2501563 ONTARIO LTD.

STORMWATER MANAGEMENT REPORT

SAUGEEN CEDAR HEIGHTS EAST SUBDIVISION

TOWN OF HANOVER

FEBRUARY 2019

COBIDE Engineering Inc
464A 10th Street
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COBIDE
ENGINEERING INC

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1. INTRODUCTION

Cobide Engineering Inc. was retained by 2501563 Ontario Inc. to complete the final stormwater management report in support of an Environmental Compliance Approval Application. The application will be to service the subject property (a 98 lot subdivision) with storm and sanitary sewers.

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 14th Street and 25th 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.

MAP SOURCE - MTO ROAD MAP

COBIDE ENGINEERING INC
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Client/Project

PROPOSED SAUGEEN CEDAR HEIGHTS EAST SUBDIVISION
PART OF LOTS 11, 12, 13 AND 14 CONCESSION 1 N.D.R.
GEOGRAPHIC TOWNSHIP OF BENTINCK
Town of Hanover, Ontario
STORMWATER MANAGEMENT REPORT

Figure No.

1

Title

REGIONAL LOCATION MAP

ORIGINAL SHEET – 8 x 11

H:\Weller\00502 MacDonald Property Subdivision – Weller\DELIVERABLES\Drawings\Submissions\2018-07-20 SWM\00502 Regional Location.dwg Aug 21, 2018 – 1:13pm

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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, MECP 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.
- 14th 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 = 0.20 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 14th Street and 25th 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 = 5.94 ha.

5.4 CATCHMENT 204

- This catchment area encompasses the valley lands on the east side of the site.
- Ctachment 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 = 6.04 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 in which case quantity control would not be required. 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 outlet directly to 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. The EIS for the development does require that the peak flows to Discharge Point #1 be maintained as close as possible to pre-development levels.

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	30.43	17.23	343.01
5 Year	53.85	44.66	30.31	457.25
25 Year	101.76	73.38	61.05	643.68
50 Year	125.46	88.63	77.38	718.84
100 Year	150.96	105.65	95.45	771.45

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 2 year storm event being nearly equivalent which 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 MECP, 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 to maximize the developable area.

The OGS has been designed in conformance with the MOE design guidelines to achieve an “Enhanced” Level of protection. The OGS will be a FD8-HC from Hydro International or approved equivalent.

Quality control for the Discharge Points #1 will be achieved via the installation of goss traps in the catchbasin leads and the deepened sumps in all structures. These areas are quite small and therefore the goss traps and deepened sumps will provide quality control.

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, large diameter rip-rap will be utilized to protect against erosion of the slope.

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 Final Stormwater Management Plan in support of the Environmental Compliance Approval 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 Dicharge Point #1. 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 Discharge Point #2 and goss traps at Discharge Point #1.

   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 MECP, SVCA, and Town of Hanover as part of the Environmental Compliance Approval Application.

Sincerely,

Cobide Engineering Inc.

Travis Burnside, P. Eng.

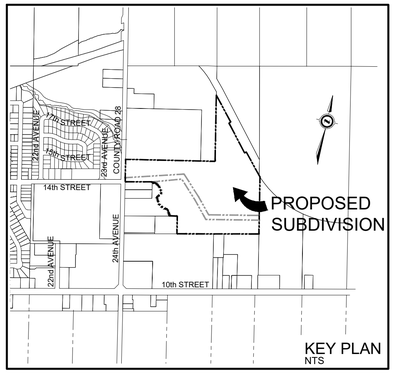
H:\Weller\00502 MacDonald Property Subdivision – Weller\DELIVERABLES\Reports\Final SWM\2018-07-17 SCHE SWM Report.docx

Appendix A

DRAWINGS

STORMWATER MANAGEMENT REPORT

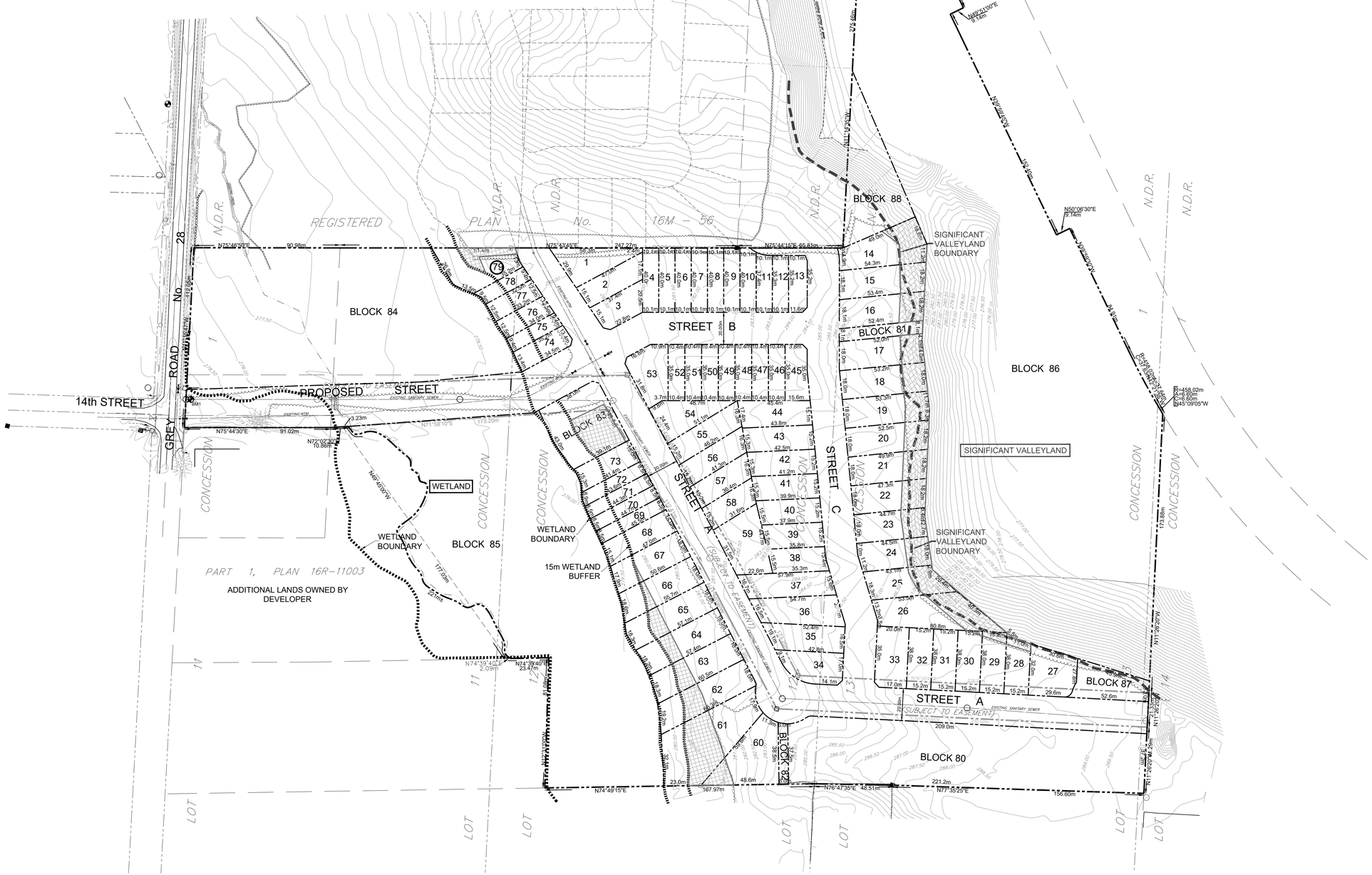
SAUGEEN CEDAR HEIGHTS EAST SUBDIVISION
TOWN OF HANOVER



KEY PLAN
NTS

LEGEND

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



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 45 TO 52)	0.699 ha.
DETACHED RESIDENTIAL LOTS (LOTS 1 TO 3, 14 TO 44 AND 53 TO 67)	4.076 ha.
TOWNHOUSE RESIDENTIAL LOTS (LOTS 68 TO 79)	0.578 ha.
MUNICIPAL STREET (14th STREET, STREETS A & B)	2.578 ha.
FUTURE DEVELOPMENT (BLOCKS 80 & 88)	1.121 ha.
DRAINAGE BLOCK (BLOCK 81)	0.039 ha.
UTILITY CORRIDOR (BLOCK 82 & 87)	0.199 ha.
OPEN SPACE (BLOCK 84, 85 & 86)	8.472 ha.
TEMPORARY TURNING CIRCLE (BLOCK 87)	0.087 ha.
TOTAL PROPOSED SUBDIVISION	17.849 ha.

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51 OF THE PLANNING ACT

a. AS SHOWN
b. AS SHOWN
c. AS SHOWN
d. SINGLE FAMILY RESIDENTIAL, SEMI-DETACHED RESIDENTIAL
e. AS SHOWN
f. AS SHOWN
g. AS SHOWN
h. MUNICIPAL WATER SUPPLY
i. SANDY SILT & GRAVEL
j. AS SHOWN
k. WATER, STORM SEWERS, SANITARY SEWERS, HYDRO, TELEPHONE
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.

August 23 2018
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.

August 22/2018
DATE

JAYSON JONES (I HAVE AUTHORITY TO BIND THE CORPORATION)
OWNER
2501563 ONTARIO INC.
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 INFROMATION SHOWN ON PLAN 16R-10098.

Benchmark Information

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

SCALE 1:1250
10 0 5 15 25 50 75 METRES
50 0 25 50 100 250 FEET

No.	DATE	DESCRIPTION	BY	APPD
2	NOV 28/18	THIRD SUBMISSION	TLB	SJC
1	SEP 24/18	SECOND SUBMISSION	TLB	SJC
0	JUL 13/18	FIRST SUBMISSION	TLB	SJC

REVISION / ISSUE

COBIDE ENGINEERING INC
464A - 10th STREET, Hanover, Ontario N4N 1R1
Telephone: (519) 506-5959
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Client: 2501563 ONTARIO INC.

Design:	TLB	Scale:	1:1250
Drawn:	JAF	Approved:	
Checked:	SJC		
Date:	JUN 2016		Design Engineer

DRAWING No. 00502-DP-1

H:\Weiler\00502 MacDonald Property Subdivision - Weiler\DELIVERABLES\Drawings\Submissions\Draft Plan\2018-11-28 Revised Draft Plan\00502 Draft Plan Rev Nov 28-18.dwg Nov 29, 2018 - 5:40pm

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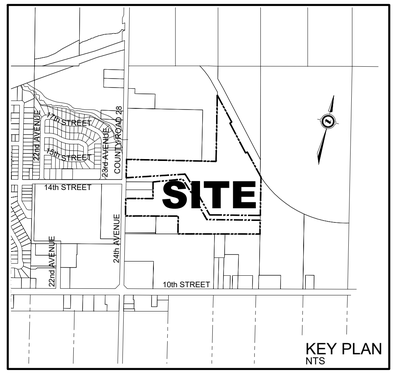
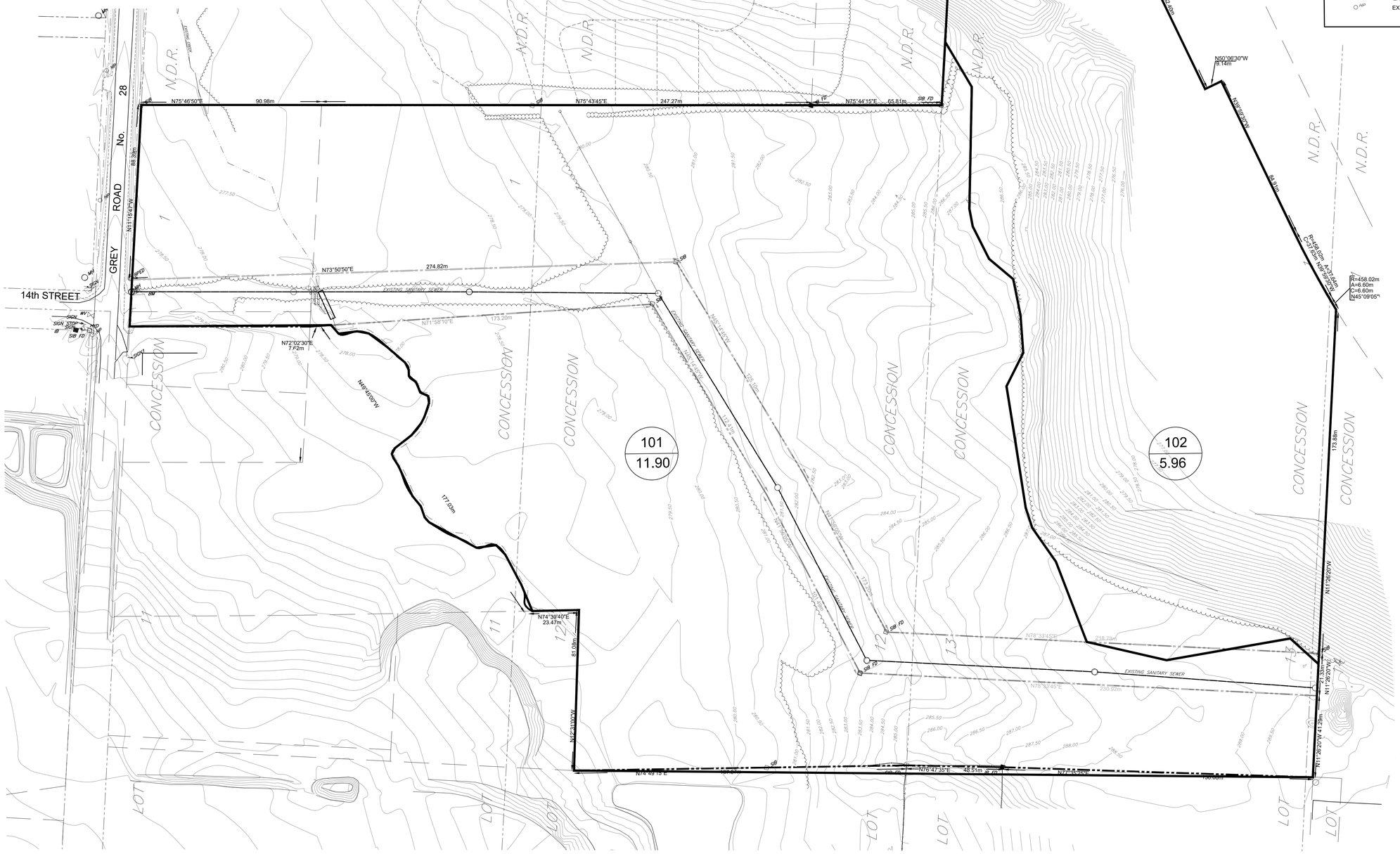


KEY PLAN
NTS



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 INFROMATION SHOWN ON PLAN 16R-10098.

LEGEND

- PROPERTY BOUNDARY
- PROPOSED STREET/PROPERTY LINES
- EDGE OF EXISTING PAVEMENT
- EDGE OF EXISTING GRAVEL
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING WATERMAIN
- SAMH — EXISTING SANITARY MANHOLE
- STMH — EXISTING STORM MANHOLE
- CB — EXISTING CATCH BASIN
- HYD — EXISTING FIRE HYDRANT
- GV — EXISTING GATE VALVE
- EXISTING HYDRO GUY WIRE
- HP — EXISTING HYDRO POLE
- CATV — EXISTING CABLE TV PEDESTAL
- BPED — EXISTING TELEPHONE PEDESTAL
- SIB — STANDARD IRON BAR
- IB — IRON BAR
- EXISTING DECIDUOUS TREE
- EXISTING CONIFEROUS TREE
- EXISTING TREE LINE
- BM — BENCHMARK
- PROPOSED TREE RETENTION AREAS
- PROPOSED TREE REPLACEMENT AREAS

Benchmark Information

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

No.	DATE	DESCRIPTION	BY	APPD
0	JUN 11/18	PRELIMINARY SUBMISSION	TLB	SJC

REVISION / ISSUE

Seal not valid unless signed and dated

COBIDE ENGINEERING INC
464A - 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

H:\Weiler\00502 MacDonald Property Subdivision - Weiler\DELIVERABLES\Drawings\Submissions\2018-07-20 SWM\00502 SWM.dwg Aug 17, 2018 - 2:56pm

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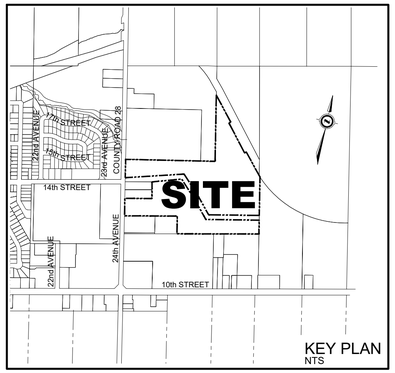
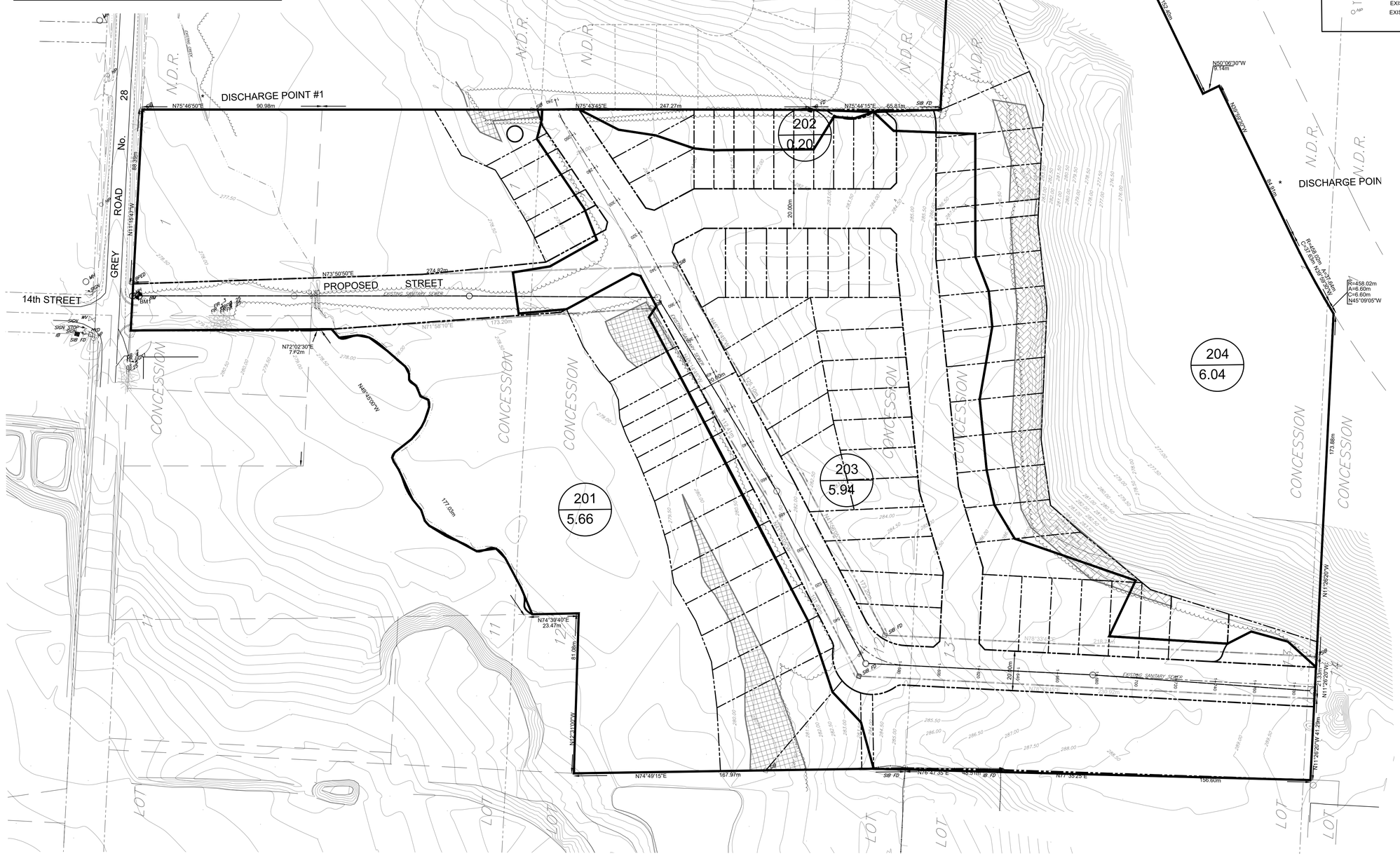


KEY PLAN
NTS



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 INFROMATION SHOWN ON PLAN 16R-10098.

LEGEND

- PROPERTY BOUNDARY
- PROPOSED STREET/PROPERTY LINES
- EDGE OF EXISTING PAVEMENT
- EDGE OF EXISTING GRAVEL
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING WATERMAIN
- SANMH — EXISTING SANITARY MANHOLE
- STMMH — EXISTING STORM MANHOLE
- CB — EXISTING CATCH BASIN
- HYD — EXISTING FIRE HYDRANT
- WV — EXISTING GATE VALVE
- EXISTING HYDRO GUY WIRE
- HP — EXISTING HYDRO POLE
- CATV — EXISTING CABLE TV PEDESTAL
- BPED — EXISTING TELEPHONE PEDESTAL
- SIB — STANDARD IRON BAR
- IB — IRON BAR
- EXISTING DECIDUOUS TREE
- EXISTING CONIFEROUS TREE
- EXISTING TREE LINE
- BM — BENCHMARK
- PROPOSED TREE RETENTION AREAS
- PROPOSED TREE REPLACEMENT AREAS

Benchmark Information

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

No.	DATE	DESCRIPTION	BY	APPD
0	JUN 11/18	PRELIMINARY SUBMISSION	TLB	SJC

REVISION / ISSUE

Seal not valid unless signed and dated

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

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

H:\Weiler\00502 MacDonald Property Subdivision - Weiler\DELIVERABLES\Drawings\Submissions\2018-07-20 SWM\00502 Final SWM.dwg Feb 05, 2019 - 8:08am

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Appendix B

PRE-CONSULTATION

STORMWATER MANAGEMENT REPORT

SAUGEEN CEDAR HEIGHTS EAST SUBDIVISION
TOWN OF HANOVER

MEETING SUMMARY

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

Action: SVCA

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.

The SVCA will be interested in ensuring that the Hurricane Hazel event can pass under the future 14th 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

Action: SVCA

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.

6.0 ENVIRONMENTAL IMPACT STUDY (EIS)

Action: WSP

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.

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

Action: WSP

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.

8.0 D-4 STUDY

Action: WSP

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.

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

Action: WSP

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

- 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

Action: WSP

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

12.0 OTHER BUSINESS

Action: Taylor

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.

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

Hydologic 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	continuous grass
Woodlot	50	55.3	60.5	67	73.5	76.8	80	0.4	forests
Long Grass	55	60	65	72	79	81.5	84	0.3	natural, not maintained
Lawns	60	65.5	71	77	83	86	89	0.25	maintained
Pasture/Range	58	61.5	65	70.5	76	78.5	81	0.17	farm pasture
Crop	66	70	74	78	82	84	86	0.13	farm land
Fallow (bare)	77	82	86	89	91	93	94	0.05	idle farm land (bare)
Built-up	60	65.5	71	77	83	89	89	0.25	Lawns Existing
Streets, paved	98	98	98	98	98	98	98	0.01	

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

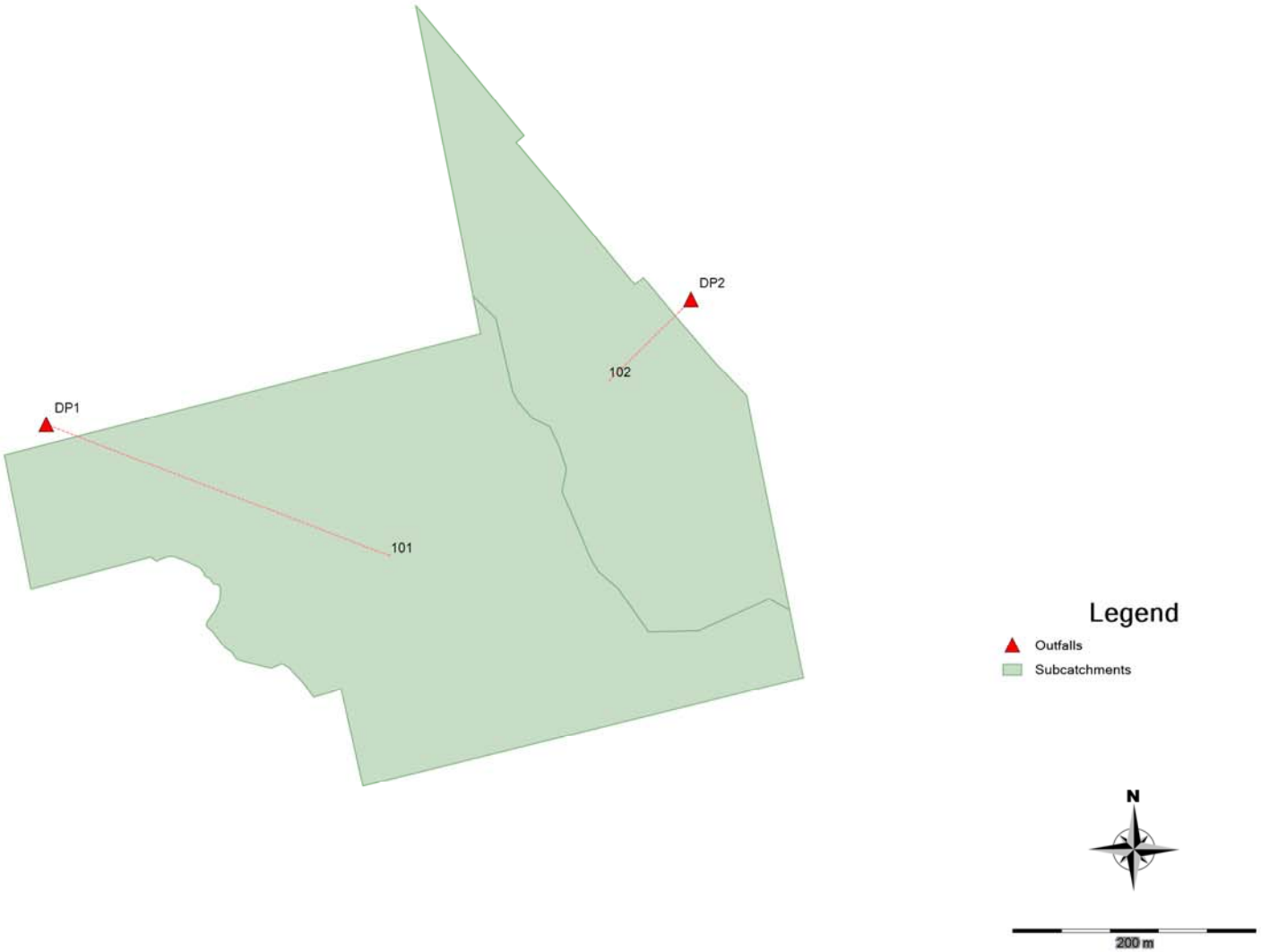
Existing Conditions

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^2 @ 100% imperv.	0.07	ha	0.6	%
	0	Roof Area	25000	m^2 @ 100% imperv.	0.00	ha	0.0	%
					0.07	**ha**		
102	0	m of	20	m wide ROW @ 45% imperv.	0.00	ha	0.0	%
	0	Impervious Area	2900	m^2 @ 100% imperv.	0.00	ha	0.0	%
	0	Roof Area	250	m^2 @ 100% imperv.	0.00	ha	0.0	%
					0.00	**ha**		

Saugeen Cedar Heights East Subdivision - Pre-Development Model Schematic



Saugeen 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
```

Saugeen Cedar Heights East Subdivision – Pre Development Model Details

```
[OUTFALLS]
;;               Invert     Outfall      Stage/Table      Tide
;;Name           Elev.      Type         Time Series      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
****************
                                                    Data       Recording
Name                 Data Source                    Type       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
************
                                          Invert      Max.    Ponded    External
Name                 Type                  Elev.     Depth      Area    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

```
**************************        Volume         Depth
Runoff Quantity Continuity     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


**************************        Volume        Volume
Flow Routing Continuity        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
***************************

-----------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff   Coeff
Subcatchment                 mm         mm         mm         mm         mm    10^6 ltr      LPS
-----------------------------------------------------------------------------------------------------------
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
****************
                                                    Data       Recording
Name                 Data Source                    Type       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
************
                                          Invert      Max.    Ponded    External
Name                 Type                  Elev.     Depth      Area    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

```
**************************        Volume         Depth
Runoff Quantity Continuity     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


**************************        Volume        Volume
Flow Routing Continuity        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
***************************

-------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff   Coeff
Subcatchment                 mm         mm         mm         mm         mm    10^6 ltr      LPS
-------------------------------------------------------------------------------------------------------
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
****************
                                                    Data       Recording
Name                 Data Source                    Type       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
************
                                          Invert      Max.    Ponded    External
Name                 Type                  Elev.     Depth      Area    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

```
**************************        Volume         Depth
Runoff Quantity Continuity     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


**************************        Volume        Volume
Flow Routing Continuity        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
***************************

-------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff   Coeff
Subcatchment                 mm         mm         mm         mm         mm    10^6 ltr      LPS
-------------------------------------------------------------------------------------------------------
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
****************
                                                    Data       Recording
Name                 Data Source                    Type       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
************
                                          Invert      Max.    Ponded    External
Name                 Type                  Elev.     Depth      Area    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

```
**************************        Volume         Depth
Runoff Quantity Continuity     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


**************************        Volume        Volume
Flow Routing Continuity        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
***************************

-------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff   Coeff
Subcatchment                 mm         mm         mm         mm         mm    10^6 ltr      LPS
-------------------------------------------------------------------------------------------------------
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
```

Saugeen 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
****************
                                                    Data       Recording
Name                 Data Source                    Type       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
************
                                          Invert      Max.    Ponded    External
Name                 Type                  Elev.     Depth      Area    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 100 Year Design Storm

```
**************************        Volume         Depth
Runoff Quantity Continuity     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


**************************        Volume        Volume
Flow Routing Continuity        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
***************************

-------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff   Coeff
Subcatchment                 mm         mm         mm         mm         mm    10^6 ltr      LPS
-------------------------------------------------------------------------------------------------------
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	0.20	180	11	3.0	20.3	100.0	0.25	60.0
	203	Majority of Lots	5.94	1900	31	2.0	65.2	47.4	0.27	58.6
	204	East Side of Subdivision	6.04	450	134	20.0	2.6	100.0	0.40	50.0

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

Soil Type
Sullivan Sand

Hydologic 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	continuous grass
Woodlot	50	55.3	60.5	67	73.5	76.8	80	0.4	forests
Long Grass	55	60	65	72	79	81.5	84	0.3	natural, not maintained
Lawns	60	65.5	71	77	83	86	89	0.25	maintained
Pasture/Range	58	61.5	65	70.5	76	78.5	81	0.17	farm pasture
Crop	66	70	74	78	82	84	86	0.13	farm land
Fallow (bare)	77	82	86	89	91	93	94	0.05	idle farm land (bare)
Built-up	60	65.5	71	77	83	89	89	0.25	Lawns Proposed
Streets, paved	98	98	98	98	98	98	98	0.01	

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	80	0	0	0	20.3	0.0	100
203	0	5	0	30	0	0	0	30.9	34.3	100
204	0	97	0	0	0	0	0	2.6	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

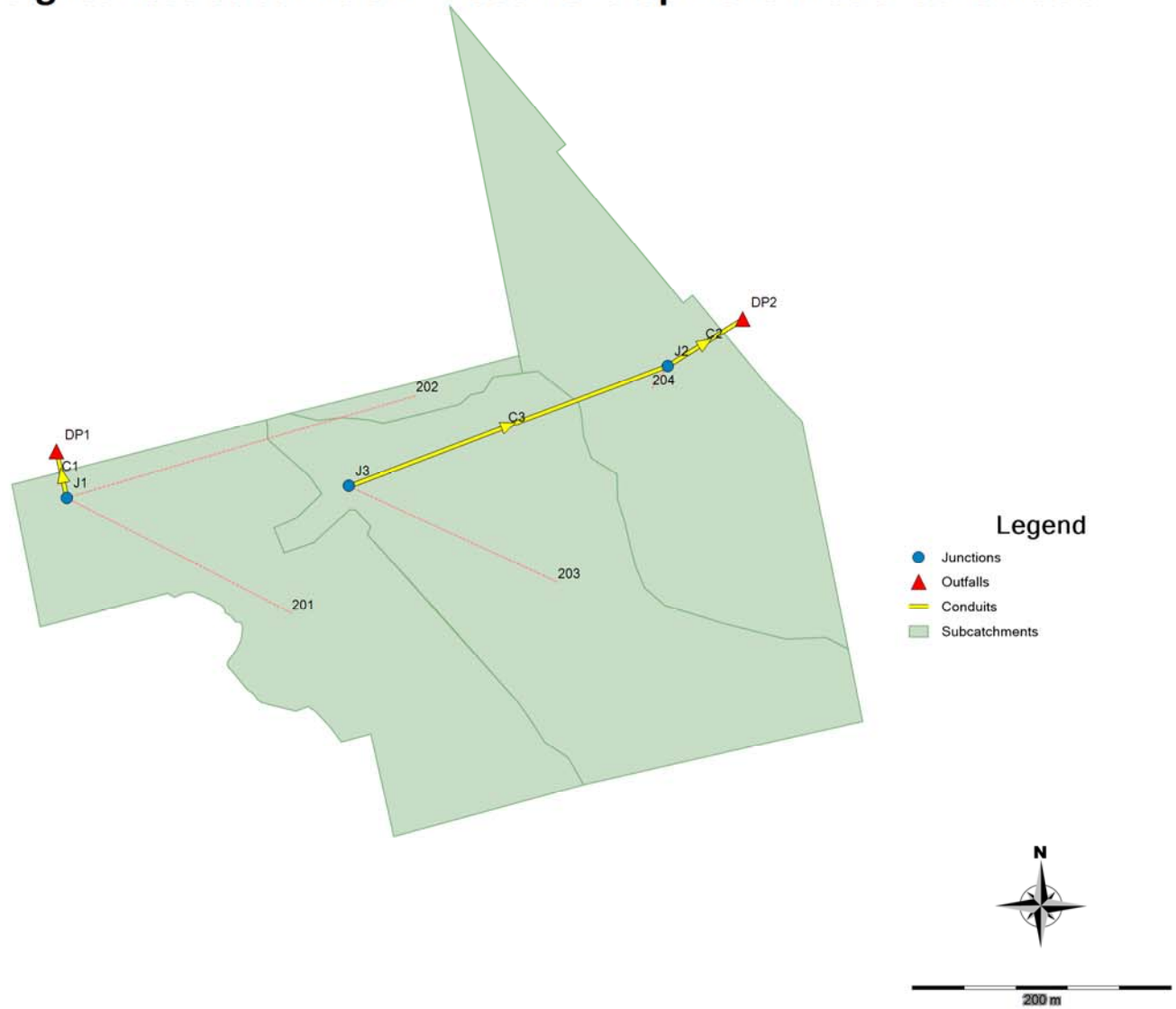
Proposed Conditions

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	0.20	0.00	0.0	0.04	20.3	20.3
203	5.94	2.04	34.3	1.84	30.9	65.2
204	6.04	0.00	0.0	0.16	2.6	2.6

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^2 @ 100% imperv.	0.00 ha	0.0 %
	6	Roof Area	125	m^2 @ 100% imperv.	0.08 ha	1.3 %
	4	Roof Area	275	m^2 @ 100% imperv.	0.11 ha	1.9 %
					0.41 ha	
202		m of	10	m wide ROW @ 62% imperv.	0.00 ha	0.0 %
		Impervious Area	100	m^2 @ 100% imperv.	0.00 ha	0.0 %
	3.25	Roof Area	125	m^2 @ 100% imperv.	0.04 ha	20.3 %
					0.00 ha	
203	950	m of	20	m wide ROW @ 57% imperv.	1.08 ha	18.2 %
	50	Impervious Area	75	m^2 @ 100% imperv.	0.38 ha	6.3 %
	58	Impervious Area	100	m^2 @ 100% imperv.	0.58 ha	9.8 %
	40.75	Roof Area	125	m^2 @ 100% imperv.	0.51 ha	8.6 %
	48.25	Roof Area	275	m^2 @ 100% imperv.	1.33 ha	22.3 %
					3.87 ha	
204	0	m of	12	m wide ROW @ 55% imperv.	0.00 ha	0.0 %
		Impervious Area	75	m^2 @ 100% imperv.	0.00 ha	0.0 %
		Impervious Area	100	m^2 @ 100% imperv.	0.00 ha	0.0 %
		Roof Area	125	m^2 @ 100% imperv.	0.00 ha	0.0 %
	5.75	Roof Area	275	m^2 @ 100% imperv.	0.16 ha	2.6 %
					0.16 ha	

Saugeen Cedar Heights East Subdivision - Post Development Model Schematic



Saugeen 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              0.2      20.3     180      3        0
203              SCS_6h_37.8mm_2Yr J3              5.94     65.2     1900     2        0
204              SCS_6h_37.8mm_2Yr J2              6.04     2.6      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   47.4
204              0.01       0.4        0.05       0.05       25         OUTLET

[INFILTRATION]
;;Subcatchment   CurveNum   HydCon     DryTime
```

Saugeen 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]
;;               Invert     Max.       Init.      Surcharge  Ponded
;;Name           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]
;;               Invert     Outfall      Stage/Table      Tide
;;Name           Elev.      Type         Time Series      Gate Route To
;;-------------- ---------- ------------ ---------------- ---- ----------------
DP1              276.4      FREE                          NO
DP2              276        FREE                          NO

[CONDUITS]
;;               Inlet            Outlet                      Manning    Inlet      Outlet     Init.      Max.
;;Name           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            0:00

;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
****************
                                                      Data       Recording
Name                 Data Source                      Type       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                         0.20    180.00     20.30    3.0000 SCS_6h_37.8mm_2Yr    J1
203                         5.94   1900.00     65.20    2.0000 SCS_6h_37.8mm_2Yr    J3
204                         6.04    450.00      2.60   20.0000 SCS_6h_37.8mm_2Yr    J2


************
Node Summary
************
                                          Invert      Max.    Ponded    External
Name                 Type                  Elev.     Depth      Area    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
*********************
                                        Full     Full     Hyd.     Max.   No. of     Full
Conduit          Shape                 Depth     Area     Rad.    Width  Barrels     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 ......         0.674        37.806
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.443        24.816
Surface Runoff ...........         0.229        12.851
Final Storage ............         0.003         0.156
Continuity Error (%) .....        -0.046


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.229         2.293
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.229         2.293
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	24.63	13.15	0.03	5.22	0.348
203	37.81	0.00	0.00	10.87	26.94	1.60	323.68	0.713
204	37.81	0.00	0.00	32.37	5.29	0.32	21.69	0.140

```
******************
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	0.04	0.34	278.74	0 02:25	0.34
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	30.48	30.48	0 02:25	0.373	0.373	0.012
J2	JUNCTION	21.69	343.25	0 02:25	0.32	1.92	0.019
J3	JUNCTION	323.68	323.68	0 02:25	1.6	1.6	-0.011
DP1	OUTFALL	0.00	30.43	0 02:25	0	0.373	0.000
DP2	OUTFALL	0.00	343.01	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	4.32	30.43	0.373
DP2	99.86	22.25	343.01	1.920
System	99.85	26.57	373.22	2.293

****
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	30.43	0 02:25	0.74	0.04	0.20
C2	CONDUIT	343.01	0 02:26	1.81	0.48	0.63
C3	CONDUIT	321.59	0 02:25	2.70	0.24	0.24

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	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	0.82	0.18	0.00	0.00	0.11	0.00
C2	1.00	0.00	0.00	0.00	0.33	0.67	0.00	0.00	0.19	0.00
C3	1.00	0.00	0.00	0.00	0.61	0.39	0.00	0.00	0.28	0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Feb 04 17:02:43 2019
Analysis ended on: Mon Feb 04 17:02:43 2019
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
****************
                                                      Data       Recording
Name                 Data Source                      Type       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                         0.20    180.00     20.30    3.0000 SCS_6h_48.1mm_5Yr    J1
203                         5.94   1900.00     65.20    2.0000 SCS_6h_48.1mm_5Yr    J3
204                         6.04    450.00      2.60   20.0000 SCS_6h_48.1mm_5Yr    J2


************
Node Summary
************
                                          Invert      Max.    Ponded    External
Name                 Type                  Elev.     Depth      Area    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
*********************
                                        Full     Full     Hyd.     Max.   No. of     Full
Conduit          Shape                 Depth     Area     Rad.    Width  Barrels     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 ......         0.858        48.107
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.546        30.617
Surface Runoff ...........         0.310        17.357
Final Storage ............         0.003         0.156
Continuity Error (%) .....        -0.045


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.310         3.097
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.310         3.097
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	29.86	18.23	0.04	7.36	0.379
203	48.11	0.00	0.00	13.28	34.84	2.07	424.53	0.724
204	48.11	0.00	0.00	40.02	7.94	0.48	36.66	0.165

```
******************
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	0.07	276.67	0 02:25	0.07
J2	JUNCTION	0.01	0.11	277.11	0 02:26	0.11
J3	JUNCTION	0.05	0.39	278.79	0 02:25	0.39
DP1	OUTFALL	0.02	0.07	276.47	0 02:25	0.07
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	44.68	44.68	0 02:25	0.547	0.547	0.010
J2	JUNCTION	36.66	457.48	0 02:25	0.48	2.55	0.019
J3	JUNCTION	424.53	424.53	0 02:25	2.07	2.07	-0.012
DP1	OUTFALL	0.00	44.66	0 02:25	0	0.547	0.000
DP2	OUTFALL	0.00	457.25	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	6.34	44.66	0.547
DP2	99.89	29.54	457.25	2.549
System	99.88	35.88	501.76	3.097

****
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	44.66	0 02:25	0.83	0.06	0.25
C2	CONDUIT	457.25	0 02:26	2.02	0.64	0.75
C3	CONDUIT	422.11	0 02:25	2.88	0.32	0.28

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	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	0.81	0.19	0.00	0.00	0.13	0.00
C2	1.00	0.00	0.00	0.00	0.32	0.68	0.00	0.00	0.20	0.00
C3	1.00	0.00	0.00	0.00	0.61	0.39	0.00	0.00	0.28	0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Feb 04 17:01:47 2019
Analysis ended on: Mon Feb 04 17:01:47 2019
Total elapsed time: < 1 sec

Saugeen 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
****************
                                                      Data       Recording
Name                 Data Source                      Type       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                         0.20    180.00     20.30    3.0000 SCS_6h_63.5mm_25Yr   J1
203                         5.94   1900.00     65.20    2.0000 SCS_6h_63.5mm_25Yr   J3
204                         6.04    450.00      2.60   20.0000 SCS_6h_63.5mm_25Yr   J2


************
Node Summary
************
                                          Invert      Max.    Ponded    External
Name                 Type                  Elev.     Depth      Area    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
*********************
                                       Full     Full     Hyd.     Max.   No. of     Full
Conduit          Shape               Depth     Area     Rad.    Width  Barrels     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 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 ......         1.133        63.510
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.686        38.453
Surface Runoff ...........         0.445        24.928
Final Storage ............         0.003         0.157
Continuity Error (%) .....        -0.045


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.445         4.448
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.445         4.447
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 (%) .....         0.004


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


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

Saugeen 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	36.81	26.70	0.05	11.05	0.420
203	63.51	0.00	0.00	16.41	47.12	2.80	581.31	0.742
204	63.51	0.00	0.00	50.53	12.84	0.78	70.26	0.202

```
******************
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 02:25	0.14
J3	JUNCTION	0.06	0.46	278.86	0 02:25	0.46
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	73.43	73.43	0 02:30	0.873	0.873	0.008
J2	JUNCTION	70.26	643.85	0 02:25	0.775	3.58	0.019
J3	JUNCTION	581.31	581.31	0 02:25	2.8	2.8	-0.013
DP1	OUTFALL	0.00	73.38	0 02:30	0	0.873	0.000
DP2	OUTFALL	0.00	643.68	0 02:26	0	3.57	0.000

```
**********************
Node Surcharge Summary
**********************
```

No nodes were surcharged.

```
*********************
Node Flooding Summary
*********************
```

No nodes were flooded.

```
************************
```

Saugeen 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	10.11	73.38	0.873
DP2	99.92	41.40	643.68	3.575
System	99.90	51.52	716.21	4.447

****
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	73.38	0 02:30	0.96	0.10	0.32
C2	CONDUIT	643.68	0 02:26	2.30	0.90	0.93
C3	CONDUIT	578.46	0 02:25	3.10	0.44	0.34

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	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	0.80	0.20	0.00	0.00	0.16	0.00
C2	1.00	0.00	0.00	0.00	0.32	0.68	0.00	0.00	0.21	0.00
C3	1.00	0.00	0.00	0.00	0.61	0.39	0.00	0.00	0.28	0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Feb 04 17:00:58 2019
Analysis ended on: Mon Feb 04 17:00:58 2019
Total elapsed time: < 1 sec

Saugeen 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
****************
                                                      Data       Recording
Name                 Data Source                      Type       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                         0.20    180.00     20.30    3.0000 SCS_6h_69.9mm_50Yr   J1
203                         5.94   1900.00     65.20    2.0000 SCS_6h_69.9mm_50Yr   J3
204                         6.04    450.00      2.60   20.0000 SCS_6h_69.9mm_50Yr   J2


************
Node Summary
************
                                          Invert      Max.    Ponded    External
Name                 Type                  Elev.     Depth      Area    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
*********************
                                       Full     Full     Hyd.     Max.   No. of     Full
Conduit          Shape               Depth     Area     Rad.    Width  Barrels     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 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 ......         1.247        69.911
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.740        41.469
Surface Runoff ...........         0.505        28.316
Final Storage ............         0.003         0.157
Continuity Error (%) .....        -0.045


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.505         5.052
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.505         5.052
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.
```

Saugeen 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	39.44	30.48	0.06	12.76	0.436
203	69.91	0.00	0.00	17.65	52.29	3.11	648.29	0.748
204	69.91	0.00	0.00	54.50	15.26	0.92	88.31	0.218

```
******************
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	0.49	278.89	0 02:25	0.49
DP1	OUTFALL	0.02	0.11	276.51	0 02:30	0.11
DP2	OUTFALL	0.02	0.15	276.15	0 02:25	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	88.70	88.70	0 02:30	1.02	1.02	0.007
J2	JUNCTION	88.31	727.24	0 02:25	0.922	4.03	0.019
J3	JUNCTION	648.29	648.29	0 02:25	3.11	3.11	-0.013
DP1	OUTFALL	0.00	88.63	0 02:30	0	1.02	0.000
DP2	OUTFALL	0.00	718.84	0 02:27	0	4.03	0.000

```
**********************
Node Surcharge Summary
**********************

No nodes were surcharged.
```

```
*********************
Node Flooding Summary
*********************

No nodes were flooded.
```

```
************************
```

Saugeen 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	11.86	88.63	1.023
DP2	99.93	46.66	718.84	4.029
System	99.91	58.51	806.16	5.052

****
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	88.63	0 02:30	1.01	0.12	0.36
C2	CONDUIT	718.84	0 02:27	2.40	1.00	1.00
C3	CONDUIT	645.63	0 02:25	3.16	0.49	0.36

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	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	0.79	0.21	0.00	0.00	0.16	0.00
C2	1.00	0.00	0.00	0.00	0.31	0.69	0.00	0.00	0.21	0.00
C3	1.00	0.00	0.00	0.00	0.61	0.39	0.00	0.00	0.29	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C2	0.01	0.07	0.01	0.06	0.01

Analysis begun on: Mon Feb 04 17:00:24 2019
Analysis ended on: Mon Feb 04 17:00:24 2019
Total elapsed time: < 1 sec

Saugeen 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
****************
                                                      Data       Recording
Name                 Data Source                      Type       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                         0.20    180.00     20.30    3.0000 SCS_6h_76.3mm_100Yr  J1
203                         5.94   1900.00     65.20    2.0000 SCS_6h_76.3mm_100Yr  J3
204                         6.04    450.00      2.60   20.0000 SCS_6h_76.3mm_100Yr  J2


************
Node Summary
************
                                          Invert      Max.    Ponded    External
Name                 Type                  Elev.     Depth      Area    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
*********************
                                       Full     Full     Hyd.     Max.   No. of     Full
Conduit          Shape               Depth     Area     Rad.    Width  Barrels     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 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 ......         1.361        76.311
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.791        44.357
Surface Runoff ...........         0.568        31.830
Final Storage ............         0.003         0.159
Continuity Error (%) .....        -0.046


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.568         5.679
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.568         5.679
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 (%) .....         0.004


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


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

Saugeen 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	41.93	34.40	0.07	14.55	0.451
203	76.31	0.00	0.00	18.78	57.57	3.42	716.21	0.754
204	76.31	0.00	0.00	58.48	17.69	1.07	108.80	0.232

```
******************
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	0.31	277.31	0 02:29	0.31
J3	JUNCTION	0.06	0.51	278.91	0 02:21	0.51
DP1	OUTFALL	0.02	0.12	276.52	0 02:30	0.12
DP2	OUTFALL	0.02	0.15	276.15	0 02:18	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	105.75	105.75	0 02:30	1.19	1.19	0.007
J2	JUNCTION	108.80	820.30	0 02:25	1.07	4.49	0.024
J3	JUNCTION	716.21	716.21	0 02:25	3.42	3.42	-0.021
DP1	OUTFALL	0.00	105.65	0 02:30	0	1.19	0.000
DP2	OUTFALL	0.00	771.45	0 02:29	0	4.49	0.000

```
**********************
Node Surcharge Summary
**********************
```

No nodes were surcharged.

```
*********************
Node Flooding Summary
*********************
```

No nodes were flooded.

```
************************
```

Saugeen 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	13.79	105.65	1.190
DP2	99.94	51.98	771.45	4.489
System	99.92	65.77	877.05	5.679

****
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	105.65	0 02:30	1.06	0.14	0.39
C2	CONDUIT	771.45	0 02:29	2.57	1.08	1.00
C3	CONDUIT	720.36	0 02:25	3.17	0.55	0.43

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	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	0.78	0.22	0.00	0.00	0.17	0.00
C2	1.00	0.00	0.00	0.00	0.32	0.68	0.00	0.00	0.20	0.00
C3	1.00	0.00	0.00	0.00	0.61	0.39	0.00	0.00	0.28	0.00

****
Conduit Surcharge Summary
****

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

Analysis begun on: Mon Feb 04 12:05:13 2019
Analysis ended on: Mon Feb 04 12:05:14 2019
Total elapsed time: 00:00:01

Appendix E

OGS SIZING

STORMWATER MANAGEMENT REPORT

SAUGEEN CEDAR HEIGHTS EAST SUBDIVISION
TOWN OF HANOVER

Hydro First Defense® - HC

Hydro International

Project Name:	**Saugeen Cedar Heights East**	*Report Date:*	**2019-02-04**
Street:	**Street C**	*City:*	**Hanover**
Province:	**ON**	*Country:*	**Canada**
Designer:	**Travis Burnside**	*email:*	**tburnside@cobideeng.co**

Paste

Teatment Parameters:

Structure ID:	OGS	
TSS Goal:	80	% Removal
TSS Particle Size:	Fine	
Area:	6.6	ha
Percent Impervious:	45%	
Rational C value:	0.57	Calc. Cn
Rainfall Station:	Owen Sound	
Peak Storm Flow:	816	L/s

RESULTS SUMMARY

Model	TSS	Volume
FD-3HC	22.2%	30.8%
FD-4HC	45.9%	56.1%
FD-6HC	75.4%	87.1%
FD-8HC	**85.7%**	**96.9%**

Model Specification:

Model:	**FD-8HC**	
Diameter:	2400	mm
No Bypass Flow:	142.00	L/s
Peak Flow Capacity:	1416.00	L/s
Sediment Storage:	2.14	m^3
Oil Storage:	4240.00	L/s

Installation Configuration:

Placement:	Online		
Outlet Pipe Size:	750	mm	*OK*
Inlet Pipe 1 Size:	750	mm	*Pipe exceeds allowable*
Inlet Pipe 2 Size:	300	mm	*OK*
Inlet Pipe 3 Size:	525	mm	*Pipe exceeds allowable*
Rim Level:	283.680	m	Calc Invs.
Outlet Pipe Invert:	277.740	m	*OK*
Invert Pipe 1:	277.790	m	*OK*
Invert Pipe 2:	281.700	m	*OK*
Invert Pipe 3:	281.200	m	*OK*

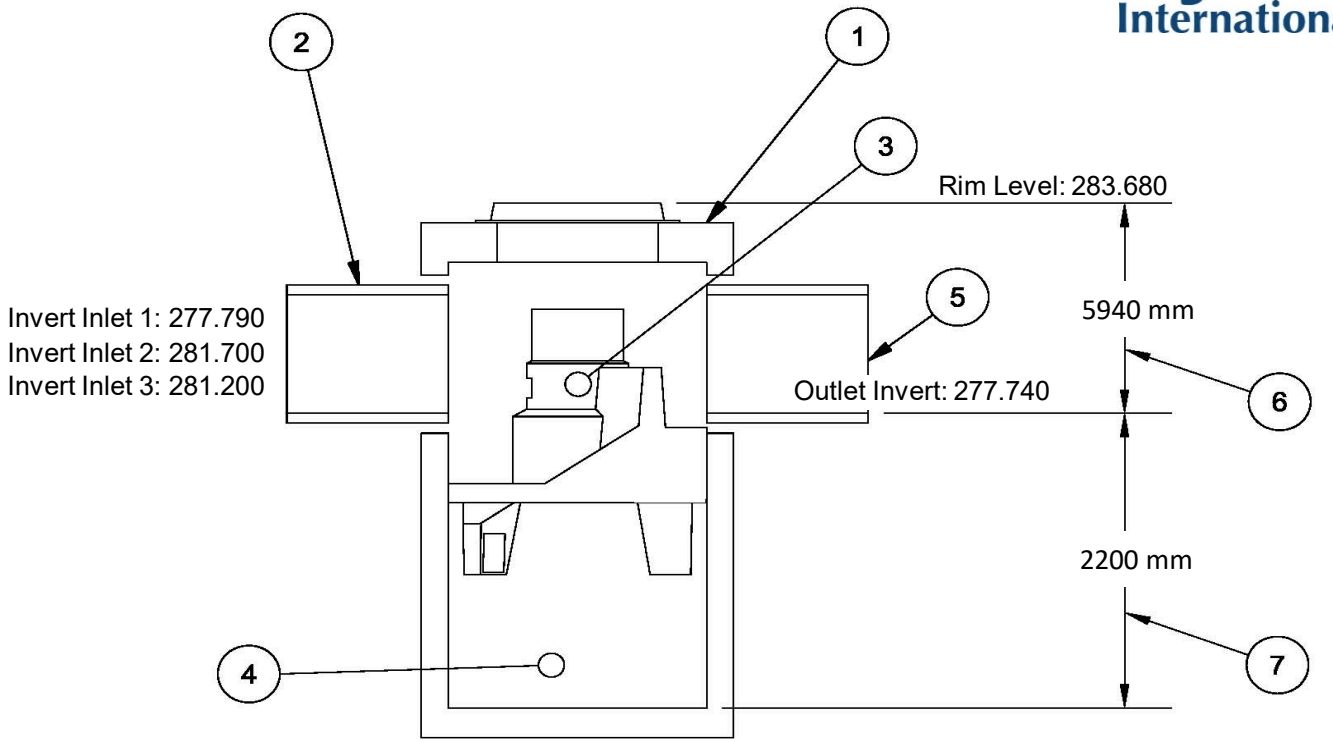
Net Annual Removal Model: FD-8HC

Intensity[1]	Fraction of Rainfall[1]	FD-8HC Removal Efficiency[2]	Weighted Net Annual Efficiency
(mm/hr)	(%)	(%)	(%)
0.50	10.1%	99.5%	10.1%
1.00	10.7%	99.0%	10.6%
1.50	10.0%	98.5%	9.9%
2.00	8.4%	98.0%	8.2%
2.50	6.6%	97.6%	6.4%
3.00	6.2%	97.1%	6.0%
3.60	4.1%	96.5%	4.0%
4.10	4.2%	96.0%	4.0%
4.60	3.7%	95.6%	3.5%
5.10	3.8%	95.1%	3.6%
6.40	6.4%	93.9%	6.0%
7.60	4.6%	92.8%	4.3%
8.90	3.3%	91.6%	3.0%
10.20	2.4%	90.4%	2.2%
11.40	2.6%	89.3%	2.3%
12.70	1.5%	88.2%	1.3%
15.20	2.1%	86.1%	1.8%
19.10	2.3%	82.8%	1.9%
25.40	3.9%	77.8%	3.0%
38.10	1.4%	0.0%	0.0%
50.80	0.6%	0.0%	0.0%
		Net Annual Treatment:	92.2%
		60 Minute Rainfall Adjustment Factor[3]:	-6.5%
		Total Net Annual Removal Efficiency:	85.7%
		Total Runoff Volume Treated:	**96.9%**

1. Rainfall data based on 37 years of rainfall data for Canadian Station Owen Sound, Owen Sound, Ontario, Canada.
2. Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution
3. Adjustment for use of 60 minute time step data with Tc < 30 min.

Designer Notes:

Hydro First Defense® - HC



All drawing elevations are metres.

FD-8HC Specification

1	Vortex Chamber Diameter	2400	mm
2	Inlet Pipe Diameter	750	mm
3	Oil Storage Capacity	4240.00	L
4	Min. Provided Sediment Storage Capacity	2.14	m^3
5	Outlet Pipe Diameter	750	mm
6	Height(Final Grade to Outlet Invert)	5940	mm
7	Sump Depth(Outlet Invert to Sump)	2200	mm
	Total Depth	**8140**	**mm**

Notes: