
HYDRANT		
BELL - UNDERGOUND BELL CABLE OR DUCT	100mm U/G BELL DUCT	100mm U/G BELL DUCT
OVERHEAD BELL LINE	O/H BELL	O/H BELL
BELL POLE	B	B
BELL MANHOLE	B	B
BELL POLE WITH GUY WIRE	B	B
TELEPHONE BOOTH	T	T
BELL PEDESTAL	B	B
HYDRO - UNDERGROUND HYDRO CABLE / DUCT	U/G HYDRO DUCT	U/G HYDRO CABLE
OVERHEAD HYDRO	O/ H HYDRO	O/H HYDRO
HYDRO POLE	H	H
HYDRO POLE WITH GUY WIRE	H	H
HYDRO TOWER		
HYDRO MANHOLE	H	H
LIGHT STANDARD		
HYDRO PEDESTAL		
GAS - GAS MAIN	100mm GAS	100mm GAS
GAS VALVE		
GAS METER		
CABLE - UNDERGOUND TV CABLE (ROGERS)		
UNDERGOUND TELECOMMUNICATIONS	CATL (TELUS)	CATL (TELUS)
SEWERS		
SEWER PIPE - COMBINED SEWER	450mm COMBINED SEWER	450mm COMBINED SEWER
STORM SEWER LESS THAN 450mm	350mm STORM SEWER	350mm STORM SEWER
STORM SEWER GREATER THAN 450mm	600mm STORM SEWER	600mm STORM SEWER
SANITARY SEWER LESS THAN 450mm	350mm SANITARY SEWER	350mm SANITARY SEWER
SANITARY SEWER GREATER THAN 450mm	500mm SANITARY SEWER	500mm SANITARY SEWER
ABANDONED STORM SEWER	ABANDONED 300mm STORM	
ABANDONED SANITARY SEWER	ABANDONED 300mm SANITARY	
Catchbasin - EXISTING CATCH BASIN		
In The Road Type Catchbasin	Exist. Edge of Pav't	PROPOSED EDGE OF PAV'T
Curb Type Catchbasin	Exist. Edge of Pav't	PROPOSED EDGE OF PAV'T
Double Road Type Catchbasin	Exist. Edge of Pav't	PROPOSED EDGE OF PAV'T
Double Curb Type Catchbasin	Exist. Edge of Pav't	PROPOSED EDGE OF PAV'T
MANHOLES - STORM MANHOLE		
SANITARY MANHOLE		
CATCH BASIN MANHOLE		
CULVERT		
CULVERT WITH HEAD WALLS		
CONCRETE CURB		ROAD OR PARKING SIDE
DITCHES AND CREEKS		

REMOVALS AND ADJUSTMENTS

- AREA TO BE CLEARED AND GRUBBED
- ARMOUR STONES
- REMOVE MANHOLE , CATCH BASIN
- X REMOVE SEWER , WATERMAIN , UTILITY

REINSTATEMENT

- RIP RAP
- GRAVEL ACCESS ROAD
- STONE DUST NATURE TRAIL AS PER SC24

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE
1385 WOODROFFE AVENUE
OTTAWA, ON K2G1V8

1385 WOODROFFE AVE.
STORMWATER MANAGEMENT POND
LEGEND

MH Ref. No. 2085345.47	Dwg. 001
Sheet 1 of 7	
Des. JF	Chk'd. AK
Dwn. NI	Chk'd. JF
Utility Circ. No. N/A	Index No. N/A
Const. Inspector N/A	
Scale: N/A	

Scott McDeromtt
Algonquin College Project Manager

Arash Khoshghalb
MH Project Manager

LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
OCT.17,2018
PROVINCE OF ONTARIO

MORRISON HERSHFIELD
2440 Don Reid Drive, Ottawa, Canada K1H 1E1
Tel: 613 739 2910 Fax: 613 739 4926 www.morrisonhershfield.com

REVISIONS

No.	Description	By	Date (dd/mm/yy)
A	ISSUED FOR DESIGN REVIEW	AIG	12/02/18
01	ISSUED FOR SITE PLAN APPLICATION	GH	21/02/18
02	ISSUED FOR TENDER	GH	22/03/18
03	ISSUED FOR CONSTRUCTION	GH	28/05/18
04	ISSUED FOR CONSTRUCTION (REVISED)	JF	26/06/18
05	ISSUED FOR CONSTRUCTION (REVISED)	JF	05/07/18
06	REISSUED FOR SITE PLAN APPLICATION	JF	17/10/18

APPROVED ☐ REFUSED ☐

THIS _____DAY OF _____________ , 20 _____

DERRICK MOODIE
MANAGER, DEVELOPMENT REVIEW - WEST
PLANNING, INFRASTRUCTURE & ECONOMIC
DEVELOPMENT DEPARTMENT, CITY OF OTTAWA

UTILITY NOTE:

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

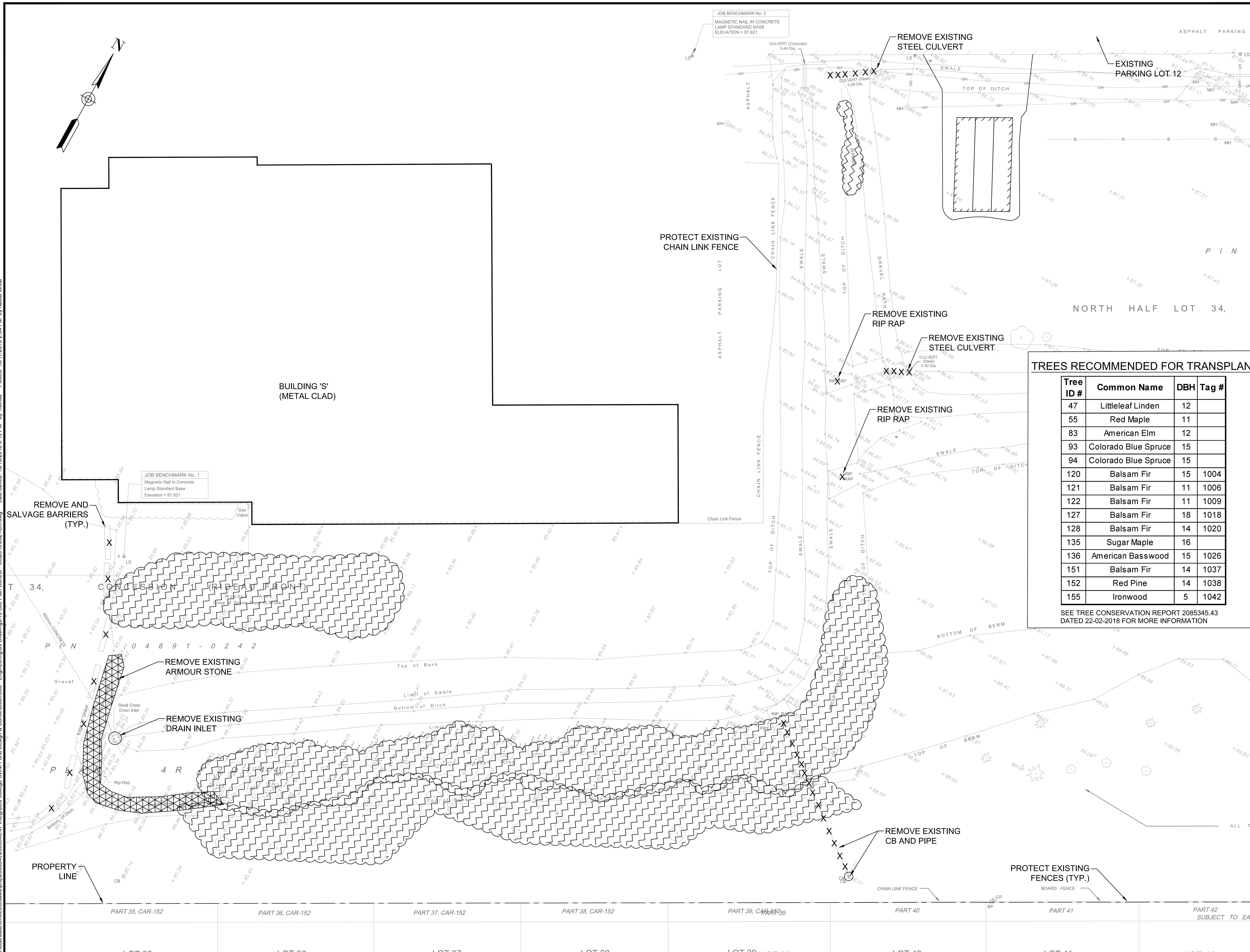
EROSION AND SEDIMENT CONTROL NOTE:

THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL, USING FILTER CLOTH UNDER THE GRATES OF CATCHBASINS AND MANHOLES AND INSTALLING SILT FENCES AND OTHER EFFECTIVE SEDIMENT TRAPS. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALITIES IMPOSED BY AN APPLICABLE REGULATORY AGENCY.

\\mh.local\data\Offices\Ottawa\proj\2085345\2085345.47 Integrated College SWM Pond Design & Construction\300 - Engineering\03 Drawings\10 Site Plan Control - Oct2018\001-legend.dwg Last Saved: 10/16/2018 3:18 PM by nionita Plotted: 10/17/2018 2:57 PM by Nadia Ionita

D07-12-18-0036

#17611



TREES RECOMMENDED FOR TRANSPLANT

Tree ID #	Common Name	DBH	Tag #
47	Littleleaf Linden	12	
55	Red Maple	11	
83	American Elm	12	
93	Colorado Blue Spruce	15	
94	Colorado Blue Spruce	15	
120	Balsam Fir	15	1004
121	Balsam Fir	11	1006
122	Balsam Fir	11	1009
127	Balsam Fir	18	1018
128	Balsam Fir	14	1020
135	Sugar Maple	16	
136	American Basswood	15	1026
151	Balsam Fir	14	1037
152	Red Pine	14	1038
155	Ironwood	5	1042

SEE TREE CONSERVATION REPORT 2085345.43
DATED 22-02-2018 FOR MORE INFORMATION

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE
1385 WOODROFFE AVENUE
OTTAWA, ON K2G1V8

1385 WOODROFFE AVE. STORMWATER MANAGEMENT POND REMOVALS

MH Ref. No. 2085345.47	Dwg. 002
Sheet 2 of 7	
Des. JF	Chk'd. AK
Dwn. NI	Chk'd. JF
Utility Circ. No. N/A	Index No. N/A
Const. Inspector N/A	

Scott McDermott
Algonquin College Project Manager

Arash Khoshghalb
MH Project Manager

LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
OCT.17,2018
PROVINCE OF ONTARIO

Scale: 0 5 10 Meters
1:250

MORRISON HERSHFIELD
2440 Don Reid Drive, Ottawa, Canada K1H 1E1
Tel: 613 739 2910 Fax: 613 739 4926 www.morrisonhershfield.com

REVISIONS

No.	Description	By	Date (dd/mm/yy)
A	ISSUED FOR DESIGN REVIEW	AIG	12/02/18
01	ISSUED FOR SITE PLAN APPLICATION	GH	21/02/18
02	ISSUED FOR TENDER	GH	22/03/18
03	ISSUED FOR CONSTRUCTION	GH	28/05/18
04	ISSUED FOR CONSTRUCTION (REVISED)	JF	26/06/18
05	ISSUED FOR CONSTRUCTION (REVISED)	JF	05/07/18
06	REISSUED FOR SITE PLAN APPLICATION	JF	17/10/18

LEGEND

- CLEARING OF EXISTING TREES / SHRUBS / LANDSCAPING
- REMOVAL OF EXISTING ARMOUR STONES
- ○ REMOVAL OF MAHOLE / CATCH BASIN
- X REMOVAL OF SEWER / WATERMAIN / UTILITY

UTILITY NOTE:

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

EROSION AND SEDIMENT CONTROL NOTE:

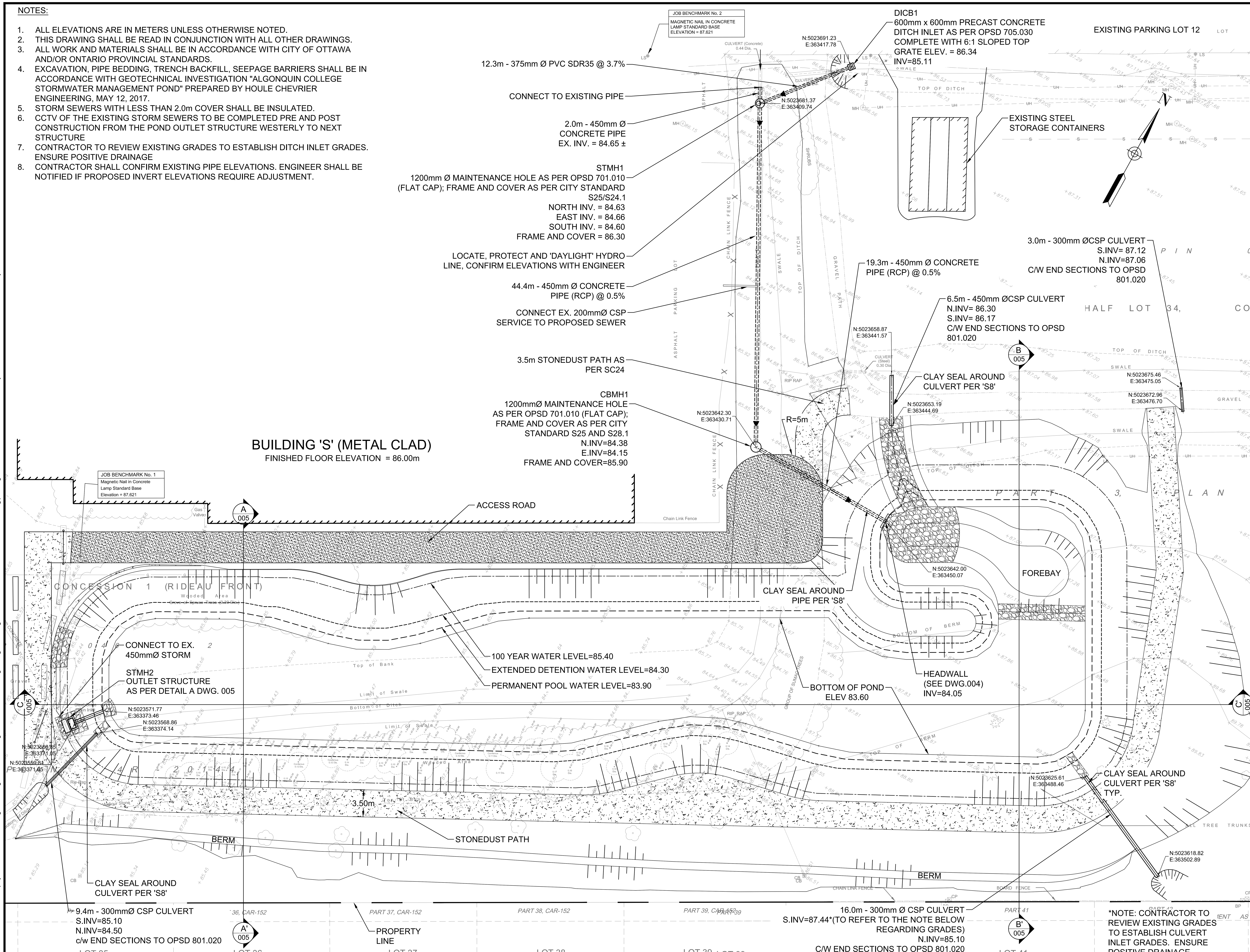
THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL, USING FILTER CLOTH UNDER THE GRATES OF CATCHBASINS AND MANHOLES AND INSTALLING SILT FENCES AND OTHER EFFECTIVE SEDIMENT TRAPS. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALITIES IMPOSED BY AN APPLICABLE REGULATORY AGENCY.

D07-12-18-0036

#17611

NOTES:

1. ALL ELEVATIONS ARE IN METERS UNLESS OTHERWISE NOTED.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS.
3. ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CITY OF OTTAWA AND/OR ONTARIO PROVINCIAL STANDARDS.
4. EXCAVATION, PIPE BEDDING, TRENCH BACKFILL, SEEPAGE BARRIERS SHALL BE IN ACCORDANCE WITH GEOTECHNICAL INVESTIGATION "ALGONQUIN COLLEGE STORMWATER MANAGEMENT POND" PREPARED BY HOULE CHEVRIER ENGINEERING, MAY 12, 2017.
5. STORM SEWERS WITH LESS THAN 2.0m COVER SHALL BE INSULATED.
6. CCTV OF THE EXISTING STORM SEWERS TO BE COMPLETED PRE AND POST CONSTRUCTION FROM THE POND OUTLET STRUCTURE WESTERLY TO NEXT STRUCTURE
7. CONTRACTOR TO REVIEW EXISTING GRADES TO ESTABLISH DITCH INLET GRADES. ENSURE POSITIVE DRAINAGE
8. CONTRACTOR SHALL CONFIRM EXISTING PIPE ELEVATIONS. ENGINEER SHALL BE NOTIFIED IF PROPOSED INVERT ELEVATIONS REQUIRE ADJUSTMENT.



ALGONQUIN COLLEGE

ALGONQUIN COLLEGE
1385 WOODROFFE AVENUE
OTTAWA, ON K2G1V8

1385 WOODROFFE AVE.
STORMWATER MANAGEMENT POND
SITE SERVICING

MH Ref. No.	Dwg.
2085345.47	003
Sheet 3 of 7	
Des. JF	Chk'd. AK
Dwn. NI	Chk'd. JF
Utility Circ. No. N/A	Index No. N/A
Const. Inspector N/A	

Scott McDermott
Algonquin College Project Manager

Arash Khoshghalb
MH Project Manager

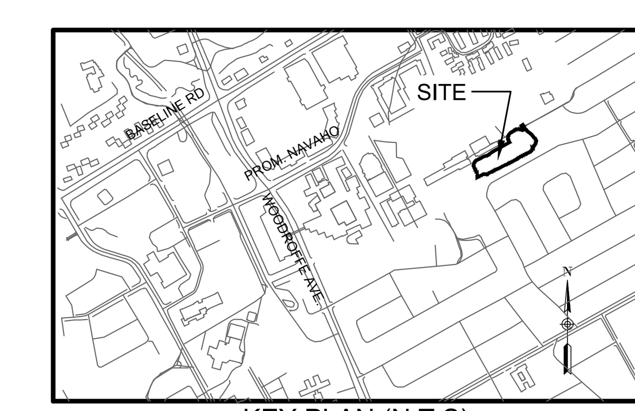
LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
OCT.17,2018
PROVINCE OF ONTARIO

Scale: 1:250

MORRISON HERSHFIELD
2440 Don Reid Drive, Ottawa, Canada K1H 1E1
Tel: 613 739 2910 Fax: 613 739 4926 www.morrisonhershfield.com

REVISIONS

No.	Description	By	Date (dd/mm/yy)
A	ISSUED FOR DESIGN REVIEW	AIG	12/02/18
01	ISSUED FOR SITE PLAN APPLICATION	GH	21/02/18
02	ISSUED FOR TENDER	GH	22/03/18
03	ISSUED FOR CONSTRUCTION	GH	28/05/18
04	ISSUED FOR CONSTRUCTION (REVISED)	JF	26/06/18
05	ISSUED FOR CONSTRUCTION (REVISED)	JF	05/07/18
06	REISSUED FOR SITE PLAN APPLICATION	JF	17/10/18



KEY PLAN (N.T.S)

UTILITY NOTE:

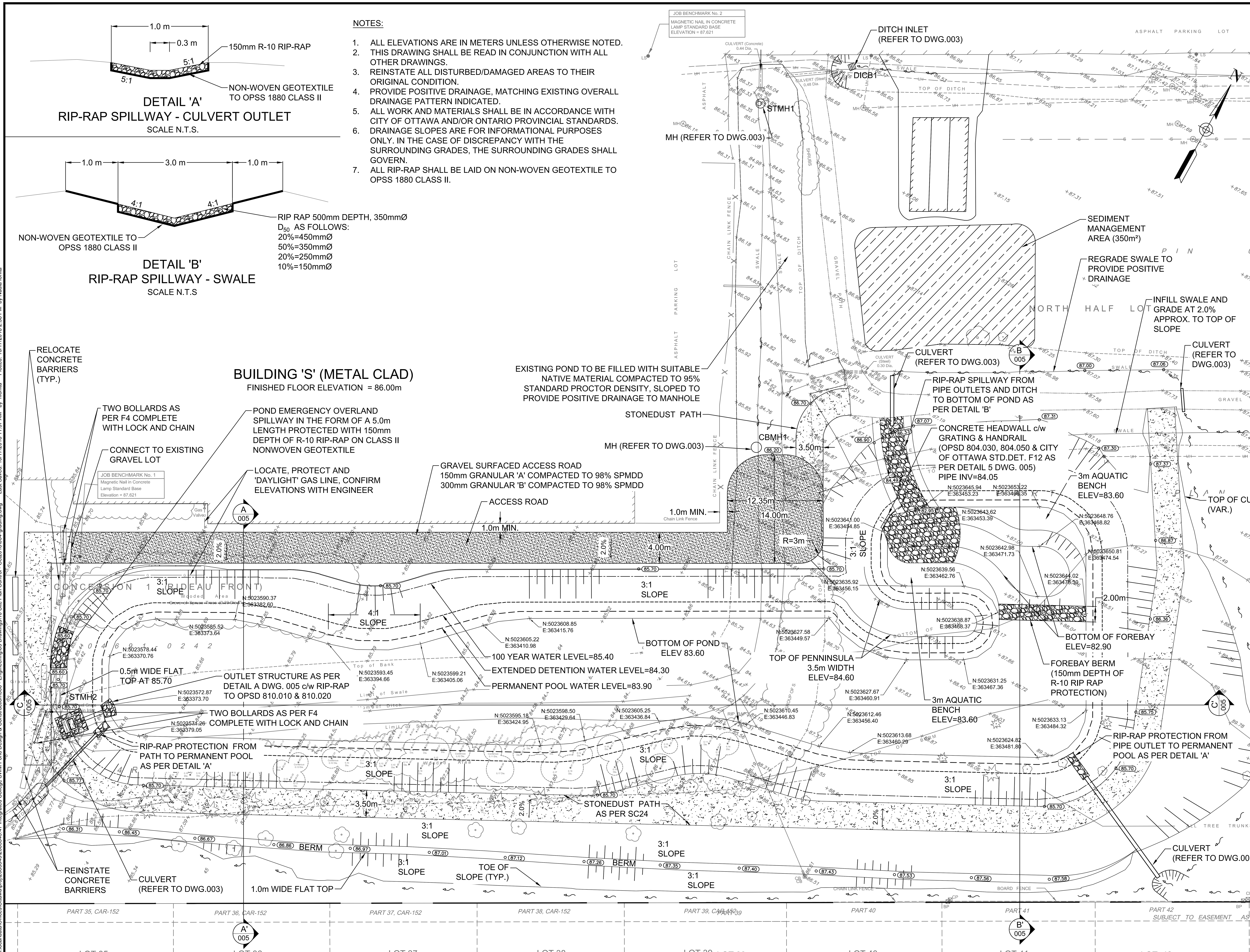
THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

EROSION AND SEDIMENT CONTROL NOTE:

THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL, USING FILTER CLOTH UNDER THE GRATES OF CATCHBASINS AND MANHOLES AND INSTALLING SILT FENCES AND OTHER EFFECTIVE SEDIMENT TRAPS. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALITIES IMPOSED BY AN APPLICABLE REGULATORY AGENCY.

D07-12-18-0036

#17611



NOTES:

1. ALL ELEVATIONS ARE IN METERS UNLESS OTHERWISE NOTED.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS.
3. REINSTATE ALL DISTURBED/DAMAGED AREAS TO THEIR ORIGINAL CONDITION.
4. PROVIDE POSITIVE DRAINAGE, MATCHING EXISTING OVERALL DRAINAGE PATTERN INDICATED.
5. ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CITY OF OTTAWA AND/OR ONTARIO PROVINCIAL STANDARDS.
6. DRAINAGE SLOPES ARE FOR INFORMATIONAL PURPOSES ONLY. IN THE CASE OF DISCREPANCY WITH THE SURROUNDING GRADES, THE SURROUNDING GRADES SHALL GOVERN.
7. ALL RIP-RAP SHALL BE LAID ON NON-WOVEN GEOTEXTILE TO OPSS 1880 CLASS II.

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE
1385 WOODROFFE AVENUE
OTTAWA, ON K2G1V8

1385 WOODROFFE AVE. STORMWATER MANAGEMENT POND GRADING AND DRAINAGE

MH Ref. No. 2085345.47	Dwg. 004
Sheet 4 of 7	
Des. JF	Chk'd. AK
Dwn. NI	Chk'd. JF
Utility Circ. No. N/A	Index No. N/A
Const. Inspector N/A	
Scale: 1:250	

Scott McDermott
Algonquin College Project Manager

Arash Khoshghalb
MH Project Manager

LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
OCT.17,2018
PROVINCE OF ONTARIO

MORRISON HERSHFIELD
2440 Don Reid Drive, Ottawa, Canada K1H 1E1
Tel: 613 739 2910 Fax: 613 739 4926 www.morrisonhershfield.com

REVISIONS

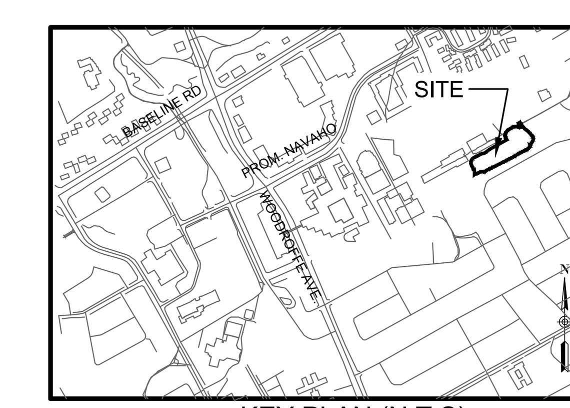
No.	Description	By	Date (dd/mm/yy)
A	ISSUED FOR DESIGN REVIEW	AIG	12/02/18
01	ISSUED FOR SITE PLAN APPLICATION	GH	21/02/18
02	ISSUED FOR TENDER	GH	22/03/18
03	ISSUED FOR CONSTRUCTION	GH	28/05/18
04	ISSUED FOR CONSTRUCTION (REVISED)	JF	26/06/18
05	ISSUED FOR CONSTRUCTION (REVISED)	JF	05/07/18
06	REISSUED FOR SITE PLAN APPLICATION	JF	17/10/18

LAYOUT & SURVEY NOTES:

1. POND IS TO HAVE A CURVILINEAR SHAPE MATCHING THE GENERAL APPEARANCE DEPICTED, AND PASSING THROUGH THE SPECIFIED LAYOUT POINTS
2. TOP OF CUT LIMITS ARE TO BE SET IN THE FIELD BASED UPON THE SPECIFIED POND BOTTOM SHAPE AND SIDESLOPES
3. COORDINATES ARE REFERRED TO MTM ZONE 9, NAD83 (CSRS) (2010) AND ARE DERIVED FROM REAL TIME NETWORK OBSERVATIONS.
4. ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM, AND ARE DERIVED FROM SURVEY OF CANADA FIRST ORDER BENCHMARK NO.0011964U3695, HAVING A PUBLISHED ORTHOMETRIC ELEVATION OF 86.752m.

LEGEND

	RIP RAP
	GRAVEL ACCESS ROAD
	STONEDUST NATURE TRAIL AS PER SC24
	POST AND RAIL FENCE
×59.94	EXISTING ELEVATION
○85.70	PROPOSED ELEVATION
	PROPOSED FLOW DIRECTION



KEY PLAN (N.T.S)

UTILITY NOTE:

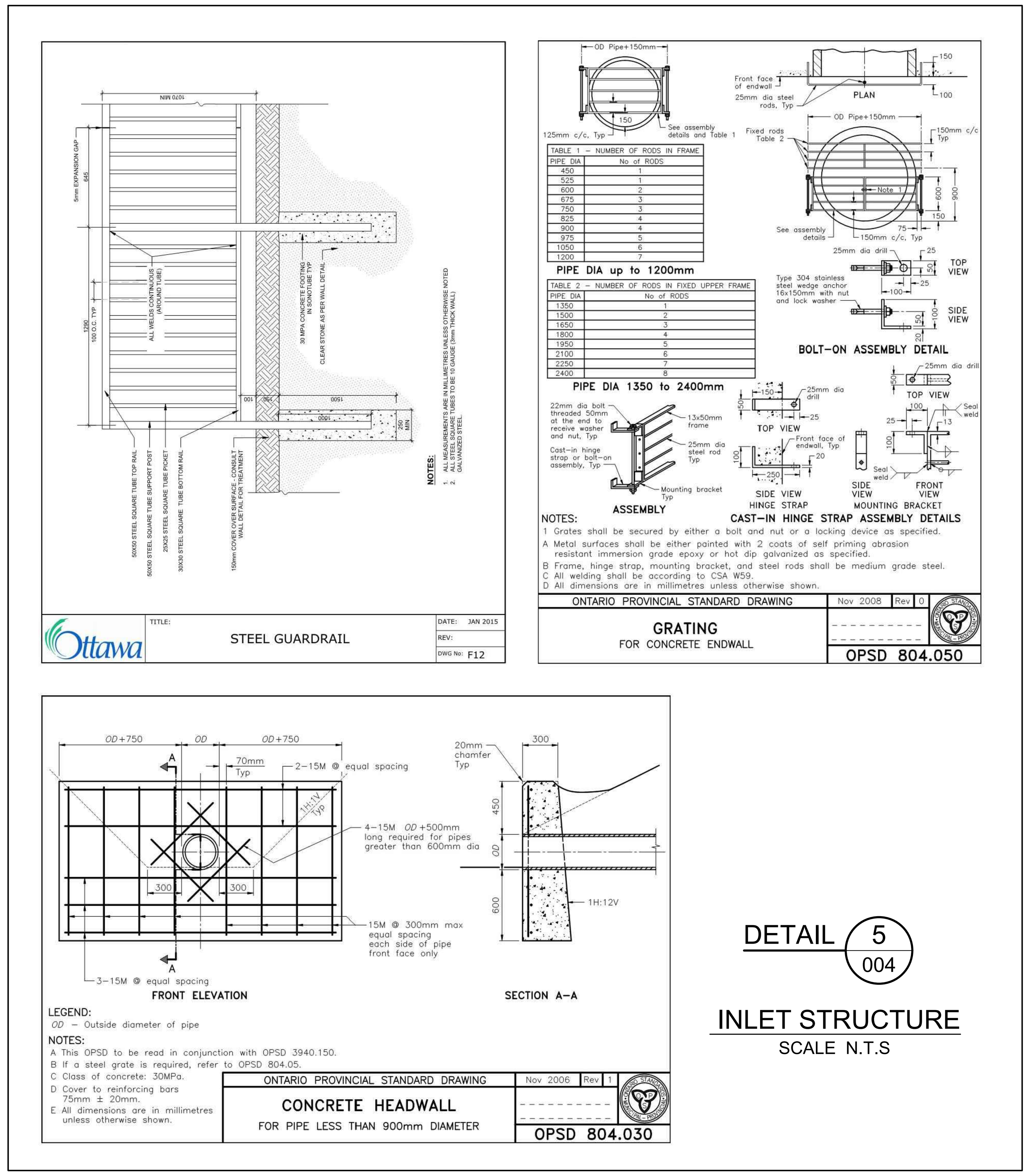
THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

EROSION AND SEDIMENT CONTROL NOTE:

THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL, USING FILTER CLOTH UNDER THE GRATES OF CATCHBASINS AND MANHOLES AND INSTALLING SILT FENCES AND OTHER EFFECTIVE SEDIMENT TRAPS. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALITIES IMPOSED BY AN APPLICABLE REGULATORY AGENCY.

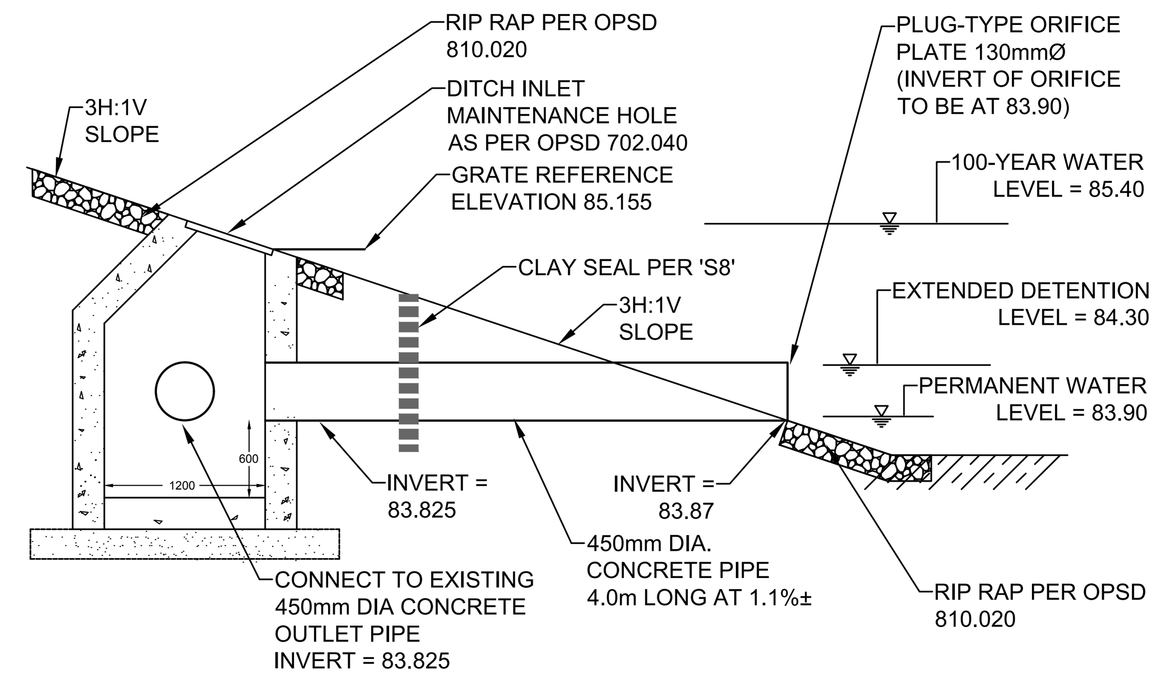
D07-12-18-0036

#17611



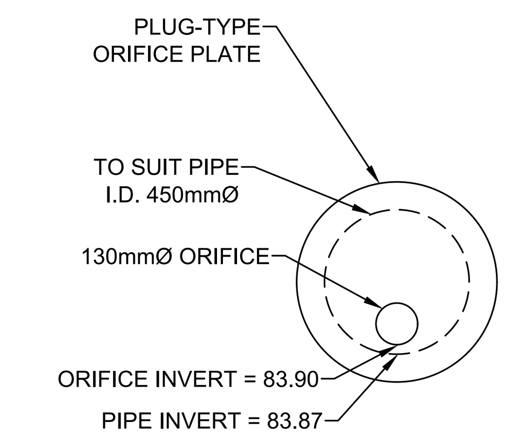
DETAIL 5 / 004

INLET STRUCTURE
SCALE N.T.S

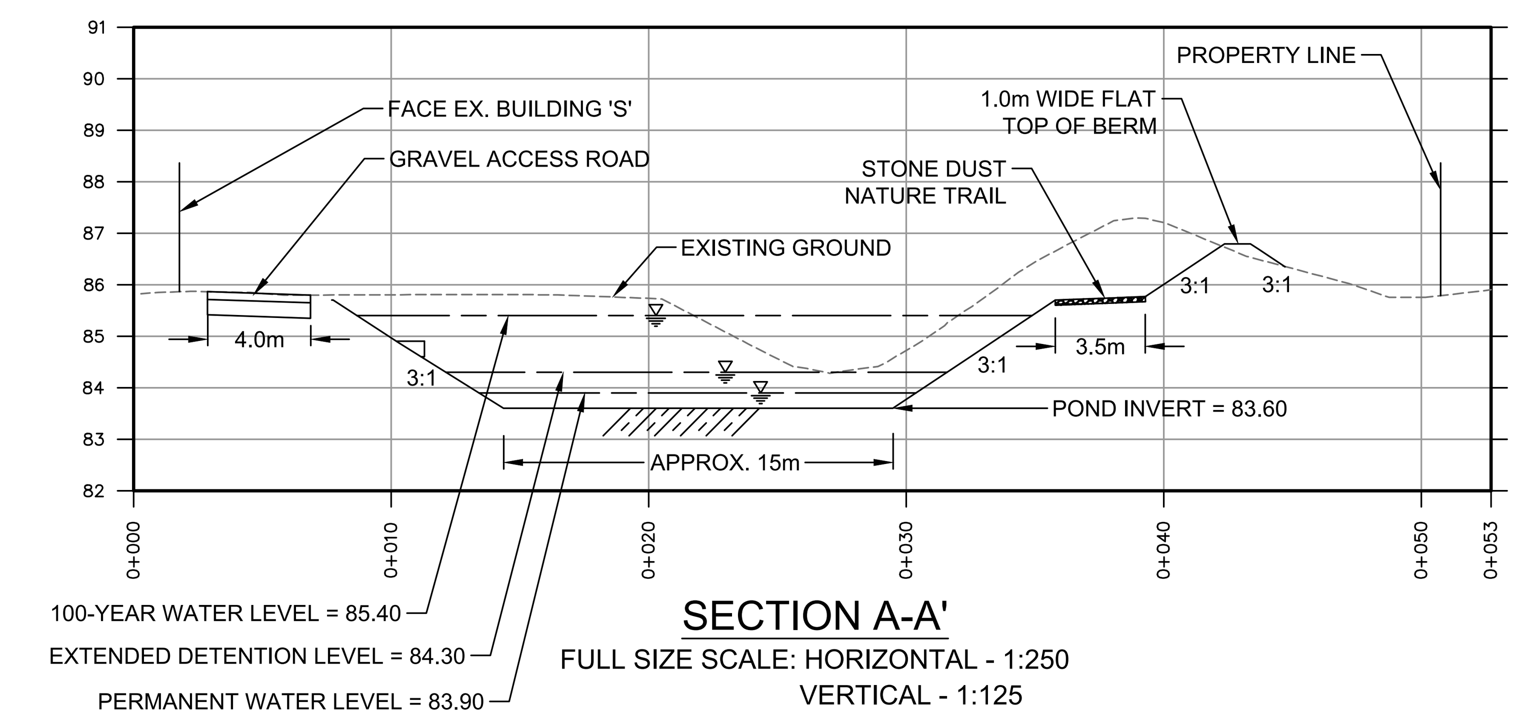


OUTLET STRUCTURE
SCALE N.T.S.

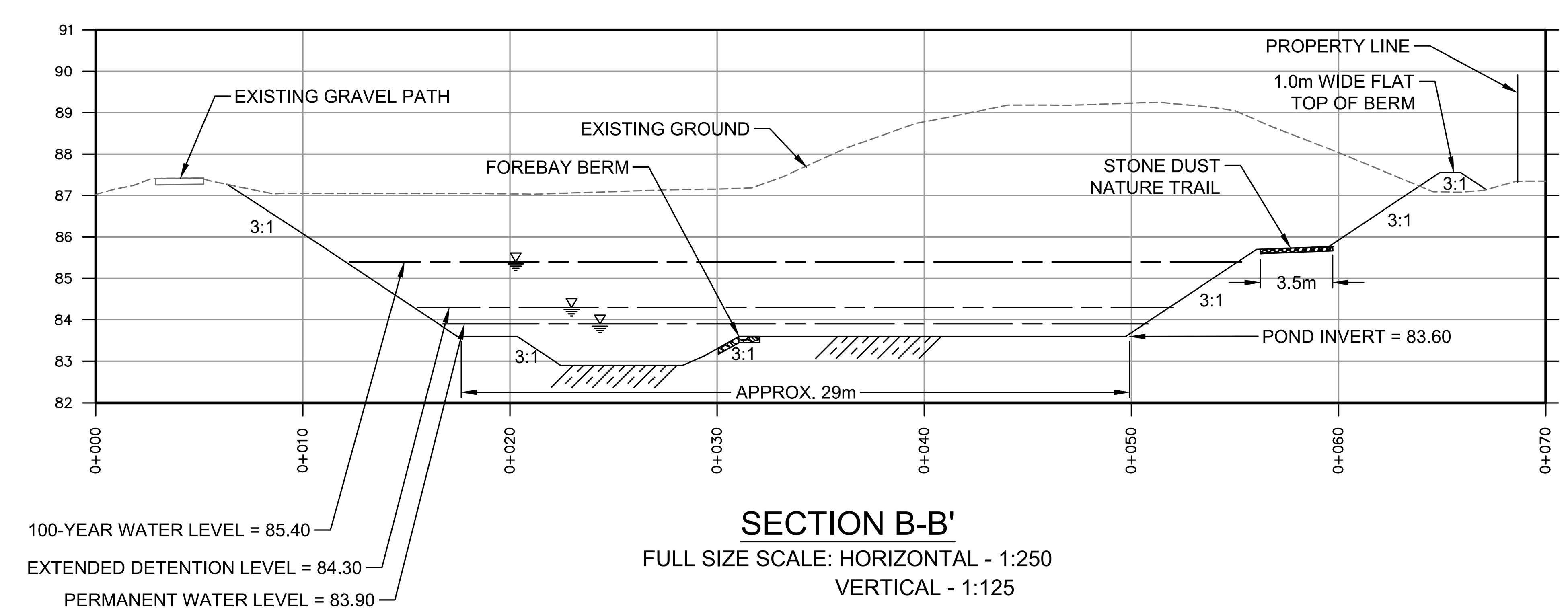
DETAIL A / 004



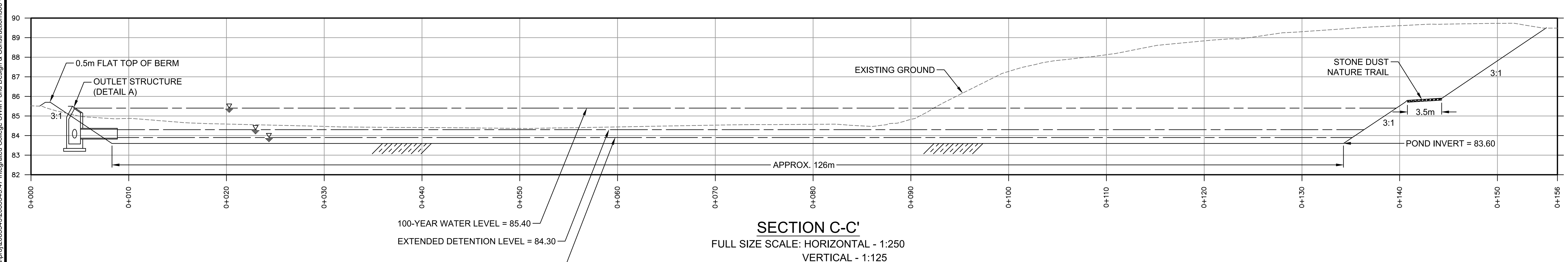
ORIFICE PLATE DETAIL
SCALE 1:20



SECTION A-A'
FULL SIZE SCALE: HORIZONTAL - 1:250
VERTICAL - 1:125



SECTION B-B'
FULL SIZE SCALE: HORIZONTAL - 1:250
VERTICAL - 1:125



SECTION C-C'
FULL SIZE SCALE: HORIZONTAL - 1:250
VERTICAL - 1:125

ALGONQUIN COLLEGE
1385 WOODROFFE AVENUE
OTTAWA, ON K2G1V8

1385 WOODROFFE AVE.
STORMWATER MANAGEMENT POND
CROSS SECTIONS AND DETAILS

Scott McDermott
Algonquin College Project Manager

Arash Khoshghalb
MH Project Manager

MH Ref. No. 2085345.47 | Dwg. 005
Sheet 5 of 7
Des. JF | Chk'd. AK
Dwn. NI | Chk'd. JF
Utility Circ. No. N/A | Index No. N/A
Const. Inspector N/A
Scale: 1:250

LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
OCT.17,2018
PROVINCE OF ONTARIO

MORRISON HERSHFIELD
2440 Don Reid Drive, Ottawa, Canada K1H 1E1
Tel: 613 739 2910 Fax: 613 739 4926 www.morrisonhershfield.com

REVISIONS

No.	Description	By	Date (dd/mm/yy)
A	ISSUED FOR DESIGN REVIEW	AIG	12/02/18
01	ISSUED FOR SITE PLAN APPLICATION	GH	21/02/18
02	ISSUED FOR TENDER	GH	22/03/18
03	ISSUED FOR CONSTRUCTION	GH	28/05/18
04	ISSUED FOR CONSTRUCTION (REVISED)	JF	26/06/18
05	ISSUED FOR CONSTRUCTION (REVISED)	JF	05/07/18
06	REISSUED FOR SITE PLAN APPLICATION	JF	17/10/18

UTILITY NOTE:

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

EROSION AND SEDIMENT CONTROL NOTE:

THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL, USING FILTER CLOTH UNDER THE GRATES OF CATCHBASINS AND MANHOLES AND INSTALLING SILT FENCES AND OTHER EFFECTIVE SEDIMENT TRAPS. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY AN APPLICABLE REGULATORY AGENCY.

D07-12-18-0036

#17611

O:\Ottawa\proj\2085345\2085345.47 Integrated College SWM Pond Design & Construction\300 - Engineering\03 Drawings\10 Site Plan Control - Oct2018\004-grading.dwg Last Saved: 10/19/2018 10:39 AM by jfookes Plotted: 10/19/2018 10:39 AM by James Fookes

NOTES:

1. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.

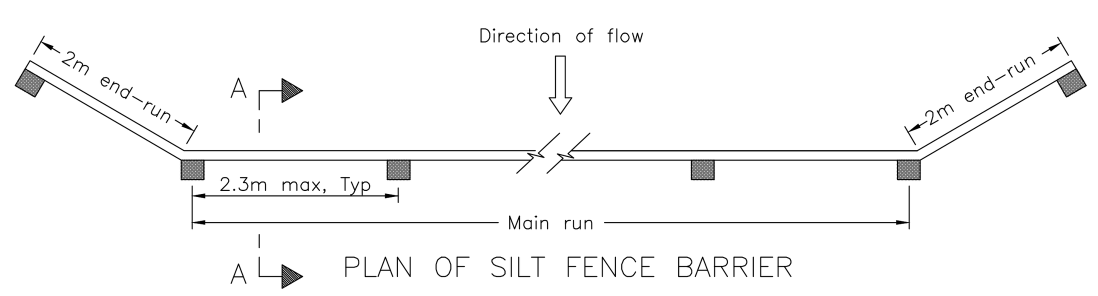
2. EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE IMPLEMENTED PRIOR TO CONSTRUCTION AND REMAIN IN PLACE UNTIL VEGETATION IS ESTABLISHED. REGULAR INSPECTION AND MAINTENANCE OF THE EROSION AND SEDIMENT MEASURES SHALL BE UNDERTAKEN. THE IMPLEMENTATION AND ADJUSTMENT AND/OR CORRECTIVE MAINTENANCE OF THE EROSION AND SEDIMENT MEASURES IS AN INTEGRAL PART OF THE PLAN AND MUST BE PERFORMED.

3. GEOTEXTILE FILTER FABRIC SHALL BE PLACED BETWEEN THE STRUCTURE FRAME AND COVER FOR ALL MANHOLES, CATCHBASINS, AND CATCHBASINS MANHOLES IN ADDITION TO SPECIFIC MEASURES SHOWN.

4. SEDIMENT CAPTURE FILTER SOCKS SHALL BE INLETSOXX BY FILTREX CANADA OR APPROVED EQUIVALENT, SHALL FULLY SURROUND THE INLET BEING PROTECTED WITH ONE FOOT OF OVERLAP, SHALL BE ANCHORED TO THE GROUND, AND INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

5. ALL EARTH WORKS SHALL BE COMPLETED IN THE DRY. BYPASS PUMPING AND DEWATERING OF THE POND SHALL BE IMPLEMENTED AS NECESSARY TO MAINTAIN THE WATER LEVEL BELOW THE INVERT OF THE OUTLET PIPE WHENEVER EARTHWORK IS IN PROGRESS. SEDIMENT-LADEN WATER SHALL NOT BE DISCHARGED TO THE STORM SEWER.

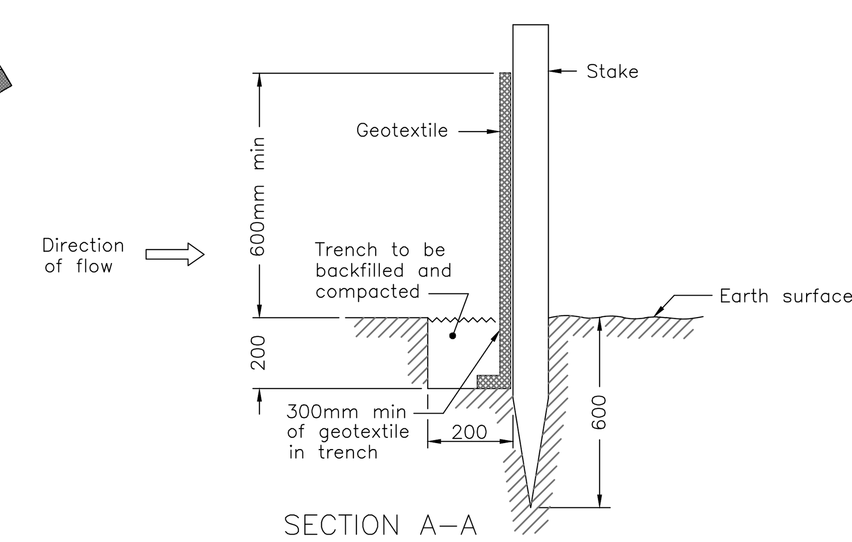
6. CONTRACTOR SHALL SUPPLY AND INSTALL EROSION BLANKET WHERE SLOPES ARE NOT SEEDED/SODDED IMMEDIATELY FOLLOWING GRADING.



PLAN OF SILT FENCE BARRIER

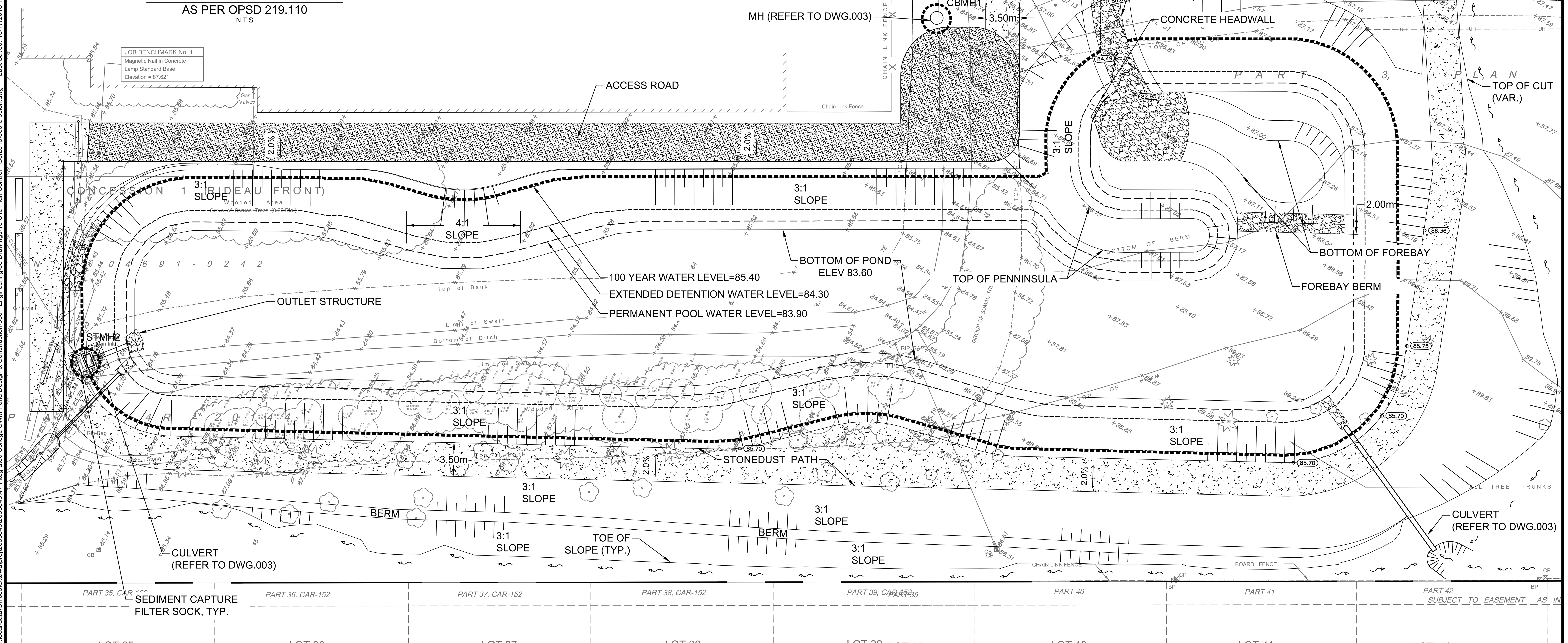
NOTES:

1) WOVEN GEOTEXTILE TO HAVE A MINIMUM EQUIVALENT OPENING SIZE OF 0.15mm AND A MAXIMUM EQUIVALENT OPENING SIZE OF 0.25mm.
2) WOVEN GEOTEXTILE TO HAVE A HORIZONTAL OVERLAP OF 1000mm AT JOINTS.
3) ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.



SECTION A–A

LIGHT DUTY SILT FENCE BARRIER
AS PER OPSD 219.110
N.T.S.



Last Saved: 10/17/2018 11:32 AM by nionita Plotted: 10/17/2018 2:59 PM by Nadia Ionita

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE
1385 WOODROFFE AVENUE
OTTAWA, ON K2G1V8

1385 WOODROFFE AVE. EROSION AND SEDIMENT CONTROL

Scott McDermott Algonquin College Project Manager	Arash Khoshghalb MH Project Manager

LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
OCT.17,2018
PROVINCE OF ONTARIO

MH Ref. No. 2085345.47	Dwg. 006
Sheet 6 of 7	
Des. JF	Chk'd. AK
Dwn. NI	Chk'd. JF
Utility Circ. No. N/A	Index No. N/A
Const. Inspector N/A	

Scale: 0 5 10 Meters
1:250

MORRISON HERSHFIELD
2440 Don Reid Drive, Ottawa, Canada K1H 1E1
Tel: 613 739 2910 Fax: 613 739 4926 www.morrisonhershfield.com

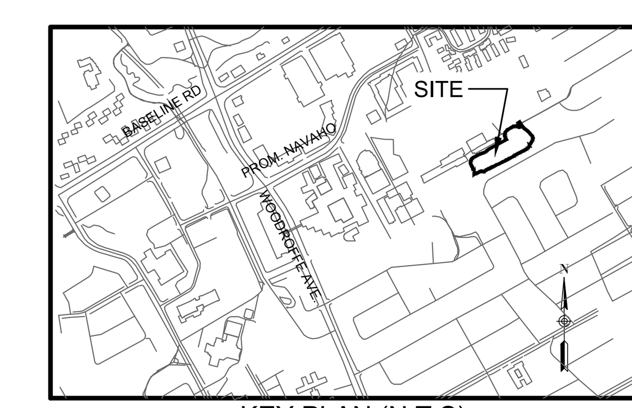
REVISIONS

No.	Description	By	Date (dd/mm/yy)
01	ISSUED FOR SITE PLAN APPLICATION	JF	06/09/18
02	REISSUED FOR SITE PLAN APPLICATION	JF	17/10/18

LEGEND

LIGHT DUTY SILT FENCE BARRIER AS PER OPSD 219.110

SEDIMENT CAPTURE FILTER SOCK



KEY PLAN (N.T.S)

UTILITY NOTE:

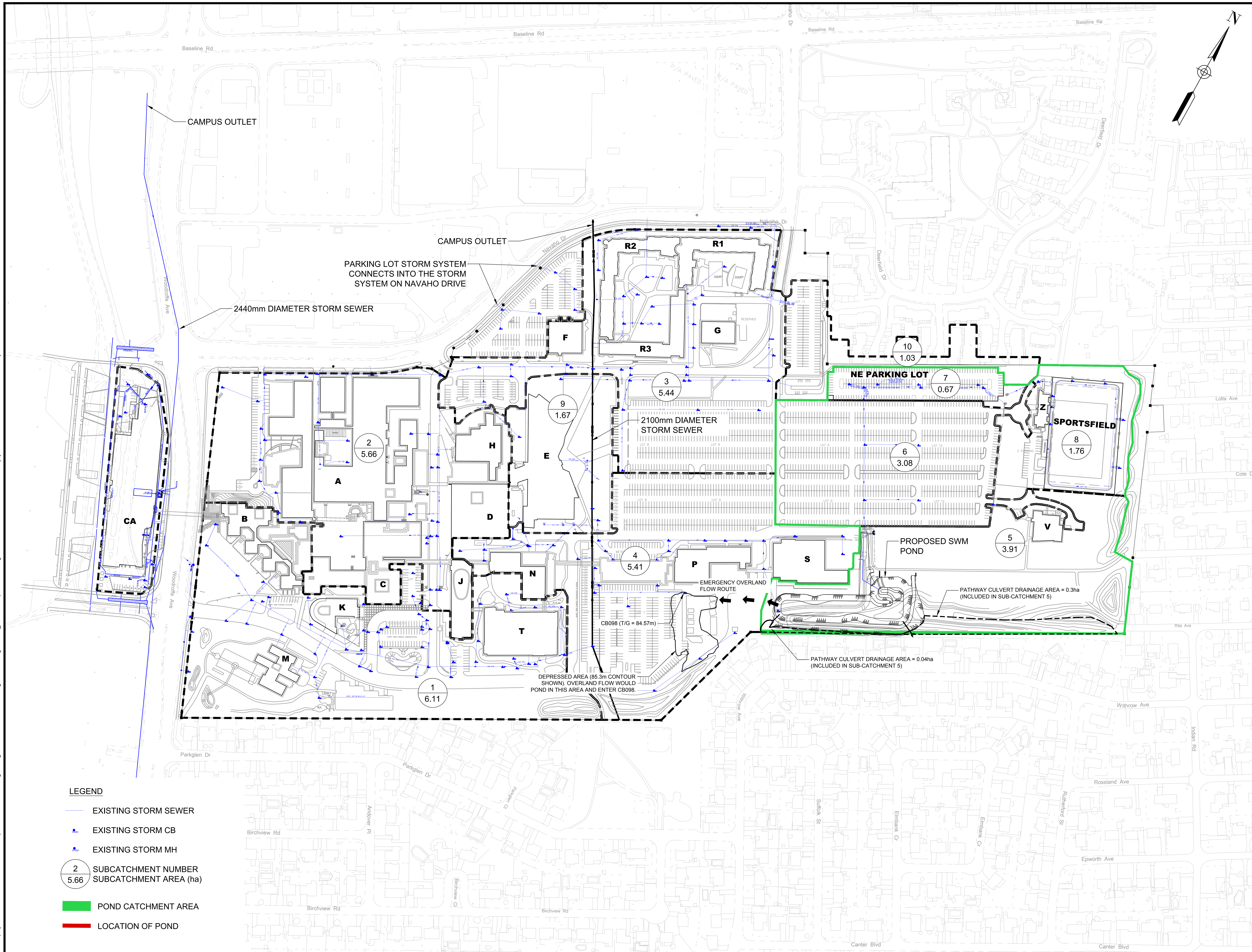
THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

EROSION AND SEDIMENT CONTROL NOTE:

THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL, USING FILTER CLOTH UNDER THE GRATES OF CATCHBASINS AND MANHOLES AND INSTALLING SILT FENCES AND OTHER EFFECTIVE SEDIMENT TRAPS. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALITIES IMPOSED BY AN APPLICABLE REGULATORY AGENCY.

D07-12-18-0036

#17611



O:\Ottawa\proj\2085345\2085345.43 Woodroffe Campus SWM Plan\300 - Engineering\08 Stormwater\RW SW Integrated Plan\Figures\007_Post-Development Plan.dwg Last Saved: 10/18/2018 4:42 PM by jfookes Plotted: 10/18/2018 4:45 PM by James Fookes

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE
1385 WOODROFFE AVENUE
OTTAWA, ON K2G1V8

1385 WOODROFFE AVE. STORMWATER MANAGEMENT POND POST-DEVELOPMENT PLAN

MH Ref. No. 2085345.47 | Dwg. 007

Sheet 7 of 7

Scott McDermott
Algonquin College Project Manager

Arash Khoshghalb
MH Project Manager

Des. JF | Chk'd. AK
Dwn. NI | Chk'd. JF
Utility Circ. No. N/A | Index No. N/A
Const. Inspector N/A

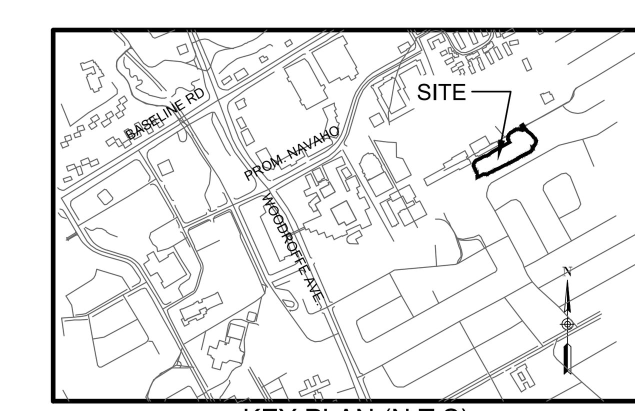
LICENSED PROFESSIONAL ENGINEER
J.G. FOOKES
OCT.17,2018
PROVINCE OF ONTARIO

Scale: 1:2000
HORIZONTAL
0m 20 40 80

MORRISON HERSHFIELD
2440 Don Reid Drive, Ottawa, Canada K1H 1E1
Tel: 613 739 2910 Fax: 613 739 4926 www.morrisonhershfield.com

REVISIONS

No.	Description	By	Date (dd/mm/yy)
01	REISSUED FOR SITE PLAN APPLICATION	JF	17/10/18



KEY PLAN (N.T.S)

UTILITY NOTE:

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

EROSION AND SEDIMENT CONTROL NOTE:

THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL, USING FILTER CLOTH UNDER THE GRATES OF CATCHBASINS AND MANHOLES AND INSTALLING SILT FENCES AND OTHER EFFECTIVE SEDIMENT TRAPS. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALITIES IMPOSED BY AN APPLICABLE REGULATORY AGENCY.

D07-12-18-0036

#17611

Appendix D

CONTENTS

Site Survey 1 pages

METRIC
DISTANCES AND ELEVATIONS SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

TOPOGRAPHIC SURVEY OF
PART OF LOT 34 CONCESSION 1, (RIDEAU FRONT) GEOGRAPHIC TOWNSHIP OF NEPEAN Now CITY OF OTTAWA

SCALE 1 : 200
0 5 10 20 metres

FAIRHALL, MOFFATT & WOODLAND LIMITED
ONTARIO LAND SURVEYORS

ELEVATION NOTES

1. ELEVATIONS SHOWN HEREON ARE REFERRED TO GEODETIC DATUM.
2. ELEVATIONS FOR MANHOLE COVERS AND CATCH BASINS HAVE TO BE INDEPENDENTLY CONFIRMED BEFORE THEY CAN BE ACCEPTED FOR FINAL DESIGN OR CONSTRUCTION PURPOSES.
3. IT IS THE RESPONSIBILITY OF THE USER OF THIS INFORMATION TO VERIFY THAT THE JOB BENCHMARK THAT NOT BEEN ALTERED OR DISTURBED AND THAT ITS RELATIVE ELEVATION AND DESCRIPTION AGREE WITH THE INFORMATION SHOWN ON THIS DRAWING.

UTILITY NOTES

1. THIS DRAWING CANNOT BE ACCEPTED AS ACKNOWLEDGING ANY UNDERGROUND UTILITIES AND IT WILL BE THE RESPONSIBILITY OF THE USER TO CONTACT THE RESPECTIVE UTILITY AUTHORITIES FOR CONFIRMATION OR LOCATION.
2. BEFORE ANY WORK INVOLVING PROBING, EXCAVATING, ETC., A FIELD LOCATION OF UNDERGROUND PLANT BY THE PERTINENT UTILITY AUTHORITY IS MANDATORY.

NOTES

1. THE COORDINATE SYSTEM OF THIS DRAWING IS GRID AND IS REFERRED TO THE CENTRAL MERIDIAN 76°30' W LONGITUDE, ZONE 9, OF THE 3° MTM ONTARIO COORDINATE SYSTEM (NAD83 ORIGINAL).
2. THE BOUNDARY IS PER PLAN 4R-20144 PREPARED BY FAIRHALL, MOFFATT & WOODLAND LTD., O.L.S., DATED FEB. 01, 2005 (REF. 141 – 1 (RF) NP.
3. THE SURVEY REPRESENTED BY THIS PLAN WAS COMPLETED ON MAY 25, 2011

LEGEND

DIA.	– DIAMETER
PIN	– PROPERTY IDENTIFIER NUMBER
	– SERIES OF RED FLAGS
CB	– CATCH BASIN
•	– BOLLARD
	– CONIFEROUS TREE
	– DECIDUOUS TREE
— ST —	– STORM SEWER
— G —	– GASMAIN

THIS IS NOT A VALID COPY UNLESS EMBOSSED WITH SEAL

Fairhall Moffatt & Woodland
LIMITED
ONTARIO LAND SURVEYORS
OTTAWA
Surveying and Land Information Services
100–600 TERRY FOX DRIVE, KANATA, ONTARIO K2L 4B6
TEL: (613) 591-2580 FAX: (613) 591-1495
www.fmw.on.ca

JOB No. N49800

E 363398, N 5023583

REFERENCE No. 152 (a) – 1 (RF) NP

S:\JOBS\N49800\DWGS 2011-05-30
TP498N-1.DWG (nj)

Appendix E

CONTENTS

Tree Conservation Report	24 pages

MORRISON HERSHFIELD

REPORT

Tree Conservation Report

Algonquin College Ottawa Campus, SWMP East of South Building

Ottawa, ON

Presented to:

City of Ottawa Planning Department
Forester

Algonquin College
c/o Scott McDermott
ON 1385 Woodroffe Ave, Nepean, ON K2G 1V8

Project No. 2085345.47 February 22, 2018

O:\OTTAWA\PROJ\2085345\2085345.47 INTEGRATED COLLEGE SWM POND DESIGN & CONSTRUCTION\300 - ENGINEERING\08 ENVIRONMENTAL\DRAFT_2085345-47_TREEREPORT_8JAN-18-REV1.DOCX

TABLE OF CONTENTS

Page

1. INTRODUCTION 1

2. INFORMATION TO BE INCLUDED WITH TREE CONSERVATION REPORT 1

2.1 A schedule of the proposed works, including the start and end dates and the construction period: 2

2.2 Confirmation of any other applications affecting the land, upon which the trees are to be protected, injured or destroyed: 2

2.3 Inventory of the trees currently on site, including species composition, size, age, and condition and health of the trees: 2

2.4 Description of the Environmental Value of the trees Within the Site 7

3. PROPOSED PROJECT 7

3.1 Vegetation to be removed 9

3.2 Mitigation Measures During Construction 10

3.3 Tree Planting and Post Construction Recommendations: 11

LIST OF FIGURES

Figure 1: Trees (location indicated with yellow circles and Tree #) assessed within property boundary with a diameter breast height of 10 cm or greater 4

Figure 2: Extent of Stormwater Pond Project.. 7

LIST OF TABLES

Table 1. Tree inventory Data 5

Appendix A – Curriculum Vitae of Certified Arborist

Appendix B – Photo Record

1. INTRODUCTION

Morrison Hershfield Limited submits this Tree Conservation Report as required due to the necessary removal of trees on a property greater than 1 ha in the urban area of Ottawa.

This report has been prepared by Bettina Henkelman, who is certified as an Arborist by the International Society of Arboriculture, and also has training in forestry, ecology, biology, and horticulture in accordance with the definition of “arborist” in Section 1 of By-law No. 2009-200. Her Curriculum Vitae is provided in Appendix A.

2. INFORMATION TO BE INCLUDED WITH TREE CONSERVATION REPORT

Owner:

Algonquin College, Ottawa Campus
c/o Scott McDermott
1385 Woodroffe Avenue
Ottawa, Ontario K2G 1V8
email: mcderms@algonquincollege.com

Arborist/Applicant on behalf of the Owner:

Bettina Henkelman
2440 Don Reid Drive
Ottawa, ON K1H 1E1
Phone: 613-739-2910 x 2470
Email: bhenkelman@morrisonhershfield.com

Contractor implementing the tree conservation plan:

To be Determined

The municipal address and legal description of the land, upon which the trees are proposed to be protected, injured or destroyed:

1195 Richmond Ro1385 Woodroffe Avenue, Ottawa ON K2G 1V8

Confirmation of existing Official Plan and zoning designations, and the status of any planning applications on the property:

Zoning on this property is I2 (Major Institutional Zone). There are no planning applications on the property.

The purpose for which the Tree Conservation Report is being prepared:

Re-design of re-construction of the Stormwater Management Pond east of the South Building must be carried out to accommodate deficits for future projects. In order to complete this work, the existing stormwater management pond must be enlarged.

2.1 A schedule of the proposed works, including the start and end dates and the construction period:

The work is scheduled to begin in summer of 2018, and will commence pending approval for tree removal. The Schedule is proposed as follows:

- January 2018 - Town Hall Meeting with the local Ward Councilor
- February 2018 - Formal Site Plan Application
- March 2018 - Public Tender
- May/June 2018 – Tree Spading of the selective trees the College wants to try and salvage
- June/July 2018 – Shovel in the ground (Earthworks)
- September/October 2018 – Landscaping Contract (including moving the salvaged trees into their final location)

The work is expected to be completed within 6 months once initiated.

2.2 Confirmation of any other applications affecting the land, upon which the trees are to be protected, injured or destroyed:

No other work is anticipated to be carried out which may affect the land at this time.

2.3 Inventory of the trees currently on site, including species composition, size, age, and condition and health of the trees:

Table 1 below corresponds to the trees shown on Figure 1, and provides the data for the inventoried trees. Any plants not noted were under 10 cm or were shrubs. Where diameter breast height (DBH) is indicated, it is measured as the trunk diameter is measured at a height of 1.2 metres. Trees that are highlighted in yellow in Table 1 are recommended for transplant due to their excellent condition and small size. Those highlighted in green should be retained and protected. **Appendix B** contains a photo record of the inventoried trees on-site.

