

2501563 ONTARIO LTD.

# STORMWATER MANAGEMENT REPORT

SAUGEEN CEDAR HEIGHTS EAST SUBDIVISION  
TOWN OF HANOVER

AUGUST 2018

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SWM1 – Existing Drainage Conditions

SWM2 – Proposed Drainage Conditions

### B – Pre Consultation

### C – Pre-Development Model Output

### D – Post Development Model Output



# 1. INTRODUCTION

Cobide Engineering Inc. was retained by 2501563 Ontario Inc. to complete a preliminary stormwater management report in support of a Draft Plan Approval Application. The application will be to subdivide the subject property into a 98 lot subdivision.

A copy of the proposed Draft Plan has been included in Appendix A as Drawing DP1.

## 1.1 LOCATION

The proposed subdivision development is located on Lots 11, 12, 13 and 14, Concession 1 N.D.R., Former Township of Bentinck, Town of Hanover, County of Grey (described herein as the “site”). A Site Location Map is included as Figure 1. The subject property is approximately 17.85 hectares in area.

## 1.2 DEVELOPMENT PROPOSAL

The subdivision will consist of 58 single family residential lots, 18 semi-detached lots and 32 townhouse lots along two (2) streets as well as a stormwater management block, two (2) utility blocks and three (3) undevelopable lots.

The road network within the subdivision will include extensions of 14<sup>th</sup> Street and 25<sup>th</sup> Avenue.

## 1.3 SCOPE OF WORK

The stormwater management report addresses the design and implementation of drainage and stormwater management facilities for the development.

The report includes:

- Details for erosion protection and sedimentation control for short term, construction phase and the long term.
- Quantity Control
- Quality Control
- Establish lot grading requirements for the proposed subdivision
- Provisions for major flows through the development

## 1.4 BACKGROUND INFORMATION

In support of this application, the following information was prepared:

- Pre-consultation with the County of Grey, Town of Hanover and Saugeen Valley Conservation Authority (SVCA) which will be discussed later in the report. A copy of the correspondence from the pre consultation meeting has been included in Appendix B.







## 2. DRAINAGE CHARACTERISTICS

### 2.1 REGIONAL

The Saugeen River is located immediately east of the site. There is also an unnamed creek that traverses through the western portion of the site

### 2.2 LOCAL

The majority of runoff from the site is conveyed by the unnamed watercourse to the Saugeen River to the west. The undevelopable lands on the east side of the site discharge directly to the Saugeen River.

### 2.3 SOILS

According to the Grey County Soils Survey (January, 1954), the soils on the site are classified as Sullivan Sand (Sus). Sullivan Sands are described as well sorted sandy outwash soils with good drainage. These soils are typically associated with the Hydrologic Soils Group (HSG) A.

### 2.4 DISCHARGE POINTS

Based on existing topography there are two discharge points for stormwater runoff from the site.

#### **Discharge Point #1**

For the purpose of this report, Discharge Point #1 will be all runoff that is conveyed offsite via the unnamed creek on the west side of the site.

#### **Discharge Point #2**

For the purpose of this report, Discharge Point #2 will be all runoff that flows to the Saugeen River to the east of the site.



### 3. STORMWATER CONTROL

The design guidelines and constraints utilized in the stormwater management review for the development are as follows:

#### 3.1 DESIGN GUIDELINES

The main design guideline utilized in the review is the Ministry of the Environment's "Stormwater Management Planning and Design (SWMP&D) Manual," dated March 2003.

The SWMP&D Manual details the methodologies for the preparation and evaluation of urban/suburban stormwater management measures. The document provides direction on the design of drainage/stormwater management facilities required to meet the goals and objectives of the various Municipal/Provincial Review Agencies.

The SWMP&D Manual also provides information on the long-term operation and maintenance techniques for stormwater management facilities that may be implemented in the development of the subdivision.

The storm sewer design criteria to be used are as follows:

- Runoff from the 5 year storm is to be conveyed to a sufficient outlet via a combination of storm sewers and grass swales/ditches;
- Major storm runoff (i.e. >5 years) is to be contained within specified drainage corridors and not adversely impact any of the proposed units within the development or off-site properties;

#### 3.2 METHODOLOGY FOR COMPUTING STORMWATER RUNOFF

As noted previously, the objectives of the Stormwater Management (SWM) Plan for development is to ensure that there is an adequate outlet to convey the runoff from the minor and major storm systems.

The objectives are to be achieved by completing the following tasks:

- i. Determining the existing drainage conditions.
- ii. Determining the post-development drainage conditions.
- iii. Design stormwater management measures that meet the criteria of the Town of Hanover, MOECC and Saugeen Valley Conservation Authority (SVCA).
- iv. Summarize the analysis by identifying conclusions and recommendations.



## 4. EXISTING CONDITIONS

The site is currently partially used for agricultural purposes with remainder of the site being forested lands.

The existing catchments areas are delineated in Drawing SWM1 in Appendix A.

Summarized below is a description of each of the drainage catchment areas.

### 4.1 CATCHMENT AREA 101

- This catchment area encompasses the majority of the site from close to the eastern treeline to County Road #28.
- Surface water flows by sheet flow to the unnamed creek traversing the site.
- Catchment Area 101 is considered to discharge at Discharge Point #1 for the purposes of this report.
- Drainage Area = 11.90 ha.

### 4.2 CATCHMENT AREA 102

- This catchment area encompasses the valley lands on the east side of the site.
- Surface water flows by sheet flow toward the Saugeen River.
- Catchment Area 102 is considered to discharge at Discharge Point #2 for the purposes of this report.
- Drainage Area = 5.96 ha.



## 5. PROPOSED CONDITIONS

The proposed catchment area boundaries are delineated on Drawing SWM2 in Appendix A.

Summarized below is a description of each of the drainage catchment areas.

### 5.1 CATCHMENT 201

- This catchment area encompasses the western portion of site including the rear yards of Lots 59-78.
- 14<sup>th</sup> Street from County Road #28 to the proposed high point (located approximately 20m west of the back of Lot 73) is included in this catchment area.
- Based on grading and the existing flow patterns, the minor and major flows from this area will flow uncontrolled to the unnamed creek.
- Catchment Area 201 is considered to discharge at Discharge Point #1 for the purposes of this report.
- Drainage Area = 5.66 ha.

### 5.2 CATCHMENT 202

- This catchment area encompasses the rear of Lots 4-14.
- Based on grading and the existing flow patterns, the minor and major flows from this area will flow uncontrolled to the unnamed creek.
- Catchment Area 202 is considered to discharge at Discharge Point #1 for the purposes of this report.
- Drainage Area = 0.33 ha.

### 5.3 CATCHMENT 203

- This catchment area encompasses the majority of the developable portion of the subdivision
- Minor flows will be captured by the storm sewers and major flows will flow overland to the low point near the intersection of 14<sup>th</sup> Street and 25<sup>th</sup> Avenue where runoff will pond before entering the storm sewers. Both the minor and major storm events will discharge to the Saugeen River.
- Based on the modelling a 900mm diameter storm sewer will accommodate all design storms up to and including the 100-year design storm event. This will be confirmed during detailed design.
- Catchment Area 203 is considered to discharge at Discharge Point #2 for the purposes of this report.
- Drainage Area = 6.38 ha.

### 5.4 CATCHMENT 204

- This catchment area encompasses the valley lands on the east side of the site.
- Catchment 204 is generally the same as Catchment Area 101.
- Catchment Area 204 is considered to discharge at Discharge Point #2 for the purposes of this report.
- Drainage Area = 5.49 ha.



## 6. QUANTITY CONTROL MODELLING

The hydrologic modelling software PCSWMM Version 5.6.1803 Professional 2D was used to determine the pre and post-development peak flows of the 2 yr., 5 yr., 25 yr., 50 yr., and 100 yr. storm events (6 hour duration, SCS Type II, AMC II storm, Mount Forest IDF Parameters). Based on the pre-consultation meeting minutes, previously discussed, it was indicated that all post development flows must match pre-development levels to the respective outlets unless the outlet was the Saugeen River. A copy of this correspondence has been included in Appendix B.

Based on this it was decided that the majority of runoff would be directed to the east to reach the Saugeen River.

The pre-development and post development parameters and model outputs are contained in Appendix C and D respectively.

### 6.1 DESIGN REQUIREMENTS

The intent of stormwater quantity control is to limit the flows under proposed conditions to existing levels or less to protect the downstream watercourses, infrastructure and properties. As per direction from the SVCA quantity control would not be required if the runoff can be directed directly to the Saugeen River as the runoff from this development would not have an impact on the overall flow of the river during a design storm event

Minor flows from the majority of the development will be conveyed to the east to the Saugeen River. This storm sewer collection system will be designed to accommodate all flows up to and including the 5 year storm event. A portion of the storm sewer may be oversized to accommodate larger storm events to ensure that runoff is directed to the Saugeen River.

Major flows (>5 year), will be conveyed overland within the road allowance of each street.

Quality Control will still be required to meet an enhanced level of control at both outlets.

### 6.2 MODELLING RESULTS

Based upon the above outlet structure, the following summarizes the pre-development and post development peak flows to the two (2) discharge points.

Table 6.1 - Peak Flow Summary

RETURN PERIOD	DISCHARGE POINT #1 (l/s)		DISCHARGE POINT #2 (l/s)	
	PRE	POST	PRE	POST
2 Year	30.52	32.20	17.23	341.11
5 Year	53.85	47.55	30.31	456.91
25 Year	101.76	78.86	61.05	646.49
50 Year	125.46	95.1	77.38	720.36
100 Year	150.96	113.17	95.45	775.83



The following summarizes the pre-development and post development results at each discharge point:

#### 6.2.1 DISCHARGE POINT #1

All storm events in the post development scenario are below pre-development levels with the exception of the 2 Year storm event which is slightly higher. This increase is not expected to be a concern as the downstream infrastructure is designed to convey flows from larger storm events. The flow rate being slightly higher during the 2 year storm event will also ensure that the wetland feature is not being starved of moisture during small rain events which are predominately the rainfall events that occur during any given year.

#### 6.2.2 DISCHARGE POINT #2

All storm events in the post development scenario are above pre-development levels however it is not expected to be a concern as the runoff is being discharged to the east toward the Saugeen River and there are no downstream properties that will be negatively impacted by this increase.



## 7. QUALITY CONTROL

To meet the requirements of the SVCA and the MOECC, stormwater quality control will be provided for the proposed development. The MOE SWMP&D Manual recommends that the required level of protection be associated with the habitat sensitivity of the receiving watercourse. The ultimate receiving watercourse for this development is the Saugeen River. For the purposes of this report, an 'Enhanced' water quality protection level will be implemented in accordance to the MOE 2003 Guidelines and SVCA requirements.

In keeping with the approach suggested in the SWMP&D manual however, a 'treatment train' approach to stormwater quality management has been proposed for this development. This approach consists of three (3) levels of treatment which are described as follows:

- Lot level control measures
- Conveyance control measures
- End-of-Pipe control measures

A review of each measure and it's suitability for use in the development is discussed below:

### 7.1 LOT LEVEL CONTROL MEASURES

The Town's design standards require minimum grades of 2% from the back of curb to the property line. Therefore, reduced lot grading of the front, side and rear yards to less than 2% is not feasible.

The subdivision property contains native soils that exhibit average drainage characteristics. The use of individual drainage pits and infiltration trenches therefore has not been considered as a feasible option based on the ongoing maintenance typically is not.

It is proposed that all runoff draining from rooftops be directed overland across the grass lawns to encourage infiltration and filtering of pollutants from this runoff. The following note will be added to the Lot Grading Plan "Roof drain troughs shall be directed to grassed areas of the property and not to driveways or private drain connections".

### 7.2 CONVEYANCE CONTROL MEASURES

The Town's standard road cross section only allows for the use of curb and gutter in new urban type subdivisions. Therefore, the use of grass swales as a conveyance control measure for runoff from the subdivision streets cannot be implemented.

Grassed drainage swales may be proposed to be constructed in the rear yards of some of the lots. These swales will provide rear yard drainage for the proposed lots. Swales will have slopes of at least 2.0% where possible. This will assist with removing pollutants and sediment from the runoff prior to draining into the municipal storm sewer system.

All catchbasins and manholes within the subdivision will be provided with minimum 600 mm and 300mm sumps respectively which will assist in removing a portion of the sediment contained in the runoff from the street.

Perforated pipes will likely be used to within the development to assist in controlling any perched groundwater. This will result in better construction conditions during home building as well as improve the bearing capacity of the road.

### 7.3 END-OF-PIPE CONTROL MEASURES

The use of a Oil Grit Separators (OGS) was selected as an 'end of pipe' control measure. The basic function of an OGS is to remove pollutants from runoff. An OGS was selected as it is the only viable



option due to space constraints for Discharge Point #1 and to maximize the developable area for discharge Point #2.

Both OGS units will be designed in conformance with the MOE design guidelines to achieve an “Enhanced” Level of protection. The OGS units for both discharge points will be selected during detailed design.



## 8. EROSION & SEDIMENTATION CONTROL

### 8.1 CONSTRUCTION STAGE

The following are details regarding the erosion and sediment control measures to be implemented during construction:

- Placement of siltation fences in all areas where surface drainage flows over disturbed areas. Siltation fence shall remain erect until construction is completed, and the upstream area is fully re-vegetated. Heavy Duty Silt Fence is to be installed along all tree retention boundaries to ensure that they are clearly delineated, and that silt is not directed into the wetland or into the valley lands.
- Placement of temporary straw check dams within swales and any other locations where a concentrated flow of runoff may occur. All proposed drainage swales are to be seeded during construction;
- Installation of filter cloth under all new and existing catchbasin grates until paving of the subdivision streets is completed;
- Mud mats will be placed at construction accesses to keep public roadways free from debris during the construction period.

Once the ground surface of the site has been stabilized, the straw bale check dams and siltation fences can then be removed.

During the construction phase, it is important to ensure that erosion/sediment control is in place to ensure against transport of sediment into the existing downstream drainage courses.

At the storm sewer outlet to the Saugeen River, either large diameter rip-rap or cable concrete matting will be utilized to protect against erosion of the slope.

A detailed Erosion and Sedimentation Control plan including drawings will be completed during detailed design.

### 8.2 LOT DEVELOPMENT

During individual construction of homes within the subdivision, siltation barriers are to be constructed, as appropriate, to prevent the erosion of materials into the storm sewer system or the existing drainage ditches. The siltation barriers can be in the form of siltation fences or shallow excavated sediment traps in the direction of flow from the construction site to the proposed drainage system.

The responsibility for the individual sediment control is the landowner constructing the dwelling.



## 9. CONCLUSIONS & RECOMMENDATIONS

The above report presented the Preliminary Stormwater Management Plan in support of the Draft Plan of Subdivision Application. Based on the findings of this report, the following conclusions are made:

1. Stormwater quantity will not be required as described previously.
2. Stormwater quantity control for the development will maintain or lower pre-development flows at Discharge Point #1 with the exception of the two-year design storm. Peak Flows at Discharge Point #2 do not need to be controlled to pre-development levels as per correspondence with the SVCA
3. Stormwater quality will be provided by a treatment train approach which will include lot level control, conveyance control and 'end-of-pipe' control measures.

Lot level control will be provided by directing most impervious areas not directly connected to the municipal storm sewer system, over vegetated areas and directing all rear yard drainage to grass swales prior to discharging into the proposed storm sewer system.

Conveyance control will be provided by and providing a minimum 600 mm sumps in all catchbasins and a minimum 300 mm sumps in all catchbasin manholes as well as goss traps in the catchbasin leads.

End-of-pipe control will be provided by an Oil Grit Separator at each Discharge Point.

All three levels of the treatment train approach will be used for the development to provide an "Enhanced" Level of protection for the development.

Based on the above conclusions of this report, it is recommended that the above Stormwater Management Report for the subdivision be submitted to the County of Grey, SVCA, and Town of Hanover as part of the Draft Plan Approval Application.

Sincerely,

**Cobide Engineering Inc.**

  
Travis Burnside, P. Eng.



# Appendix A

**DRAWINGS**

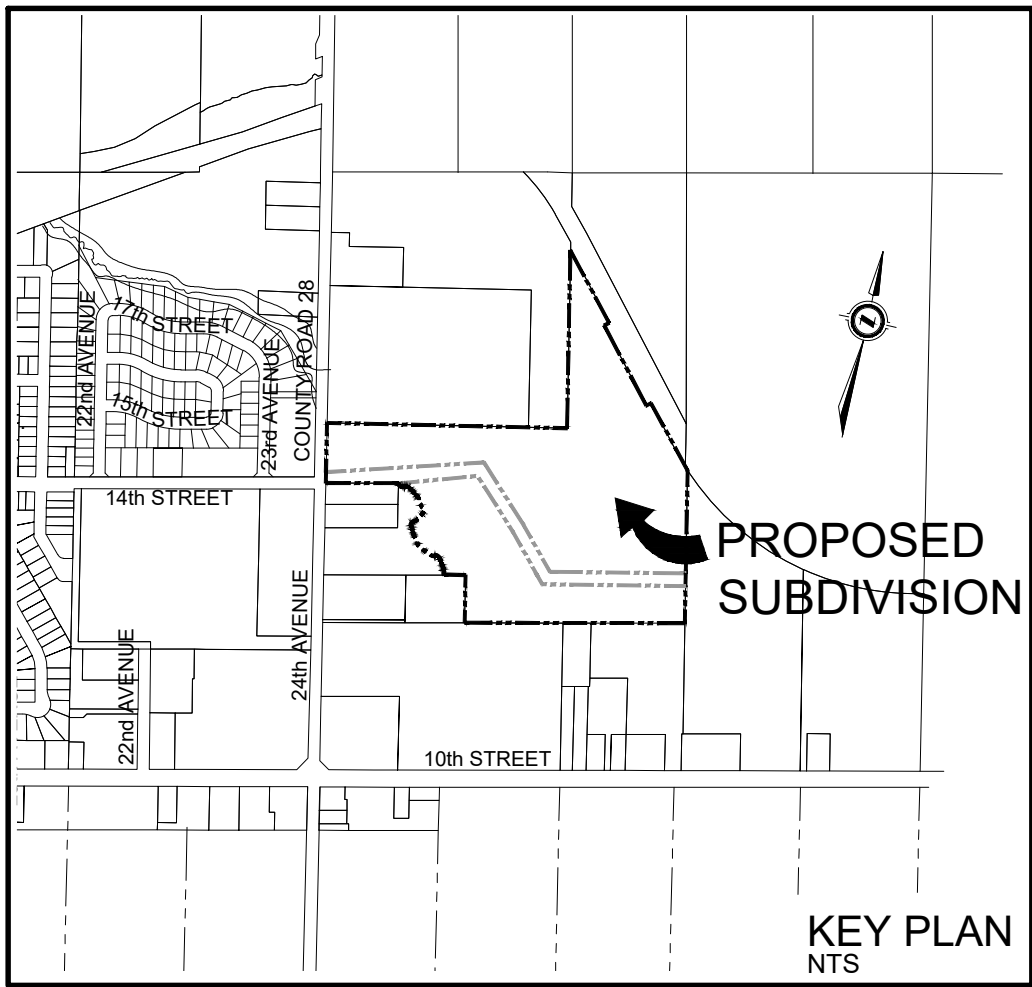
**STORMWATER MANAGEMENT REPORT**

**SAUGEEN CEDAR HEIGHTS EAST SUBDIVISION  
TOWN OF HANOVER**

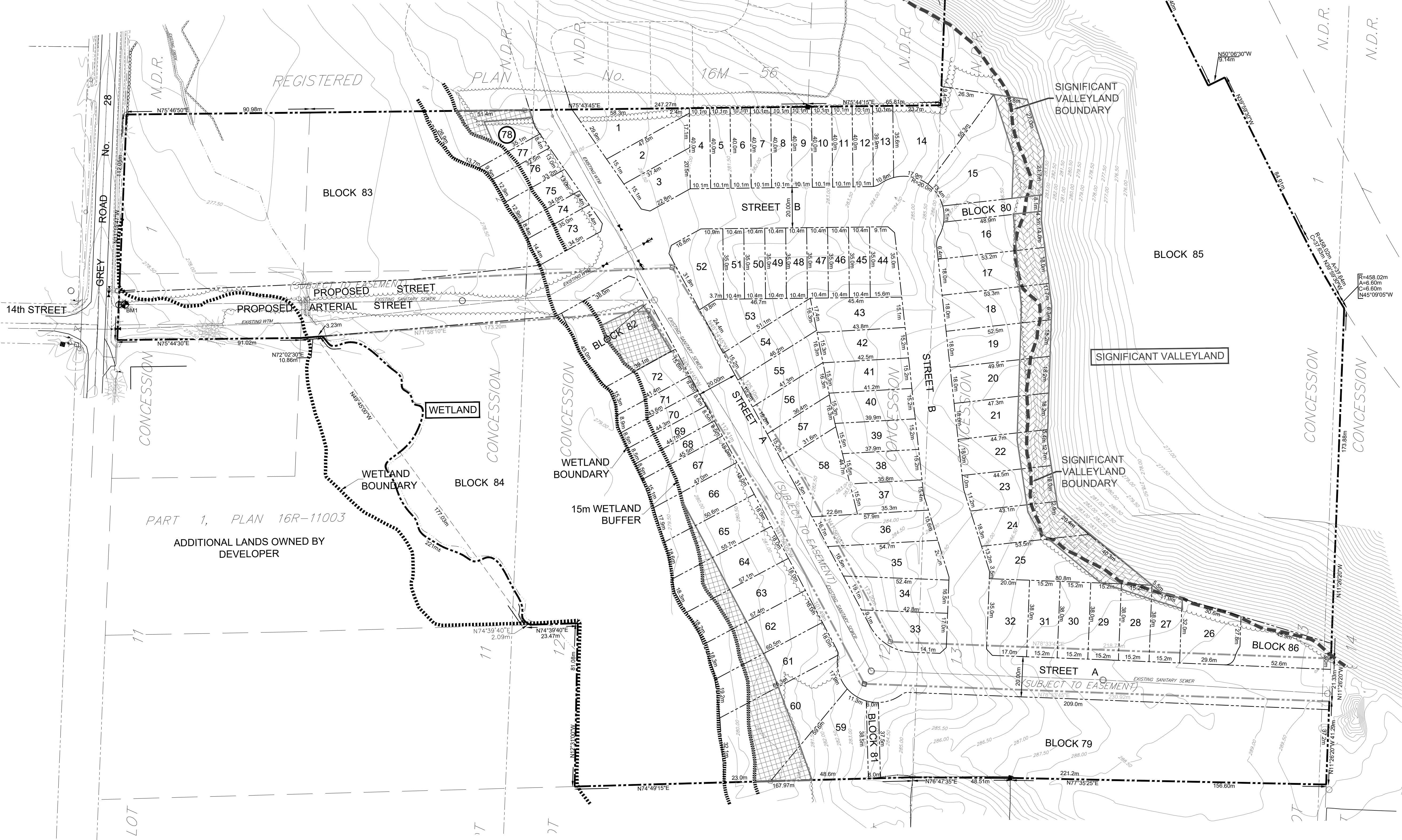








LEGEND	
---	EXISTING STREET/PROPERTY LINES
---	PROPOSED STREET/PROPERTY LINES
---	EDGE OF EXISTING PAVEMENT
---	EDGE OF EXISTING GRAVEL
---	EXISTING STORM SEWER
---	EXISTING FENCE
---	EXISTING TREE LINE
---	EXISTING UNDERGROUND TELEPHONE CABLE
---	EXISTING UNDERGROUND GAS LINE
---	EXISTING UNDERGROUND HYDRO CABLE
---	EXISTING DITCH
---	EXISTING MANHOLE
---	EXISTING CATCH BASIN
---	EXISTING HYDRO GUY WIRE
---	EXISTING TELEPHONE PEDESTAL
---	STANDARD IRON BAR
---	IRON BAR
---	EXISTING DECIDUOUS TREE AND DIAMETER
---	EXISTING CONIFEROUS TREE AND DIAMETER
---	BENCHMARK
---	EXISTING CONTOUR



DRAFT PLAN OF SUBDIVISION  
PART OF LOTS 11, 12, 13 AND 14  
CONCESSION 1 N.D.R.  
GEOGRAPHIC TOWNSHIP OF BENTINCK  
TOWN OF HANOVER  
COUNTY OF GREY

RELEVANT SITE INFORMATION	
SEMI-DETACHED RESIDENTIAL LOTS (LOTS 4 TO 13 AND 44 TO 51)	0.705 ha.
DETACHED RESIDENTIAL LOTS (LOTS 1 TO 3, 14 TO 43 AND 52 TO 66)	4.129 ha.
TOWNHOUSE RESIDENTIAL LOTS (LOTS 67 TO 78)	0.570 ha.
MUNICIPAL STREET (14th STREET, STREETS A & B)	2.501 ha.
FUTURE DEVELOPMENT (BLOCK 79)	0.880 ha.
DRAINAGE BLOCK (BLOCK 80)	0.039 ha.
UTILITY CORRIDOR (BLOCK 81 & 82)	0.199 ha.
OPEN SPACE (BLOCK 83, 84 & 85)	8.739 ha.
TEMPORARY TURNING CIRCLE (BLOCK 86)	0.087 ha.
TOTAL PROPOSED SUBDIVISION	17.849 ha.

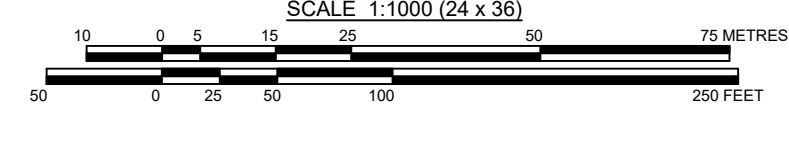
ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51 OF THE PLANNING ACT	
a. AS SHOWN	g. AS SHOWN
b. AS SHOWN	h. MUNICIPAL WATER SUPPLY
c. AS SHOWN	i. SANDY SILT & GRAVEL
d. SINGLE FAMILY RESIDENTIAL, SEMI-DETACHED RESIDENTIAL	j. AS SHOWN
e. AS SHOWN	k. WATER, STORM SEWERS, SANITARY SEWERS, HYDRO, TELEPHONE
f. AS SHOWN	l. AS SHOWN

SURVEYOR'S CERTIFICATE	
I CERTIFY THAT: THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE CORRECTLY SHOWN.	
DATE	
NEIL C. MILNE ONTARIO LAND SURVEYOR HEWETT & MILNE LTD.	

OWNER'S CERTIFICATE	
I, THE REGISTERED OWNER OF THESE LANDS, HEREBY AUTHORIZE COBIDE ENGINEERING INC. TO SUBMIT THIS DRAFT PLAN FOR APPROVAL.	
DATE	
OWNER: 2501563 ONTARIO INC. c/o JOERG WELLER 302300 CONCESSION ROAD 2 S.D.R. HANOVER, ON N4N 3B8	

Notes	
1. TOPOGRAPHICAL INFORMATION DERIVED FROM FIELD SURVEY BY WSP CANADA INC. COMPLETED ON JUNE 9, 2016.	
2. PROPERTY BOUNDARY DERIVED FROM INFORMATION SHOWN ON PLAN 16R-10068.	

Benchmark Information	
BM1 SOUTHEAST CORNER OF CONCRETE TRANSFORMER VAULT AT THE INTERSECTION OF 14th STREET AND GREY COUNTY ROAD No. 28. ELEVATION 280.10m	



Revision / Issue	
No.	DATE
0	JUL 13/18
FIRST SUBMISSION	
DESCRIPTION	
BY APPD	

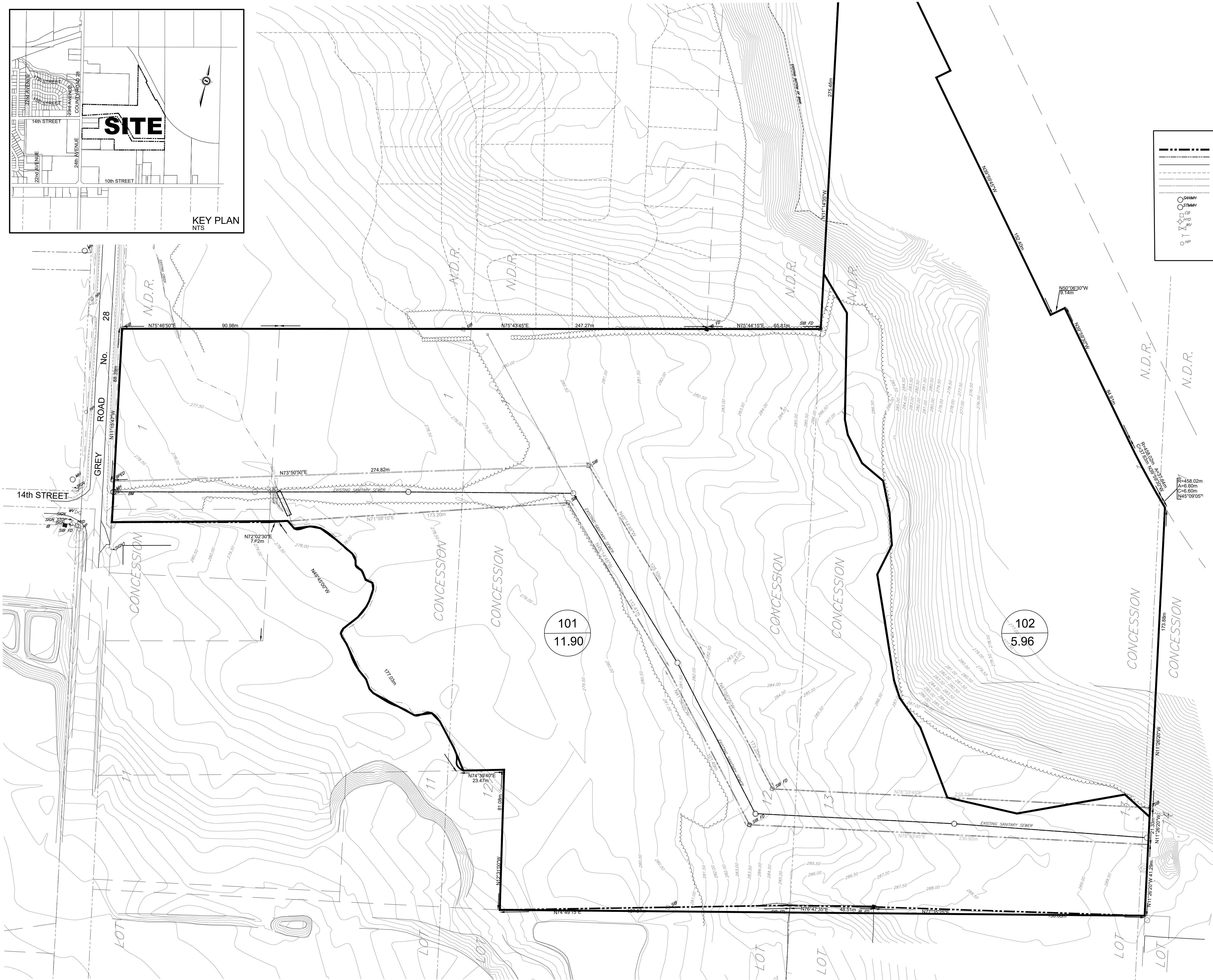
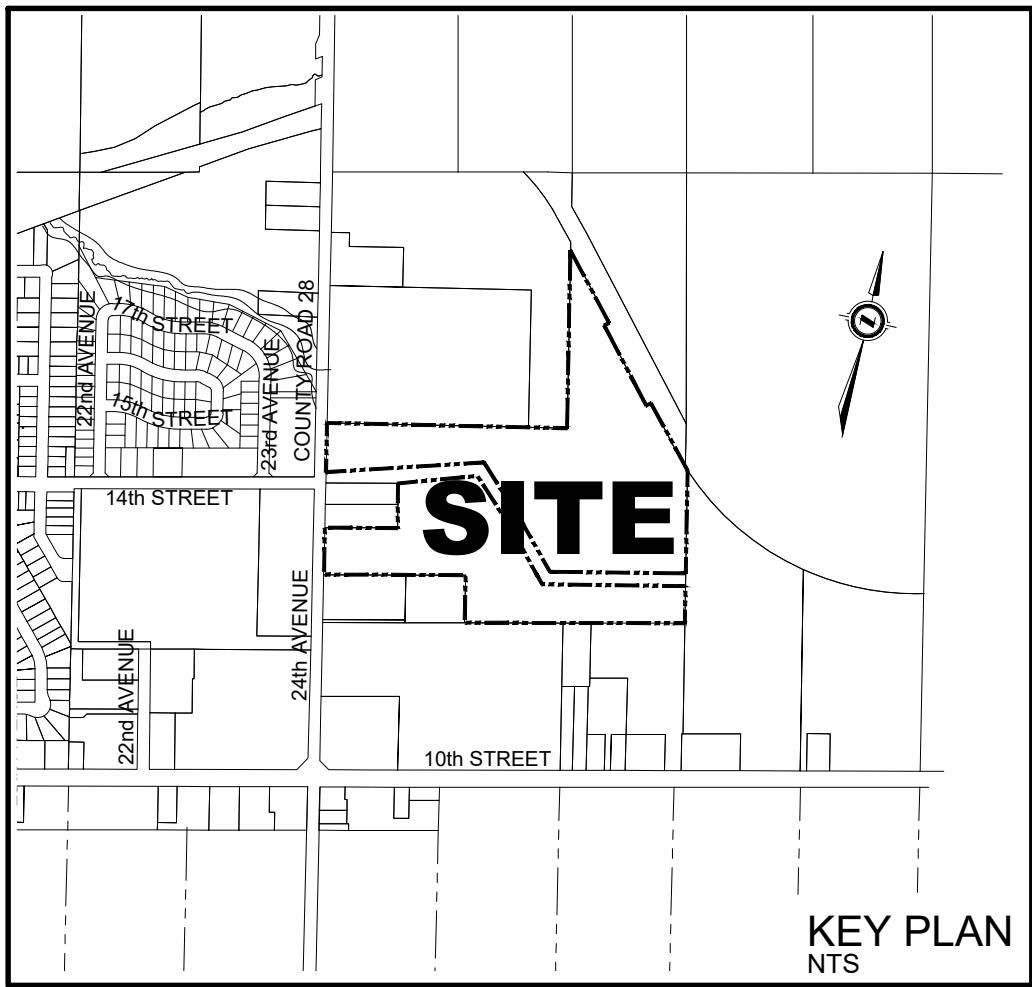
**COBIDE**  
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464A - 10th STREET, Hanover, Ontario N4N 1R1  
Telephone: (519) 506-5959  
www.cobideeng.com

Client:	
2501563 ONTARIO INC.	
Design:	TLB
Scale:	1:1000
Drawn:	JAF
Approved:	
Checked:	SJC
Date:	JUN 2016
Drawing No.	00502-DP-1









CAUTION:  
THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS  
AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND  
STRUCTURES IS NOT NECESSARILY SHOWN ON THE DRAWINGS,  
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.

#### Notes

1. TOPOGRAPHICAL INFORMATION DERIVED FROM FIELD SURVEY BY WSP  
CANADA INC. COMPLETED ON JUNE 9, 2016.
2. PROPERTY BOUNDARY DERIVED FROM INFORMATION SHOWN ON PLAN  
16R-10098.

#### LEGEND

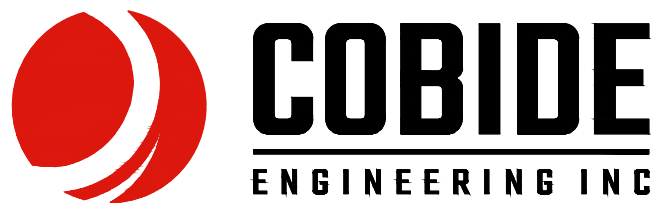
---	PROPERTY BOUNDARY	□ CATV	EXISTING CABLE TV PEDESTAL
---	PROPOSED STREET/PROPERTY LINES	□ BPPD	EXISTING TELEPHONE PEDESTAL
---	EDGE OF EXISTING PAVEMENT	□ SB	EXISTING TELEPHONE PEDESTAL
---	EDGE OF EXISTING GRAVEL	□ IR	EXISTING TELEPHONE PEDESTAL
---	EXISTING SANITARY SEWER	○	EXISTING DECIDUOUS TREE
---	EXISTING STORM SEWER	○	EXISTING CONIFEROUS TREE
---	EXISTING WATERMAIN	○	EXISTING TREE LINE
---	EXISTING SANITARY MANHOLE	○	BENCHMARK
---	EXISTING STORM MANHOLE	○	PROPOSED TREE RETENTION AREAS
---	EXISTING CATCH BASIN	○	PROPOSED TREE REPLACEMENT AREAS
---	EXISTING FIRE HYDRANT	○	
---	EXISTING GATE VALVE	○	
---	EXISTING HYDRO GUY WIRE	○	
---	EXISTING HYDRO POLE	○	

#### Benchmark Information

BM1  
SOUTHEAST CORNER OF CONCRETE TRANSFORMER VAULT AT THE  
INTERSECTION OF 14th STREET AND GREY COUNTY ROAD No. 28.  
ELEVATION 280.10m

0	JUN 11/18	PRELIMINARY SUBMISSION	TLB	SJC
No.	DATE	DESCRIPTION	BY	APP'D
REVISION / ISSUE				

Seal not valid unless signed and dated



464-A - 10th STREET, Hanover, Ontario N4N 1R1  
Telephone: (519) 506-5959  
www.cobideeng.com

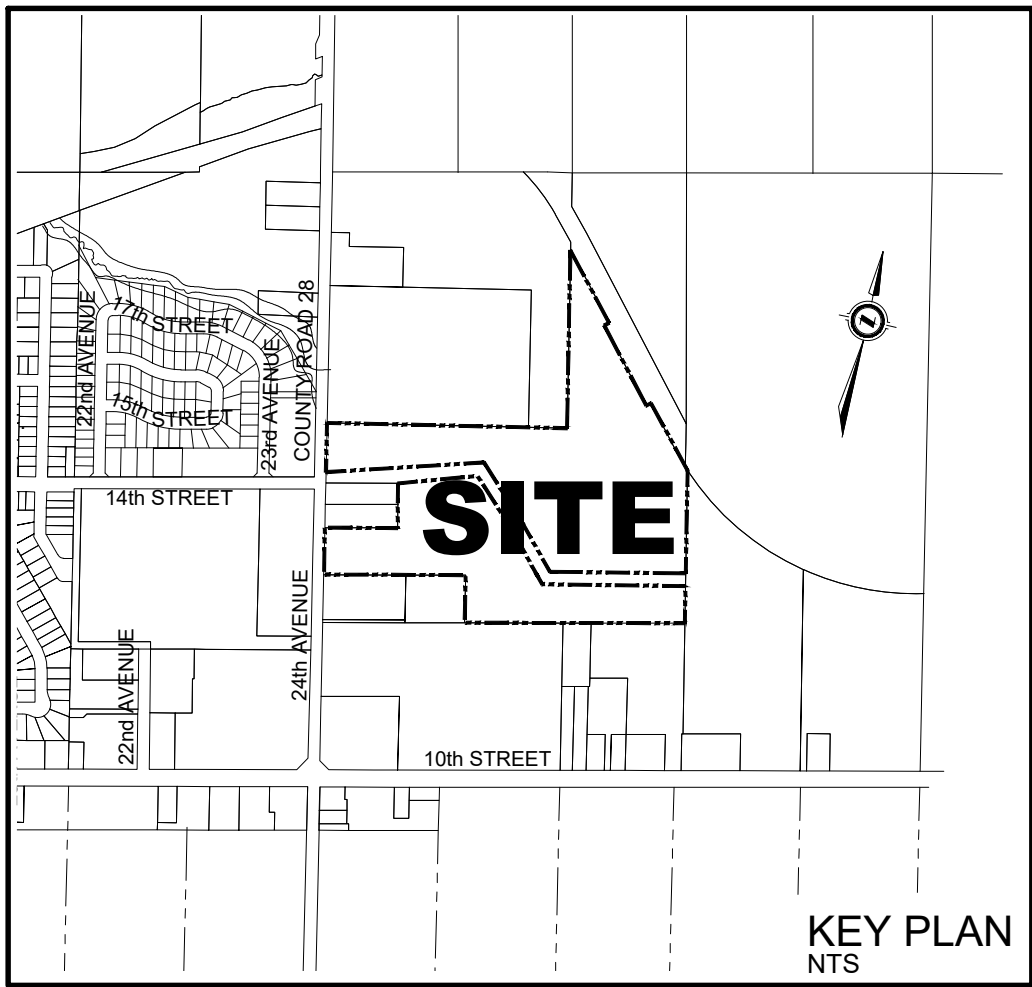
Title: SAUGEEN CEDAR HEIGHTS  
EAST SUBDIVISION  
TOWN OF HANOVER  
PRE DEVELOPMENT CATCHMENT AREAS

Client:		
Design:	TLB	Scale: 1:1000
Drawn:	JAF	Approved:
Checked:	SJC	
Date:	JUN 2016	Design Engineer
DRAWING No.	00502-SWM1	









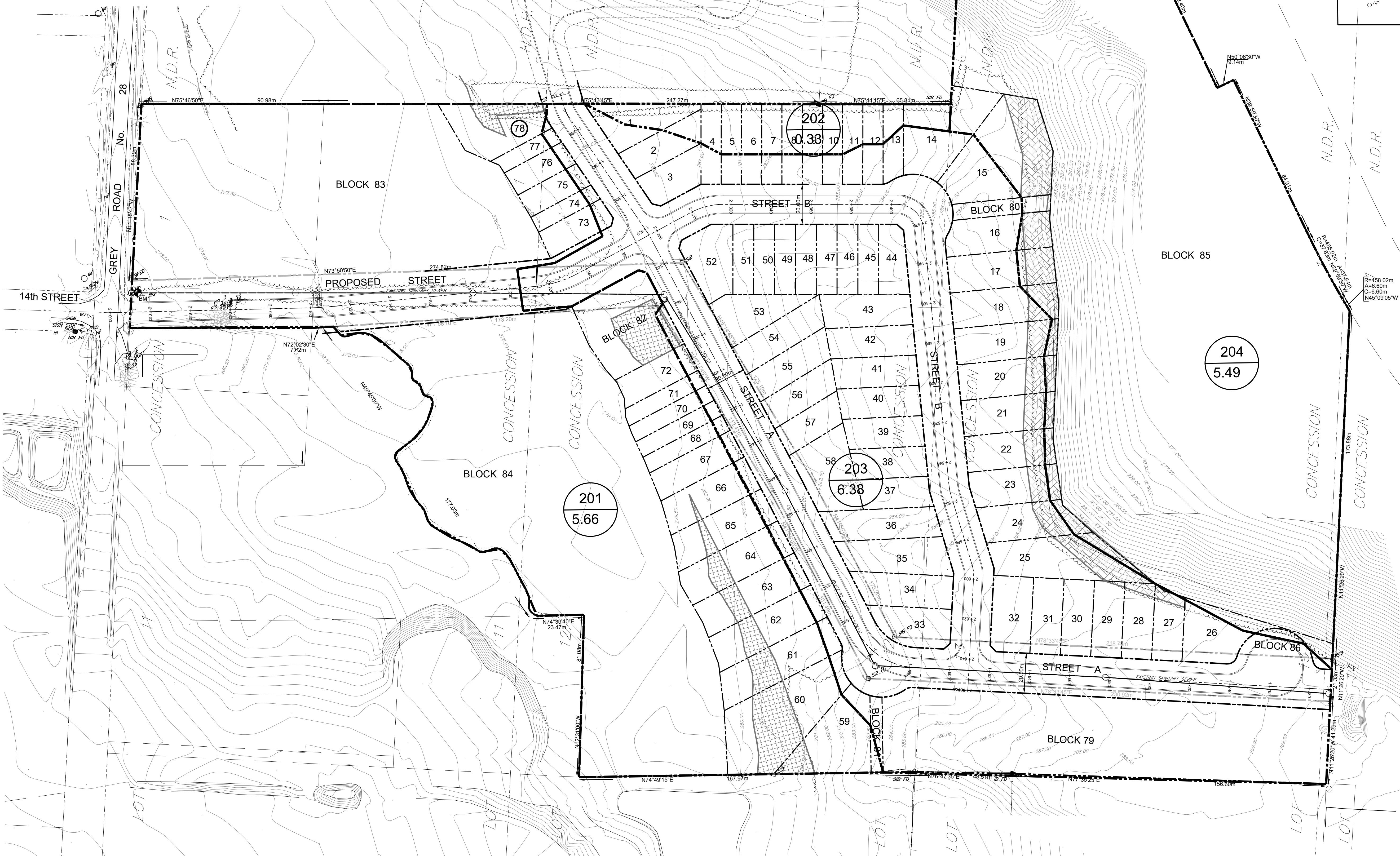
CAUTION:  
THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS  
AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND  
STRUCTURES IS NOT NECESSARILY SHOWN ON THE DRAWINGS,  
AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH  
UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE  
STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE  
EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND  
SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

#### Notes

1. TOPOGRAPHICAL INFORMATION DERIVED FROM FIELD SURVEY BY WSP  
CANADA INC. COMPLETED ON JUNE 9, 2016.
2. PROPERTY BOUNDARY DERIVED FROM INFORMATION SHOWN ON PLAN  
16R-10098.

#### LEGEND

---	PROPERTY BOUNDARY	□ CATV	EXISTING CABLE TV PEDESTAL
---	PROPOSED STREET/PROPERTY LINES	□ BPPED	EXISTING TELEPHONE PEDESTAL
---	EDGE OF EXISTING PAVEMENT	□ SIB	STANDARD IRON BAR
---	EDGE OF EXISTING GRAVEL	□ IRB	IRON BAR
---	EXISTING SANITARY SEWER	○	EXISTING DECIDUOUS TREE
---	EXISTING STORM SEWER	○	EXISTING CONIFEROUS TREE
---	EXISTING WATERMAIN	○	EXISTING TREE LINE
---	EXISTING SANITARY MANHOLE	○	BENCHMARK
---	EXISTING STORM MANHOLE	○	PROPOSED TREE RETENTION AREAS
---	EXISTING CATCH BASIN	○	PROPOSED TREE REPLACEMENT AREAS
---	EXISTING FIRE HYDRANT	○	
---	EXISTING GATE VALVE	○	
---	EXISTING HYDRO GUY WIRE	○	
---	EXISTING HYDRO POLE	○	



#### Benchmark Information

BM1  
SOUTHEAST CORNER OF CONCRETE TRANSFORMER VAULT AT THE  
INTERSECTION OF 14th STREET AND GREY COUNTY ROAD No. 28.  
ELEVATION 280.10m

0	JUN 11/18	PRELIMINARY SUBMISSION	TLB	SJC
No.	DATE	DESCRIPTION	BY	APP'D
REVISION / ISSUE				

Seal not valid unless signed and dated



Title: SAUGEEN CEDAR HEIGHTS  
EAST SUBDIVISION  
TOWN OF HANOVER  
POST DEVELOPMENT CATCHMENT AREAS

Client:		
Design:	TLB	Scale: 1:1000
Drawn:	JAF	Approved:
Checked:	SJC	
Date:	JUN 2016	Design Engineer
DRAWING No.	00502-SWM2	







# Appendix B

**PRE-CONSULTATION**

**STORMWATER MANAGEMENT REPORT**

**SAUGEEN CEDAR HEIGHTS EAST SUBDIVISION  
TOWN OF HANOVER**







---

**MacDonald Property Development****161-04890-00**

**Date:** April 6, 2016 **Project:** 161-04890  
**Time:** 2:00 pm **Location:** Hanover Municipal Office  
**Attendees:** Mr. Brian Tocheri, Town of Hanover  
Mr. Don Tedford, Town of Hanover  
Mr. Ron Cooper, Town of Hanover  
Mr. Scott Taylor, County of Grey  
Ms. Kelly Henderson, County of Grey  
Mr. Erik Downing, Saugeen Valley Conservation Authority  
Mr. Joerg Weller, Developer  
Mr. Jason Long, Developer  
Mr. Stephen J. Cobean, P.Eng., WSP Canada Inc.  
Mr. Travis Burnside, E.I.T., WSP Canada Inc.  
**Purpose:** Pre- Consultation Meeting  
**Distribution:** All Present  
**Prepared By:** Travis Burnside

---

On April 6, 2016, a pre-consultation meeting was held to review the submission requirements related to the MacDonald Property Development project. The following is a review of items discussed.

---

**1.0 OVERVIEW OF PROPERTY**

The proposed subdivision concept will consist of residential and commercial lots. The commercial lots will be primarily located along the southern property boundary. The property will also have a future arterial roadway running through it.

There is an existing trunk sanitary sewer on the property.

**2.0 OFFICIAL PLAN**

The property currently contains a mix of residential, commercial and hazard lands use designations. An Official Plan Amendment (OPA) will be required to change a portion of the Hazard Lands to residential.

**Action:**  
**WSP**

**3.0 ZONING BY-LAW**

The property is currently zoned 'Future Development' therefore, a Zoning By-Law Amendment will be required to allow for residential and commercial development of the property. It was discussed that the Zoning By-Law amendment and Draft Plan be submitted at one time and therefore only one public meeting will be required.

**Action:**  
**WSP**

A Planning Justification report will be required as part of the Zoning By-Law Amendment.



#### **4.0 WESTERN HAZARD AREA**

The SVCA will evaluate the western hazard area to determine if it is floodplain or a wetland feature. If it is floodplain only, modelling can be completed to prove the true extent of the floodplain. If it is a wetland, the hazard boundary is considered to be the wetland boundary. The wetland boundary could possibly be adjusted with the completion of an EIS.

*Action:*  
**SVCA**

The SVCA will be interested in ensuring that the Hurricane Hazel event can pass under the future 14<sup>th</sup> Street extension without impacting upstream properties. The timeline for a second entrance to the subdivision will also be of interest.

#### **5.0 EASTERN HAZARD AREA**

The SVCA will evaluate the eastern hazard area to determine where the hazard boundary should be located. This will be based on where the setback to the stable slope is located.

*Action:*  
**SVCA**

#### **6.0 ENVIRONMENTAL IMPACT STUDY (EIS)**

An EIS will be required to assess the impact of the development on the Significant Woodland that is located on site as well as Species at Risk. The EIS will also need to include a Natural Heritage Assessment.

*Action:*  
**WSP**

Depending on the outcome of the SVCA's assessment of the western hazard area, the EIS may need to include an assessment of that area as well.

*Action:*  
**WSP**

The EIS will assess all areas that are going to be impacted by the development and determine how to mitigate or reduce the impact.

#### **7.0 STORMWATER MANAGEMENT**

A stormwater management report will be required to address the impacts of the development. Runoff will be required to be treated to an enhanced level of treatment. Quantity control will be required for runoff being directed towards the creek located on the west side of the property. Since the property is directly adjacent to the Town owned Rail Trail, the developer can discharge directly to the Saugeen River without quantity control. Quality control would still need to be provided.

*Action:*  
**WSP**

#### **8.0 D-4 STUDY**

A D-4 Study will be required due to the landfill on the adjacent property to the southwest. The assessment will review the possibility of contamination from methane and/or leachate migration.

*Action:*  
**WSP**

The Town may undertake a study to review the impact on all surrounding properties with financial requirements from surrounding properties. If the Town undertakes a study to review the impact in all directions, each individual developer would not be required to undertake their own study.



## 9.0 OTHER REQUIRED REPORTS

The County indicated that the following reports will be required in support of the Draft Plan of Subdivision Application:

**Action:**  
**WSP**

- Archeological Assessment
- Planning Report
- Functional Servicing Report
  - Will address the sanitary sewer (which will connect to the trunk sewer), watermain capacity and pressure, as well as servicing from various utilities (Westario, Wightman, Eastlink, Union Gas)
- Traffic Impact Study – Mr. Taylor will discuss the need with the Transportation Services Department. Subsequent to the meeting, it was confirmed that a Traffic Impact Study will be required. It can build on the report that was completed for the subdivision to the north and address the impact of the future arterial roadway. Mr. Taylor indicated that ideally there would be some synergies between the work for the subdivision and for the arterial roadway.

## 10.0 SITE SERVICING

The site will be serviced with a storm sewer system that will outlet to a proposed SWM Pond or to the Saugeen River.

The sanitary sewer will connect to the existing trunk sewer located on the property.

The watermain cannot be looped as the Town does not own the Walmart entrance at the present time.

The Town will require the internal road to be built to an urban cross section with 8.5m of asphalt, curb and gutter and 1.5m sidewalk on one side of the road.

## 11.0 DENSITY

The development will require a density of 25 units per net hectare which excludes roads, hazard lands and commercial areas.

**Action:**  
**WSP**



## 12.0 OTHER BUSINESS

Mr. Taylor to send information to the developer regarding the County's Tree Clearing Policy as the developer would like to start removing some of the trees from the site. The trees are proposed to be mulched as long as they are not in the wetland area.

**Action:**  
**Taylor**

The County's Forest Management By-law can be found at:

<http://www.grey.ca/explore-grey/forests-trails-1/grey-county-forest-management-by-law/>

The meeting adjourned at 3:15 pm.

The foregoing is considered to be a true and accurate record of all items discussed. If any discrepancies or inconsistencies are noted, please contact the writer immediately.

### WSP CANADA INC.



Travis Burnside, E.I.T.  
Engineering Intern

H:\Projects\161\04890-00 MacDonald Property Subdivision – Weller\TECHNICAL - DESIGN and STUDY\Correspondence\Meeting Notes\2016-04-06 Pre-Consultation Meeting Summary 161-04890.doc



# Appendix C

**PRE DEVELOPMENT MODEL PARAMETERS AND OUTPUT**

**STORMWATER MANAGEMENT REPORT**

**SAUGEEN CEDAR HEIGHTS EAST SUBDIVISION  
TOWN OF HANOVER**







**Table A.1 Parameter Summary Table**

Existing Conditions										
Outlet Location	Model Catchment ID	Description	Area (ha)	Drainage Channel (m)	Flow Length (m)	Gradient (%)	Total Imperv. Connected (%)	Not Connected Imperv. (%)	Manning's 'n' (Perv.)	CN (Perv.)
	101	West Side of Site	11.90	445	267	3.0	0.6	0%	0.25	58.9
	102	East Side of Site	5.96	450	66	20.0	0.0	0%	0.39	50.8



**Table A.2 Site Soils: (as per Ontario Soil Survey Report No. 16 for Bruce County)**

**Soil Type**  
Sullivan Sand

**Hydrologic Soil Group**  
A

TABLE OF CURVE NUMBERS (CN's)								
Land Use	Hydrologic Soil Type							
	A	AB	B	BC	C	CD	D	Manning's 'n'
Meadow	50	54	58	64.5	71	74.5	78	0.4
Woodlot	50	55.3	60.5	67	73.5	76.8	80	0.4
Long Grass	55	60	65	72	79	81.5	84	0.3
Lawns	60	65.5	71	77	83	86	89	0.25
Pasture/Range	58	61.5	65	70.5	76	78.5	81	0.17
Crop	66	70	74	78	82	84	86	0.13
Fallow (bare)	77	82	86	89	91	93	94	0.05
Built-up	60	65.5	71	77	83	89	89	0.25
Streets, paved	98	98	98	98	98	98	98	0.01

continuous grass  
forests  
natural, not maintained  
maintained  
farm pasture  
farm land  
idle farm land (bare)  
Lawns Existing

HYDROLOGIC SOIL TYPE (%) - Existing Conditions								
Catchment	Hydrologic Soil Type							
	A	AB	B	BC	C	CD	D	TOTAL
101	100	0	0	0	0	0	0	100
102	100	0	0	0	0	0	0	100

LAND USE (%) - Existing Conditions										
Catchment	Meadow	Woodlot	Long Grass	Lawns	Pasture Range	Crop	Fallow (Bare)	Imperv. Not Connected (Rooftops)	Imperv. Connected	Total
101	0	44.4	0	0	0	55.0	0	0.0	0.6	100
102	0	95	0	0	0	5	0	0.0	0.0	100

CURVE NUMBER (CN) - Existing Conditions											
Catchment	Meadow	Woodlot	Long Grass	Lawns	Pasture Range	Crop	Fallow (Bare)	Built-up	Imperv. Not Connected (Rooftops)	Weighted CN - Pervious	Manning's 'n'
101	50	50	55	60	58	66	77	60	90	58.9	0.25
102	50	50	55	60	58	66	77	60	90	50.8	0.39



Table A.3: Impervious Area Determination for Subcatchment 101

Existing Conditions						
Area of Concern	Total Area (ha)	Impervious Area Connected		Impervious Area Not Connected (Rooftops)		Total (%)
		(ha)	(%)	(ha)	(%)	
101	11.90	0.07	0.6	0.00	0.0	0.6
102	5.96	0.00	0.0	0.00	0.0	0.0

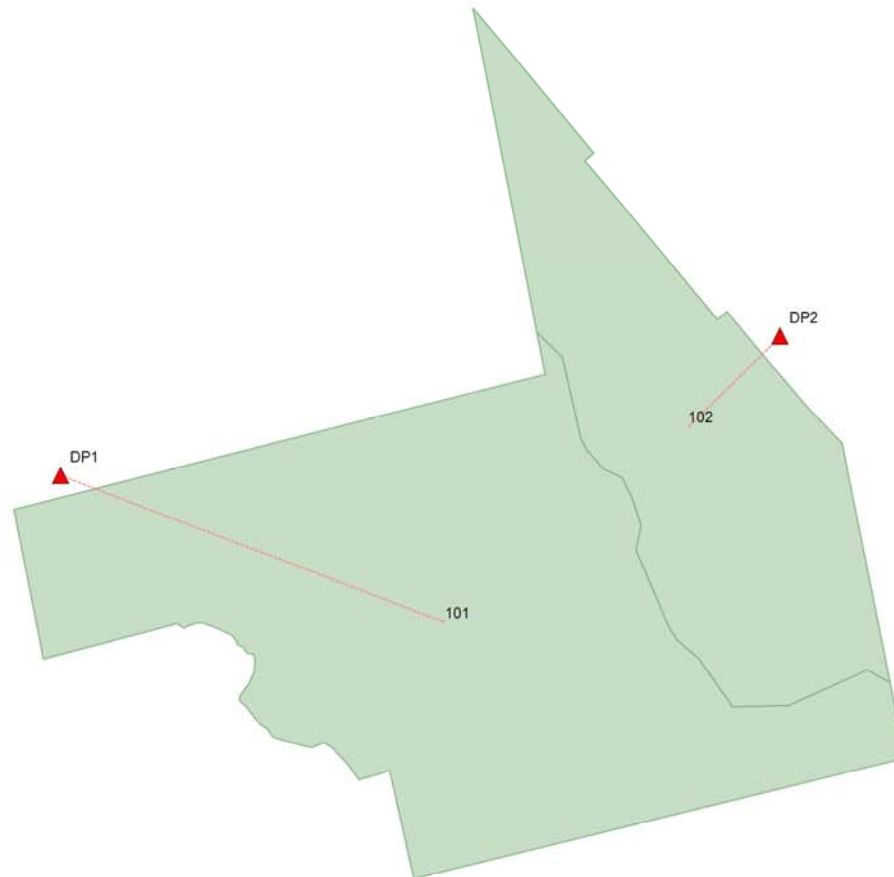


Table A.3 - Impervious Area Determination for Existing Catchments 101-103

Catchment					Imperv. Area	Imperv %
101	0	m of	20	m wide ROW @ 45% imperv.	0.00 ha	0.0 %
	1	Impervious Area	720	m <sup>2</sup> @ 100% imperv.	0.07 ha	0.6 %
	0	Roof Area	25000	m <sup>2</sup> @ 100% imperv.	0.00 ha	0.0 %
					<b>0.07 ha</b>	
102	0	m of	20	m wide ROW @ 45% imperv.	0.00 ha	0.0 %
	0	Impervious Area	2900	m <sup>2</sup> @ 100% imperv.	0.00 ha	0.0 %
	0	Roof Area	250	m <sup>2</sup> @ 100% imperv.	0.00 ha	0.0 %
					<b>0.00 ha</b>	

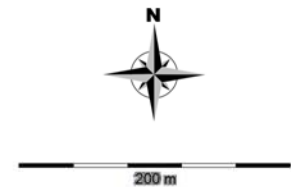


## Saugeen Cedar Heights East Subdivision - Pre-Development Model Schematic



**Legend**

- ▲ Outfalls
- Subcatchments









# Sageen Cedar Heights East Subdivision – Pre Development Model Details

## [TITLE]

## [OPTIONS]

```

;;Options      Value
;;-----
FLOW_UNITS      LPS
INFILTRATION     CURVE_NUMBER
FLOW_ROUTING     DYNWAVE
START_DATE       7/23/2018
START_TIME       00:00
REPORT_START_DATE 7/23/2018
REPORT_START_TIME 00:00
END_DATE         7/24/2018
END_TIME         00:00
SWEEP_START      1/1
SWEEP_END        12/31
DRY_DAYS         0
REPORT_STEP      00:01:00
WET_STEP         00:05:00
DRY_STEP         00:05:00
ROUTING_STEP     5
ALLOW_PONDING    NO
INERTIAL_DAMPING  PARTIAL
VARIABLE_STEP    0.75
LENGTHENING_STEP 0
MIN_SURFAREA     0
NORMAL_FLOW_LIMITED BOTH
SKIP_STEADY_STATE NO
FORCE_MAIN_EQUATION H-W
LINK_OFFSETS     DEPTH
MIN_SLOPE        0
MAX_TRIALS       8
HEAD_TOLERANCE   0
SYS_FLOW_TOL     5
LAT_FLOW_TOL     5
MINIMUM_STEP     0.5
THREADS          2

```

## [EVAPORATION]

```

;;Type      Parameters
;;-----
CONSTANT    0.0
DRY_ONLY    NO

```

## [RAINGAGES]

```

;;      Rain      Time      Snow      Data
;;Name      Type      Intrvl Catch      Source
;;-----
SCS_6h_37.8mm_2Yr  INTENSITY 0:05    1.0    TIMESERIES SCS_6h_37.8mm_2Yr
SCS_6h_48.1mm_5Yr  INTENSITY 0:05    1.0    TIMESERIES SCS_6h_48.1mm_5Yr
SCS_6h_63.5mm_25Yr INTENSITY 0:05    1.0    TIMESERIES SCS_6h_63.5mm_25Yr
SCS_6h_69.9mm_50Yr INTENSITY 0:05    1.0    TIMESERIES SCS_6h_69.9mm_50Yr
SCS_6h_76.3mm_100Yr INTENSITY 0:05    1.0    TIMESERIES SCS_6h_76.3mm_100Yr

```

## [SUBCATCHMENTS]

```

;;      Total      Pcnt.      Pcnt.      Curb      Snow
;;Name      Raingage      Outlet      Area      Imperv      Width      Slope      Length      Pack
;;-----
101          SCS_6h_76.3mm_100Yr DP1          11.9      0.6      445      3      0
102          SCS_6h_76.3mm_100Yr DP2          5.96      0      450      20      0

```

## [SUBAREAS]

```

;;Subcatchment  N-Imperv  N-Perv  S-Imperv  S-Perv  PctZero  RouteTo  PctRouted
;;-----
101             0.01      0.25      0.05      0.05      25      OUTLET
102             0.01      0.39      0.05      0.05      25      OUTLET

```

## [INFILTRATION]

```

;;Subcatchment  CurveNum  HydCon  DryTime
;;-----
101             58.9      0.5      7
102             50.8      0.5      7

```



## Sageen Cedar Heights East Subdivision – Pre Development Model Details

### [OUTFALLS]

;;Name	Invert Elev.	Outfall Type	Stage/Table Time Series	Tide Gate Route To
DP1	276.4	FREE		NO
DP2	276	FREE		NO

### [TIMESERIES]

;;Name	Date	Time	Value
;SCS_6h_37.8mm design storm, total rainfall = 37.8 mm, rain units = mm/hr.			
SCS_6h_37.8mm_2Yr			
;SCS_6h_48.1mm design storm, total rainfall = 48.1 mm, rain units = mm/hr.			
SCS_6h_48.1mm_5Yr			
;SCS_6h_63.5mm design storm, total rainfall = 63.5 mm, rain units = mm/hr.			
SCS_6h_63.5mm_25Yr			
;SCS_6h_69.9mm design storm, total rainfall = 69.9 mm, rain units = mm/hr.			
SCS_6h_69.9mm_50Yr			
;SCS_6h_76.3mm design storm, total rainfall = 76.3 mm, rain units = mm/hr.			
SCS_6h_76.3mm_100Yr			

### [REPORT]

INPUT YES  
 CONTROLS NO  
 SUBCATCHMENTS ALL  
 NODES ALL  
 LINKS ALL

### [TAGS]

### [MAP]

DIMENSIONS 499379.967574369 4889432.07407248 500102.544600649 4890137.8073031  
 UNITS Meters



# Saugeen Cedar Heights East Subdivision – Pre Development 2 Year Design Storm

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)

\*\*\*\*\*  
Element Count  
\*\*\*\*\*

Number of rain gages ..... 5  
Number of subcatchments ... 2  
Number of nodes ..... 2  
Number of links ..... 0  
Number of pollutants ..... 0  
Number of land uses ..... 0

\*\*\*\*\*  
Raingage Summary  
\*\*\*\*\*

Name	Data Source	Data Type	Recording Interval
SCS_6h_37.8mm_2Yr	SCS_6h_37.8mm_2Yr	INTENSITY	5 min.
SCS_6h_48.1mm_5Yr	SCS_6h_48.1mm_5Yr	INTENSITY	5 min.
SCS_6h_63.5mm_25Yr	SCS_6h_63.5mm_25Yr	INTENSITY	5 min.
SCS_6h_69.9mm_50Yr	SCS_6h_69.9mm_50Yr	INTENSITY	5 min.
SCS_6h_76.3mm_100Yr	SCS_6h_76.3mm_100Yr	INTENSITY	5 min.

\*\*\*\*\*  
Subcatchment Summary  
\*\*\*\*\*

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	11.90	445.00	0.60	3.0000	SCS_6h_37.8mm_2Yr	DP1
102	5.96	450.00	0.00	20.0000	SCS_6h_37.8mm_2Yr	DP2

\*\*\*\*\*  
Node Summary  
\*\*\*\*\*

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
DP1	OUTFALL	276.40	0.00	0.0	
DP2	OUTFALL	276.00	0.00	0.0	

\*\*\*\*\*  
NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
\*\*\*\*\*

\*\*\*\*\*  
Analysis Options  
\*\*\*\*\*

Flow Units ..... LPS

Process Models:

Rainfall/Runoff ..... YES  
RDII ..... NO  
Snowmelt ..... NO  
Groundwater ..... NO  
Flow Routing ..... NO  
Water Quality ..... NO

Infiltration Method ..... CURVE\_NUMBER

Starting Date ..... 07/23/2018 00:00:00

Ending Date ..... 07/24/2018 00:00:00

Antecedent Dry Days ..... 0.0

Report Time Step ..... 00:01:00

Wet Time Step ..... 00:05:00

Dry Time Step ..... 00:05:00



## Saugeen Cedar Heights East Subdivision – Pre Development 2 Year Design Storm

```

*****
Runoff Quantity Continuity      Volume      Depth
                                hectare-m    mm
*****
Total Precipitation .....      0.675      37.806
Evaporation Loss .....          0.000          0.000
Infiltration Loss .....          0.587      32.880
Surface Runoff .....            0.082       4.591
Final Storage .....             0.006       0.335
Continuity Error (%) .....      -0.001

```

```

*****
Flow Routing Continuity      Volume      Volume
                                hectare-m    10^6 ltr
*****
Dry Weather Inflow .....          0.000          0.000
Wet Weather Inflow .....          0.082          0.820
Groundwater Inflow .....          0.000          0.000
RDII Inflow .....              0.000          0.000
External Inflow .....          0.000          0.000
External Outflow .....          0.082          0.820
Flooding Loss .....            0.000          0.000
Evaporation Loss .....          0.000          0.000
Exfiltration Loss .....          0.000          0.000
Initial Stored Volume ....        0.000          0.000
Final Stored Volume .....        0.000          0.000
Continuity Error (%) .....          0.000

```

```

*****
Subcatchment Runoff Summary
*****

```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
101	37.81	0.00	0.00	32.80	4.58	0.55	30.52	0.121
102	37.81	0.00	0.00	33.05	4.61	0.27	17.23	0.122

```

Analysis begun on:  Mon Aug 20 13:47:53 2018
Analysis ended on:  Mon Aug 20 13:47:53 2018
Total elapsed time: < 1 sec

```



# Saugeen Cedar Heights East Subdivision – Pre Development 5 Year Design Storm

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)

\*\*\*\*\*  
Element Count  
\*\*\*\*\*

Number of rain gages ..... 5  
Number of subcatchments ... 2  
Number of nodes ..... 2  
Number of links ..... 0  
Number of pollutants ..... 0  
Number of land uses ..... 0

\*\*\*\*\*  
Raingage Summary  
\*\*\*\*\*

Name	Data Source	Data Type	Recording Interval
SCS_6h_37.8mm_2Yr	SCS_6h_37.8mm_2Yr	INTENSITY	5 min.
SCS_6h_48.1mm_5Yr	SCS_6h_48.1mm_5Yr	INTENSITY	5 min.
SCS_6h_63.5mm_25Yr	SCS_6h_63.5mm_25Yr	INTENSITY	5 min.
SCS_6h_69.9mm_50Yr	SCS_6h_69.9mm_50Yr	INTENSITY	5 min.
SCS_6h_76.3mm_100Yr	SCS_6h_76.3mm_100Yr	INTENSITY	5 min.

\*\*\*\*\*  
Subcatchment Summary  
\*\*\*\*\*

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	11.90	445.00	0.60	3.0000	SCS_6h_37.8mm_2Yr	DP1
102	5.96	450.00	0.00	20.0000	SCS_6h_37.8mm_2Yr	DP2

\*\*\*\*\*  
Node Summary  
\*\*\*\*\*

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
DP1	OUTFALL	276.40	0.00	0.0	
DP2	OUTFALL	276.00	0.00	0.0	

\*\*\*\*\*  
NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
\*\*\*\*\*

\*\*\*\*\*  
Analysis Options  
\*\*\*\*\*

Flow Units ..... LPS

Process Models:

Rainfall/Runoff ..... YES  
RDII ..... NO  
Snowmelt ..... NO  
Groundwater ..... NO  
Flow Routing ..... NO  
Water Quality ..... NO

Infiltration Method ..... CURVE\_NUMBER

Starting Date ..... 07/23/2018 00:00:00

Ending Date ..... 07/24/2018 00:00:00

Antecedent Dry Days ..... 0.0

Report Time Step ..... 00:01:00

Wet Time Step ..... 00:05:00

Dry Time Step ..... 00:05:00



## Saugeen Cedar Heights East Subdivision – Pre Development 5 Year Design Storm

```

*****
Runoff Quantity Continuity      Volume      Depth
                                hectare-m    mm
*****
Total Precipitation .....      0.675      37.806
Evaporation Loss .....          0.000          0.000
Infiltration Loss .....          0.587      32.880
Surface Runoff .....            0.082       4.591
Final Storage .....             0.006       0.335
Continuity Error (%) .....      -0.001

```

```

*****
Flow Routing Continuity      Volume      Volume
                                hectare-m    10^6 ltr
*****
Dry Weather Inflow .....          0.000          0.000
Wet Weather Inflow .....          0.082          0.820
Groundwater Inflow .....          0.000          0.000
RDII Inflow .....              0.000          0.000
External Inflow .....           0.000          0.000
External Outflow .....           0.082          0.820
Flooding Loss .....             0.000          0.000
Evaporation Loss .....           0.000          0.000
Exfiltration Loss .....           0.000          0.000
Initial Stored Volume ....        0.000          0.000
Final Stored Volume .....         0.000          0.000
Continuity Error (%) .....         0.000

```

```

*****
Subcatchment Runoff Summary
*****

```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
101	37.81	0.00	0.00	32.80	4.58	0.55	30.52	0.121
102	37.81	0.00	0.00	33.05	4.61	0.27	17.23	0.122

```

Analysis begun on:  Mon Aug 20 13:47:53 2018
Analysis ended on:  Mon Aug 20 13:47:53 2018
Total elapsed time: < 1 sec

```



# Saugeen Cedar Heights East Subdivision – Pre Development 25 Year Design Storm

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)

\*\*\*\*\*  
Element Count  
\*\*\*\*\*

Number of rain gages ..... 5  
Number of subcatchments ... 2  
Number of nodes ..... 2  
Number of links ..... 0  
Number of pollutants ..... 0  
Number of land uses ..... 0

\*\*\*\*\*  
Raingage Summary  
\*\*\*\*\*

Name	Data Source	Data Type	Recording Interval
SCS_6h_37.8mm_2Yr	SCS_6h_37.8mm_2Yr	INTENSITY	5 min.
SCS_6h_48.1mm_5Yr	SCS_6h_48.1mm_5Yr	INTENSITY	5 min.
SCS_6h_63.5mm_25Yr	SCS_6h_63.5mm_25Yr	INTENSITY	5 min.
SCS_6h_69.9mm_50Yr	SCS_6h_69.9mm_50Yr	INTENSITY	5 min.
SCS_6h_76.3mm_100Yr	SCS_6h_76.3mm_100Yr	INTENSITY	5 min.

\*\*\*\*\*  
Subcatchment Summary  
\*\*\*\*\*

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	11.90	445.00	0.60	3.0000	SCS_6h_63.5mm_25Yr	DP1
102	5.96	450.00	0.00	20.0000	SCS_6h_63.5mm_25Yr	DP2

\*\*\*\*\*  
Node Summary  
\*\*\*\*\*

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
DP1	OUTFALL	276.40	0.00	0.0	
DP2	OUTFALL	276.00	0.00	0.0	

\*\*\*\*\*  
NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
\*\*\*\*\*

\*\*\*\*\*  
Analysis Options  
\*\*\*\*\*

Flow Units ..... LPS

Process Models:

Rainfall/Runoff ..... YES  
RDII ..... NO  
Snowmelt ..... NO  
Groundwater ..... NO  
Flow Routing ..... NO  
Water Quality ..... NO

Infiltration Method ..... CURVE\_NUMBER

Starting Date ..... 07/23/2018 00:00:00

Ending Date ..... 07/24/2018 00:00:00

Antecedent Dry Days ..... 0.0

Report Time Step ..... 00:01:00

Wet Time Step ..... 00:05:00

Dry Time Step ..... 00:05:00



## Saugeen Cedar Heights East Subdivision – Pre Development 25 Year Design Storm

```

*****
Runoff Quantity Continuity      Volume      Depth
                                hectare-m    mm
*****
Total Precipitation .....      1.134      63.510
Evaporation Loss .....          0.000          0.000
Infiltration Loss .....          0.901      50.465
Surface Runoff .....            0.227      12.701
Final Storage .....             0.006          0.345
Continuity Error (%) .....      -0.001

```

```

*****
Flow Routing Continuity      Volume      Volume
                                hectare-m    10^6 ltr
*****
Dry Weather Inflow .....          0.000          0.000
Wet Weather Inflow .....          0.227          2.268
Groundwater Inflow .....          0.000          0.000
RDII Inflow .....              0.000          0.000
External Inflow .....           0.000          0.000
External Outflow .....           0.227          2.268
Flooding Loss .....             0.000          0.000
Evaporation Loss .....           0.000          0.000
Exfiltration Loss .....           0.000          0.000
Initial Stored Volume ....        0.000          0.000
Final Stored Volume .....         0.000          0.000
Continuity Error (%) .....          0.000

```

```

*****
Subcatchment Runoff Summary
*****

```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
101	63.51	0.00	0.00	49.97	13.10	1.56	101.72	0.206
102	63.51	0.00	0.00	51.44	11.91	0.71	61.05	0.188

```

Analysis begun on:  Mon Aug 20 13:50:02 2018
Analysis ended on:  Mon Aug 20 13:50:02 2018
Total elapsed time: < 1 sec

```



# Saugeen Cedar Heights East Subdivision – Pre Development 50 Year Design Storm

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)

\*\*\*\*\*  
Element Count  
\*\*\*\*\*

Number of rain gages ..... 5  
Number of subcatchments ... 2  
Number of nodes ..... 2  
Number of links ..... 0  
Number of pollutants ..... 0  
Number of land uses ..... 0

\*\*\*\*\*  
Raingage Summary  
\*\*\*\*\*

Name	Data Source	Data Type	Recording Interval
SCS_6h_37.8mm_2Yr	SCS_6h_37.8mm_2Yr	INTENSITY	5 min.
SCS_6h_48.1mm_5Yr	SCS_6h_48.1mm_5Yr	INTENSITY	5 min.
SCS_6h_63.5mm_25Yr	SCS_6h_63.5mm_25Yr	INTENSITY	5 min.
SCS_6h_69.9mm_50Yr	SCS_6h_69.9mm_50Yr	INTENSITY	5 min.
SCS_6h_76.3mm_100Yr	SCS_6h_76.3mm_100Yr	INTENSITY	5 min.

\*\*\*\*\*  
Subcatchment Summary  
\*\*\*\*\*

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	11.90	445.00	0.60	3.0000	SCS_6h_69.9mm_50Yr	DP1
102	5.96	450.00	0.00	20.0000	SCS_6h_69.9mm_50Yr	DP2

\*\*\*\*\*  
Node Summary  
\*\*\*\*\*

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
DP1	OUTFALL	276.40	0.00	0.0	
DP2	OUTFALL	276.00	0.00	0.0	

\*\*\*\*\*  
NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
\*\*\*\*\*

\*\*\*\*\*  
Analysis Options  
\*\*\*\*\*

Flow Units ..... LPS

Process Models:

Rainfall/Runoff ..... YES  
RDII ..... NO  
Snowmelt ..... NO  
Groundwater ..... NO  
Flow Routing ..... NO  
Water Quality ..... NO

Infiltration Method ..... CURVE\_NUMBER

Starting Date ..... 07/23/2018 00:00:00

Ending Date ..... 07/24/2018 00:00:00

Antecedent Dry Days ..... 0.0

Report Time Step ..... 00:01:00

Wet Time Step ..... 00:05:00

Dry Time Step ..... 00:05:00



## Saugeen Cedar Heights East Subdivision – Pre Development 50 Year Design Storm

```

*****
Runoff Quantity Continuity      Volume      Depth
                                hectare-m    mm
*****
Total Precipitation .....      1.249      69.911
Evaporation Loss .....          0.000          0.000
Infiltration Loss .....          0.970          54.286
Surface Runoff .....            0.273          15.278
Final Storage .....             0.006          0.346
Continuity Error (%) .....      -0.001

```

```

*****
Flow Routing Continuity      Volume      Volume
                                hectare-m    10^6 ltr
*****
Dry Weather Inflow .....          0.000          0.000
Wet Weather Inflow .....          0.273          2.729
Groundwater Inflow .....          0.000          0.000
RDII Inflow .....              0.000          0.000
External Inflow .....           0.000          0.000
External Outflow .....           0.273          2.729
Flooding Loss .....             0.000          0.000
Evaporation Loss .....           0.000          0.000
Exfiltration Loss .....           0.000          0.000
Initial Stored Volume ....        0.000          0.000
Final Stored Volume .....         0.000          0.000
Continuity Error (%) .....         0.000

```

```

*****
Subcatchment Runoff Summary
*****

```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
101	69.91	0.00	0.00	53.65	15.82	1.88	125.46	0.226
102	69.91	0.00	0.00	55.56	14.20	0.85	77.38	0.203

```

Analysis begun on:  Mon Aug 20 13:51:59 2018
Analysis ended on:  Mon Aug 20 13:51:59 2018
Total elapsed time: < 1 sec

```



# Sageen Cedar Heights East Subdivision – Pre Development 100 Year Design Storm

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)

\*\*\*\*\*  
Element Count  
\*\*\*\*\*

Number of rain gages ..... 5  
Number of subcatchments ... 2  
Number of nodes ..... 2  
Number of links ..... 0  
Number of pollutants ..... 0  
Number of land uses ..... 0

\*\*\*\*\*  
Raingage Summary  
\*\*\*\*\*

Name	Data Source	Data Type	Recording Interval
SCS_6h_37.8mm_2Yr	SCS_6h_37.8mm_2Yr	INTENSITY	5 min.
SCS_6h_48.1mm_5Yr	SCS_6h_48.1mm_5Yr	INTENSITY	5 min.
SCS_6h_63.5mm_25Yr	SCS_6h_63.5mm_25Yr	INTENSITY	5 min.
SCS_6h_69.9mm_50Yr	SCS_6h_69.9mm_50Yr	INTENSITY	5 min.
SCS_6h_76.3mm_100Yr	SCS_6h_76.3mm_100Yr	INTENSITY	5 min.

\*\*\*\*\*  
Subcatchment Summary  
\*\*\*\*\*

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	11.90	445.00	0.60	3.0000	SCS_6h_76.3mm_100Yr	DP1
102	5.96	450.00	0.00	20.0000	SCS_6h_76.3mm_100Yr	DP2

\*\*\*\*\*  
Node Summary  
\*\*\*\*\*

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
DP1	OUTFALL	276.40	0.00	0.0	
DP2	OUTFALL	276.00	0.00	0.0	

\*\*\*\*\*  
NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.  
\*\*\*\*\*

\*\*\*\*\*  
Analysis Options  
\*\*\*\*\*

Flow Units ..... LPS

Process Models:

Rainfall/Runoff ..... YES  
RDII ..... NO  
Snowmelt ..... NO  
Groundwater ..... NO  
Flow Routing ..... NO  
Water Quality ..... NO

Infiltration Method ..... CURVE\_NUMBER

Starting Date ..... 07/23/2018 00:00:00

Ending Date ..... 07/24/2018 00:00:00

Antecedent Dry Days ..... 0.0

Report Time Step ..... 00:01:00

Wet Time Step ..... 00:05:00

Dry Time Step ..... 00:05:00



## Sageen Cedar Heights East Subdivision – Pre Development 100 Year Design Storm

```

*****
Runoff Quantity Continuity      Volume      Depth
                                hectare-m    mm
*****
Total Precipitation .....      1.363      76.311
Evaporation Loss .....          0.000          0.000
Infiltration Loss .....          1.035      57.928
Surface Runoff .....            0.322      18.039
Final Storage .....             0.006          0.345
Continuity Error (%) .....      -0.001

```

```

*****
Flow Routing Continuity      Volume      Volume
                                hectare-m    10^6 ltr
*****
Dry Weather Inflow .....          0.000          0.000
Wet Weather Inflow .....          0.322          3.222
Groundwater Inflow .....          0.000          0.000
RDII Inflow .....              0.000          0.000
External Inflow .....           0.000          0.000
External Outflow .....           0.322          3.222
Flooding Loss .....             0.000          0.000
Evaporation Loss .....           0.000          0.000
Exfiltration Loss .....           0.000          0.000
Initial Stored Volume ....        0.000          0.000
Final Stored Volume .....         0.000          0.000
Continuity Error (%) .....         0.000

```

```

*****
Subcatchment Runoff Summary
*****

```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
101	76.31	0.00	0.00	57.15	18.72	2.23	150.96	0.245
102	76.31	0.00	0.00	59.48	16.68	0.99	95.45	0.219

```

Analysis begun on:  Mon Aug 20 13:52:55 2018
Analysis ended on:  Mon Aug 20 13:52:55 2018
Total elapsed time: < 1 sec

```



# Appendix D

**POST DEVELOPMENT MODEL PARAMETERS AND OUTPUT**

**STORMWATER MANAGEMENT REPORT**

**SAUGEEN CEDAR HEIGHTS EAST SUBDIVISION  
TOWN OF HANOVER**







**Table B.1 Parameter Summary Table**

Proposed Conditions										
Outlet Location	Model Catchment ID	Description	Area (ha)	Drainage Channel (m)	Flow Length (m)	Gradient (%)	Total Imperv. (%)	Not Connected Imperv. (%)	Manning's 'n' (Perv.)	CN (Perv.)
	201	West Side of Site	5.66	445	127	3.0	7.2	45.4	0.37	51.9
	202	North Side of Site	0.33	180	18	3.0	17.3	100.0	0.25	60.0
	203	Majority of Lots	6.38	1900	34	2.0	63.0	49.3	0.27	58.6
	204	East Side of Subdivision	5.49	450	122	20.0	0.0	0.0	0.40	50.0



**Table B.2 Site Soils: (as per Ontario Soil Survey Report No. 16 for Bruce County)**

**Soil Type**  
Sullivan Sand

**Hydrologic Soil Group**  
A

TABLE OF CURVE NUMBERS (CN's)								
Land Use	Hydrologic Soil Type							
	A	AB	B	BC	C	CD	D	Manning's 'n'
Meadow	50	54	58	64.5	71	74.5	78	0.4
Woodlot	50	55.3	60.5	67	73.5	76.8	80	0.4
Long Grass	55	60	65	72	79	81.5	84	0.3
Lawns	60	65.5	71	77	83	86	89	0.25
Pasture/Range	58	61.5	65	70.5	76	78.5	81	0.17
Crop	66	70	74	78	82	84	86	0.13
Fallow (bare)	77	82	86	89	91	93	94	0.05
Built-up	60	65.5	71	77	83	89	89	0.25
Streets, paved	98	98	98	98	98	98	98	0.01

continuous grass  
forests  
natural, not maintained  
maintained  
farm pasture  
farm land  
idle farm land (bare)  
Lawns Proposed

HYDROLOGIC SOIL TYPE (%) - Proposed Conditions								
Catchment	Hydrologic Soil Type							
	A	AB	B	BC	C	CD	D	TOTAL
201	100	0	0	0	0	0	0	100
202	100	0	0	0	0	0	0	100
203	100	0	0	0	0	0	0	100
204	100	0	0	0	0	0	0	100

LAND USE (%) - Proposed Conditions										
Catchment	Meadow	Woodlot	Long Grass	Lawns	Pasture Range	Crop	Fallow (Bare)	Imperv. Not Connected (Rooftops)	Imperv. Connected	Total
201	0	75	0	18	0	0	0	3.3	3.9	100
202	0	0	0	83	0	0	0	17.3	0.0	100
203	0	5	0	32	0	0	0	31.0	32.0	100
204	0	100	0	0	0	0	0	0.0	0.0	100

CURVE NUMBER (CN) - Proposed Conditions											
Catchment	Meadow	Woodlot	Long Grass	Lawns	Pasture Range	Crop	Fallow (Bare)	Built-up	Imperv. Not Connected (Rooftops)	Weighted CN - Pervious	Manning's 'n'
201	50	50	55	60	58	66	77	60	90	51.9	0.37
202	50	50.0	55	60	58.0	66	77	60.0	90	60.0	0.25
203	50	50	55	60	58	66	77	60	90	58.6	0.27
204	50	50	55	60	58	66	77	60	90	50.0	0.40



**Table A.3: Impervious Area Determination for Subcatchments 201 - 202**

**Proposed Conditions**

Area of Concern	Total Area (ha)	Impervious Area Connected		Impervious Area Not Connected (Rooftops)		Total (%)
		(ha)	(%)	(ha)	(%)	
201	5.66	0.22	3.9	0.19	3.3	7.2
202	0.33	0.00	0.0	0.06	17.3	17.3
203	6.38	2.04	32.0	1.98	31.0	63.0
204	5.49	0.00	0.0	0.00	0.0	0.0

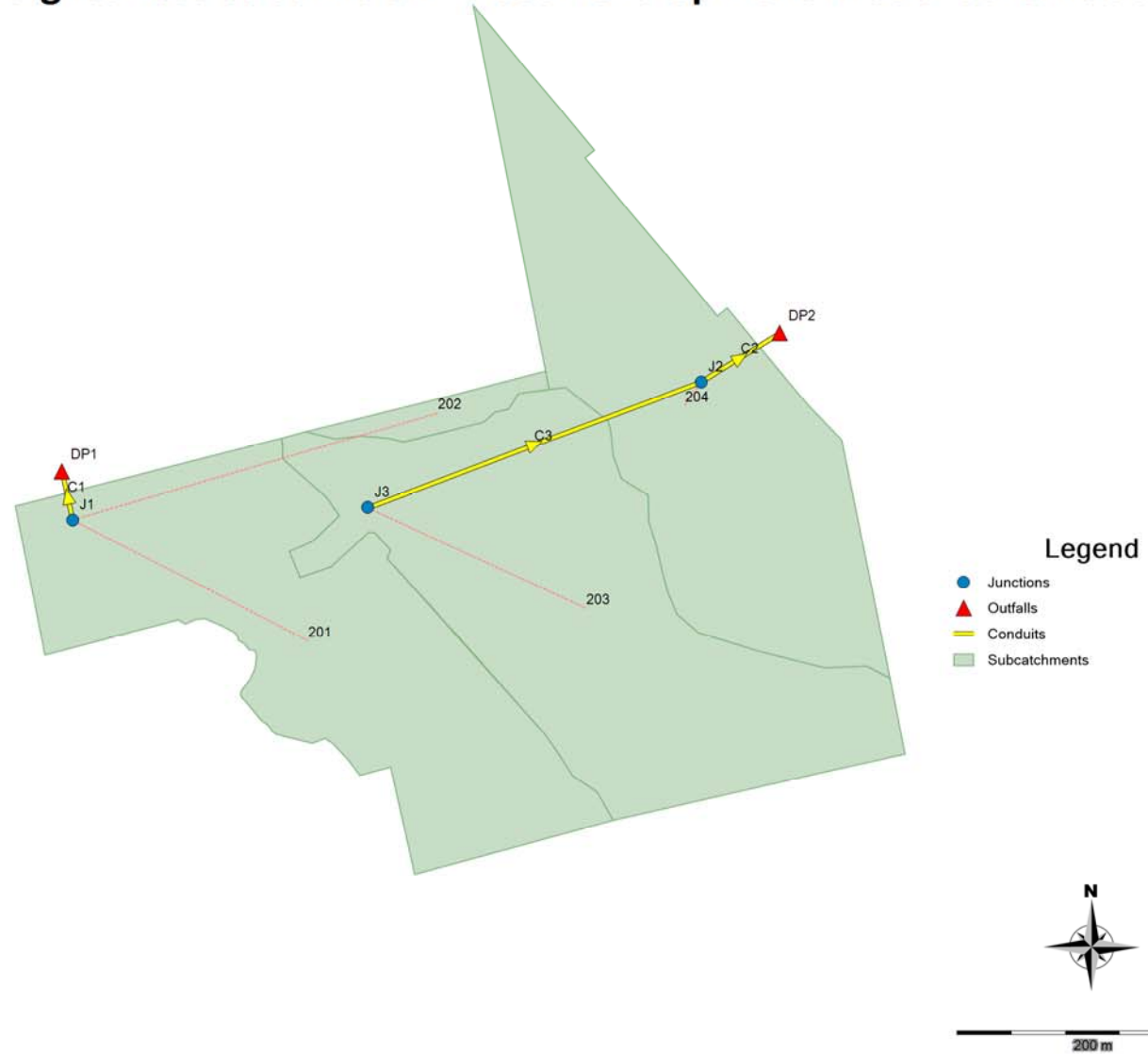


**Table B.3 - Impervious Area Determination for Proposed Catchments 201 - 202**

Catchment					Imperv. Area	Imperv %
201	195	m of	20	m wide ROW @ 57% imperv.	0.22 ha	3.9 %
		Impervious Area	100	m <sup>2</sup> @ 100% imperv.	0.00 ha	0.0 %
	6	Roof Area	125	m <sup>2</sup> @ 100% imperv.	0.08 ha	1.3 %
	4	Roof Area	275	m <sup>2</sup> @ 100% imperv.	0.11 ha	1.9 %
					<b>0.41 ha</b>	
202		m of	10	m wide ROW @ 62% imperv.	0.00 ha	0.0 %
		Impervious Area	100	m <sup>2</sup> @ 100% imperv.	0.00 ha	0.0 %
	4.5	Roof Area	125	m <sup>2</sup> @ 100% imperv.	0.06 ha	17.3 %
					<b>0.00 ha</b>	
203	950	m of	20	m wide ROW @ 57% imperv.	1.08 ha	17.0 %
	50	Impervious Area	75	m <sup>2</sup> @ 100% imperv.	0.38 ha	5.9 %
	58	Impervious Area	100	m <sup>2</sup> @ 100% imperv.	0.58 ha	9.1 %
	39.5	Roof Area	125	m <sup>2</sup> @ 100% imperv.	0.49 ha	7.7 %
	54	Roof Area	275	m <sup>2</sup> @ 100% imperv.	1.49 ha	23.3 %
					<b>4.02 ha</b>	
204	0	m of	12	m wide ROW @ 55% imperv.	0.00 ha	0.0 %
		Impervious Area	75	m <sup>2</sup> @ 100% imperv.	0.00 ha	0.0 %
		Impervious Area	100	m <sup>2</sup> @ 100% imperv.	0.00 ha	0.0 %
		Roof Area	125	m <sup>2</sup> @ 100% imperv.	0.00 ha	0.0 %
		Roof Area	275	m <sup>2</sup> @ 100% imperv.	0.00 ha	0.0 %
					<b>0.00 ha</b>	



## Sageen Cedar Heights East Subdivision - Post Development Model Schematic









## Sageen Cedar Heights East Subdivision – Post Development Model Details

### [TITLE]

### [OPTIONS]

```

;;Options      Value
;;-----
FLOW_UNITS      LPS
INFILTRATION     CURVE_NUMBER
FLOW_ROUTING     DYNWAVE
START_DATE       7/23/2018
START_TIME       00:00
REPORT_START_DATE 7/23/2018
REPORT_START_TIME 00:00
END_DATE         7/24/2018
END_TIME         00:00
SWEEP_START      1/1
SWEEP_END        12/31
DRY_DAYS         0
REPORT_STEP      00:01:00
WET_STEP         00:05:00
DRY_STEP         00:05:00
ROUTING_STEP     5
ALLOW_PONDING    NO
INERTIAL_DAMPING  PARTIAL
VARIABLE_STEP    0.75
LENGTHENING_STEP 0
MIN_SURFAREA     0
NORMAL_FLOW_LIMITED BOTH
SKIP_STEADY_STATE NO
FORCE_MAIN_EQUATION H-W
LINK_OFFSETS     DEPTH
MIN_SLOPE        0
MAX_TRIALS       8
HEAD_TOLERANCE   0
SYS_FLOW_TOL     5
LAT_FLOW_TOL     5
MINIMUM_STEP     0.5
THREADS          2

```

### [EVAPORATION]

```

;;Type      Parameters
;;-----
CONSTANT    0.0
DRY_ONLY    NO

```

### [RAINGAGES]

```

;;      Rain      Time      Snow      Data
;;Name      Type      Intrvl Catch      Source
;;-----
SCS_6h_37.8mm_2Yr  INTENSITY 0:05    1.0    TIMESERIES SCS_6h_37.8mm_2Yr
SCS_6h_48.1mm_5Yr  INTENSITY 0:05    1.0    TIMESERIES SCS_6h_48.1mm_5Yr
SCS_6h_63.5mm_25Yr INTENSITY 0:05    1.0    TIMESERIES SCS_6h_63.5mm_25Yr
SCS_6h_69.9mm_50Yr INTENSITY 0:05    1.0    TIMESERIES SCS_6h_69.9mm_50Yr
SCS_6h_76.3mm_100Yr INTENSITY 0:05    1.0    TIMESERIES SCS_6h_76.3mm_100Yr

```

### [SUBCATCHMENTS]

```

;;      Total      Pcnt.      Pcnt.      Curb      Snow
;;Name      Raingage      Outlet      Area      Imperv      Width      Slope      Length      Pack
;;-----
201          SCS_6h_37.8mm_2Yr J1          5.66      7.2        445        3          0
202          SCS_6h_37.8mm_2Yr J1          0.33      17.3       180        3          0
203          SCS_6h_37.8mm_2Yr J3          6.38      63         1900       2          0
204          SCS_6h_37.8mm_2Yr J2          5.49      0          450        20         0

```

### [SUBAREAS]

```

;;Subcatchment  N-Imperv  N-Perv      S-Imperv  S-Perv      PctZero      RouteTo      PctRouted
;;-----
201             0.01      0.37        0.05      0.05        25           PERVIOUS     45.4
202             0.01      0.25        0.05      0.05        25           PERVIOUS     100
203             0.01      0.27        0.05      0.05        25           PERVIOUS     49.3
204             0.01      0.4         0.05      0.05        25           OUTLET

```

### [INFILTRATION]

```

;;Subcatchment  CurveNum  HydCon      DryTime

```



## Sageen Cedar Heights East Subdivision – Post Development Model Details

```

;;-----
201          51.9      0.5      7
202          60       0.5      7
203          58.6     0.5      7
204          50       0.5      7

[JUNCTIONS]
;;
;;Name      Invert      Max.      Init.      Surcharge      Pondered
;;          Elev.       Depth     Depth     Depth         Area
;;-----
J1          276.6      0.4      0         0             0
J2          277       1       0         0             0
J3          278.4     0       0         0             0

[OUTFALLS]
;;
;;Name      Invert      Outfall      Stage/Table      Tide
;;          Elev.       Type         Time Series     Gate Route To
;;-----
DP1         276.4      FREE
DP2         276       FREE          NO
          NO

[CONDUITS]
;;
;;Name      Inlet      Outlet      Length      Manning      Inlet      Outlet      Init.      Max.
;;          Node      Node         Length      N            Offset     Offset     Flow      Flow
;;-----
C1          J1         DP1         36.42      0.013       0         0         0         0
C2          J2         DP2         68.56      0.013       0         0         0         0
C3          J3         J2         263.09     0.013       0         0         0         0

[XSECTIONS]
;;Link      Shape      Geom1      Geom2      Geom3      Geom4      Barrels
;;-----
C1          TRAPEZOIDAL  0.3       0.5       3         3         1
C2          RECT_OPEN  0.15     2         0         0         1
C3          CIRCULAR   0.9       0         0         0         1

[LOSSES]
;;Link      Inlet      Outlet      Average      Flap Gate      SeepageRate
;;-----

[TIMESERIES]
;;Name      Date      Time      Value
;;-----

;SCS_6h_37.8mm design storm, total rainfall = 37.8 mm, rain units = mm/hr.
SCS_6h_37.8mm_2Yr

;SCS_6h_48.1mm design storm, total rainfall = 48.1 mm, rain units = mm/hr.
SCS_6h_48.1mm_5Yr

;SCS_6h_63.5mm design storm, total rainfall = 63.5 mm, rain units = mm/hr.
SCS_6h_63.5mm_25Yr

;SCS_6h_69.9mm design storm, total rainfall = 69.9 mm, rain units = mm/hr.
SCS_6h_69.9mm_50Yr

;SCS_6h_76.3mm design storm, total rainfall = 76.3 mm, rain units = mm/hr.
SCS_6h_76.3mm_100Yr

[REPORT]
INPUT      YES
CONTROLS   NO
SUBCATCHMENTS ALL
NODES     ALL
LINKS     ALL

[TAGS]

[MAP]
DIMENSIONS 499379.967376563 4889432.07407248 500102.544610069 4890137.8073031
UNITS      Meters

```



# Saugeen Cedar Heights East Subdivision – Post Development 2 Year Design Storm

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)

\*\*\*\*\*

Element Count

\*\*\*\*\*

Number of rain gages ..... 5  
 Number of subcatchments ... 4  
 Number of nodes ..... 5  
 Number of links ..... 3  
 Number of pollutants ..... 0  
 Number of land uses ..... 0

\*\*\*\*\*

Raingage Summary

\*\*\*\*\*

Name	Data Source	Data Type	Recording Interval
SCS_6h_37.8mm_2Yr	SCS_6h_37.8mm_2Yr	INTENSITY	5 min.
SCS_6h_48.1mm_5Yr	SCS_6h_48.1mm_5Yr	INTENSITY	5 min.
SCS_6h_63.5mm_25Yr	SCS_6h_63.5mm_25Yr	INTENSITY	5 min.
SCS_6h_69.9mm_50Yr	SCS_6h_69.9mm_50Yr	INTENSITY	5 min.
SCS_6h_76.3mm_100Yr	SCS_6h_76.3mm_100Yr	INTENSITY	5 min.

\*\*\*\*\*

Subcatchment Summary

\*\*\*\*\*

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
201	5.66	445.00	7.20	3.0000	SCS_6h_37.8mm_2Yr	J1
202	0.33	180.00	17.30	3.0000	SCS_6h_37.8mm_2Yr	J1
203	6.38	1900.00	63.00	2.0000	SCS_6h_37.8mm_2Yr	J3
204	5.49	450.00	0.00	20.0000	SCS_6h_37.8mm_2Yr	J2

\*\*\*\*\*

Node Summary

\*\*\*\*\*

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	276.60	0.40	0.0	
J2	JUNCTION	277.00	1.00	0.0	
J3	JUNCTION	278.40	0.90	0.0	
DP1	OUTFALL	276.40	0.30	0.0	
DP2	OUTFALL	276.00	0.15	0.0	

\*\*\*\*\*

Link Summary

\*\*\*\*\*

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J1	DP1	CONDUIT	36.4	0.5492	0.0130
C2	J2	DP2	CONDUIT	68.6	1.4587	0.0130
C3	J3	J2	CONDUIT	263.1	0.5321	0.0130

\*\*\*\*\*

Cross Section Summary

\*\*\*\*\*

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	TRAPEZOIDAL	0.30	0.42	0.18	2.30	1	749.65
C2	RECT_OPEN	0.15	0.30	0.13	2.00	1	716.89
C3	CIRCULAR	0.90	0.64	0.23	0.90	1	1320.67



## Saugeen Cedar Heights East Subdivision – Post Development 2 Year Design Storm

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are  
 based on results found at every computational time step,  
 not just on results from each reporting time step.  
 \*\*\*\*\*

### \*\*\*\*\* Analysis Options \*\*\*\*\*

Flow Units ..... LPS  
 Process Models:  
   Rainfall/Runoff ..... YES  
   RDII ..... NO  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... YES  
   Ponding Allowed ..... NO  
   Water Quality ..... NO  
 Infiltration Method ..... CURVE\_NUMBER  
 Flow Routing Method ..... DYNWAVE  
 Starting Date ..... 07/23/2018 00:00:00  
 Ending Date ..... 07/24/2018 00:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 00:01:00  
 Wet Time Step ..... 00:05:00  
 Dry Time Step ..... 00:05:00  
 Routing Time Step ..... 5.00 sec  
 Variable Time Step ..... YES  
 Maximum Trials ..... 8  
 Number of Threads ..... 1  
 Head Tolerance ..... 0.001524 m

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	0.675	37.806
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.442	24.747
Surface Runoff .....	0.231	12.925
Final Storage .....	0.003	0.152
Continuity Error (%) .....	-0.048	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.231	2.309
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.231	2.308
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.002	

\*\*\*\*\*  
 Time-Step Critical Elements  
 \*\*\*\*\*  
 None

\*\*\*\*\*  
 Highest Flow Instability Indexes  
 \*\*\*\*\*  
 All links are stable.



## Saugeen Cedar Heights East Subdivision – Post Development 2 Year Design Storm

\*\*\*\*\*

### Routing Time Step Summary

\*\*\*\*\*

```

Minimum Time Step      :      4.50 sec
Average Time Step      :      5.00 sec
Maximum Time Step      :      5.00 sec
Percent in Steady State :      0.00
Average Iterations per Step :      2.00
Percent Not Converging :      0.00
  
```

\*\*\*\*\*

### Subcatchment Runoff Summary

\*\*\*\*\*

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
201	37.81	0.00	0.00	31.40	6.12	0.35	25.43	0.162
202	37.81	0.00	0.00	25.56	12.21	0.04	7.33	0.323
203	37.81	0.00	0.00	11.59	26.21	1.67	334.10	0.693
204	37.81	0.00	0.00	33.12	4.54	0.25	15.60	0.120

\*\*\*\*\*

### Node Depth Summary

\*\*\*\*\*

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J1	JUNCTION	0.02	0.06	276.66	0 02:25	0.06
J2	JUNCTION	0.01	0.09	277.09	0 02:26	0.09
J3	JUNCTION	0.05	0.35	278.75	0 02:25	0.35
DP1	OUTFALL	0.01	0.06	276.46	0 02:25	0.06
DP2	OUTFALL	0.01	0.09	276.09	0 02:26	0.09

\*\*\*\*\*

### Node Inflow Summary

\*\*\*\*\*

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	32.25	32.25	0 02:25	0.387	0.387	0.012
J2	JUNCTION	15.60	341.33	0 02:25	0.249	1.92	0.020
J3	JUNCTION	334.10	334.10	0 02:25	1.67	1.67	-0.012
DP1	OUTFALL	0.00	32.20	0 02:25	0	0.387	0.000
DP2	OUTFALL	0.00	341.11	0 02:26	0	1.92	0.000

\*\*\*\*\*

### Node Surcharge Summary

\*\*\*\*\*

No nodes were surcharged.

\*\*\*\*\*

### Node Flooding Summary

\*\*\*\*\*

No nodes were flooded.

\*\*\*\*\*



## Saugeen Cedar Heights East Subdivision – Post Development 2 Year Design Storm

### Outfall Loading Summary

\*\*\*\*\*

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
DP1	99.84	4.48	32.20	0.387
DP2	99.75	22.30	341.11	1.922
System	99.80	26.78	373.09	2.308

### Link Flow Summary

\*\*\*\*\*

Link	Type	Maximum  Flow  LPS	Time of Max Occurrence days hr:min	Maximum  Veloc  m/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	32.20	0 02:25	0.75	0.04	0.21
C2	CONDUIT	341.11	0 02:26	1.81	0.48	0.63
C3	CONDUIT	331.89	0 02:25	2.74	0.25	0.25

### Flow Classification Summary

\*\*\*\*\*

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class								
		----- Up Dry Dry		Down	Sub	Sup	Up	Down	Norm	Inlet
		Dry	Dry	Dry	Crit	Crit	Crit	Crit	Ltd	Ctrl
C1	1.00	0.00	0.00	0.00	0.82	0.18	0.00	0.00	0.12	0.00
C2	1.00	0.00	0.00	0.00	0.34	0.65	0.00	0.00	0.20	0.00
C3	1.00	0.00	0.00	0.00	0.58	0.42	0.00	0.00	0.09	0.00

### Conduit Surcharge Summary

\*\*\*\*\*

No conduits were surcharged.

Analysis begun on: Mon Aug 20 14:26:19 2018  
 Analysis ended on: Mon Aug 20 14:26:19 2018  
 Total elapsed time: < 1 sec



# Saugeen Cedar Heights East Subdivision – Post Development 5 Year Design Storm

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)

\*\*\*\*\*

Element Count

\*\*\*\*\*

Number of rain gages ..... 5  
 Number of subcatchments ... 4  
 Number of nodes ..... 5  
 Number of links ..... 3  
 Number of pollutants ..... 0  
 Number of land uses ..... 0

\*\*\*\*\*

Raingage Summary

\*\*\*\*\*

Name	Data Source	Data Type	Recording Interval
SCS_6h_37.8mm_2Yr	SCS_6h_37.8mm_2Yr	INTENSITY	5 min.
SCS_6h_48.1mm_5Yr	SCS_6h_48.1mm_5Yr	INTENSITY	5 min.
SCS_6h_63.5mm_25Yr	SCS_6h_63.5mm_25Yr	INTENSITY	5 min.
SCS_6h_69.9mm_50Yr	SCS_6h_69.9mm_50Yr	INTENSITY	5 min.
SCS_6h_76.3mm_100Yr	SCS_6h_76.3mm_100Yr	INTENSITY	5 min.

\*\*\*\*\*

Subcatchment Summary

\*\*\*\*\*

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
201	5.66	445.00	7.20	3.0000	SCS_6h_48.1mm_5Yr	J1
202	0.33	180.00	17.30	3.0000	SCS_6h_48.1mm_5Yr	J1
203	6.38	1900.00	63.00	2.0000	SCS_6h_48.1mm_5Yr	J3
204	5.49	450.00	0.00	20.0000	SCS_6h_48.1mm_5Yr	J2

\*\*\*\*\*

Node Summary

\*\*\*\*\*

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	276.60	0.40	0.0	
J2	JUNCTION	277.00	1.00	0.0	
J3	JUNCTION	278.40	0.90	0.0	
DP1	OUTFALL	276.40	0.30	0.0	
DP2	OUTFALL	276.00	0.15	0.0	

\*\*\*\*\*

Link Summary

\*\*\*\*\*

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J1	DP1	CONDUIT	36.4	0.5492	0.0130
C2	J2	DP2	CONDUIT	68.6	1.4587	0.0130
C3	J3	J2	CONDUIT	263.1	0.5321	0.0130

\*\*\*\*\*

Cross Section Summary

\*\*\*\*\*

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	TRAPEZOIDAL	0.30	0.42	0.18	2.30	1	749.65
C2	RECT_OPEN	0.15	0.30	0.13	2.00	1	716.89
C3	CIRCULAR	0.90	0.64	0.23	0.90	1	1320.67



## Saugeen Cedar Heights East Subdivision – Post Development 5 Year Design Storm

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are  
 based on results found at every computational time step,  
 not just on results from each reporting time step.  
 \*\*\*\*\*

### \*\*\*\*\* Analysis Options

\*\*\*\*\*  
 Flow Units ..... LPS  
 Process Models:  
   Rainfall/Runoff ..... YES  
   RDII ..... NO  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... YES  
   Ponding Allowed ..... NO  
   Water Quality ..... NO  
 Infiltration Method ..... CURVE\_NUMBER  
 Flow Routing Method ..... DYNWAVE  
 Starting Date ..... 07/23/2018 00:00:00  
 Ending Date ..... 07/24/2018 00:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 00:01:00  
 Wet Time Step ..... 00:05:00  
 Dry Time Step ..... 00:05:00  
 Routing Time Step ..... 5.00 sec  
 Variable Time Step ..... YES  
 Maximum Trials ..... 8  
 Number of Threads ..... 1  
 Head Tolerance ..... 0.001524 m

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	0.859	48.107
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.545	30.504
Surface Runoff .....	0.312	17.474
Final Storage .....	0.003	0.151
Continuity Error (%) .....	-0.047	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.312	3.121
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.312	3.121
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.003	

\*\*\*\*\*  
 Time-Step Critical Elements  
 \*\*\*\*\*  
 None

\*\*\*\*\*  
 Highest Flow Instability Indexes  
 \*\*\*\*\*  
 All links are stable.



## Saugeen Cedar Heights East Subdivision – Post Development 5 Year Design Storm

\*\*\*\*\*

### Routing Time Step Summary

\*\*\*\*\*

Minimum Time Step : 4.50 sec  
 Average Time Step : 5.00 sec  
 Maximum Time Step : 5.00 sec  
 Percent in Steady State : 0.00  
 Average Iterations per Step : 2.00  
 Percent Not Converging : 0.00

\*\*\*\*\*

### Subcatchment Runoff Summary

\*\*\*\*\*

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
201	48.11	0.00	0.00	38.80	9.03	0.51	37.40	0.188
202	48.11	0.00	0.00	30.98	17.09	0.06	10.69	0.355
203	48.11	0.00	0.00	14.12	34.00	2.17	439.99	0.707
204	48.11	0.00	0.00	40.96	7.01	0.38	27.51	0.146

\*\*\*\*\*

### Node Depth Summary

\*\*\*\*\*

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J1	JUNCTION	0.02	0.08	276.68	0 02:25	0.08
J2	JUNCTION	0.01	0.11	277.11	0 02:26	0.11
J3	JUNCTION	0.05	0.40	278.80	0 02:25	0.40
DP1	OUTFALL	0.02	0.08	276.48	0 02:25	0.08
DP2	OUTFALL	0.01	0.11	276.11	0 02:26	0.11

\*\*\*\*\*

### Node Inflow Summary

\*\*\*\*\*

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	47.54	47.54	0 02:25	0.567	0.567	0.009
J2	JUNCTION	27.51	457.13	0 02:25	0.385	2.55	0.020
J3	JUNCTION	439.99	439.99	0 02:25	2.17	2.17	-0.013
DP1	OUTFALL	0.00	47.55	0 02:25	0	0.567	0.000
DP2	OUTFALL	0.00	456.91	0 02:26	0	2.55	0.000

\*\*\*\*\*

### Node Surcharge Summary

\*\*\*\*\*

No nodes were surcharged.

\*\*\*\*\*

### Node Flooding Summary

\*\*\*\*\*

No nodes were flooded.

\*\*\*\*\*



## Saugeen Cedar Heights East Subdivision – Post Development 5 Year Design Storm

### Outfall Loading Summary

\*\*\*\*\*

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
DP1	99.86	6.58	47.55	0.567
DP2	99.77	29.62	456.91	2.554
System	99.82	36.20	504.35	3.121

### Link Flow Summary

\*\*\*\*\*

Link	Type	Maximum  Flow  LPS	Time of Max Occurrence days hr:min	Maximum  Veloc  m/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	47.55	0 02:25	0.84	0.06	0.26
C2	CONDUIT	456.91	0 02:26	2.02	0.64	0.75
C3	CONDUIT	437.43	0 02:25	2.92	0.33	0.29

### Flow Classification Summary

\*\*\*\*\*

Conduit	Adjusted /Actual Length	----- Up Dry Dry		Fraction of Down Sub Dry Crit		Time in Flow Class Sup Up Crit Crit		Down Norm Crit Crit Ltd		Inlet Ctrl
C1	1.00	0.00	0.00	0.00	0.81	0.19	0.00	0.00	0.14	0.00
C2	1.00	0.00	0.00	0.00	0.34	0.66	0.00	0.00	0.21	0.00
C3	1.00	0.00	0.00	0.00	0.58	0.42	0.00	0.00	0.09	0.00

### Conduit Surcharge Summary

\*\*\*\*\*

No conduits were surcharged.

Analysis begun on: Mon Aug 20 14:18:02 2018  
 Analysis ended on: Mon Aug 20 14:18:03 2018  
 Total elapsed time: 00:00:01



# Sageen Cedar Heights East Subdivision – Post Development 25 Year Design Storm

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)

\*\*\*\*\*

Element Count

\*\*\*\*\*

Number of rain gages ..... 5  
 Number of subcatchments ... 4  
 Number of nodes ..... 5  
 Number of links ..... 3  
 Number of pollutants ..... 0  
 Number of land uses ..... 0

\*\*\*\*\*

Raingage Summary

\*\*\*\*\*

Name	Data Source	Data Type	Recording Interval
SCS_6h_37.8mm_2Yr	SCS_6h_37.8mm_2Yr	INTENSITY	5 min.
SCS_6h_48.1mm_5Yr	SCS_6h_48.1mm_5Yr	INTENSITY	5 min.
SCS_6h_63.5mm_25Yr	SCS_6h_63.5mm_25Yr	INTENSITY	5 min.
SCS_6h_69.9mm_50Yr	SCS_6h_69.9mm_50Yr	INTENSITY	5 min.
SCS_6h_76.3mm_100Yr	SCS_6h_76.3mm_100Yr	INTENSITY	5 min.

\*\*\*\*\*

Subcatchment Summary

\*\*\*\*\*

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
201	5.66	445.00	7.20	3.0000	SCS_6h_63.5mm_25Yr	J1
202	0.33	180.00	17.30	3.0000	SCS_6h_63.5mm_25Yr	J1
203	6.38	1900.00	63.00	2.0000	SCS_6h_63.5mm_25Yr	J3
204	5.49	450.00	0.00	20.0000	SCS_6h_63.5mm_25Yr	J2

\*\*\*\*\*

Node Summary

\*\*\*\*\*

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	276.60	0.40	0.0	
J2	JUNCTION	277.00	1.00	0.0	
J3	JUNCTION	278.40	0.90	0.0	
DP1	OUTFALL	276.40	0.30	0.0	
DP2	OUTFALL	276.00	0.15	0.0	

\*\*\*\*\*

Link Summary

\*\*\*\*\*

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J1	DP1	CONDUIT	36.4	0.5492	0.0130
C2	J2	DP2	CONDUIT	68.6	1.4587	0.0130
C3	J3	J2	CONDUIT	263.1	0.5321	0.0130

\*\*\*\*\*

Cross Section Summary

\*\*\*\*\*

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	TRAPEZOIDAL	0.30	0.42	0.18	2.30	1	749.65
C2	RECT_OPEN	0.15	0.30	0.13	2.00	1	716.89
C3	CIRCULAR	0.90	0.64	0.23	0.90	1	1320.67



## Sageen Cedar Heights East Subdivision – Post Development 25 Year Design Storm

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are  
 based on results found at every computational time step,  
 not just on results from each reporting time step.  
 \*\*\*\*\*

### \*\*\*\*\* Analysis Options

\*\*\*\*\*  
 Flow Units ..... LPS  
 Process Models:  
   Rainfall/Runoff ..... YES  
   RDII ..... NO  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... YES  
   Ponding Allowed ..... NO  
   Water Quality ..... NO  
 Infiltration Method ..... CURVE\_NUMBER  
 Flow Routing Method ..... DYNWAVE  
 Starting Date ..... 07/23/2018 00:00:00  
 Ending Date ..... 07/24/2018 00:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 00:01:00  
 Wet Time Step ..... 00:05:00  
 Dry Time Step ..... 00:05:00  
 Routing Time Step ..... 5.00 sec  
 Variable Time Step ..... YES  
 Maximum Trials ..... 8  
 Number of Threads ..... 1  
 Head Tolerance ..... 0.001524 m

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	1.134	63.510
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.684	38.307
Surface Runoff .....	0.448	25.080
Final Storage .....	0.003	0.153
Continuity Error (%) .....	-0.048	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.448	4.480
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.448	4.479
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.005	

\*\*\*\*\*  
 Time-Step Critical Elements  
 \*\*\*\*\*  
 None

\*\*\*\*\*  
 Highest Flow Instability Indexes  
 \*\*\*\*\*  
 All links are stable.



## Sageen Cedar Heights East Subdivision – Post Development 25 Year Design Storm

\*\*\*\*\*  
Routing Time Step Summary  
\*\*\*\*\*

Minimum Time Step : 4.50 sec  
Average Time Step : 5.00 sec  
Maximum Time Step : 5.00 sec  
Percent in Steady State : 0.00  
Average Iterations per Step : 2.00  
Percent Not Converging : 0.00

\*\*\*\*\*  
Subcatchment Runoff Summary  
\*\*\*\*\*

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
201	63.51	0.00	0.00	48.75	14.48	0.82	62.50	0.228
202	63.51	0.00	0.00	38.20	25.29	0.08	16.41	0.398
203	63.51	0.00	0.00	17.50	46.03	2.94	605.36	0.725
204	63.51	0.00	0.00	51.72	11.64	0.64	55.81	0.183

\*\*\*\*\*  
Node Depth Summary  
\*\*\*\*\*

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J1	JUNCTION	0.02	0.10	276.70	0 02:30	0.10
J2	JUNCTION	0.02	0.14	277.14	0 02:26	0.14
J3	JUNCTION	0.06	0.47	278.87	0 02:25	0.47
DP1	OUTFALL	0.02	0.10	276.50	0 02:30	0.10
DP2	OUTFALL	0.02	0.14	276.14	0 02:26	0.14

\*\*\*\*\*  
Node Inflow Summary  
\*\*\*\*\*

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	78.91	78.91	0 02:30	0.903	0.903	0.008
J2	JUNCTION	55.81	646.63	0 02:25	0.639	3.58	0.019
J3	JUNCTION	605.36	605.36	0 02:25	2.94	2.94	-0.013
DP1	OUTFALL	0.00	78.86	0 02:30	0	0.903	0.000
DP2	OUTFALL	0.00	646.49	0 02:26	0	3.58	0.000

\*\*\*\*\*  
Node Surcharge Summary  
\*\*\*\*\*

No nodes were surcharged.

\*\*\*\*\*  
Node Flooding Summary  
\*\*\*\*\*

No nodes were flooded.

\*\*\*\*\*



## Sageen Cedar Heights East Subdivision – Post Development 25 Year Design Storm

### Outfall Loading Summary

\*\*\*\*\*

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
DP1	99.88	10.46	78.86	0.903
DP2	99.80	41.47	646.49	3.576
System	99.84	51.94	724.07	4.479

### Link Flow Summary

\*\*\*\*\*

Link	Type	Maximum  Flow  LPS	Time of Max Occurrence days hr:min	Maximum  Veloc  m/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	78.86	0 02:30	0.98	0.11	0.34
C2	CONDUIT	646.49	0 02:26	2.30	0.90	0.94
C3	CONDUIT	602.31	0 02:25	3.14	0.46	0.34

### Flow Classification Summary

\*\*\*\*\*

Conduit	Adjusted /Actual Length	----- Up Dry Dry		Fraction of Time in Flow Class Down Sub Sup		Up Down Norm		Inlet	
				Dry	Crit	Crit	Crit	Ltd	Ctrl
C1	1.00	0.00	0.00	0.00	0.80	0.20	0.00	0.00	0.16 0.00
C2	1.00	0.00	0.00	0.00	0.34	0.66	0.00	0.00	0.21 0.00
C3	1.00	0.00	0.00	0.00	0.58	0.42	0.00	0.00	0.09 0.00

### Conduit Surcharge Summary

\*\*\*\*\*

No conduits were surcharged.

Analysis begun on: Mon Aug 20 14:17:07 2018  
 Analysis ended on: Mon Aug 20 14:17:08 2018  
 Total elapsed time: 00:00:01



# Sageen Cedar Heights East Subdivision – Post Development 50 Year Design Storm

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)

\*\*\*\*\*

Element Count

\*\*\*\*\*

Number of rain gages ..... 5  
 Number of subcatchments ... 4  
 Number of nodes ..... 5  
 Number of links ..... 3  
 Number of pollutants ..... 0  
 Number of land uses ..... 0

\*\*\*\*\*

Raingage Summary

\*\*\*\*\*

Name	Data Source	Data Type	Recording Interval
SCS_6h_37.8mm_2Yr	SCS_6h_37.8mm_2Yr	INTENSITY	5 min.
SCS_6h_48.1mm_5Yr	SCS_6h_48.1mm_5Yr	INTENSITY	5 min.
SCS_6h_63.5mm_25Yr	SCS_6h_63.5mm_25Yr	INTENSITY	5 min.
SCS_6h_69.9mm_50Yr	SCS_6h_69.9mm_50Yr	INTENSITY	5 min.
SCS_6h_76.3mm_100Yr	SCS_6h_76.3mm_100Yr	INTENSITY	5 min.

\*\*\*\*\*

Subcatchment Summary

\*\*\*\*\*

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
201	5.66	445.00	7.20	3.0000	SCS_6h_69.9mm_50Yr	J1
202	0.33	180.00	17.30	3.0000	SCS_6h_69.9mm_50Yr	J1
203	6.38	1900.00	63.00	2.0000	SCS_6h_69.9mm_50Yr	J3
204	5.49	450.00	0.00	20.0000	SCS_6h_69.9mm_50Yr	J2

\*\*\*\*\*

Node Summary

\*\*\*\*\*

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	276.60	0.40	0.0	
J2	JUNCTION	277.00	1.00	0.0	
J3	JUNCTION	278.40	0.90	0.0	
DP1	OUTFALL	276.40	0.30	0.0	
DP2	OUTFALL	276.00	0.15	0.0	

\*\*\*\*\*

Link Summary

\*\*\*\*\*

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J1	DP1	CONDUIT	36.4	0.5492	0.0130
C2	J2	DP2	CONDUIT	68.6	1.4587	0.0130
C3	J3	J2	CONDUIT	263.1	0.5321	0.0130

\*\*\*\*\*

Cross Section Summary

\*\*\*\*\*

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	TRAPEZOIDAL	0.30	0.42	0.18	2.30	1	749.65
C2	RECT_OPEN	0.15	0.30	0.13	2.00	1	716.89
C3	CIRCULAR	0.90	0.64	0.23	0.90	1	1320.67



## Sageen Cedar Heights East Subdivision – Post Development 50 Year Design Storm

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are  
 based on results found at every computational time step,  
 not just on results from each reporting time step.  
 \*\*\*\*\*

### \*\*\*\*\* Analysis Options

\*\*\*\*\*  
 Flow Units ..... LPS  
 Process Models:  
   Rainfall/Runoff ..... YES  
   RDII ..... NO  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... YES  
   Ponding Allowed ..... NO  
   Water Quality ..... NO  
 Infiltration Method ..... CURVE\_NUMBER  
 Flow Routing Method ..... DYNWAVE  
 Starting Date ..... 07/23/2018 00:00:00  
 Ending Date ..... 07/24/2018 00:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 00:01:00  
 Wet Time Step ..... 00:05:00  
 Dry Time Step ..... 00:05:00  
 Routing Time Step ..... 5.00 sec  
 Variable Time Step ..... YES  
 Maximum Trials ..... 8  
 Number of Threads ..... 1  
 Head Tolerance ..... 0.001524 m

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	1.249	69.911
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.738	41.342
Surface Runoff .....	0.508	28.450
Final Storage .....	0.003	0.152
Continuity Error (%) .....	-0.048	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.508	5.082
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.508	5.081
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.005	

\*\*\*\*\*  
 Time-Step Critical Elements  
 \*\*\*\*\*  
 None

\*\*\*\*\*  
 Highest Flow Instability Indexes  
 \*\*\*\*\*  
 All links are stable.



## Sageen Cedar Heights East Subdivision – Post Development 50 Year Design Storm

\*\*\*\*\*  
Routing Time Step Summary  
\*\*\*\*\*

```

Minimum Time Step      :      4.50 sec
Average Time Step      :      5.00 sec
Maximum Time Step      :      5.00 sec
Percent in Steady State :      0.00
Average Iterations per Step :      2.00
Percent Not Converging  :      0.00
  
```

\*\*\*\*\*  
Subcatchment Runoff Summary  
\*\*\*\*\*

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
201	69.91	0.00	0.00	52.63	17.00	0.96	76.18	0.243
202	69.91	0.00	0.00	41.03	28.87	0.10	19.00	0.413
203	69.91	0.00	0.00	18.77	51.18	3.27	676.22	0.732
204	69.91	0.00	0.00	55.95	13.82	0.76	70.66	0.198

\*\*\*\*\*  
Node Depth Summary  
\*\*\*\*\*

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J1	JUNCTION	0.02	0.11	276.71	0 02:30	0.11
J2	JUNCTION	0.02	0.16	277.16	0 02:27	0.16
J3	JUNCTION	0.06	0.50	278.90	0 02:25	0.50
DP1	OUTFALL	0.02	0.11	276.51	0 02:30	0.11
DP2	OUTFALL	0.02	0.15	276.15	0 02:24	0.15

\*\*\*\*\*  
Node Inflow Summary  
\*\*\*\*\*

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	95.19	95.19	0 02:30	1.06	1.06	0.007
J2	JUNCTION	70.66	731.95	0 02:25	0.759	4.02	0.019
J3	JUNCTION	676.22	676.22	0 02:25	3.27	3.27	-0.013
DP1	OUTFALL	0.00	95.10	0 02:30	0	1.06	0.000
DP2	OUTFALL	0.00	720.36	0 02:27	0	4.02	0.000

\*\*\*\*\*  
Node Surcharge Summary  
\*\*\*\*\*

No nodes were surcharged.

\*\*\*\*\*  
Node Flooding Summary  
\*\*\*\*\*

No nodes were flooded.

\*\*\*\*\*



## Sageen Cedar Heights East Subdivision – Post Development 50 Year Design Storm

### Outfall Loading Summary

\*\*\*\*\*

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
DP1	99.89	12.25	95.10	1.058
DP2	99.81	46.66	720.36	4.024
System	99.85	58.91	814.16	5.081

\*\*\*\*\*

### Link Flow Summary

\*\*\*\*\*

Link	Type	Maximum  Flow  LPS	Time of Max Occurrence days hr:min	Maximum  Veloc  m/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	95.10	0 02:30	1.03	0.13	0.37
C2	CONDUIT	720.36	0 02:27	2.40	1.00	1.00
C3	CONDUIT	673.67	0 02:25	3.20	0.51	0.37

\*\*\*\*\*

### Flow Classification Summary

\*\*\*\*\*

Conduit	Adjusted /Actual Length	----- Up Dry		Down Dry		Sub Crit		Sup Crit		Up Crit		Down Crit		Norm Ltd	Inlet Ctrl
C1	1.00	0.00	0.00	0.00	0.00	0.78	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00
C2	1.00	0.00	0.00	0.00	0.00	0.34	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00
C3	1.00	0.00	0.00	0.00	0.00	0.58	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00

\*\*\*\*\*

### Conduit Surcharge Summary

\*\*\*\*\*

Conduit	----- Both Ends	Hours Full Upstream	----- Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C2	0.01	0.09	0.01	0.09	0.01

Analysis begun on: Mon Aug 20 14:15:59 2018

Analysis ended on: Mon Aug 20 14:16:00 2018

Total elapsed time: 00:00:01



# Sageen Cedar Heights East Subdivision – Post Development 100 Year Design Storm

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)

\*\*\*\*\*

Element Count

\*\*\*\*\*

Number of rain gages ..... 5  
 Number of subcatchments ... 4  
 Number of nodes ..... 5  
 Number of links ..... 3  
 Number of pollutants ..... 0  
 Number of land uses ..... 0

\*\*\*\*\*

Raingage Summary

\*\*\*\*\*

Name	Data Source	Data Type	Recording Interval
SCS_6h_37.8mm_2Yr	SCS_6h_37.8mm_2Yr	INTENSITY	5 min.
SCS_6h_48.1mm_5Yr	SCS_6h_48.1mm_5Yr	INTENSITY	5 min.
SCS_6h_63.5mm_25Yr	SCS_6h_63.5mm_25Yr	INTENSITY	5 min.
SCS_6h_69.9mm_50Yr	SCS_6h_69.9mm_50Yr	INTENSITY	5 min.
SCS_6h_76.3mm_100Yr	SCS_6h_76.3mm_100Yr	INTENSITY	5 min.

\*\*\*\*\*

Subcatchment Summary

\*\*\*\*\*

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
201	5.66	445.00	7.20	3.0000	SCS_6h_76.3mm_100Yr	J1
202	0.33	180.00	17.30	3.0000	SCS_6h_76.3mm_100Yr	J1
203	6.38	1900.00	63.00	2.0000	SCS_6h_76.3mm_100Yr	J3
204	5.49	450.00	0.00	20.0000	SCS_6h_76.3mm_100Yr	J2

\*\*\*\*\*

Node Summary

\*\*\*\*\*

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	276.60	0.40	0.0	
J2	JUNCTION	277.00	1.00	0.0	
J3	JUNCTION	278.40	0.90	0.0	
DP1	OUTFALL	276.40	0.30	0.0	
DP2	OUTFALL	276.00	0.15	0.0	

\*\*\*\*\*

Link Summary

\*\*\*\*\*

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J1	DP1	CONDUIT	36.4	0.5492	0.0130
C2	J2	DP2	CONDUIT	68.6	1.4587	0.0130
C3	J3	J2	CONDUIT	263.1	0.5321	0.0130

\*\*\*\*\*

Cross Section Summary

\*\*\*\*\*

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	TRAPEZOIDAL	0.30	0.42	0.18	2.30	1	749.65
C2	RECT_OPEN	0.15	0.30	0.13	2.00	1	716.89
C3	CIRCULAR	0.90	0.64	0.23	0.90	1	1320.67



## Sageen Cedar Heights East Subdivision – Post Development 100 Year Design Storm

\*\*\*\*\*  
 NOTE: The summary statistics displayed in this report are  
 based on results found at every computational time step,  
 not just on results from each reporting time step.  
 \*\*\*\*\*

### \*\*\*\*\* Analysis Options

\*\*\*\*\*  
 Flow Units ..... LPS  
 Process Models:  
   Rainfall/Runoff ..... YES  
   RDII ..... NO  
   Snowmelt ..... NO  
   Groundwater ..... NO  
   Flow Routing ..... YES  
   Ponding Allowed ..... NO  
   Water Quality ..... NO  
 Infiltration Method ..... CURVE\_NUMBER  
 Flow Routing Method ..... DYNWAVE  
 Starting Date ..... 07/23/2018 00:00:00  
 Ending Date ..... 07/24/2018 00:00:00  
 Antecedent Dry Days ..... 0.0  
 Report Time Step ..... 00:01:00  
 Wet Time Step ..... 00:05:00  
 Dry Time Step ..... 00:05:00  
 Routing Time Step ..... 5.00 sec  
 Variable Time Step ..... YES  
 Maximum Trials ..... 8  
 Number of Threads ..... 1  
 Head Tolerance ..... 0.001524 m

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	1.363	76.311
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.789	44.158
Surface Runoff .....	0.572	32.035
Final Storage .....	0.003	0.155
Continuity Error (%) .....	-0.048	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.572	5.722
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.572	5.722
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.005	

\*\*\*\*\*  
 Time-Step Critical Elements  
 \*\*\*\*\*  
 None

\*\*\*\*\*  
 Highest Flow Instability Indexes  
 \*\*\*\*\*  
 All links are stable.



## Sageen Cedar Heights East Subdivision – Post Development 100 Year Design Storm

\*\*\*\*\*  
 Routing Time Step Summary  
 \*\*\*\*\*

```

Minimum Time Step      :      4.50 sec
Average Time Step      :      5.00 sec
Maximum Time Step      :      5.00 sec
Percent in Steady State :      0.00
Average Iterations per Step :      2.00
Percent Not Converging  :      0.00
  
```

\*\*\*\*\*  
 Subcatchment Runoff Summary  
 \*\*\*\*\*

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
201	76.31	0.00	0.00	56.22	19.81	1.12	91.58	0.260
202	76.31	0.00	0.00	43.62	32.69	0.11	21.69	0.428
203	76.31	0.00	0.00	19.97	56.38	3.60	748.19	0.739
204	76.31	0.00	0.00	59.87	16.30	0.90	87.09	0.214

\*\*\*\*\*  
 Node Depth Summary  
 \*\*\*\*\*

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J1	JUNCTION	0.03	0.12	276.72	0 02:30	0.12
J2	JUNCTION	0.02	0.32	277.32	0 02:30	0.32
J3	JUNCTION	0.06	0.52	278.92	0 02:22	0.52
DP1	OUTFALL	0.02	0.12	276.52	0 02:30	0.12
DP2	OUTFALL	0.02	0.15	276.15	0 02:19	0.15

\*\*\*\*\*  
 Node Inflow Summary  
 \*\*\*\*\*

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	113.28	113.28	0 02:30	1.23	1.23	0.007
J2	JUNCTION	87.09	826.48	0 02:25	0.895	4.49	0.025
J3	JUNCTION	748.19	748.19	0 02:25	3.6	3.6	-0.021
DP1	OUTFALL	0.00	113.17	0 02:30	0	1.23	0.000
DP2	OUTFALL	0.00	775.83	0 02:30	0	4.49	0.000

\*\*\*\*\*  
 Node Surcharge Summary  
 \*\*\*\*\*

No nodes were surcharged.

\*\*\*\*\*  
 Node Flooding Summary  
 \*\*\*\*\*

No nodes were flooded.

\*\*\*\*\*



## Sageen Cedar Heights East Subdivision – Post Development 100 Year Design Storm

### Outfall Loading Summary

\*\*\*\*\*

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
DP1	99.90	14.24	113.17	1.229
DP2	99.82	52.09	775.83	4.492
System	99.86	66.33	888.94	5.722

\*\*\*\*\*

### Link Flow Summary

\*\*\*\*\*

Link	Type	Maximum  Flow  LPS	Time of Max Occurrence days hr:min	Maximum  Veloc  m/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	113.17	0 02:30	1.08	0.15	0.40
C2	CONDUIT	775.83	0 02:30	2.59	1.08	1.00
C3	CONDUIT	752.38	0 02:25	3.22	0.57	0.45

\*\*\*\*\*

### Flow Classification Summary

\*\*\*\*\*

Conduit	Adjusted /Actual Length	----- Up Dry Dry		Fraction of Time in Flow Class Down Sub Dry Crit		Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C1	1.00	0.00	0.00	0.00	0.78	0.22	0.00	0.00	0.18	0.00
C2	1.00	0.00	0.00	0.00	0.33	0.67	0.00	0.00	0.21	0.00
C3	1.00	0.00	0.00	0.00	0.58	0.42	0.00	0.00	0.09	0.00

\*\*\*\*\*

### Conduit Surcharge Summary

\*\*\*\*\*

Conduit	----- Both Ends	Hours Full Upstream	----- Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C2	0.01	0.29	0.01	0.28	0.01

Analysis begun on: Tue Jul 24 09:32:19 2018

Analysis ended on: Tue Jul 24 09:32:19 2018

Total elapsed time: < 1 sec