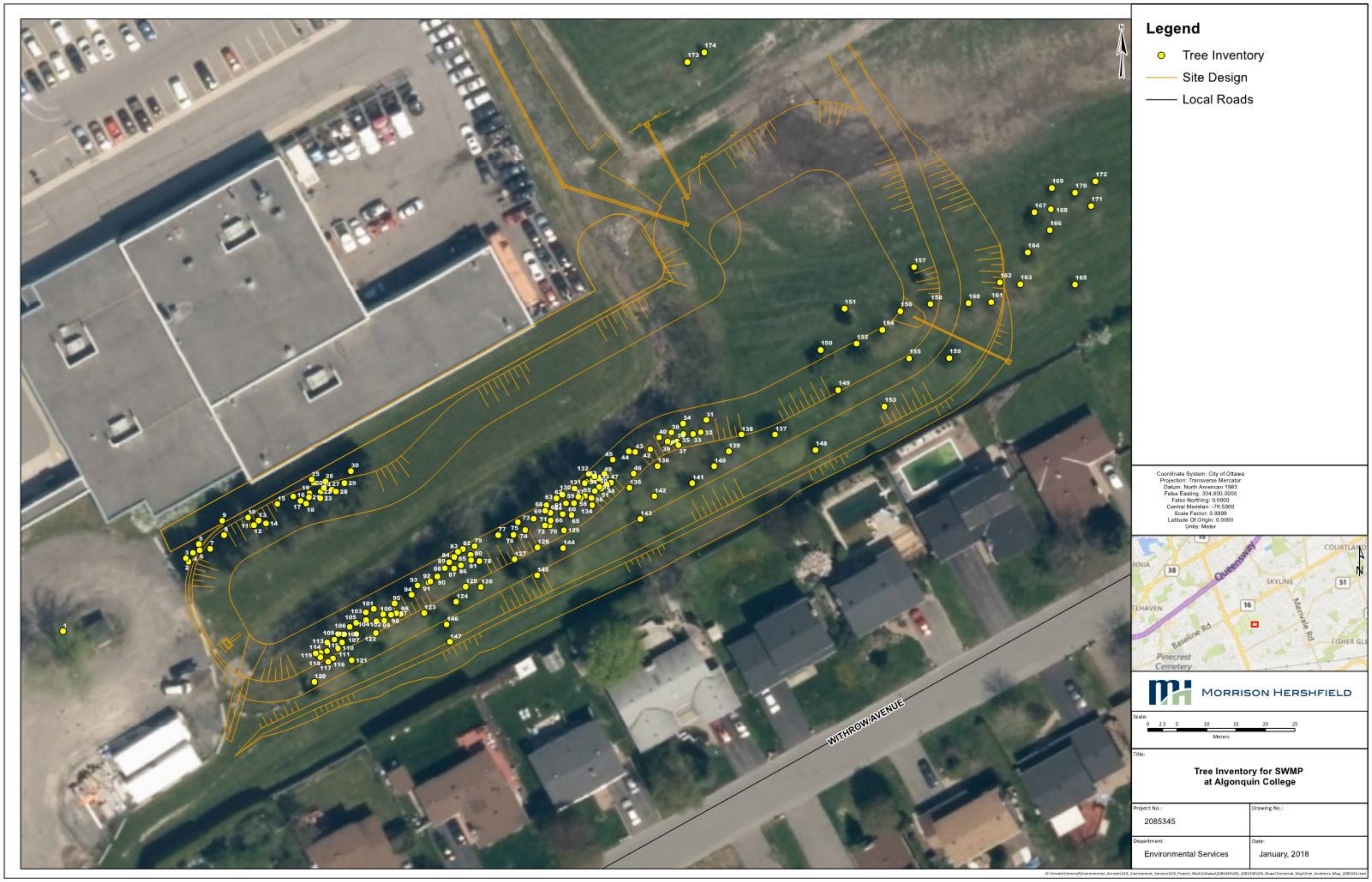


Figure 1: Trees (location indicated with yellow circles and Tree #) assessed within property boundary with a DBH of 10 cm or greater, or a planted specimen with a smaller DBH

Table 1. Tree inventory Data; highlighted in yellow are recommended for transplant, highlighted in green should be retained and protected

Tree ID #	Common Name	Scientific Name	DBH	Condition	number of trunks	Notes	Tag #
1	Silver Maple	*Acer saccharinum*	34	2	5	Poor Pruning cuts in crown, cavity in roots	697
2	Colorado Blue Spruce	*Picea pungens 'glauca'*	34	2	1	Crowded by adjacent trees	699
3	Colorado Blue Spruce	*Picea pungens 'glauca'*	19	2	1	Crowded by adjacent trees	700
4	Colorado Blue Spruce	*Picea pungens 'glauca'*	17	2	1	Crowded by adjacent trees	701
5	Colorado Blue Spruce	*Picea pungens 'glauca'*	8	2	1	Crowded by adjacent trees	702
6	Colorado Blue Spruce	*Picea pungens 'glauca'*	10	3	1	Crowded by adjacent trees	703
7	Colorado Blue Spruce	*Picea pungens 'glauca'*	21	2	1	Crowded by adjacent trees	704
8	Colorado Blue Spruce	*Picea pungens 'glauca'*	25	2	1	Crowded by adjacent trees	706
9	Colorado Blue Spruce	*Picea pungens 'glauca'*	28	2	1	Crowded by adjacent trees	707
10	Colorado Blue Spruce	*Picea pungens 'glauca'*	24	2	1	Crowded by adjacent trees	709
11	Colorado Blue Spruce	*Picea pungens 'glauca'*	13	2	1	Crowded by adjacent trees	710
12	Colorado Blue Spruce	*Picea pungens 'glauca'*	23	2	1	Crowded by adjacent trees	711
13	Colorado Blue Spruce	*Picea pungens 'glauca'*	16	3	1	Crowded by adjacent trees	713
14	Colorado Blue Spruce	*Picea pungens 'glauca'*	29	2	1	Crowded by adjacent trees	712
15	Colorado Blue Spruce	*Picea pungens 'glauca'*	32	2	1	Trunk damage due to equipment, Scarring over 16-30% of trunk, crowded by adjacent trees	714
16	Colorado Blue Spruce	*Picea pungens 'glauca'*	17	3	1	Trunk damage due to equipment, Scarring over 16-30% of trunk, crowded by adjacent trees	715
17	Colorado Blue Spruce	*Picea pungens 'glauca'*	17	4	1	Trunk damage due to equipment, Scarring over >30% of trunk, crowded by adjacent trees	716
18	Colorado Blue Spruce	*Picea pungens 'glauca'*	24	3	1	Trunk damage due to equipment, Scarring over 16-30% of trunk, crowded by adjacent trees	718
19	Colorado Blue Spruce	*Picea pungens 'glauca'*	15	2	1	Shaded by adjacent trees	717

Tree ID #	Common Name	Scientific Name	DBH	Condition	number of trunks	Notes	Tag #
20	Colorado Blue Spruce	*Picea pungens 'glauca'*	15	3	1	Scar over 5-15% of trunk, caused by equipment, trunk gall	719
21	Colorado Blue Spruce	*Picea pungens 'glauca'*	15	2	1	Crowded by adjacent trees	720
22	Colorado Blue Spruce	*Picea pungens 'glauca'*	12	3	1	Crowded by adjacent trees	722
23	Colorado Blue Spruce	*Picea pungens 'glauca'*	11	3	1	Crowded by adjacent trees, unbalanced crown	721
24	Colorado Blue Spruce	*Picea pungens 'glauca'*	8	4	1	Crowded by adjacent trees	724
25	Colorado Blue Spruce	*Picea pungens 'glauca'*	22	3	1	Crowded by adjacent trees	723
26	Colorado Blue Spruce	*Picea pungens 'glauca'*	15	3	1	Crowded by adjacent trees	728
27	Colorado Blue Spruce	*Picea pungens 'glauca'*	21	2	1	Crowded by adjacent trees	725
28	Colorado Blue Spruce	*Picea pungens 'glauca'*	25	2	1	Crowded by adjacent trees	726
29	Colorado Blue Spruce	*Picea pungens 'glauca'*	24	2	1	Crowded by adjacent trees	727
30	Colorado Blue Spruce	*Picea pungens 'glauca'*	35	2	1	Crowded by adjacent trees, unbalanced crown	729
31	Staghorn Sumac	*Rhus typhina*	10	1	44	Grove of suckering Staghorn Sumac	
32	Staghorn Sumac	*Rhus typhina*	10	1	3	Trunk lean >1%	
33	Littleleaf Linden	*Tilia cordata*	7	1	1		
34	Littleleaf Linden	*Tilia cordata*	8	2	1	Epicormic growth from roots	
35	Littleleaf Linden	*Tilia cordata*	6	1	1		
36	Red Maple	*Acer rubra*	17	2	2	Scar over 5-15% of trunk	
37	Hackberry	*Celtis occidentalis*	15	3	1	Trunk lean >1%, Scar over 16-30% of trunk	
38	Red Maple	*Acer rubra*	15	2	2	Epicormic growth, included bark	
39	Red Maple	*Acer rubra*	15	2	3	Weak union	
40	Hackberry	*Celtis occidentalis*	12	2	1	Trunk lean >1%	
41	Colorado Blue Spruce	*Picea pungens 'glauca'*	9	3	1	Dieback over 16-30% of crown	

Tree ID #	Common Name	Scientific Name	DBH	Condition	number of trunks	Notes	Tag #
42	Colorado Blue Spruce	*Picea pungens 'glauca'*	11	3	1	Trunk lean >1%, No Leader; sidebranch dominant	
43	Red Maple	*Acer rubra*	10	3	3	Scar over 16-30% of trunk, epicormic growth	
44	Red Maple	*Acer rubra*	10	3	5	Dieback over 5-15% of crown	
45	Trembling Aspen	*Populus tremuloides*	5	2	2	Scar over 5-15% of trunk	
46	Red Maple	*Acer rubra*	23	2	8	Crowded by adjacent trees	
47	Littleleaf Linden	*Tilia cordata*	12	1	2		
48	Littleleaf Linden	*Tilia cordata*	9	2	1	Crowded by adjacent trees	
49	Hackberry	*Celtis occidentalis*	6	2	1	Trunk lean >1%	
50	Trembling Aspen	*Populus tremuloides*	16	2	1	Trunk lean >1%, epicormic growth, Scar over 5-15% of trunk	
51	Trembling Aspen	*Populus tremuloides*	18	1	1		
52	Hackberry	*Celtis occidentalis*	10	2	1	Trunk lean >1%	
53	Trembling Aspen	*Populus tremuloides*	15	1	1		
54	Red Maple	*Acer rubra*	7	2	1	Trunk lean >1%	
55	Red Maple	*Acer rubra*	11	1	1	Crowded by adjacent trees	
56	Red Maple	*Acer rubra*	6	3	3	No Leader; sidebranch dominant	
57	Red Maple	*Acer rubra*	11	2	1	Unbalanced crown, crowded by adjacent trees	
58	Hackberry	*Celtis occidentalis*	10	2	1	Trunk lean >1%	
59	Red Maple	*Acer rubra*	23	2	1	Trunk lean >1%, weak union	1513
60	Silver Maple	*Acer saccharinum*	20	1	1		
61	Silver Maple	*Acer saccharinum*	9	2	1	Unbalanced crown	
62	Hackberry	*Celtis occidentalis*	4	2	1	Trunk lean >1%	
63	Red Maple	*Acer rubra*	10	2	2	Trunk lean >1%	
64	Trembling Aspen	*Populus tremuloides*	13	2	1	Bent top	1511
65	Trembling Aspen	*Populus tremuloides*	22	3	1	Crown broken off, Scar over 5-15% of trunk	1512
66	Hackberry	*Celtis occidentalis*	7	2	1	Trunk lean >1%	

Tree ID #	Common Name	Scientific Name	DBH	Condition	number of trunks	Notes	Tag #
67	Trembling Aspen	*Populus tremuloides*	11	1	2		
68	Silver Maple	*Acer saccharinum*	11	2	1	Trunk lean >1%	
69	Silver Maple	*Acer saccharinum*	11	2	1	Epicormic growth	
70	Silver Maple	*Acer saccharinum*	13	3	2	Epicormic growth	
71	Hackberry	*Celtis occidentalis*	9	2	1	Trunk lean >1%, unbalanced crown	
72	Hackberry	*Celtis occidentalis*	12	2	1	Scar over 5-15% of trunk	
73	Littleleaf Linden	*Tilia cordata*	9	3	1	Weak union, unbalanced crown, epicormic growth	
74	Littleleaf Linden	*Tilia cordata*	34	2	1	Weak union	
75	Colorado Blue Spruce	*Picea pungens 'glauca'*	10	2	1	Dieback over 5-15% of crown	
76	Colorado Blue Spruce	*Picea pungens 'glauca'*	14	2	1	Dieback over 5-15% of crown	
77	Colorado Blue Spruce	*Picea pungens 'glauca'*	14	2	1	Dieback over 5-15% of crown	
78	Red Maple	*Acer rubra*	22	2	1	Trunk lean >1%, epicormic growth, weak union	
79	Trembling Aspen	*Populus tremuloides*	19	1	1		
80	Trembling Aspen	*Populus tremuloides*	14	2	1	Trunk lean >1%	
81	Silver Maple	*Acer saccharinum*	18	2	1	Trunk lean >1%	
82	Silver Maple	*Acer saccharinum*	11	2	1	Trunk lean >1%	
83	American Elm	*Ulmus americana*	12	1	1		
84	American Elm	*Ulmus americana*	12	2	2	Weak union, included bark	
85	Hackberry	*Celtis occidentalis*	3	2	3	Scar over 5-15% of trunk	
86	Hackberry	*Celtis occidentalis*	15	2	1	Trunk lean >1%	
87	Hackberry	*Celtis occidentalis*	11	2	1	Trunk lean >1%	
88	Littleleaf Linden	*Tilia cordata*	13	2	1	Trunk lean >1%, double leader	
89	Hackberry	*Celtis occidentalis*	13	2	1	Trunk lean >1%, unbalanced crown	
90	Littleleaf Linden	*Tilia cordata*	16	2	3	Epicormic growth	
91	Hackberry	*Celtis occidentalis*	16	1	1		
92	Hackberry	*Celtis occidentalis*	12	3	1	Trunk lean >1%, Scar over 16-30% of trunk	

Tree ID #	Common Name	Scientific Name	DBH	Condition	number of trunks	Notes	Tag #
93	Colorado Blue Spruce	*Picea pungens 'glauca'*	15	1	1		
94	Colorado Blue Spruce	*Picea pungens 'glauca'*	15	1	1		
95	Colorado Blue Spruce	*Picea pungens 'glauca'*	13	3	1	Dieback over 16-30% of crown	
96	Hackberry	*Celtis occidentalis*	12	2	1	Trunk lean >1%	
97	Hackberry	*Celtis occidentalis*	20	2	1	Unbalanced crown	
98	Hackberry	*Celtis occidentalis*	14	2	1	Unbalanced crown, included bark	
99	Silver Maple	*Acer saccharinum*	5	2	1	No Leader; sidebranch dominant	
100	Hackberry	*Celtis occidentalis*	15	2	1	Unbalanced crown, Epicormic growth	
101	American Basswood	*Tilia americana*	11	2	1	Epicormic growth	
102	Silver Maple	*Acer saccharinum*	7	3	1	Scar over 16-30% of trunk	1487
103	American Basswood	*Tilia americana*	5	2	2		
104	American Basswood	*Tilia americana*	13	2	1	Epicormic growth	
105	Red Mulberry	*Morus rubra*	17	2	3	Weak union	1486
106	American Elm	*Ulmus americana*	11	2	1	Trunk lean >1%	
107	Trembling Aspen	*Populus tremuloides*	18	2	4	Included bark	1482
108	American Elm	*Ulmus americana*	15	2	1	Epicormic growth	
109	American Elm	*Ulmus americana*	8	2	2	Included bark	
110	Trembling Aspen	*Populus tremuloides*	14	2	1	Trunk lean >1%, unbalanced crown	1481
111	Silver Maple	*Acer saccharinum*	6	3	1	Scar over 16-30% of trunk	
112	Red Mulberry	*Morus rubra*	20	2	1	Included bark, weak union	1480
113	Red Mulberry	*Morus rubra*	16	2	2	Included bark, unbalanced crown	
114	Red Mulberry	*Morus rubra*	16	3	1	Trunk lean >1%, unbalanced crown, included bark	1478
115	Hackberry	*Celtis occidentalis*	5	2	1	Epicormic growth	
116	Silver Maple	*Acer saccharinum*	6	2	1	Scar over 5-15% of root flare	
117	Hackberry	*Celtis occidentalis*	16	2	1	Unbalanced crown	1477

Tree ID #	Common Name	Scientific Name	DBH	Condition	number of trunks	Notes	Tag #
118	Hackberry	*Celtis occidentalis*	10	2	2	Unbalanced crown	1476
119	Red Mulberry	*Morus rubra*	19	2	1	Unbalanced crown	1475
120	Balsam Fir	*Abies balsamea*	15	1	1		1004
121	Balsam Fir	*Abies balsamea*	11	1	1		1006
122	Balsam Fir	*Abies balsamea*	11	1	1		1009
123	Purple-leaved Chokecherry	*Prunus virginiana 'Schubert'*	9	2	1	Scar over >30% of root flare	
124	Purple-leaved Chokecherry	*Prunus virginiana 'Schubert'*	8	2	1	Scar over >30% of root flare	1013
125	Purple-leaved Chokecherry	*Prunus virginiana 'Schubert'*	10	2	1	Moderate Fungal Black Knot disease infestation	1014
126	Purple-leaved Chokecherry	*Prunus virginiana 'Schubert'*	8	5	1		
127	Balsam Fir	*Abies balsamea*	18	1	1		1018
128	Balsam Fir	*Abies balsamea*	14	1	1		1020
129	Balsam Fir	*Abies balsamea*	12	2	1	Unbalanced crown	1022
130	Silver Maple	*Acer saccharinum*	23	2	1	Circling roots	1514
131	Silver Maple	*Acer saccharinum*	17	1	1		1515
132	Trembling Aspen	*Populus tremuloides*	21	2	1	Unbalanced crown	1518
133	Trembling Aspen	*Populus tremuloides*	17	1	1		1516
134	Trembling Aspen	*Populus tremuloides*	20	1	1		1517
135	Sugar Maple	*Acer saccharum*	16	1	1		
136	American Basswood	*Tilia americana*	15	1	1		1026
137	Red Maple	*Acer rubra*	23	2	1	Scar over 5-15% of trunk	
138	Sugar Maple	*Acer saccharum*	14	2	1	Scar over 5-15% of roots, epicormic growth	1031
139	Sugar Maple	*Acer saccharum*	15	4	1	Scar over >30% of trunk, dieback over 31% of crown	1029

Tree ID #	Common Name	Scientific Name	DBH	Condition	number of trunks	Notes	Tag #
140	Sugar Maple	*Acer saccharum*	19	2	1	Weak union	
141	Sugar Maple	*Acer saccharum*	17	2	1	Included bark, weak union	
142	Sugar Maple	*Acer saccharum*	10	2	1	Scar over >30% of roots	1025
143	Sugar Maple	*Acer saccharum*	20	2	1	Weak union	
144	Littleleaf Linden	*Tilia cordata*	18	1	1		
145	Littleleaf Linden	*Tilia cordata*	19	1	1		
146	Sugar Maple	*Acer saccharum*	19	2	1	Weak union	
147	Red Oak	*Quercus rubra*	17	2	1	Scar over 5-15% of roots	1011
148	Littleleaf Linden	*Tilia cordata*	15	2	1	Epicormic growth	1034
149	Littleleaf Linden	*Tilia cordata*	16	2	1	Epicormic growth	1035
150	Red Pine	*Pinus resinosa*	20	2	1	Dieback over 5-15% of crown	1036
151	Balsam Fir	*Abies balsamea*	14	1	1		1037
152	Red Pine	*Pinus resinosa*	14	1	1		1038
153	Red Oak	*Quercus rubra*	19	1	1		1039
154	Paper Birch	*Betula papyrifera*	13	2	2		1040
155	Ironwood	*Ostrya virginiana*	5	1	1		1042
156	Paper Birch	*Betula papyrifera*	12	2	3		1041
157	Balsam Fir	*Abies balsamea*	11	2	1	Dieback over 5-15% of crown	1043
158	Paper Birch	*Betula papyrifera*	13	2	2		1044
159	Manitoba Maple	*Acer negundo*	17	3	1	Included Bark, Scar over 5-15% of trunk	1045
160	Black Birch	*Betula nigra*	9	2	2	Epicormic growth	1047
161	Black Birch	*Betula nigra*	11	2	3	Epicormic growth	1048
162	Black Birch	*Betula nigra*	11	2	2	Epicormic growth	1049
163	Black Birch	*Betula nigra*	9	2	3		1050
164	Littleleaf Linden	*Tilia cordata*	13	2	1	Epicormic growth	1051
165	Littleleaf Linden	*Tilia cordata*	15	2	1	Epicormic growth	1053
166	Ironwood	*Ostrya virginiana*	7	3	1	Epicormic growth, Scar over 16-30% of root flare	1054
167	Red Pine	*Pinus resinosa*	12	1	1	Trunk lean >1%	1052

Tree ID #	Common Name	Scientific Name	DBH	Condition	number of trunks	Notes	Tag #
168	Ironwood	*Ostrya virginiana*	4	4	1	Scar over >30% of root flare	1055
169	Ironwood	*Ostrya virginiana*	8	2	1	Scar over 16-30% of root flare	1056
170	Ironwood	*Ostrya virginiana*	8	1	1		1057
171	Red Oak	*Quercus rubra*	8	2	1	Scar over 5-15% of root flare	1058
172	Ironwood	*Ostrya virginiana*	8	2	1	Scar over 5-15% of root flare	1059
173	Freeman Maple	*Acer x freemanii*	15	4	1	Scar over >30% of trunk	241
174	Silk Lilac tree	*Syringa japonica*	9	2	1	Scar over 5-15% of trunk	730

2.4 Description of the Environmental Value of the trees Within the Site

There are no natural surface water features, wetlands or watercourses; However, a man-made ditch and stormwater pond were present on the site.

There were no steep slopes (including valleys and escarpments), valued woodlots designated as Urban Natural Features or Natural Environment Areas, areas evaluated in the Urban Natural Areas Environmental Evaluation Study (UNAEES), or other areas that meet the criteria used in the UNAEES.

The site does provide greenspace linkages as identified in the Greenspace Master Plan being near a multi-use pathway and the Ottawa River Corridor, but no natural linages are present. The site does not contain rare communities or other unique ecological features, or Species at Risk and their habitat.

3. PROPOSED PROJECT

The proposed project is for the re-design and re-construction of the stormwater management pond and part of the ditch on the Algonquin College Campus southeast of the Transportation Technology Centre. Figure 2 depicts the extent of the proposed work.

It is recommended that the base of the pond is covered with non-woven geotextile, followed by a minimum of 300 mm of compacted crushed Granular B Type II stone. Two (2) earth berms with side slopes of 3 horizontal to 1 vertical will be constructed to elevation of 84.1 and 80.0 m within the northern area of the proposed pond.

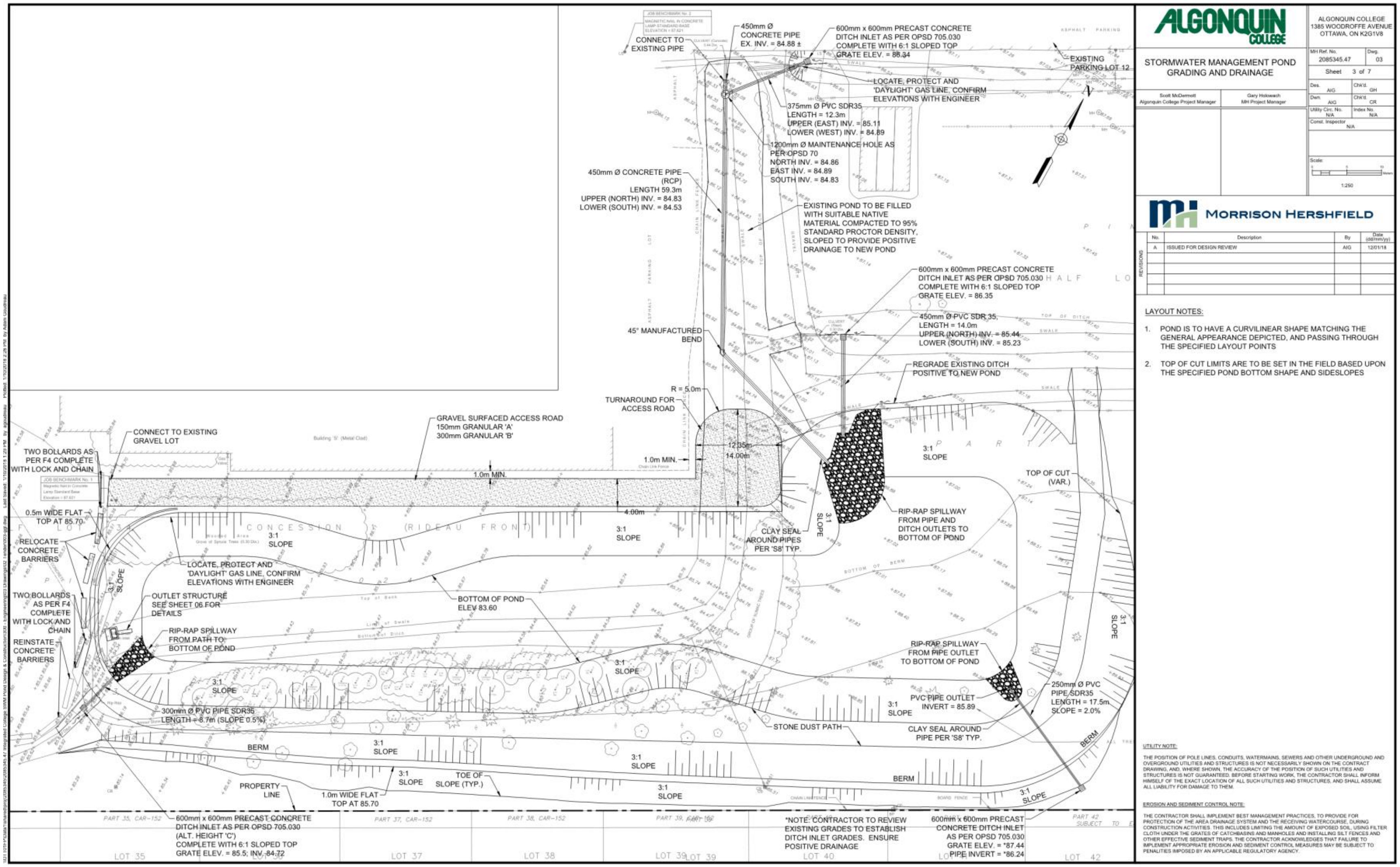


Figure 2: Extent of Stormwater Pond Project

3.1 Vegetation to be removed

The vegetation within the Stormwater Management Pond must be removed.

The excavated material and construction staging area must be kept out of non-project areas, and trees not identified as requiring removal will not have excavated materials and other construction equipment placed over top of their roots systems.

There will be no permanent changes to impervious surfaces, or to the water table. During construction, minor changes will occur; however, it is unlikely that the impacts will be great enough or lengthy enough in duration to affect plant material. There will be permanent changes to grades and drainage patterns, thus replanting must be carried out to suit the proposed site conditions.

It is recommended that the trees be removed outside of the breeding bird season (generally May 1 to July 31) to avoid the contravention of the *Migratory Birds Convention Act* (1994), however if this not possible, it is advised that the vegetation to be removed is inspected for nests as per ECCC guidelines (https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/technical-information-risk-factors.html#_01), and if nests are observed, no activities are carried out which may harm or harass birds or nests as per the *Migratory Birds Convention Act* (1994).

Prior to removing trees in winter, spring and early summer, inspect the trees for wildlife, as they may contain overwintering species in the trees, or bearing young. Refer to the City of Ottawa's Protocol for Wildlife Protection during Construction for other recommendations and mitigations (http://documents.ottawa.ca/sites/documents.ottawa.ca/files/documents/construction_en.pdf).

All vegetation to be removed must be done in a manner in compliant with the Ministerial Order which has been issued by the Federal Government restricting the movement of wood out of the Regional area due to Emerald Ash Borer (EAB). Due to Emerald Ash borer invasion, it is recommended that the owners have them removed by a reputable Contractor. The Contractor must dispose of all wood at registered Waste Facility.

For properties where the emerald ash borer has been confirmed, a prohibition of movement will be issued. A prohibition of movement prohibits the movement of regulated materials from that specific property. This measure is taken to prevent movement of potentially infested materials off the property.

The Ministerial Order states that Regulated articles include the following:

- ash nursery stock;
- ash trees;
- ash logs;
- ash wood;
- rough lumber (including pallets and other wood packaging materials containing ash, wood, bark, wood chips or bark chips from ash trees); and
- firewood of all tree species.

The ministerial order extends to vehicles that were used to carry any of these items.

Moving these materials from regulated areas is permitted only if the following conditions are met:

- the materials have been treated to kill or remove all life stages of the emerald ash borer; and
- written permission has been obtained from a Canadian Food Inspection Agency (CFIA) inspector.

Although this area is not regulated for Asian Long-horn beetle, it is advised that all wood being removed be inspected for this invasive pest. If any are observed, the CFIA should be contacted immediately and none of this wood may be moved without written permission from the CFIA.

3.2 Mitigation Measures During Construction

The health and vigour of trees continually change over time due to seasonal variations in weather, changes in site conditions, phenology, and other factors. For this reason, the assessment presented in this report is valid at the time of inspection, and no guarantee is made about the continued health of trees that are currently deemed to be in good condition. It is recommended that the trees be re-assessed prior to project activities, if they are not imminent. While every standing tree has potential for failure and, therefore, poses some risk, a tree assessment provides valuable information regarding current health, as well as any potential problems.

Details of individuals recommended to be retained, relocated, or removed are provided in **Table 1**. Trees in Excellent or Good condition are likely to have good longevity with minimal maintenance, and should be retained wherever possible. Several trees within removal areas were noted to be in excellent condition and of a sufficiently small size (generally under 15 cm dbh) to be potentially transplanted – these are highlighted in green on **Table 1**. However, transplanting requires specialized care to ensure a large enough rootball is excavated, and should be carried out and replanted while the trees are dormant to facilitate some measure of success.

Where trees must be removed due to unavoidable construction impacts, native trees ≤ 10 cm in DBH, should be relocated to suitable areas nearby. Trees in Fair condition are expected to require significant maintenance and may need to be monitored for changes in health that could cause them to become hazardous. Depending on their proximity to future infrastructure and other potential sources of impact, as well as the severity and extent of disturbance likely to occur near them, such trees may not be worth preserving. Additionally, all trees rated in Poor condition or Dead need not be retained as they may become a risk to public safety. As well, all non-native and/or invasive tree species (e.g. Manitoba Maple) in poor condition or dead should not be retained because of known ecological impacts associated with such species. Any transplanting work should be done under the supervision and guidance of a Certified Arborist or Registered Forester.

Based on the health assessment of the inventoried trees, a total 12 trees are recommended for on-site relocation where possible, and 145 for removal and compensation where possible. It should be noted, that these numbers may change once the detailed design for the stormwater pond are finalized.

According to Forestry By-law 2006-279, Part 1 General the following definitions are provided:

- **Critical Root Zone (CRZ):** the area of land within a radius of ten (10) cm from the trunk of a tree for every one (1) cm of trunk diameter. Used synonymously with the term dripline (the area of ground below a tree, delineated by the outermost circumference of the canopy).
- **Diameter:** the measurement of trunk width at a height of one-hundred and twenty (120) cm for trees of fifteen (15) cm or greater, and a height of thirty (30) cm for trees of less than fifteen (15) cm.

In order to protect species not required for removal due to the proposed project, the following mitigations measures should be carried out (from Standard Tree Protection Forestry By-law 2006-279 and Special Provision No: F-5651):

1) Trees whose driplines are within five (5) metres of the work area must be protected by installing a snow fence outside of the trees' driplines.

2) The Contractor is responsible for the maintenance of 'Tree Protection Fencing' at all times during construction. Maintenance includes the repair of damaged fence sections and the reinstatement of 'Tree Protection Fencing' as required.
3) During excavation, equipment must be maintained within the confines of the work area, so as not to disrupt any turf or tree roots unnecessarily, and the storage of equipment and vehicles around trees within the right of way is prohibited.
4) All excavated material, including imported material, must be removed immediately and not placed on grass or near trees, in order to prevent root damage, accidental hitting of adjacent trees, and turf damage outside of the work area.
5) Disturbed turf is to be reinstated to its original state immediately upon completion of work.
6) Equipment working around the tree canopy (i.e. high hoe) must be utilized in such a way as to prevent damage to tree branches and avoid them.
7) No fuel is to be stored within the dripline of any tree and exhaust fumes from all equipment must not be directed towards any trees' canopy.

As well, according to Tree Protection, Part II Sect. 8 (a) and (b), the following apply:

a. In the event of injury to any tree as determined by the director, to reimburse the City for the cost of treatment for the tree or cause the tree to be repaired by a qualified arborist and bear the cost of repairs and labour;
b. In the event that the tree is irreparably injured as determined by the Director, to reimburse the City for the cost of removal and replacement of the tree and pay the City the cash value of the injured tree and the cash value of a replacement tree.

Additionally, the following protection measures are recommended:

- Do not attach any signs, notices or posters to any tree;
- Do not raise or lower the existing grade within the CRZ more than 5 centimetres without approval from the Contract Administrator;
- When tunneling or boring below the trees, maintain a minimum of 500 mm below the ground surface within the CRZ of trees to be retained
- Do not damage the root system, trunk or branches of any tree; if any roots are encountered during excavation, they shall be cut off cleanly
- All exposed roots of trees to be retained shall be covered in a minimum of 5 cm of firm soil within 24 hours of exposure

3.3 Tree Planting and Post Construction Recommendations:

Trees to be avoided include Ash (*Fraxinus* sp.), as they are susceptible to the Emerald Ash Borer, and brittle trees such as Manitoba Maple (*Acer negundo*) and Siberian Elm (*Ulmus pumila*) are to be avoided.

All grass around trees should be mowed and trimmed carefully to avoid bark removal or damage to bark 9mower damage was evident on many of the existing trees). If possible, the base of all trees should be mulched in a minimum 0.5 metre wide ring with 3-4 inches of mulch and pulled 5 cm away from the bark to prevent grass/weed growth necessitating mowing directly around the root collar and inadvertent damage. Removal and damage to the bark and cambium can allow diseases.

For any trees which have had work done within the CRZ, follow-up care is to be provided. Maintain adequate soil moisture, nutrition, and aeration throughout the following year; trees should be monitored on a yearly basis, during an appropriate time of year, for 2 years following work within the CRZ, to determine whether further follow-up action is required.se to enter as well as the trees ability to transport nutrients.

A 2:1 planting of trees for every tree lost is recommended as several trees to be retained are showing signs of decline and the large Ash trees may be lost to Emerald Ash Borer in the near future.

By planting additional trees in the near future, the property owners will ensure that their landscaping contains mature healthy trees, shade, a windbreak and noise barrier, and cooling during the summer which will offset cooling costs. As well, the aesthetic value of the property will be maintained and consequently the economic value will also remain high.

Some recommended small to medium-sized trees include:

- Cedar [*Thuja occidentalis* or *orientalis*]
- River Birch [*Betula nigra*]
- Buckeye [*Aesculus glabra*]
- Black Cherry, or Choke or Pin Cherry [*Prunus serotina, virginiana, pensylvanica*]
- Tamarisk, Salt Cedar [*Tamarix sp.*]
- Red Elder [*Sambucus racemosa*]
- Hazelnut [*Corylus avellana*]
- Smoketree [*Cotinus sp*.]
- Wayfaring Tree [*Viburnum lantana*]
- Witchhazel [*Hamamelis virginiana*]
- Smooth Sumac [*Rhus glabra*]
- Various columnar trees [*Pyrus, Malus, Quercus, Cupressus, Fagus, Chamaecyparis, Juniperus, Carpinus*]

Some recommended larger-sized trees include:

- Kentucky Coffee Tree [*Gymnocladus dioicus*]
- Ginkgo [*Gingko biloba*]
- Hackberry [*Celtis occidentalis*]
- Bitternut Hickory [*Carya cordiformis*]
- Honey Locust [*Gleditsia triacanthos var. inermis*]
- Red Maple (*Acer rubrum*)
- Catalpa [*Catalpa speciosa*]
- Freeman's Maple [*Acer saccharinum x Acer rubrum*
- Basswood, or Linden [*Tilia americana or cordata*]
- Bur Oak [*Quercus macrocarpa*]
- Pin Oak [*Quercus ellipsoidalis*]
- Black Walnut [*Juglans nigra*]
- Sugar Maple [*Acer saccharum*]

Sincerely,
Morrison Hershfield Limited

B Henkelman

Prepared By:
Bettina Henkelman, BSc. TRAQ ISA, EP.
Certified TRAQ Arborist and Senior Biologist

APPENDIX A – CURRICULUM VITAE OF STAFF PREPARING THE TREE CONSERVATION REPORT

Bettina Henkelman

B.Sc., Environmental Science, CCEP

Terrestrial Restoration Ecologist, Arborist, Horticulturist, Community Sustainability Specialist

Experience

Bettina brings over 20 years of experience to her position of Arborist /Forestry Technician and Horticulturist/Landscape Designer at MH. She has a rich history of experience in various horticultural and environmental fields. The following is a summary of varied skills.

Arborist/Forestry Technician

- Acquired International Society International Society of Arboriculture Certified Arborist and Tree Risk Assessor, Certification No.: ON-1266A).
- Conducted tree retention reports, urban forest management plans and arborist evaluations for public and private clients. Projects include:
  - Public park remediation projects for B.C. Provincial Parks, Garibalidi/Sunshine Coast District, BC
  - Forest/woodlot management plan for Oxbow Creek Enhancement project, Ottawa, ON
  - Arborist Assessments within Simcoe and Grey County, ON
  - Tree Retention Report for Hamilton Creek, Collingwood, ON
- Performed forestry analysis for Austria's Federal Forestry Research Institute, Vienna, Austria.

Horticulture/Landscape Design

- Managed and designed landscape plans for residential and commercial developments, Municipal and Federal projects.
- Carried out landscape design for North Halton Golf and Country Club, West Vancouver Golf and Country Club, Park and Tilford Gardens, Governor General's Residence, and large residential developments in Simcoe County, the City of Toronto, and the City of Barrie.
- Created tailored planting plans and designs, incorporating low maintenance, practical landscape solutions to traditional, highly manicured, and naturalistic styles.

Restoration/Naturalization Ecologist

- Designed restoration plans for terrestrial, wetlands and riparian systems based on specific site requirements and local ecosystems, restoring natural function and creating self-sustaining habitats, while fulfilling the objectives of municipal planning authorities and clients for private and public lands.
- Authored training manual on best management practices for shoreline landscaping and developed guide for native plant best suited for landscape plantings.
- Project Leader and on the Advisory Committee for Audubon Certification with the Cooperative Sanctuary Program, including designing of areas to be naturalized.

Education

B.Sc. Environmental Science Carleton University

Landscaping/Horticulture, Capilano College

Forestry, Sir Sandford Fleming College

Professional Affiliations

Field Botanists of Ontario & Ecological Society of America

Society for Ecological Restoration & Ontario Field Naturalists

APPENDIX B – PHOTO RECORD OF TREE SURVEY

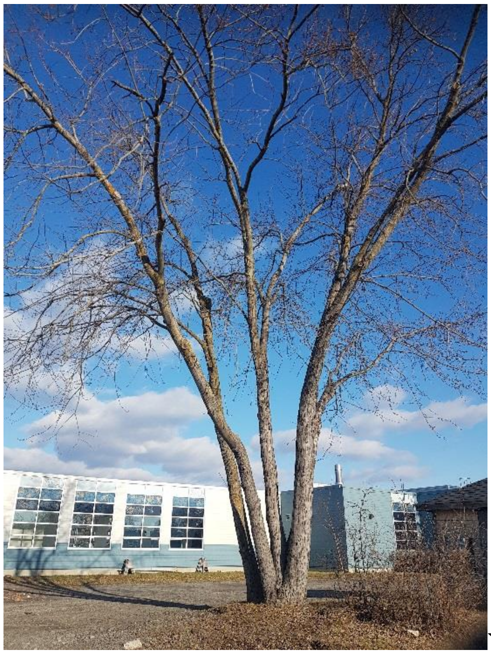


Photo 1: Tree #1

Photo 2: Example of scarring on trunk

Photo 3: Ditch in north end of site

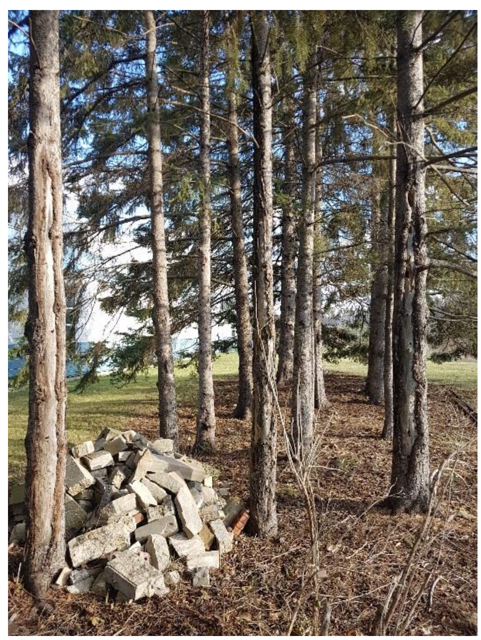


Photo 4: Coniferous Trees

Photo 5: Trees above existing wetland

Photo 6: Broken tree within hedgerow

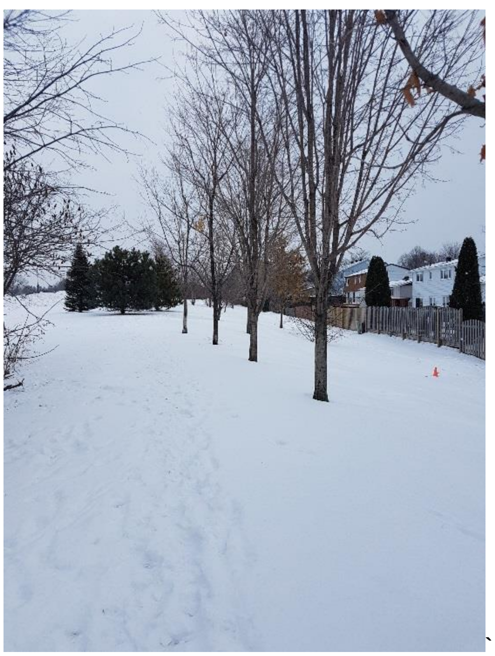


Photo 7: Row of maples, #141 in foreground

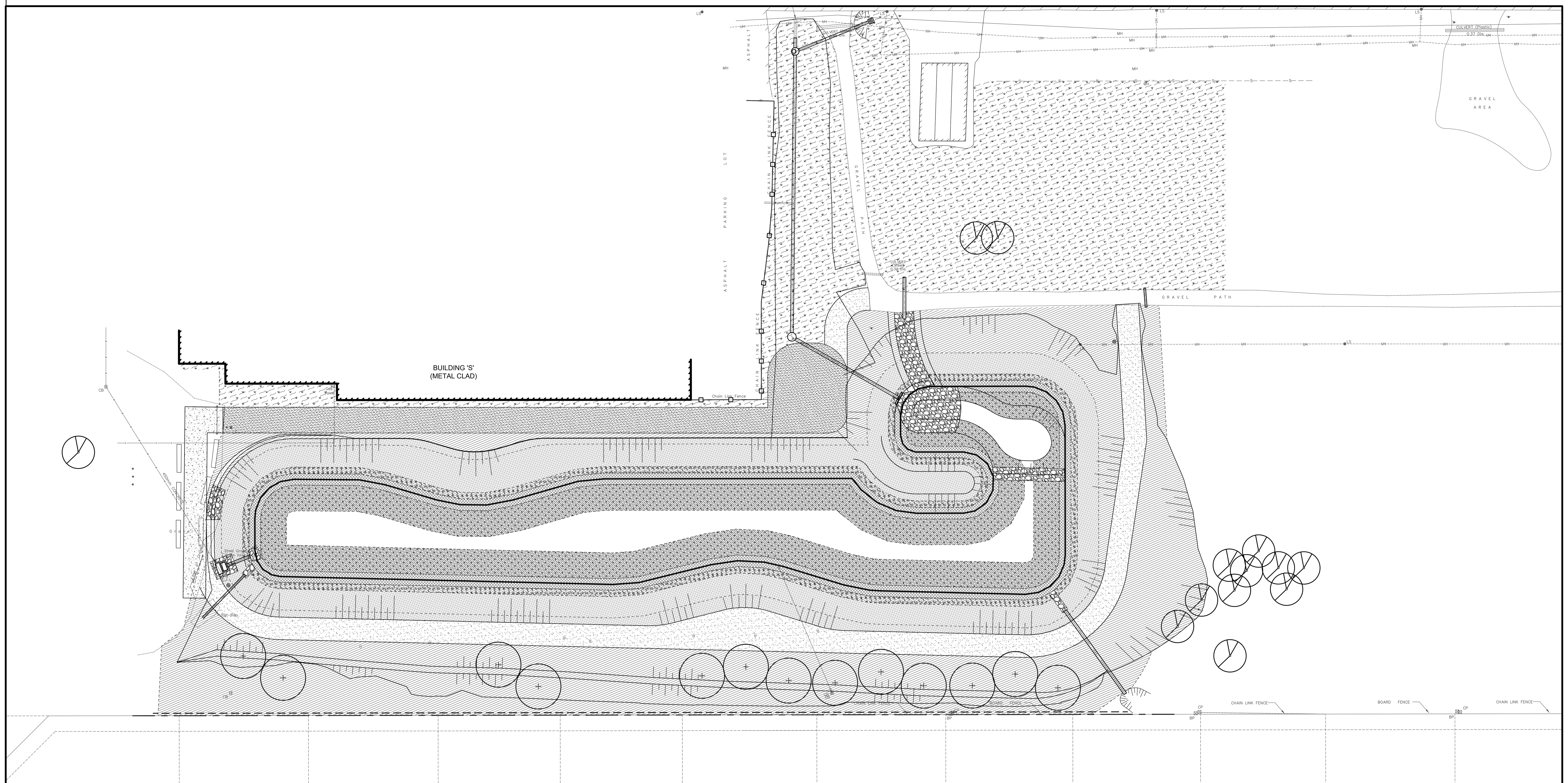
Photo 8: Bark of Black Birch

`

Appendix F

CONTENTS

Landscape Drawings 3 pages



ALGONQUIN COLLEGE

ALGONQUIN COLLEGE

STORM WATER MANAGEMENT POND

LANDSCAPE

L.000	Cover
L.101	Topsoil Depth Plan
L.102	Planting Plan & Layout Plan
L.103	Hydroseeding Planting Plan
L.200	Details

CIVIL

2085345.47 – 006	Erosion and Sediment Control

DRAWING ISSUE RECORD

01	2018-08-08	ISSUED FOR TENDER
02	2018-09-07	ISSUED FOR ADDENDUM

CONSULTANT DIRECTORY

LANDSCAPE ARCHITECT

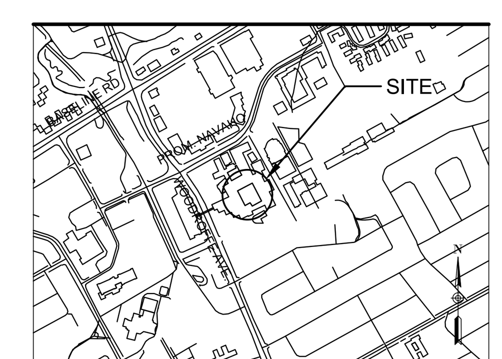
BrookMcIlroy/
ARCHITECTURE - LANDSCAPE ARCHITECTURE
URBAN DESIGN - PLANNING

TORONTO OFFICE
200 - 161 SPADINA AVE.
TORONTO, ON M5V 2L6
T. 416 504 5997 F. 416 504 7712

CIVIL / CONTACT ADMINISTRATOR/ PRIME CONSULTANT

MORRISON HERSHFIELD

2440 Don Reid Drive
Ottawa, ON K1H 1E1
T: +1 613 739 2910



KEY PLAN (N.T.S)

REVISIONS

NO.	DATE	REVISIONS

DRAWING ISSUE RECORD

NO.	DATE	DRAWING ISSUE RECORD	MEDIA
01	2018-08-08	ISSUED FOR TENDER	36X24
01	2018-09-07	ISSUED FOR ADDENDUM	36X24

DISCLAIMER

PROJECT

ALGONQUIN COLLEGE
STORM WATER MANAGEMENT POND

CLIENT

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE

1385 WOODROFFE AVENUE
OTTAWA, ON K2G1V8

BrookMcIlroy/

ARCHITECTURE - LANDSCAPE ARCHITECTURE - URBAN DESIGN - PLANNING

200-161 SPADINA AVENUE
TORONTO, ON M5V 2V6
T. 416 504 5997 F. 416 504 7712

SHEET TITLE

COVER

PROJECT NO.	17-003
DESIGNED	CB
DRAWN	AA/TK
DATE	2018-08-08
SCALE	1:250
SHEET NO.	L.000

D07-12-18-0036

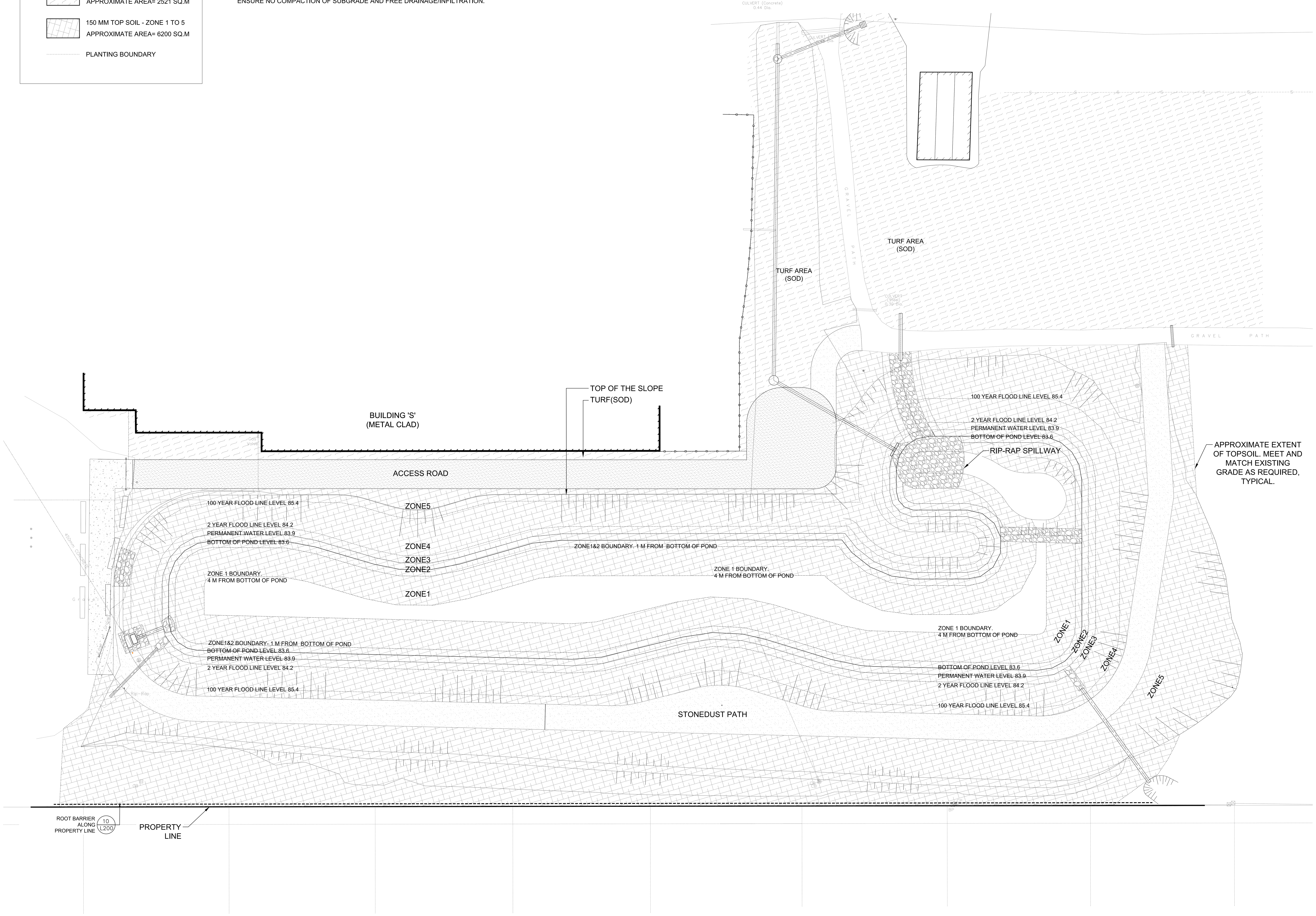
#17611

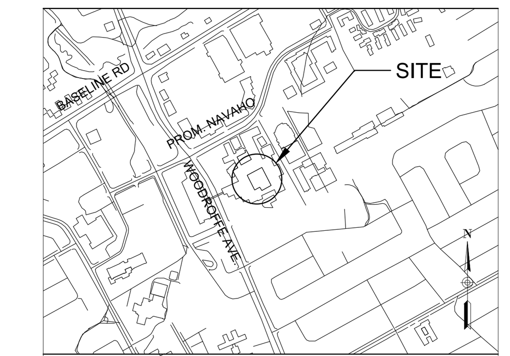
LEGEND

	100 MM TOPSOIL - SOD AREA APPROXIMATE AREA= 2521 SQ.M
	150 MM TOP SOIL - ZONE 1 TO 5 APPROXIMATE AREA= 6200 SQ.M
	PLANTING BOUNDARY

NOTES

SCARIFY SUB-GRADE TO A MINIMUM DEPTH OF 300MM PRIOR TO PLACING TOPSOIL. SCARIFICATION PROCESS SHALL ENSURE NO COMPACTION OF SUBGRADE AND FREE DRAINAGE/INFILTRATION.





KEY PLAN (N.T.S)

REVISIONS

NO.	DATE	REVISIONS

DRAWING ISSUE RECORD

NO.	DATE	DRAWING ISSUE RECORD	MEDIA
01	2018-09-07	ISSUED FOR ADDENDUM	36X24
01	2018-08-08	ISSUED FOR TENDER	36X24

DISCLAIMER

PROJECT

ALGONQUIN COLLEGE
STORM WATER MANAGEMENT POND

CLIENT

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE

1385 WOODROFFE AVENUE
OTTAWA, ON K2G1V8

BrookMcIlroy/

ARCHITECTURE • LANDSCAPE ARCHITECTURE • URBAN DESIGN • PLANNING

200-161 SPADINA AVENUE
TORONTO, ON M5V 2V6
T. 416 504 5997 F. 416 504 7712

SHEET TITLE

TOPSOIL DEPTH PLAN

PROJECT NO.	17-003
DESIGNED	CB
DRAWN	AA/TK
DATE	2018-08-08
SCALE	1:250
SHEET NO.	L101

D07-12-18-0036

#17611

AQUATIC PLANTING SCHEDULE

AQUATIC					
Zone 1 - Deep Water Area (Total = 1167 sq m)					
Spacing notes: aim to provide a minimum of 40% vegetative cover to minimize shallow water warming and the help prevent algae growth. Recommended number of plants is three plants per linear meter of water's edge.					
Plant Type	**Common Name**	**Botanical Name**	**Condition**	**SPACING(m)**	**QUANTITY**
Submergent	*Ceratophyllum demersum*	Common Hornwort	plugs	0.4	113
	Elodea canadensis	Broad Waterweed	plugs	0.4	113
	Potamogeton pusillus	Slender Pondweed	plugs	0.4	122
	Vallisneria americana	Tape Grass	plugs	0.4	122
Floating	*Nymphaea odorata ssp. Odorata*	White Water Lily	plugs	0.6	50
	Nuphar luteassp. Variegata	Yellow Pond Lily	plugs	0.4	117
	Potamogeton amplifolius	Large-leaved Pondweed	plugs	0.4	117
	Potamogeton natans	Floating Pondweed	plugs	0.4	122
Zone 2 - Shallow Water Area (Total = 580 sq m)					
Spacing notes: aim to provide 100% vegetative cover to discourage loafing geese and to act as a barrier to casual entry.					
Plant Type	**Common Name**	**Botanical Name**	**Condition**	**SPACING(m)**	**QUANTITY**
Robust Emergent	*Schoenoplectusspp.*	Bulrush	plugs	0.3	135
	Typha latifolia	Common Cattail	plugs	0.3	135
Broadleaved Emergent	*Sagittaria latifolia*	Broadleaf Arrowhead	plugs	0.3	135
	Alisma plantago-aquatica	Common Water Plantain	plugs	0.3	135
Narrowleaved Emergent	*Calamagrostis canadensis*	Bluejoint	plugs	0.3	135
	Carex comosa	Bristly Sedge	plugs	0.3	135
	Carex crinita	Fringed Sedge	plugs	0.3	135
	Carex pseudocyperus	Cypress Sedge	plugs	0.3	135
	Carex retrorsa	Retrorse Sedge	plugs	0.3	124
	Carex stricta	Upright Sedge	plugs	0.3	124
	Carex vulpinoidea	Fox Sedge	plugs	0.3	124
	Glyceria maxima var. 'Variegata'	Variegated Mannagrass	plugs	0.3	124
	Glyceria striata	Fowl Mannagrass	plugs	0.3	124
	Leersia oryzoides	Rice Cut Grass	plugs	0.3	124
	Sparganium eurycarpum	Giant Bur-reed	plugs	0.3	124
	Sparganium fluctuans	Floating Bur Reed	plugs	0.3	124

PLANTING SCHEDULE

Symbol	Quantity	Common Name	Scientific Name	Size	Notes	Cond.
TREES - DECIDUOUS						
AR	3	Red Maple	*Acer rubrum*	50mm cal.	Deciduous Tree	W.B.
AS	2	Silver Maple	*Acer saccharinum*	50mm cal.	Deciduous Tree	W.B.
BP	4	Paper Birch	*Betula papyrifera*	50mm cal.	Multi-Stem	W.B.
CC	2	Bitternut Hickory	*Carya cordiformis*	50mm cal.	Deciduous Tree	B.B
LL	4	American Larch	*Larix laricina*	150cm	Deciduous Tree	W.B.
PSE	4	Wild Black Cherry	*Prunus serotina*	50mm cal.	Deciduous Tree	W.B.
PT	3	Trembling Aspen	*Populus tremuloides*	50mm cal.	Deciduous Tree	W.B.
QR	4	Red Oak	*Quercus rubra*	60mm Cal	Deciduous Tree	W.B.
SN	7	Black Willow	*Salix nigar*	50mm cal.	Deciduous Tree	W.B.
TA	4	American Basswood	*Tilia americana*	60mm Cal	Deciduous Tree	W.B.
TREES - EVERGREEN						
AB	2	Balsam Fir	*Abies balsamea*	150cm	Evergreen Tree	B.B
PG	5	White Spruce	*Picea glauca*	150cm	Evergreen Tree	B.B
PS	3	Eastern White Pine	Pinus strobus	150cm	Evergreen Tree	B.B
SHRUBS - DECIDUOUS						
RT	109	Staghorn Sumac	*Rhus typhina*	100cm	Deciduous Shrub	3 gal

EXISTING TREES TO BE TRANSPLANTED

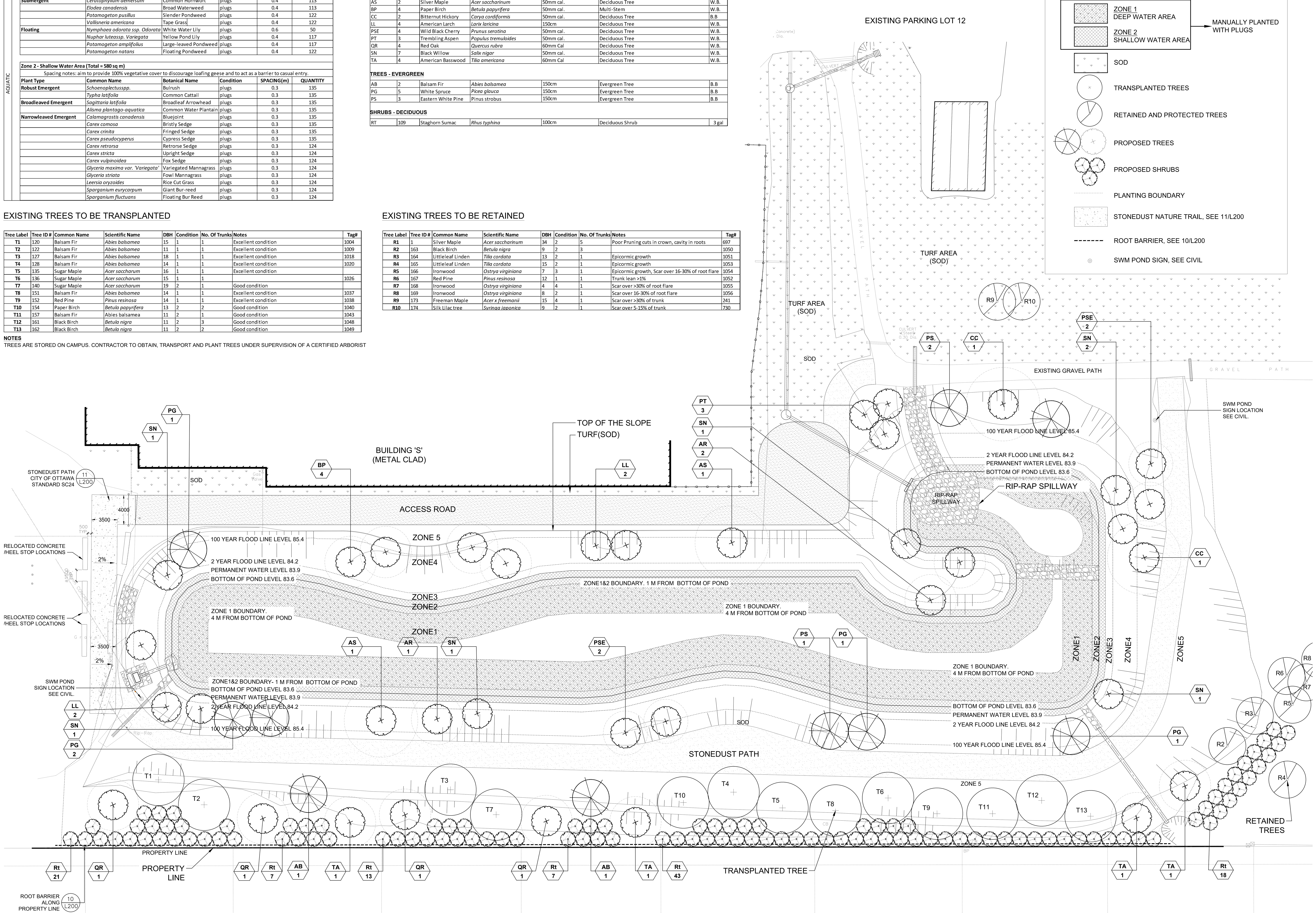
Tree Label	Tree ID #	Common Name	Scientific Name	DBH	Condition	No. Of Trunks	Notes	Tag#
T1	120	Balsam Fir	*Abies balsamea*	15	1	1	Excellent condition	1004
T2	122	Balsam Fir	*Abies balsamea*	11	1	1	Excellent condition	1009
T3	127	Balsam Fir	*Abies balsamea*	18	1	1	Excellent condition	1018
T4	128	Balsam Fir	*Abies balsamea*	14	1	1	Excellent condition	1020
T5	135	Sugar Maple	*Acer saccharum*	16	1	1	Excellent condition	
T6	136	Sugar Maple	*Acer saccharum*	15	1	1		1026
T7	140	Sugar Maple	*Acer saccharum*	19	2	1	Good condition	
T8	151	Balsam Fir	*Abies balsamea*	14	1	1	Excellent condition	1037
T9	152	Red Pine	*Pinus resinosa*	14	1	1	Excellent condition	1038
T10	154	Paper Birch	*Betula papyrifera*	13	2	2	Good condition	1040
T11	157	Balsam Fir	Abies balsamea	11	2	1	Good condition	1043
T12	161	Black Birch	*Betula nigra*	11	2	3	Good condition	1048
T13	162	Black Birch	*Betula nigra*	11	2	2	Good condition	1049

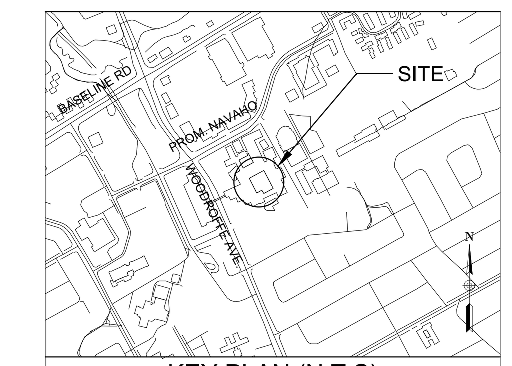
NOTES

TREES ARE STORED ON CAMPUS. CONTRACTOR TO OBTAIN, TRANSPORT AND PLANT TREES UNDER SUPERVISION OF A CERTIFIED ARBORIST

EXISTING TREES TO BE RETAINED

Tree Label	Tree ID #	Common Name	Scientific Name	DBH	Condition	No. Of Trunks	Notes	Tag#
R1	1	Silver Maple	*Acer saccharinum*	34	2	5	Poor Pruning cuts in crown, cavity in roots	697
R2	163	Black Birch	*Betula nigra*	9	2	3		1050
R3	164	Littleleaf Linden	*Tilia cordata*	13	2	1	Epicormic growth	1051
R4	165	Littleleaf Linden	*Tilia cordata*	15	2	1	Epicormic growth	1053
R5	166	Ironwood	*Ostrya virginiana*	7	3	1	Epicormic growth, Scar over 16-30% of root flare	1054
R6	167	Red Pine	*Pinus resinosa*	12	1	1	Trunk lean >1%	1052
R7	168	Ironwood	*Ostrya virginiana*	4	4	1	Scar over >30% of root flare	1055
R8	169	Ironwood	*Ostrya virginiana*	8	2	1	Scar over 16-30% of root flare	1056
R9	173	Freeman Maple	*Acer x freemanii*	15	4	1	Scar over >30% of trunk	241
R10	174	Silk Lilac tree	*Syringa japonica*	9	2	1	Scar over 5-15% of trunk	730





KEY PLAN (N.T.S)

REVISIONS

NO.	DATE	REVISIONS

DRAWING ISSUE RECORD

NO.	DATE	DRAWING ISSUE RECORD	MEDIA
01	2018-09-07	ISSUED FOR ADDENDUM	36X24
01	2018-08-08	ISSUED FOR TENDER	36X24

DISCLAIMER

PROJECT

ALGONQUIN COLLEGE
STORM WATER MANAGEMENT POND

CLIENT

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE

1385 WOODROFFE AVENUE
OTTAWA, ON K2G1V8

BrookMcIlroy/

ARCHITECTURE - LANDSCAPE ARCHITECTURE - URBAN DESIGN - PLANNING

200-161 SPADINA AVENUE
TORONTO, ON M5V 2V6
T. 416 504 5997 F. 416 504 7712

SHEET TITLE

PLANTING PLAN & LAYOUT PLAN

PROJECT NO. 17-003

DESIGNED CB

DRAWN AA/TK

DATE 2018-08-08

SCALE 1:250

SHEET NO.

L102

D07-12-18-0036

#17611

HYDROSEEDING PLANTING SCHEDULE

TERRESTRIAL

Zone 3 - Extended Detention or Shoreline Fringe Area (Total = 340 sq m)

Spacing notes: aim to provide 100% vegetative cover to discourage loafing geese and to act as a barrier to casual entry

Plant Type	Common Name	Botanical Name	Condition	QUANTITY
Herbaceous	*Andropogon gerardii*	Big Bluestem	Seed	**seeding rate: 30 to 35kg/ha**
	Aster novae-angliae	New England Aster	Seed	
	Echinacea purpurea	Purple Coneflower	Seed	
	Elymus canadensis	Canada Wild Rye	Seed	
	Eupatorium maculatum	Joe Pyeweed	Seed	
	Eupatorium perfoliatum	Common Boneset	Seed	
	Rudbeckia hirta	Black Eyed Susan	Seed	
	Sorghastrum nutans	Indiangrass	Seed	
	Verbena hastata	Blue Vervain	Seed	

Zone 4 - Flood Fringe Areas (Total = 1520 sq m)

Spacing notes: aim to provide a minimum of 50% overall planting coverage

Plant Type	Common Name	Botanical Name	Condition	QUANTITY
Herbaceous	*Aster puniceus*	Purple Stemmed Aster	Seed	**seeding rate: 30 to 35kg/ha**
	Carex vulpinoidea	Fox Sedge	Seed	
	Elymus canadensis	Canada Wild Rye	Seed	
	Panicum virgatum	Switch Grass	Seed	
	Schizachyrium scoparium	Little Bluestem	Seed	
	Symphyotrichum novae-angliae	New England Aster	Seed	

Zone 5 - Shoreline Area (Total = 2610)

Spacing notes: aim to provide a minimum of 50% overall planting coverage

Plant Type	Common Name	Botanical Name	Condition	QUANTITY
Herbaceous	*Aster novae-angliae*	New England Aster	Seed	**seeding rate: 30 to 35kg/ha**
	Aster puniceus	Purple Stemmed Aster	Seed	
	Bouteloua curtipendula	Side Oats Grama	Seed	
	Bromus kalmii	Prarie Brome	Seed	
	Chelone glabra	Turtlehead	Seed	
	Elymus canadensis	Canada Wild Rye	Seed	
	Elymus virginicus	Virginia Wild Rye	Seed	

NOTES

A NURSE CROP OF OATS OR FALL RYE TO BE APPLIES TO PROTECT THE SEEDLINGS, RECOMMENDED RATE FOR A NURSE CROP TO BE 35KG/HA

LEGEND

ZONE 3
EXTENDED DETENTION
OR SHORELINE FRINGE AREA

ZONE 4
FLOOD FRINGE AREA

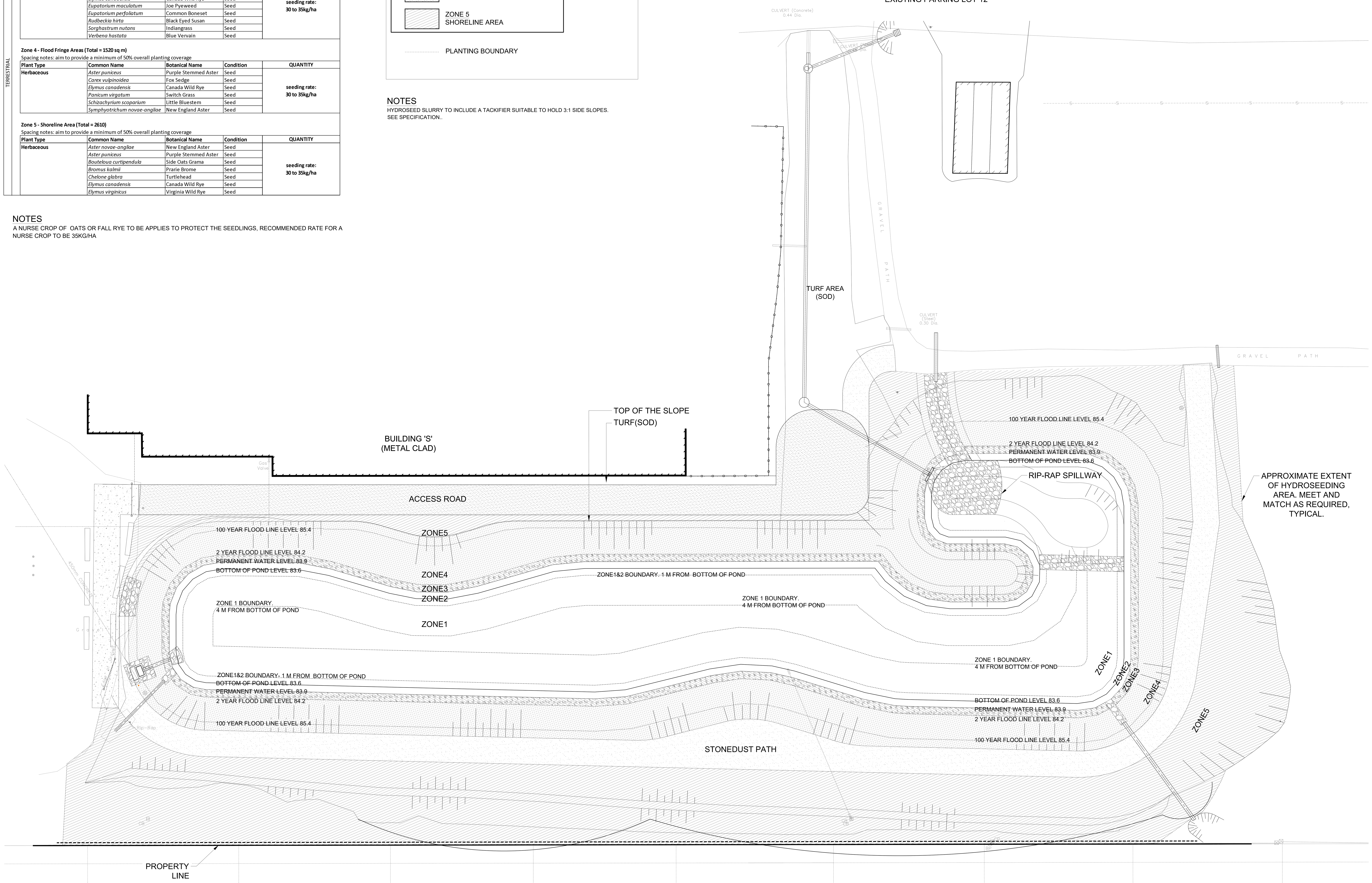
ZONE 5
SHORELINE AREA

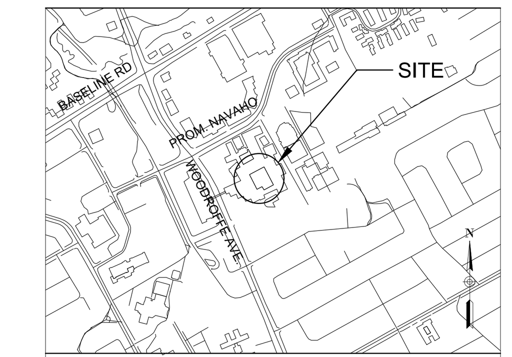
SEEDED VIA HYDROSEED

PLANTING BOUNDARY

NOTES

HYDROSEED SLURRY TO INCLUDE A TACKIFIER SUITABLE TO HOLD 3:1 SIDE SLOPES. SEE SPECIFICATION..





KEY PLAN (N.T.S)

REVISIONS

NO.	DATE	REVISIONS

DRAWING ISSUE RECORD

NO.	DATE	DRAWING ISSUE RECORD	MEDIA
01	2018-09-07	ISSUED FOR ADDENDUM	36X24
01	2018-08-08	ISSUED FOR TENDER	36X24

DISCLAIMER

PROJECT

ALGONQUIN COLLEGE
STORM WATER MANAGEMENT POND

CLIENT

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE

1385 WOODROFFE AVENUE
OTTAWA, ON K2G1V8

BrookMcIlroy/

ARCHITECTURE - LANDSCAPE ARCHITECTURE - URBAN DESIGN - PLANNING

200-161 SPADINA AVENUE
TORONTO, ON M5V 2V6
T. 416 504 5997 F. 416 504 7712

SHEET TITLE

HYDROSEEDING PLAN

PROJECT NO.
17-003

DESIGNED
CB

DRAWN
AA/TK

DATE
2018-08-08

SCALE
1:250

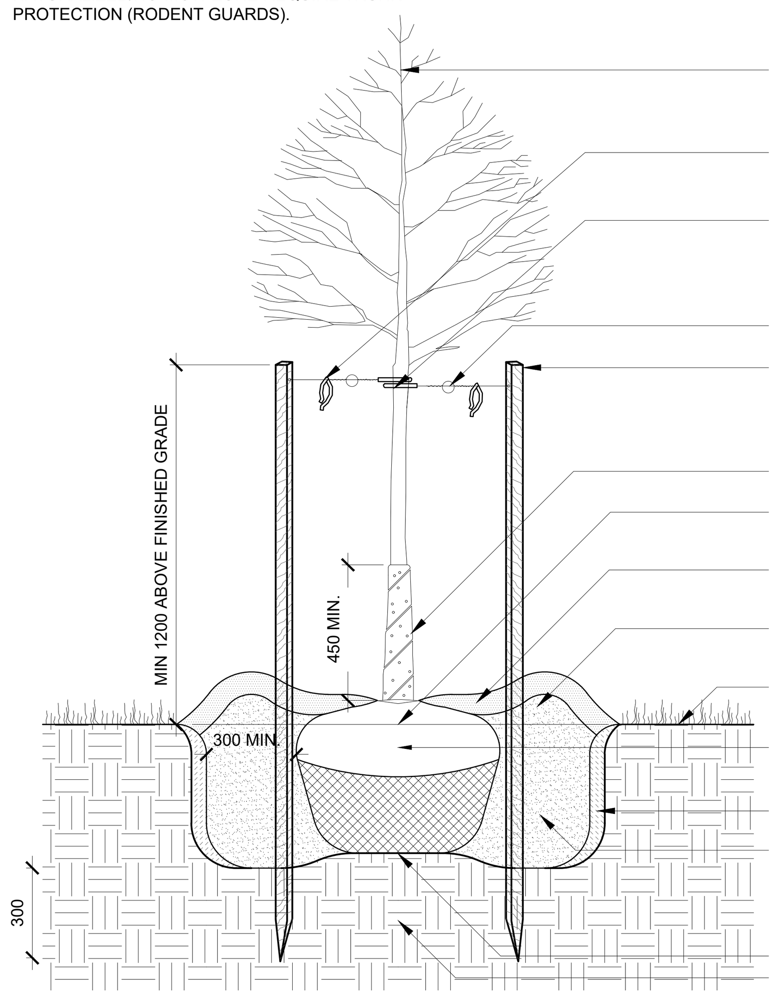
SHEET NO.
L103

D07-12-18-0036

#17611

NOTES:

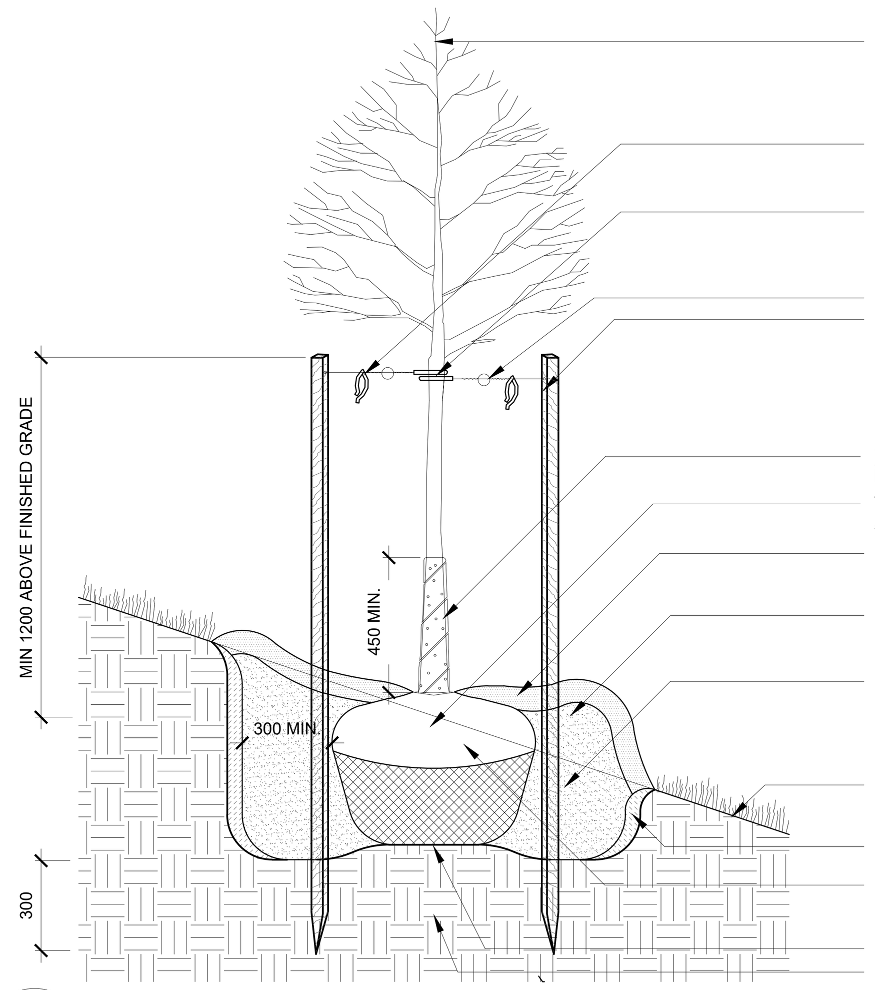
1. ALL DIMENSIONS SHOWN IN MILLIMETRES
2. THIS DETAIL DOES NOT REPRESENT ANY PARTICULAR TREE SPECIES.
3. ONLY TREES PLANTED WITHIN THE NATURALIZED/NO-MOW ZONE REQUIRE TRUNK PROTECTION (RODENT GUARDS).



1 DECIDUOUS TREE PLANTING
L200 SCALE: 1:20

NOTES:

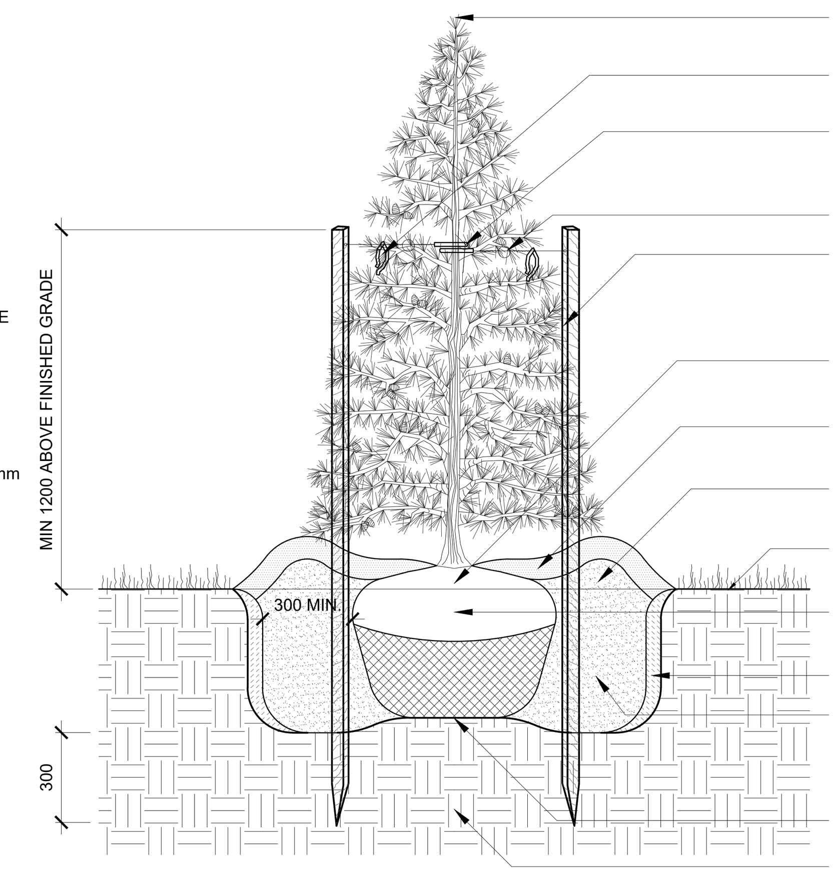
1. ALL DIMENSIONS SHOWN IN MILLIMETRES
2. THIS DETAIL DOES NOT REPRESENT ANY PARTICULAR TREE SPECIES.
3. ONLY TREES PLANTED WITHIN THE NATURALIZED/NO-MOW ZONE REQUIRE TRUNK PROTECTION (RODENT GUARDS).



2 DECIDUOUS TREE PLANTING - ON SLOPE
L200 SCALE: 1:20

NOTES:

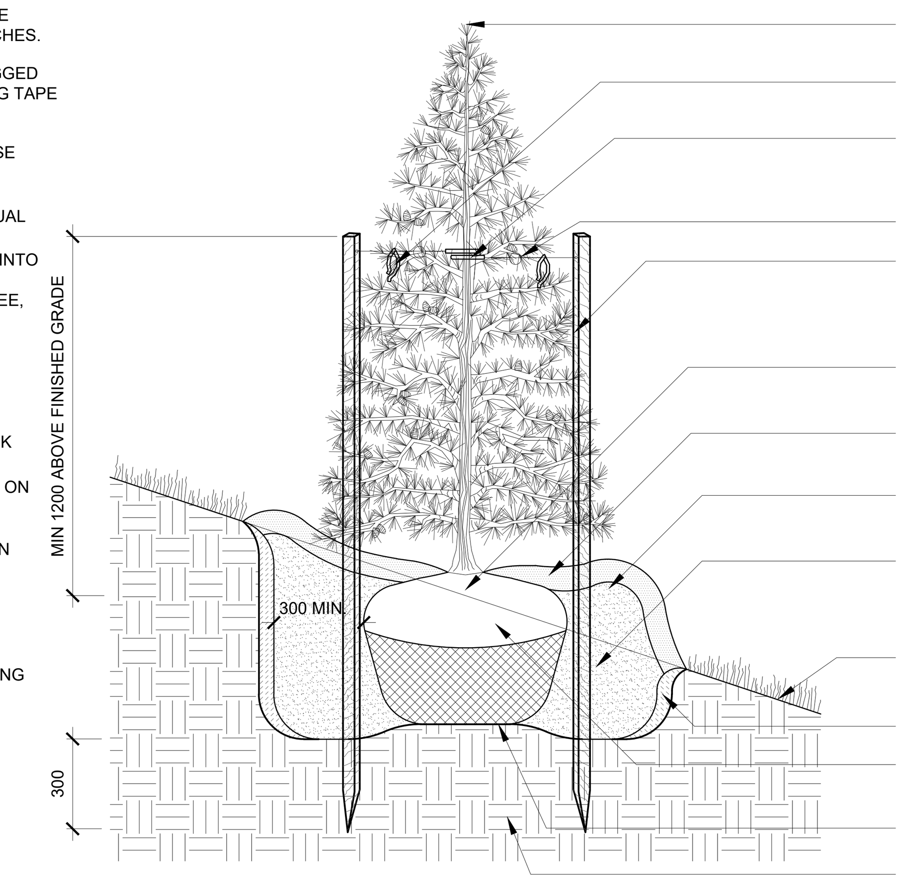
1. THIS DETAIL IS FOR TREES WITH LESS THAN 180CM IN HEIGHT. PLEASE USE ANOTHER DETAIL FOR LARGER TREES.
2. ALL DIMENSIONS SHOWN IN MILLIMETERS.
3. THIS DETAIL DOES NOT REPRESENT ANY PARTICULAR TREE SPECIES.
4. TREES UNDER 1800mm REQUIRE TWO STAKES. TREES OVER 1800mm REQUIRE THREE STAKES.



3 CONIFEROUS TREE PLANTING
L200 SCALE: 1:20

NOTES:

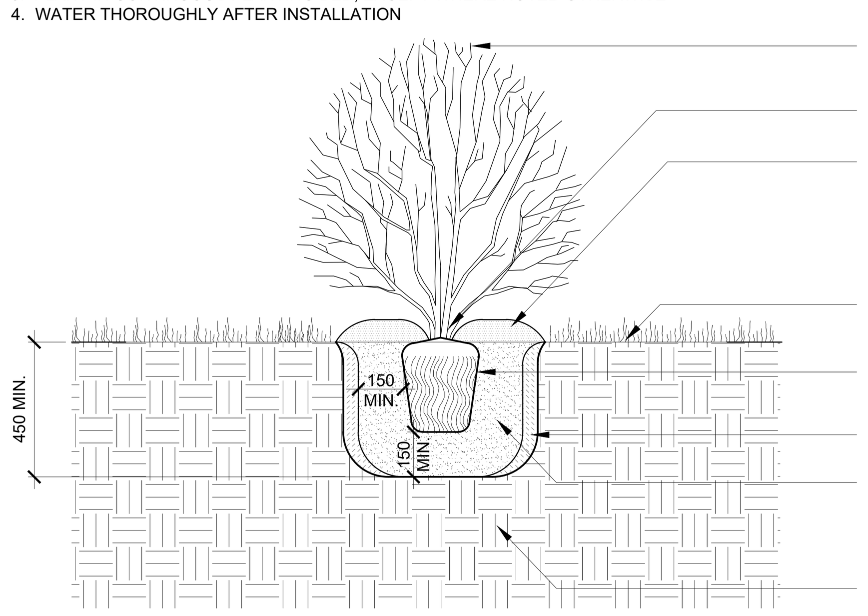
1. ALL DIMENSIONS SHOWN IN MILLIMETRES
2. THIS DETAIL DOES NOT REPRESENT ANY PARTICULAR TREE SPECIES.
3. TREES UNDER 1800mm REQUIRE TWO STAKES. TREES OVER 1800mm REQUIRE THREE STAKES.



4 CONIFEROUS TREE PLANTING ON SLOPE
200 SCALE: 1:20

NOTES:

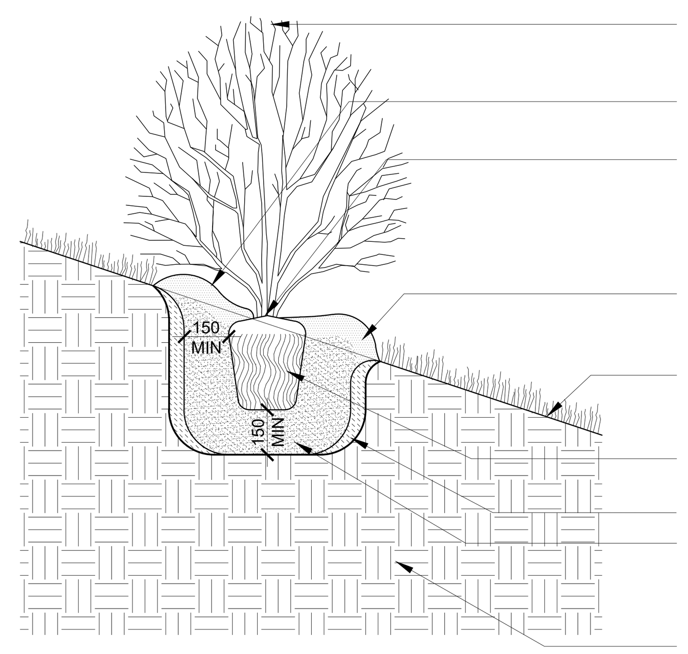
1. ALL DIMENSIONS SHOWN IN MILLIMETRES
2. THE ABOVE DETAIL DOES NOT REPRESENT ANY PARTICULAR SPECIES
3. PLANT IN CONTINUOUS PLANTING BED, EXCEPT WHERE NOTED OTHERWISE
4. WATER THOROUGHLY AFTER INSTALLATION



5 SINGLE SHRUB PLANTING
L200 SCALE: 1:20

NOTES:

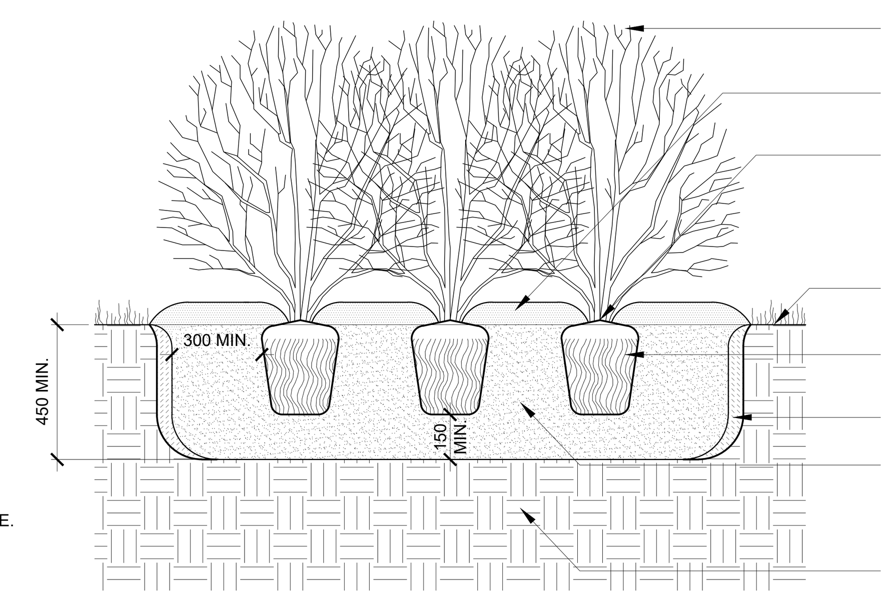
1. ALL DIMENSIONS SHOWN IN MILLIMETRES
2. ALL SHRUBS TO BE PLANTED IN CONTINUOUS BEDS
3. THIS DETAIL DOES NOT REPRESENT ANY PARTICULAR SHRUB SPECIES.



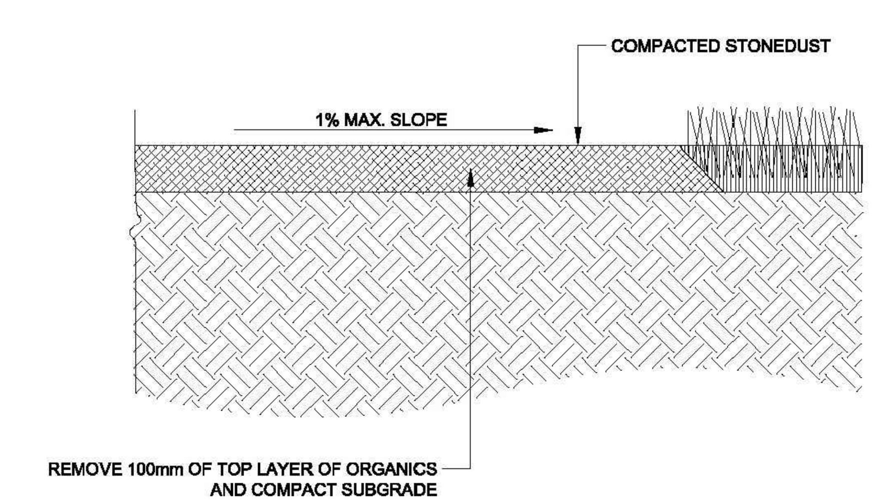
6 SINGLE SHRUB PLANTING ON SLOPE
L200 SCALE: 1:20

NOTES:

1. ALL DIMENSIONS SHOWN IN MILLIMETRES
2. THE ABOVE DETAIL DOES NOT REPRESENT ANY PARTICULAR SPECIES
3. PLANT IN CONTINUOUS PLANTING BED, EXCEPT WHERE NOTED OTHERWISE
4. WATER THOROUGHLY AFTER INSTALLATION



7 SHRUB PLANTING - CONTINUOUS BED
L200 SCALE: 1:20

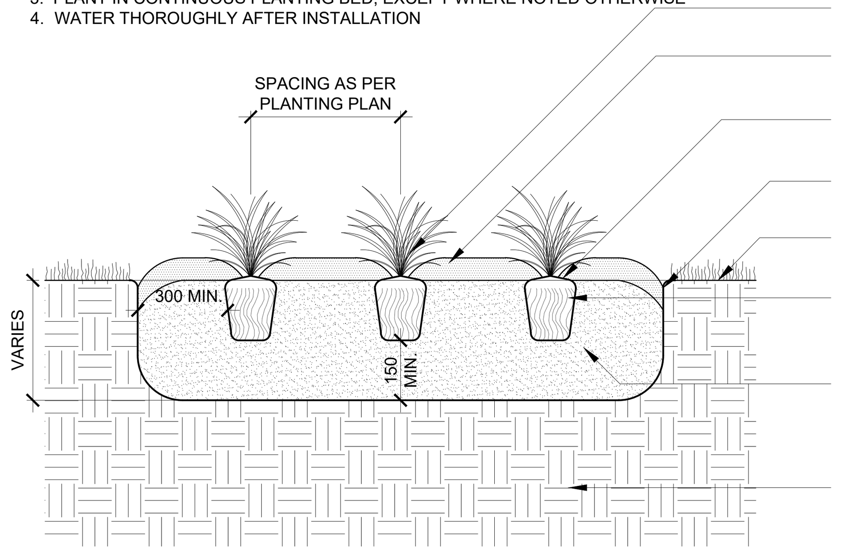


NOTES:
1. ALL MEASUREMENTS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. DO NOT DISTURB ROOTS OF ADJACENT TREES.

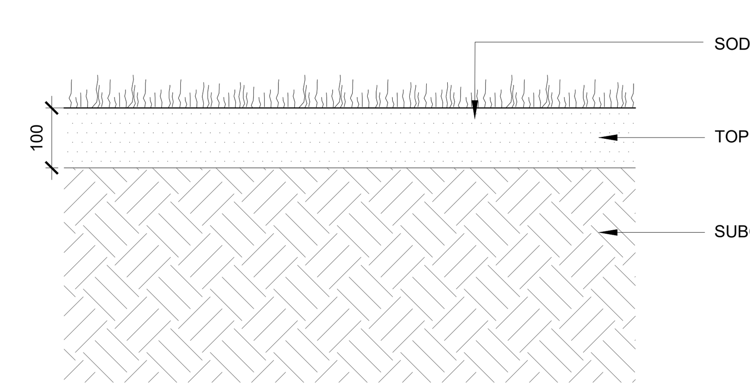
Ottawa	TITLE: STONEDUST NATURE TRAIL	DATE: FEB 2013
		REV: FEB 2014
		DWG No: SC24

NOTES:

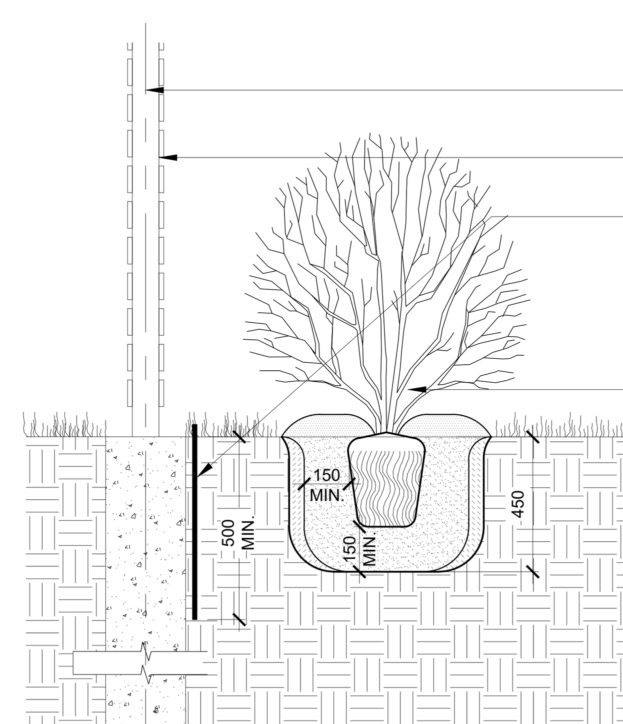
1. ALL DIMENSIONS SHOWN IN MILLIMETRES
2. THE ABOVE DETAIL DOES NOT REPRESENT ANY PARTICULAR SPECIES
3. PLANT IN CONTINUOUS PLANTING BED, EXCEPT WHERE NOTED OTHERWISE
4. WATER THOROUGHLY AFTER INSTALLATION



8 HERBACEOUS PLANTING
L200 SCALE: 1:20

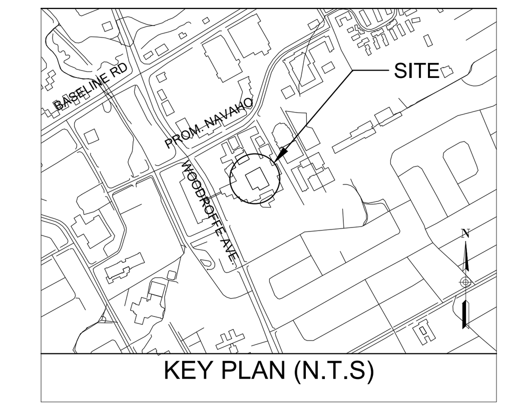


9 SODDING DETAIL
L200 SCALE: 1:10



10 ROOT BARRIER
L200 SCALE: 1:20

11 STONEDUST NATURE TRAIL
L200 SCALE: NTS



REVISIONS

NO.	DATE	REVISIONS

DRAWING ISSUE RECORD

NO.	DATE	DRAWING ISSUE RECORD	MEDIA
01	2018-09-07	ISSUED FOR ADDENDUM	36X24
01	2018-08-08	ISSUED FOR TENDER	36X24

DISCLAIMER

PROJECT

ALGONQUIN COLLEGE
STORM WATER MANAGEMENT POND

CLIENT

ALGONQUIN COLLEGE

ALGONQUIN COLLEGE

1385 WOODROFFE AVENUE
OTTAWA, ON K2G1V8

BrookMcIlroy/

ARCHITECTURE - LANDSCAPE ARCHITECTURE - URBAN DESIGN - PLANNING

200-161 SPADINA AVENUE
TORONTO, ON M5V 2V6
T. 416 504 5997 F. 416 504 7712

SHEET TITLE
DETAILS

PROJECT NO.
17-003

DESIGNED
CB

DRAWN
AA/TK

DATE
2018-08-08

SCALE

SHEET NO.
L200

D07-12-18-0036

#17611

Appendix G

CONTENTS

Nest Inspection & Clearance 3 pages

Bowfin Environmental Consulting

168 Montreal Road
Cornwall, ON K6H 1B3
Tel: 613.935.6139
Fax: 613.935.6295

Blair MacSweyn
W.H. MacSweyn Inc.
196 Bronson Ave
Ottawa, ON K1R 6H4
P-613-407-4694

June 21, 2018

Re.:   Nest Visit and Clearance at Algonquin College

Mr. MacSweyn:

At your request, I completed a site visit to look at the potential for breeding birds in the construction area for the stormwater management pond. Breeding birds are protected under the *Migratory Bird Convention Act* (MBCA). Under the MBCA it is against the law to destroy or disturb an active nest of any migratory bird, or to take or handle nests, eggs, or nestlings. In the City of Ottawa, the standard nesting period is between April 15 and August 15. Outside of this timing window, it is considered unlikely that birds would be nesting. Note, while not applicable at this site, there are some birds (birds of prey, herons etc.) that do begin nesting earlier in the year. It should also be noted, that if an active nest is present before or after the above dates that it is still protected. These dates serve as a guideline.

The standard best practice is to use avoidance measures. The removal of vegetation should take place prior to or after the timing window or barriers should be installed before nesting period begins (netting, tarping etc.). If these avoidance measures cannot be completed in time or are not effective and nesting occurs, then you must wait until the young are fully fledged before beginning construction. If you need to clear vegetation during the nesting season, then a qualified professional should be brought on-site to survey the vegetation that needs to be cleared for signs of active nests.

To this effect, Bowfin completed a nest survey on June 19, 2018. The survey consisted of visually searching the vegetation to be removed for nests using binoculars, listening for signs of active nests (i.e. territorial displays by adult birds, chirping of young) or observing signs of activity (i.e. adults returning with food, nesting materials or white-washing). Nest searching was

168 Montreal Road
Cornwall, ON K6H 1B3
Tel: 613.935.6139
Fax: 613.935.6295

considered appropriate for this site as it was a small area, and the vegetation is spaced far apart. As such it had a minimal risk of false negatives and was non-intrusive.

The visit was completed by Michelle Lavictoire (B. Sc. Wildlife Biology and M.Sc. Natural Resources) on June 19, 2018 at 0630. The weather conditions were appropriate (low wind, no precipitation) and the air temperature was 13°C. I offer the following comments:

- There was little bird activity on-site
- A pair of Song Sparrows was noted however they were not defending any specific area and no nests could be found.
- A pair of Red-winged Blackbirds were observed. The male was actively defending an area from intruders and the female was carrying food. The approximate location of the nest is indicated in the attached map.

Clearing of vegetation can take place as needed over the next 2-days. Additional care should be taken when removing any vegetation on the west side of the study area, near where the Song Sparrows were observed in case a nest is present. The trees should be felled away from the ditch to avoid disrupting the Red-winged Blackbirds. Further, the dredging of the ditch near their nest should be delayed until the young have fledged.

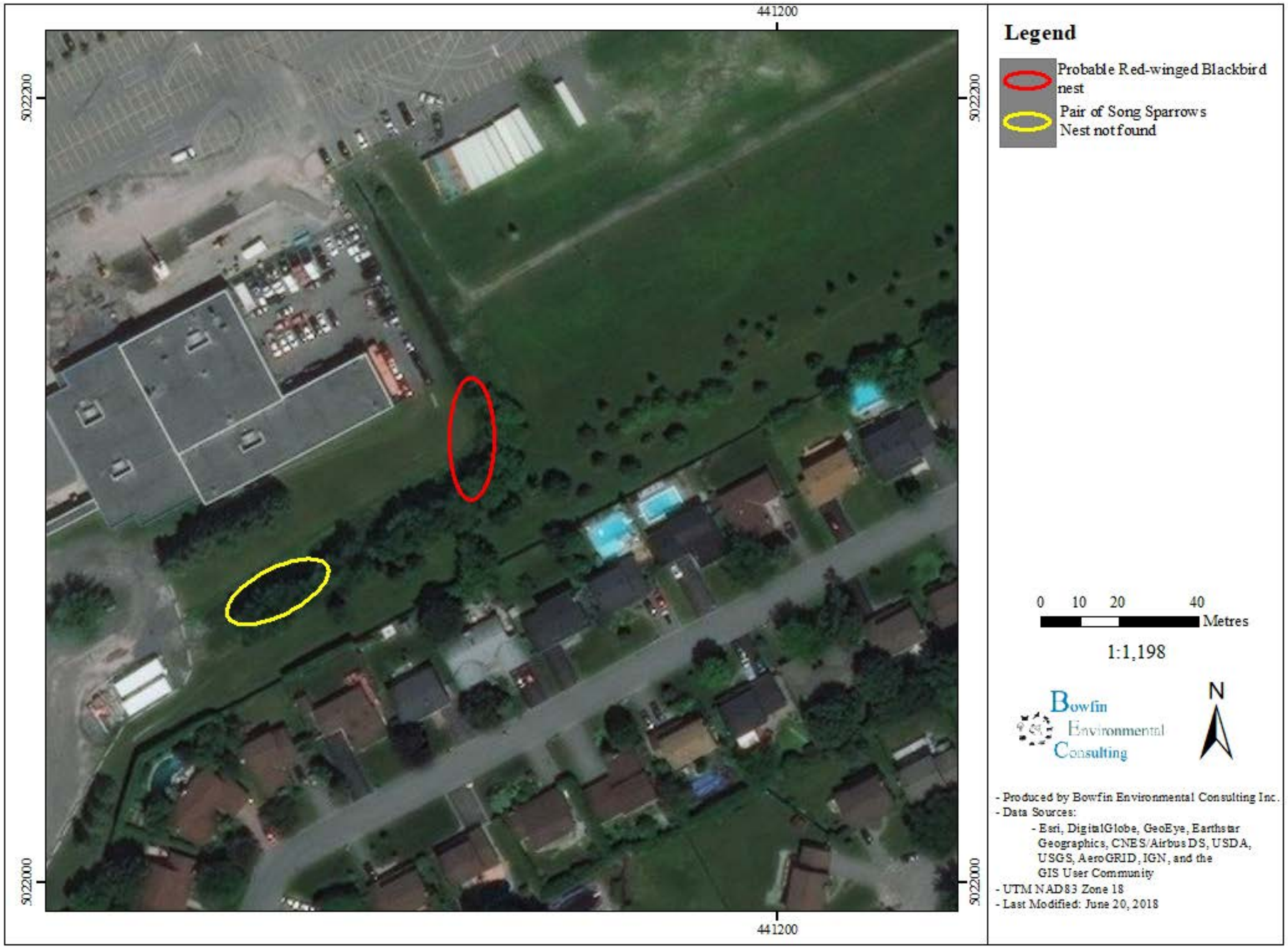
I trust that this will satisfactorily meet your needs. If you have any questions or comments please do not hesitate to contact me at 613.935.6139.

Sincerely,

M Lavictoire

Michelle Lavictoire
Principal/Senior Biologist

Figure 1 Summary of Results



Appendix H

CONTENTS

Erosion & Sediment Control Plan 7 pages

Erosion and Sediment Control Plan

Algonquin College Ottawa Campus, SWMP East of South Building

Report No. 2085345.47 October 19, 2018

\\MH.LOCAL\DATA\OFFICES\OTTAWA\PROJ\2085345\2085345.47 INTEGRATED COLLEGE SWM POND DESIGN & CONSTRUCTION\300 - ENGINEERING\07 SITE PLAN CONTROL\EROSION AND SEDIMENT CONTROL PLAN\REV 2\EROSION AND SEDIMENT CONTROL PLAN - ALGONQUIN SWMP - REV 2.DOCX

TABLE OF CONTENTS

Page

1.	INTRODUCTION	1
2.	EROSION AND SEDIMENT CONTROL MEASURES	1
	2.1 Clearing Limits	1
	2.2 Catch Basin and Inlet Protections	1
	2.3 Silt Fence	2
3.	INSPECTION AND MAINTENANCE PROGRAM	2
4.	EROSION AND SEDIMENT CONTROL PERSONNEL	2
5.	CLOSURE	3

APPENDIX A: Erosion and Sediment Control Inspection Sample Checklist

1. Introduction

The Algonquin College Storm Water Management (SWM) Pond on the Ottawa Campus is being constructed to address a cumulative shortfall related to meeting the qualitative and quantitative criteria for the Pinecrest Creek Watershed.

2. Erosion and Sediment Control Measures

Erosion and sedimentation control measures for this project will:

- Prevent soil loss during construction by storm water runoff and/or wind erosion
- Prevent sedimentation of storm sewers or receiving streams
- Prevent polluting the air with dust and particulate matter
- Minimize the amount of disturbed soil

The following measures will be implemented prior to commencement of construction and maintained in good order until vegetation has been established. Refer to Drawing 006 (Erosion and Sediment Control) for the placement of these measures and additional details.

2.1 Clearing Limits

Purpose: The purpose of setting clearing limits is to delineate the areas that are not to be disturbed during construction, reducing the potential for erosion. It will also serve to limit construction traffic to designated construction entrances.

Method: Clearing Limits will be delineated by a silt fencing barrier in accordance with OPSD 219.110, installed prior to excavation activity on site.

2.2 Catch Basin and Inlet Protections

Purpose: The purpose of catch basin and inlet protection is to prevent coarse sediment from entering the storm drainage system. Each catch basin and inlet will be covered with filter fabric and surrounded by a sediment capture filter sock. Each catch basin and inlet will be inspected on a regular basis.

Method: Geotextile cloth will be installed between all catch basin covers and frames in order to catch sediments prior to entering the City's infrastructure. The filter fabric will be stretched tight across the underside of the catch basin cover and secured at the sides to obtain this protection. Sediment capture filter socks will be installed in a circle around the inlet or catch basin being protected with 300mm of overlap, and will be anchored to the ground (e.g. with wooden stakes).

2.3 Silt Fence

Purpose: The purpose of the silt fence is to prevent erosion of the excavated side slopes of the SWM pond due to surface runoff, and therefore prevent sediment from entering the SWM pond and the storm water drainage system. The silt fence is intended to slow and distribute surface runoff, preventing concentrated runoff which would otherwise cause erosion.

Method: Light duty silt fence in accordance with OPSD 219.110 will be installed around the perimeter of the excavation. The silt fence will be inspected and maintained on a regular basis. The silt fence will remain in place until vegetation is established.

3. Inspection and Maintenance Program

The goal of the inspection and maintenance program is to ensure that all erosion and sediment measures are functioning. The Contractor will be responsible for ensuring the above erosion and sedimentation control measures are maintained and that all repairs and documentation required are completed in accordance with the inspection checklists. The erosion and sedimentation control plan consists of a daily visual inspection, reports performed weekly and after heavy rainstorms or snow melts. Written logs of all inspection and maintenance activities will be maintained throughout the duration of the project.

4. Erosion and Sediment Control Personnel

The Contractor's Supervisor is the contact person between the trades, contractor staff, and consultants for the project

The Supervisor is responsible for:

- Ensuring all measures outlined above are part of the construction program.
- Supervising on-site Erosion and Sedimentation Control (ESC) activities on a daily basis
- Conducting ESC inspections weekly, correcting deficiencies and taking photographs before and after
- Coordinating ESC tasks with subcontractors to ensure timely and orderly progress of the work
- Directing the maintenance, modifications and removal of all erosion and sedimentation control measures
- Preparing ESC documentation and submittals for circulation to consultants

The Contractor's Field staff are responsible for:

- Ensuring all measures outlined above are part of the construction program.
- Supervising on-site Erosion and Sedimentation Control (ESC) activities on a daily basis in each of the project specified areas

- Conducting visual inspections on a daily basis in each of their specified areas
- Coordinating ESC tasks with subcontractors to ensure timely and orderly progress of the work
- Directing the maintenance, modifications and removal of all erosion and sedimentation control measures in each of their project specific areas
- Assisting with ESC documentation and submittals per their project specific areas

In addition to the Supervisor, the Contractor's site super intendents and the sub trades will be responsible for monitoring the control measures as implemented on site. If a deficiency or potential problem is observed, the area Field Coordinator will be advised and take the appropriate steps to rectify the situation with the sub trades.

All subcontractors working on site will be informed of the Erosion and Sedimentation Control Plan and be expected to comply with the measures that apply to their work.

5. Closure

We trust that this report is sufficient for your current requirements. Please contact us with any questions or clarifications.

Sincerely,

Morrison Hershfield Limited

James Fookes, P.Eng.

APPENDIX A: Erosion and Sediment Control Inspection Sample Checklist

Project Name:	Algonquin College Storm Water Management Pond	Completed by:	
Project Location:	1385 Woodroffe Avenue, Ottawa, Ontario, K2G 3G7	Date:	

	ITEM	NOTES	INITIAL
Clearing Limits			
☐	Silt fence installed around the perimeter of the work zone prevent erosion		
☐	Monitor washout		
Traffic Area Stabilization			
☐	Mud mat in place		
☐	Public roadways clear of dirt and debris		
Catch Basin and Inlet Protections			
☐	Filter fabric in place and not damaged		
☐	Catch basin area is free from coarse sediment		
☐	Filter sock installed around catch basin		
Silt Fence around Perimeter of Excavation			
☐	Silt fence in place and free from damage		
Stockpile Covers			
☐	Check for tears and lifting		
☐	Adequate weight to hold down tarpaulin		

*I hereby certify that the information provided is complete, correct and complies with the requirements of EPA Best Management Practices.

Signature Title Date

Appendix I

CONTENTS

Geotechnical Investigation	31 pages

GEMTEC

www.gemtec.ca

Algonquin College Stormwater Management Pond
1385 Woodroffe Avenue
Transportation Technology Centre
Ottawa, Ontario

www.gemtec.ca

Submitted to:

Morrison Hershfield Ltd.
2440 Don Reid Drive
Ottawa, Ontario
K1H 1E1

Algonquin College Stormwater Management Pond
1385 Woodroffe Avenue
Transportation Technology Centre
Ottawa, Ontario

October 1, 2018
Project: 64152.36

experience • knowledge • integrity

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 DESCRIPTION OF PROJECT AND SITE 1

2.1 Project Description 1
2.2 Review of Geology Maps 1

3.0 SUBSURFACE INVESTIGATION 1

3.1 Subsurface Investigation 1

4.0 SUBSURFACE CONDITIONS 2

4.1 General 2
4.2 Topsoil, Topsoil Fill 3
4.3 Fill Material 3
4.4 Sandy Silt 3
4.5 Silty Clay 4
4.6 Glacial Till 5
4.7 Auger Refusal 5
4.8 Groundwater Levels 6

5.0 GEOTECHNICAL GUIDELINES AND RECOMMENDATIONS 6

5.1 General 6
5.2 Design Considerations 6
5.3 Excavation 6
5.3.1 Overburden Excavation 6
5.3.2 Excavation near Existing Structures 7
5.3.3 Groundwater Pumping and Management, and Groundwater Impacts 7

5.4 Bottom Treatment 8
5.4.1 Compacted Clay Liner (if necessary) 8
5.4.2 Granular Material 8

5.5 Berms 8
5.5.1 Construction 8
5.5.2 Erosion Protection 9
5.5.3 Stability and Settlement 9

5.6 Side Slopes to the Proposed Pond 9
5.7 Services 10
5.7.1 Excavation 10
5.7.2 Groundwater Pumping 10
5.7.3 Pipe Bedding and Cover 11
5.7.4 Trench Backfill 11

5.8 Other Considerations 12
5.8.1 Construction Induced Vibration 12
5.8.2 Winter Construction 12
5.8.3 Disposal of Excess Material 12
5.8.4 Planting/Landscaping Restrictions 13
5.8.5 Seepage Barriers 13
5.8.6 Design Review 13

LIST OF TABLES

Table 4.1 – Summary of Grain Size Distribution Testing (Silty Clay) 4
Table 4.2 – Summary of Atterberg Limits Testing..5

LIST OF FIGURES

Figure 1..14
Figure 2..15

LIST OF APPENDICES

List of Abbreviations and Terminology

Appendix A	Record of Borehole Sheets
Appendix B	Results of Laboratory Classification Testing

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation carried out for the proposed stormwater management pond to be located southeast of the Transportation Technology Centre for Algonquin College Woodroffe Campus, in the City of Ottawa, Ontario. The purpose of the investigation was to identify the general subsurface conditions at the site by means of a borehole investigation and, based on the factual information obtained, to provide engineering guidelines on the geotechnical design aspects of the project, including construction considerations that could influence design decisions.

This investigation was carried out in general accordance with our proposal dated December 23, 2016.

Note that this report constitutes a revision and includes comments provided in response to information requests from the City of Ottawa based on their review of our original report dated June 29, 2017.

2.0 DESCRIPTION OF PROJECT AND SITE

2.1 Project Description

The stormwater pond is located southeast of the existing Transportation Technology Centre in the southeast area of the campus. The approximate limits of the study area are shown on the Key Plan, Figure 1.

It is understood that the pond bottom is at about 83.6 metres and the permanent pond elevation is 83.9 metres.

Previously, the area consisted of undeveloped grassland with small vegetation.

2.2 Review of Geology Maps

Review of surficial geology maps indicate that the overburden is expected to consist of offshore marine sediments of clay and silt. Bedrock and drift thickness maps indicate that the bedrock is composed of shale of the Rockliffe formation at a depth ranging from 2 to 3 metres below ground surface. Fill material associated with previous use of this site should also be anticipated.

3.0 SUBSURFACE INVESTIGATION

3.1 Subsurface Investigation

The field work for this investigation was carried out on April 18 and 19, 2017. During this time a total of six (6) boreholes (numbered 17-1 and 17-3 to 17-7, inclusive) were advanced to depths ranging from about 3.6 to 6.9 metres below surface grade. Borehole 17-2 was omitted due to the presence of ponded water at the proposed borehole location at the time of the investigation.

The boreholes were advanced using a track mounted, hollow stem, CME 45 auger drill rig supplied and operated by George Downing Estate Drilling Ltd. of Grenville-sur-la-Rouge, Quebec.

Standard penetration tests were carried out in the boreholes and samples of the soils encountered were recovered using a 50 millimetre diameter split barrel sampler.

Following the field work, the soil samples were returned to our laboratory for examination by a geotechnical engineer. Selected samples of the soil were tested for water content, grain size distribution, and Atterberg Limits.

The approximate locations of the boreholes are shown on the Borehole Location Plan, Figure 2. The results of the boreholes are provided on the Record of Borehole sheets in Appendix A. The results of the soil classification testing are provided on the Record of Borehole sheets and Figures B1 and B2 in Appendix B.

The borehole locations were selected by Morrison Hershfield Ltd. The ground surface elevations at the boreholes were determined using a Trimble R10 GPS survey instrument. The elevations are referenced to geodetic datum.

4.0 SUBSURFACE CONDITIONS

4.1 General

As previously indicated, the soil conditions identified in the boreholes are given on the Record of Borehole sheets (Appendix A). The logs indicate the subsurface conditions at the specific borehole locations only. Boundaries between zones on the logs are often not distinct, but rather can be transitional and have been interpreted. The precision with which subsurface conditions are indicated depends on the method of drilling, the frequency and recovery of samples, the method of sampling, and the uniformity of the subsurface conditions. Subsurface conditions at other than the borehole locations may vary from the conditions encountered in the boreholes. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties.

The soil descriptions in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil involves judgement and GEMTEC Consulting Engineers and Scientists Limited does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice.

The following presents an overview of the subsurface conditions encountered in the boreholes advanced during this investigation.

4.2 Topsoil, Topsoil Fill

A surficial layer of topsoil measuring 50 and 130 millimetres, respectively, was encountered the location of boreholes 17-1 and 17-3. Topsoil fill was encountered at the location of boreholes 17-4, 17-6, and 17-7. the topsoil fill is about 50 millimetres thick at these locations. The topsoil and topsoil fill varies in composition across the site from dark brown sandy silt to silty sand, with varying amounts of clay, gravel, and organic material.

A layer of former topsoil was encountered underlying the fill material at boreholes 17-6 and 17-7 at depths of about 2.4 and 2.3 metres below surface grade, respectively. The former topsoil is composed of dark grey sandy silt and has a thickness measuring about 0.5 metres in borehole 17-6 and about 0.1 metres in borehole 17-7.

The water content measured in a sample of the former topsoil in borehole 17-7 is about 30 percent.

4.3 Fill Material

Fill material was encountered at four (4) borehole locations (17-4 to 17-7, inclusive). The fill material was encountered underlying the topsoil fill in boreholes 17-4, 17-6, and 17-7, and from ground surface at borehole 17-5. The thickness of the fill material ranges from about 0.8 to 2.4 metres.

The fill material varies in composition and can be generally described as grey brown silty sand with trace to some clay and gravel. Asphaltic concrete and brick debris was noted in the fill material in boreholes 17-6 and 17-7.

Standard penetration testing carried out in the fill material gave N values ranging from static weight of hammer to 22 blows per 0.3 metres of penetration, which reflects a very loose to compact relative density.

The water content measured in samples of the fill material in borehole 17-7 ranges from 14 to 19 percent.

4.4 Sandy Silt

A native deposit of grey brown sandy silt was encountered underlying the topsoil in borehole 17-1. The sandy silt extends to a depth of about 0.8 metres below surface grade.

The water content measured in a sample of the sandy silt is about 29 percent.

4.5 Silty Clay

Native deposits of silty clay were encountered at all borehole locations at varying depths ranging from about 0.1 to 3.0 metres below surface grade. The thickness of the silty clay ranges from about 1.1 to 3.1 metres and extends to depths ranging from 1.8 to 5 metres below surface grade.

The silty clay at boreholes 17-3, 17-6, and 17-7, and the upper portions of the silty clay at boreholes 17-1 and 17-5 have been desiccated to form a weathered crust. The SPT N values measured in the weathered crust range from 5 to 10 blows per 0.3 metres of penetration, which reflects a stiff to very stiff consistency.

Below the weathered crust the silty clay is grey in colour. The SPT N values recorded in the grey silty clay in boreholes 17-1, 17-4, and 17-5 range from 1 to 4 blows per 0.3 metres of penetration. Based on our local experience and our review of the soil samples, recorded N values within the silty clay deposits are indicative of a stiff to very stiff consistency.

Representative samples of the silty clay were tested for:

- Moisture content;
- Grain size distribution, and;
- Atterberg Limits.

The results of two (2) grain size distribution tests are provided on Figure B1 (Appendix B) and summarized in Table 4.1.

Table 4.1 – Summary of Grain Size Distribution Testing (Silty Clay)

Location	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
17-1	3	1.4 – 2.0	0	8	46	46
17-6	6	3.8 – 4.4	1	2	46	51

Two (2) Atterberg limits test were undertaken on samples of the silty clay. The results are provided on the Record of Boreholes sheets (Appendix A), Figure B2 (Appendix B), and summarized in Table 4.2.

Table 4.2 – Summary of Atterberg Limits Testing

Location	Sample Number	Sample Depth	Moisture (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
17-1	3	1.4 – 2.0	34	44	19	25
17-6	6	3.8 – 4.4	29	39	18	21

The results of the Atterberg limits indicate that the cohesive soils at this site have a low degree of plasticity.

The moisture contents of samples of the silty clay from the majority of the boreholes range from about 29 to 34 percent, which is below the liquid limit value. In contrast, the moisture contents measured in two samples of the silty clay underlying the weathered crust in borehole 17-1 (samples 4 and 5) measure 49 and 74 percent, which is above the measured liquid limit values.

4.6 Glacial Till

Glacial till was encountered below the silty clay at all borehole locations. The glacial till was encountered at depths ranging from about 1.8 to 5.0 metres below ground surface. All boreholes terminated within the glacial till. Boreholes 17-1 and 17-3 to 17-6 terminated with auger refusal within the glacial till on possible bedrock surface.

Glacial till is a heterogeneous mixture of all grain sizes. For this site the glacial till composition is generally described as brown to grey silty sand with varying amounts of gravel, clay, and probable cobbles and boulders. Pockets of grey brown silty clay were noted in the glacial till in borehole 17-4.

Standard penetration testing carried out in the glacial till gave N values ranging from 4 to over 50 blows per 0.3 metres of penetration which reflects a loose to very dense relative density. The high variability in the test results likely represent the presence of cobbles and boulders within the glacial till.

The water content of samples of the glacial till ranges from about 7 to 15 percent.

4.7 Auger Refusal

Auger refusal on possible bedrock was encountered in boreholes 17-1, and 17-3 to 17-6, inclusive, at depths ranging from about 3.6 to 6.9 metres below surface grade (elevations 81.1 to 82.4 metres, geodetic datum). It should be noted that auger refusal can occur on boulders found in glacial till.

4.8 Groundwater Levels

Standpipe piezometers were not installed as part of our investigation due to the fact that the initial schedule had planned for excavation soon after the submission of the report. However, at the time of the field work we noted wet soil conditions in the recovered samples at elevations ranging from about 81.9 to 84.2 metres, geodetic datum.

It should be noted that the groundwater conditions are variable and will change throughout the year and due to precipitation conditions.

5.0 GEOTECHNICAL GUIDELINES AND RECOMMENDATIONS

5.1 General

The information in the following sections is provided for the guidance of the design engineers and is intended for the design of this project only. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data as it affects their construction techniques, schedule, safety and equipment capabilities.

The professional services retained for this project include only the geotechnical aspects of the subsurface conditions. The implications of possible surface and/or subsurface contamination resulting from previous uses or activities of this site or adjacent properties, and/or resulting from the introduction onto the site from materials from offsite sources are outside the terms of reference for this report and have not been addressed.

5.2 Design Considerations

Based on preliminary detailed drawing provided to us by Morrison Hershfield Ltd. the following design details are available:

- The elevation of the bottom of the proposed pond will be at about 83.6 metres, geodetic datum.
- The permanent pond elevation will be about 83.9 metres, geodetic datum.
- The pond will have side slopes ranging from 3 horizontal to 1 vertical and 4 horizontal to 1 vertical around the southern end.
- The northern portion of the pond will be surrounded by an armour stone wall approximately 130 metres long, with a height ranging from about 3.0 to 4.5 metres.

5.3 Excavation

5.3.1 Overburden Excavation

Based on the results of the boreholes, excavation for the proposed stormwater management pond will be carried out through topsoil, sandy silt, fill material, silty clay, and glacial till.

The sides of temporary excavations within overburden soils should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Occupational Health and Safety Act. According to the Act, most of the soils at this site can be classified as Type 3 soils. Therefore, for design purposes, allowance should be made for 1 horizontal to 1 vertical, or flatter, excavation slopes.

5.3.2 Excavation near Existing Structures

The foundation conditions for neighbouring structures are not currently available. For adjacent existing structures, the excavation for the proposed pond and armour stone wall should not encroach within a line extending downwards and outwards from the edge of the existing footings at an inclination of 1 vertical to 1 horizontal.

Depending on the depth of the excavation, it is recommended that the foundation conditions for the adjacent buildings be obtained to identify the excavation requirements next to adjacent buildings to ensure that undermining does not occur.

5.3.3 Groundwater Pumping and Management, and Groundwater Impacts

At the time of our investigation wet soil conditions were noted in the recovered samples at elevations ranging from about 81.9 to 84.2 metres, geodetic datum. Based on this information and the expected permanent water level of 83.9 metres (confirmed by Morrison Hershfield Ltd. observations during construction), some groundwater inflow into the pond could occur.

The rate of inflow from the silty clay deposits will likely be relatively low, while a slightly higher rate of inflow should be expected from the glacial till. Based on recent changes to Ontario Regulations, an Environmental Activitiy and Sector Registrty (EASR), in accordance with Environmental Protection Act PartII.2 Section 20.21, is required for construction site dewatering of between 50,000 and 400,000 litres per day (as opposed to the former Category 2 Permit to Take Water (PTTW)). It is noted that a Water Taking report and a Discharge Plan prepared by a qualified person are required to complete the EASR. If pumping exceeds 50,000 litres a day at this site an EASR will be required.

If construction site dewatering exceeds 400,000 litres per day, a Category 3 PTTW will be required for pumping from within the excavations in accordance with the Ministry of the Environment (MOE). Issuance of the permit by the MOE usually takes about 60 to 90 business days. However, based on our analysis of the subsurface samples, it is unlikely that a Category 3 PTTW will be required at this site.

The thickness of the silty clay in the vicinity of the pond ranges from about 1.1 to 3.1 metres. Also, the standard penetration test results combined with our experience in the Ottawa area indicate that the silty clay has an estimated stiff to very stiff consistency. Based on this information, it is our opinion that the increase in stress on the native deposits due to groundwater lowering will be tolerable and not result in measurable settlement.

5.4 Bottom Treatment

5.4.1 Compacted Clay Liner (if necessary)

Bedrock was not encountered above elevation 82.4 metres, geodetic datum at the borehole locations. Since the proposed pond bottom elevation is 83.6 metres, a liner is likely not required for a pond at this site (the bottom will likely be constructed in the native deposits of silty clay or glacial till). It is possible that bedrock is higher at other than the borehole locations. In the case that bedrock is encountered within the proposed pond depth, a liner will be required in accordance with current City of Ottawa design guidelines. If necessary, consideration could be given to the use of a compacted clay liner (CCL) constructed from the onsite native deposits of silty clay. The following comments are provided regarding the CCL:

- The CCL should have a minimum thickness of 450 millimetres.
- The CCL should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the Standard Proctor dry density. This material is sensitive to changes in water content; compaction and lower hydraulic conductivities are best achieved when the material has a moisture content that is 2 to 4 percent above the standard Proctor optimum water content. If the silty clay material is outside of the optimum water content range (e.g., due to precipitation, heat, exposure, etc.), some drying and/or wetting of the material may be required in order to achieve the specified compaction. The silty clay material could be compacted using a pad foot roller or a combination of pad foot roller and smooth drum roller.
- Full time compaction testing will be required during construction of the CCL.

5.4.2 Granular Material

To allow for future maintenance and cleaning, the pond bottom should be covered with a non-woven geotextile, followed by a minimum of 300 millimetres of crushed stone meeting Ontario Provincial Standards Specification (OPSS) requirements for Granular B Type II. Any disturbed or loose material should be removed from the pond bottom prior to placement of the geotextile. In silty clay deposits, the use of a shovel with a flat blade will assist in this regard.

The granular material should be compacted to at least 95 percent of the standard Proctor dry density using a large (minimum 10 tonne) steel drum roller.

5.5 Berms

5.5.1 Construction

Two (2) earth berms with side slopes of 3 horizontal to 1 vertical will be constructed to elevation 84.1 and 84.0 metres, respectively, within the northern area of the proposed pond.

In preparation for construction of the berm, all topsoil, organic material, and wet or disturbed soil should be removed from the subgrade surface. The subgrade surface should scarified in a direction parallel to the alignment of the berm to ensure a direct interface between the base of the berm and the underlying soil.

The grade along the berm could be raised with on-site material composed of glacial till. Boulders greater than about 300 millimetres in diameter should be removed from the glacial till to facilitate compaction. The earth fill should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value.

5.5.2 Erosion Protection

It is our understanding that the side slopes will be constructed at an inclination of 3 horizontal to 1 vertical, which is considered suitable to prevent erosion of material from the surface of the berm. The slopes of the berm could be vegetated or covered with a proprietary erosion protection system.

5.5.3 Stability and Settlement

Given the relatively low height of the berm the stability and settlement of the berm in the short or long term is not of concern from a geotechnical perspective.

5.6 Side Slopes to the Proposed Pond

A slope stability analyses of the pond side slopes was carried out using SLIDE, a state of the art, two dimensional limit equilibrium slope stability program for cross-sections A-A' and B-B' provided on Sheet 4 of the final grading plan prepared by Morrison Hershfield Ltd. ("Algonquin College Stormwater Management Pond, Site Servicing & Grading and Drainage, Issued for Construction May 28, 2018"). As a conservative approach, we have assumed that the silty clay is fully saturated with the groundwater level at ground surface and groundwater flow towards the toe of the slope.

The slope stability analyses were carried out using soil parameters, fully saturated conditions and a slope profile that attempt to model the slope in question but do not exactly represent the actual conditions. For the purposes of this study, a computed factor of safety of less than 1.0 to 1.3 is considered to represent a slope bordering on failure to marginally stable, respectively; a factor of safety of 1.3 to 1.5 is considered to indicate a slope that is less likely to fail in the long term and provides a degree of confidence against failure ranging from marginal (1.3) to adequate (1.4 and greater) should conditions vary from the assumed conditions. A factor of safety of 1.5, or greater, is considered to indicate adequate long term stability.

The results of the slope stability analyses indicates that the side slopes, in their proposed configurations, have a factor of safety against overall rotational failure of greater than 1.5 for static loading conditions, which is considered to indicate adequate long term stability.

In addition, pseudo-static slope stability analyses were also carried out in an attempt to model seismic loading conditions. A seismic coefficient (k_h) of 0.16 was used in the analysis. The slope stability analyses indicates the pond side slopes, in their proposed configuration, have a factor of safety against instability of greater than 1.1 for pseudo-static (seismic) conditions, which is considered acceptable.

To account for fluctuating water conditions in the pond we have carried out a rapid drawdown analysis for the side slopes. The results of this analysis with the initial water level at the normal operating level indicate a factor of safety well above 1.5. The results of the rapid drawdown analysis with an initial water level at the 100 year water level indicate a factory of safety of 1.4, which is considered acceptable for this scenario.

The overburden slopes could be protected against erosion using topsoil and seed. If topsoil is to be placed on the sides of the proposed pond, consideration should be given to carrying out this work using light, track mounted equipment after a period of drying over the summer period. To reduce erosion during the development of vegetative cover, consideration could be given to temporarily protecting the slopes with a layer of mulch or a photodegradable erosion control blanket, such as those manufactured by North American Green.

5.7 Services

The following sections provide our comments on the storm sewers and structures related to the proposed stormwater pond.

5.7.1 Excavation

Based on the results of the investigation, the excavations for the storm sewers and structures within the site will be carried out through topsoil, fill material, sandy silt, silty clay and glacial till.

The sides of the excavations should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Occupational Health and Safety Act. According to the Act, the soils at this site can be classified as Type 3 soils. Therefore, for design purposes, allowance should be made for 1 horizontal to 1 vertical, or flatter, excavation slopes within the native soils at this site. As an alternative to sloping the excavations, all services installations could be carried out within a tightly fitting, braced steel trench box, which is specifically designed for this purpose.

5.7.2 Groundwater Pumping

Possible groundwater inflow from the overburden deposits into the excavations could be controlled by pumping from filtered sumps within the excavations. It is not expected that short term pumping during excavation will have any significant affect on nearby structures and services.

The groundwater handling should be carried out in accordance with provincial and local regulations.

Suitable detention and filtration will be required before discharging water. The contractor should be required to submit an excavation and groundwater management plan for review.

Depending on the depth of proposed services and groundwater level at the time of construction, an Environmental Activity and Sector Registry (EASR) in accordance with Environmental Protection Act Part II may be required.

5.7.3 Pipe Bedding and Cover

The bedding for the storm sewers should be in accordance with OPSD 802.010 and 802.031 for flexible and rigid pipes, respectively.

The bedding for pipes or structures should consist of at least 150 millimetres of well graded crushed stone meeting OPSS requirements for Granular A. OPSS documents allow recycled asphaltic concrete and concrete to be used in Granular A and Granular B Type II material. Since the source of recycled material cannot be determined, it is suggested that any granular materials used in the service trenches be composed of virgin (i.e., not recycled) material only.

Allowance should be made for subexcavation of any existing fill, organic deposits, or disturbed material encountered at subgrade level.

Allowance should be made to place a subbedding layer composed of 150 to 300 millimetres of OPSS Granular B Type II in areas where wet silty clay or glacial till is encountered at the pipe subgrade level to reduce the potential for disturbance.

Cover material, from pipe spring line to at least 300 millimetres above the top of the pipe, should consist of granular material, such as OPSS Granular A.

The use of clear crushed stone should not be permitted for the installation of site services, since it could exacerbate groundwater lowering of the overburden materials due to “French Drain” effects.

The subbedding, bedding and cover materials should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density using suitable vibratory compaction equipment.

5.7.4 Trench Backfill

The general backfilling procedures should be carried out in a manner that is compatible with the future use of the area above the service trenches or structures. Based on our review of the plans, the new sewer installation and associated structures will be in soft landscaped areas with possible “stone dust” pathways at some locations. As such, it is considered that some differential frost heave above these areas can be accommodated and imported Earth Borrow or the on site material is considered acceptable for use as trench backfill.

In landscaped areas the trench backfill should be compacted in maximum 300 millimetre thick lifts to at least 90 percent of the standard Proctor dry density value, provided that some minor, post construction ground settlement is acceptable. Below the “stone dust” pathways the backfill should be compacted to at least 95 percent of the standard Proctor dry density value.

The silty clay from the excavations may have moisture contents above optimum for compaction. Furthermore, this material is sensitive to changes in moisture content. Unless the material is allowed to dry, the specified densities will not likely be possible to achieve and, as a consequence, some settlement of these backfill materials could occur. Consideration could be implementing one or a combination of the following measures to reduce post construction settlement above the trenches and structures, depending on the weather conditions encountered during the construction:

- Allow the overburden materials to dry prior to compaction.
- Reuse any wet materials in the lower part of the trenches and make provision to re-grade the ground surface or pathways 6 months to 1 year following the backfilling.

5.8 Other Considerations

5.8.1 Construction Induced Vibration

Some of the construction operations (such as excavation, compaction, etc.) will cause ground vibrations on and off of the site. The vibrations will attenuate with distance from the source, but may be felt at nearby structures. Assuming that any excavation is carried out in accordance with the guidelines in this report, the magnitude of the vibrations will be much less than that is required to cause damage to the nearby structures or services in good condition. However, we recommend that preconstruction surveys be carried out on the adjacent structures and that vibration monitoring be carried out during the construction, at least initially, so that any damage claims can be addressed in a fair manner.

5.8.2 Winter Construction

In the event that construction is required during freezing temperatures, the native subgrade and CCL (if required) should be protected from freezing using straw, propane heaters and insulated tarpaulins, or other suitable means.

5.8.3 Disposal of Excess Material

It is noted that the professional services retained for this project include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible surface and/or subsurface contamination, including naturally occurring source of contamination, are outside the terms of reference for this report.

5.8.4 Planting/Landscaping Restrictions

Based on the results of our investigation, there are no planting/landscaping restrictions from a geotechnical perspective. Guidelines on providing vegetation for erosion protection purposes are provided in Sections 5.5.2 and 5.6.

5.8.5 Seepage Barriers

It is recommended that seepage barriers be constructed at the inlet and outlet areas to reduce the potential for groundwater flow through the relatively permeable granular bedding and cover material and subsequent groundwater lowering.

The seepage barriers should begin at subgrade level and extend vertically through the granular pipe bedding and granular surround to within the native backfill materials, and horizontally across the full width of the service trench excavation. The seepage barriers could consist of 1.5 metre wide dykes of compacted silty clay or clayey silt. The native silty clay deposits at this site are considered suitable for this purpose. The silty clay/clayey silt should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value.

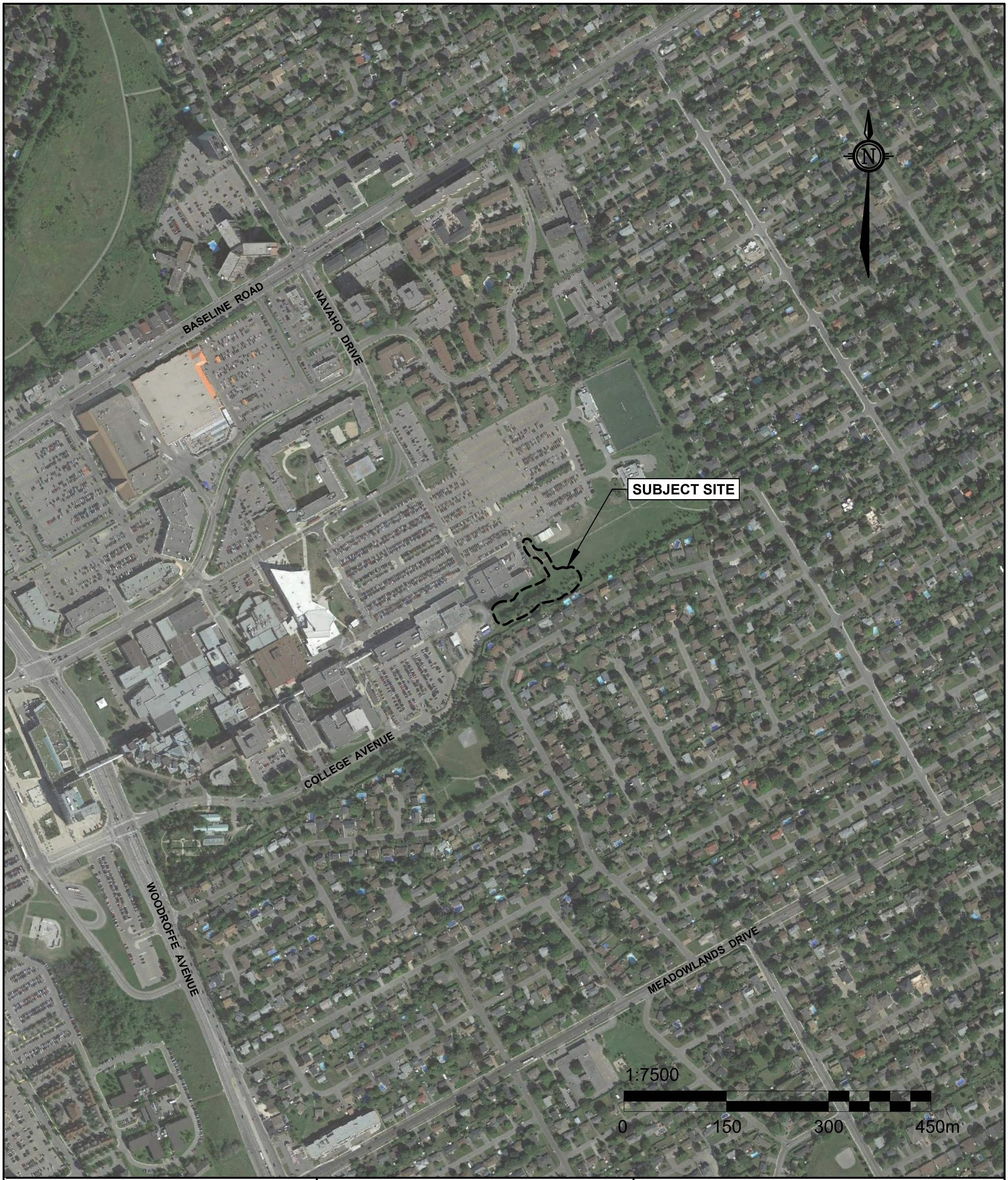
5.8.6 Design Review

We have reviewed the final grading plan prepared by Morrison Hershfield Ltd. titled: "Algonquin College Stormwater Management Pond, Site Servicing & Grading and Drainage, Sheet 1 to 4, Issued for Construction May 28, 2018". Based on our review, it is our opinion that the grading, proposed pond features are in conformance with the recommendations and conclusions outlined above. We have no concerns from a geotechnical perspective on the proposed rip-rap spillways at the minor system inlets to the pond.

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.

LICENSED PROFESSIONAL ENGINEER
B.D. WIEBE
100060438
01 Oct 2018
PROVINCE OF ONTARIO

Brent Wiebe, P.Eng.
VP Operations - Ontario
P:\0. Files\64100\64152.36\Report\64152.36_RPT_V02_2018-10-01.docx



GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

32 Steacie Drive, Ottawa, ON
T: (613) 836-1422 | www.gemtec.ca | ottawa@gemtec.ca

Project		ALGONQUIN COLLEGE STORMWATER MANAGEMENT POND 1385 WOODROFFE AVENUE TRANSPORTATION TECHNOLOGY CENTRE OTTAWA, ONTARIO	Drawing		KEY PLAN
Drwn By	Chkd By	Date	Project No.	Revision No.	
P.C.	B.V.	OCTOBER 2018	64152.36	0	**FIGURE 1**

P:\0. Files\64100\64152.36\Drafting\Drawings\64152.36_(01)_FG1_V01_2017-05-04.dwg, Key Plan, 10/1/2018 8:44:24 AM

LEGEND

BH 17-1 85.73 — BOREHOLE LOCATION IN PLAN (current investigation by Gemtec Ltd.)

GROUND SURFACE ELEVATION IN METRES GEODETIC DATUM

Scale 1:500

0 10 20 30m

GEMTEC CONSULTING ENGINEERS AND SCIENTISTS

32 Steacie Drive
Ottawa, ON
Tel: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

Client	MORRISON HERSHFIELD LIMITED	Project	64152.36
Location	ALGONQUIN COLLEGE 1385 WOODROFFE AVENUE, OTTAWA, ONTARIO		
Drwn by P.C.	Chkd by B.V.	BOREHOLE LOCATION PLAN	
Date OCTOBER 2018	Rev. 0	FIGURE 2	

P:\0. Files\64100\64152.36\Drafting\Drawings\64152.36_(01)_FG2_V01_2017-05-04.dwg, BHLP, 10/1/2018 8:46:07 AM

APPENDIX A

Record of Borehole Sheets
List of Abbreviations and Terminology

Report to: Morrison Hershfield Ltd.
Project: 64152.36 (October 1, 2018)

RECORD OF BOREHOLE 17-1

CLIENT:
PROJECT:
JOB#:
LOCATION: See Borehole Location Plan, Figure 2

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: Apr 19 2017

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200 mm Diameter Hollow Stem	Ground Surface	85.73						Backfilled with auger cuttings
		Dark brown sandy silt, some clay, with organic material (TOPSOIL)	85.60 0.13						
		Grey brown SANDY SILT, some clay		1	50 D.O.		9		
1		Stiff to very stiff, grey brown SILTY CLAY, trace sand (WEATHERED CRUST)	84.97 0.76	2	50 D.O.		10		
2				3	50 D.O.		7	MH, See Fig. B1	
		Stiff to very stiff, grey SILTY CLAY, trace sand	83.44 2.29	4	50 D.O.		4		
3				5	50 D.O.		1		
4		Loose to very dense grey silty sand, some gravel, trace clay, with possible cobbles and boulders (GLACIAL TILL)	81.92 3.81	6	50 D.O.		7		
				7	50 D.O.		> 50 for 100 mm		
5		End of Borehole Auger Refusal	81.06 4.67						
6									
7									
8									

● PENETRATION RESISTANCE (N), BLOWS/0.3m
▲ DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED
WATER CONTENT, % W_P W W_L
10 20 30 40 50 60 70 80 90

GEO - BOREHOLE LOG GINT BOREHOLE LOGS.GPJ GEMTEC 2018.GDT 1/10/18

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

LOGGED: M.L.
CHECKED:

RECORD OF BOREHOLE 17-2

CLIENT:
PROJECT:
JOB#:
LOCATION: See Borehole Location Plan, Figure 2

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: Apr 19 2017

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, mm	SAMPLES: BLOWS/0.3m	● PENETRATION RESISTANCE (N), BLOWS/0.3m; ▲ DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m; SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED; WATER CONTENT, % W_P W W_L; 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0		Borehole omitted.		0.00							
1											
2											
3											
4											
5											
6											
7											
8											

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

LOGGED: M.L.
CHECKED:

RECORD OF BOREHOLE 17-3

CLIENT:
PROJECT:
JOB#:
LOCATION: See Borehole Location Plan, Figure 2

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: Apr 19 2017

Boring Method: Power Auger, 200 mm Diameter Hollow Stem

Depth Scale (m)	Description	Elev. / Depth (m)	Sample Number	Type	Recovery, mm	Blows/0.3m	Piezometer or Standpipe Installation
0	Ground Surface	85.79					
	Dark brown silty clay, trace sand, with organic material (TOPSOIL)	85.74 / 0.05					Backfilled with auger cuttings.
	Stiff to very stiff, grey brown SILTY CLAY, trace sand (WEATHERED CRUST)		1	50 D.O.		5	
1			2	50 D.O.		5	
	Very dense, brown to grey sand and gravel, some silt, trace clay, with possible cobbles and boulders (GLACIAL TILL)	84.01 / 1.78	3	50 D.O.		4	
2			4	50 D.O.		72	
3			5	50 D.O.		> 50 for 125 mm	
	End of Borehole Auger Refusal	82.23 / 3.56					

Chart headings: PENETRATION RESISTANCE (N), BLOWS/0.3m; DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m; SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED; WATER CONTENT, % W_P W W_L; scale 10 20 30 40 50 60 70 80 90; ADDITIONAL LAB. TESTING

Depth scale: 0 1 2 3 4 5 6 7 8

GEMTEC Consulting Engineers and Scientists

LOGGED: M.L.

CHECKED:

GEO - BOREHOLE LOG GINT BOREHOLE LOGS.GPJ GEMTEC 2018.GDT 1/10/18

RECORD OF BOREHOLE 17-4

CLIENT:
PROJECT:
JOB#:
LOCATION: See Borehole Location Plan, Figure 2

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: Apr 18 2017

Boring method: Power Auger, 200 mm Diameter Hollow Stem

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
0	Ground Surface	86.76					
	Dark brown silty sand, trace clay, with organic material (TOPSOIL FILL)	86.71 / 0.05					Backfilled with auger cuttings.
	Very loose to loose, grey brown silty sand, some clay, trace gravel (FILL MATERIAL)		1	50 D.O.		7	
1			2	50 D.O.		7	
			3	50 D.O.		WH	
2	Stiff to very stiff, grey brown SILTY CLAY, trace sand	84.47 / 2.29	4	50 D.O.		4	
3			5	50 D.O.		11	
	Loose to very dense, grey silty sand, some gravel, trace clay with pockets of grey brown silty clay, and probable cobbles and boulders (GLACIAL TILL)	83.36 / 3.40					
4			6	50 D.O.		4	
			7	50 D.O.		> 50 for 100 mm	
5	End of Borehole Auger Refusal	81.88 / 4.88					
6							
7							
8							

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, %: W_P — W — W_L
10 20 30 40 50 60 70 80 90
ADDITIONAL LAB. TESTING

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

LOGGED: M.L.
CHECKED:

RECORD OF BOREHOLE 17-5

CLIENT:
PROJECT:
JOB#:
LOCATION: See Borehole Location Plan, Figure 2

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: Apr 18 2017

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200 mm Diameter Hollow Stem	Ground Surface	87.09					
		Compact, grey brown silty sand, some gravel, trace clay (FILL MATERIAL)		1	50 D.O.		22	Backfilled with auger cuttings.
1		Stiff to very stiff, grey brown SILTY CLAY, trace sand (WEATHERED CRUST)	86.33 0.76	2	50 D.O.		7	
2				3	50 D.O.		7	
		Stiff to very stiff grey brown SILTY CLAY, trace sand	84.80 2.29	4	50 D.O.		4	
3				5	50 D.O.		3	
4		Dense to very dense grey brown silty sand, some gravel, trace clay, with probable cobbles and boulders (GLACIAL TILL)	83.28 3.81	6	50 D.O.		35	
				7	50 D.O.		> 50 for 150 mm	
5		End of Borehole Auger Refusal	82.06 5.03					
6								
7								
8								

PENETRATION RESISTANCE (N), BLOWS/0.3m ● — DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m ▲ — SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED — WATER CONTENT, %: W_P — W — W_L — 10 20 30 40 50 60 70 80 90 — ADDITIONAL LAB. TESTING — STRATA PLOT

GEMTEC Consulting Engineers and Scientists

LOGGED: M.L.

CHECKED:

RECORD OF BOREHOLE 17-6

CLIENT:
PROJECT:
JOB#:
LOCATION: See Borehole Location Plan, Figure 2

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: Apr 18 2017

BORING METHOD: Power Auger, 200 mm Diameter Hollow Stem

DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
Ground Surface	89.29						
Dark brown silty sand, with organic material (TOPSOIL FILL)	89.24 / 0.05						Backfilled with auger cuttings.
Loose, grey brown silty sand, some clay, trace gravel, with asphaltic concrete and brick debris (FILL MATERIAL)		1	50 D.O.		3		
		2	50 D.O.		7		
		3	50 D.O.		5		
Dark grey sandy silt (FORMER TOPSOIL LAYER)	86.85 / 2.44	4	50 D.O.		14		
Stiff to very stiff, grey brown SILTY CLAY, trace sand, trace gravel (WEATHERED CRUST)	86.34 / 2.95	5	50 D.O.		5		
		6	50 D.O.		7	MH, See Fig B1	
		7	50 D.O.		7		
Dense to very dense brown to grey silty sand, some gravel, trace clay, with probable cobbles and boulders (GLACIAL TILL)	84.26 / 5.03	8	50 D.O.		35		
		9	50 D.O.		37		
		10	50 D.O.		> 50 for 100 mm		
End of Borehole Auger Refusal	82.41 / 6.88						

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED
WATER CONTENT, % W_P W W_L
10 20 30 40 50 60 70 80 90

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8

GEMTEC
Consulting Engineers and Scientists

LOGGED: M.L.
CHECKED:

RECORD OF BOREHOLE 17-7

CLIENT:
PROJECT:
JOB#:
LOCATION: See Borehole Location Plan, Figure 2

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: Apr 18 2017

BORING METHOD: Power Auger, 200 mm Diameter Hollow Stem

DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
Ground Surface	89.27				
Dark brown silty sand, with organic material (TOPSOIL FILL)	89.22 / 0.05				
Loose, grey brown silty sand, some clay, trace gravel, with asphaltic concrete and brick debris (FILL MATERIAL)		1	50 D.O.		8
		2	50 D.O.		6
		3	50 D.O.		5
Dark grey sandy silt (FORMER TOPSOIL LAYER)	86.98 / 2.29				
Stiff to very stiff, grey brown SILTY CLAY, trace sand, trace gravel (WEATHERED CRUST)	86.88 / 2.39	4	50 D.O.		8
		5	50 D.O.		7
		6	50 D.O.		7
Compact grey brown silty sand, some gravel, trace clay, with probable cobbles and boulders (GLACIAL TILL)	84.70 / 4.57	7	50 D.O.		14
		8	50 D.O.		25
End of Borehole	83.33 / 5.94				

DEPTH SCALE METRES: 0, 1, 2, 3, 4, 5, 6, 7, 8

● PENETRATION RESISTANCE (N), BLOWS/0.3m
▲ DYNAMIC PENETRATION RESISTANCE (N), BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, %: W_P — W — W_L
10 20 30 40 50 60 70 80 90

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Backfilled with auger cuttings.

GEO - BOREHOLE LOG GINT BOREHOLE LOGS.GPJ GEMTEC 2018.GDT 1/10/18

GEMTEC Consulting Engineers and Scientists

LOGGED: M.L.
CHECKED:

ABBREVIATIONS AND TERMINOLOGY USED ON RECORDS OF BOREHOLES AND TEST PITS

SAMPLE TYPES	
AS	Auger sample
CA	Casing sample
CS	Chunk sample
BS	Borros piston sample
GS	Grab sample
MS	Manual sample
RC	Rock core
SS	Split spoon sampler
ST	Slotted tube
TO	Thin-walled open shelby tube
TP	Thin-walled piston shelby tube
WS	Wash sample

SOIL TESTS	
w	Water content
PL, w_p	Plastic limit
LL, w_L	Liquid limit
C	Consolidation (oedometer) test
D_R	Relative density
DS	Direct shear test
G_S	Specific gravity
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	Organic content test
UC	Unconfined compression test
γ	Unit weight

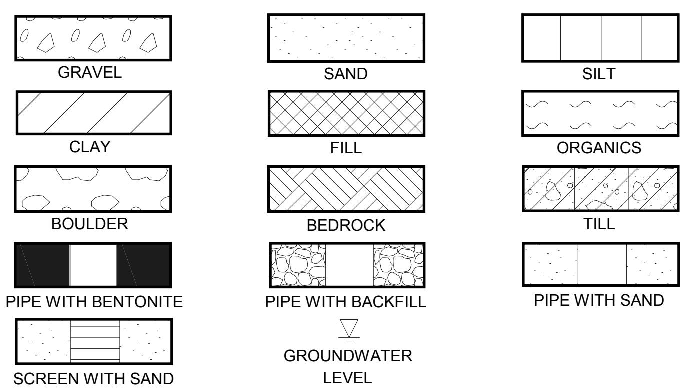
PENETRATION RESISTANCE

Standard Penetration Resistance, N
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 millimetres (30 in.) required to drive a 50 mm split spoon sampler for a distance of 300 mm (12 in.). For split spoon samples where less than 300 mm of penetration was achieved, the number of blows is reported over the sampler penetration in mm.

Dynamic Penetration Resistance
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive a 50 mm (2 in.) diameter 60° cone attached to 'A' size drill rods for a distance of 300 mm (12 in.).

WH	Sampler advanced by static weight of hammer and drill rods
WR	Sampler advanced by static weight of drill rods
PH	Sampler advanced by hydraulic pressure from drill rig
PM	Sampler advanced by manual pressure

COHESIONLESS SOIL Compactness		COHESIVE SOIL Consistency	
SPT N-Values	Description	Cu, kPa	Description
0-4	Very Loose	0-12	Very Soft
4-10	Loose	12-25	Soft
10-30	Compact	25-50	Firm
30-50	Dense	50-100	Stiff
>50	Very Dense	100-200	Very Stiff
		>200	Hard



GRAIN SIZE

0.01 | 0.1 | 1.0 | 10 | 100 | 1000mm

SILT CLAY	SAND: Fine	SAND: Medium	SAND: Coarse	GRAVEL	COBBLE	BOULDER
< 0.08	0.08–0.4	0.4–2	2–5	5–80	80–200	> 200

DESCRIPTIVE TERMINOLOGY

(Based on the CANFEM 4th Edition)

0–10	10–20	20–35	35
TRACE	SOME	ADJECTIVE	noun > 35% and main fraction
trace clay, etc	some gravel, etc.	silty, etc.	sand and gravel, etc.

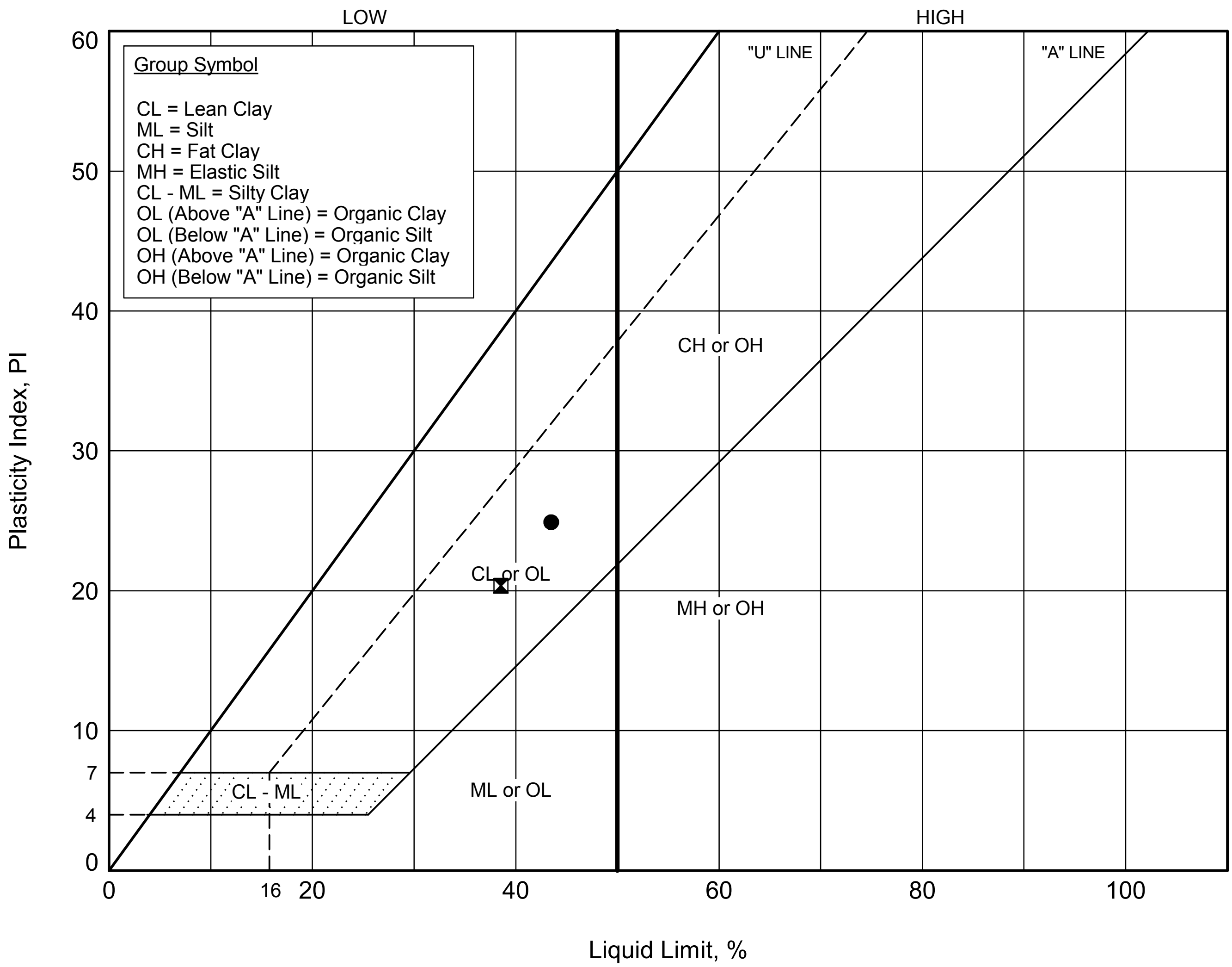
APPENDIX B

Results of Laboratory Classification Testing
Figures B1 and B2

Report to: Morrison Hershfield Ltd.
Project: 64152.36 (October 1, 2018)

PLASTICITY CHART

FIGURE B2



Legend	Borehole	Sample	Depth (m)	Water Content %	LL %	PL %	PI %
●	17-1	3	1.4 - 2.0	34.3	43.5	18.6	24.9
⧗	17-6	6	3.8 - 4.4	29.1	38.6	18.2	20.4

HCE ATTERBERG LIMITS GINT BOREHOLE LOGS.GPJ HOULE CHEVRIER FEB 9 2011.GDT 4/5/17

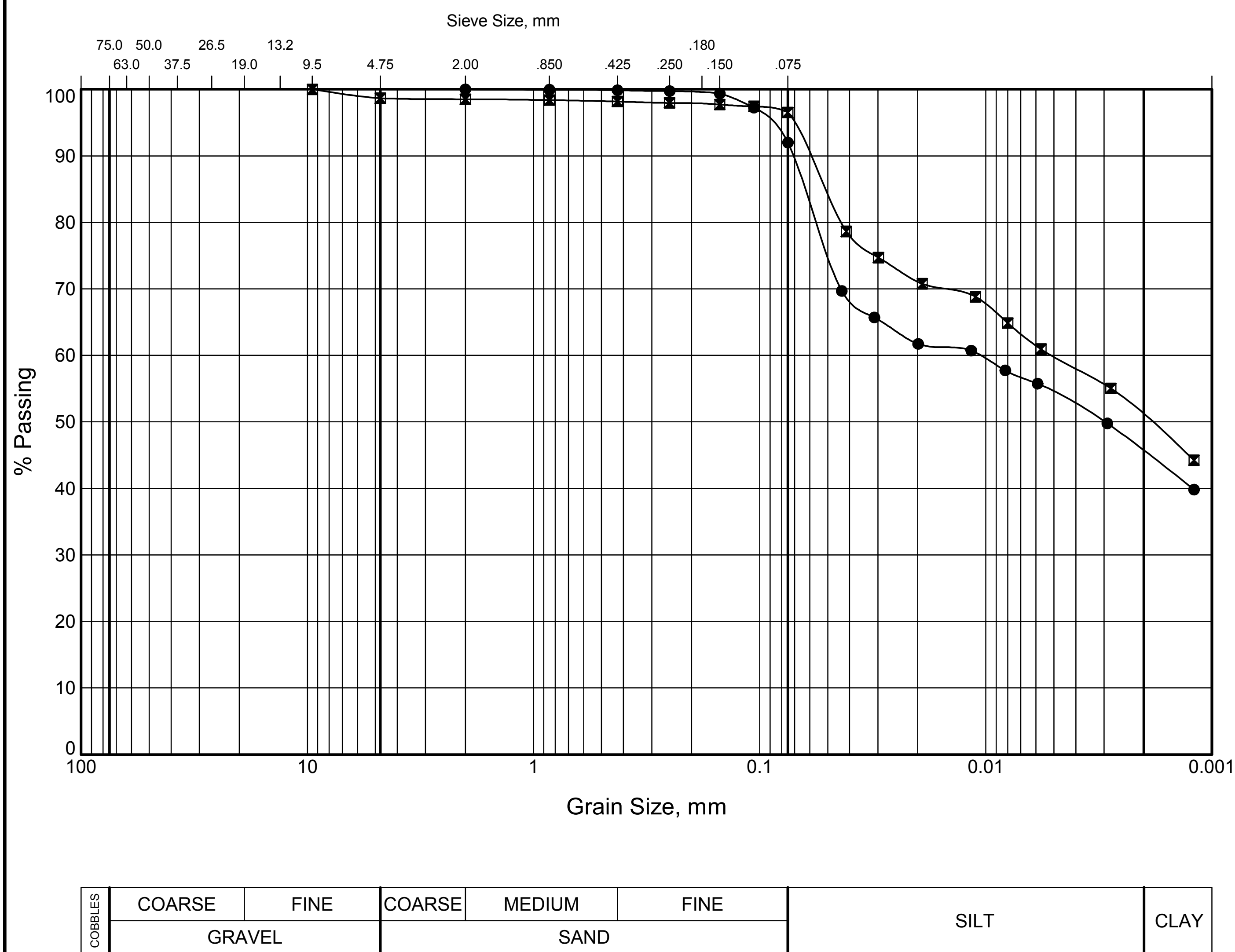
GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

Date: April 2017

Project: 64152.36

GRAIN SIZE DISTRIBUTION

FIGURE B1



Legend	Borehole	Sample	Depth (m)	% Gravel	% Sand	% Silt	% Clay
●	17-1	3	1.4 - 2.0	0	8	46	46
⧗	17-6	6	3.8 - 4.4	1	2	46	51

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

Date: April 2017

Project: 64152.36

SOILS GRAIN SIZE GRAPH UNIFIED % (HYDRO) GINT BOREHOLE LOGS.GPJ HOULE CHEVRIER FEB 9 2011.GDT 4/5/17 experience • knowledge • integrity

civil	civil
geotechnical	géotechnique
environmental	environnementale
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

expérience • connaissance • intégrité

Appendix J

CONTENTS

Stakeholder Correspondence 5 pages

James Fookes

From:	Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Sent:	Monday 22 October 2018 3:29 PM
To:	James Fookes
Subject:	RE: SWM Pond at Algonquin College - ECA Requirements

Hi James,

If the parcels were consolidated into one, an ECA would not be required. The MOE does not consider the college to be industrial lands.

Hope this helps clarify things.

Regards,

Emily Diamond
Environmental Officer
Ministry of the Environment, Conservation and Parks
Ottawa District Office
2430 Don Reid Drive
Ottawa, Ontario, K1H 1E1
Tel: 613-521-3450 ext 238
Fax: 613-521-5437
e-mail: emily.diamond@ontario.ca

From: James Fookes [mailto:JFookes@morrisonhershfield.com]
Sent: October 22, 2018 3:27 PM
To: Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Hi Emily,

Just following up on my message below. Our view is that the Algonquin College Woodroffe campus does not meet the definition of "Industrial Lands", but the City is requiring that we clarify this with you. Please let me know.

Thanks,
James

From: James Fookes
Sent: Wednesday 03 October 2018 11:58 AM
To: Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Hi Emily,

Thank you for this information. The College has advised that there is no particular reason why the site is split into two parcels, and they are looking into consolidating it into a single parcel, which is preferable to them for a number of reasons.

In the event that the College does complete the consolidation of the parcels, can you advise whether an ECA would still be required? The City's Development Review Project Manager (Mark Fraser) mentioned that the MOECP may consider the College campus to be "Industrial Lands" as defined under O.Reg. 525/98, and requested that we ask you to clarify this.

Thanks and regards,
James

James Fookes, P.Eng.
Senior Water and Wastewater Engineer
jfookes@morrisonhershfield.com

MORRISON HERSHFIELD
People • Culture • Capabilities
2440 Don Reid Drive | Ottawa, ON K1H 1E1 Canada
Dir: 613 739 2910 x1022225 | Cell: 613 869 9592 | Fax: 613 739 4926
morrisonhershfield.com

From: Diamond, Emily (MECP) [mailto:Emily.Diamond@ontario.ca]
Sent: Tuesday 25 September 2018 9:25 AM
To: James Fookes <JFookes@morrisonhershfield.com>
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Good Morning James,

Based on the information provided, an ECA would be required for the proposed stormwater pond servicing Algonquin College. Regardless of who owns the two parcels, the Ministry considers the parcels to be separate. The exemption set out under Ontario Regulation 525/98 would only apply if the stormwater pond was servicing one parcel with a single PIN.

Regards,

Emily Diamond
Environmental Officer
Ministry of the Environment, Conservation and Parks
Ottawa District Office
2430 Don Reid Drive
Ottawa, Ontario, K1H 1E1
Tel: 613-521-3450 ext 238
Fax: 613-521-5437
e-mail: emily.diamond@ontario.ca

From: James Fookes [mailto:JFookes@morrisonhershfield.com]
Sent: September 24, 2018 11:44 AM
To: Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Cc: Des Rochers, Christina (MECP) <Christina.Desrochers@ontario.ca>
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Hi Emily,

I would appreciate if we could get some feedback regarding the Stormwater Management Pond at Algonquin. Let me know if you need more details from me, or would like to set up a pre-consultation meeting.

Regards,
James

James Fookes, P.Eng.
Senior Water and Wastewater Engineer
jfookes@morrisonhershfield.com

MORRISON HERSHFIELD
People • Culture • Capabilities
2440 Don Reid Drive | Ottawa, ON K1H 1E1 Canada
Dir: 613 739 2910 x1022225 | Cell: 613 869 9592 | Fax: 613 739 4926
morrisonhershfield.com

From: James Fookes
Sent: Tuesday 11 September 2018 9:11 AM
To: Des Rochers, Christina (MECP) <Christina.Desrochers@ontario.ca>; Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Thanks Christina. I look forward to hearing from Emily. We have a meeting with the City at 11am tomorrow, so any feedback that can be provided in advance of that would be very much appreciated.

Regards,
James

From: Des Rochers, Christina (MECP) [mailto:Christina.Desrochers@ontario.ca]
Sent: Monday 10 September 2018 5:17 PM
To: James Fookes <JFookes@morrisonhershfield.com>; Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Hi James,

I forwarded your original email to Emily Diamond after we spoke last week and actually touched base with her this morning. I will forward this new information along to her and she will hopefully get back to you soon.

Thanks.

Christina

Christina Des Rochers
Water Inspector | Inspectrice de l'eau
Safe Drinking Water Branch | Direction du contrôle de la qualité de l'eau potable
Ministry of the Environment, Conservation and Parks | Ministère de l'Environnement, de la Protection de la nature et des Parcs
Tel. 613-521-3450 ex. 231
Fax. 613-521-5437
Spills Action Centre | Centre d'intervention en cas de déversement 1-800-268-6060

From: James Fookes [mailto:JFookes@morrisonhershfield.com]
Sent: September-10-18 5:02 PM

To: Des Rochers, Christina (MECP)
Subject: RE: SWM Pond at Algonquin College - ECA Requirements

Hi Christina,

I'm just following up regarding my email below. Do you know if your colleague has had a chance to look into this?

Also we have some new information about the separate parcel of land issue. Our planning colleagues at Fotenn have confirmed the 'Algonquin College of Applied Arts and Technology' owns both parcels and (according to the Planning Act) they should be considered one parcel of land. The parcel abstracts for the two different PINS are attached.

Thanks and regards,
James

James Fookes, P.Eng.
Senior Water and Wastewater Engineer
jfookes@morrisonhershfield.com

MORRISON HERSHFIELD
People • Culture • Capabilities
2440 Don Reid Drive | Ottawa, ON K1H 1E1 Canada
Dir: 613 739 2910 x1022225 | Cell: 613 869 9592 | Fax: 613 739 4926
morrisonhershfield.com

From: James Fookes
Sent: Wednesday 05 September 2018 11:32 AM
To: Des Rochers, Christina (MOECC) <Christina.Desrochers@ontario.ca>
Subject: SWM Pond at Algonquin College - ECA Requirements

Hi Christina,

Firstly, I'm not sure whether you are the appropriate person to contact about this – if not I would appreciate if you could forward this email appropriately.

We are involved in the design of a stormwater management pond at Algonquin College (1385 Woodroffe Avenue, Ottawa). We had previously been of the opinion that the pond did not require an ECA, since it only services the College property (i.e. institutional land use), and discharges to a sewer that is not a combined sewer. However, through the Site Plan Control process, the City of Ottawa has commented that:

1. Part of the catchment appears to be a separate parcel of land (130 Lotta Ave), and although also owned by the College, this would trigger an ECA; and,
2. In the City's opinion the site could be considered Industrial Land as defined under O. Reg. 525/98.

The City has requested that the contact the MOECP District Office to determine whether an ECA is required.

We would appreciate a pre-consultation to discuss this, if possible today or first thing tomorrow, to clarify this before a meeting that the college has scheduled with us tomorrow. We are available to meet whenever suits you – just email or call and we will come downstairs.

Thanks and regards,
James

James Fookes, P.Eng.

Senior Water and Wastewater Engineer
jfookes@morrisonhershfield.com

MORRISON HERSHFIELD
People • Culture • Capabilities

2440 Don Reid Drive | Ottawa, ON K1H 1E1 Canada
Dir: 613 739 2910 x1022225 | Cell: 613 869 9592 | Fax: 613 739 4926
morrisonhershfield.com

James Fookes

From: Fraser, Mark <Mark.Fraser@ottawa.ca>
Sent: Friday 09 November 2018 11:17 AM
To: James Fookes
Cc: Matt McElligott; Arash Khoshghalb; Marsh, Amanda
Subject: RE: Algonquin College SWM Pond
Attachments: Appendix J.pdf

Hi James,

Thank you for providing the attached correspondence with the Ministry of the Environment, Conservation and Parks as requested. Please include this correspondence in the Appendix of the updated Design Brief as supporting documentation. Algonquin College will be required to consolidate the parcels and provide evidence that the consolidation has been completed prior to registration of the Site Plan Agreement. The forthcoming letter shall be amended to recognize the commitment to consolidate the parcels prior to registration. Please include this letter in the report and attached with the response comments.

Regards,

Mark Fraser
Project Manager, Planning Services
Development Review West Branch
City of Ottawa | Ville d'Ottawa
Planning, Infrastructure and Economic Development Department
110 Laurier Avenue West. 4th Floor, Ottawa ON, K1P 1J1
Tel:613.580.2424 ext. 27791
Fax: 613-580-2576
Mail: Code 01-14
Email: Mark.Fraser@ottawa.ca

From: James Fookes <JFookes@morrisonhershfield.com>
Sent: November 07, 2018 4:26 PM
To: Fraser, Mark <Mark.Fraser@ottawa.ca>
Cc: Matt McElligott <mcelligott@fotenn.com>; Arash Khoshghalb <AKhoshghalb@morrisonhershfield.com>
Subject: Algonquin College SWM Pond

Hi Mark,

We are in the process of finalizing the resubmission for the above project, and should have it with you in the next few days.

Before we send it, I wanted to update you on our correspondence with the MOECP regarding the need for an ECA.

The attached emails from Emily Diamond (“Appendix J.pdf”) confirm that an ECA is not required provided the separate property parcels are consolidated into one. She also confirms that the MOECP does not consider the college to be industrial lands. We will include this correspondence as an Appendix to the updated Design Brief.

The College is in the process of consolidating the parcels. To move forward with the Site Plan Control approval, we would like to include a letter of undertaking from the College. The proposed wording is as follows:

Dear Mark:

Re: The Algonquin College of Applied Arts and Technology (the "College") - Consolidation of PIN 04691-0238, PIN 04691-0007 and PIN 04691-0281

As requested in order to allow for the timely processing and completion of the site plan for the storm water control pond on the College property, this will confirm that the College undertakes to consolidate the following PINs:

PIN 04691-0007 (former school site at east end of campus)
PIN 0461-0238 (triangular site - west of the residence)
PIN 0461-0281 (the main campus - largest parcel)

See PIN maps attached showing the locations of the parcels involved.

Upon completion of the consolidation, the College will provide documentation to the City of Ottawa as evidence that the consolidation has been completed.

Yours truly,

Please could you confirm whether this approach, and the proposed wording of the letter, is acceptable. Please also advise whether the letter should be included in the appendices of the Design Brief, or should just be attached with our response to the City's comments.

Thanks and regards,
James

James Fookes, P.Eng.
Senior Water and Wastewater Engineer
jfookes@morrisonhershfield.com

MORRISON HERSHFIELD
People • Culture • Capabilities
2440 Don Reid Drive | Ottawa, ON K1H 1E1 Canada
Dir: 613 739 2910 x1022225 | Cell: 613 869 9592 | Fax: 613 739 4926
morrisonhershfield.com

'

'

ALGONQUIN COLLEGE

Thursday, November 15, 2018

BY COURIER

Mark Fraser
Project Manager, Planning Services
Development Review West Branch
Mail Code 01-14
City of Ottawa | Ville d' Ottawa
Planning, Infrastructure and Economic Development Department
110 Laurier Avenue West, 4th Floor
Ottawa, ON K1P 1J1

RE: The Algonquin College of Applied Arts and Technology (the "College") - Consolidation of PIN 04691-0007, PIN 04691-0238 and PIN 04691-0281

Dear Mark:

As requested in order to allow for the timely processing and completion of the Site Plan Agreement for the storm water management pond on the College property, this will confirm that the College undertakes to consolidate the following PINs:

PIN 04691-0007 (former school site at east end of campus)
PIN 04691-0238 (triangular site - west of the residence)
PIN 04691-0281 (the main campus - largest parcel)

Please see PIN maps attached showing the locations of the parcels involved.

Upon completion of the consolidation, and prior to registration of the Site Plan Agreement, the College will provide documentation to the City of Ottawa as evidence that the consolidation has been completed.

Yours truly,

Duane McNair,
Vice President, Finance and Administration
Algonquin College

MEMO

2611 Queensview Drive, Suite 300, Ottawa ON K2B 8K2 Tel: 613-829-2800 ~ Fax: 613-829-8299

TO:	Ahmed Elsayed, P.Eng., Project Manager Stream Shen, MCIP, RPP, Planner II, File Lead City of Ottawa Planning, Infrastructure and Economic Development Department Development Review - West	**DATE:**	September 24, 2019
FROM:	Ding Bang (Winston) Yang, P.Eng. Ben Worth, P.Eng. C.Eng. MICE	**PROJECT NO.:**	191-01517-00
PROJECT:	Athletics and Recreation Centre (ARC) – Algonquin College 1385 Woodroffe Avenue		
SUBJECT:	Response to site plan control application first round comments dated August 14, 2019 City of Ottawa File D07-12-19-0114		

The following paragraphs respond to the engineering review comments provided in the City of Ottawa letter dated August 14, 2019 pertaining to the site plan and site servicing engineering submission for a proposed Athletics and Recreation Centre (ARC) and associated site changes at Algonquin College. The response numbers correspond to those of the City comments.

The responses listed here indicate changes made to the Servicing and Stormwater Management Reports and civil engineering drawings, revised copies of which accompany the submission of this response. A new revision note and date have been added to all drawings. Responses from other parties are also being submitted for comments not covered by this memo.

Engineering Comments

A. List of Drawing(s):

General comments:

1. Drawings have no frames, please print drawings showing frames.
   Frames have been added to all drawings.

2. Key plan does not show the project area clearly, show different buildings names.
   Building names have been added to the key plan.

3. Include project boundary on all drawings and any easements that are delegated for the city of Ottawa.
   Project boundary and easements are indicated on the drawings.

4. Please clearly include information for existing sewers, manholes and watermains, including inverts, pipes sizes and flow direction.
   The information for the existing underground infrastructure have been added.

5. Add project number D07-12-19-0114 and Plan # 17981 at the bottom right side of the drawings, as per the city standards.
   File number and plan number have been added to the civil drawings.

6. It is recommended to produce a CUP showing all utilities to avoid any conflicts in the future.
   A CUP drawing C07 is included for this submission.

7. The applicant must provide certification from an acceptable professional engineer that the electrical details satisfy these criteria; All exterior light fixtures must be included and approved as part of the site plan approval. Therefore, the lights must be clearly identified by make, model and part number. All external light fixtures must meet the criteria for full cut-off classification as recognized by the Illuminating Engineering Society of North America (IESNA or IES) and must result in minimal light spillage onto adjacent properties (as a guideline, 0.5 fc is normally the maximum allowable spillage). The location of all exterior fixtures, a table showing the fixture types (including make, model, part number), and the mounting heights must be included on a plan.
   Please refer to Architectural and Electrical drawings for details.

Pipe Services Removal Plan, C02, prepared by WSP, 191-01517-00, revision 01, dated 2019-06-24.

A1. Please show a bigger area to give a better idea about the existing sewers and watermains.
A bigger area has been shown.

A2. Please clearly show information for existing sewers, manholes and watermains, including inverts, pipes sizes and flow direction.
The information for the existing underground infrastructure has been added.

Grading Plan, C03, prepared by WSP, 191-01517-00, revision 01, dated 2019-06-24.

A3. 100-yr ponding limit is not clear on the drawings.
The 100-yr ponding limit has been added.

A4. Show 100yr + 20% ponding limits.
The max ponding limit has been added.

A5. Include manholes names and TG on the drawings.
Manholes names and TG have been added.

A6. Minimum accepted slope is 1%, some slopes do not meet the minimum, slopes reach 0.4% at some areas, these areas are considered flat.
The grading has been revised.

A7. Please include more slopes at the west side where the wall is located.
More slopes have been added.

A8. Please include details for the proposed retaining wall.
Please refer the Architectural and Landscaping Drawings for details.

A9. Depressed curbs grades need to be reviewed vs the site plan to be where needed.
Depressed curbs have been added to the architectural site plan, landscaping plan and the civil drawings.

Servicing Plan, C04, prepared by WSP, 191-01517-00, revision 01, dated 2019-06-24.

A10. Show more information on existing sewers and watermains including diameter, slopes and flow directions.
The information for the existing underground infrastructure has been added.

A11. Provide details for connection between proposed watermain services and existing pipes referring to city standards.
Typical connection detail from new to existing watermain W25.1 has been added to watermain note on C01.

A12. Show more details for the watermain under the North service road, the watermain stop west side without showing any specifics.
The watermain continues west to Woodroffe Ave along North Service Road.

A13. Provide invert for every CB lead and services connection connecting to the existing line, it says 1% slope for all of them, but doesn't show if the 1% is the slope needed.
Inverts at the connection point have been added. The leads can be kept at 1% minimum, and then dropped for entry to the sewer via a vertical bend as per standard sewer connection procedures.

A14. Show each catch basin with hydrovortex as per the report including flow and head.
Type of proposed inlet control device has been added to the specific catch basins, including flow and head.

A15. Please include the minimum clearance (Hmin) specified for each hydrovortex on every manhole as per manufacture requirements.
Minimum clearance has been specified for each proposed hydrovortex on the drawing.

A16. Show details for Stormtech chambers including plan & profile, details for catch basins connection to Stormtech chambers and ground water levels.
Details for Stormtech chambers including plan & profile is included for this submission.

A17. Include note on the STM west line that will be replaced.
Replacement note has been added for the STM west line.

A18. Confirm the pipe length before and after the STC300 meets manufacturer's requirements, also the invert drops meets what they specify.
Inverts have been checked with the Stormceptor STC4000 for 80% TSS removal.

A19. Please explain why catch basins are located beside the curbs, this is leading to slopes reaching 0.4% at some locations, which is not accepted, also the catch basins that are located at the accessible parking spots needs to be moved.
The existing drainage pattern for the parking area is sloping away from the existing parking median towards the north toward the existing catchbasins CB110, CB109 and CB108. In order to reinstate the existing drainage pattern, multiple catchbasins have been proposed along the curb to capture the surface runoff into the proposed StormTech chamber. Grading has been revised and accessible parking spots have been removed along the proposed curb.

A20. Show information for sewer line from exist CB107 to STMH5.
The information for the existing underground infrastructure has been added.

Post-Development Storm Drainage Area Plan, C05, prepared by WSP, 191-01517-00, revision 01, dated 2019-06-24

No Comments

Erosion and Sedimentation Control Plan, C06, prepared by WSP, 191-01517-00, revision 01, dated 2019-06-24

A21. Include Manhole numbers on the drawing for existing and proposed.
Manhole numbers have been added on the drawing for existing and proposed.

B. List of Report(s):

Athletics and Recreation Centre (ARC) Algonquin College, Ottawa, ON, Servicing Report, WSP, 191-01517-00, revision 01, dated 2019-06-24

B1. Please include a section talking about pipes to be removed, discussing what buildings/ areas these pipes were servicing, how this might affect serviceability and explain if any relocation for these pipes is needed or not.
Discussion regarding the relocation of the existing sewer and watermain has been included under section 1.11 Impact on private services and also included in section 2 and 3 of the servicing report.

B2. Referring to the Pre-consultation meeting, a note discussing relocation of 152 mm dia was included but doesn't seem to be addressed in the report.
The 150 mm dia. watermain and the 250 mm dia. sanitary running south-north have been included in section 2 and 3 of the servicing report. They were not included previously we had received reports indicating they were no longer in service. It has now been verified that they are active.

B3. As per the pre-consultation meeting notes, a stress-test of the proposed storm water management system needs to be performed.
The stress test has been performed, results are provided in the attached stormwater management strategy report.

B4. Please provide stormtech chambers details including volume vs water height table, also discuss the ground water and cover requirements and what is provided.
Further details regarding anticipated groundwater elevations have been shown on drawings, and additional discussion has been provided in the stormwater management strategy report.

B5. Geotechnical report shows ground water to be at levels that might not be suitable for the underground storage chambers.
Further details regarding anticipated groundwater elevations have been shown on drawings, and additional discussion has been provided in the stormwater management strategy report. It is noted that sufficient clearance from GW elevation to underside of underground storage chamber can be achieved.

B6. Storm sewer design sheet shows Avail cap (5yr), where it supposes to show Avail cap (2 yr).
Wording for Avail Cap (5yr) has been revised to Avail Cap (2yr).

B7. Storm sewer design sheet shows available capacity less than 10 % which is not recommended.

Storm sewer design has been revised, available capacity in each run has exceeded 10%.

B8. Storm sewer design sheet shows the flow after CBMH3 to be 228.86 L/s although there is a flow restrictor proposed at this manhole, please show the expected head vs flow for the 2-yrs storm.

The storm sewer rational method design sheet was used to design the storm sewer in free flow condition. Restricted flow rate and head have been discussed in stormwater management strategy report.

B9. What's the reason to propose CBMH2 & CBMH3 to be catch basin manholes instead of being manholes especially that no flow is associated to them.

CBMH3 is located at the ponding zone, it allows water to spill out. CBMH2 has been changed to STMH2.

B10. Please include the hydrovortex details and the selection points on the graphs.

Hydrovortex details have been included in stormwater management strategy report.

B11. Please include release rates expected for the catch basins for sub catchments A9, 10, 12 & 13 proofing that total flow will not exceed the allowable.

Release rates have been included on the stormwater management strategy report.

B12. Please include calculations that were used to select the STC 300 size showing that this size will be enough.

The calculations and details for stormceptor STC4000 have been added to Appendix C.

B13. The report mentions the replacement of the 375mm sewer with 450mm sewer not to account for flow reduction, what is the reason behind that approach and how will the interim situation during construction be managed especially that this line is conveying flows coming from CB 107.

Most of the existing overland runoff was draining toward existing CB110 and CB109 then discharged to CB108 from east to west. On the other side, some runoff was draining toward existing CB107 then discharged to CB108. The slope from existing CB108 to existing MHSTM45 was 3.76%. For the new development, most of the runoff will go directly to the sewer from existing CB107 to CB108, but the existing slope from existing CB107 to existing CB108 was 0.68%. Upsizing of the existing 375mm sewer to 450mm sewer is required since more flow is diverted to this existing sewer. Temporary pumping of storm water will be required during replacement of the existing storm sewer downstream of existing CB107 with a 450mm dia storm sewer.

B14. What is the reason behind avoiding any surface ponding in the parking lot.

It is to encourage for infiltration. Refer to stormwater management strategy report for detail discussion.

B15. There are 2 uncontrolled areas A18 and A19, these areas were not subtracted from the total area considered to calculate the allowable release rate.

Calculation of post-development flow rates includes runoff from the uncontrolled areas. Please refer to the stormwater management strategy report for detailed discussion.

APPENDIX

B

- WATERMAIN BOUNDARY CONDITIONS FROM CITY OF OTTAWA
- EMAILS FROM CITY OF OTTAWA
- FIRE UNDERWRITERS SURVEY – FIRE FLOW CALCULATION
- WATER DEMAND CALCULATION

Yang, Winston

From:	Fraser, Mark <Mark.Fraser@ottawa.ca>
Sent:	June-20-19 10:42 AM
To:	Winston Yang
Cc:	Johnston, Jim
Subject:	RE: Boundary Condition Request for Athletics and Recreation Centre (ARC) - Algonquin College
Attachments:	1385 Woodroffe June 2019.pdf; 191-01517-00_FUS calculation.pdf; 191-01517-00_SK1 _Site Location-SK1.pdf; RE: ARC - Algonquin College; RE: ARC - Algonquin College

Hi Winston,

The following are boundary conditions, HGL, for hydraulic analysis at 1385 Woodroffe Ave. (zone 2W) assumed to be connected to the 203mm dia. watermain on Navaho Dr.

Minimum HGL = 127.0m, same at both connections
Maximum HGL = 134.8m, same at both connections.
MaxDay + Fireflow (133L/s) = 120.0m, same at both connections

These are for current conditions and are based on computer model simulation.

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation.

If you have any questions please let me know.

Regards,

Mark Fraser
Project Manager, Planning Services
Development Review Central Branch
City of Ottawa | Ville d'Ottawa
Planning, Infrastructure and Economic Development Department
110 Laurier Avenue West. 4th Floor, Ottawa ON, K1P 1J1
Tel:613.580.2424 ext. 27791
Fax: 613-580-2576
Mail: Code 01-14
Email: Mark.Fraser@ottawa.ca

From: Fraser, Mark
Sent: June 17, 2019 8:51 AM
To: 'Winston Yang' <Winston.Yang@ibigroup.com>
Cc: Jim Johnson <james.johnston@wspgroup.com>
Subject: RE: Boundary Condition Request for Athletics and Recreation Centre (ARC) - Algonquin College

Hi Winston,

Please accept this email as confirmation that boundary conditions, HGL, for hydraulic analysis have been requested from the Water Resources Assets Unit based on the water demands provided for the subject development. Please note that it takes approximately 5-10 business days to receive and provide you with boundary conditions.

The watermain within the North Service Road is private therefore fire flow information is not available. Boundary conditions will be provided at the nearest public watermain.

Increase or Decrease for Occupancy
Low Contents Fire Hazard

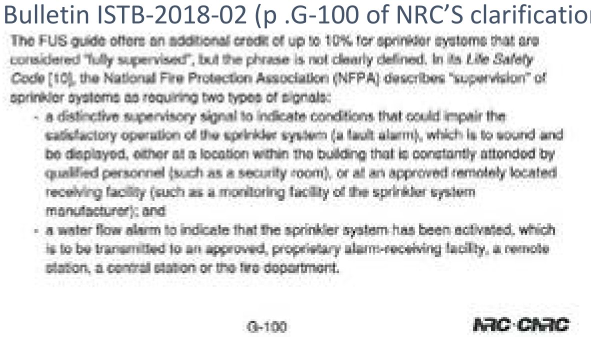
- A Low Contents Fire Hazard has been identified and a 25% reduction has been applied. It will be a requirement to provide justification for this charge value selection.

Exposure

- It will be a requirement to document the separation distances between the building and nearby structures on a sketch to support the applied 5% exposure charge.

Fully Supervised Sprinkler System

- If a Fully Supervised Sprinkler System is assumed, a letter from the mechanical engineer will be required. Please ensure all parts required for a fully supervised sprinkler system are mentioned in the letter as discussed in Technical Bulletin ISTB-2018-02 (p .G-100 of NRC'S clarification of FUS calculations).



The FUS guide offers an additional credit of up to 10% for sprinkler systems that are considered "fully supervised", but the phrase is not clearly defined. In its *Life Safety Code* [10], the National Fire Protection Association (NFPA) describes "supervision" of sprinkler systems as requiring two types of signals:

- a distinctive supervisory signal to indicate conditions that could impair the satisfactory operation of the sprinkler system (a fault alarm), which is to sound and be displayed, either at a location within the building that is constantly attended by qualified personnel (such as a security room), or at an approved remotely located receiving facility (such as a monitoring facility of the sprinkler system manufacturer); and
- a water flow alarm to indicate that the sprinkler system has been activated, which is to be transmitted to an approved, proprietary alarm-receiving facility, a remote station, a central station or the fire department.

G-100 NRC·CNRC

Hydrant Capacity Requirement

- It will be a requirement to document that the aggregate fire flow capacity of all contributing fire hydrants within 150m of the proposed building is not less than the required fire flow.

If you have any questions please let me know.

Regards,

Mark Fraser
Project Manager, Planning Services
Development Review West Branch
City of Ottawa | Ville d'Ottawa
Planning, Infrastructure and Economic Development Department
110 Laurier Avenue West. 4th Floor, Ottawa ON, K1P 1J1
Tel:613.580.2424 ext. 27791
Fax: 613-580-2576
Mail: Code 01-14
Email: Mark.Fraser@ottawa.ca

From: Yang, Winston <Winston.Yang@wsp.com>
Sent: June 14, 2019 12:09 PM
To: Fraser, Mark <Mark.Fraser@ottawa.ca>

Cc: Johnston, Jim <James.Johnston@wsp.com>
Subject: Boundary Condition Request for Athletics and Recreation Centre (ARC) - Algonquin College

CAUTION: This email originated from an External Sender. Please do not click links or open attachments unless you recognize the source.

ATTENTION : Ce courriel provient d'un expéditeur externe. Ne cliquez sur aucun lien et n'ouvrez pas de pièce jointe, excepté si vous connaissez l'expéditeur.

Hi Mark,

We are working on the Site Servicing Study for the proposed Athletics and Recreation Centre (ARC) at Algonquin College. The proposed development is a two storeys with a partial basement to the east. The building is proposed to be serviced from the 203 mm Diameter watermain along the North Service Road. Please see attached SK1 for site location. The total gross building area is confirmed to be 11,658 m² by the Architect. The architect has also confirmed that the type of construction of the proposed building is non-combustible construction. Mechanical Engineer has confirmed that the building will be protected with a supervised automatic fire protection sprinkler system. Please see attached emails for your reference.

The domestic water demands were calculated using the City of Ottawa's Water Design Guidelines where the institutional consumption rate of 28,000 L/ha/d was used to estimate average day demand. But the average daily demand for the ARC will be increased by a factor of 16/8 since we have assumed the ARC will be operated 16 hours a day instead of 8 hours a day. Site area was confirmed to be 11,176 m². Maximum daily demand was calculated by multiplying average day by a factor of 1.5. Maximum hour demand was calculated by multiplying maximum daily demand by a factor of 1.8.

The fire flow required was determined following the Fire Underwriter Survey (FUS) method.
The resulting FUS fire flow is 8,000 L/min or 133 L/s. Please see attached pdf for the detail FUS calculation.

In summary:
Average Daily Demand = 0.72 L/s
Maximum Daily Demand = 1.09 L/s
Maximum Hour Demand = 1.96 L/s
Required Fire Flow = 133 L/s

Please provide fire flow information for the fire hydrant along the North Service Road in the vicinity of the property.

Should you have any questions please do not hesitate to contact me.

Thank you,

Ding Bang (Winston) Yang, P.Eng.
Project Engineer
Infrastructure

T+ 1 613-690-0538

2611 Queensview Drive, Suite 300

Ottawa, Ontario,
K2B 8K2, Canada

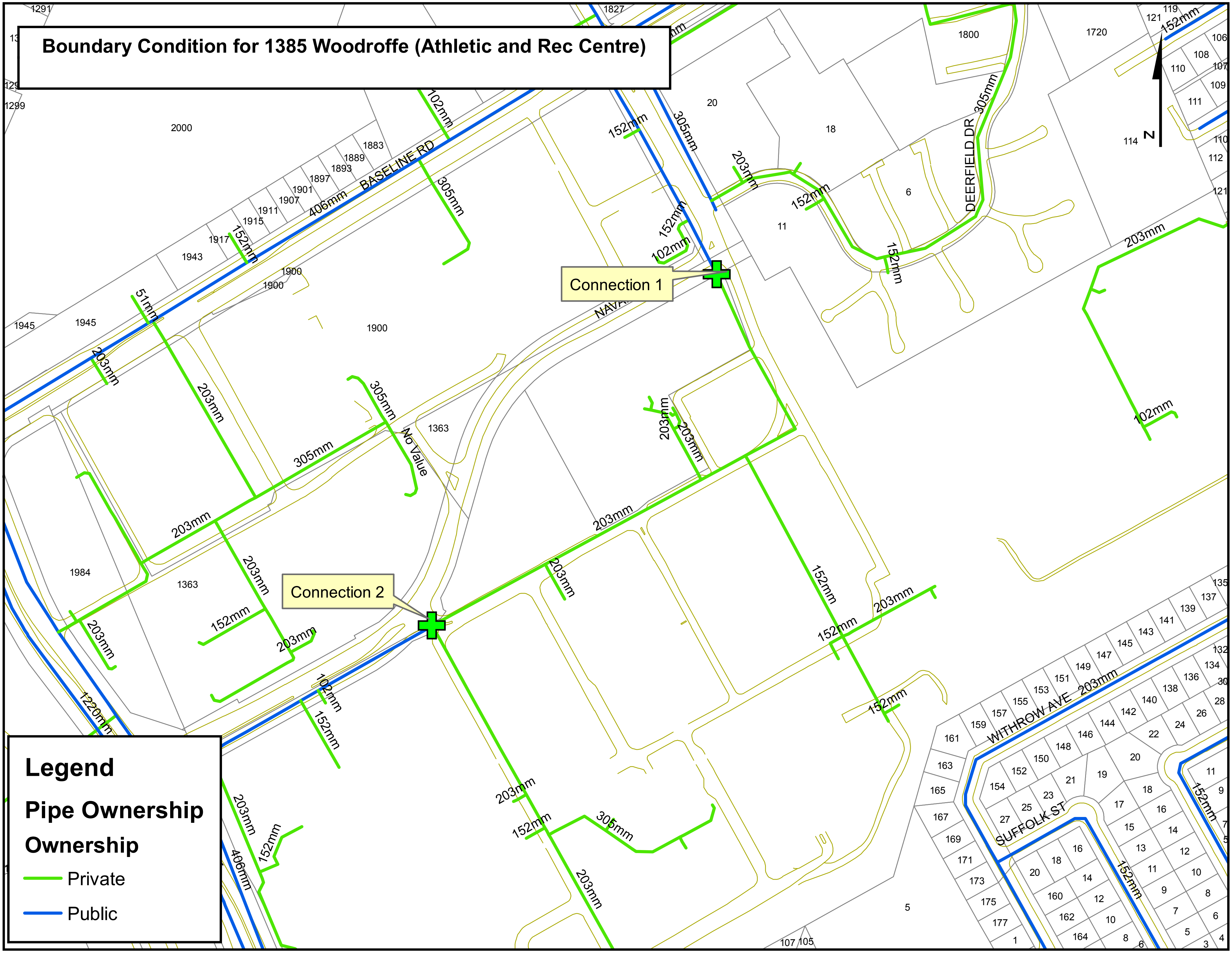
www.wsp.com

-LAEmHhHzdJzBiTWfa4Hgs7pbKI

'

'

Boundary Condition for 1385 Woodroffe (Athletic and Rec Centre)



Yang, Winston

From: LeRoy, Tom <Tom.LeRoy@wsp.com>
Sent: June-07-19 3:37 PM
To: Yang, Winston; Richard Smith
Cc: Angelo Montenegrino; Johnston, Jim; Bourgoin, Andre
Subject: RE: ARC - Algonquin College

Hi Winston,

To follow up on our conversation: the building will be protected with a supervised automatic fire protection sprinkler system.

Tom LeRoy, P.Eng., LEED® AP
Project Manager
Buildings – Mechanical & Electrical Engineering

T+ 1 613-690-3908

wsp.com

From: Yang, Winston
Sent: June-07-19 2:39 PM
To: Richard Smith <richard.smith@hok.com>; LeRoy, Tom <Tom.LeRoy@wsp.com>
Cc: Angelo Montenegrino <angelo.montenegrino@hok.com>; Johnston, Jim <James.Johnston@wsp.com>
Subject: ARC - Algonquin College

Hi Richard and Tom,

We are going to put up the request to ask the city to provide the boundary condition at our connection point along the north service road.
The existing private fire hydrant is located within 45m from the building, no private fire hydrant is required for this development.

Before we submit the request, we want to get confirmation from you regarding the following:

1) The gross floor area will be
   Lower level: 3002 m^2
   Level 1: 4650 m^2
   Level 2: 3285 m^2
   Mezzanine: 721 m^2
   Total: 11,658 m^2
2) The type of construction of the proposed building, ordinary construction or noncombustible construction.
3) (Tom) The type of sprinkler system. (Will the building be equipped with Automatic Sprinkler Protection?)
4) The estimated maximum occupancy limit for ARC during a typical day.

Should you have any questions please do not hesitate to contact me or Jim.

Yours truly,

Ding Bang (Winston) Yang, P.Eng.
Project Engineer
Infrastructure

T+ 1 613-690-0538

2611 Queensview Drive, Suite 300
Ottawa, Ontario,
K2B 8K2, Canada

www.wsp.com

Yang, Winston

From: Richard Smith <richard.smith@hok.com>
Sent: June-07-19 4:41 PM
To: Yang, Winston; LeRoy, Tom
Cc: Angelo Montenegrino; Johnston, Jim
Subject: RE: ARC - Algonquin College

Hi Winston,
Responses below.

RICHARD SMITH
HOK
richard.smith@hok.com
t +1 613 683 1819

From: Yang, Winston [mailto:Winston.Yang@wsp.com]
Sent: Friday, June 7, 2019 2:39 PM
To: Richard Smith <richard.smith@hok.com>; LeRoy, Tom <Tom.LeRoy@wsp.com>
Cc: Angelo Montenegrino <angelo.montenegrino@hok.com>; Johnston, Jim <James.Johnston@wsp.com>
Subject: ARC - Algonquin College

Hi Richard and Tom,

We are going to put up the request to ask the city to provide the boundary condition at our connection point along the north service road.
The existing private fire hydrant is located within 45m from the building, no private fire hydrant is required for this development.

Before we submit the request, we want to get confirmation from you regarding the following:

1) The gross floor area will be
   Lower level: 3002 m²
   Level 1: 4650 m²
   Level 2: 3285 m²
   Mezzanine: 721 m²
   Total: 11,658 m² Correct
2) The type of construction of the proposed building, ordinary construction or noncombustible construction.
3) (Tom) The type of sprinkler system. (Will the building be equipped with Automatic Sprinkler Protection?)
4) The estimated maximum occupancy limit for ARC during a typical day. In progress. Am waiting on final occupancy calc's from Judy. Can this one wait till we have real numbers?

Should you have any questions please do not hesitate to contact me or Jim.

Yours truly,

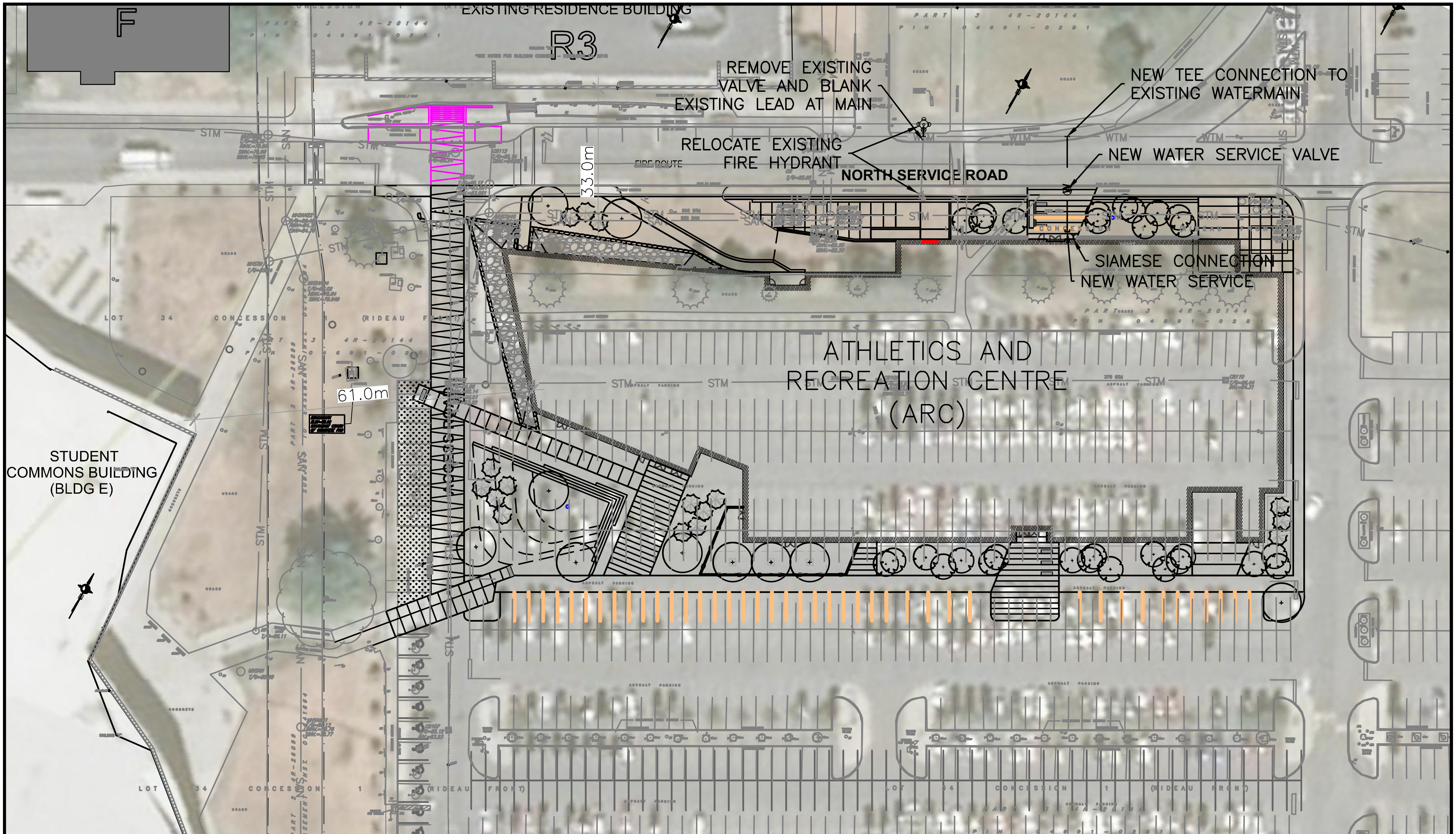
Ding Bang (Winston) Yang, P.Eng.
Project Engineer
Infrastructure

T+ 1 613-690-0538

2611 Queensview Drive, Suite 300
Ottawa, Ontario,
K2B 8K2, Canada

www.wsp.com

-LAEmHhHzdJzBlTWfa4Hgs7pbKl



300-2611 QUEENSVIEW DRIVE
OTTAWA ONTARIO CANADA K2B 8K2
TEL.: 1-613-829-2800 | FAX: 1-613-829-8299 | WWW.WSPGROUP.COM

PROJECT:
ATHLETICS AND RECREATION CENTRE (ARC)

ALGONQUIN COLLEGE
OTTAWA, ON K2G 1V8

PROJECT NO.: 191-01517-00

DRAWING NAME:
SITE LOCATION

DATE: 2019-06-14

SCALE: NTS

REVIEWED BY: D.B.Y.

DESIGNED BY: D.B.Y.

DRAWN BY: D.B.Y.

SHEET: SK1

Fire Flow Design Sheet (FUS)
Athletics and Recreation Centre (ARC)
Algonquin College
City of Ottawa
WSP Project No. 191-01517-00

Date: 14-Jun-19

Fire Flow Requirements Based on Fire Underwriters Survey (FUS) 1999

1. An estimate of the Fire Flow required for a given fire area may be estimated by: $F = 220\,C\sqrt{A}$

F = required fire flow in litres per minute
C = coefficient related to the type of construction
- 1.5 for wood construction (structure essentially combustible)
- 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
- 0.8 for noncombustible construction (unprotected metal structural components, masonry or metal walls)
- 0.6 for fire-resistive construction (fully protected frame, floors, roof)

A = total floor area in square metres (including all storeys, but excluding basements at least 50% below grade)

A = 11658 m^2
C = 0.8
F = 19003.1 L/min

rounded off to 19,000 L/min (min value of 2000 L/min)

2. The value obtained in 1. may be reduced by as much as 25% for occupancies having a low contents fire hazard.

Non-combustible	-25%
Limited Combustible	-15%
Combustible	0%
Free Burning	15%
Rapid Burning	25%

Reduction due to low occupancy hazard -25% x 19,000 = 14,250 L/min

3. The value obtained in 2. may be reduced by as much as 50% for buildings equipped with automatic sprinkler protection.

Adequate Sprinkler confirms to NFPA13	-30%
Water supply common for sprinklers & fire hoses	-10%
Fully supervised system	-10%
No Automatic Sprinkler System	0%

Reduction due to Sprinkler System -50% x 14,250 = -7,125 L/min

4. The value obtained in 2. is increased for structures exposed within 45 metres by the fire area under consideration.

Separation	Charge
0 to 3 m	25%
3.1 to 10 m	20%
10.1 to 20 m	15%
20.1 to 30 m	10%
30.1 to 45 m	5%

Side 1	33	5%	north side
Side 2	300	0%	east side
Side 3	110	0%	south side
Side 4	61	0%	west side
		5%	(Total shall not exceed 75%)

Increase due to separation 5% x 14,250 = 713 L/min

5. The flow requirement is the value obtained in 2., minus the reduction in 3., plus the addition in 4.

The fire flow requirement is 8,000 L/min (Rounded to nearest 1000 L/min)
or **133 L/sec**
or 2,113 gpm (us)
or 1,760 gpm (uk)

Based on method described in:
"Water Supply for Public Fire Protection - A Guide to Recommended Practice", 1991
by Fire Underwriters Survey

Water Demand Calculation Sheet

Project:	**Athletics and Recreation Centre (ARC)**	**Date:**	**14/06/2019**
Location:	**Algonquin College, City of Ottawa**	**Design:**	**WY**
WSP Project No.	**191-01517-00**	**Page:**	**1 of 1**

Proposed Buildings	Residential				Non-Residentail			Average Daily			Maximum Daily			Maximum Hourly			Fire
	Units			Beds	Industrial	Institutional	Commercial	Demand (l/s)			Demand (l/s)			Demand (l/s)			Demand
	SF	APT	ST		(ha)	(ha)	(ha)	Res.	Non-Res.	Total	Res.	Non-Res.	Total	Res.	Non-Res.	Total	(l/min)
Athletics and Recreation Centre (ARC)						1.12			0.72	0.72		1.09	1.09		1.96	1.96	8,000

Population Densities

Single Family	3.4 person/unit
Semi-Detached	2.7 person/unit
Duplex	2.3 person/unit
Townhome (Row)	2.7 person/unit
Bachelor Apartment	1.4 person/unit
1 Bedroom Apartment	1.4 person/unit
2 Bedroom Apartment	2.1 person/unit
3 Bedroom Apartment	3.1 person/unit
4 Bedroom Apartment	4.1 person/unit
Avg. Apartment	1.8 person/unit

Average Daily Demand

Residentail	280 l/cap/day
Industrial	35000 l/ha/day
Institutional	28000 l/ha/day
Commercial	28000 l/ha/day

Maximum Daily Demand

Residential	2.5 x avg. day
Industrial	1.5 x avg. day
Institutional	1.5 x avg. day
Commercial	1.5 x avg. day

Maximum Hourly Demand

Residential	2.2 x max. day
Industrial	1.8 x max. day
Institutional	1.8 x max. day
Commercial	1.8 x max. day

Typical Operating Hours for Athletics and Recreation Centre will be 16 hours/day

Average Daily Demand for the Athletics and Recreation Centre will be increased by a factor of 16/8

Instituional 56000 l/ha/day

APPENDIX

C

- STORMWATER MANAGEMENT REPORT BY WSP
- STORM SEWER DESIGN SHEET
- POST-DEVELOPMENT STORM DRAINAGE AREA PLAN C05
- PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN FIGURE 2
- GRADING PLAN C03
- SERVICING PLAN C04
- STORMTECH CHAMBERS MC-3500
- STORMCEPTOR STC-4000

MEMO

TO: Jim Johnston, Winston Yang - WSP

FROM: Ben Worth

SUBJECT: **Algonquin College ARC – Stormwater Management Strategy**

DATE: **September 24, 2019**

INTRODUCTION

This memo is provided to document the proposed stormwater management (SWM) strategy for the Algonquin College Athletics and Recreation Centre (ARC) project.

The subject site is located on the Algonquin College campus, south off Navajo Drive, immediately east of the Student Commons Building.

EXISTING CONDITIONS

In existing conditions, the subject site consists of an asphalt-surfaced parking lot and grassed verge area adjacent to Navajo Drive. There is an existing storm sewer system draining northward along the western edge of the subject site, and westward within Navajo Drive. Surface grades currently drain runoff to the north and west, and there is an existing overland flow path running northward toward Navajo Drive along the west edge of the site.

Please refer to the Stantec topographic survey, 2019, for illustration of existing conditions.

The Geotechnical Engineer on the project (Paterson Group Consulting Engineers) provided a Subsoil Infiltration Review memo (appended for reference, dated March 5, 2019), which analyzed borehole results and geotechnical investigations, and concluded that a design infiltration rate for the soils on site would lie within the range of 7 to 26 mm/hour. These results were also supplemented by onsite permeameter testing, which calculated infiltration rates of 9.5 to 20.5 mm/hour (additional Paterson memo attached for reference, dated July 25, 2019). These values indicate that an infiltration-based SWM system is feasible.

Additional Geotechnical investigations were also completed on site recently to establish design groundwater elevations (see attached Paterson memo, date September 16, 2019). This memo states that long-term groundwater level is anticipated at a depth of 4 to 5 m. Using a conservative value here, and based on the location of test pits, a design groundwater elevation of 81.5 m was deemed suitable for design of SWM features.

Suite 300
2611 Queensview Drive
Ottawa, ON, Canada K2B 8K2

T: +1 613 829-2800
F: +1 613 829-8299
wsp.com

PROPOSED CONDITIONS

The proposed ARC facility includes a multi-level athletics and recreation building in the northern part of the site, surrounded by reconfigured hard and soft landscaped areas, and a re-graded parking lot area to the south.

The primary offsite storm drainage connection will be from the south-west corner of the site, to the existing storm sewer that runs northward within the access road. Several local CB connections are also proposed along the north side of the site from landscaped areas out to the existing storm sewer system. The existing storm sewers along the west and north sides of the building combine at the northwest corner of the building, and then discharge to a municipal storm trunk sewer located in an easement to the west of the proposed building site.

The existing overland flow path running northward along the western edge of the site will be maintained unaffected in post-development conditions.

DESIGN CRITERIA

As confirmed by City of Ottawa staff during the pre-consultation process, the project is subject to the requirements of the *SWM Guidelines for the Pinecrest Creek/Westboro Area* (JFSA, on behalf of the City of Ottawa, ref. June 2012 "Final Draft" document). Key criteria applicable to the ARC project are summarized below.

Excerpt from Table 3.1 (SWM Guidelines for the Pinecrest Creek/Westboro Area):

COMMERCIAL/INSTITUTIONAL AND INDUSTRIAL DEVELOPMENTS - DISCHARGING UPSTREAM OF THE OTTAWA RIVER PARKWAY PIPE (ORPP) INLET			
Runoff Volume Reduction	**Water Quality TSS Removal**	**Water Quantity Flood Flow Mgmt.**	**Water Quantity Erosion Control**
A minimum on-site retention of the 10 mm design storm; refer to LID references for guidance on prudent approach to planning infiltration-based LID best management practices.	*On-site removal of 80% of TSS; some of which would be accomplished by on-site retention of first 10 mm of rainfall and detention of the 25 mm design storm.*	*The more stringent of the following criteria will govern: (i) 1:100 year discharge from site not to exceed 33.5 L/s/ha) or; (ii) Requirements of City of Ottawa Sewer Design Guidelines.*	*Control (detain) the runoff from the 25 mm design storm such that the peak outflow from the site does not exceed 5.8 L/s/ha.*

PROPOSED SWM STRATEGY

OVERVIEW

Please refer to engineering drawings C04 and C05 for details of the SWM system proposed to achieve compliance with the applicable design criteria. Key features of the system include:

- Controlled flow rooftop drains (Watts Adjustable Accutrol units, or similar) to utilize storage available on the rooftop and limit discharge rates.
- Bio-retention features in soft landscaped areas surrounding the proposed building (CB overflows set 150 mm above base of depressed landscape area).
- A stormwater infiltration retention/detention chamber below the proposed parking lot area to achieve target flow controls and runoff retention targets.

It should be noted that as part of the College's sustainability strategy for the development, the proposed SWM system has been designed to achieve compliance with the Rainwater Management LEED credits (BD+C: New Construction, v4.1), which requires on-site retention and treatment beyond the requirements set out by the *SWM Guidelines for the Pinecrest Creek/Westboro Area* targets.

CATCHMENT ANALYSIS

The appended **Table 1** summarizes the sub-catchment area breakdown in proposed conditions. It should be read in conjunction with Drawing C05 (Post-Development Storm Drainage Area Plan).

Based on the total application site area of 1.551 ha, the applicable peak discharge targets are established as follows:

- Flood Flow Management: 100-year event controlled to 33.5 L/sec/ha: **52.0 l/sec**
- Erosion Control: 25mm design storm peak controlled to 5.8 l/sec/ha: **9.0 l/sec**

MODELLING & ANALYSIS

RUNOFF VOLUME REDUCTION

The runoff retention targets are achieved through provision of localized, depressed bio-retention features in soft landscaping areas in conjunction with a large, centralized sub-surface infiltration chamber below the parking lot, which provides sufficient retention volume for impervious surfaces across the site.

The rightmost columns in **Table 1** summarize the applicable retention volumes (for both the City's Pinecrest Creek/Westboro criteria, and the targeted LEED credits).

Bio-retention features are proposed in each soft landscaped area; providing a total of 19.2 m^3 within catchments A4, A6, A12, A13, A20, A21, and A22. These volumes will be provided by depressing the finished surface locally, and elevating CB grate outflows by 150 mm from the base elevation of the area. Where feasible (and consistent with landscaping strategy), it is recommended that an amended topsoil mix be provided in each of these areas to promote infiltration.

The centralized infiltration chamber will provide a total retention volume of 325.2 m^3 below the level of the gravity outflow pipe. Additional volume will be provided as active storage (above the outflow elevation) to meet target peak flow control rates, as described further in subsequent sections of this memo. Please refer to Drawing C04 for proposed details of the chamber.

The total retention volume provided on site is 344.4 m^3. Minimum target to satisfy the *SWM Guidelines for the Pinecrest Creek/Westboro Area* is 154.9 m^3. As noted previously, the proposed strategy exceeds minimum requirements significantly given that LEED Rainwater Management credits are being targeted as part of the project's sustainability strategy.

Note that the previously established design groundwater elevation (81.5 m) was referenced in the design of the sub-surface chamber, and a minimum clearance of 1.0 m from the base of the chamber to the groundwater elevation has been provided—in accordance with best practice LID design approaches.

WATER QUALITY

The target water quality criteria (on-site treatment/removal of 80% of total suspended solids, TSS) will be achieved via significant runoff retention on site (up to 22.2 mm per LEED strategy), supplemented by an Oil-Grit Separator (OGS) unit at the primary storm drainage outlet, downstream of the infiltration chamber.

As noted in the *SWM Guidelines for the Pinecrest Creek/Westboro Area*, meeting the required retention targets in conjunction with detention of the 25 mm storm event (per Water Quantity Erosion Control criteria, discussed in the subsequent section) will provide significant water quality benefits. Provision of an OGS unit (specified to provide 80% TSS removal) in addition to these features is considered sufficient to meet water quality treatment requirements.

WATER QUANTITY

As noted previously, the *SWM Guidelines for the Pinecrest Creek/Westboro Area* set two separate targets for control of peak runoff rates; 52.0 l/sec for 100-year flood flow management, and 9.0 l/sec for erosion control detention of a 25 mm storm event.

Proposed features to achieve these targets include;

- Rooftop flow control drains to utilize storage on roof areas.
- Active storage within infiltration retention/detention chamber below parking lot, with vortex flow control device on outlet.

A HydroCAD model has been developed to simulate performance of the proposed system, and establish the necessary storage volumes and flow control rates required to meet the applicable design criteria. Full model results for each storm analysed are appended to this memo.

In accordance with City requirements, the storms analysed were:

1. SCS Type II 100-year, 24-hour event (defined as per Ottawa Sewer Design Guidelines)
2. 4-hour, 25mm depth event (Chicago Storm distribution)

The HydroCAD model was set up using the SCS TR-20 method to generate runoff hydrographs from each sub-catchment. Sub-catchments were created as per area takeoffs described in Table 1, and all areas were defined using a Curve Number (CN) value of 98. This value represents an impervious surface, regardless of underlying Hydrologic Soil Group (HSG). Storage areas were defined using “pond” nodes in the model, with appropriate stage-storage relationships based on the volumes available in each area. Outflow controls (i.e. vortex flow devices) were defined using appropriate rating curves on the outlets of storage nodes, where applicable. Note that for the infiltration retention/detention chamber, an additional surface storage volume was included in the stage-storage definition, representing ponding available in the depressed, “amphitheatre” area in sub-catchment A-8. This ponding volume is directly linked via CB to the chamber, and grading has been designed to contain ponding up to 300 mm depth.

Rooftop storage has been defined based on the average area available per roof drain, up to a maximum depth of 150 mm. Rating curves based on the proposed rooftop flow control drains have been used, and the number of drain outlets has been coordinated with architectural plans (12 no. outlets within roof sub-catchment A-15, 19 no. within A-16, and 14 no. within A-17).

It is assumed that all storage volumes within the site are empty at the start of each storm event analysed.

Per Table 1, two uncontrolled drainage areas have been included in the model; A-18 and A-19. Given grading constraints it has not been possible to configure the drainage system to collect runoff at these locations around the edge of the site, and runoff from these areas will therefore drain directly offsite onto surrounding lands. These uncontrolled areas are included in the analysis however, and the proposed system over-controls as required to ensure net runoff rates (including discharge from the uncontrolled areas) complies with the applicable targets.

The model was developed and tested in an iterative manner, to determine the necessary storage volumes and flow control rates from individual features. A summary of the requirements follows:

- The infiltration retention/detention chamber should provide a total minimum volume of 525 m^3 (configured with 325 m^3 below the level of the outlet, per runoff retention requirements) and the remainder as active storage above the outlet elevation.
- Outflow from the infiltration chamber shall be controlled with a Hydrovex 150-VHV-2 vortex flow control valve (or similar), to achieve peak discharge rate of 35 l/sec at a head of 1.80 m.
- Rooftop drainage outlets shall be Watts Adjustable Accutrol units (or similar), set to weir fully closed position for constant 5 GPM (0.32 l/sec) outflow, up to maximum head of 150 mm.

The model results demonstrate that a system configured as described above achieves a net 100-year peak runoff rate of 51.7 l/sec, which is within the target rate of 52.0 l/sec.

Results of the 4-hour, 25 mm event show a net peak runoff rate from the site of 17.2 l/sec. It is acknowledged that this is above the target release rate of 9.0 l/sec, however in this situation the runoff leaving site is solely from the uncontrolled areas (A-18 and A-19), and the landscaped areas along the northern edge of the site which have limited control opportunities. All other areas are providing full retention of the rainfall volume. On this basis, the system is considered compliant with the *intent* of the criteria, and performance is functionally equivalent to the desired outcome.

SURFACE PONDING

To estimate peak ponding depths at catchbasin (CB) locations on the surface, standalone rational method analysis has been completed—see appended calculations. For each catchment area the peak 100-year runoff rate has been established (based on a minimum storm duration of 10 minutes), and these flow rates were referenced against the rating curve for a standard 600 mm square CB sag inlet (per MTO Design Chart 4.19, also provided in the City of Ottawa Sewer Design Guidelines Appendix 7-A.9) to determine maximum ponding depths.

The analysis also included a 20% stress test on the 100-year rainfall intensities, and these results were plotted on the proposed grading plan to show maximum anticipated extent of ponding.

CONCLUSIONS

The proposed SWM strategy for the Algonquin College ARC facility, as described above in this memo—and per modelling analysis appended—complies with the SWM requirements of the City of Ottawa (as defined in the *SWM Guidelines for the Pinecrest Creek/Westboro Area*) with regard to Runoff Volume Reduction, Water Quality, and Water Quantity (for both Flood Flow Management and Erosion Control Detention criteria). Runoff volume reduction targets are exceeded significantly due to project targeting the Rainwater Management LEED credits (BD+C: New Construction, v4.1), which requires on-site retention and treatment beyond the requirements set out by the *SWM Guidelines for the Pinecrest Creek/Westboro Area* targets.

Respectfully submitted,

Ben Worth, P.Eng.
Manager, Water Resources

Appended:

- *Table 1: Sub-Catchment Breakdown & Runoff Retention Summary*
- *HydroCAD Model Output (Chicago 4hr-25mm & SCS II 24hr-100yr events)*
- *Hydrovex VHV Selection Chart (annotated)*
- *Watts Accutrol Roof Drain Specification Sheet*
- *CB Surface Ponding Rational Method Calculations*
- *Paterson Group Geotechnical Memos:*
  - *Subsoil Infiltration Review, March 2019*
  - *Permeameter Test Investigation, July 2019*
  - *Geotechnical Review Comments, September 2019*

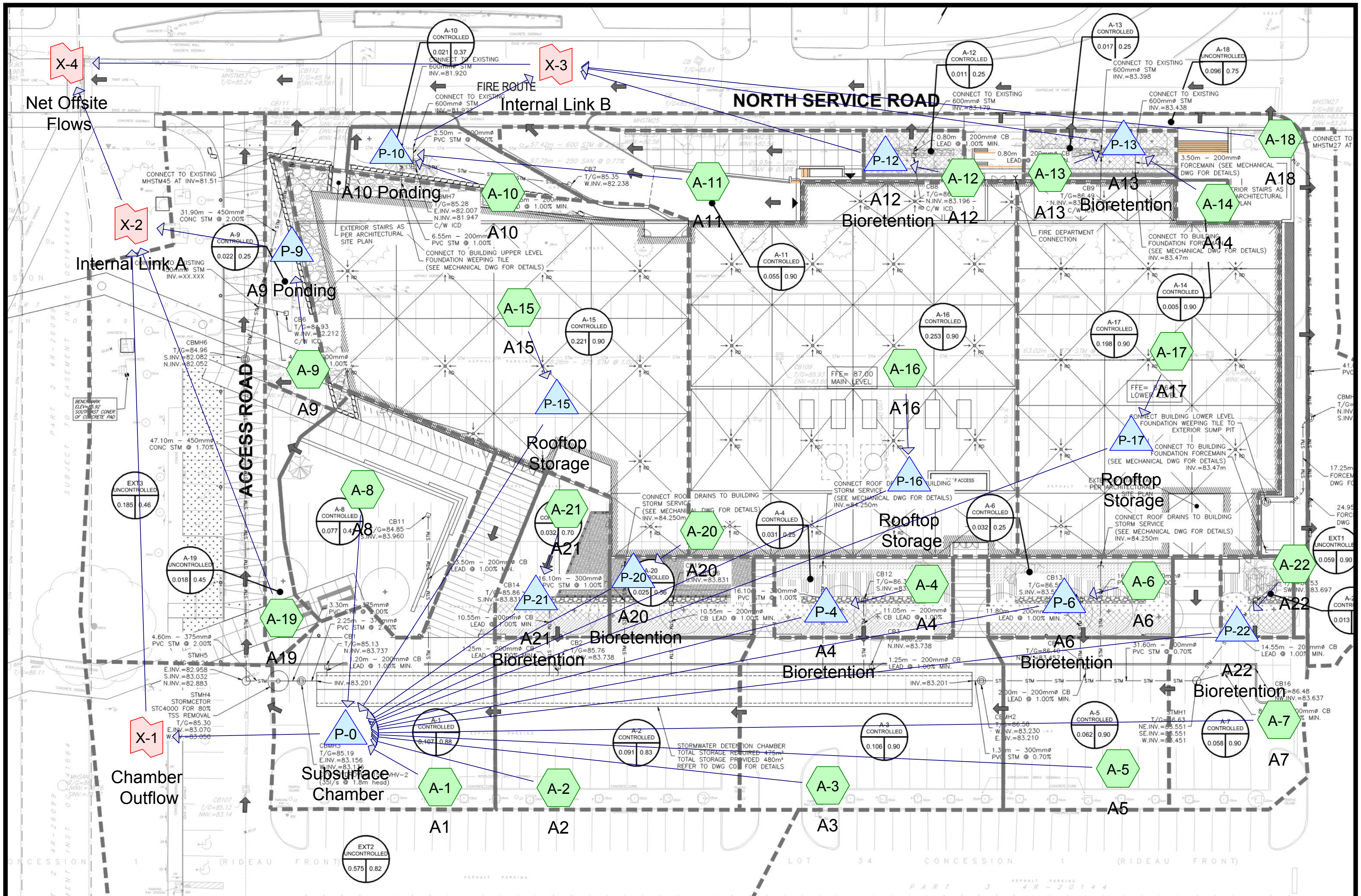
Table 1 – Sub-Catchment Breakdown & Runoff Retention Summary

REF.	AREA BREAKDOWN (HA)			TOTAL AREA (HA)	DISCHARGE LOCATION	RUNOFF RETENTION VOLUME TARGETS (M^3)		RUNOFF RETENTION VOLUMES PROVIDED (M^3)	
	GRASS	ROOF	ASPHALT			10mm (City)	22.2mm (90^{th} percentile LEED)	Bio-Retention Features	Centralized Infiltration Chamber
A1	0.003		0.104	0.107	To chamber	10.7	23.8		23.8
A2	0.010		0.081	0.091	To chamber	9.1	20.2		20.2
A3			0.106	0.106	To chamber	10.6	23.5		23.5
A4	0.031			0.031	Bio-retention, then to chamber	3.1	6.9	4.0	-
A5			0.062	0.062	To chamber	6.2	13.8		13.8
A6	0.032			0.032	Bio-retention, then to chamber	3.2	7.1	5.4	-
A7			0.058	0.058	To chamber	5.8	12.9		12.9
A8	0.058		0.019	0.077	To chamber	7.7	17.1		17.1
A9	0.022			0.022	Surface ponding, then offsite	2.2	4.9		4.9
A10	0.017		0.004	0.021	Surface ponding, then offsite	2.1	4.7		4.7
A11			0.055	0.055	Offsite via A-10	5.5	12.2		12.2
A12	0.011			0.011	Bio-retention, then offsite	1.1	2.4	2.5	-
A13	0.017			0.017	Bio-retention, then offsite	1.7	3.8	3.0	-
A14			0.005	0.005	Offsite via A-13	0.5	1.1		1.1
A15		0.221		0.221	Rooftop control, then to chamber	22.1	49.1		49.1
A16		0.253		0.253	Rooftop control, then to chamber	25.3	56.2		56.2
A17		0.198		0.198	Rooftop control, then to chamber	19.8	44.0		44.0
A18	0.022		0.074	0.096	Uncontrolled offsite	9.6	21.3		21.3
A19	0.006		0.012	0.018	Uncontrolled offsite	1.8	4.0		4.0
A20	0.013		0.012	0.025	Bio-retention, then offsite	2.5	5.6	0.7	-
A21	0.013			0.032	Bio-retention, then offsite	3.2	7.1	1.2	-
A22	0.013			0.013	Bio-retention, then offsite	1.3	2.9	2.4	-
	0.268	0.672	0.592	**1.551**		**155.1**	**344.3**	**19.2**	**325.2**
								344.4*	

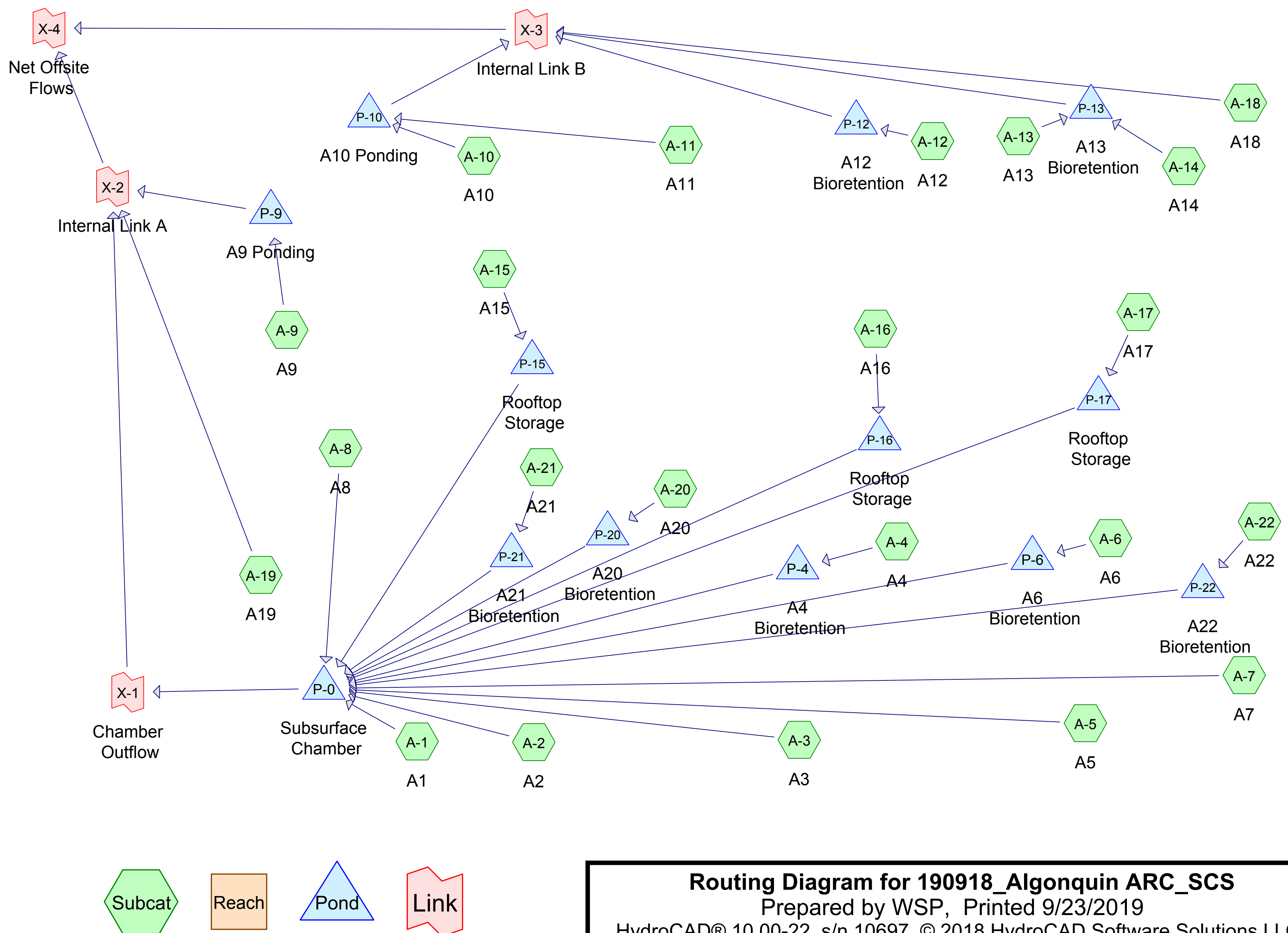
** Total cistern retention volume includes an additional 16.6 m^3 to offset shortfall from retention volumes available within individual bio-retention features, to ensure site-wide targets are hit.*

Suite 300
2611 Queensview Drive
Ottawa, ON, Canada K2B 8K2

T: +1 613 829-2800
F: +1 613 829-8299
wsp.com



Routing Diagram for 190918_Algonquin ARC_SCS
Prepared by WSP, Printed 9/23/2019
HydroCAD® 10.00-22 s/n 10697 © 2018 HydroCAD Software Solutions LLC



Routing Diagram for 190918_Algonquin ARC_SCS
Prepared by WSP, Printed 9/23/2019
HydroCAD® 10.00-22 s/n 10697 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-meters)	CN	Description (subcatchment-numbers)
15,510.0	98	(A-1, A-10, A-11, A-12, A-13, A-14, A-15, A-16, A-17, A-18, A-19, A-2, A-20, A-21, A-22, A-3, A-4, A-5, A-6, A-7, A-8, A-9)
15,510.0	**98**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA-1: A1 Runoff Area=0.1070 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00974 m³/s 21.1 m³

SubcatchmentA-10: A10 Runoff Area=0.0210 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00191 m³/s 4.1 m³

SubcatchmentA-11: A11 Runoff Area=0.0550 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00501 m³/s 10.8 m³

SubcatchmentA-12: A12 Runoff Area=0.0110 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00100 m³/s 2.2 m³

SubcatchmentA-13: A13 Runoff Area=0.0170 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00155 m³/s 3.3 m³

SubcatchmentA-14: A14 Runoff Area=0.0050 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00046 m³/s 1.0 m³

SubcatchmentA-15: A15 Runoff Area=0.2210 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.02012 m³/s 43.5 m³

SubcatchmentA-16: A16 Runoff Area=0.2530 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.02304 m³/s 49.8 m³

SubcatchmentA-17: A17 Runoff Area=0.1980 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.01803 m³/s 39.0 m³

SubcatchmentA-18: A18 Runoff Area=0.0960 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00874 m³/s 18.9 m³

SubcatchmentA-19: A19 Runoff Area=0.0180 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00164 m³/s 3.5 m³

SubcatchmentA-2: A2 Runoff Area=0.0910 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00829 m³/s 17.9 m³

SubcatchmentA-20: A20 Runoff Area=0.0250 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00228 m³/s 4.9 m³

SubcatchmentA-21: A21 Runoff Area=0.0320 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00291 m³/s 6.3 m³

SubcatchmentA-22: A22 Runoff Area=0.0130 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00118 m³/s 2.6 m³

SubcatchmentA-3: A3 Runoff Area=0.1060 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00965 m³/s 20.9 m³

SubcatchmentA-4: A4 Runoff Area=0.0310 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00282 m³/s 6.1 m³

SubcatchmentA-5: A5 Runoff Area=0.0620 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00564 m³/s 12.2 m³

SubcatchmentA-6: A6 Runoff Area=0.0320 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00291 m³/s 6.3 m³

SubcatchmentA-7: A7 Runoff Area=0.0580 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00528 m³/s 11.4 m³

SubcatchmentA-8: A8 Runoff Area=0.0770 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00701 m³/s 15.2 m³

SubcatchmentA-9: A9 Runoff Area=0.0220 ha 100.00% Impervious Runoff Depth=20 mm
Tc=10.0 min CN=98 Runoff=0.00200 m³/s 4.3 m³

Pond P-0: Subsurface Chamber Peak Elev=-0.250 m Storage=243.6 m³ Inflow=0.06315 m³/s 243.6 m³
Outflow=0.00000 m³/s 0.0 m³

Pond P-10: A10 Ponding Peak Elev=10.034 m Storage=0.5 m³ Inflow=0.00692 m³/s 15.0 m³
Outflow=0.00686 m³/s 15.0 m³

Pond P-12: A12 Bioretention Peak Elev=10.130 m Storage=2.2 m³ Inflow=0.00100 m³/s 2.2 m³
Outflow=0.00000 m³/s 0.0 m³

Pond P-13: A13 Bioretention Peak Elev=10.152 m Storage=3.1 m³ Inflow=0.00200 m³/s 4.3 m³
Outflow=0.00036 m³/s 1.3 m³

Pond P-15: Rooftop Storage Peak Elev=100.085 m Storage=20.1 m³ Inflow=0.02012 m³/s 43.5 m³
Outflow=0.00378 m³/s 43.6 m³

Pond P-16: Rooftop Storage Peak Elev=100.079 m Storage=18.2 m³ Inflow=0.02304 m³/s 49.8 m³
Outflow=0.00630 m³/s 49.8 m³

Pond P-17: Rooftop Storage Peak Elev=100.083 m Storage=15.4 m³ Inflow=0.01803 m³/s 39.0 m³
Outflow=0.00441 m³/s 39.0 m³

Pond P-20: A20 Bioretention Peak Elev=10.161 m Storage=1.0 m³ Inflow=0.00228 m³/s 4.9 m³
Outflow=0.00217 m³/s 4.2 m³

Pond P-21: A21 Bioretention Peak Elev=10.173 m Storage=2.4 m³ Inflow=0.00291 m³/s 6.3 m³
Outflow=0.00179 m³/s 5.1 m³

Pond P-22: A22 Bioretention Peak Elev=10.151 m Storage=2.4 m³ Inflow=0.00118 m³/s 2.6 m³
Outflow=0.00005 m³/s 0.2 m³

Pond P-4: A4 Bioretention Peak Elev=10.153 m Storage=4.2 m³ Inflow=0.00282 m³/s 6.1 m³
Outflow=0.00050 m³/s 2.1 m³

Pond P-6: A6 Bioretention Peak Elev=10.151 m Storage=5.5 m³ Inflow=0.00291 m³/s 6.3 m³
Outflow=0.00019 m³/s 0.9 m³

Pond P-9: A9 Ponding Peak Elev=10.118 m Storage=4.3 m³ Inflow=0.00200 m³/s 4.3 m³
Outflow=0.00000 m³/s 0.0 m³

Link X-1: Chamber Outflow Inflow=0.00000 m³/s 0.0 m³
Primary=0.00000 m³/s 0.0 m³

Link X-2: Internal Link A Inflow=0.00164 m³/s 3.5 m³
Primary=0.00164 m³/s 3.5 m³

Link X-3: Internal Link B Inflow=0.01556 m³/s 35.2 m³
Primary=0.01556 m³/s 35.2 m³

Link X-4: Net Offsite Flows Inflow=0.01720 m³/s 38.8 m³
Primary=0.01720 m³/s 38.8 m³

Total Runoff Area = 15,510.0 m² Runoff Volume = 305.6 m³ Average Runoff Depth = 20 mm
0.00% Pervious = 0.0 m² 100.00% Impervious = 15,510.0 m²

Summary for Subcatchment A-1: A1

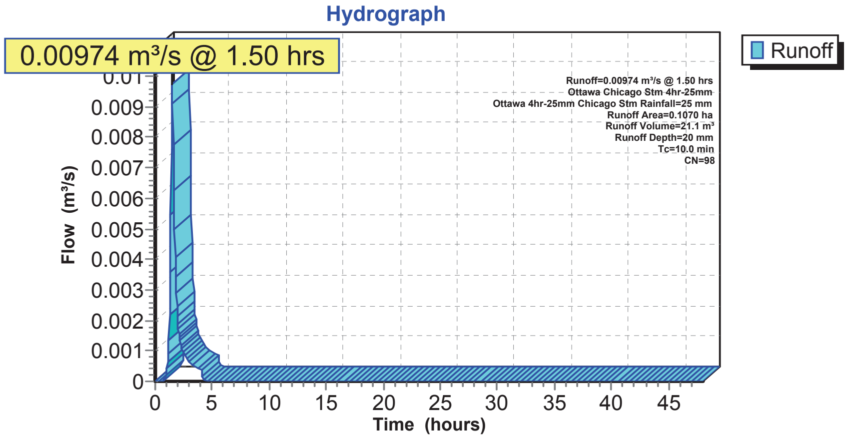
Runoff = 0.00974 m³/s @ 1.50 hrs, Volume= 21.1 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.1070	98	
	0.1070		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-1: A1



Summary for Subcatchment A-10: A10

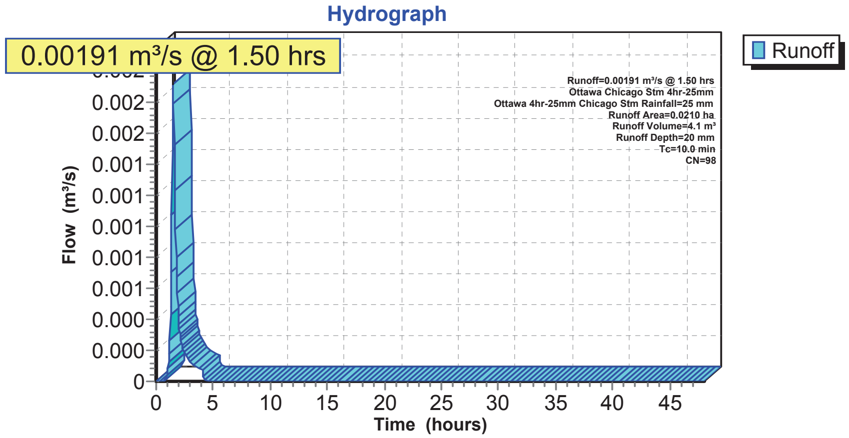
Runoff = 0.00191 m³/s @ 1.50 hrs, Volume= 4.1 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0210	98	
	0.0210		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-10: A10



Summary for Subcatchment A-11: A11

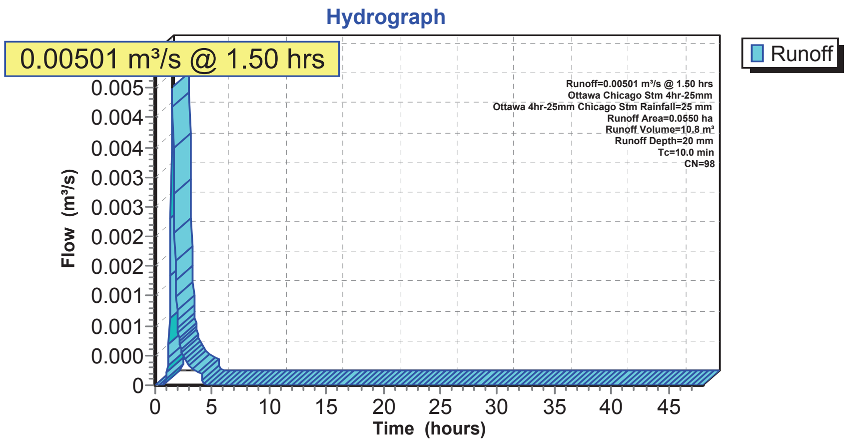
Runoff = 0.00501 m³/s @ 1.50 hrs, Volume= 10.8 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0550	98	
	0.0550		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-11: A11



Summary for Subcatchment A-12: A12

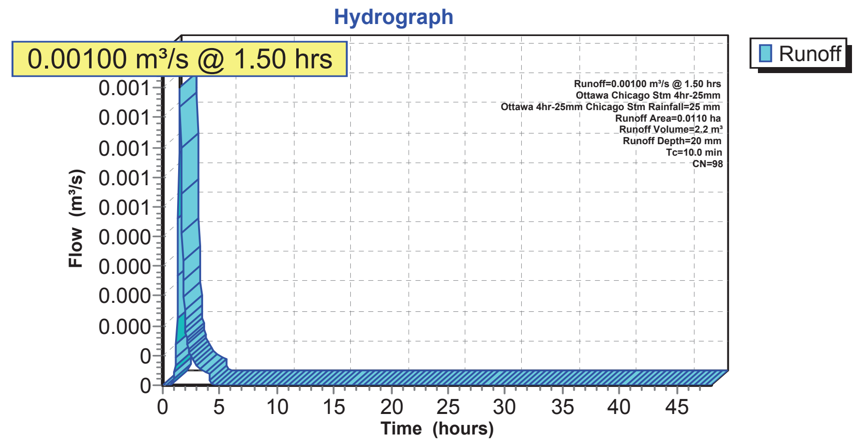
Runoff = 0.00100 m³/s @ 1.50 hrs, Volume= 2.2 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0110	98	
	0.0110		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-12: A12



Summary for Subcatchment A-13: A13

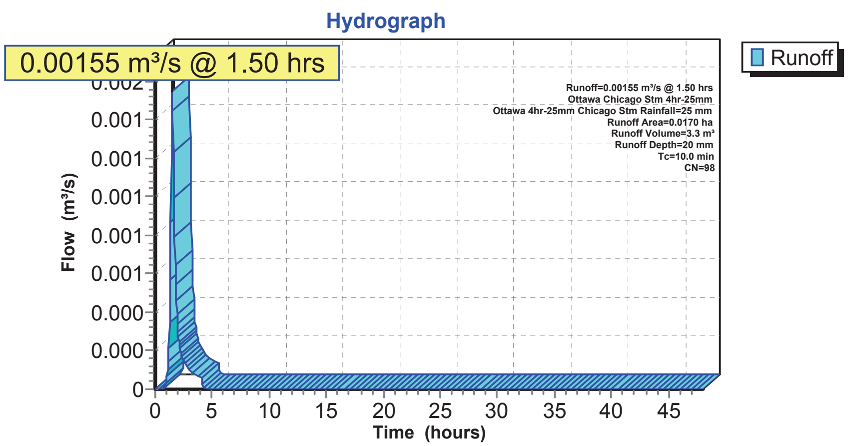
Runoff = 0.00155 m³/s @ 1.50 hrs, Volume= 3.3 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0170	98	
	0.0170		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-13: A13



Summary for Subcatchment A-14: A14

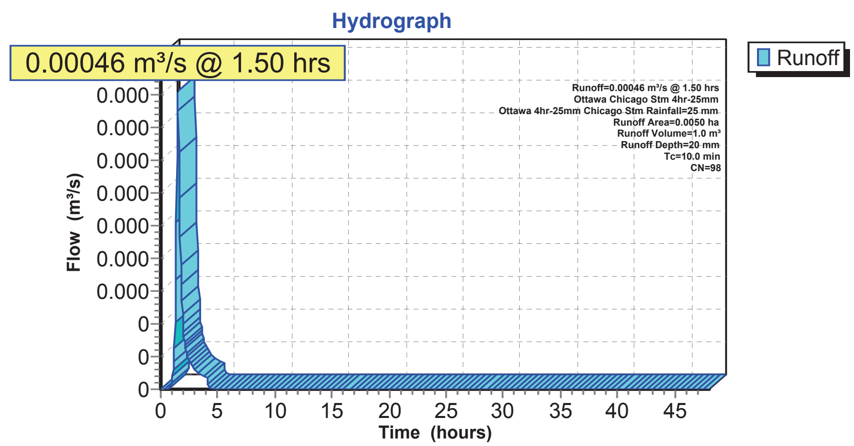
Runoff = 0.00046 m³/s @ 1.50 hrs, Volume= 1.0 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0050	98	
	0.0050		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-14: A14



Summary for Subcatchment A-15: A15

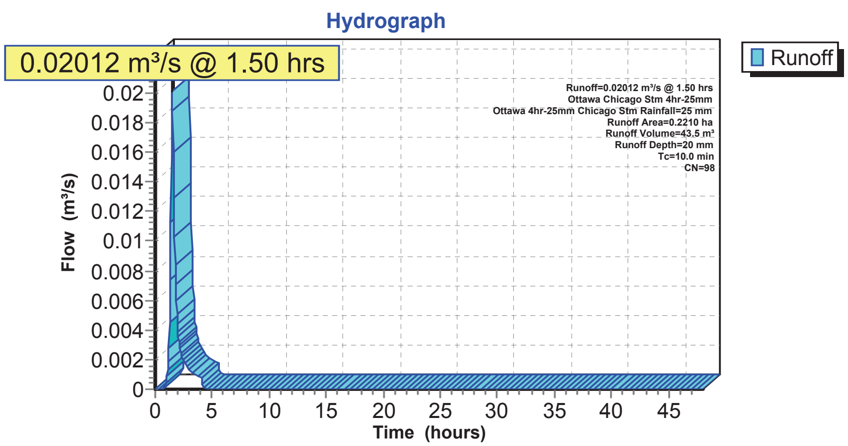
Runoff = 0.02012 m³/s @ 1.50 hrs, Volume= 43.5 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.2210	98	
	0.2210		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-15: A15



Summary for Subcatchment A-16: A16

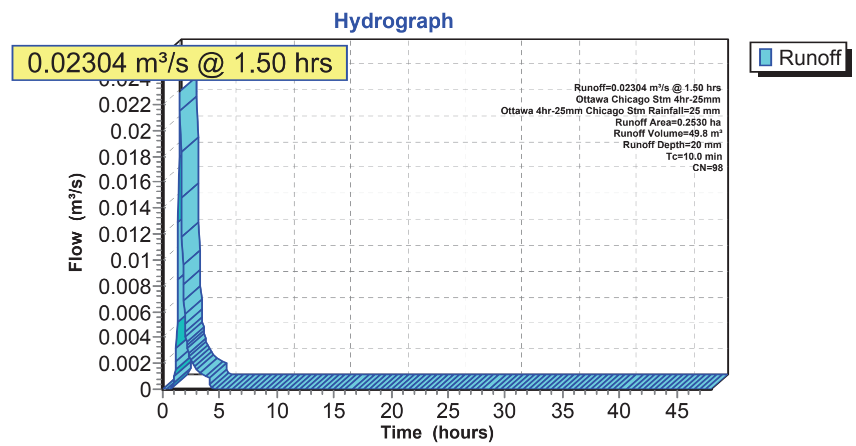
Runoff = 0.02304 m³/s @ 1.50 hrs, Volume= 49.8 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.2530	98	
	0.2530		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-16: A16



Summary for Subcatchment A-17: A17

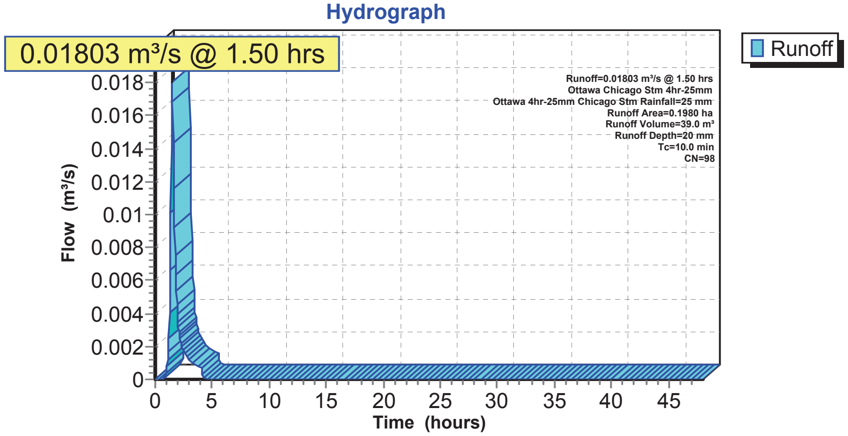
Runoff = 0.01803 m³/s @ 1.50 hrs, Volume= 39.0 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.1980	98	
	0.1980		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-17: A17



Summary for Subcatchment A-18: A18

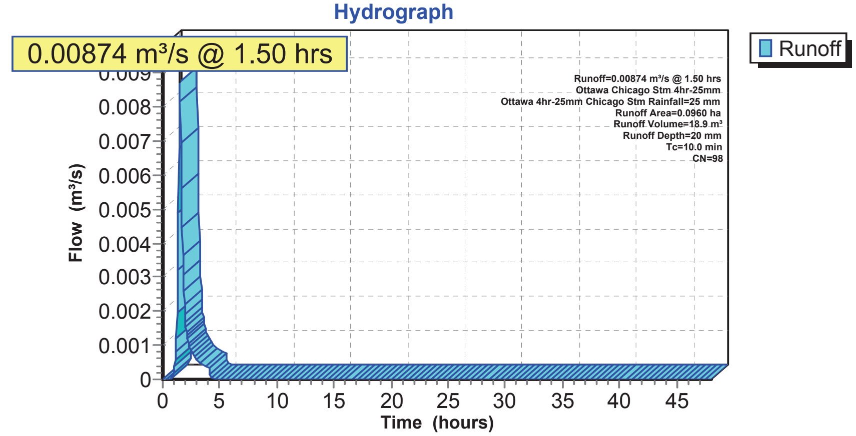
Runoff = 0.00874 m³/s @ 1.50 hrs, Volume= 18.9 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0960	98	
	0.0960		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-18: A18



Summary for Subcatchment A-19: A19

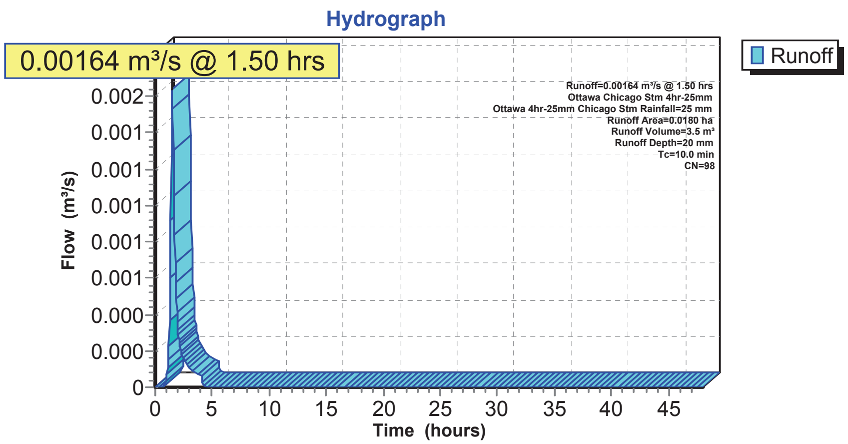
Runoff = 0.00164 m³/s @ 1.50 hrs, Volume= 3.5 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0180	98	
	0.0180		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-19: A19



Summary for Subcatchment A-2: A2

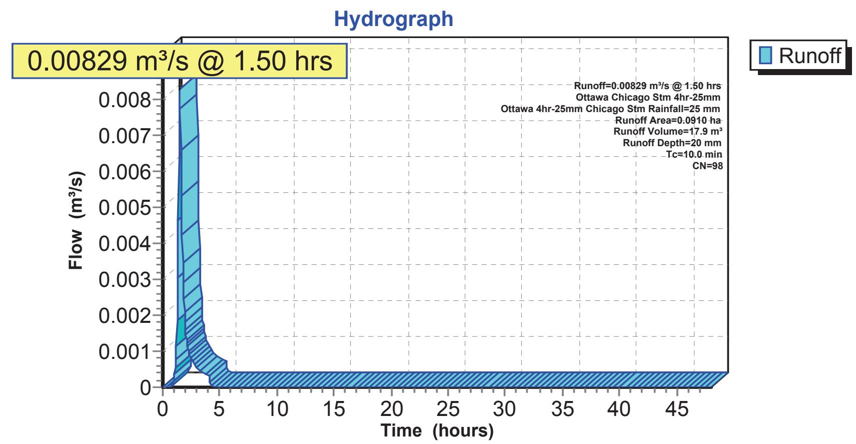
Runoff = 0.00829 m³/s @ 1.50 hrs, Volume= 17.9 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0910	98	
	0.0910		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-2: A2



Summary for Subcatchment A-20: A20

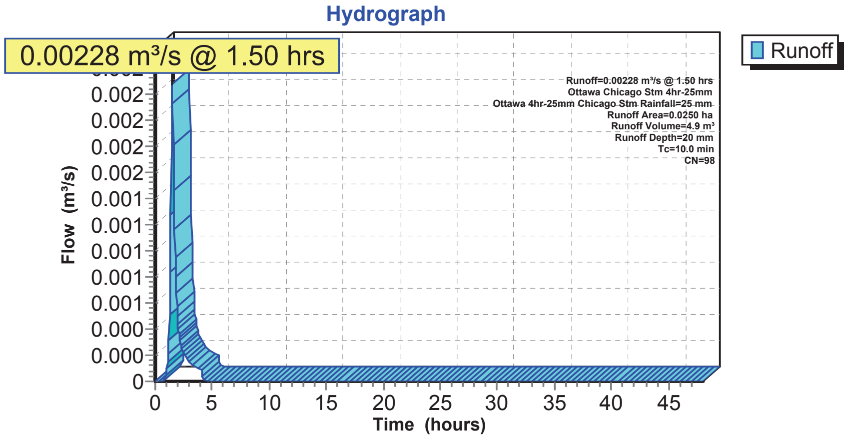
Runoff = 0.00228 m³/s @ 1.50 hrs, Volume= 4.9 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0250	98	
	0.0250		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-20: A20



Summary for Subcatchment A-21: A21

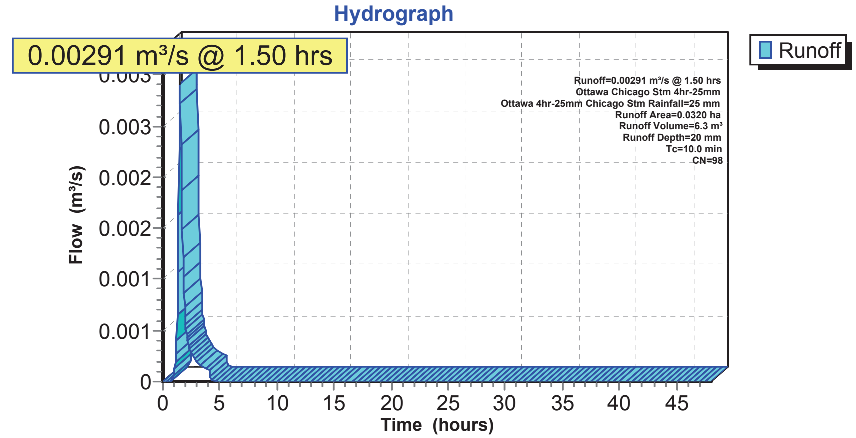
Runoff = 0.00291 m³/s @ 1.50 hrs, Volume= 6.3 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0320	98	
	0.0320		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-21: A21



Summary for Subcatchment A-22: A22

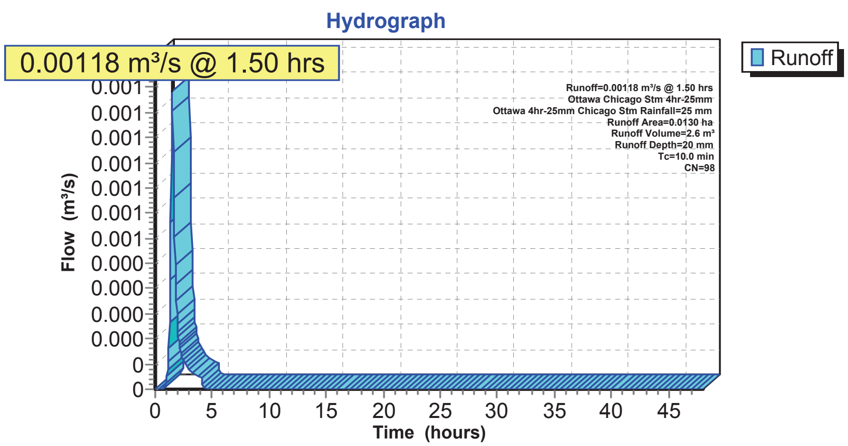
Runoff = 0.00118 m³/s @ 1.50 hrs, Volume= 2.6 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0130	98	
	0.0130		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-22: A22



Summary for Subcatchment A-3: A3

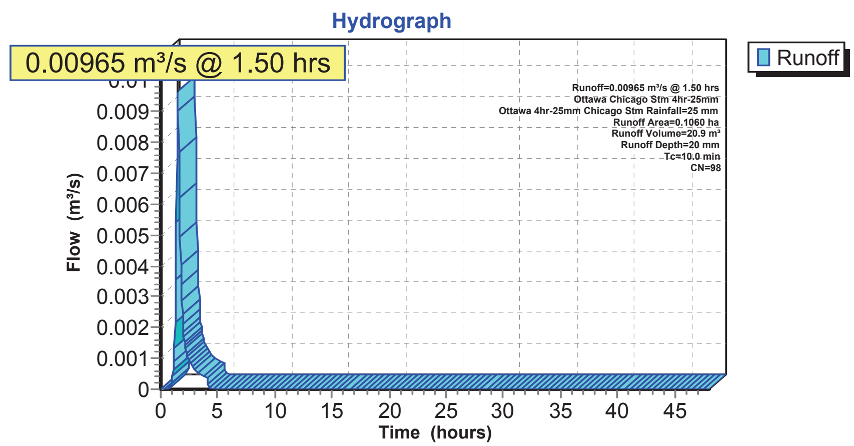
Runoff = 0.00965 m³/s @ 1.50 hrs, Volume= 20.9 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.1060	98	
	0.1060		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-3: A3



Summary for Subcatchment A-4: A4

Runoff = 0.00282 m³/s @ 1.50 hrs, Volume= 6.1 m³, Depth= 20 mm

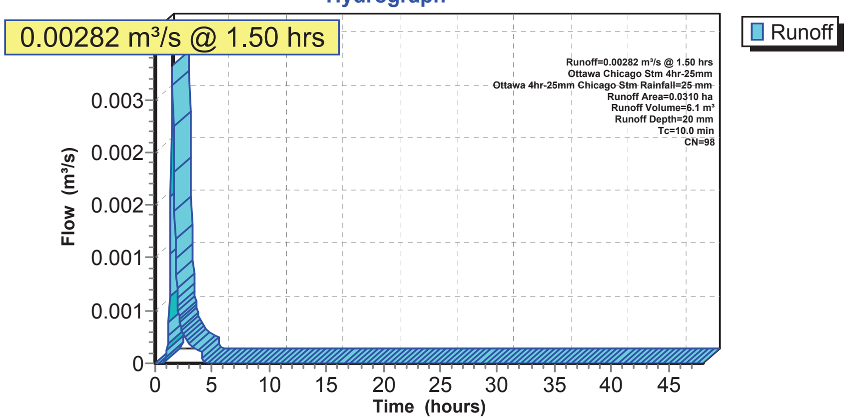
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0310	98	
	0.0310		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-4: A4

Hydrograph



Summary for Subcatchment A-5: A5

Runoff = 0.00564 m³/s @ 1.50 hrs, Volume= 12.2 m³, Depth= 20 mm

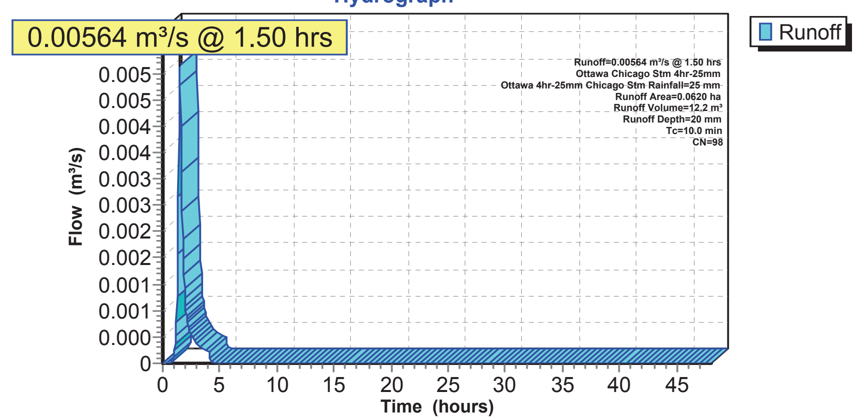
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0620	98	
	0.0620		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-5: A5

Hydrograph



Summary for Subcatchment A-6: A6

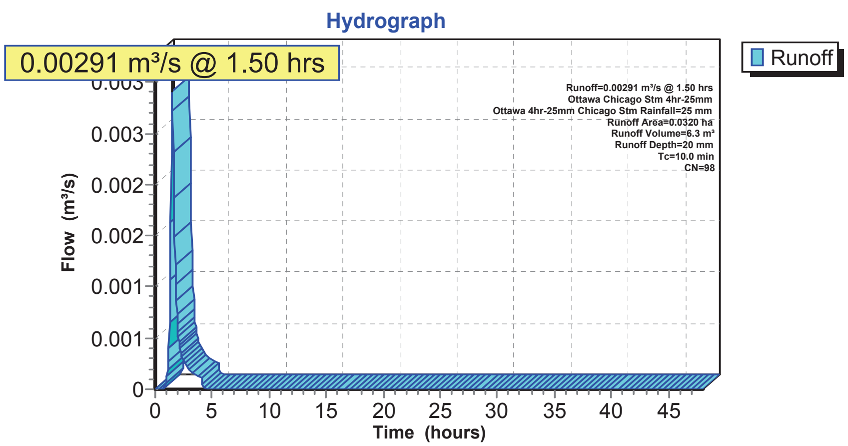
Runoff = 0.00291 m³/s @ 1.50 hrs, Volume= 6.3 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0320	98	
	0.0320		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-6: A6



Summary for Subcatchment A-7: A7

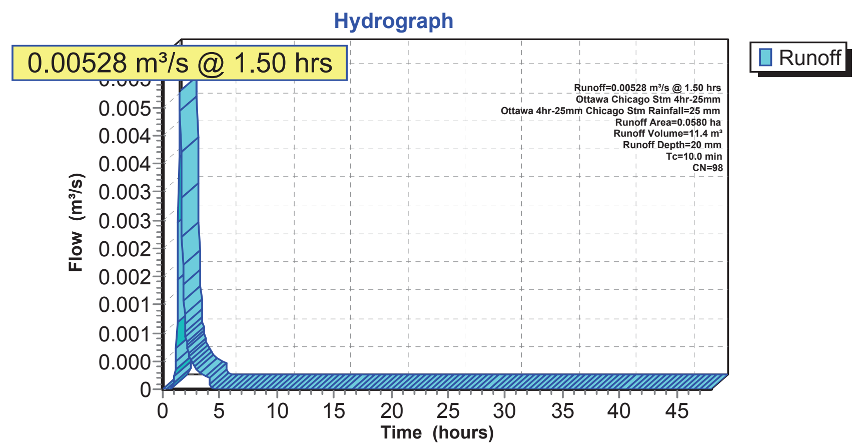
Runoff = 0.00528 m³/s @ 1.50 hrs, Volume= 11.4 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0580	98	
	0.0580		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-7: A7



Summary for Subcatchment A-8: A8

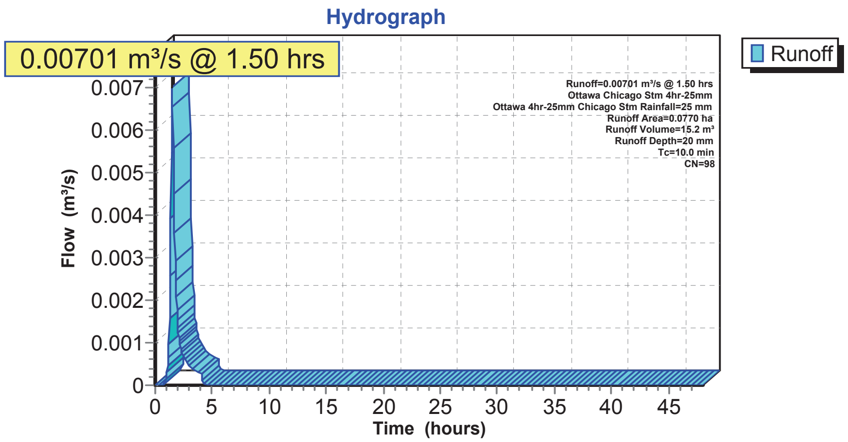
Runoff = 0.00701 m³/s @ 1.50 hrs, Volume= 15.2 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0770	98	
	0.0770		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-8: A8



Summary for Subcatchment A-9: A9

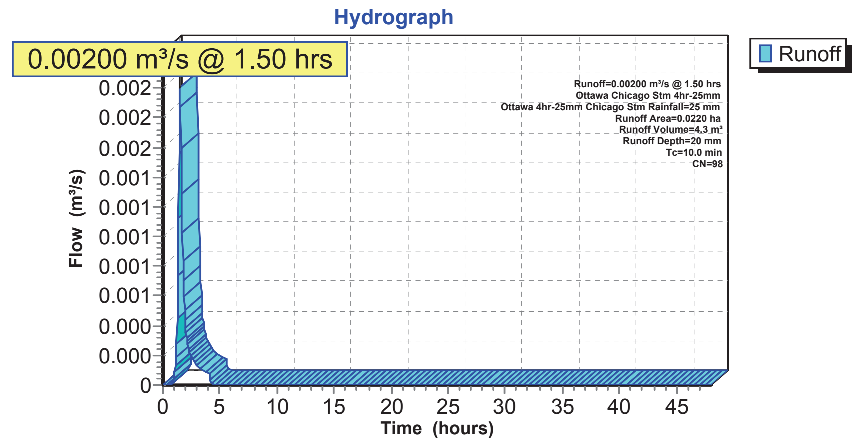
Runoff = 0.00200 m³/s @ 1.50 hrs, Volume= 4.3 m³, Depth= 20 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa Chicago Stm 4hr-25mm Ottawa 4hr-25mm Chicago Stm Rainfall=25 mm

	Area (ha)	CN	Description
*	0.0220	98	
	0.0220		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-9: A9



Summary for Pond P-0: Subsurface Chamber

Inflow Area = 13,060.0 m²,100.00% Impervious, Inflow Depth = 19 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.06315 m³/s @ 1.50 hrs, Volume= 243.6 m³
Outflow = 0.00000 m³/s @ 0.00 hrs, Volume= 0.0 m³, Atten= 100%, Lag= 0.0 min
Primary = 0.00000 m³/s @ 0.00 hrs, Volume= 0.0 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= -0.250 m @ 9.25 hrs Surf.Area= 0.0 m² Storage= 243.6 m³

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	-1.000 m	525.0 m³	**Subsurface Chamber** Listed below
#2	1.600 m	22.2 m³	**A-8 Surface Ponding** Listed below
		547.2 m³	Total Available Storage

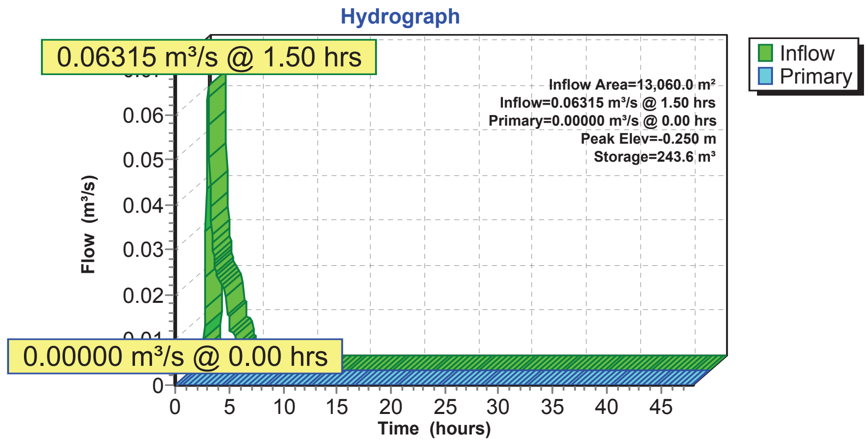
Elevation (meters)	Cum.Store (cubic-meters)
-1.000	0.0
0.000	325.0
1.200	525.0

Elevation (meters)	Cum.Store (cubic-meters)
1.600	0.0
1.900	22.2

Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**HYDROVEX 150-VHV-2** Elev. (meters) 0.000 0.200 0.750 1.000 1.500 2.000 3.000 4.500 6.000 Disch. (m³/s) 0.000000 0.000100 0.022000 0.026000 0.032000 0.038000 0.047000 0.057000 0.067000

Primary OutFlow Max=0.00000 m³/s @ 0.00 hrs HW=-1.000 m (Free Discharge)
└─**1=HYDROVEX 150-VHV-2** (Controls 0.00000 m³/s)

Pond P-0: Subsurface Chamber



Summary for Pond P-10: A10 Ponding

Inflow Area = 760.0 m²,100.00% Impervious, Inflow Depth = 20 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.00692 m³/s @ 1.50 hrs, Volume= 15.0 m³
Outflow = 0.00686 m³/s @ 1.52 hrs, Volume= 15.0 m³, Atten= 1%, Lag= 1.2 min
Primary = 0.00686 m³/s @ 1.52 hrs, Volume= 15.0 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.034 m @ 1.52 hrs Surf.Area= 0.0 m² Storage= 0.5 m³

Plug-Flow detention time= 1.2 min calculated for 15.0 m³ (100% of inflow)
Center-of-Mass det. time= 1.2 min (114.0 - 112.8)

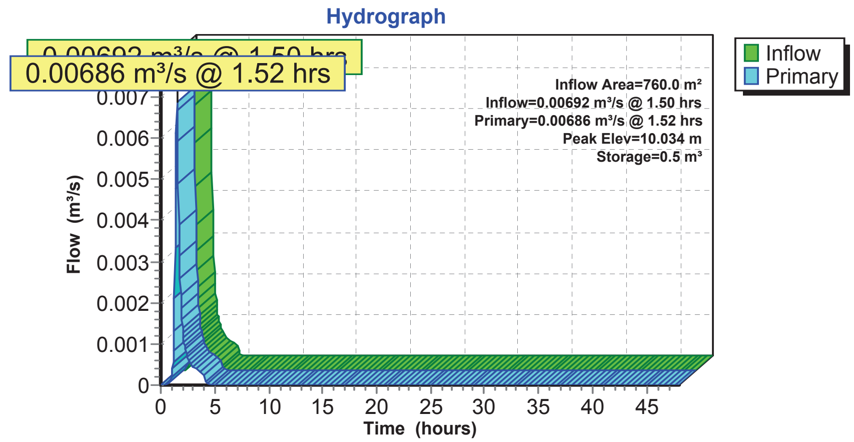
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	2.2 m³	**Surface Ponding at CB**Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	2.2

Device	Routing	Invert	Outlet Devices
#1	Primary	10.000 m	**600sq CB Inlet Sag_Single OPSD 400-01 400-03** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 0.500 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000 0.250000

Primary OutFlow Max=0.00677 m³/s @ 1.52 hrs HW=10.034 m (Free Discharge)
└─**1=600sq CB Inlet Sag_Single OPSD 400-01 400-03**(Custom Controls 0.00677 m³/s)

Pond P-10: A10 Ponding



Summary for Pond P-12: A12 Bioretention

Inflow Area = 110.0 m²,100.00% Impervious, Inflow Depth = 20 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.00100 m³/s @ 1.50 hrs, Volume= 2.2 m³
Outflow = 0.00000 m³/s @ 0.00 hrs, Volume= 0.0 m³, Atten= 100%, Lag= 0.0 min
Primary = 0.00000 m³/s @ 0.00 hrs, Volume= 0.0 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.130 m @ 4.60 hrs Surf.Area= 0.0 m² Storage= 2.2 m³

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

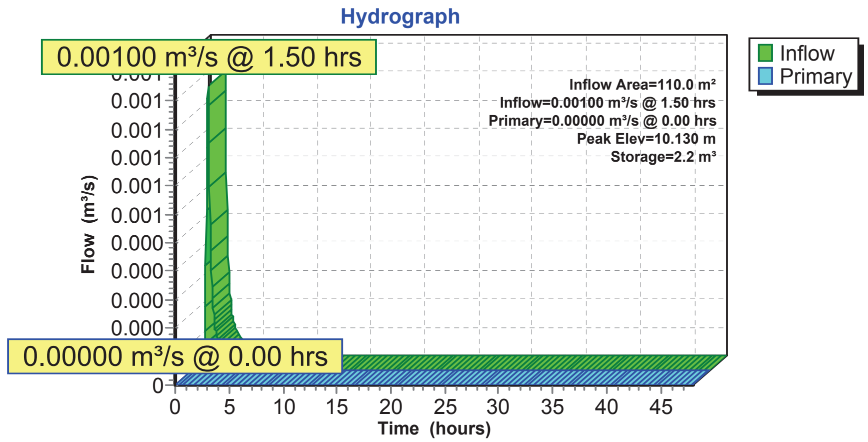
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	6.7 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	2.5
10.300	6.7

Device	Routing	Invert	Outlet Devices
#1	Primary	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000

Primary OutFlow Max=0.00000 m³/s @ 0.00 hrs HW=10.000 m (Free Discharge)
└─**1=CB inlet (Sag)** (Controls 0.00000 m³/s)

Pond P-12: A12 Bioretention



Summary for Pond P-13: A13 Bioretention

Inflow Area = 220.0 m²,100.00% Impervious, Inflow Depth = 20 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.00200 m³/s @ 1.50 hrs, Volume= 4.3 m³
Outflow = 0.00036 m³/s @ 2.04 hrs, Volume= 1.3 m³, Atten= 82%, Lag= 32.9 min
Primary = 0.00036 m³/s @ 2.04 hrs, Volume= 1.3 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.152 m @ 2.04 hrs Surf.Area= 0.0 m² Storage= 3.1 m³

Plug-Flow detention time= 83.3 min calculated for 1.3 m³ (31% of inflow)
Center-of-Mass det. time= 52.5 min (165.2 - 112.8)

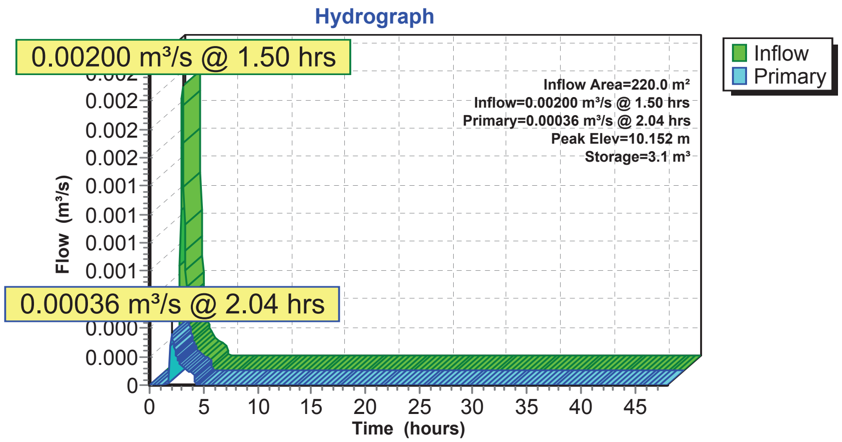
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	10.1 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	3.0
10.300	10.1

Device	Routing	Invert	Outlet Devices
#1	Primary	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000

Primary OutFlow Max=0.00036 m³/s @ 2.04 hrs HW=10.152 m (Free Discharge)
└─**1=CB inlet (Sag)** (Custom Controls 0.00036 m³/s)

Pond P-13: A13 Bioretention



Summary for Pond P-15: Rooftop Storage

Inflow Area = 2,210.0 m²,100.00% Impervious, Inflow Depth = 20 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.02012 m³/s @ 1.50 hrs, Volume= 43.5 m³
Outflow = 0.00378 m³/s @ 1.30 hrs, Volume= 43.6 m³, Atten= 81%, Lag= 0.0 min
Primary = 0.00378 m³/s @ 1.30 hrs, Volume= 43.6 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 100.085 m @ 2.02 hrs Surf.Area= 711.2 m² Storage= 20.1 m³

Plug-Flow detention time= 51.2 min calculated for 43.5 m³ (100% of inflow)
Center-of-Mass det. time= 51.3 min (164.1 - 112.8)

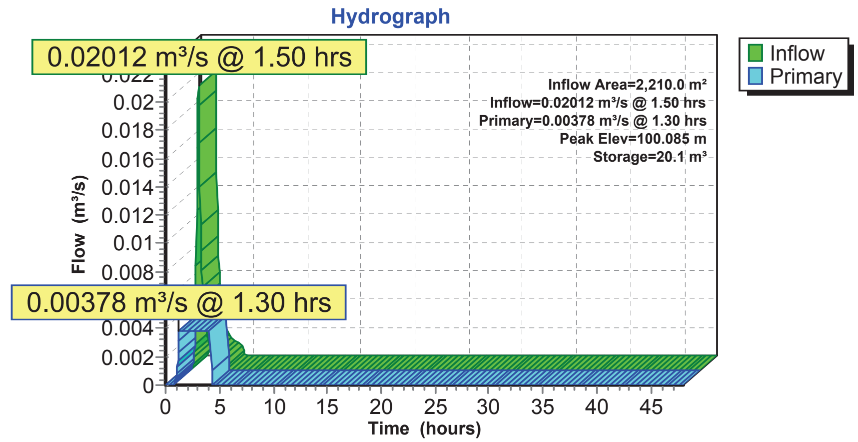
Volume	Invert	Avail.Storage	Storage Description
#1	100.000 m	111.0 m³	**Avg. Rooftop Storage (Pyramidal)** Listed below (Recalc) x 12

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	185.0	9.3	9.3	185.0

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-Closed X 12.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000315 0.000315 0.000315 0.000315 0.000315 0.000315

Primary OutFlow Max=0.00378 m³/s @ 1.30 hrs HW=100.028 m (Free Discharge)
└─**1=WATTS Accutrol_5-Closed** (Custom Controls 0.00378 m³/s)

Pond P-15: Rooftop Storage



Summary for Pond P-16: Rooftop Storage

Inflow Area =	2,530.0 m²,100.00% Impervious,	Inflow Depth = 20 mm	for Ottawa 4hr-25mm Chicago Str	
Inflow =	0.02304 m³/s @	1.50 hrs, Volume=	49.8 m³	
Outflow =	0.00630 m³/s @	1.35 hrs, Volume=	49.8 m³,	Atten= 73%, Lag= 0.0 min
Primary =	0.00630 m³/s @	1.35 hrs, Volume=	49.8 m³	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 100.079 m @ 1.87 hrs Surf.Area= 689.4 m² Storage= 18.2 m³

Plug-Flow detention time= 25.0 min calculated for 49.8 m³ (100% of inflow)
Center-of-Mass det. time= 24.8 min (137.6 - 112.8)

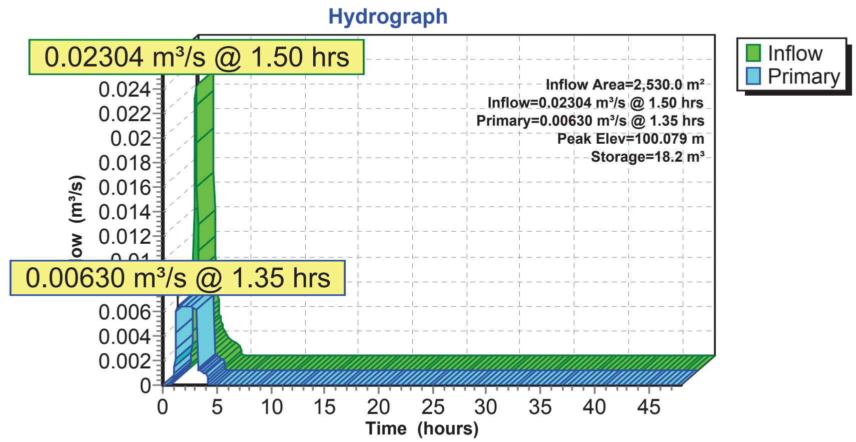
Volume	Invert	Avail.Storage	Storage Description
#1	100.000 m	123.5 m³	**Avg. Rooftop Storage (Pyramidal)** Listed below (Recalc) x 19

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	130.0	6.5	6.5	130.0

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-Closed X 20.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000315 0.000315 0.000315 0.000315 0.000315 0.000315

Primary OutFlow Max=0.00630 m³/s @ 1.35 hrs HW=100.033 m (Free Discharge)
└—**1=WATTS Accutrol_5-Closed** (Custom Controls 0.00630 m³/s)

Pond P-16: Rooftop Storage



Summary for Pond P-17: Rooftop Storage

Inflow Area = 1,980.0 m²,100.00% Impervious, Inflow Depth = 20 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.01803 m³/s @ 1.50 hrs, Volume= 39.0 m³
Outflow = 0.00441 m³/s @ 1.30 hrs, Volume= 39.0 m³, Atten= 76%, Lag= 0.0 min
Primary = 0.00441 m³/s @ 1.30 hrs, Volume= 39.0 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 100.083 m @ 1.91 hrs Surf.Area= 556.9 m² Storage= 15.4 m³

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 31.1 min (143.9 - 112.8)

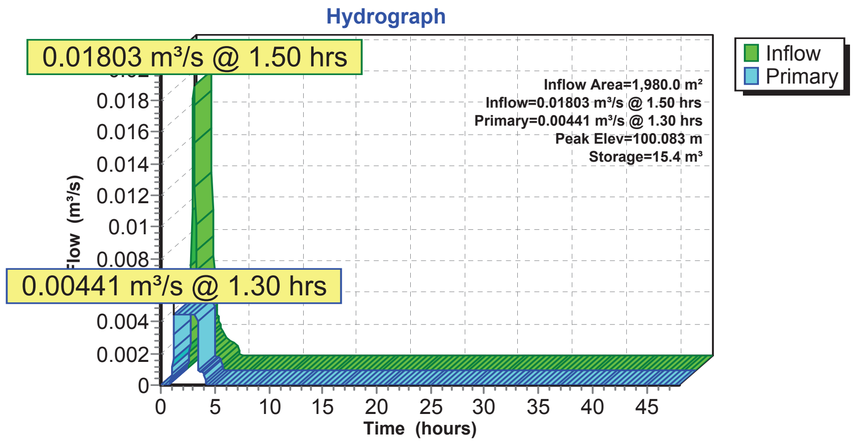
Volume	Invert	Avail.Storage	Storage Description
#1	100.000 m	91.0 m³	**Avg. Rooftop Storage (Pyramidal)** Listed below (Recalc) x 14

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	130.0	6.5	6.5	130.0

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-Closed X 14.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000315 0.000315 0.000315 0.000315 0.000315 0.000315

Primary OutFlow Max=0.00441 m³/s @ 1.30 hrs HW=100.025 m (Free Discharge)
└─**1=WATTS Accutrol_5-Closed** (Custom Controls 0.00441 m³/s)

Pond P-17: Rooftop Storage



Summary for Pond P-20: A20 Bioretention

Inflow Area = 250.0 m²,100.00% Impervious, Inflow Depth = 20 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.00228 m³/s @ 1.50 hrs, Volume= 4.9 m³
Outflow = 0.00217 m³/s @ 1.54 hrs, Volume= 4.2 m³, Atten= 4%, Lag= 2.8 min
Primary = 0.00217 m³/s @ 1.54 hrs, Volume= 4.2 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.161 m @ 1.54 hrs Surf.Area= 0.0 m² Storage= 1.0 m³

Plug-Flow detention time= 22.3 min calculated for 4.2 m³ (86% of inflow)
Center-of-Mass det. time= 8.4 min (121.2 - 112.8)

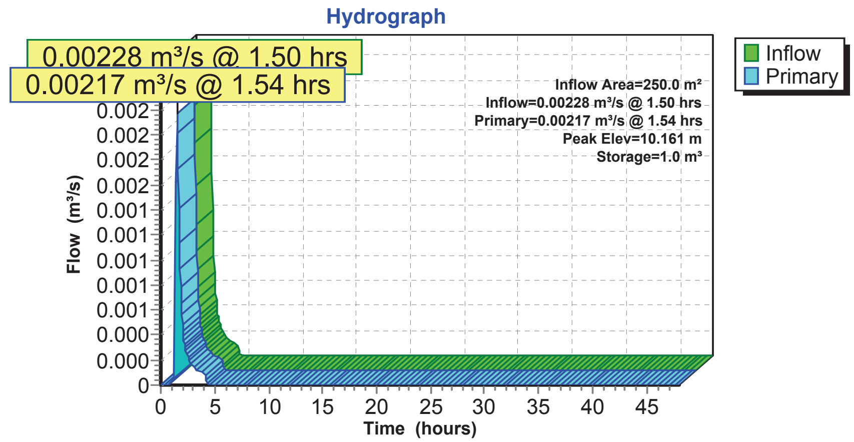
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	5.0 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	0.7
10.300	5.0

Device	Routing	Invert	Outlet Devices
#1	Primary	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000

Primary OutFlow Max=0.00216 m³/s @ 1.54 hrs HW=10.161 m (Free Discharge)
└─**1=CB inlet (Sag)** (Custom Controls 0.00216 m³/s)

Pond P-20: A20 Bioretention



Summary for Pond P-21: A21 Bioretention

Inflow Area = 320.0 m²,100.00% Impervious, Inflow Depth = 20 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.00291 m³/s @ 1.50 hrs, Volume= 6.3 m³
Outflow = 0.00179 m³/s @ 1.66 hrs, Volume= 5.1 m³, Atten= 38%, Lag= 10.1 min
Primary = 0.00179 m³/s @ 1.66 hrs, Volume= 5.1 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.173 m @ 1.66 hrs Surf.Area= 0.0 m² Storage= 2.4 m³

Plug-Flow detention time= 36.0 min calculated for 5.1 m³ (81% of inflow)
Center-of-Mass det. time= 19.0 min (131.8 - 112.8)

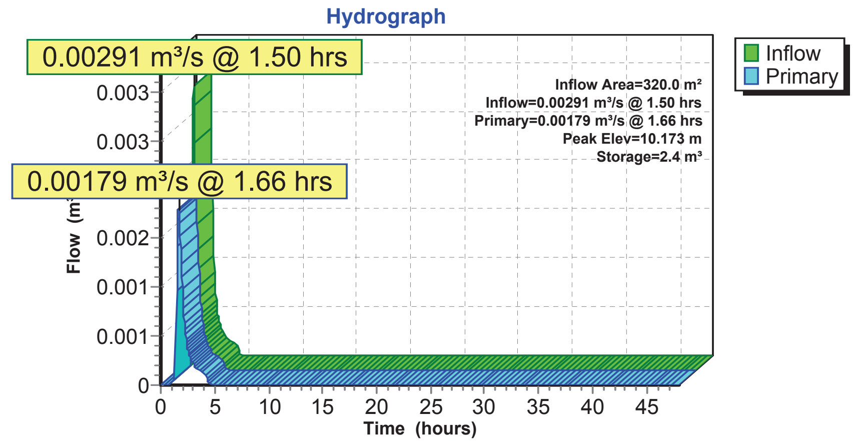
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	8.9 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	1.2
10.300	8.9

Device	Routing	Invert	Outlet Devices
#1	Device 2	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000
#2	Primary	8.800 m	**HYDROVEX 50-VHV-1** Head (meters) 0.000 0.300 0.500 1.000 2.000 3.000 6.000 Disch. (m³/s) 0.000000 0.001400 0.001850 0.002800 0.004100 0.005000 0.007000

Primary OutFlow Max=0.00328 m³/s @ 1.66 hrs HW=10.173 m (Free Discharge)
└─**2=HYDROVEX 50-VHV-1** (Custom Controls 0.00328 m³/s)
  └─**1=CB inlet (Sag)** (Passes 0.00328 m³/s of 0.00452 m³/s potential flow)

Pond P-21: A21 Bioretention



Summary for Pond P-22: A22 Bioretention

Inflow Area = 130.0 m²,100.00% Impervious, Inflow Depth = 20 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.00118 m³/s @ 1.50 hrs, Volume= 2.6 m³
Outflow = 0.00005 m³/s @ 3.72 hrs, Volume= 0.2 m³, Atten= 96%, Lag= 133.7 min
Primary = 0.00005 m³/s @ 3.72 hrs, Volume= 0.2 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.151 m @ 3.72 hrs Surf.Area= 0.0 m² Storage= 2.4 m³

Plug-Flow detention time= 161.3 min calculated for 0.2 m³ (6% of inflow)
Center-of-Mass det. time= 118.2 min (230.9 - 112.8)

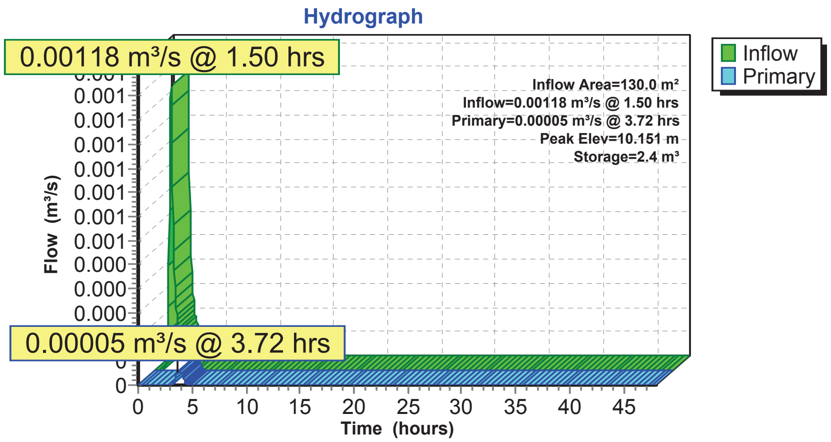
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	8.2 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	2.4
10.300	8.2

Device	Routing	Invert	Outlet Devices
#1	Device 2	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000
#2	Primary	8.800 m	**HYDROVEX 50-VHV-1** Head (meters) 0.000 0.300 0.500 1.000 2.000 3.000 6.000 Disch. (m³/s) 0.000000 0.001400 0.001850 0.002800 0.004100 0.005000 0.007000

Primary OutFlow Max=0.00013 m³/s @ 3.72 hrs HW=10.151 m (Free Discharge)
└─**2=HYDROVEX 50-VHV-1** (Passes 0.00013 m³/s of 0.00326 m³/s potential flow)
  └─**1=CB inlet (Sag)** (Custom Controls 0.00013 m³/s)

Pond P-22: A22 Bioretention



Summary for Pond P-4: A4 Bioretention

Inflow Area = 310.0 m²,100.00% Impervious, Inflow Depth = 20 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.00282 m³/s @ 1.50 hrs, Volume= 6.1 m³
Outflow = 0.00050 m³/s @ 2.05 hrs, Volume= 2.1 m³, Atten= 82%, Lag= 33.0 min
Primary = 0.00050 m³/s @ 2.05 hrs, Volume= 2.1 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.153 m @ 2.05 hrs Surf.Area= 0.0 m² Storage= 4.2 m³

Plug-Flow detention time= 81.2 min calculated for 2.1 m³ (34% of inflow)
Center-of-Mass det. time= 51.3 min (164.1 - 112.8)

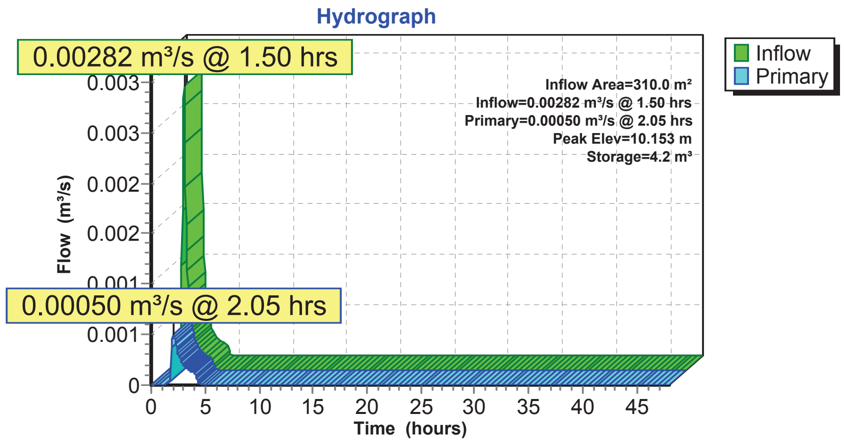
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	18.8 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	4.0
10.300	18.8

Device	Routing	Invert	Outlet Devices
#1	Primary	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000

Primary OutFlow Max=0.00050 m³/s @ 2.05 hrs HW=10.153 m (Free Discharge)
└─**1=CB inlet (Sag)** (Custom Controls 0.00050 m³/s)

Pond P-4: A4 Bioretention



Summary for Pond P-6: A6 Bioretention

Inflow Area = 320.0 m²,100.00% Impervious, Inflow Depth = 20 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.00291 m³/s @ 1.50 hrs, Volume= 6.3 m³
Outflow = 0.00019 m³/s @ 3.01 hrs, Volume= 0.9 m³, Atten= 94%, Lag= 90.7 min
Primary = 0.00019 m³/s @ 3.01 hrs, Volume= 0.9 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.151 m @ 3.01 hrs Surf.Area= 0.0 m² Storage= 5.5 m³

Plug-Flow detention time= 129.8 min calculated for 0.9 m³ (14% of inflow)
Center-of-Mass det. time= 93.6 min (206.3 - 112.8)

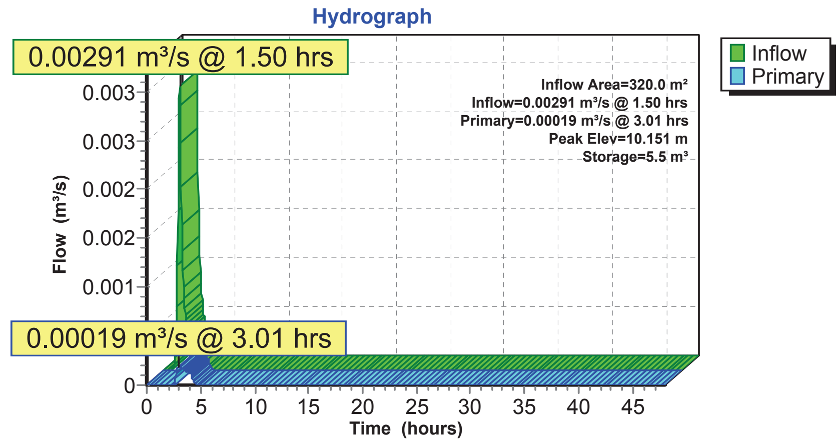
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	23.6 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	5.4
10.300	23.6

Device	Routing	Invert	Outlet Devices
#1	Primary	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000

Primary OutFlow Max=0.00019 m³/s @ 3.01 hrs HW=10.151 m (Free Discharge)
└─**1=CB inlet (Sag)** (Custom Controls 0.00019 m³/s)

Pond P-6: A6 Bioretention



Summary for Pond P-9: A9 Ponding

Inflow Area = 220.0 m²,100.00% Impervious, Inflow Depth = 20 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.00200 m³/s @ 1.50 hrs, Volume= 4.3 m³
Outflow = 0.00000 m³/s @ 0.00 hrs, Volume= 0.0 m³, Atten= 100%, Lag= 0.0 min
Primary = 0.00000 m³/s @ 0.00 hrs, Volume= 0.0 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.118 m @ 4.60 hrs Surf.Area= 0.0 m² Storage= 4.3 m³

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

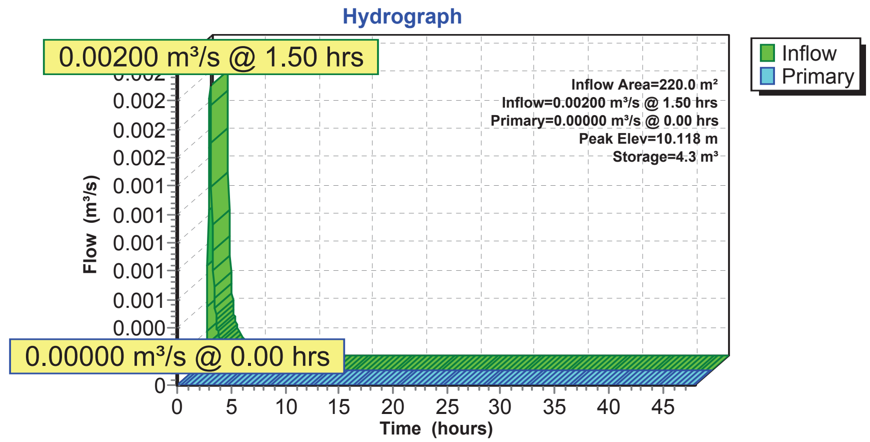
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	11.0 m³	**Surface Ponding at CB**Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	5.5
10.300	11.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000
#2	Primary	8.800 m	**HYDROVEX 50-VHV-1** Head (meters) 0.000 0.300 0.500 1.000 2.000 3.000 6.000 Disch. (m³/s) 0.000000 0.001400 0.001850 0.002800 0.004100 0.005000 0.007000

Primary OutFlow Max=0.00000 m³/s @ 0.00 hrs HW=10.000 m (Free Discharge)
└**2=HYDROVEX 50-VHV-1** (Passes 0.00000 m³/s of 0.00306 m³/s potential flow)
 └**1=CB inlet (Sag)** (Controls 0.00000 m³/s)

Pond P-9: A9 Ponding

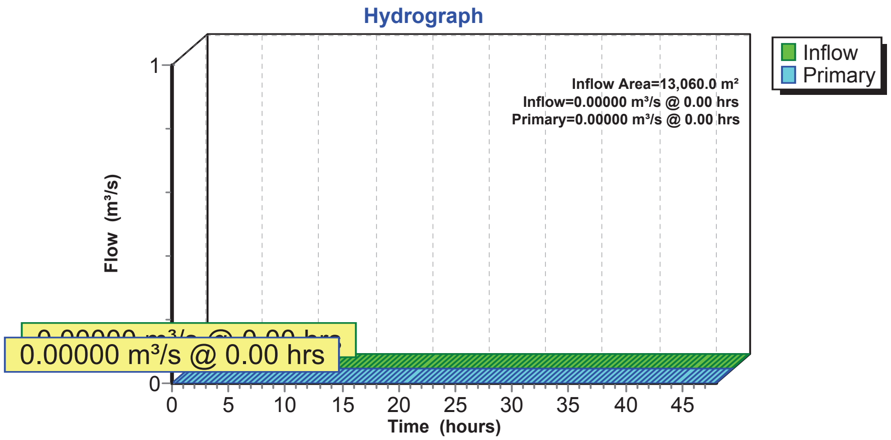


Summary for Link X-1: Chamber Outflow

Inflow Area = 13,060.0 m²,100.00% Impervious, Inflow Depth = 0 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.00000 m³/s @ 0.00 hrs, Volume= 0.0 m³
Primary = 0.00000 m³/s @ 0.00 hrs, Volume= 0.0 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link X-1: Chamber Outflow

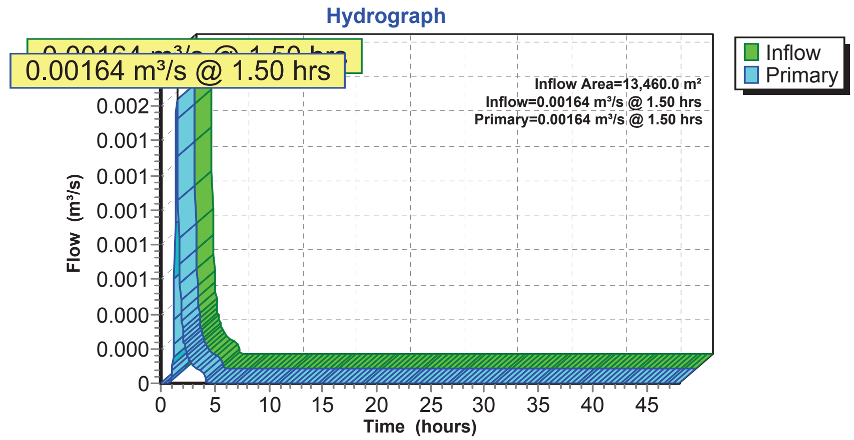


Summary for Link X-2: Internal Link A

Inflow Area = 13,460.0 m²,100.00% Impervious, Inflow Depth = 0 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.00164 m³/s @ 1.50 hrs, Volume= 3.5 m³
Primary = 0.00164 m³/s @ 1.50 hrs, Volume= 3.5 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link X-2: Internal Link A

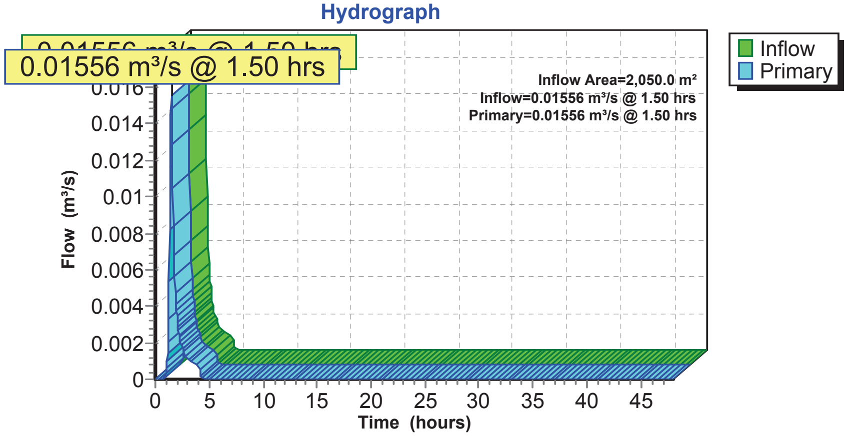


Summary for Link X-3: Internal Link B

Inflow Area = 2,050.0 m²,100.00% Impervious, Inflow Depth = 17 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.01556 m³/s @ 1.50 hrs, Volume= 35.2 m³
Primary = 0.01556 m³/s @ 1.50 hrs, Volume= 35.2 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link X-3: Internal Link B

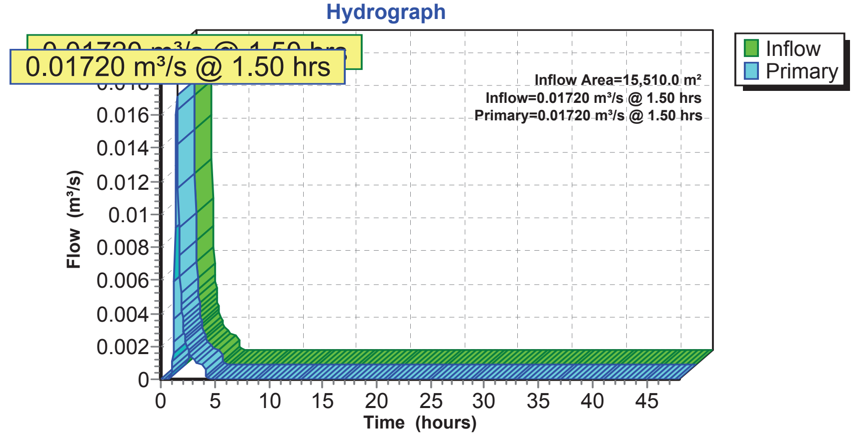


Summary for Link X-4: Net Offsite Flows

Inflow Area = 15,510.0 m²,100.00% Impervious, Inflow Depth = 2 mm for Ottawa 4hr-25mm Chicago Str
Inflow = 0.01720 m³/s @ 1.50 hrs, Volume= 38.8 m³
Primary = 0.01720 m³/s @ 1.50 hrs, Volume= 38.8 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link X-4: Net Offsite Flows



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA-1: A1 Runoff Area=0.1070 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.01292 m³/s 108.1 m³

SubcatchmentA-10: A10 Runoff Area=0.0210 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00254 m³/s 21.2 m³

SubcatchmentA-11: A11 Runoff Area=0.0550 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00664 m³/s 55.6 m³

SubcatchmentA-12: A12 Runoff Area=0.0110 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00133 m³/s 11.1 m³

SubcatchmentA-13: A13 Runoff Area=0.0170 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00205 m³/s 17.2 m³

SubcatchmentA-14: A14 Runoff Area=0.0050 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00060 m³/s 5.1 m³

SubcatchmentA-15: A15 Runoff Area=0.2210 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.02669 m³/s 223.3 m³

SubcatchmentA-16: A16 Runoff Area=0.2530 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.03055 m³/s 255.6 m³

SubcatchmentA-17: A17 Runoff Area=0.1980 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.02391 m³/s 200.0 m³

SubcatchmentA-18: A18 Runoff Area=0.0960 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.01159 m³/s 97.0 m³

SubcatchmentA-19: A19 Runoff Area=0.0180 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00217 m³/s 18.2 m³

SubcatchmentA-2: A2 Runoff Area=0.0910 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.01099 m³/s 91.9 m³

SubcatchmentA-20: A20 Runoff Area=0.0250 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00302 m³/s 25.3 m³

SubcatchmentA-21: A21 Runoff Area=0.0320 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00386 m³/s 32.3 m³

SubcatchmentA-22: A22 Runoff Area=0.0130 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00157 m³/s 13.1 m³

SubcatchmentA-3: A3 Runoff Area=0.1060 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.01280 m³/s 107.1 m³

SubcatchmentA-4: A4 Runoff Area=0.0310 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00374 m³/s 31.3 m³

SubcatchmentA-5: A5 Runoff Area=0.0620 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00749 m³/s 62.6 m³

SubcatchmentA-6: A6 Runoff Area=0.0320 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00386 m³/s 32.3 m³

SubcatchmentA-7: A7 Runoff Area=0.0580 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00700 m³/s 58.6 m³

SubcatchmentA-8: A8 Runoff Area=0.0770 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00930 m³/s 77.8 m³

SubcatchmentA-9: A9 Runoff Area=0.0220 ha 100.00% Impervious Runoff Depth=101 mm
Tc=10.0 min CN=98 Runoff=0.00266 m³/s 22.2 m³

Pond P-0: Subsurface Chamber Peak Elev=1.882 m Storage=545.8 m³ Inflow=0.08955 m³/s 1,305.7 m³
Outflow=0.03658 m³/s 953.4 m³

Pond P-10: A10 Ponding Peak Elev=10.046 m Storage=0.7 m³ Inflow=0.00918 m³/s 76.8 m³
Outflow=0.00916 m³/s 76.8 m³

Pond P-12: A12 Bioretention Peak Elev=10.157 m Storage=2.7 m³ Inflow=0.00133 m³/s 11.1 m³
Outflow=0.00132 m³/s 8.6 m³

Pond P-13: A13 Bioretention Peak Elev=10.163 m Storage=3.6 m³ Inflow=0.00266 m³/s 22.2 m³
Outflow=0.00261 m³/s 19.2 m³

Pond P-15: Rooftop Storage Peak Elev=100.144 m Storage=97.8 m³ Inflow=0.02669 m³/s 223.3 m³
Outflow=0.00378 m³/s 223.3 m³

Pond P-16: Rooftop Storage Peak Elev=100.137 m Storage=93.5 m³ Inflow=0.03055 m³/s 255.6 m³
Outflow=0.00630 m³/s 255.6 m³

Pond P-17: Rooftop Storage Peak Elev=100.142 m Storage=77.7 m³ Inflow=0.02391 m³/s 200.0 m³
Outflow=0.00441 m³/s 200.0 m³

Pond P-20: A20 Bioretention Peak Elev=10.165 m Storage=1.1 m³ Inflow=0.00302 m³/s 25.3 m³
Outflow=0.00300 m³/s 24.6 m³

Pond P-21: A21 Bioretention Peak Elev=10.198 m Storage=3.7 m³ Inflow=0.00386 m³/s 32.3 m³
Outflow=0.00332 m³/s 31.1 m³

Pond P-22: A22 Bioretention Peak Elev=10.169 m Storage=3.1 m³ Inflow=0.00157 m³/s 13.1 m³
Outflow=0.00149 m³/s 10.7 m³

Pond P-4: A4 Bioretention Peak Elev=10.168 m Storage=5.8 m³ Inflow=0.00374 m³/s 31.3 m³
Outflow=0.00355 m³/s 27.3 m³

Pond P-6: A6 Bioretention	Peak Elev=10.168 m Storage=7.6 m³ Inflow=0.00386 m³/s 32.3 m³ Outflow=0.00360 m³/s 26.9 m³
Pond P-9: A9 Ponding	Peak Elev=10.182 m Storage=6.7 m³ Inflow=0.00266 m³/s 22.2 m³ Outflow=0.00252 m³/s 16.7 m³
Link X-1: Chamber Outflow	Inflow=0.03658 m³/s 953.4 m³ Primary=0.03658 m³/s 953.4 m³
Link X-2: Internal Link A	Inflow=0.03829 m³/s 988.3 m³ Primary=0.03829 m³/s 988.3 m³
Link X-3: Internal Link B	Inflow=0.02464 m³/s 201.6 m³ Primary=0.02464 m³/s 201.6 m³
Link X-4: Net Offsite Flows	Inflow=0.05166 m³/s 1,189.9 m³ Primary=0.05166 m³/s 1,189.9 m³

Total Runoff Area = 15,510.0 m² Runoff Volume = 1,566.8 m³ Average Runoff Depth = 101 mm
0.00% Pervious = 0.0 m² 100.00% Impervious = 15,510.0 m²

Summary for Subcatchment A-1: A1

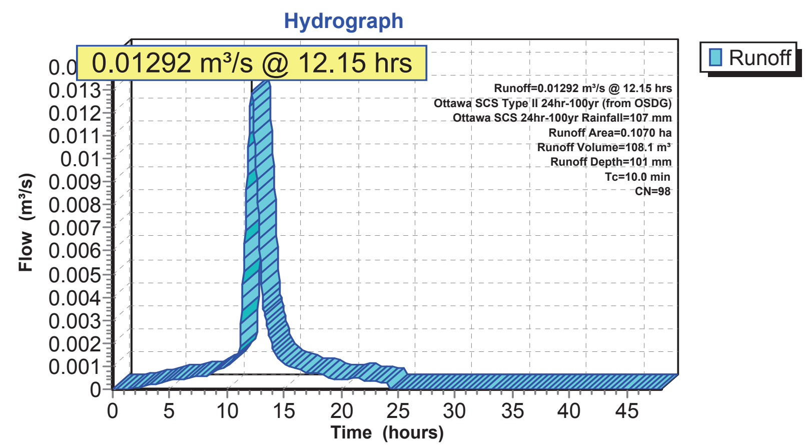
Runoff = 0.01292 m³/s @ 12.15 hrs, Volume= 108.1 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.1070	98	
	0.1070		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-1: A1



Summary for Subcatchment A-10: A10

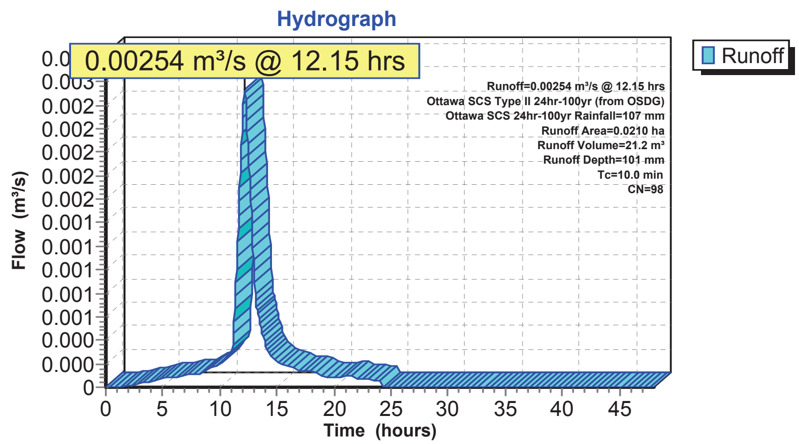
Runoff = 0.00254 m^3/s @ 12.15 hrs, Volume= 21.2 m^3, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0210	98	
	0.0210		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m^3/s)	Description
10.0					**Direct Entry,**

Subcatchment A-10: A10



Summary for Subcatchment A-11: A11

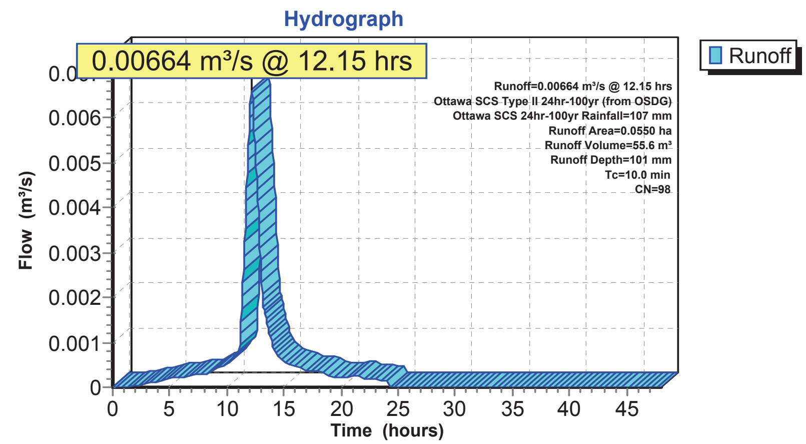
Runoff = 0.00664 m^3/s @ 12.15 hrs, Volume= 55.6 m^3, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0550	98	
	0.0550		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m^3/s)	Description
10.0					**Direct Entry,**

Subcatchment A-11: A11



Summary for Subcatchment A-12: A12

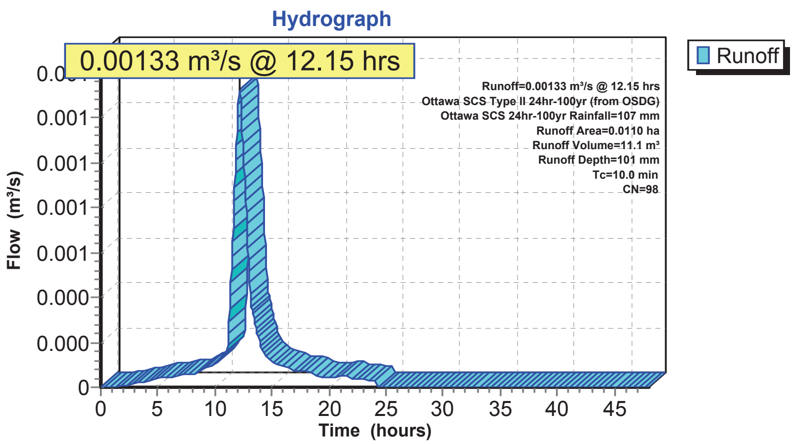
Runoff = 0.00133 m³/s @ 12.15 hrs, Volume= 11.1 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0110	98	
	0.0110		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-12: A12



Summary for Subcatchment A-13: A13

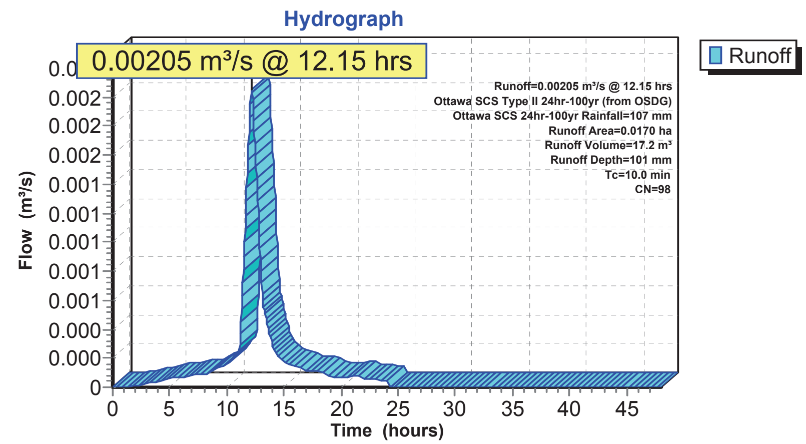
Runoff = 0.00205 m³/s @ 12.15 hrs, Volume= 17.2 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0170	98	
	0.0170		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-13: A13



Summary for Subcatchment A-14: A14

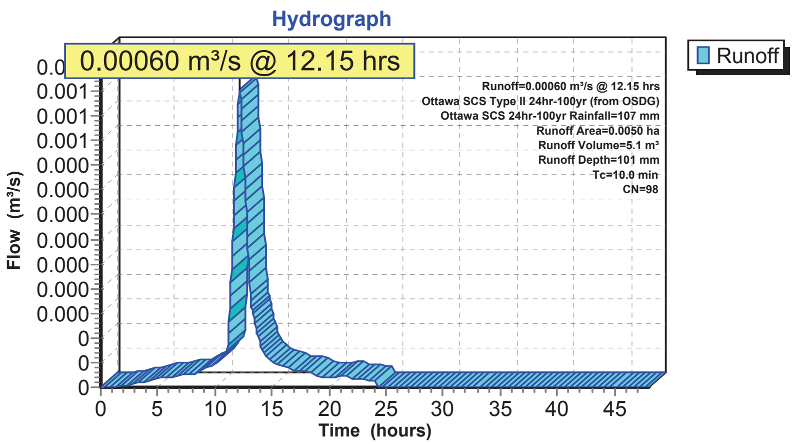
Runoff = 0.00060 m³/s @ 12.15 hrs, Volume= 5.1 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0050	98	
	0.0050		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-14: A14



Summary for Subcatchment A-15: A15

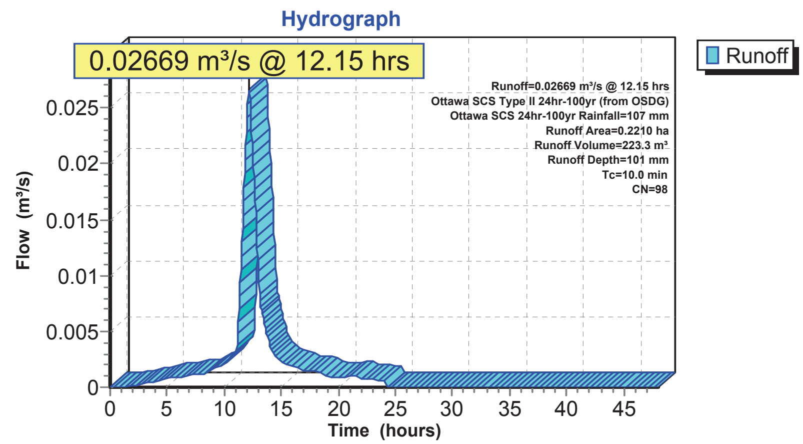
Runoff = 0.02669 m³/s @ 12.15 hrs, Volume= 223.3 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.2210	98	
	0.2210		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-15: A15



Summary for Subcatchment A-16: A16

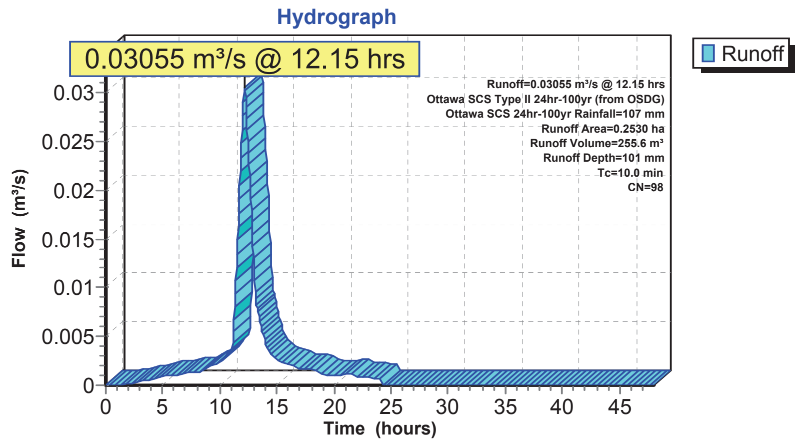
Runoff = 0.03055 m³/s @ 12.15 hrs, Volume= 255.6 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.2530	98	
	0.2530		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-16: A16



Summary for Subcatchment A-17: A17

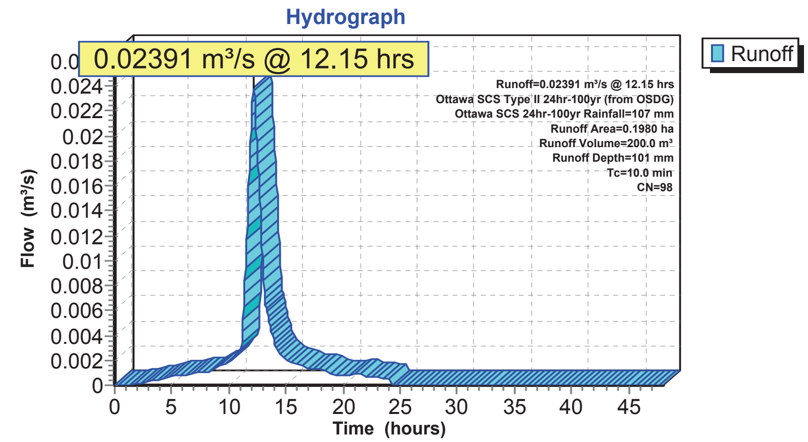
Runoff = 0.02391 m³/s @ 12.15 hrs, Volume= 200.0 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.1980	98	
	0.1980		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-17: A17



Summary for Subcatchment A-18: A18

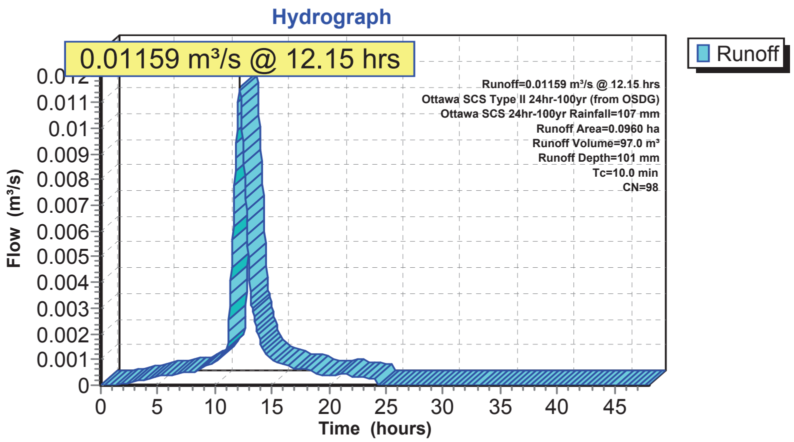
Runoff = 0.01159 m³/s @ 12.15 hrs, Volume= 97.0 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0960	98	
	0.0960		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					Direct Entry,

Subcatchment A-18: A18



Summary for Subcatchment A-19: A19

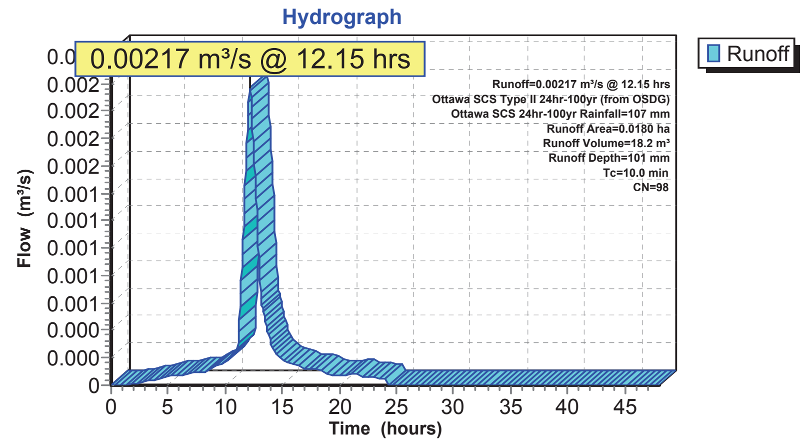
Runoff = 0.00217 m³/s @ 12.15 hrs, Volume= 18.2 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0180	98	
	0.0180		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					Direct Entry,

Subcatchment A-19: A19



Summary for Subcatchment A-2: A2

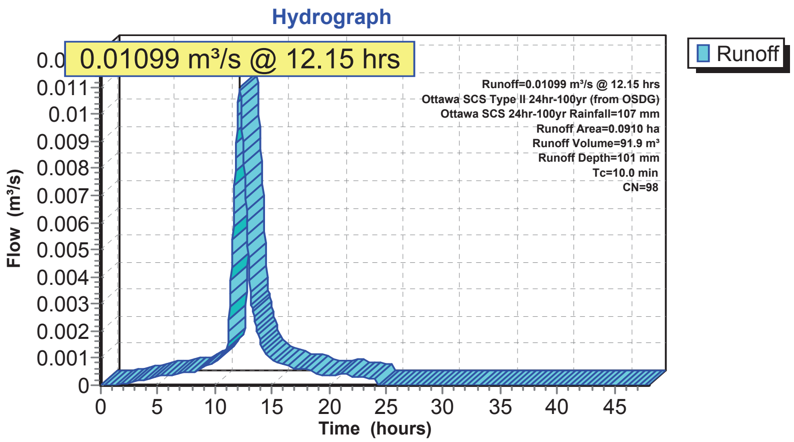
Runoff = 0.01099 m³/s @ 12.15 hrs, Volume= 91.9 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0910	98	
	0.0910		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-2: A2



Summary for Subcatchment A-20: A20

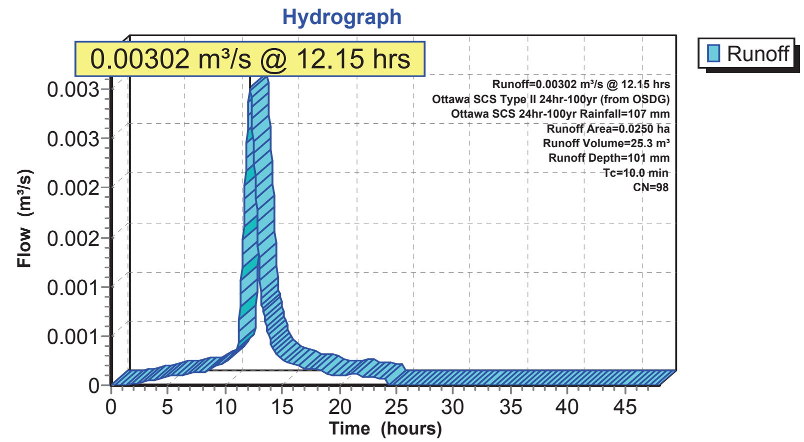
Runoff = 0.00302 m³/s @ 12.15 hrs, Volume= 25.3 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0250	98	
	0.0250		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-20: A20



Summary for Subcatchment A-21: A21

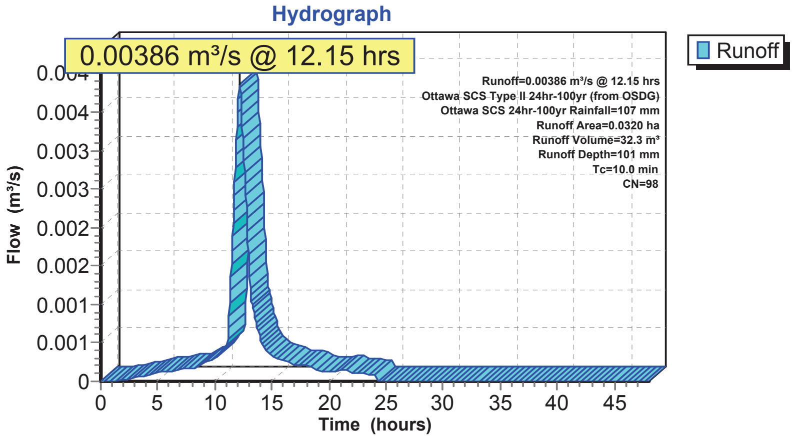
Runoff = 0.00386 m³/s @ 12.15 hrs, Volume= 32.3 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0320	98	
	0.0320		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-21: A21



Summary for Subcatchment A-22: A22

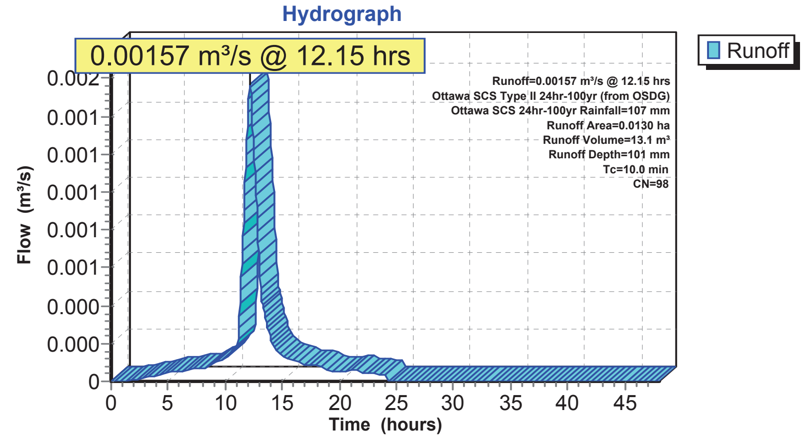
Runoff = 0.00157 m³/s @ 12.15 hrs, Volume= 13.1 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0130	98	
	0.0130		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-22: A22



Summary for Subcatchment A-3: A3

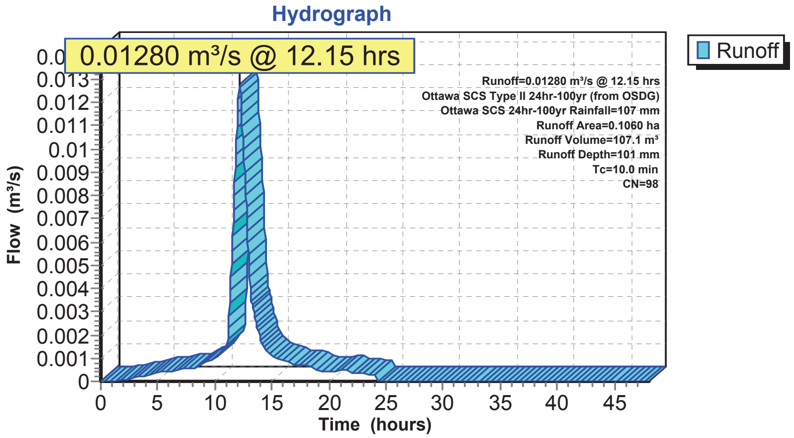
Runoff = 0.01280 m³/s @ 12.15 hrs, Volume= 107.1 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.1060	98	
	0.1060		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-3: A3



Summary for Subcatchment A-4: A4

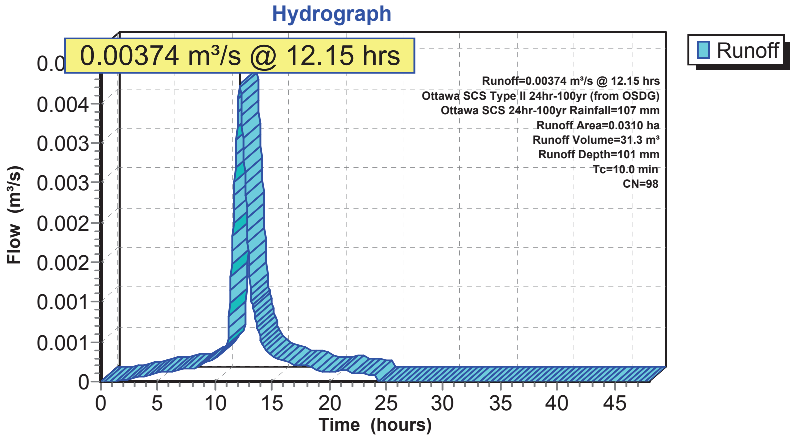
Runoff = 0.00374 m³/s @ 12.15 hrs, Volume= 31.3 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0310	98	
	0.0310		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-4: A4



Summary for Subcatchment A-5: A5

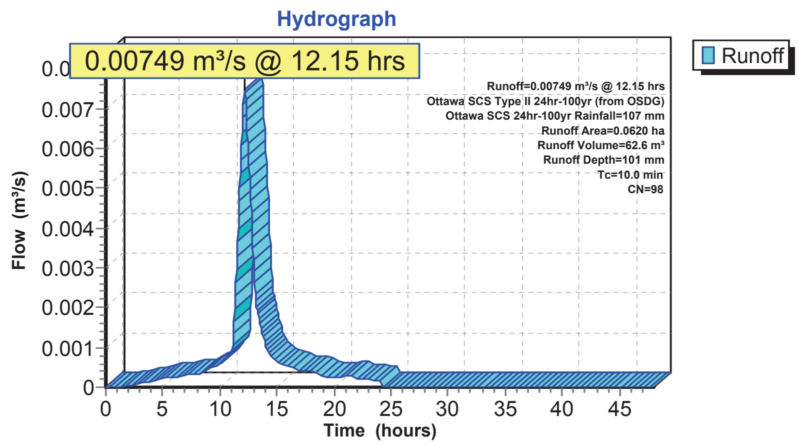
Runoff = 0.00749 m³/s @ 12.15 hrs, Volume= 62.6 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0620	98	
	0.0620		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-5: A5



Summary for Subcatchment A-6: A6

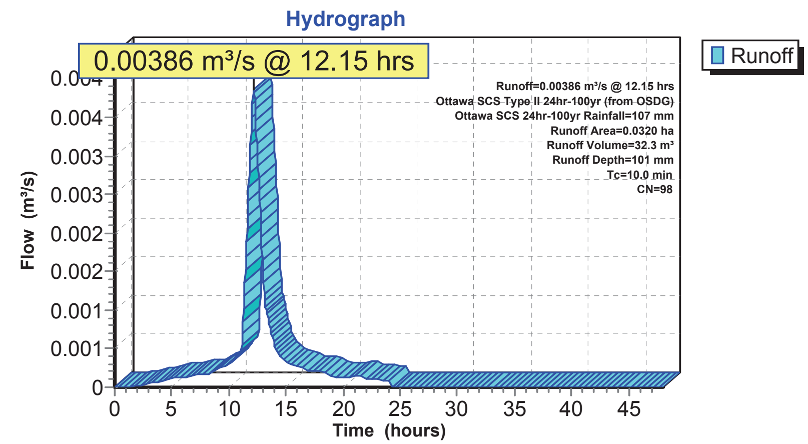
Runoff = 0.00386 m³/s @ 12.15 hrs, Volume= 32.3 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0320	98	
	0.0320		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-6: A6



Summary for Subcatchment A-7: A7

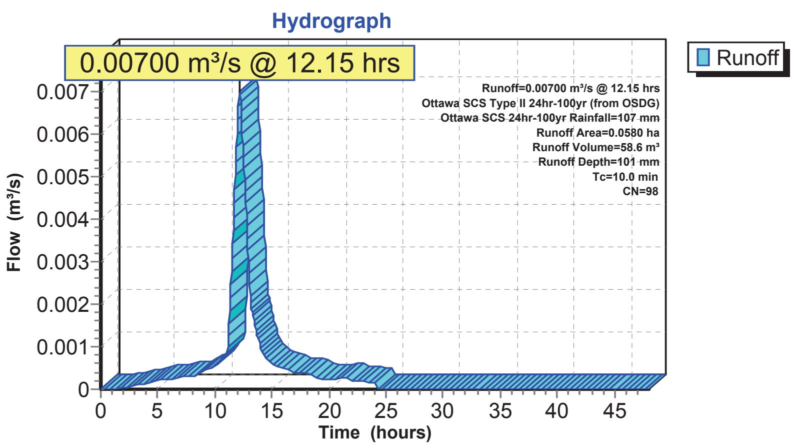
Runoff = 0.00700 m³/s @ 12.15 hrs, Volume= 58.6 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0580	98	
	0.0580		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-7: A7



Summary for Subcatchment A-8: A8

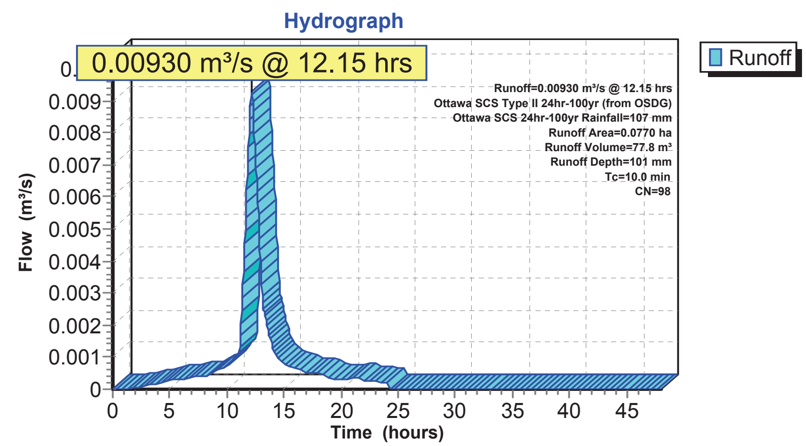
Runoff = 0.00930 m³/s @ 12.15 hrs, Volume= 77.8 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0770	98	
	0.0770		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-8: A8



Summary for Subcatchment A-9: A9

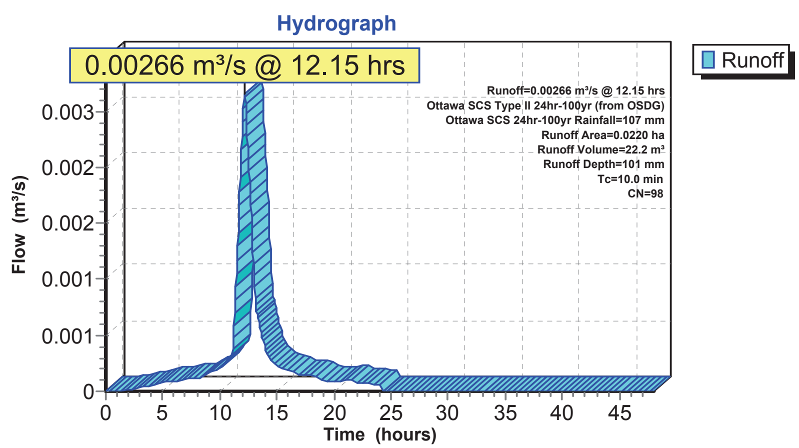
Runoff = 0.00266 m³/s @ 12.15 hrs, Volume= 22.2 m³, Depth= 101 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Ottawa SCS Type II 24hr-100yr (from OSDG) Ottawa SCS 24hr-100yr Rainfall=107 mm

	Area (ha)	CN	Description
*	0.0220	98	
	0.0220		100.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment A-9: A9



Summary for Pond P-0: Subsurface Chamber

Inflow Area = 13,060.0 m²,100.00% Impervious, Inflow Depth = 100 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.08955 m³/s @ 12.16 hrs, Volume= 1,305.7 m³
Outflow = 0.03658 m³/s @ 13.20 hrs, Volume= 953.4 m³, Atten= 59%, Lag= 62.3 min
Primary = 0.03658 m³/s @ 13.20 hrs, Volume= 953.4 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1.882 m @ 13.20 hrs Surf.Area= 0.0 m² Storage= 545.8 m³

Plug-Flow detention time= 313.7 min calculated for 953.4 m³ (73% of inflow)
Center-of-Mass det. time= 190.1 min (1,041.6 - 851.5)

Volume	Invert	Avail.Storage	Storage Description
#1	-1.000 m	525.0 m³	**Subsurface Chamber** Listed below
#2	1.600 m	22.2 m³	**A-8 Surface Ponding** Listed below
		547.2 m³	Total Available Storage

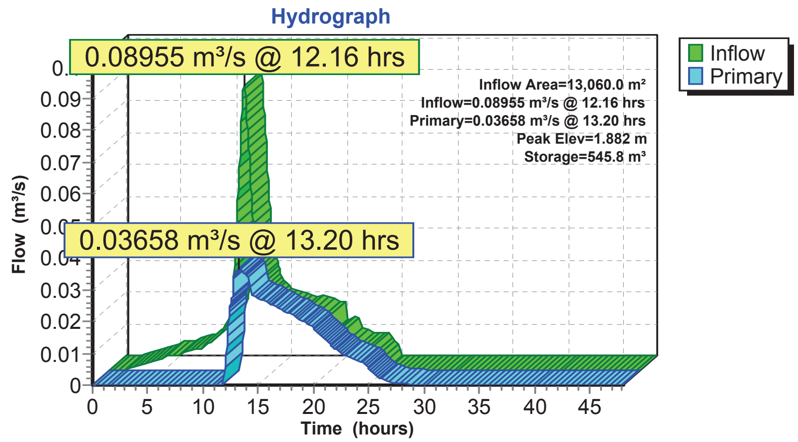
Elevation (meters)	Cum.Store (cubic-meters)
-1.000	0.0
0.000	325.0
1.200	525.0

Elevation (meters)	Cum.Store (cubic-meters)
1.600	0.0
1.900	22.2

Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**HYDROVEX 150-VHV-2** Elev. (meters) 0.000 0.200 0.750 1.000 1.500 2.000 3.000 4.500 6.000 Disch. (m³/s) 0.000000 0.000100 0.022000 0.026000 0.032000 0.038000 0.047000 0.057000 0.067000

Primary OutFlow Max=0.03658 m³/s @ 13.20 hrs HW=1.881 m (Free Discharge)
└─**1=HYDROVEX 150-VHV-2** (Custom Controls 0.03658 m³/s)

Pond P-0: Subsurface Chamber



Summary for Pond P-10: A10 Ponding

Inflow Area = 760.0 m²,100.00% Impervious, Inflow Depth = 101 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.00918 m³/s @ 12.15 hrs, Volume= 76.8 m³
Outflow = 0.00916 m³/s @ 12.17 hrs, Volume= 76.8 m³, Atten= 0%, Lag= 1.2 min
Primary = 0.00916 m³/s @ 12.17 hrs, Volume= 76.8 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.046 m @ 12.17 hrs Surf.Area= 0.0 m² Storage= 0.7 m³

Plug-Flow detention time= 1.2 min calculated for 76.7 m³ (100% of inflow)
Center-of-Mass det. time= 1.2 min (771.1 - 769.9)

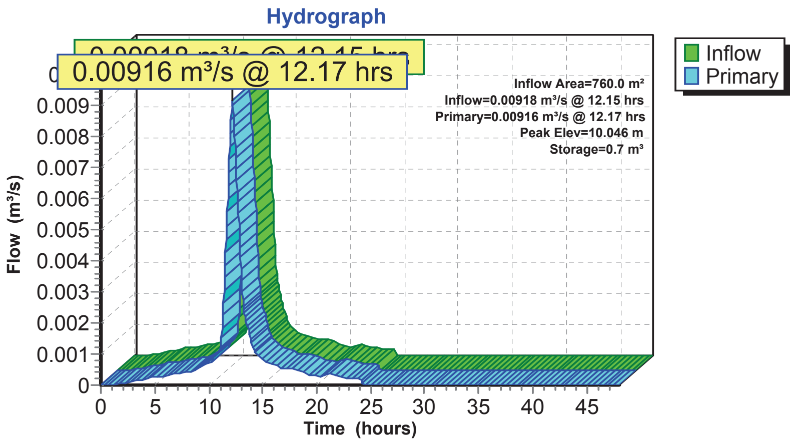
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	2.2 m³	**Surface Ponding at CB**Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	2.2

Device	Routing	Invert	Outlet Devices
#1	Primary	10.000 m	**600sq CB Inlet Sag_Single OPSD 400-01 400-03** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 0.500 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000 0.250000

Primary OutFlow Max=0.00913 m³/s @ 12.17 hrs HW=10.046 m (Free Discharge)
└─**1=600sq CB Inlet Sag_Single OPSD 400-01 400-03**(Custom Controls 0.00913 m³/s)

Pond P-10: A10 Ponding



Summary for Pond P-12: A12 Bioretention

Inflow Area = 110.0 m²,100.00% Impervious, Inflow Depth = 101 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.00133 m³/s @ 12.15 hrs, Volume= 11.1 m³
Outflow = 0.00132 m³/s @ 12.19 hrs, Volume= 8.6 m³, Atten= 1%, Lag= 2.4 min
Primary = 0.00132 m³/s @ 12.19 hrs, Volume= 8.6 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.157 m @ 12.19 hrs Surf.Area= 0.0 m² Storage= 2.7 m³

Plug-Flow detention time= 154.0 min calculated for 8.6 m³ (78% of inflow)
Center-of-Mass det. time= 70.0 min (839.8 - 769.9)

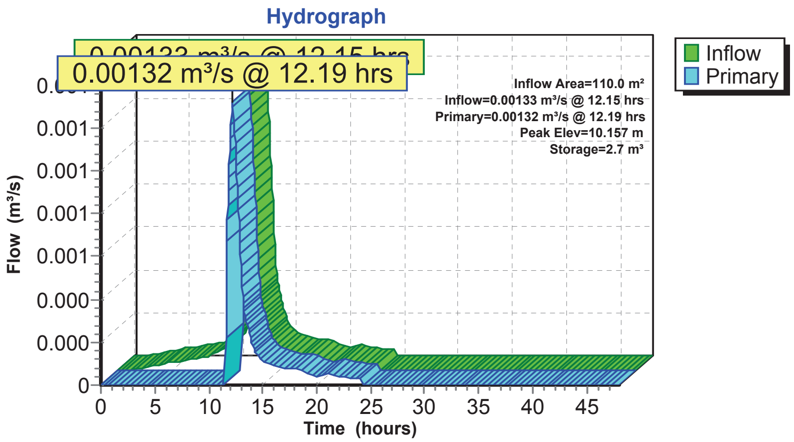
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	6.7 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	2.5
10.300	6.7

Device	Routing	Invert	Outlet Devices
#1	Primary	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000

Primary OutFlow Max=0.00132 m³/s @ 12.19 hrs HW=10.157 m (Free Discharge)
└**1=CB inlet (Sag)** (Custom Controls 0.00132 m³/s)

Pond P-12: A12 Bioretention



Summary for Pond P-13: A13 Bioretention

Inflow Area = 220.0 m²,100.00% Impervious, Inflow Depth = 101 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.00266 m³/s @ 12.15 hrs, Volume= 22.2 m³
Outflow = 0.00261 m³/s @ 12.22 hrs, Volume= 19.2 m³, Atten= 2%, Lag= 3.9 min
Primary = 0.00261 m³/s @ 12.22 hrs, Volume= 19.2 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.163 m @ 12.22 hrs Surf.Area= 0.0 m² Storage= 3.6 m³

Plug-Flow detention time= 115.9 min calculated for 19.2 m³ (86% of inflow)
Center-of-Mass det. time= 54.1 min (824.0 - 769.9)

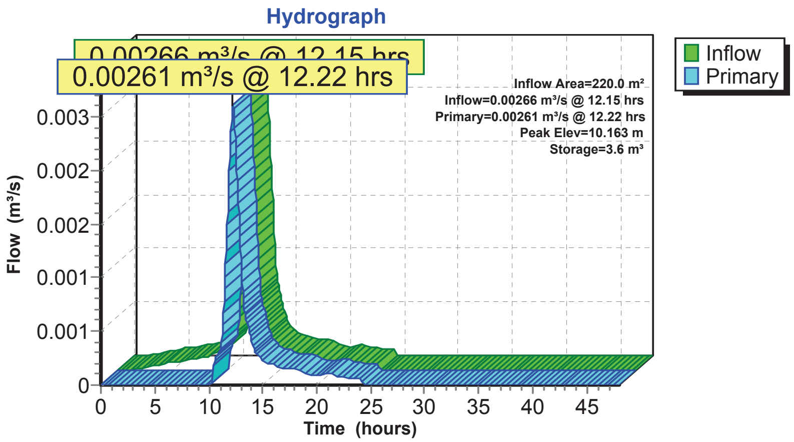
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	10.1 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	3.0
10.300	10.1

Device	Routing	Invert	Outlet Devices
#1	Primary	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000

Primary OutFlow Max=0.00261 m³/s @ 12.22 hrs HW=10.163 m (Free Discharge)
└─**1=CB inlet (Sag)** (Custom Controls 0.00261 m³/s)

Pond P-13: A13 Bioretention



Summary for Pond P-15: Rooftop Storage

Inflow Area = 2,210.0 m²,100.00% Impervious, Inflow Depth = 101 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.02669 m³/s @ 12.15 hrs, Volume= 223.3 m³
Outflow = 0.00378 m³/s @ 11.20 hrs, Volume= 223.3 m³, Atten= 86%, Lag= 0.0 min
Primary = 0.00378 m³/s @ 11.20 hrs, Volume= 223.3 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 100.144 m @ 14.00 hrs Surf.Area= 2,040.2 m² Storage= 97.8 m³

Plug-Flow detention time= 209.4 min calculated for 223.1 m³ (100% of inflow)
Center-of-Mass det. time= 209.4 min (979.3 - 769.9)

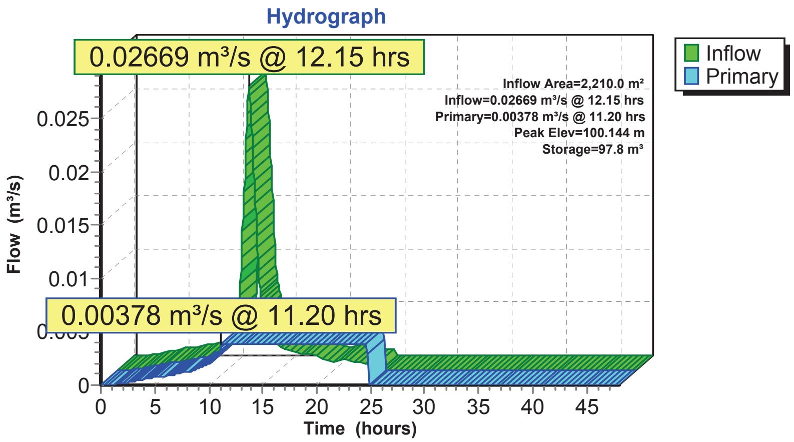
Volume	Invert	Avail.Storage	Storage Description
#1	100.000 m	111.0 m³	**Avg. Rooftop Storage (Pyramidal)** Listed below (Recalc) x 12

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	185.0	9.3	9.3	185.0

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-Closed X 12.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000315 0.000315 0.000315 0.000315 0.000315 0.000315

Primary OutFlow Max=0.00378 m³/s @ 11.20 hrs HW=100.026 m (Free Discharge)
└─**1=WATTS Accutrol_5-Closed** (Custom Controls 0.00378 m³/s)

Pond P-15: Rooftop Storage



Summary for Pond P-16: Rooftop Storage

Inflow Area = 2,530.0 m²,100.00% Impervious, Inflow Depth = 101 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.03055 m³/s @ 12.15 hrs, Volume= 255.6 m³
Outflow = 0.00630 m³/s @ 11.30 hrs, Volume= 255.6 m³, Atten= 79%, Lag= 0.0 min
Primary = 0.00630 m³/s @ 11.30 hrs, Volume= 255.6 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 100.137 m @ 13.57 hrs Surf.Area= 2,051.3 m² Storage= 93.5 m³

Plug-Flow detention time= 108.6 min calculated for 255.6 m³ (100% of inflow)
Center-of-Mass det. time= 108.5 min (878.4 - 769.9)

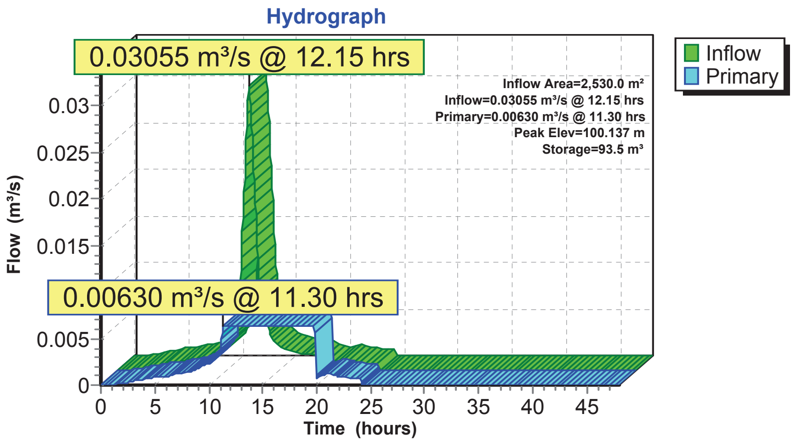
Volume	Invert	Avail.Storage	Storage Description
#1	100.000 m	123.5 m³	**Avg. Rooftop Storage (Pyramidal)** Listed below (Recalc) x 19

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	130.0	6.5	6.5	130.0

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-Closed X 20.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000315 0.000315 0.000315 0.000315 0.000315 0.000315

Primary OutFlow Max=0.00630 m³/s @ 11.30 hrs HW=100.026 m (Free Discharge)
└1=**WATTS Accutrol_5-Closed** (Custom Controls 0.00630 m³/s)

Pond P-16: Rooftop Storage



Summary for Pond P-17: Rooftop Storage

Inflow Area = 1,980.0 m²,100.00% Impervious, Inflow Depth = 101 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.02391 m³/s @ 12.15 hrs, Volume= 200.0 m³
Outflow = 0.00441 m³/s @ 11.30 hrs, Volume= 200.0 m³, Atten= 82%, Lag= 0.0 min
Primary = 0.00441 m³/s @ 11.30 hrs, Volume= 200.0 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 100.142 m @ 13.71 hrs Surf.Area= 1,637.6 m² Storage= 77.7 m³

Plug-Flow detention time= 132.8 min calculated for 200.0 m³ (100% of inflow)
Center-of-Mass det. time= 132.7 min (902.6 - 769.9)

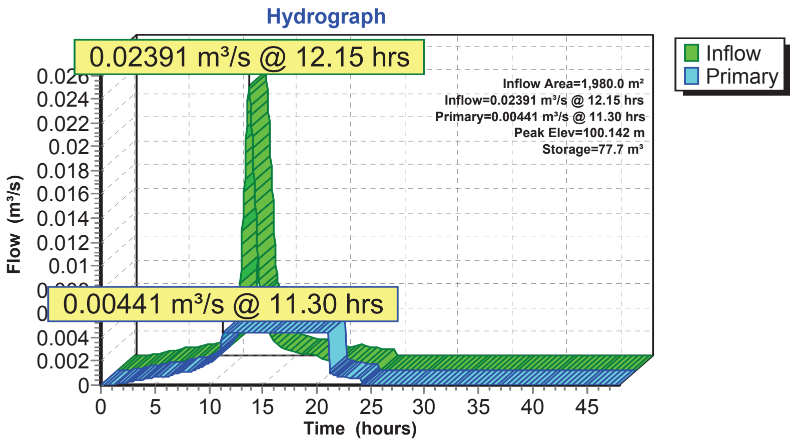
Volume	Invert	Avail.Storage	Storage Description
#1	100.000 m	91.0 m³	**Avg. Rooftop Storage (Pyramidal)** Listed below (Recalc) x 14

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)	Wet.Area (sq-meters)
100.000	0.0	0.0	0.0	0.0
100.150	130.0	6.5	6.5	130.0

Device	Routing	Invert	Outlet Devices
#1	Primary	100.000 m	**WATTS Accutrol_5-Closed X 14.00** Head (meters) 0.000 0.025 0.051 0.076 0.102 0.127 0.152 Disch. (m³/s) 0.000000 0.000315 0.000315 0.000315 0.000315 0.000315 0.000315

Primary OutFlow Max=0.00441 m³/s @ 11.30 hrs HW=100.029 m (Free Discharge)
└─**1=WATTS Accutrol_5-Closed** (Custom Controls 0.00441 m³/s)

Pond P-17: Rooftop Storage



Summary for Pond P-20: A20 Bioretention

Inflow Area = 250.0 m²,100.00% Impervious, Inflow Depth = 101 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.00302 m³/s @ 12.15 hrs, Volume= 25.3 m³
Outflow = 0.00300 m³/s @ 12.19 hrs, Volume= 24.6 m³, Atten= 1%, Lag= 2.5 min
Primary = 0.00300 m³/s @ 12.19 hrs, Volume= 24.6 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.165 m @ 12.19 hrs Surf.Area= 0.0 m² Storage= 1.1 m³

Plug-Flow detention time= 34.4 min calculated for 24.5 m³ (97% of inflow)
Center-of-Mass det. time= 17.5 min (787.3 - 769.9)

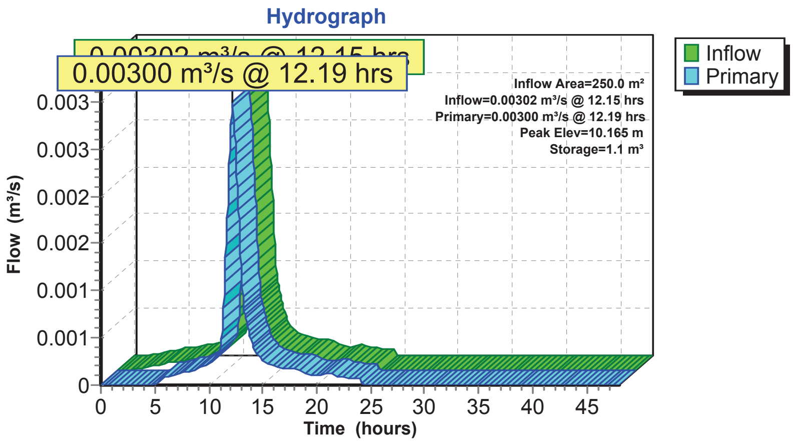
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	5.0 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	0.7
10.300	5.0

Device	Routing	Invert	Outlet Devices
#1	Primary	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000

Primary OutFlow Max=0.00299 m³/s @ 12.19 hrs HW=10.165 m (Free Discharge)
└─**1=CB inlet (Sag)** (Custom Controls 0.00299 m³/s)

Pond P-20: A20 Bioretention



Summary for Pond P-21: A21 Bioretention

Inflow Area = 320.0 m²,100.00% Impervious, Inflow Depth = 101 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.00386 m³/s @ 12.15 hrs, Volume= 32.3 m³
Outflow = 0.00332 m³/s @ 12.40 hrs, Volume= 31.1 m³, Atten= 14%, Lag= 14.8 min
Primary = 0.00332 m³/s @ 12.40 hrs, Volume= 31.1 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.198 m @ 12.40 hrs Surf.Area= 0.0 m² Storage= 3.7 m³

Plug-Flow detention time= 52.8 min calculated for 31.1 m³ (96% of inflow)
Center-of-Mass det. time= 30.4 min (800.3 - 769.9)

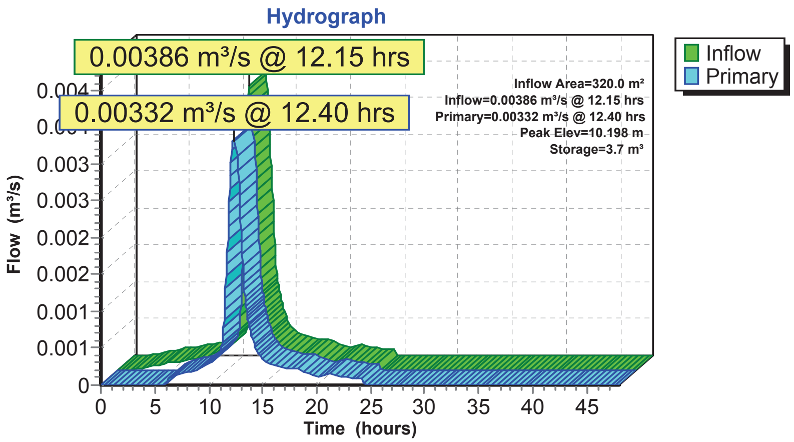
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	8.9 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	1.2
10.300	8.9

Device	Routing	Invert	Outlet Devices
#1	Device 2	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000
#2	Primary	8.800 m	**HYDROVEX 50-VHV-1** Head (meters) 0.000 0.300 0.500 1.000 2.000 3.000 6.000 Disch. (m³/s) 0.000000 0.001400 0.001850 0.002800 0.004100 0.005000 0.007000

Primary OutFlow Max=0.00332 m³/s @ 12.40 hrs HW=10.198 m (Free Discharge)
└─**2=HYDROVEX 50-VHV-1** (Custom Controls 0.00332 m³/s)
  └─**1=CB inlet (Sag)** (Passes 0.00332 m³/s of 0.00967 m³/s potential flow)

Pond P-21: A21 Bioretention



Summary for Pond P-22: A22 Bioretention

Inflow Area = 130.0 m²,100.00% Impervious, Inflow Depth = 101 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.00157 m³/s @ 12.15 hrs, Volume= 13.1 m³
Outflow = 0.00149 m³/s @ 12.28 hrs, Volume= 10.7 m³, Atten= 5%, Lag= 7.4 min
Primary = 0.00149 m³/s @ 12.28 hrs, Volume= 10.7 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.169 m @ 12.28 hrs Surf.Area= 0.0 m² Storage= 3.1 m³

Plug-Flow detention time= 143.3 min calculated for 10.7 m³ (82% of inflow)
Center-of-Mass det. time= 68.0 min (837.9 - 769.9)

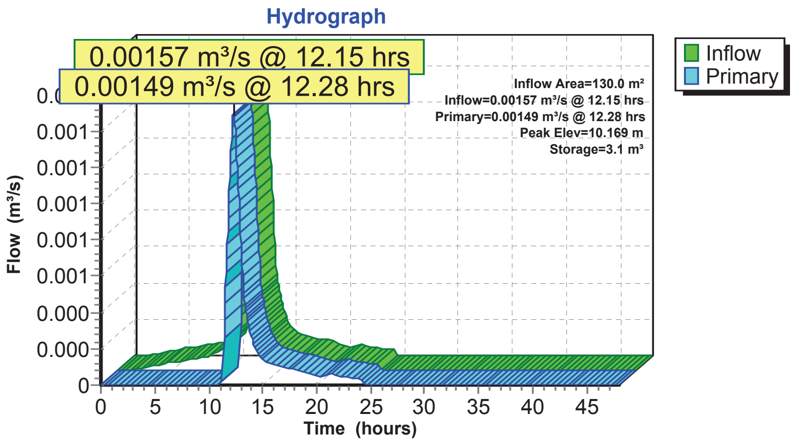
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	8.2 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	2.4
10.300	8.2

Device	Routing	Invert	Outlet Devices
#1	Device 2	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000
#2	Primary	8.800 m	**HYDROVEX 50-VHV-1** Head (meters) 0.000 0.300 0.500 1.000 2.000 3.000 6.000 Disch. (m³/s) 0.000000 0.001400 0.001850 0.002800 0.004100 0.005000 0.007000

Primary OutFlow Max=0.00328 m³/s @ 12.28 hrs HW=10.169 m (Free Discharge)
└─**2=HYDROVEX 50-VHV-1** (Custom Controls 0.00328 m³/s)
  └─**1=CB inlet (Sag)** (Passes 0.00328 m³/s of 0.00377 m³/s potential flow)

Pond P-22: A22 Bioretention



Summary for Pond P-4: A4 Bioretention

Inflow Area = 310.0 m²,100.00% Impervious, Inflow Depth = 101 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.00374 m³/s @ 12.15 hrs, Volume= 31.3 m³
Outflow = 0.00355 m³/s @ 12.28 hrs, Volume= 27.3 m³, Atten= 5%, Lag= 7.4 min
Primary = 0.00355 m³/s @ 12.28 hrs, Volume= 27.3 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.168 m @ 12.28 hrs Surf.Area= 0.0 m² Storage= 5.8 m³

Plug-Flow detention time= 116.7 min calculated for 27.3 m³ (87% of inflow)
Center-of-Mass det. time= 56.7 min (826.6 - 769.9)

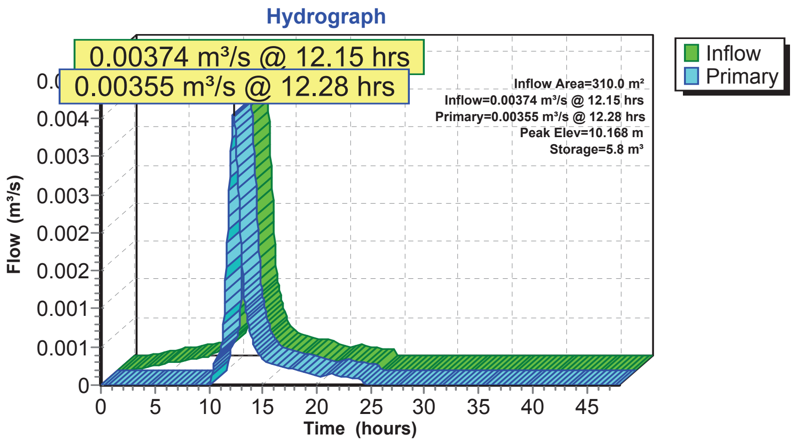
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	18.8 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	4.0
10.300	18.8

Device	Routing	Invert	Outlet Devices
#1	Primary	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000

Primary OutFlow Max=0.00354 m³/s @ 12.28 hrs HW=10.168 m (Free Discharge)
1=CB inlet (Sag) (Custom Controls 0.00354 m³/s)

Pond P-4: A4 Bioretention



Summary for Pond P-6: A6 Bioretention

Inflow Area = 320.0 m²,100.00% Impervious, Inflow Depth = 101 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.00386 m³/s @ 12.15 hrs, Volume= 32.3 m³
Outflow = 0.00360 m³/s @ 12.30 hrs, Volume= 26.9 m³, Atten= 7%, Lag= 9.0 min
Primary = 0.00360 m³/s @ 12.30 hrs, Volume= 26.9 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.168 m @ 12.30 hrs Surf.Area= 0.0 m² Storage= 7.6 m³

Plug-Flow detention time= 137.7 min calculated for 26.9 m³ (83% of inflow)
Center-of-Mass det. time= 67.0 min (836.9 - 769.9)

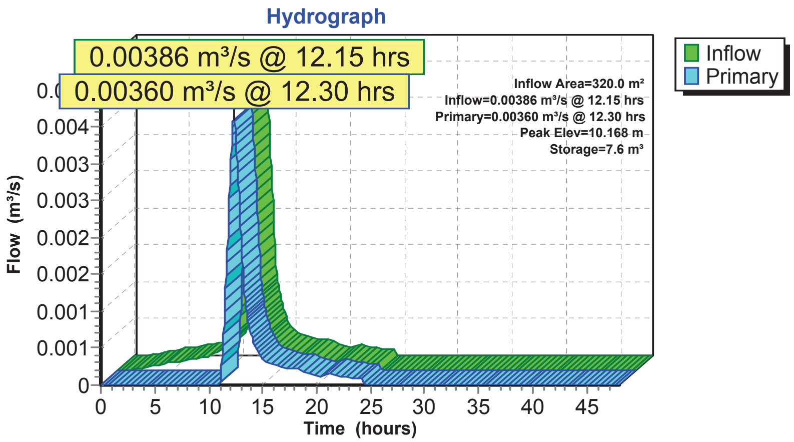
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	23.6 m³	**Bioretention** Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	5.4
10.300	23.6

Device	Routing	Invert	Outlet Devices
#1	Primary	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000

Primary OutFlow Max=0.00360 m³/s @ 12.30 hrs HW=10.168 m (Free Discharge)
└─**1=CB inlet (Sag)** (Custom Controls 0.00360 m³/s)

Pond P-6: A6 Bioretention



Summary for Pond P-9: A9 Ponding

Inflow Area = 220.0 m²,100.00% Impervious, Inflow Depth = 101 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.00266 m³/s @ 12.15 hrs, Volume= 22.2 m³
Outflow = 0.00252 m³/s @ 12.28 hrs, Volume= 16.7 m³, Atten= 5%, Lag= 7.4 min
Primary = 0.00252 m³/s @ 12.28 hrs, Volume= 16.7 m³

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 10.182 m @ 12.28 hrs Surf.Area= 0.0 m² Storage= 6.7 m³

Plug-Flow detention time= 167.8 min calculated for 16.7 m³ (75% of inflow)
Center-of-Mass det. time= 79.6 min (849.5 - 769.9)

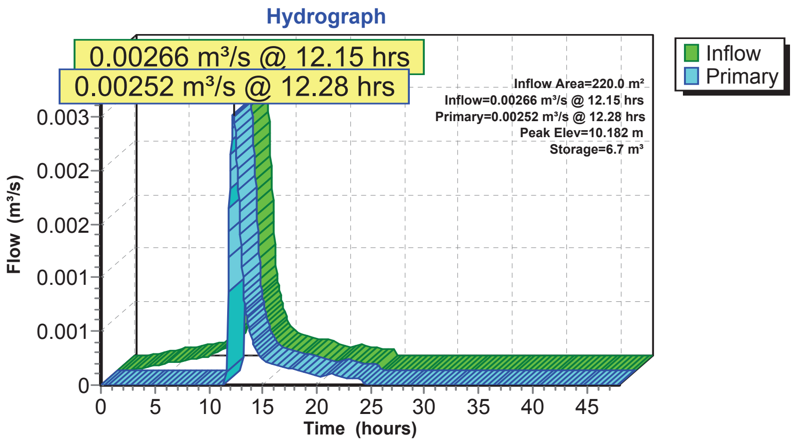
Volume	Invert	Avail.Storage	Storage Description
#1	10.000 m	11.0 m³	**Surface Ponding at CB**Listed below

Elevation (meters)	Cum.Store (cubic-meters)
10.000	0.0
10.150	5.5
10.300	11.0

Device	Routing	Invert	Outlet Devices
#1	Device 2	10.150 m	**CB inlet (Sag)** Head (meters) 0.000 0.050 0.100 0.150 0.200 0.250 0.300 Disch. (m³/s) 0.000000 0.010000 0.060000 0.120000 0.155000 0.180000 0.200000
#2	Primary	8.800 m	**HYDROVEX 50-VHV-1** Head (meters) 0.000 0.300 0.500 1.000 2.000 3.000 6.000 Disch. (m³/s) 0.000000 0.001400 0.001850 0.002800 0.004100 0.005000 0.007000

Primary OutFlow Max=0.00330 m³/s @ 12.28 hrs HW=10.182 m (Free Discharge)
└─**2=HYDROVEX 50-VHV-1** (Custom Controls 0.00330 m³/s)
└─**1=CB inlet (Sag)** (Passes 0.00330 m³/s of 0.00639 m³/s potential flow)

Pond P-9: A9 Ponding

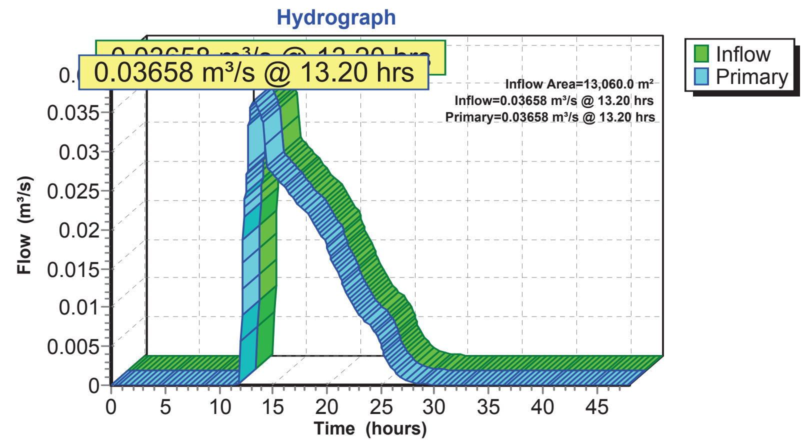


Summary for Link X-1: Chamber Outflow

Inflow Area =	13,060.0 m²,100.00% Impervious,	Inflow Depth > 73 mm	for Ottawa SCS 24hr-100yr event
Inflow =	0.03658 m³/s @ 13.20 hrs,	Volume= 953.4 m³	
Primary =	0.03658 m³/s @ 13.20 hrs,	Volume= 953.4 m³,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link X-1: Chamber Outflow

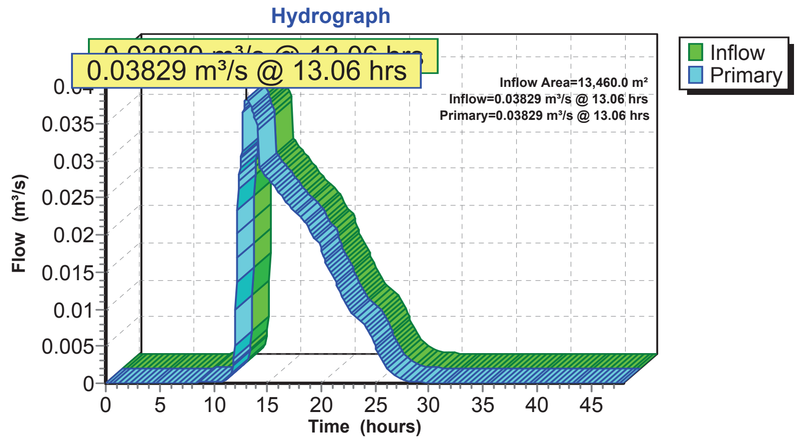


Summary for Link X-2: Internal Link A

Inflow Area = 13,460.0 m²,100.00% Impervious, Inflow Depth > 73 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.03829 m³/s @ 13.06 hrs, Volume= 988.3 m³
Primary = 0.03829 m³/s @ 13.06 hrs, Volume= 988.3 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link X-2: Internal Link A

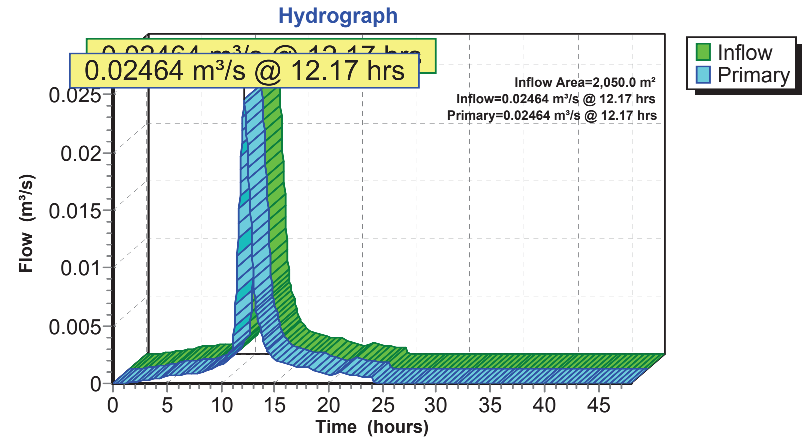


Summary for Link X-3: Internal Link B

Inflow Area = 2,050.0 m²,100.00% Impervious, Inflow Depth = 98 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.02464 m³/s @ 12.17 hrs, Volume= 201.6 m³
Primary = 0.02464 m³/s @ 12.17 hrs, Volume= 201.6 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link X-3: Internal Link B

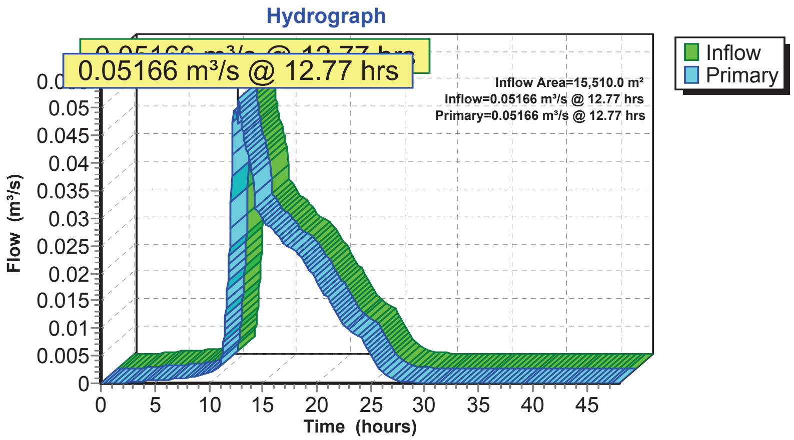


Summary for Link X-4: Net Offsite Flows

Inflow Area = 15,510.0 m²,100.00% Impervious, Inflow Depth > 77 mm for Ottawa SCS 24hr-100yr event
Inflow = 0.05166 m³/s @ 12.77 hrs, Volume= 1,189.9 m³
Primary = 0.05166 m³/s @ 12.77 hrs, Volume= 1,189.9 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link X-4: Net Offsite Flows



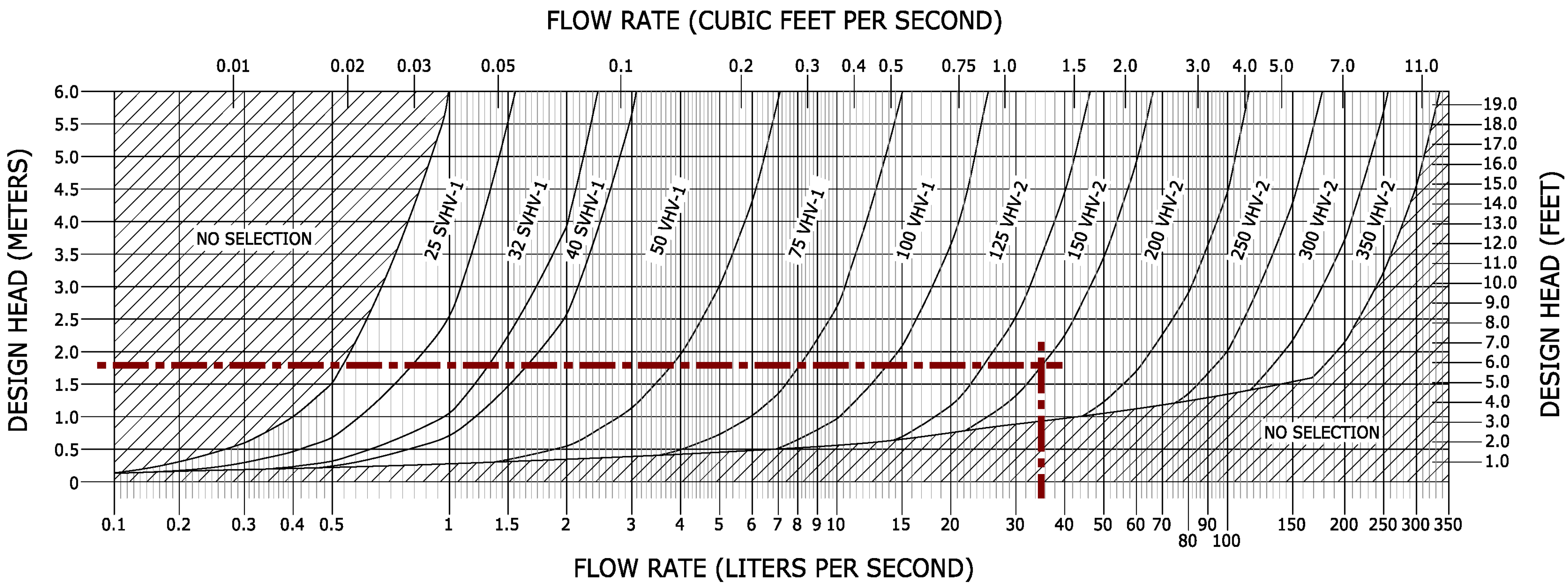


Figure 3 : HYDROVEX® VHV/SVHV Selection Chart

Watts	Adjustable Accutrol Weir	Adjustable Flow Control for Roof Drains
	Tag: ________________	

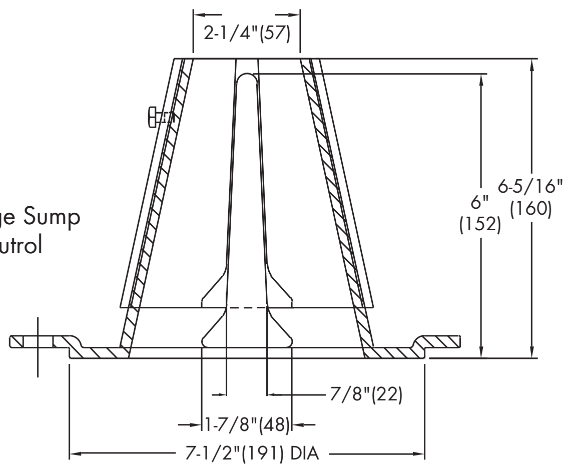
ADJUSTABLE ACCUTROL (for Large Sump Roof Drains only)

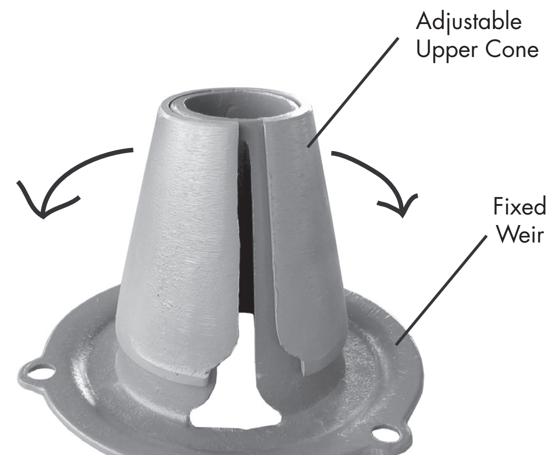
For more flexibility in controlling flow with heads deeper than 2", Watts Drainage offers the Adjustable Accutrol. The Adjustable Accutrol Weir is designed with a single parabolic opening that can be covered to restrict flow above 2" of head to less than 5 gpm per inch, up to 6" of head. To adjust the flow rate for depths over 2" of head, set the slot in the adjustable upper cone according to the flow rate required. Refer to Table 1 below.
Note: Flow rates are directly proportional to the amount of weir opening that is exposed.

EXAMPLE:

For example, if the adjustable upper cone is set to cover 1/2 of the weir opening, flow rates above 2"of head will be restricted to 2-1/2 gpm per inch of head.

Therefore, at 3"of head, the flow rate through the Accutrol Weir that has 1/2 the slot exposed will be:
[5 gpm (per inch of head) x 2 inches of head] + 2-1/2 gpm (for the third inch of head) = 12-1/2 gpm.





1/2 Weir Opening Exposed Shown Above

TABLE 1. Adjustable Accutrol Flow Rate Settings

Weir Opening Exposed	1"	2"	3"	4"	5"	6"
	Flow Rate (gallons per minute)					
Fully Exposed	5	10	15	20	25	30
3/4	5	10	13.75	17.5	21.25	25
1/2	5	10	12.5	15	17.5	20
1/4	5	10	11.25	12.5	13.75	15
Closed	5	5	5	5	5	5

Job Name ______________________ Contractor ______________________

Job Location ______________________ Contractor's P.O. No. ______________________

Engineer ______________________ Representative ______________________

USA: Tel: (800) 338-2581 • Fax: (828) 248-3929 • Watts.com
Canada: Tel: (905) 332-4090 • Fax: (905) 332-7068 • Watts.ca
Latin America: Tel: (52) 81-1001-8600 • Fax: (52) 81-8000-7091 • Watts.com

A Watts Water Technologies Company

Project: Algonquin ARC	No.: 191-01517-00	
By: BW	Date: 23/Sep/19	Page: 1
Checked:		

Subject: **Stormwater Management Calculations - 100-year (and 20% Stress Test) Surface Ponding Depths**

Calculation of existing runoff rate is undertaken using the Rational Method: $Q = 2.78CiA$

Where: Q = peak flow rate (litres/second)
C = runoff coefficient
i = rainfall intensity (mm/hour)
A = catchment area (hectares)

Rainfall intensity calculated in accordance with City of Ottawa Sewer Design Guidelines (section 5.4.2):

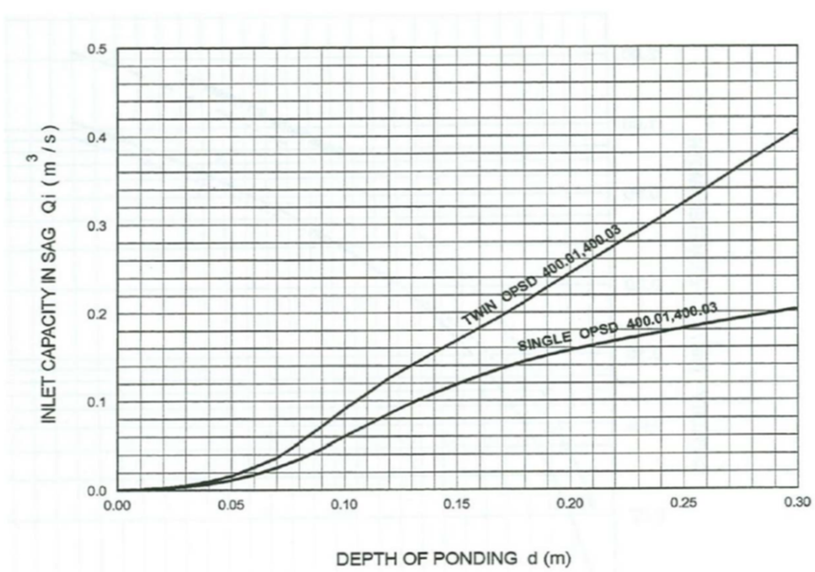
$$i = \left[\frac{A}{(Td + C)^B}\right]$$

Where: A, B, C = regression constants for each return period (defined in section 5.4.2)
i = rainfall intensity (mm/hour)
Td = storm duration (minutes) **10** minutes

Return Period (Years)	2	5	10	25	50	**100**
A	733.0	998.1	1,174.2	1,402.9	1,569.6	1,735.7
B	0.810	0.814	0.816	0.819	0.820	0.820
C	6.199	6.053	6.014	6.018	6.014	6.014

Ref.	Area (ha)	RC	100-year			100-year +20% stress test		
			Intensity (mm/hr)	Peak Rate (l/sec)	CB Ponding Depth (m)	Intensity (mm/hr)	Peak Rate (l/sec)	CB Ponding Depth (m)
A1	0.107	0.88	178.6	46.7	0.090	214.3	56.1	0.097
A2	0.091	0.83	178.6	37.5	0.082	214.3	45.0	0.088
A3	0.106	0.90	178.6	47.4	0.090	214.3	56.8	0.098
A4	0.031	0.25	178.6	3.8	0.032	214.3	4.6	0.034
A5	0.062	0.90	178.6	27.7	0.072	214.3	33.2	0.078
A6	0.032	0.25	178.6	4.0	0.032	214.3	4.8	0.034
A7	0.058	0.90	178.6	25.9	0.070	214.3	31.1	0.076
A8	0.077	0.41	178.6	15.7	0.056	214.3	18.8	0.061
A9	0.022	0.25	178.6	2.7	0.027	214.3	3.3	0.030
A10	0.021	0.37	178.6	3.9	0.032	214.3	4.6	0.034
A11	0.055	0.90	178.6	24.6	0.068	214.3	29.5	0.074
A12	0.011	0.25	178.6	1.4	0.010	214.3	1.6	0.020
A13	0.017	0.25	178.6	2.1	0.023	214.3	2.5	0.025
A14	0.005	0.90	178.6	2.2	0.024	214.3	2.7	0.026
A15	0.221	0.90	178.6	98.7	-	214.3	118.5	-
A16	0.253	0.90	178.6	113.0	-	214.3	135.6	-
A17	0.198	0.90	178.6	88.5	-	214.3	106.1	-
A18	0.096	0.75	178.6	35.7	-	214.3	42.9	-
A19	0.018	0.45	178.6	4.0	-	214.3	4.8	-
A20	0.025	0.56	178.6	6.9	0.041	214.3	8.3	0.044
A21	0.032	0.70	178.6	11.1	0.049	214.3	13.3	0.053
A22	0.013	0.25	178.6	1.6	0.020	214.3	1.9	0.022

Design Chart 4.19: Inlet Capacity at Road Sag



patersongroup **memorandum**

consulting engineers

re:	**Subsoil Infiltration Review** **Proposed Infiltration Gallery** **Algonquin College - Woodroffe Campus - Ottawa**
to:	Colliers Project Leaders - **Mr. Philip Belanger** - philip.belanger@colliersprojectleaders.com
date:	March 5, 2019
file:	PG4624-MEMO.01

Paterson Group (Paterson) has prepared the current memorandum report to provide anticipated infiltration rates to be encountered within the subsoils below the proposed infiltration system based on Paterson's geotechnical investigation. The memo should be read in conjunction with Paterson Report PG4624-1 dated September 13, 2018.

Background Information

At the time of writing this report, it is understood that the development will consist of a one-storey slab-on-grade building. One level of underground parking may considered once the detailed design drawings are finalized. An infiltration gallery is also being considered in order to manage the stormwater accumulation at the subject site.

Paterson completed a geotechnical investigation at the subject site on August 16, 2018. At that time, a total of nine (9) boreholes were advanced to a maximum depth of 6.7 m below existing ground surface.

The results of the geotechnical investigation indicated that, in general, the subsurface profile at the borehole locations consisted of a pavement structure overlying a hard to stiff brown silty clay crust followed by a very stiff to stiff grey silty clay deposit. Glacial till was encountered at BH 4 consisting of grey silty clay with sand and gravel. A fill layer consisting of brown silty sand with crushed stone and/or brown silty clay with sand and gravel was encountered within BH 1, BH 2 and BH 4 where the former drainage ditch ran along the west portion of the site. It should be noted that a layer of topsoil and organics was encountered directly below the fill material in BH 1 and BH 2. Practical refusal to DCPT was encountered at a depth of 9.9, 8.5 and 9.1 m at BH 2, BH 3 and BH 4, respectively.

Based on the recovered soil samples' moisture levels, colouring and consistency, the long-term groundwater level at the subject site is anticipated at 4 to 5 m depth. Groundwater levels are subject to seasonal fluctuations and could vary at the time of construction.

Subsoil Infiltration Values

At the time of writing this report, details for the proposed infiltration system have not been provided for the subject site. However, it is anticipated that the subsoil below the proposed infiltration system will consist of a hard to stiff brown silty clay. It is recommended the infiltration gallery be placed above the long-term groundwater as it can limit water infiltration to the subsoil.

Hydraulic conductivity testing was not completed as part of the geotechnical investigation for the proposed development. However, based upon previous experience at similar sites in the area with similar stratigraphy and typical published values for hard to stiff brown silty clay, the hydraulic conductivity value was conservatively estimated to be in the order of 1×10^{-7} to 1×10^{-9} m/sec. Based on the above noted hydraulic conductivity values, the infiltration rates range from 7 to 26 mm/hr. It should be noted that a safety correction factor was not applied to the above noted infiltration rates for calculating the design infiltration rates.

To determine site specific design infiltration rates, it is recommended to complete a series of permeameter tests at the invert elevation of the proposed infiltration system prior to finalizing the design.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
Mar. 5-2019
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Nicholas Zulinski, P.Geo., géo.

David J. Gilbert, P.Eng.

Paterson Group Inc.

Head Office and Laboratory
154 Colonnade Road South
Ottawa - Ontario - K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

Northern Office and Laboratory
63 Gibson Street
North Bay - Ontario - P1B 8Z4
Tel: (705) 472-5331 Fax: (705) 472-2334

St. Lawrence Office
993 Princess Street
Kingston - Ontario - K7L 1H3
Tel: (613) 542-7381

re: **Permeameter Test Investigation**
Athletic Recreational Complex (ARC)
Algonquin College - Woodroffe Campus - Ottawa

to: Colliers Project Leaders **- Mr. Phillip Belanger** - phillip.belanger@colliersprojectleaders.com

date: July 25, 2019

file: PH3842-MEMO.01

Further to your request, Paterson Group (Paterson) conducted a permeameter test investigation for the proposed Athletic Recreational Complex (ARC) located at Algonquin College, Woodroffe Campus, Ottawa. The purpose of the investigation was to provide hydraulic conductivity values and estimated infiltration rates to be encountered within the subsoils of the proposed infiltration system at the aforementioned site. The memo should be read in conjunction with Paterson Report PG4624-1 Revision 1 dated June 3, 2019.

Proposed Project

It is our understanding that the proposed development will consist of a one-storey slab-on-grade building with a partial basement to be used as a gymnasium and other facilities. The proposed development will occupy the majority of the existing parking area. It is also expected that the proposed building will be municipally serviced and will be integrated with the existing surrounding hard surfaces. Furthermore, it is understood that an underground storm water storage system will be installed south of the proposed building footprint with an approximate base elevation of 82.5 m.

Field Investigation

Field Program

The field program conducted by Paterson for the investigation was completed on June 27, 2019. At that time, three (3) test pits were excavated between 1.3 to 2.1 m depth below existing grade followed by hand auger holes to depths ranging between 0.3 to 0.5 m below the base of the excavation for the purpose of permeameter testing. The test hole locations were selected by Paterson and distributed in a manner to avoid disturbing existing hard surfaces as well as taking into consideration underground utilities and existing site features. A previous geotechnical investigation was completed at the subject site by Paterson on August 16, 2018 and consisted of nine (9) boreholes to a maximum depth of 6.7 m below existing grade. The test hole locations are presented on Drawing PH3842-1 - Test Hole Location Plan attached to this report.

In-Situ Testing

Permeameter testing was conducted using a Pask (Constant Head Well) Permeameter. An 83 mm hole was excavated using a Riverside/Bucket auger to a depth of 0.3 to 0.45 m below the base of the excavation at each location. All soil from the auger flights were visually inspected and initially classified on site. The permeameter reservoir was filled with water and inverted into the hole, ensuring it was relatively vertical and resting on the bottom of the hole. The water level of the reservoir was monitored at 1 minute intervals until the rate of fall out of the permeameter reached equilibrium, known as *quasi "steady state"* flow rate. Quasi steady state flow can be considered to have been obtained after measuring 3 to 5 consecutive rate of fall readings with identical values. The values for the steady state rate of fall were recorded for each location.

Field Observations

Surface Conditions

The majority of the subject site is currently occupied by an at-grade, asphalt covered car parking area and access lanes. A landscaped area with mature trees was also noted along the north boundary of the site. The subject site is relatively flat with a slight downslope towards the northwest portion. It should be noted that a former drainage ditch bisected the west portion of the subject site in a north-south direction.

Subsurface Profile

Generally, the subsurface profile at the test pits located along the north boundary of Parking Lot 8/9 consists of a topsoil layer followed by fill material to a maximum depth of 1.1 m. The above noted layer is underlain by a thin layer of silty sand with trace clay followed by a very stiff brown silty clay crust. Permeameter testing at all test hole locations were carried out in the brown silty clay crust.

Groundwater

Groundwater infiltration was not present in the test pits at the time of excavation. Groundwater levels were measured in piezometers following the completion of the geotechnical investigation and have been summarized in Table 1. Groundwater levels are subject to seasonal fluctuations and, therefore, the groundwater levels could vary at the time of construction.

Table 1 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Depth (m)	Groundwater Elevation (m)	Date
BH 1	85.84	3.08	82.76	August 21, 2018
BH 2	86.07	3.07	83.00	August 21, 2018
BH 3	86.55	2.82	83.73	August 21, 2018
BH 4	85.58	2.96	82.62	August 21, 2018
BH 5	86.24	2.84	83.40	August 21, 2018
BH 6	86.92	Blocked	-	August 21, 2018
BH 7	86.82	Blocked	-	August 21, 2018
BH 8	86.67	2.04	84.63	August 21, 2018
BH 9	87.08	2.72	84.36	August 21, 2018

Note: The ground surface at the test hole locations was referenced to a geodetic benchmark consisting of the top of spindle of the fire hydrant located to the south of the subject section of the site. A elevation of 86.84 was assigned to the benchmark.

Permeameter Results

A total of 6 constant head Pask permeameter tests were conducted in the grass/treed area along the north boundary of Parking Lot 8/9. Based on existing site conditions and required excavation depths, Paterson was unable to safely complete permeameter testing at the proposed invert elevation of the infiltration system. Alternatively, preliminary permeameter testing was completed between 1.5 to 2.5 m below existing grade to verify the hydraulic conductivities and estimate the infiltration rates of the brown silty clay at the subject site. It is our understanding that the invert level of the infiltration system at the subject site is proposed to be within the brown silty clay crust. Preparation and testing of this investigation are in accordance with the Canadian Standards Association (CSA) B65-12 - Annex E. The hydraulic conductivity (K_{fs}) values and estimated infiltration rates for each test hole location is presented in Table 2.

Hydraulic conductivity values were determined using Engineering Technologies Canada (ETC) Ltd. reference tables provided in the most recent ETC Pask Permeameter User Guide dated March 2016. Infiltration rates have been determined based on approximate relationships between field saturated hydraulic conductivity, percolation time and infiltration rate. The above noted relationship has been provided by the Ontario Ministry of Municipal Affairs and Housing - Supplementary Guidelines to the Ontario Building Code, 1997 - SG-6 - Percolation Time and Soil Descriptions.

The field saturated hydraulic conductivity values that are calculated based upon Pask Permeameter testing are known to provide values that are less than or equal to half of the saturated hydraulic conductivity. The reduced hydraulic conductivity values are encountered due to air entrapment within the soils as shown by W.D. Reynolds (1993).

Table 2 - Field Saturated Hydraulic Conductivity and Permeability Results					
Test Hole ID	**Ground Elevation (m)**	**Depth bgs (m)**	**Material**	**K_{fs} (m/sec)**	**Infiltration Rate (mm/hr)**
AH 1A	86.88	1.55	Brown Silty Clay	2.1E-08	17
AH 1B	86.88	2.5	Brown Silty Clay	<3.1E-09	<9.5
AH 2A	86.61	1.75	Brown Silty Clay	4.2E-08	20.5
AH 2B	86.61	2.25	Brown Silty Clay	2.1E-08	17
AH 3A	86.41	1.5	Brown Silty Clay	2.1E-08	17
AH 3B	86.41	2.5	Brown Silty Clay	<3.1E-09	<9.5
Note: The ground surface at the auger hole locations was referenced to a geodetic benchmark consisting of the top of grate of a manhole located on the sidewalk of the southeast corner of Commons Boulevard and Navaho Drive. An elevation of 85.50 was assigned to the benchmark.					

Based on the above testing, field saturated hydraulic conductivity values for the brown silty clay at the test hole locations ranged from <3.1 x 10^{-9} to 4.2 x 10^{-8} m/sec with estimated infiltration rates between <9.5 to 20.5 mm/hr.

The values measured within the test holes are consistent with similar material Paterson has encountered on other sites and typical values for brown silty clay. These values typically range from 1 x 10^{-7} to 1 x 10^{-9} m/sec due to the variability of the material encountered.

It is recommended that additional permeameter testing be completed at the invert level of the proposed infiltration system location once construction has commenced and it is safely accessible.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

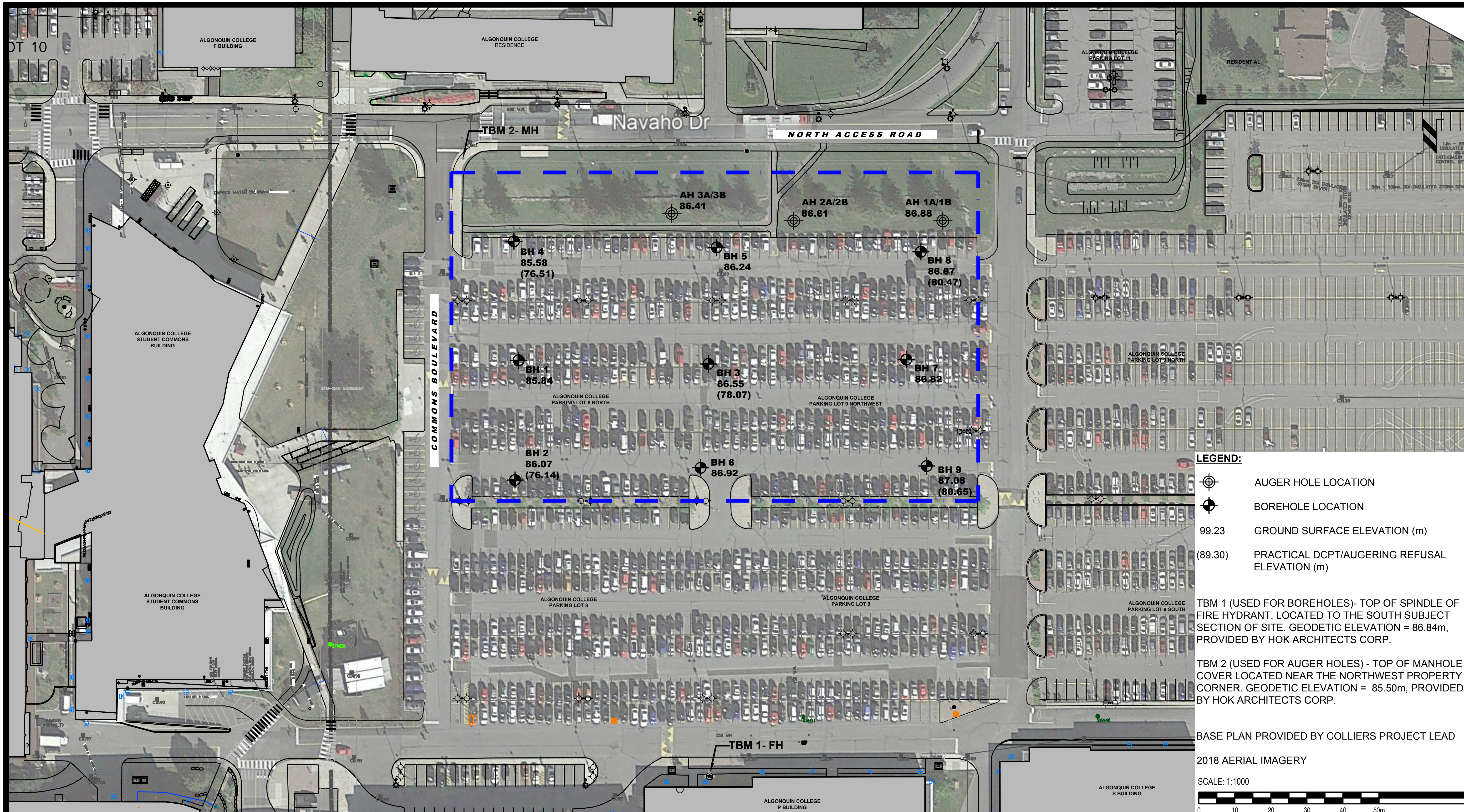
LICENSED PROFESSIONAL ENGINEER
25/07/19
M. S. KILLAM
100221103
PROVINCE OF ONTARIO

Nicholas Zulinski, P.Geo., géo.

Michael Killam, P.Eng.

Attachments

❏ Drawing PH3842-1 - Test Hole Location Plan



LEGEND:

(symbol)	AUGER HOLE LOCATION
(symbol)	BOREHOLE LOCATION
99.23	GROUND SURFACE ELEVATION (m)
(89.30)	PRACTICAL DCPT/AUGERING REFUSAL ELEVATION (m)

TBM 1 (USED FOR BOREHOLES)- TOP OF SPINDLE OF FIRE HYDRANT, LOCATED TO THE SOUTH SUBJECT SECTION OF SITE. GEODETIC ELEVATION = 86.84m, PROVIDED BY HOK ARCHITECTS CORP.

TBM 2 (USED FOR AUGER HOLES) - TOP OF MANHOLE COVER LOCATED NEAR THE NORTHWEST PROPERTY CORNER. GEODETIC ELEVATION = 85.50m, PROVIDED BY HOK ARCHITECTS CORP.

BASE PLAN PROVIDED BY COLLIERS PROJECT LEAD

2018 AERIAL IMAGERY

SCALE: 1:1000

0 10 20 30 40 50m 75m

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
1	GROUND SURFACE ELEVATIONS CONVERTED TO GEODETIC	05/31/2019	FA

COLLIERS PROJECT LEADERS

PERMEAMETER INVESTIGATION - PROPOSED ATHLETIC RECREATION COMPLEX (ARC)
ALGONQUIN COLLEGE - WOODROFFE AVENUE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1000	Date: 09/2018
Drawn by: RCG	Report No.: PH3842-1
Checked by: RG	Dwg. No.: PH3842-1
Approved by: DJG	Revision No.: 1

p:\autocad drawings\hydrogeology\ph38xx\ph3842-1.dwg

patersongroup **memorandum**
consulting engineers

re: **Geotechnical Review Comments**
Proposed Athletic Recreation Complex
Algonquin College - Woodroffe Campus - Ottawa

to: Colliers Project Leaders - **Mr. Philip Belanger** - philip.belanger@colliersprojectleaders.com

date: September 16, 2019

file: PG4624-MEMO.02

Further to your request and authorization, Paterson Group (Paterson) prepared a follow up commentary based on a geotechnical review of test pits excavated at the subject site to assess subsurface conditions.

Groundwater

In the geotechnical report, Paterson stated the following:

"Based on these observations, the long-term groundwater level is anticipated at a **4 to 5 m depth**."

Based on the observations on September 11, 2019, the above long term groundwater levels were confirmed. Glacial till was encountered at a depth of approximately 4.5 m at this location. Therefore, a water suppression system will not be required. Paterson suggests the following:

❏ During the excavation program, groundwater can be easily managed with conventional pumping.

❏ Footings can be poured directly on the native soil which is directly or indirectly on the glacial till deposit.

❏ A perimeter drainage system can handle water infiltration adjacent to foundation walls. Therefore, one or two inlet points along the footing will suffice to direct infiltration water to the sump pit in the basement area or to a storm sewer outlet based on gravity flow.

❏ An underfloor drainage system will be required below the basement floor to manage groundwater. It's expected that a spacing of 9 m will be acceptable.

❏ A composite drainage layer will be required for the exterior vertical face of the foundation walls for the partial basement area.

Fill Areas Below the Proposed Founding Elevation

For the western portion of the site, there is an existing fill layer that extends to depths up to 3.5 to 4 m below the existing grade. The fill consists of a silty clay material most likely from site sources from previous developments. The fill material is relatively compact and behaved similar to the native silty clay at depth. The following options are available for constructing in the fill areas:

Option A – Extend Footings to the Native Soil

Extending the footings to the native soil is a significant undertaking. Although this is an option, it's considered unfeasible and will most likely not be undertaken.

Option B – Lean Concrete Filled Trenches

Option B consists of excavating for foundations using a conventional approach. If native soil is not encountered, deepen the excavation trench vertically for strip and pad footings (approximately the same dimensions of the footings) and fill the open trench with lean concrete. Please footing on the concrete filled trench at the proposed founding elevation. Although this is a viable option, there will be a cost associated with filling with lean concrete. The advantage is that most of the existing fill can remain in place and settlements will be similar to placing footings on native material.

Option C – Remove 600 mm of Fill below the Proposed Footings and Fill with OPSS Granular B Type II

Similar to Option B, the fill material, when encountered, will be subexcavated to a depth of at least 600 mm below the proposed founding elevation and approximately 600 mm beyond the exterior sides of the footings. The subexcavated area can be backfilled with OPSS Granular B Type II, placed in 300 mm lifts and compacted to 98% of the material's standard Proctor maximum dry density. This should be the least costly option. However, due to the fill layer remaining below the engineered fill, the area may be subjects to slightly increased settlements (estimated 35 mm total and 25 mm differential).

Bearing Resistance Values (Basement)

For the basement portion of the building within the eastern portion of the development, it's expected that the depth of the foundation will be approximately 5.3 m below the existing grade. The proposed foundation will encounter the dense glacial till deposit at depths ranging from 4.5 to 6 m below the existing grade. Footings can be founded directly or indirectly (lean concrete filled trenches extending to the glacial till deposit) using the following design criteria:

- ❏ Footings placed on the glacial till deposit or concrete filled trenches extending to the dense glacial till depopsit can be designed using the bearing resistance value at serviceability limit states (SLS) of **250 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **400 kPa**.

- ❏ An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, wether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

- ❏ The above noted bearing resistance value at SLS will be subjected to total and differential settlements of 25 and 20 mm, respectively.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

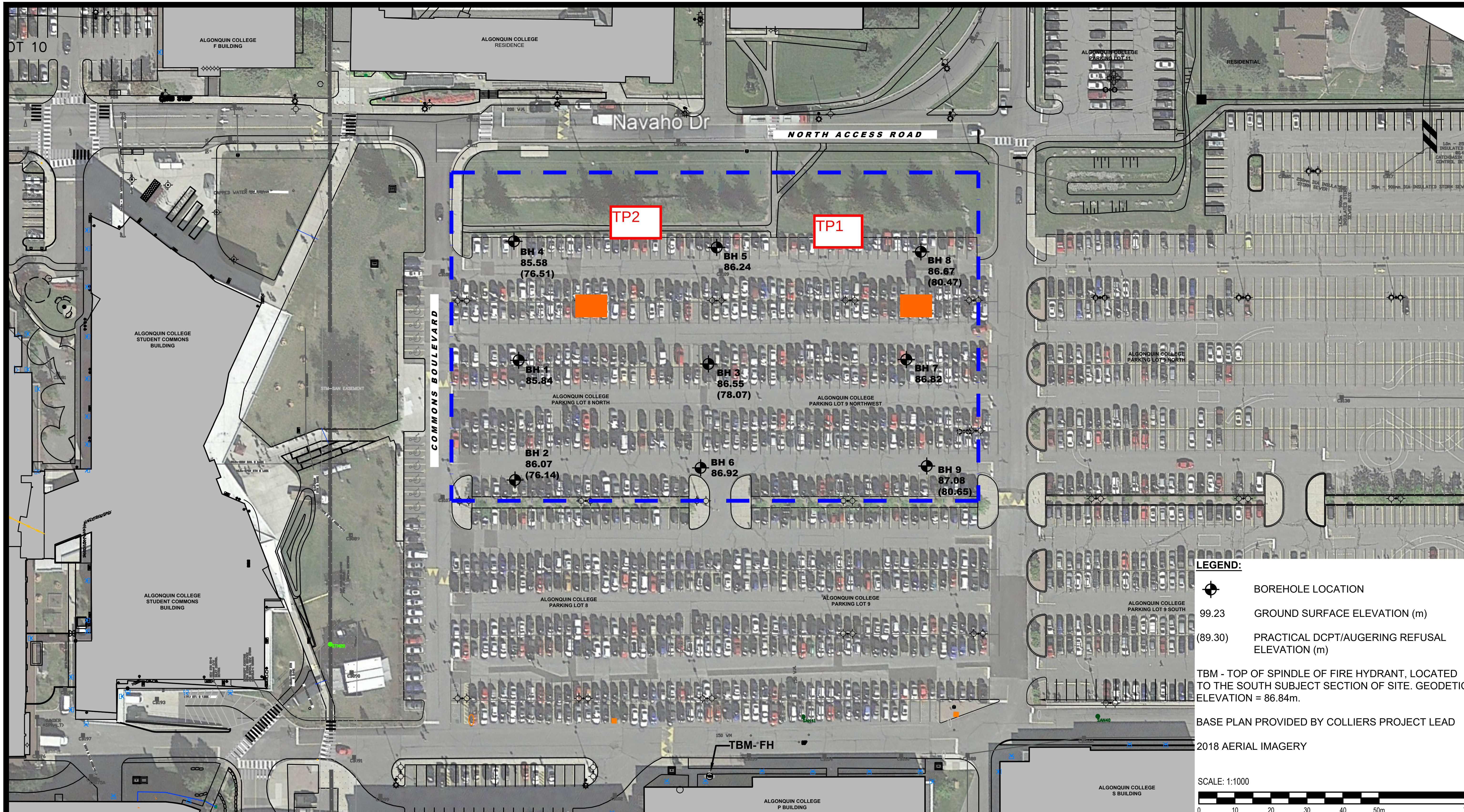
Carlos P. Da Silva, P.Eng., ing., QP_{ESA}

LICENSED PROFESSIONAL ENGINEER
C. P. DA SILVA
PROVINCE OF ONTARIO

TP1 - Excavated to approximately 5 m below the existing grade. Minor water infiltration during the excavation program.

Groundwater observed after 30 minutes in TP1 at a depth of approximately 4.2 m.

TP-2 - Silty clay fill is relatively compact and similar to native soil. Native silty clay deposit encountered at approximately 3.2 m depth.



LEGEND:

⌖	BOREHOLE LOCATION
99.23	GROUND SURFACE ELEVATION (m)
(89.30)	PRACTICAL DCPT/AUGERING REFUSAL ELEVATION (m)

TBM - TOP OF SPINDLE OF FIRE HYDRANT, LOCATED TO THE SOUTH SUBJECT SECTION OF SITE. GEODETIC ELEVATION = 86.84m.

BASE PLAN PROVIDED BY COLLIERS PROJECT LEAD

2018 AERIAL IMAGERY

SCALE: 1:1000

0 10 20 30 40 50m 75m

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
1	GROUND SURFACE ELEVATIONS CONVERTED TO GEODETIC	05/31/2019	FA

COLLIERS PROJECT LEADERS

GEOTECHNICAL INVESTIGATION - PROPOSED ATHLETIC RECREATION COMPLEX (ARC)
ALGONQUIN COLLEGE - WOODROFFE AVENUE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1000	Date: 09/2018
Drawn by: RCG	Report No.: PG4624-1
Checked by: RG	Dwg. No.: **PG4624-1**
Approved by: DJG	Revision No.: 1

p:\autocad drawings\geotechnical\pg46xx\pg4624\pg4624-1 rev1 thlp.dwg

STORM SEWER DESIGN SHEET

Athletics and Recreation Centre (ARC)
Algonquin College, Ottawa, ON
Project: 191-01517-00
Date: September, 2019

LOCATION				AREA (Ha)						RATIONAL DESIGN FLOW													PROPSOED SEWER DATA								
STREET	AREA ID	FROM	TO	C= 0.25	C= 0.35	C= 0.50	C= 0.60	C= 0.75	C= 0.90	IND 2.78AC	CUM 2.78 AC	INLET (min)	TOTAL (min)	i (2) (mm/hr)	i (5) (mm/hr)	i (100) (mm/hr)	BLDG FLOW (L/s)	2yr PEAK FLOW (L/s)	5yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	MATERIAL PIPE	SIZE (mm)	SLOPE (%)	LENGTH (m)	CAPACITY (l/s)	VELOCITY (m/s)	TIME IN PIPE	AVAIL CAP (2yr) (L/s)	(%)
POST-DEVELOPMENT																															
To Access Road																															
Access Road	A-7	CB5	STMH1						0.058	0.145	0.145	10.00	10.23	76.81	104.19	178.56		11.15				11.15	PVC DR-35	200.0	1.00	14.55	32.83	1.04	0.23	21.69	66.05%
Access Road	A-21	CB16	STMH1	0.013						0.009	0.009	10.00	10.14	76.81	104.19	178.56		0.69				0.69	PVC DR-35	200.0	1.00	8.55	32.83	1.04	0.14	32.14	97.89%
Access Road	A-17	Building	STMH1-STMH2						0.198	0.495	0.495	10.00	10.21	76.81	104.19	178.56		38.05				38.05	PVC DR-35	300.0	1.00	16.85	96.80	1.37	0.21	58.75	60.69%
Access Road	A-6	CB13	STMH1-STMH2	0.032						0.022	0.022	10.00	10.19	76.81	104.19	178.56		1.71				1.71	PVC DR-35	200.0	1.00	11.80	32.83	1.04	0.19	31.12	94.80%
Access Road	A-5	CB4	STMH1-STMH2						0.062	0.155	0.155	10.00	10.03	76.81	104.19	178.56		11.91				11.91	PVC DR-35	200.0	1.00	2.00	32.83	1.04	0.03	20.92	63.71%
Access Road		STMH1	STMH2							0.000	0.827	10.23	10.69	75.92	102.98	176.46		62.78				62.78	PVC DR-35	300.0	0.70	31.60	80.99	1.14	0.46	18.20	22.48%
Access Road		STMH2	DETENTION CHAMBER							0.000	0.827	10.69	10.71	74.24	100.67	172.47		61.39				61.39	PVC DR-35	300.0	0.70	1.30	80.99	1.14	0.02	19.59	24.19%
Access Road	A-4	CB12	DETENTION CHAMBER	0.031						0.022	0.022	10.00	10.18	76.81	104.19	178.56		1.65				1.65	PVC DR-35	200.0	1.00	11.05	32.83	1.04	0.18	31.18	94.96%
Access Road	A-3	CB3	DETENTION CHAMBER						0.106	0.265	0.265	10.00	10.02	76.81	104.19	178.56		20.37				20.37	PVC DR-35	200.0	1.00	1.25	32.83	1.04	0.02	12.46	37.96%
Access Road	A-16	Building	DETENTION CHAMBER						0.253	0.633	0.633	10.00	10.20	76.81	104.19	178.56		48.62				48.62	PVC DR-35	300.0	1.00	16.10	96.80	1.37	0.20	48.18	49.77%
Access Road	A-15	Building	DETENTION CHAMBER						0.221	0.553	0.553	10.00	10.20	76.81	104.19	178.56		42.47				42.47	PVC DR-35	300.0	1.00	16.10	96.80	1.37	0.20	54.33	56.13%
Access Road	A-2	CB2	DETENTION CHAMBER						0.091	0.228	0.228	10.00	10.02	76.81	104.19	178.56		17.49				17.49	PVC DR-35	200.0	1.00	1.25	32.83	1.04	0.02	15.34	46.74%
Access Road	A20	CB15	DETENTION CHAMBER	0.013					0.012	0.039	0.039	10.00	10.17	76.81	104.19	178.56		3.00				3.00	PVC DR-35	200.0	1.00	10.55	32.83	1.04	0.17	29.83	90.86%
Access Road	A19	CB14	DETENTION CHAMBER	0.010					0.022	0.062	0.062	10.00	10.17	76.81	104.19	178.56		4.76				4.76	PVC DR-35	200.0	1.00	10.55	32.83	1.04	0.17	28.07	85.50%
Access Road	A-8	CB11	DETENTION CHAMBER	0.058					0.019	0.088	0.088	10.00	10.38	76.81	104.19	178.56		6.75				6.75	PVC DR-35	200.0	1.00	23.50	32.83	1.04	0.38	26.08	79.45%
Access Road	A-1	CB1	DETENTION CHAMBER	0.004					0.103	0.260	0.260	10.00	10.02	76.81	104.19	178.56		20.01				20.01	PVC DR-35	200.0	1.00	1.20	32.83	1.04	0.02	12.82	39.06%
Access Road		DETENTION CHAMBER	CBMH3							0.000	2.977	10.71	10.73	74.18	100.58	172.31		220.80				220.80	PVC DR-35	375.0	2.00	2.25	248.20	2.25	0.02	27.40	11.04%
Access Road		CBMH3	STMH4							0.000	2.977	10.73	10.75	74.12	100.50	172.17		220.63				220.63	PVC DR-35	375.0	2.00	3.30	248.20	2.25	0.02	27.58	11.11%
Access Road		STMH4	STMH5							0.000	2.977	10.75	10.79	74.03	100.38	171.96		220.37				220.37	PVC DR-35	375.0	2.00	4.60	248.20	2.25	0.03	27.84	11.22%
Access Road	EXT2	*Ex.CB107*	STMH5	0.073					0.502	1.307	1.307	10.00	10.20	76.81	104.19	178.56		100.36				100.36	PVC DR-35	*375.0*	*0.68*	*15.81*	144.73	1.31	0.20	44.36	30.65%
Access Road		STMH5	CBMH6							0.000	4.283	10.79	11.12	73.91	100.21	171.67		316.59				316.59	PVC DR-35	450.0	1.70	47.10	372.11	2.34	0.34	55.52	14.92%
Access Road	A-9	CB6	*CBMH6-Ex.MHSTM45*	0.022						0.015	0.015	10.00	10.07	76.81	104.19	178.56		1.17				1.17	PVC DR-35	200.0	1.00	4.30	32.83	1.04	0.07	31.66	96.42%
Access Road	EXT3	CBMH6	*Ex.MHSTM45*	0.125					0.060	0.237	4.536	11.12	11.35	72.75	98.62	168.91		329.96				329.96	PVC DR-35	450.0	1.70	31.90	372.11	2.34	0.23	42.15	11.33%

Definition:
Q=2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (Ha)
i = Rainfall Intensity in millimeters per hour (mm/hr)
i = 732.951/(TC+6.199)^0.810 — 2 Year
i = 1174.184/(TC+6.014)^0.816 — 5 Year
i = 1735.688/(TC+6.014)^0.820 — 100 Year

Notes:
1. Mannings coefficient (n) = 0.013

Time-of-Concentration in the Swale
FAA Equation: t (min) = 3.258 [(1.1 - C) L^0.5 / S^.33]
Where: Longest Watercourse Length, L (m). S (%)
Runoff Coef.C = Impervious

No.	L (m)	S %
1		

Tc= #DIV/0! min

Designed: D.B.Y.
Checked: D.B.Y./J.J.
Dwg. Reference: C05

No.	Revision	Date
1.	City Submission No. 1	24/06/2019
2.	City Submission No. 2	24/09/2019

File Reference:	Date:	Sheet No:
191-01517-00	24/06/2019	1 of 2

STORM SEWER DESIGN SHEET

Athletics and Recreation Centre (ARC)
Algonquin College, Ottawa, ON
Project: 191-01517-00
Date: September, 2019

LOCATION				AREA (Ha)						RATIONAL DESIGN FLOW													PROPSOED SEWER DATA								
STREET	AREA ID	FROM	TO	C= 0.25	C= 0.35	C= 0.50	C= 0.60	C= 0.75	C= 0.90	IND 2.78AC	CUM 2.78 AC	INLET (min)	TOTAL (min)	i (2) (mm/hr)	i (5) (mm/hr)	i (100) (mm/hr)	BLDG FLOW (L/s)	2yr PEAK FLOW (L/s)	5yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	MATERIAL PIPE	SIZE (mm)	SLOPE (%)	LENGTH (m)	CAPACITY (l/s)	VELOCITY (m/s)	TIME IN PIPE	AVAIL CAP (2yr) (L/s)	(%)
To North Service Road																															
North Service Road		Building Foundation	Ex.MHST27-Ex.MHST42							0.000	0.000	10.00	10.00	76.81	104.19	178.56		0.00			0.02	0.02	PVC DR-35	200.0	1.00	3.50	32.83	Forcemain			
North Service Road	A-13	CB9	Ex.MHST27-Ex.MHST42	0.017						0.012	0.012	10.00	10.01	76.81	104.19	178.56		0.91				0.91	PVC DR-35	200.0	1.00	0.80	32.83	1.04	0.01	31.92	97.24%
North Service Road	A-12	CB8	Ex.MHST27-Ex.MHST42	0.011						0.008	0.008	10.00	10.01	76.81	104.19	178.56		0.59				0.59	PVC DR-35	200.0	1.00	0.80	32.83	1.04	0.01	32.24	98.21%
North Service Road	A-11	CB7	CBMH7						0.055	0.138	0.138	10.00	10.37	76.81	104.19	178.56		10.57				10.57	PVC DR-35	200.0	1.00	23.05	32.83	1.04	0.37	22.26	67.81%
North Service Road	A-10	CBMH7	Ex.MHST25-Ex.MHST45	0.017					0.004	0.022	0.159	10.37	10.41	75.42	102.29	175.26		12.02				12.02	PVC DR-35	200.0	1.00	2.50	32.83	1.04	0.04	20.81	63.38%
North Service Road		Building Foundation	CBMH8							0.000	0.000	10.00	10.00	76.81	104.19	178.56		0.00			0.02	0.02	PVC DR-35	200.0	1.00	24.95	32.83	Forcemain			
North Service Road	EXT1	CBMH8	Ex.MHST27	0.126					0.059	0.235	0.235	10.00	10.93	76.81	104.19	178.56		18.06			0.02	18.08	PVC DR-35	200.0	0.50	41.05	23.22	0.74	0.93	5.13	22.11%
PRE-DEVELOPMENT CAPACITY CHECK																															
	PA-1	Ex.CB110	Ex.CB109	0.020					0.159	0.412	0.412	10.00	10.76	76.81	104.19	178.56		31.62				31.62	PVC DR-35	375.0	0.76	63.02	153.00	1.38	0.76	121.38	79.33%
	PA-2	Ex.CB109	Ex.CB108	0.064					0.450	1.170	1.582	10.76	11.57	74.01	100.35	171.91		117.09				117.09	PVC DR-35	375.0	1.02	78.26	177.25	1.60	0.81	60.16	33.94%
	PA-3	Ex.CB107	Ex.CB108	0.073					0.535	1.389	1.389	10.00	10.80	76.81	104.19	178.56		106.71				106.71	PVC DR-35	375.0	0.68	62.94	144.73	1.31	0.80	38.02	26.27%
	PA-4	Ex.CB108	Ex.MHSTM45	0.168					0.644	1.728	4.699	11.57	11.73	71.25	96.56	165.36		334.85				334.85	PVC DR-35	450.0	3.76	31.91	553.40	3.48	0.15	218.55	39.49%

Definition:
Q=2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (Ha)
i = Rainfall Intensity in millimeters per hour (mm/hr)
i = 732.951/(TC+6.199)^0.810 — 2 Year
i = 1174.184/(TC+6.014)^0.816 — 5 Year
i = 1735.688/(TC+6.014)^0.820 — 100 Year

Notes:
1. Mannings coefficient (n) = 0.013

Time-of-Concentration in the Swale
FAA Equation: t (min) = 3.258 [(1.1 - C) L^0.5 / S^.33]
Where: Longest Watercourse Length, L (m). S (%)
Runoff Coef.C = Impervious

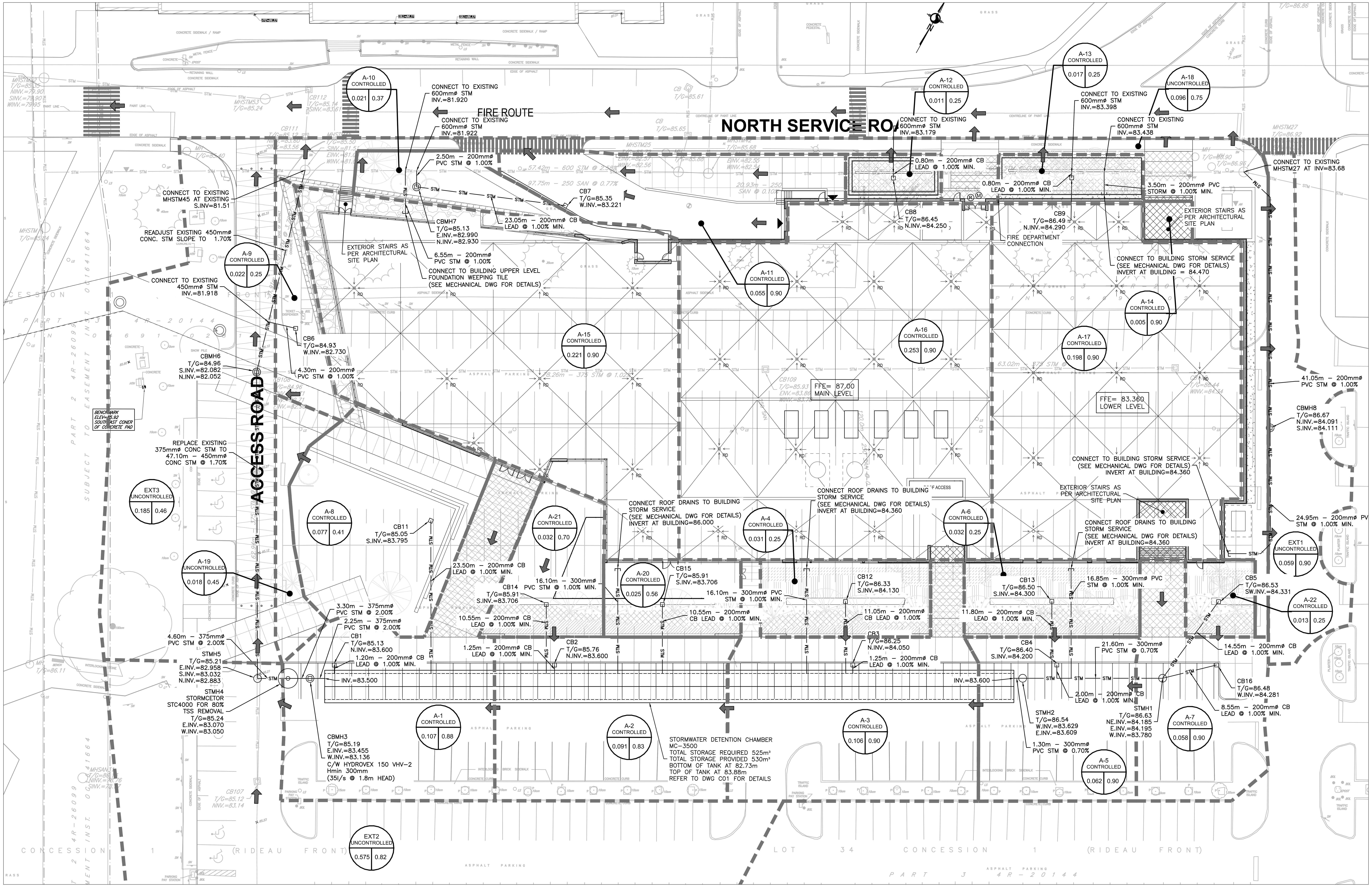
No.	L (m)	S %
1		

Tc= #DIV/0! min

Designed: D.B.Y.
Checked: D.B.Y./J.J.
Dwg. Reference: C05

No.	Revision	Date
1.	City Submission No. 1	24/06/2019
2.	City Submission No. 2	24/09/2019

File Reference:	Date:	Sheet No:
191-01517-00	24/06/2019	2 of 2



LEGEND:

EXISTING FIRE HYDRANT	PROPOSED METER	STORM DRAINAGE BOUNDARY
EXISTING V&VB	PROPOSED CATCHBASIN MANHOLE	ID DENOTES WATERSHED NAME
EXISTING VALVE CHAMBER	PROPOSE CATCHBASIN	A DENOTES AREA IN HECTARES
PROPOSED FIRE HYDRANT	EXISTING CATCHBASIN MANHOLE	C DENOTES RUNOFF COEFFICIENT
PROPOSED V&B	EXISTING STORM SEWER AND MANHOLE	OVERLAND MAJOR FLOW ROUTE
PROPOSED REMOTE METER	PROPOSED STORM SEWER AND MANHOLE	

ID CONTROLLED A C

0 5m 10m 20m 30m
SCALE: 1:300

ALGONQUIN COLLEGE
Algonquin Students' Association

Project
ATHLETICS AND RECREATION CENTRE (ARC)

Prepared For
ALGONQUIN STUDENTS' ASSOCIATION

HOK Architects Corporation
205 Catherine Street, Suite 101
Ottawa, Ontario K2P 1C3 Canada
t +1 613 226 9650 f +1 613 226 9656

In Association with

WSP
STRUCTURAL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

WSP
MECHANICAL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

WSP
ELECTRICAL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

WSP
CIVIL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

CSW Landscape Architects
LANDSCAPE
319 McRae Avenue, Suite 502
Ottawa, ON, K1Z 0B9

WSP
SUSTAINABILITY
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

Key Plan

Professional Seals

REGISTERED PROFESSIONAL ENGINEER
D. B. YANG
100230568
2019-09-24
PROVINCE OF ONTARIO

No.	Description	Date
1	SITE PLAN APPROVAL	2019-06-24
2	ISSUED FOR PERMIT/TENDER	2019-08-20
3	RESPONSE TO SPA COMMENTS	2019-09-24

Drawn by: D.B.Y. Reviewed by: J.J.
Project No: 191-01517-00

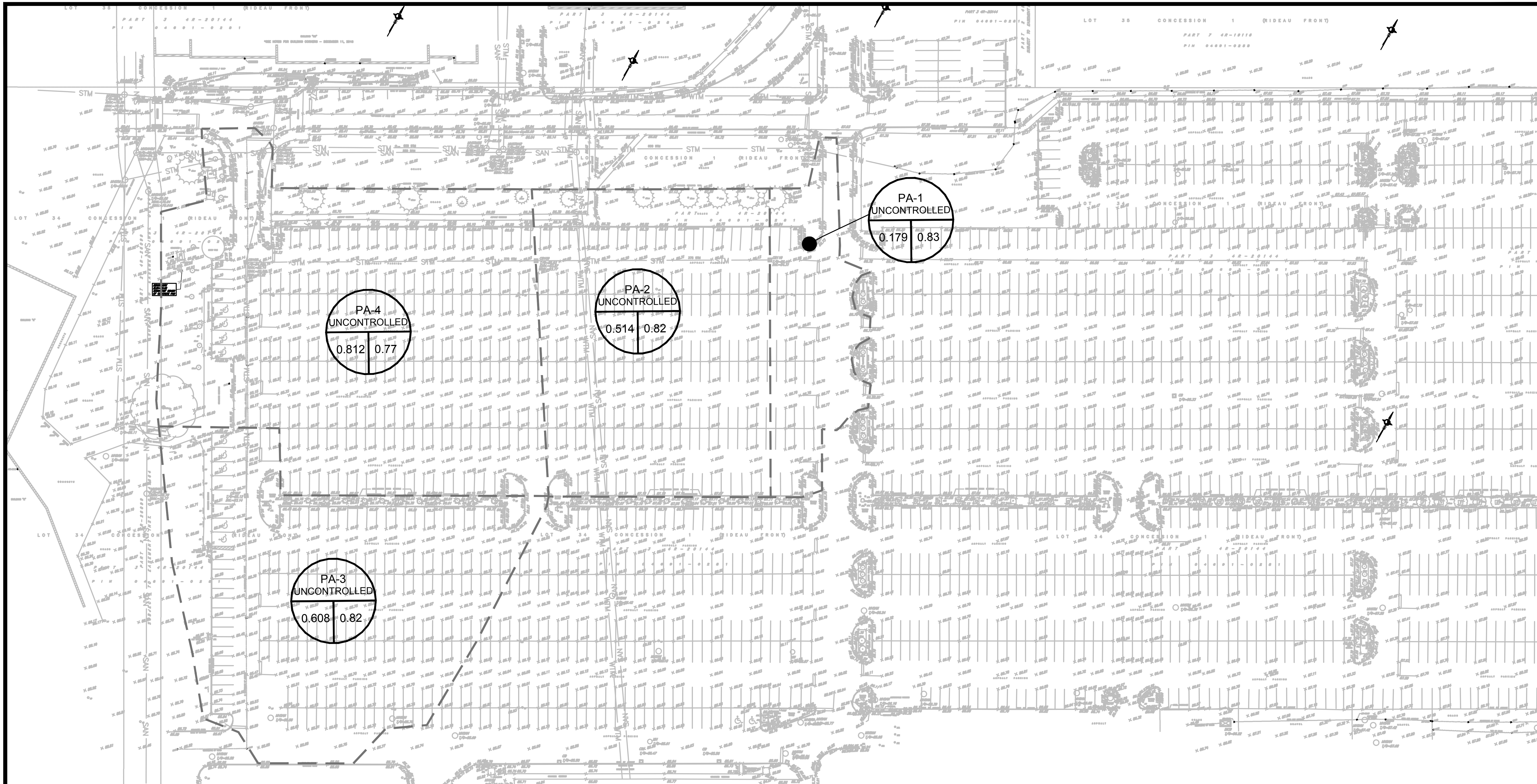
Sheet Title
POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

Original drawing is A1. Do not scale contents of this drawing.

Sheet Number
C05

D07-12-19-0114
#17981

FILENAME: P:\2019 Projects\191-01517-00_Algonquin College - ARC\Civil\Drawings\2 Working Drawings\Sheets\191-01517-00_CIVIL.dwg
PLOTDATE: Sep 24, 2019 - 4:26pm, caiwy069741



wsp

300-2611 QUEENSVIEW DRIVE
OTTAWA ONTARIO CANADA K2B 8K2
TEL.: 1-613-829-2800 | FAX: 1-613-829-8299 | WWW.WSPGROUP.COM

PROJECT: ATHLETICS AND RECREATION CENTRE (ARC)

ADDRESS: ALGONQUIN COLLEGE OTTAWA, ONTARIO

PROJECT NO.: 191-01517-00

DRAWING NAME: PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN

DATE: 2019-06-24

REVIEWED BY: J.J

SCALE: 1 : 750

LEGEND

I.D. DENOTES STORM DRAINAGE AREA ID
A DENOTES DRAINAGE AREA
C DENOTES RUNOFF COEFFICIENT

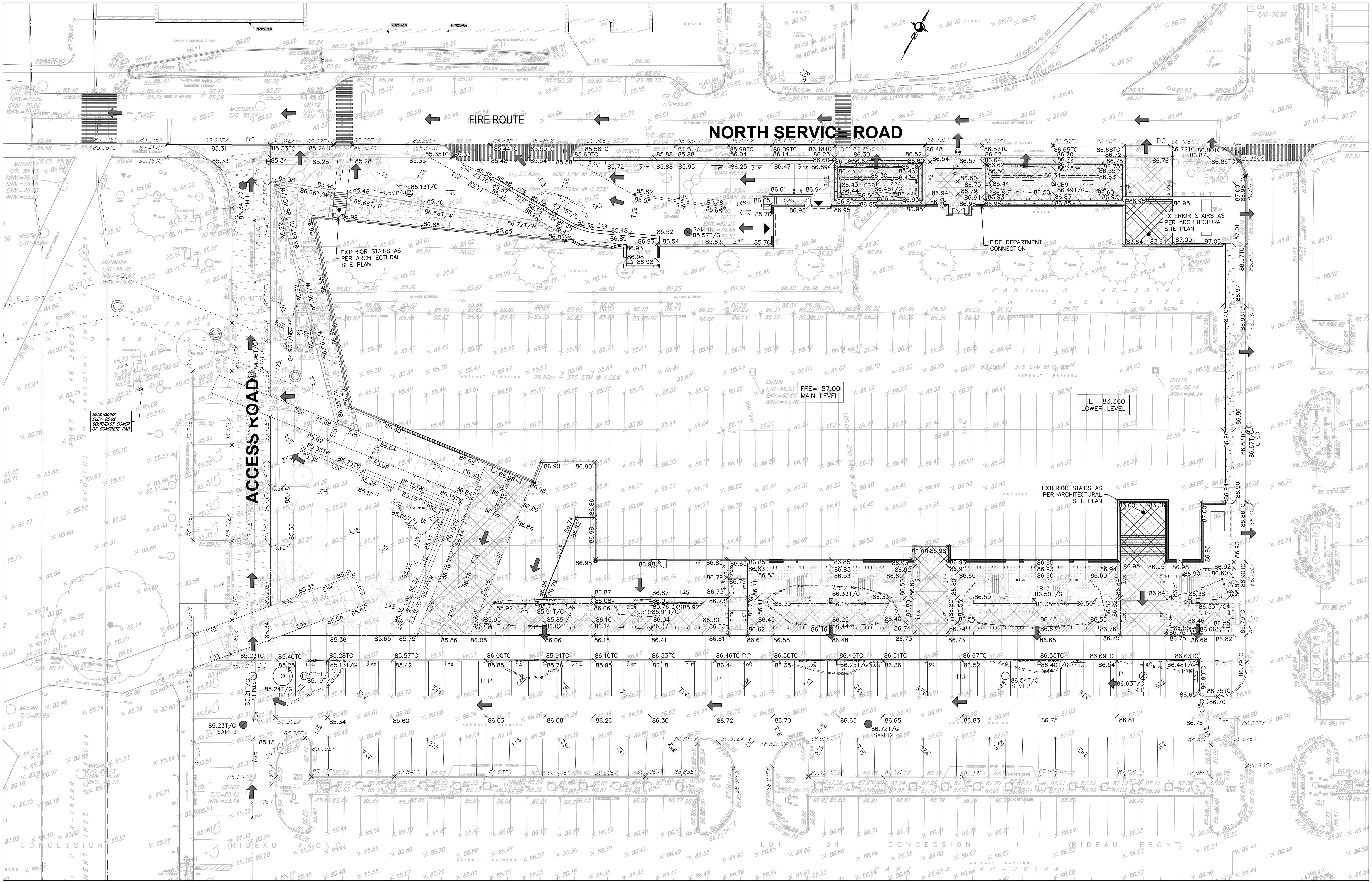
PRE-DEVELOPMENT STORM DRAINAGE BOUNDARY

DESIGNED BY: D.Y.

DRAWN BY: D.Y.

SHEET: FIG2

FILENAME: P:\2019 Projects\191-01517-00_Algonquin College - ARC\Civil\Drawings\2 Working Drawings\Sheets\191-01517-00_CIVIL.dwg
PLOTDATE: Jun 21, 2019 - 3:45pm, cawy069741



LEGEND:

	EXISTING FIRE HYDRANT		PROPOSED METER	×86.15TC	PROPOSED TOP OF CURB		PROPOSED CONCRETE CURB
	EXISTING V&VB		PROPOSED CATCHBASIN MANHOLE	×86.15(s)	PROPOSED SWALE ELEVATION		EXISTING BUILDING OR STRUCTURE
	EXISTING VALVE CHAMBER		PROPOSE CATCHBASIN	2.0%	PROPOSED SLOPE		LIMIT OF CONSTRUCTION
	PROPOSED FIRE HYDRANT		EXISTING CATCHBASIN MANHOLE	100 YR	100 YEAR + 20% PONDING LIMIT 100 YEAR PONDING LIMIT		PROPOSED CENTERLINE OF SWALE
	PROPOSED V&B	×86.43EX	EXISTING GRADE		SIAMESE CONNECTION		PROPOSED TERRACING (3:1 MAX)
	PROPOSED REMOTE METER	×86.10	PROPOSED GRADE		OVERLAND MAJOR FLOW ROUTE		EXISTING CONCRETE CURB

0 5m 10m 20m 30m

SCALE: 1:300

FILENAME: P:\2019 Projects\191-01517-00_Algonquin College - ARC\Civil\Drawings\2 Working Drawings\Sheets\191-01517-00_CIVIL.dwg
PLOTDATE: Sep 24, 2019 - 4:25pm, cawy069741

ALGONQUIN COLLEGE

Algonquin Students' Association

Project
ATHLETICS AND RECREATION CENTRE (ARC)

Prepared For
ALGONQUIN STUDENTS' ASSOCIATION

HOK Architects Corporation
205 Catherine Street, Suite 101
Ottawa, Ontario K2P 1C3 Canada
t +1 613 226 9650 f +1 613 226 9656

In Association with

WSP
STRUCTURAL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

WSP
MECHANICAL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

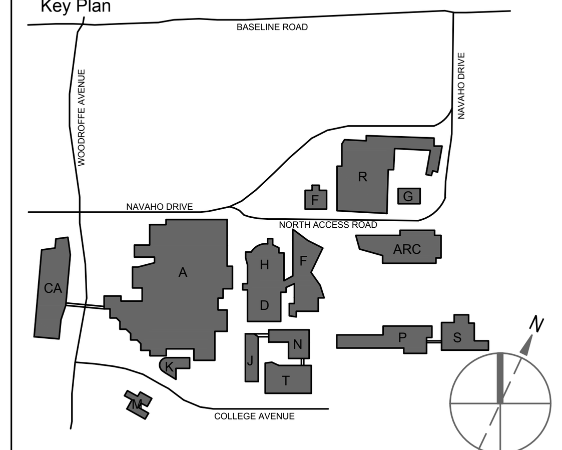
WSP
ELECTRICAL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

WSP
CIVIL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

CSW Landscape Architects
LANDSCAPE
319 McRae Avenue, Suite 502
Ottawa, ON, K1Z 0B9

WSP
SUSTAINABILITY
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

Key Plan



Professional Seals

REGISTERED PROFESSIONAL ENGINEER
D. B. YANG
100230568
2019-09-24
PROVINCE OF ONTARIO

No.	Description	Date
1	SITE PLAN APPROVAL	2019-06-24
2	ISSUED FOR PERMIT/TENDER	2019-08-20
3	RESPONSE TO SPA COMMENTS	2019-08-24

Drawn by: D.B.Y. Reviewed by: J.J.
Project No: 191-01517-00

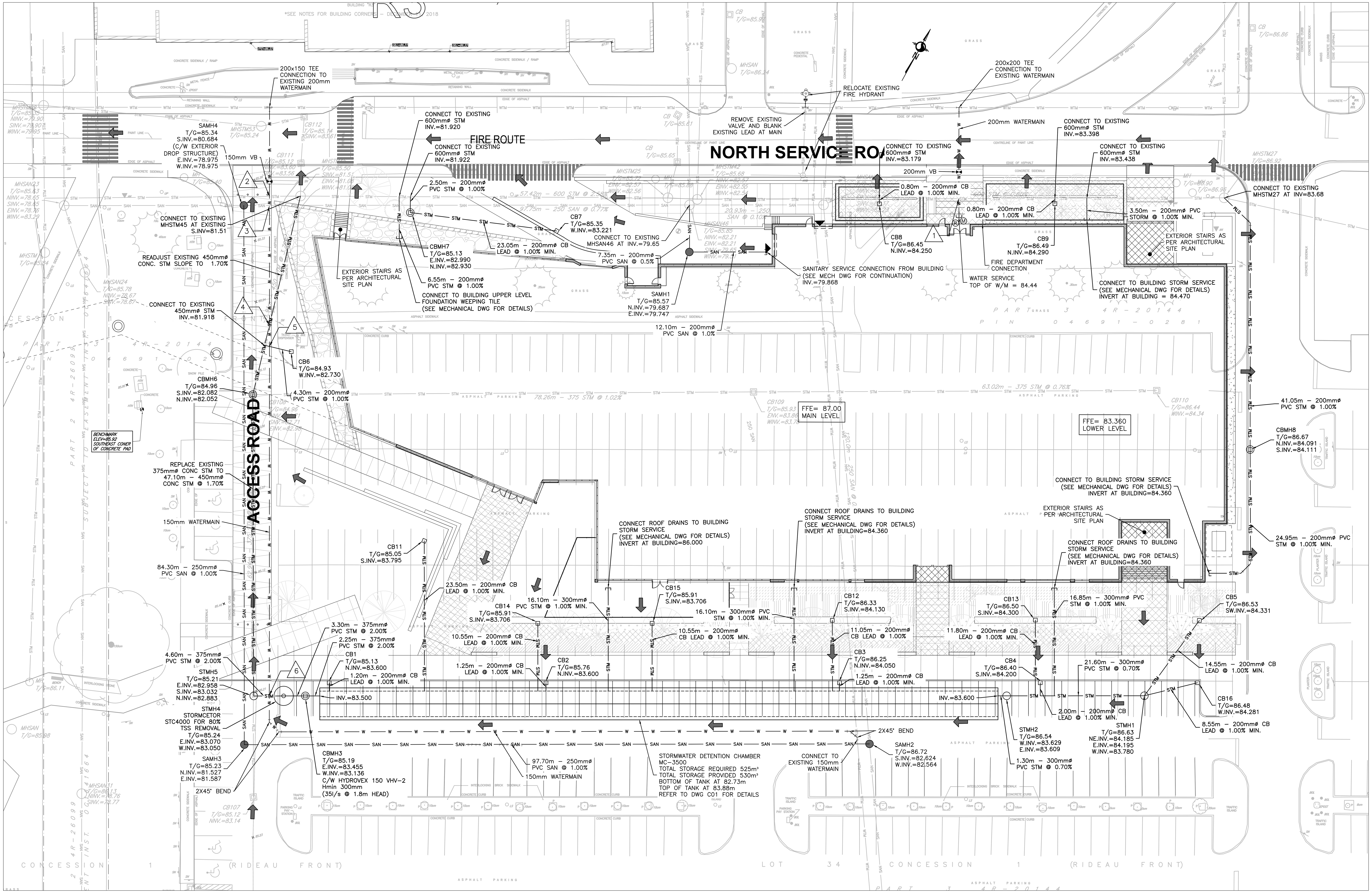
Sheet Title
GRADING PLAN

Original drawing is A1. Do not scale contents of this drawing.

Sheet Number
C03

D07-12-19-0114

#17981



LEGEND:

- EXISTING FIRE HYDRANT
- EXISTING V&VB
- EXISTING VALVE CHAMBER
- PROPOSED FIRE HYDRANT
- PROPOSED V&B
- PROPOSED REMOTE METER
- PROPOSED METER
- PROPOSED CATCHBASIN MANHOLE
- PROPOSE CATCHBASIN
- EXISTING CATCHBASIN MANHOLE
- EXISTING SANITARY SEWER AND MANHOLE
- PROPOSED SANITARY SEWER AND MANHOLE
- EXISTING STORM SEWER AND MANHOLE
- PROPOSED STORM SEWER AND MANHOLE
- PROPOSED WATERMAIN
- EXISTING WATERMAIN
- PROPOSED FIRE HYDRANT
- PROPOSED V&B
- PROPOSED CENTERLINE OF SWALE
- PROPOSED TERRACING (3:1 MAX)
- PROPOSED CONCRETE CURB
- EXISTING BUILDING OR STRUCTURE
- LIMIT OF CONSTRUCTION
- EXISTING CONCRETE CURB

0 5m 10m 20m 30m
SCALE: 1:300

ALGONQUIN COLLEGE

Algonquin Students' Association

Project
ATHLETICS AND RECREATION CENTRE (ARC)

Prepared For
ALGONQUIN STUDENTS' ASSOCIATION

HOK Architects Corporation
205 Catherine Street, Suite 101
Ottawa, Ontario K2P 1C3 Canada

In Association with

WSP
STRUCTURAL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

WSP
MECHANICAL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

WSP
ELECTRICAL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

WSP
CIVIL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

CSW Landscape Architects
LANDSCAPE
319 McRae Avenue, Suite 502
Ottawa, ON, K1Z 0B9

WSP
SUSTAINABILITY
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

Key Plan

Professional Seals

REGISTERED PROFESSIONAL ENGINEER
D. B. YANG
100230568
2019-09-24
PROVINCE OF ONTARIO

No.	Description	Date
1	SITE PLAN APPROVAL	2019-06-24
2	ISSUED FOR PERMIT/TENDER	2019-08-20
3	RESPONSE TO SPA COMMENTS	2019-09-24

Drawn by: D.B.Y. Reviewed by: J.J.
Project No: 191-01517-00

Sheet Title
SERVICING PLAN

Original drawing is A1. Do not scale contents of this drawing.

Sheet Number
C04

D07-12-19-0114

#17981

User Inputs

Chamber Model	MC-3500
Outlet Control Structure	Yes (Outlet)
Project Name	Algonquin College - ARC
Project Location	Ottawa
Project Date	09/24/2019
Engineer	Ding Bang Yang
Measurement Type	Metric
Required Storage Volume	525 cubic meters
Stone Porosity	40%
Stone Above Chambers	305 mm.
Stone Foundation Depth	229 mm.
Average Cover Over Chambers	610 mm.
Design Constraint	Width
Design Constraint Dimension	5 meters

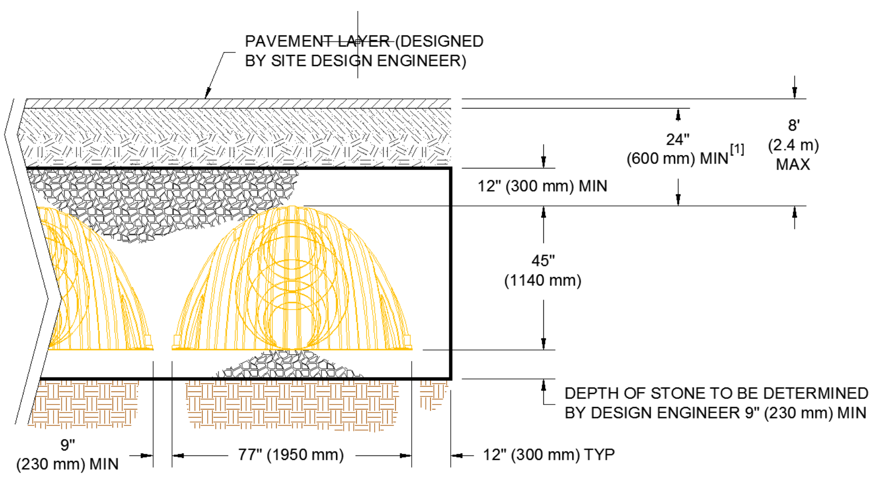
Results

System Volume and Bed Size

Installed Storage Volume	528 cubic meters
Storage Volume Per Chamber	5.0 cubic meters
Storage Volume Per End Cap	1.3 cubic meters
Number Of Chambers Required	94 each
Number Of End Caps Required	4 each
Rows/Chambers	2 row(s) of 47 chamber(s)
Maximum Length	106.69 meters
Maximum Width	4.93 meters
Approx. Bed Size Required	524 square meters

System Components

Amount Of Stone Required	584 cubic meters
Volume Of Excavation (Not Including Fill)	878 cubic meters
Non-woven Filter Fabric Required	1449 square meters
Length Of Isolator Row	103.79 meters
Woven Isolator Row Fabric	577 square meters



[1] - TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 30" (750 mm).

ADVANCED DRAINAGE SYSTEMS, INC.

FOR STORMTECH INSTRUCTIONS, DOWNLOAD THE INSTALLATION APP

Algonquin College - ARC

Ottawa

STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500 OR APPROVED EQUAL.
2. CHAMBERS SHALL BE MADE FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORT PANELS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
4. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
5. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
6. CHAMBERS SHALL BE DESIGNED AND ALLOWABLE LOADS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
7. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. THE CHAMBER MANUFACTURER SHALL SUBMIT THE FOLLOWING UPON REQUEST TO THE SITE DESIGN ENGINEER FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE:
   a. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY AASHTO FOR THERMOPLASTIC PIPE.
   b. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET. THE 50 YEAR CREEP MODULUS DATA SPECIFIED IN ASTM F2418 MUST BE USED AS PART OF THE AASHTO STRUCTURAL EVALUATION TO VERIFY LONG-TERM PERFORMANCE.
   c. STRUCTURAL CROSS SECTION DETAIL ON WHICH THE STRUCTURAL EVALUATION IS BASED.
8. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS.

   STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 9" (230 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE 3/4-2" (20-50 mm) MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING..
10. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

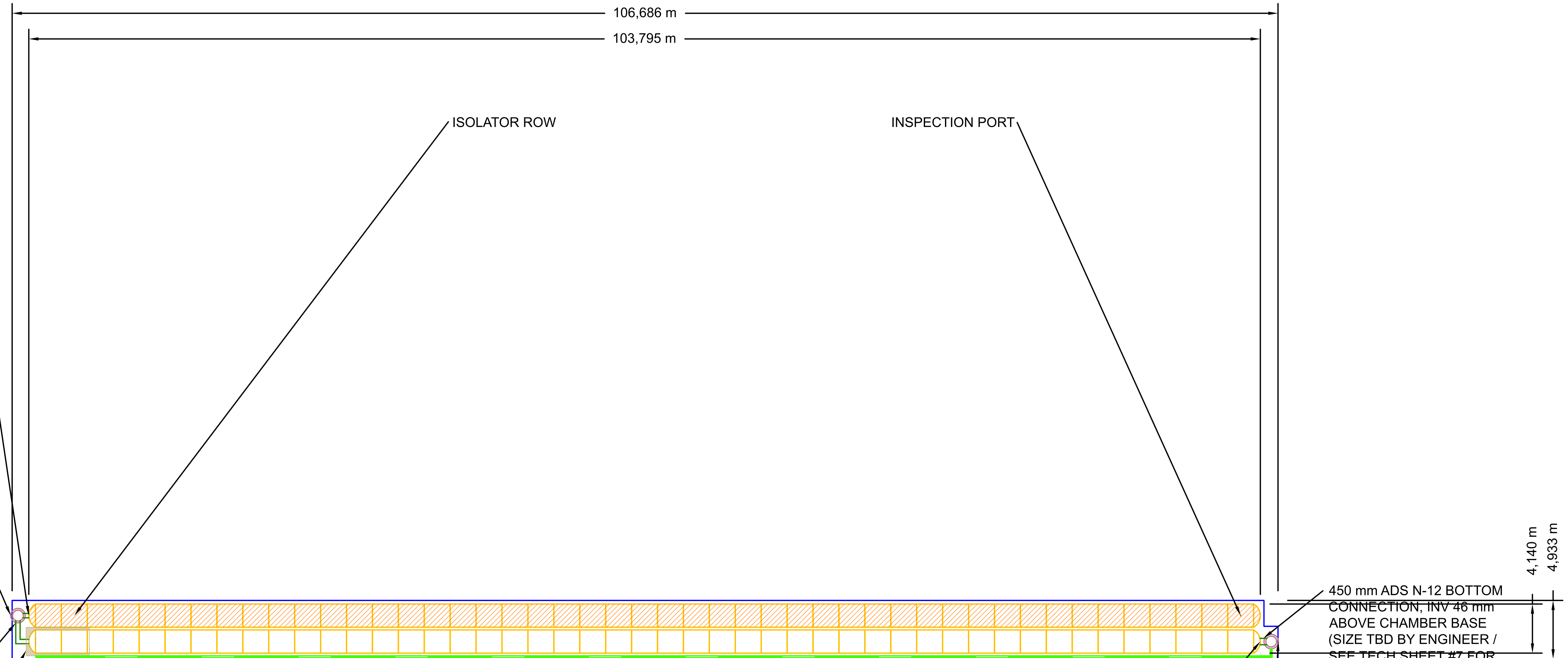
USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

CONCEPTUAL LAYOUT

COMPUTER GENERATED CONCEPTUAL LAYOUT - NOT FOR CONSTRUCTION

(94) STORMTECH MC-3500 CHAMBERS
(4) STORMTECH MC-3500 END CAPS
INSTALLED WITH 305 mm COVER STONE, 229 mm BASE STONE, 40% STONE VOID
INSTALLED SYSTEM VOLUME: 528 m³
AREA OF SYSTEM: 524 m²
PERIMETER OF SYSTEM: 223 m



ISOLATOR ROW

INSPECTION PORT

600 mm CORED END CAP PART# MC3500IEPP24BC TYP OF ALL MC-3500 600 mm CONNECTIONS AND ISOLATOR ROWS

PROPOSED STRUCTURE W/ELEVATED BYPASS MANIFOLD (DESIGN BY ENGINEER / PROVIDED BY OTHERS)

450 mm ADS N-12 BOTTOM CONNECTION, INV 46 mm ABOVE CHAMBER BASE (SIZE TBD BY ENGINEER / SEE TECH SHEET #7 FOR MANIFOLD SIZING GUIDANCE)

300 mm x 300 mm ADS N-12 TOP MANIFOLD, INV 671 mm ABOVE CHAMBER BASE (SIZE TBD BY ENGINEER / SEE TECH SHEET #7 FOR MANIFOLD SIZING GUIDANCE)

PLACE MINIMUM 5.3 m OF ADS GEOSYNTHETICS 315WTK WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

150 mm ADS N-12 DUAL WALL PERFORATED HDPE UNDERDRAIN (SIZE TBD BY ENGINEER)

450 mm CORED END CAP PART# MC3500IEPP18BC TYP OF ALL MC-3500 450 mm BOTTOM CONNECTIONS

PROPOSED OUTLET CONTROL STRUCTURE (DESIGN BY ENGINEER / PROVIDED BY OTHERS)

Algonquin College - ARC
Ottawa

DATE: 09/24/2019
DRAWN: DY
PROJECT #: Tool
CHECKED: ---

REV	DRW	CHK	DESCRIPTION

StormTech® Detention · Retention · Water Quality
70 INWOOD ROAD, SUITE 3 | ROCKY HILL | CT | 06067
860-529-8188 | 888-892-2694 | WWW.STORMTECH.COM

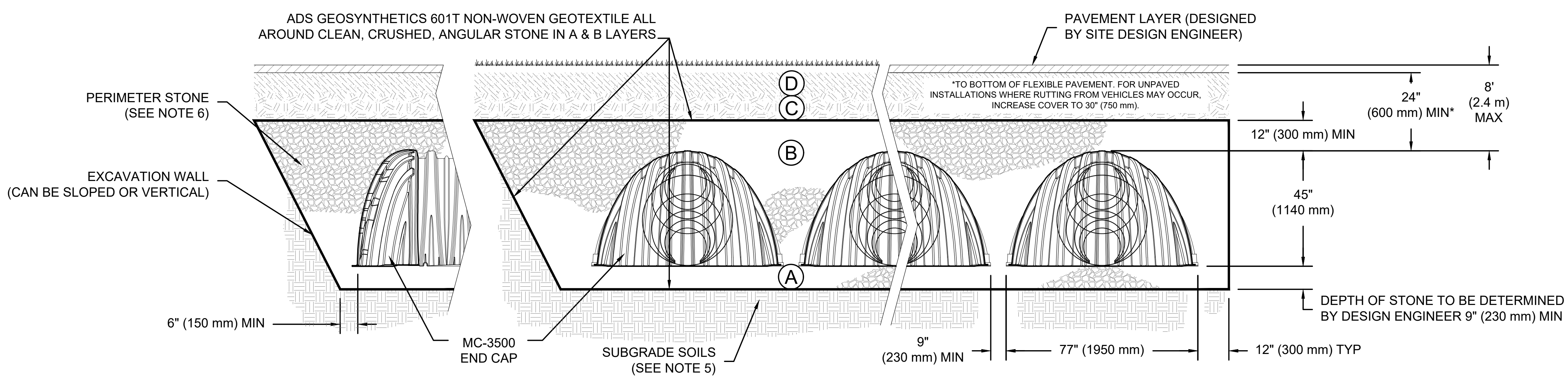
ADS® ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

NOT TO SCALE

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE, NOMINAL SIZE DISTRIBUTION BETWEEN 3/4-2 INCH (20-50 mm)	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE, NOMINAL SIZE DISTRIBUTION BETWEEN 3/4-2 INCH (20-50 mm)	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE. [2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.



NOTES:

1. MC-3500 CHAMBERS SHALL CONFORM TO THE REQUIREMENTS OF ASTM F2418 "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. "ACCEPTABLE FILL MATERIALS" TABLE ABOVE PROVIDES MATERIAL LOCATIONS, DESCRIPTIONS, GRADATIONS, AND COMPACTION REQUIREMENTS FOR FOUNDATION, EMBEDMENT, AND FILL MATERIALS.
4. THE "SITE DESIGN ENGINEER" REFERS TO THE ENGINEER RESPONSIBLE FOR THE DESIGN AND LAYOUT OF THE STORMTECH CHAMBERS FOR THIS PROJECT.
5. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
6. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
7. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.

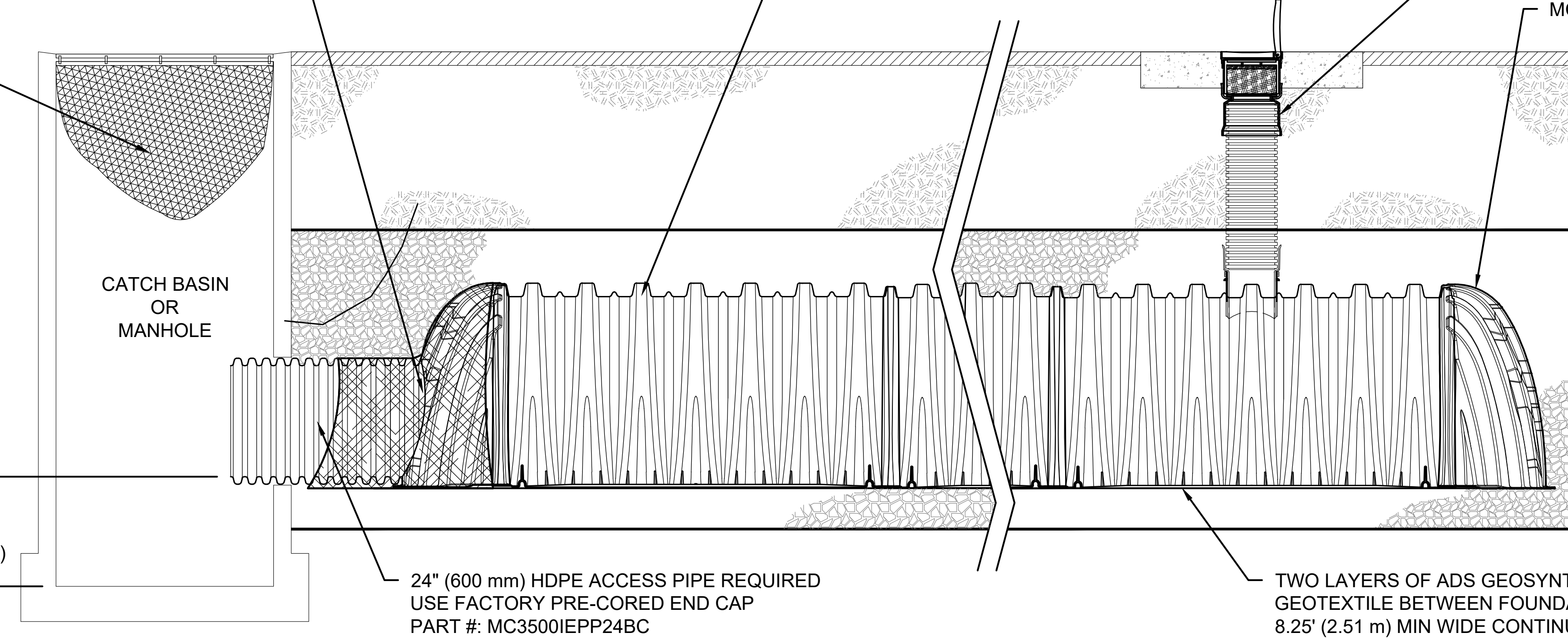
Algonquin College - ARC
Ottawa

DATE: 09/24/2019 DRAWN: DY
PROJECT #: Tool CHECKED: ---

REV	DRW	CHK	DESCRIPTION

StormTech
Detention • Retention • Water Quality
70 INWOOD ROAD, SUITE 3 | ROCKY HILL | CT | 06067
860-529-8188 | 888-892-2694 | WWW.STORMTECH.COM

ADS
ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473



MC-3500 ISOLATOR ROW DETAIL

NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

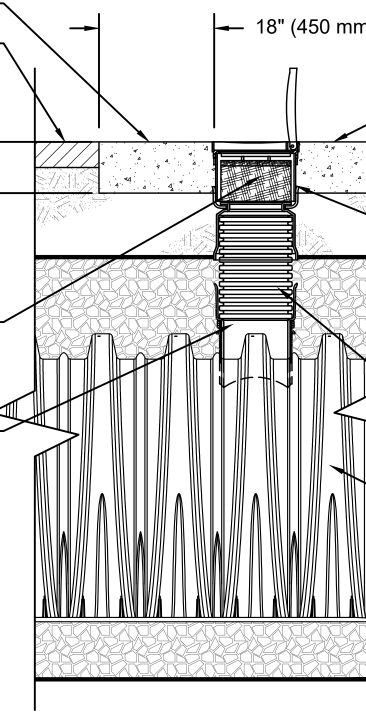
STEP 2) CLEAN OUT ISOLATOR ROW USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



MC-3500 6" INSPECTION PORT DETAIL

NTS

Algonquin College - ARC
Ottawa

DATE: 09/24/2019 DRAWN: DY
PROJECT #: Tool CHECKED: ---

REV	DRW	CHK	DESCRIPTION

StormTech® Detention • Retention • Water Quality
70 INWOOD ROAD, SUITE 3 | ROCKY HILL | CT | 06067
860-529-8188 | 888-892-2694 | WWW.STORMTECH.COM

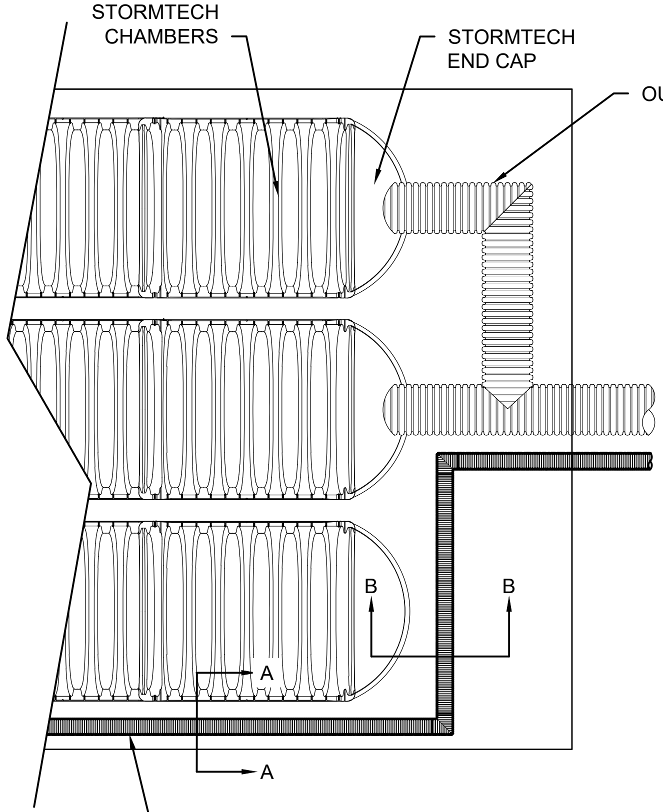
ADS® ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO ADS UNDER THE DIRECTION OF THE SITE DESIGN ENGINEER OR OTHER PROJECT REPRESENTATIVE. THE SITE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

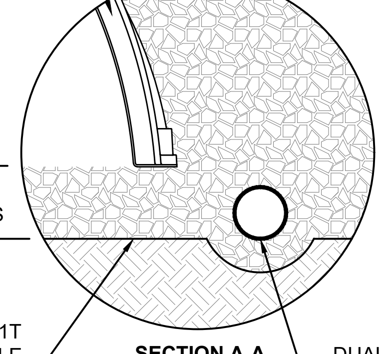
SHEET
4 OF 6

UNDERDRAIN DETAIL

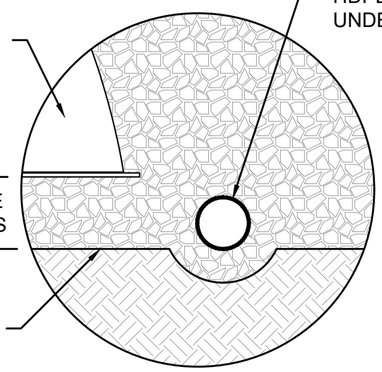
NTS



NUMBER AND SIZE OF UNDERDRAINS PER SITE DESIGN ENGINEER
4" (100 mm) TYP FOR SC-310 SYSTEMS
6" (150 mm) TYP FOR SC-740, DC-780, MC-3500 & MC-4500 SYSTEMS



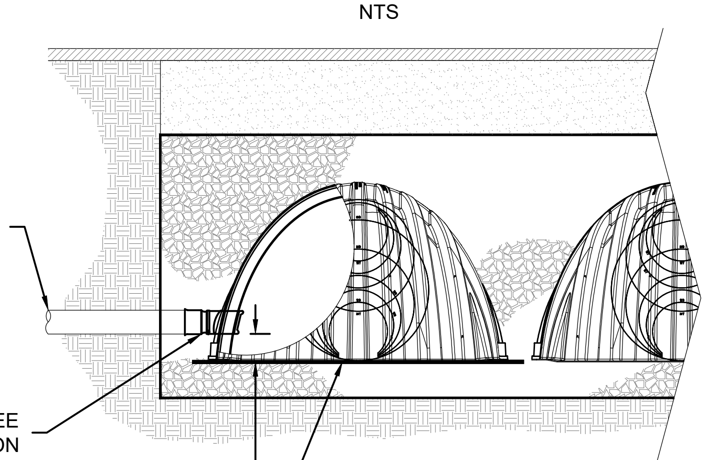
SECTION A-A



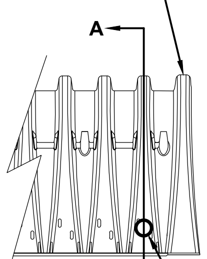
SECTION B-B

INSERTA TEE DETAIL

NTS



SECTION A-A



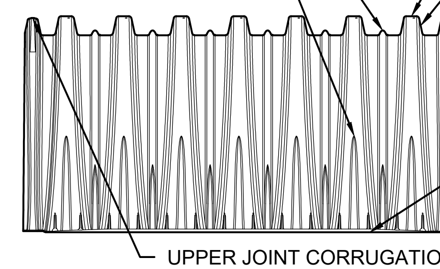
SIDE VIEW

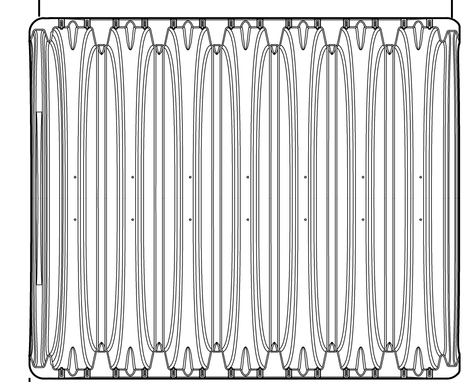
CHAMBER	MAX DIAMETER OF INSERTA TEE	HEIGHT FROM BASE OF CHAMBER (X)
SC-310	6" (150 mm)	4" (100 mm)
SC-740	10" (250 mm)	4" (100 mm)
DC-780	10" (250 mm)	4" (100 mm)
MC-3500	12" (300 mm)	6" (150 mm)
MC-4500	12" (300 mm)	8" (200 mm)
INSERTA TEE FITTINGS AVAILABLE FOR SDR 26, SDR 35, SCH 40 IPS GASKETED & SOLVENT WELD, N-12, HP STORM, C-900 OR DUCTILE IRON		

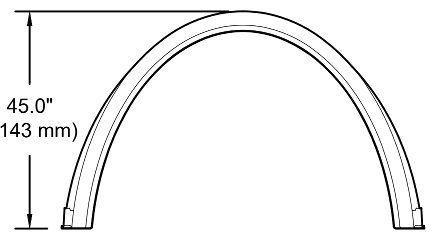
NOTE:
PART NUMBERS WILL VARY BASED ON INLET PIPE MATERIALS. CONTACT STORMTECH FOR MORE INFORMATION.

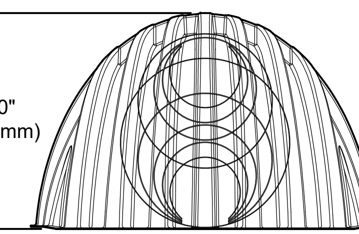
MC-3500 TECHNICAL SPECIFICATION

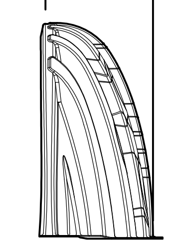
NTS











NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 86.0"	(1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE	109.9 CUBIC FEET	(3.11 m^3)
MINIMUM INSTALLED STORAGE*	178.9 CUBIC FEET	(5.06 m^3)
WEIGHT	135.0 lbs.	(61.2 kg)

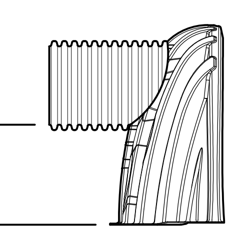
NOMINAL END CAP SPECIFICATIONS

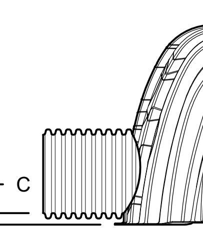
SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 22.5"	(1956 mm X 1143 mm X 571 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m^3)
MINIMUM INSTALLED STORAGE*	46.0 CUBIC FEET	(1.30 m^3)
WEIGHT	50.0 lbs.	(22.7 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION AND BETWEEN CHAMBERS, 12" (305 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP30BC	30" (750 mm)	---	





NOTE: ALL DIMENSIONS ARE NOMINAL

CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS.
CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm)
THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHTEST POSSIBLE FOR THE PIPE SIZE.

Algonquin College - ARC
Ottawa

DATE: 09/24/2019
DRAWN: DY
PROJECT #: Tool
CHECKED: ---

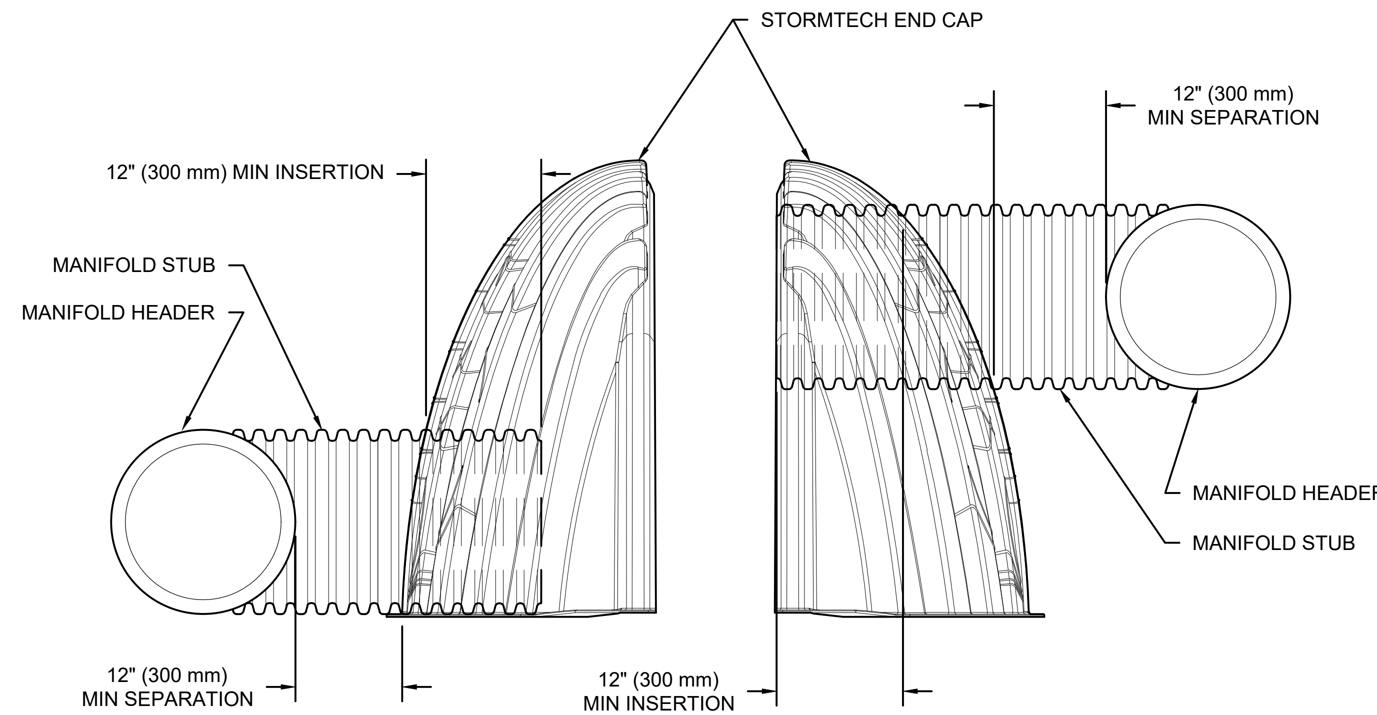
REV	DRW	CHK	DESCRIPTION

StormTech
Detention • Retention • Water Quality
70 INWOOD ROAD, SUITE 3 | ROCKY HILL | CT | 06067
860-529-8188 | 888-892-2694 | WWW.STORMTECH.COM

ADS
ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

MC-SERIES END CAP INSERTION DETAIL

NTS



NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL
FOR A PROPER FIT IN END CAP OPENING.

Algonquin College - ARC
Ottawa

DATE: 09/24/2019 DRAWN: DY

PROJECT #: Tool CHECKED: ---

REV	DRW	CHK	DESCRIPTION

StormTech®
Detention • Retention • Water Quality
70 INWOOD ROAD, SUITE 3 | ROCKY HILL | CT | 06067
860-529-8188 | 888-892-2694 | WWW.STORMTECH.COM

ADS®
ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

Detailed Stormceptor Sizing Report – Athletics and Recreation Centre (ARC)

Project Information & Location			
Project Name	Athletics and Recreation Centre (ARC)	**Project Number**	191-01517-00
City	Ottawa	**State/ Province**	Ontario
Country	Canada	**Date**	6/21/2019
Designer Information		**EOR Information (optional)**	
Name	Ding Bang Yang	**Name**	
Company	WSP Canada Inc	**Company**	
Phone #	613-690-0538	**Phone #**	
Email	winston.yang@wsp.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Athletics and Recreation Centre (ARC)
Recommended Stormceptor Model	STC 4000
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	82
PSD	Fine Distribution
Rainfall Station	OTTAWA MACDONALD-CARTIER INT'L A

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 300	59
STC 750	71
STC 1000	72
STC 1500	73
STC 2000	76
STC 3000	78
STC 4000	82
STC 5000	83
STC 6000	85
STC 9000	88
STC 10000	88
STC 14000	91
StormceptorMAX	Custom

Stormceptor

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

• Site parameters
• Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
• Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
• TSS load
• Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Ontario	**Total Number of Rainfall Events**	4093
Rainfall Station Name	OTTAWA MACDONALD-CARTIER INT'L A	**Total Rainfall (mm)**	20978.1
Station ID #	6000	**Average Annual Rainfall (mm)**	567.0
Coordinates	45°19'N, 75°40'W	**Total Evaporation (mm)**	1675.5
Elevation (ft)	370	**Total Infiltration (mm)**	3553.6
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	15749.0

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (ha)	1.338
Imperviousness %	83.0

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	35.00

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Design Details	
Stormceptor Inlet Invert Elev (m)	83.18
Stormceptor Outlet Invert Elev (m)	83.16
Stormceptor Rim Elev (m)	85.25
Normal Water Level Elevation (m)	83.16
Pipe Diameter (mm)	375
Pipe Material	PVC - plastic
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	Athletics and Recreation Centre (ARC)

Site Details

Drainage Area	
Total Area (ha)	1.338
Imperviousness %	83.0

Surface Characteristics	
Width (m)	231.00
Slope %	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency	
Maintenance Frequency (months) >	12

Infiltration Parameters	
Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (mm/hr)	61.98
Min. Infiltration Rate (mm/hr)	10.16
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation	
Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow	
Dry Weather Flow (lps)	0

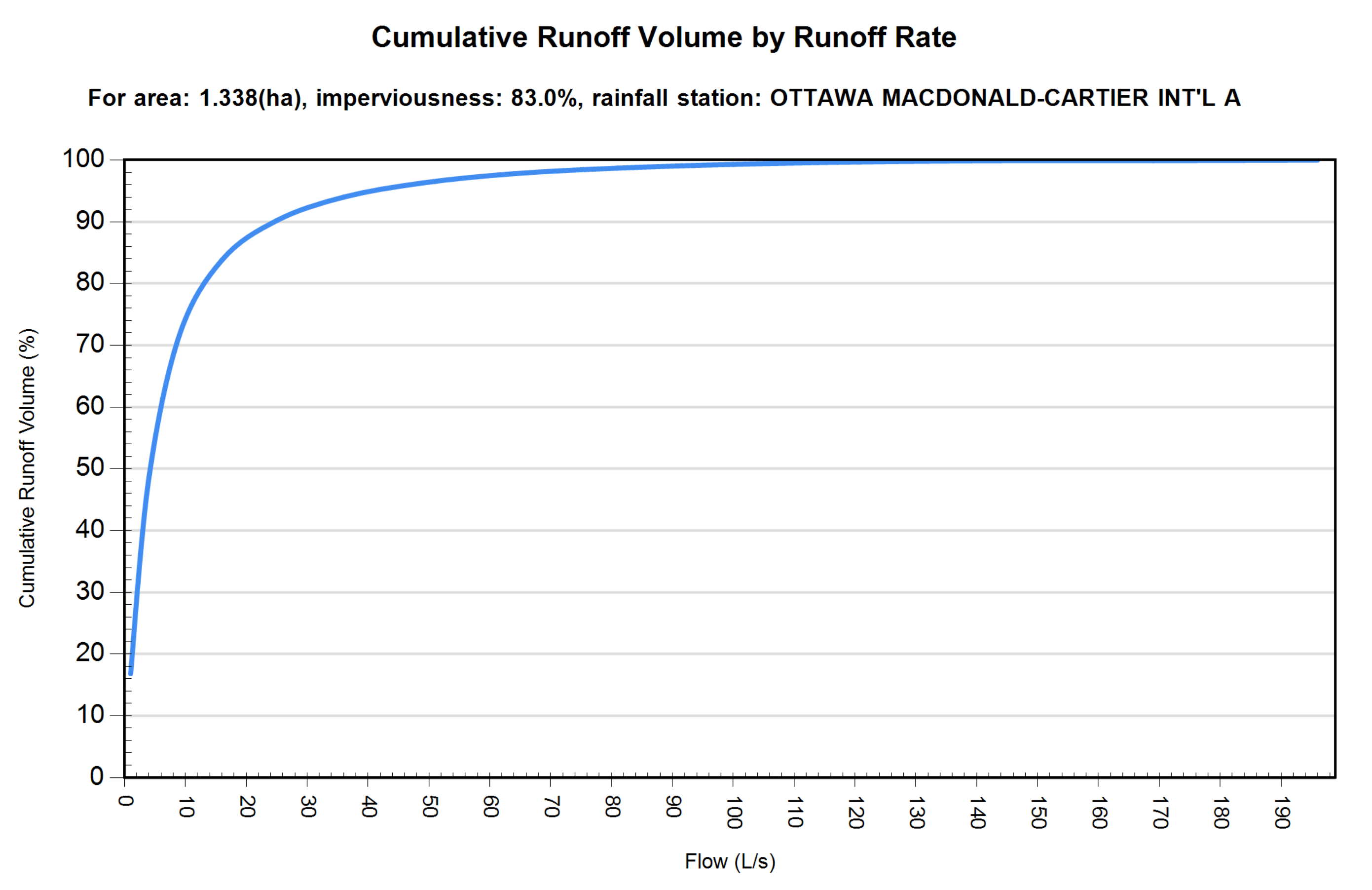
Winter Months	
Winter Infiltration	0

TSS Loading Parameters	
TSS Loading Function	

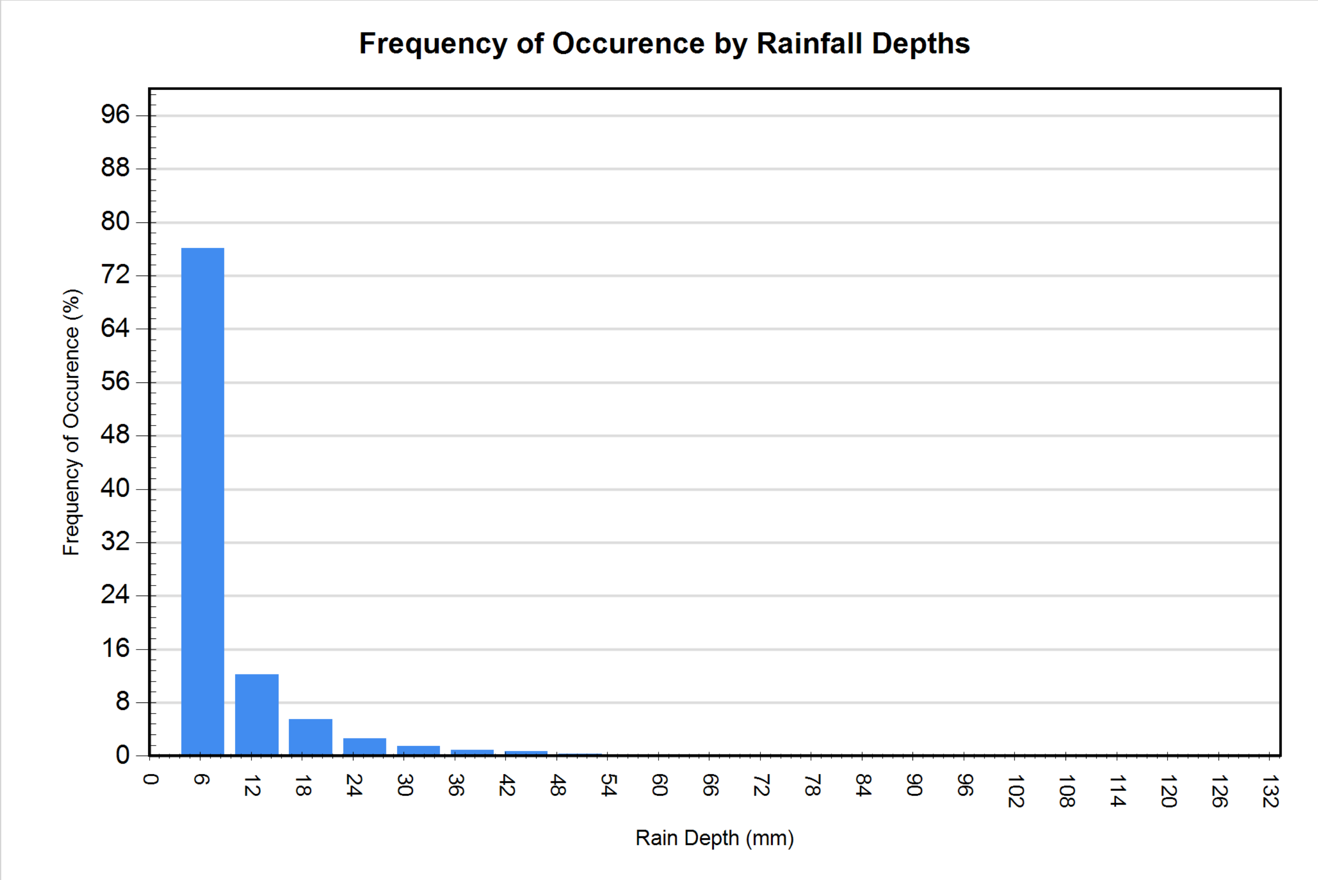
Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

TSS Availability Parameters	
Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	**Runoff Volume (m³)**	**Volume Over (m³)**	**Cumulative Runoff Volume (%)**
1	35662	176306	16.8
4	102833	109141	48.5
9	151873	60151	71.6
16	177581	34401	83.8
25	191141	20850	90.2
36	199311	12674	94.0
49	204215	7771	96.3
64	207325	4659	97.8
81	209262	2723	98.7
100	210520	1464	99.3
121	211339	645	99.7
144	211694	290	99.9
169	211865	119	99.9
196	211947	37	100.0



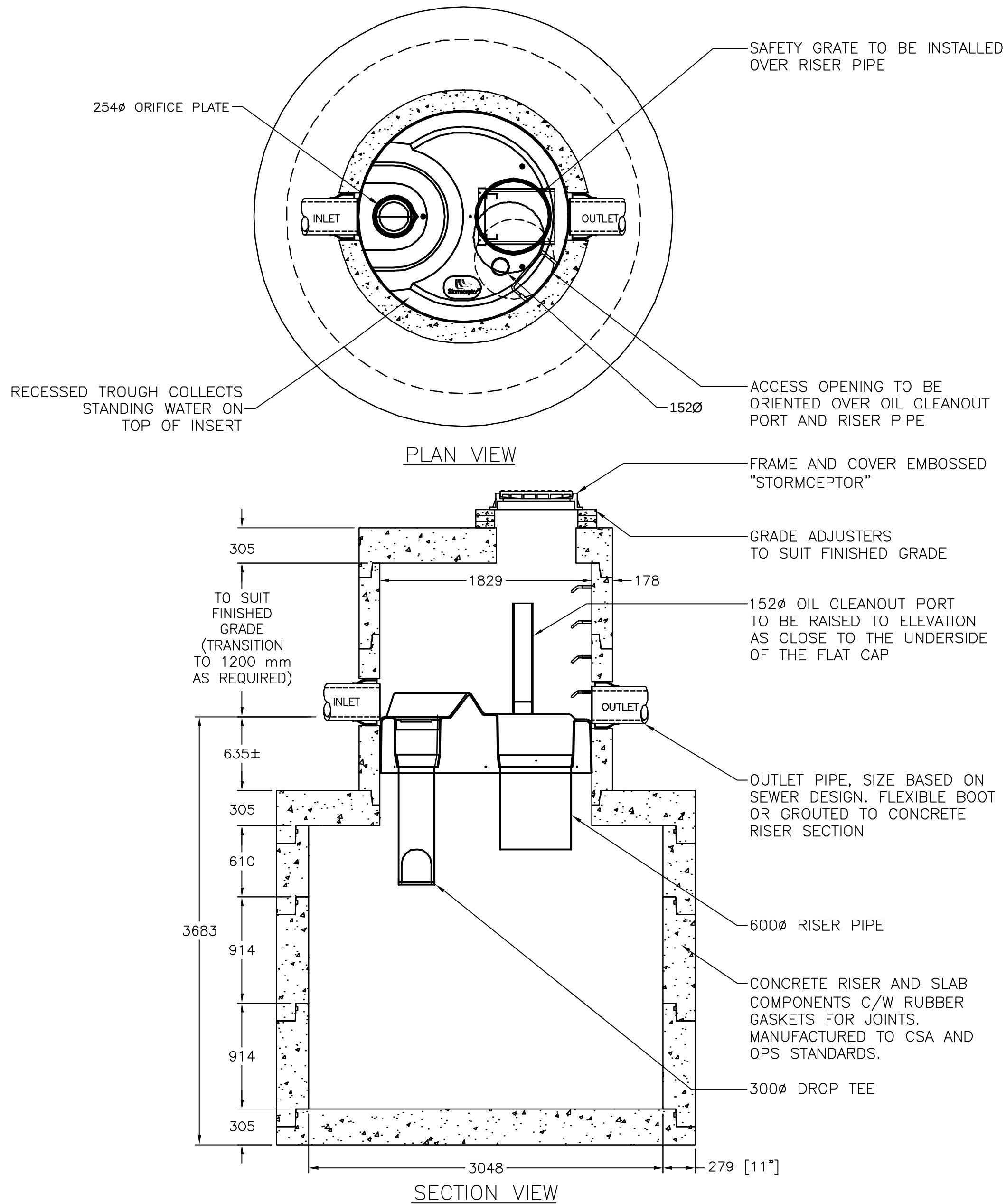
Rainfall Event Analysis				
Rainfall Depth (mm)	No. of Events	Percentage of Total Events (%)	Total Volume (mm)	Percentage of Annual Volume (%)
6.35	3113	76.1	5230	24.9
12.70	501	12.2	4497	21.4
19.05	225	5.5	3469	16.5
25.40	105	2.6	2317	11.0
31.75	62	1.5	1765	8.4
38.10	35	0.9	1206	5.8
44.45	28	0.7	1163	5.5
50.80	12	0.3	557	2.7
57.15	7	0.2	378	1.8
63.50	1	0.0	63	0.3
69.85	1	0.0	64	0.3
76.20	1	0.0	76	0.4
82.55	0	0.0	0	0.0
88.90	1	0.0	84	0.4
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0
107.95	0	0.0	0	0.0
114.30	1	0.0	109	0.5
120.65	0	0.0	0	0.0
127.00	0	0.0	0	0.0



For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

DRAWING NOT TO BE USED FOR CONSTRUCTION

THE STORMCEPTOR SYSTEM IS PROTECTED BY ONE OR MORE OF THE FOLLOWING PATENTS:
United States Patent No. 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690 • 7,582,216 • 7,666,303 | Australia Patent No. 693,164 • 707,133 • 729,096 • 779,401 • 289,647 • 2008,279,378 • 2008,288,900 | Canadian Patent No. 2,009,280 • 2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 | Indonesian Patent No. 007058 | Japan Patent No. 3581233 • 9-11476 | Korea Patent No. 10-1451593 • 0519212 | Malaysia Patent No. 118987 | New Zealand Patent No. 314,646 • 583,583 • 583,008 | South African Patent No. 2010/00683 • 2010/01796 |



Stormceptor®

imbrium®
WWW.IMBRIUMSYSTEMS.COM
407 FAIRVIEW DRIVE, WHITBY, ON L1N 3A9
TF 800-565-4801 CA 416-960-9900 INTL +1-416-960-9900

STC 4000
STANDARD MODEL
####

REV #	DATE	REVISION DESCRIPTION	BY

SHEET NUMBER 1 OF 1

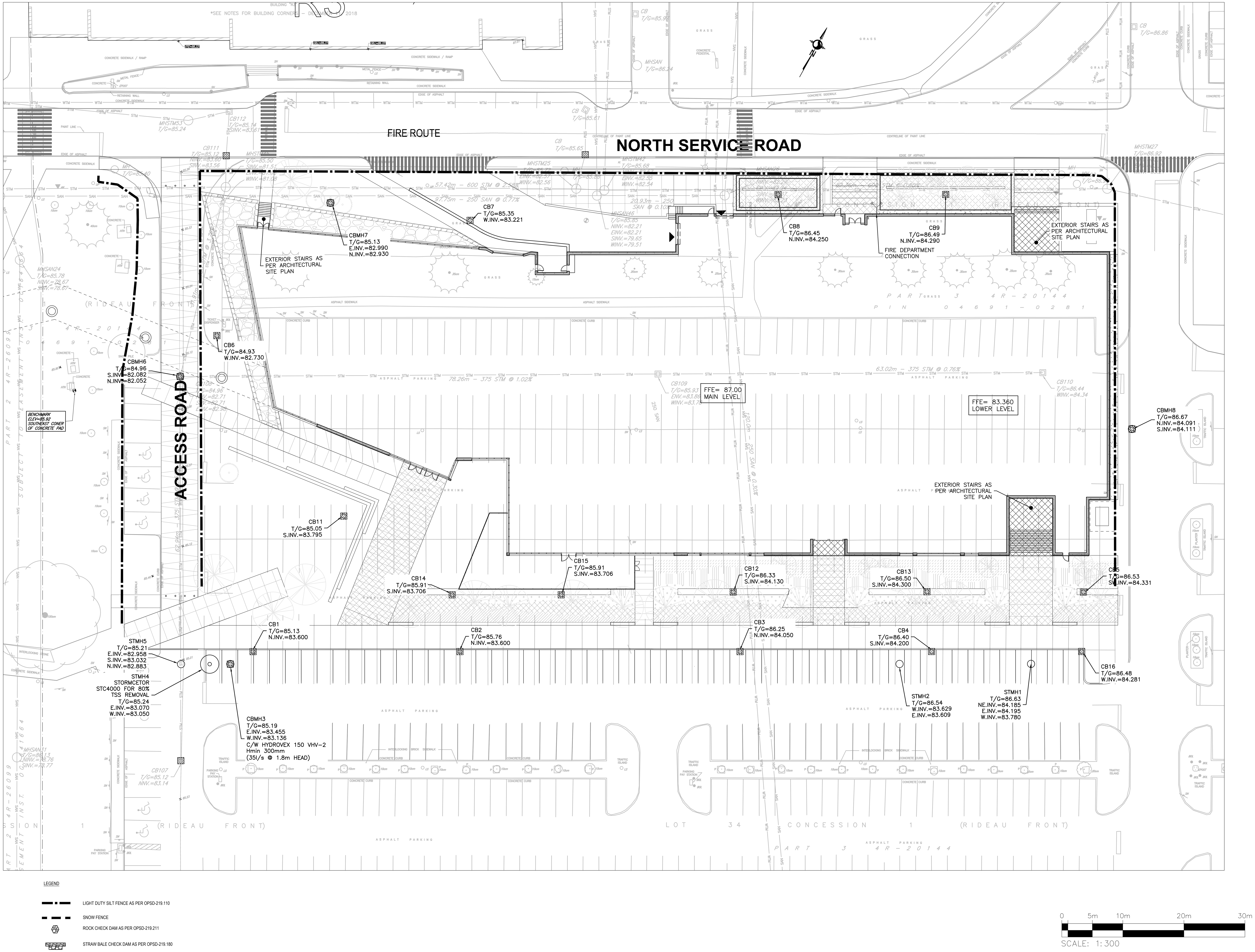
DATE: ######## | SCALE: 50 | PROJECT No.: ##### | DRAWN: ### | CHECKED: ###

I:\IMBRIUM\PRODUCTS\STORMCEPTOR STC\40 DRAWINGS & DETAILS\STANDARD DETAILS\METRIC\STC 4000.DWG 4/12/2019 1:26 PM

APPENDIX

D

- EROSION AND SEDIMENTATION CONTROL PLAN C06



LEGEND

LIGHT DUTY SILT FENCE AS PER OPSD-219.110

SNOW FENCE

ROCK CHECK DAM AS PER OPSD-219.211

STRAW BALE CHECK DAM AS PER OPSD-219.180

FILTER CLOTH PLACED UNDER CB AND CBMH COVER

FILENAME: P:\2019 Projects\191-01517-00_Algonquin College - ARC\Civil\Drawings\2 Working Drawings\Sheets\191-01517-00_CIVIL.dwg
PLOTDATE: Sep 24, 2019 - 4:27pm, caseyj069741

ALGONQUIN COLLEGE

Algonquin Students' Association

Project
ATHLETICS AND RECREATION CENTRE (ARC)

Prepared For
ALGONQUIN STUDENTS' ASSOCIATION

h+k
HOK Architects Corporation
205 Catherine Street, Suite 101
Ottawa, Ontario K2P 1C3 Canada
t +1 613 226 9650 f +1 613 226 9656

In Association with

WSP
STRUCTURAL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

WSP
MECHANICAL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

WSP
ELECTRICAL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

WSP
CIVIL
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

CSW Landscape Architects
LANDSCAPE
319 McRae Avenue, Suite 502
Ottawa, ON, K1Z 0B9

WSP
SUSTAINABILITY
2611 Queensview Drive, Suite 300
Ottawa, ON, K2B 8K2

Key Plan

Professional Seals

REGISTERED PROFESSIONAL ENGINEER
D. B. YANG
100230568
2019-09-24
PROVINCE OF ONTARIO

No.	Description	Date
1	SITE PLAN APPROVAL	2019-06-24
2	ISSUED FOR PERMIT/TENDER	2019-08-20
3	RESPONSE TO SPA COMMENTS	2019-09-24

Drawn by: D.B.Y. Reviewed by: J.J.
Project No: 191-01517-00

Sheet Title
EROSION AND SEDMENTATION CONTROL PLAN

Original drawing is A1. Do not scale contents of this drawing.

Sheet Number
C06

D07-12-19-0114

#17981

APPENDIX

E

- SUBMISSION CHECK LIST

4.1 General Content

☒ Executive Summary (for larger reports only).

Comments: Refer to Servicing Report Section 1.1

☒ Date and revision number of the report.

Comments: *Refer to front page of the Report*

☒ Location map and plan showing municipal address, boundary, and layout of proposed development.

Comments: *Refer to Figure 1.1 Site Location for Location Map and Plan*

☒ Plan showing the site and location of all existing services.

Comments: *Refer to drawing C04*

☒ Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.

Comments: *Refer to Architectural Site Plan for development statistics and Servicing Report for technical references.*

☒ Summary of Pre-consultation Meetings with City and other approval agencies.

Comments: Refer to Appendix A for Pre-Consultation Meeting Notes

☒ Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.

Comments: *Reference is provided to Pinecrest Creek Watershed SWM criteria, and conformance is confirmed in the Stormwater Management Report (Appendix C).*

☒ Statement of objectives and servicing criteria.

Comments: Refer to Servicing Report Section 1.7

☒ Identification of existing and proposed infrastructure available in the immediate area.

Comments: *Refer to drawing C04*

☒ Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).

Comments: *N/A*

☒ Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.

Comments: *Refer to drawing C03*

☒ Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.

Comments: *N/A*

☒ Proposed phasing of the development, if applicable.

Comments: *N/A*

☒ Reference to geotechnical studies and recommendations concerning servicing.

Comments: Reference provided to Paterson Group report.

☒ All preliminary and formal site plan submissions should have the following information:

- ☒ Metric scale
- ☒ North arrow (including construction North)
- ☒ Key plan
- ☒ Name and contact information of applicant and property owner
- ☒ Property limits including bearings and dimensions
- ☒ Existing and proposed structures and parking areas
- ☒ Easements, road widening and rights-of-way
- ☒ Adjacent street names

Comments: *Refer to drawing C03 and C04*

4.2 Development Servicing Report: Water

☒ Confirm consistency with Master Servicing Study, if available

Comments: *Refer to Servicing Report Section 2.1*

☒ Availability of public infrastructure to service proposed development

Comments: Refer to Servicing Report Section 2.1

☒ Identification of system constraints

Comments: N/A

☒ Identify boundary conditions

Comments: *Refer to Servicing Report Section 2.2*

☒ Confirmation of adequate domestic supply and pressure

Comments: *Refer to Servicing Report Section 2.3*

☒ Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow at locations throughout the development.

Comments: *Refer to Servicing Report Section 2.4*

☒ Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves.

Comments: *Refer to Servicing Report Section 2.5*

☒ Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design

Comments: *Refer to Servicing Report Section 2.6*

☒ Address reliability requirements such as appropriate location of shut-off valves

Comments: *Refer to Servicing Report Section 2.7*

☒ Check on the necessity of a pressure zone boundary modification.

Comments: *Refer to Servicing Report Section 2.8*

☒ Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range

Comments: *Refer to Servicing Report Section 2.9*

☒ Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions.

Comments: *Refer to Servicing Report Section 2.10*

☒ Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation.

Comments: *Refer to Servicing Report Section 2.11*

☒ Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.

Comments: *Refer to Servicing Report Section 2.12*

☒ Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.

Comments: Model schematic is not required. Refer to Servicing Report Section 2.13

4.3 Development Servicing Report: Wastewater

☒ Summary of proposed design criteria (Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure).

Comments: *Refer to Servicing Report Section 3.1*

☒ Confirm consistency with Master Servicing Study and/or justifications for deviations.

Comments: Refer to Servicing Report Section 3.2. Design based on Ottawa Sewer Design Guidelines.

☒ Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age and condition of sewers.

Comments: *Refer to Servicing Report Section 3.3*

☒ Description of existing sanitary sewer available for discharge of wastewater from proposed development.

Comments: *Refer to Servicing Report Section 3.4*

☒ Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable)

Comments: *Refer to Servicing Report Section 3.5*

☒ Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.

Comments: Refer to Servicing Report Section 3.9 and 3.11

☒ Special considerations such as contamination, corrosive environment etc.

Comments: *Refer to Servicing Report Section 3.8*

4.4 Development Servicing Report: Stormwater

☒ Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)

Comments: *Refer to Servicing Report Section 4.1*

☒ Analysis of available capacity in existing public infrastructure.

Comments: *Refer to Servicing Report Section 4.2*

☒ A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.

Comments: *Refer to drawing C04*

☒ Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.

Comments: *Refer to Stormwater Management Report*

☒ Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.

Comments: Refer to Stormwater Management Report

☒ Description of the stormwater management concept with facility locations and descriptions with references and supporting information.

Comments: *Refer to Stormwater Management Report*

☒ Set-back from private sewage disposal systems.

Comments: *N/A*

☒ Watercourse and hazard lands setbacks.

Comments: N/A

☒ Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.

Comments: Refer to Appendix A

☒ Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.

Comments: *Consistency confirmed with requirements for Pinecrest Creek watershed.*

☒ Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).

Comments: *Refer to Stormwater Management Report in Appendix C for storage requirements and major events. Refer to Section 4 for existing minor system capacity and*

☒ Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.

Comments: N/A

☒ Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.

Comments: *Refer to Stormwater Management Report*

☒ Any proposed diversion of drainage catchment areas from one outlet to another.

Comments: *Refer to Servicing Report Section 4.13*

☒ Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.

Comments: Refer to Servicing Report Section 4.6-4.10, Appendix D and drawing C04

☒ If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event.

Comments: N/A

☒ Identification of potential impacts to receiving watercourses

Comments: *Refer to Servicing Report Section 4.15*

☒ Identification of municipal drains and related approval requirements.

Comments: N/A

☒ Descriptions of how the conveyance and storage capacity will be achieved for the development.

Comments: *Refer to Servicing Report Section 4.17*

☒ 100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.

Comments: Refer to drawings C03 and C04.

☒ Inclusion of hydraulic analysis including hydraulic grade line elevations.

Comments: *Refer to Servicing Report Section 4.18*

☒ Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.

Comments: *Refer to Servicing Report Section 5.0*

☒ Identification of floodplains - proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.

Comments: *N/A*

☒ Identification of fill constraints related to floodplain and geotechnical investigation.

Comments: *N/A*

4.5 Approval and Permit Requirements: Checklist

The Servicing Study shall provide a list of applicable permits and regulatory approvals necessary for the proposed development as well as the relevant issues affecting each approval. The approval and permitting shall include but not be limited to the following:

☐ Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.

Comments: *No approval anticipated. RVCA will be circulated.*

☐ Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.

Comments: No ECA required based on information provided from previous inquiry made by City of Ottawa with MECP.

☐ Changes to Municipal Drains.

Comments: *Not applicable.*

☐ Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)

Comments: *Not applicable.*

4.6 Conclusion Checklist

☒ Clearly stated conclusions and recommendations

Comments:

☐ Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.

Comments: *Further comments to be added following site plan application review.*

☒ All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario

Comments: