

SARAH PROPERTIES LTD.

STORMWATER MANAGEMENT REPORT

DURHAM SUBDIVISION

MUNICIPALITY OF WEST GREY

FEBRUARY 2020

COBIDE Engineering Inc
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1. INTRODUCTION

Cobide Engineering Inc. was retained by Sarah Properties Ltd. to complete the civil engineering design including the stormwater management report in support of a Draft Plan of Subdivision Application. The application will be to subdivide the property into a 118 lot subdivision with five (5) multi-family blocks.

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 Part of Divisions 2 and 3 of Lot 24, Concession 1, East of the Garafraxa Road, Former Geographic Township of Glenelg, Municipality of West Grey, County of Grey (described herein as the "site"). A Site Location Map is included as Figure 1. The subject property is approximately 13.8 hectares in area.

1.2 DEVELOPMENT PROPOSAL

The proposed plan is to develop the site into a residential subdivision. The subdivision will involve the creation of a number of new streets as well as the extension of Jackson Street. The development will consist of the following:

- 118 Single Family Lots (Lots 1-118)
- Five (5) Street Townhouse Blocks (Blocks 119-123) resulting in 51 – 87 Townhouse Units
- One (1) Drainage Blocks for conveyance and stormwater quality and quantity control

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

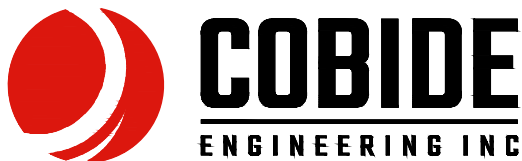
1.4 BACKGROUND INFORMATION

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

- Pre-consultation with the County of Grey, Municipality of West Grey 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



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Client/Project

SARAH PROPERTIES SUBDIVISION
PART OF DIVISIONS 2 AND 3 OF LOT 24 CONC. 1 E.G.R.
GEOGRAPHIC TOWNSHIP OF GLENELG
Municipality of West Grey, Ontario
STORMWATER MANAGEMENT REPORT

Figure No.

1

Title

REGIONAL LOCATION MAP

2. DRAINAGE CHARACTERISTICS

2.1 REGIONAL

The site is located north of the Saugeen River; however no part of the subdivision abuts the river.

2.2 LOCAL

On the property to the west, there is a drainage corridor that conveys runoff from a portion of the site southerly across Durham Road to the Saugeen River.

The Durham Road Municipal Drain conveys runoff from a portion of the site in its existing condition.

The remainder of the site discharges easterly onto the neighbouring property.

2.3 SOILS

According to the Grey County Soils Survey (January, 1954), the soils on the site are classified as Harriston Silt Loam (Tes). Harriston Silt Loams are described as medium-textured soils derived from dolomitic limestone till with good drainage. These soils are typically associated with the Hydrologic Soils Group (HSG) BC.

2.4 DISCHARGE POINTS

For the purposes of the report, Discharge Point #1 is the Durham Road Municipal Drain.

Discharge Point #2 is the property to the east of the development.

Discharge Point #3 is any runoff that discharges onto the neighbouring property and towards the ravine on the neighbouring property.

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 Municipality of West Grey, Ministry of Environment, Conservation and Parks (MECP) and Saugeen Valley Conservation Authority (SVCA).
- iv. Summarize the analysis by identifying conclusions and recommendations.

4. EXISTING CONDITIONS

The site was previously used for agricultural purposes.

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 southern portion of the site.
- Surface water flows by sheet flow to the neighbouring properties and eventually to the Durham Road Municipal Drain.
- Catchment Area 101 is considered to discharge at Discharge Point #1 for the purposes of this report.
- Drainage Area = 5.14 ha.

4.2 CATCHMENT AREA 102

- This catchment area encompasses the northeastern portion of the property.
- Surface water flows by sheet flow onto the neighbouring property.
- Catchment Area 102 is considered to discharge at Discharge Point #2 for the purposes of this report.
- Drainage Area = 4.95 ha.

4.3 CATCHMENT AREA 103

- This catchment area encompasses the northwest corner of the site.
- Surface water flows by sheet flow onto the neighbouring property and eventually into the existing ravine.
- Catchment Area 103 is considered to discharge at Discharge Point #3 for the purposes of this report.
- Drainage Area = 3.69 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 majority of the development including the SWM facility.
- Minor flows will be captured by the storm sewers and major flows will flow overland both discharging to the SWM facility.
- Catchment Area 201 is considered to discharge at Discharge Point #1 for the purposes of this report.
- Drainage Area = 11.47 ha.

5.2 CATCHMENT 202

- This catchment area encompasses the rear of the lots backing onto the neighbouring development to the west. The majority of this area is woodlot that is expected to remain and therefore cannot be graded.
- Minor flows will flow mainly flow overland however as much as possible will be captured by the storm sewers and major flows will flow overland both discharging to the future storm sewer network on the adjacent property.
- Catchment Area 202 is considered to discharge at Discharge Point #3 for the purposes of this report.
- Drainage Area = 0.72 ha.

5.3 CATCHMENT 203

- This catchment area is the westerly entrance road into the development.
- Minor flows and major flows will flow overland both discharging to the existing roadside ditches on Durham Road.
- Catchment Area 203 is considered to discharge at Discharge Point #1 for the purposes of this report.
- Drainage Area = 0.17 ha.

5.4 CATCHMENT 204

- This catchment area is the easterly entrance road into the development.
- Minor flows and major flows will flow overland both discharging to the existing roadside ditches on Durham Road.
- Catchment Area 204 is considered to discharge at Discharge Point #1 for the purposes of this report.
- Drainage Area = 0.12 ha.

5.5 CATCHMENT 205

- This catchment area encompasses the back of the lots along the eastern property line that due to existing grades will not be possible to convey to the SWM facility.
- Minor flows and major flows will flow overland both discharging to the neighbouring property to the east. As much runoff as possible will be conveyed to the SWM facility.
- Catchment Area 205 is considered to discharge at Discharge Point #2 for the purposes of this report.
- Drainage Area = 1.30 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). A copy of the IDF Rainfall Data has been included as Appendix C. 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. A copy of this correspondence has been included in Appendix B.

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

Minor flows from the majority of the development will be conveyed to the proposed stormwater management facility via a new storm sewer collection system that will be constructed throughout the development. This storm sewer collection system will be designed to accommodate all flows up to and including the 5 year storm event.

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

Due to the increase in impervious area, stormwater quantity control will be required for the site. The design of the stormwater management facility has assumed a free outlet from the pond.

6.2 SWM FACILITY CHARACTERISTICS

The stormwater management facility and outlet structure have been designed to control peak runoff rates as well as conform to MOE best practices.

In order to provide the above required volumes and discharges, the following SWM Facility geometry is being proposed:

Table 6.1 – SWM Facility Geometry

SWM FACILITY	DETAILED DESIGN
Side Slope	3:1
SWM Facility Bottom	381.00 m
Permanent Pool Elevation	382.00 m
Top Elevation	384.30 m
High Water Elevation	383.56 m

The outlet configuration for the SWM Facility will be as follows:

- A reversed sloped 300 mm diameter storm sewer with a 150 mm orifice on the outlet at an elevation of 382.00 m;
- The outlet pipe will discharge to a storm structure on the proposed roadway which will convey the runoff to Durham Road. Depending on the timing of the reconstruction of Durham Road, the sewer will either outlet to the roadside ditch or into the proposed storm sewers that are being installed
- An emergency overflow weir will allow for storm events larger than the 100 year storm or if the outlets are blocked to drain away from the pond towards Durham Road East on the westerly Street. The weir will be 3m wide with 5:1 sideslopes and a depth of 0.3m. The emergency overflow weir will be located above the 100 year water level.

As seen by the proposed inverts, the proposed stormwater management facility will be constructed as a wet pond.

6.2.1 SWM FACILITY PERFORMANCE

Below is a summary of the hydraulic performance of the stormwater SWM Facility during the various storm events.

Table 6.2 – SWM Facility Performance

RETURN PERIOD	ELEVATION (m)	STORAGE (m³)	DISCHARGE (l/s)
2 Year	382.73	2,790	41
5 Year	382.94	3,725	47
25 Year	383.27	5,200	56
50 Year	383.40	5,830	59
100 Year	383.53	6,460	61

6.3 MODELLING RESULTS

Based upon the above outlet structure, the following summarizes the pre-development and post development peak flows to the three (3) discharge points.

Table 6.3 - Peak Flow Summary

RETURN PERIOD	DISCHARGE POINT #1 (l/s)		DISCHARGE POINT #2 (l/s)		DISCHARGE POINT #3 (l/s)	
	PRE	POST	PRE	POST	PRE	POST
2 Year	66	44	62	35	17	17
5 Year	118	54	112	52	30	25
25 Year	220	69	208	83	54	39
50 Year	269	75	255	97	67	46
100 Year	319	81	303	111	79	53

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

6.3.1 DISCHARGE POINT #1

All storm events in the post development scenario are below pre-development levels. There will be significant improvement to the drainage for the existing lots fronting onto Durham Road East as the proposed development will convey all runoff to the pond rather than through the existing properties.

6.3.2 DISCHARGE POINT #2

All storm events in the post development scenario are below pre-development levels. There will be significant improvement to the drainage for the existing property to the east as the peak runoff rates will be significantly reduced.

6.3.3 DISCHARGE POINT #3

All storm events in the post development scenario are below pre-development levels. It is proposed to convey as much runoff as possible to Jackson Street to be conveyed via the storm sewers.

7. QUALITY CONTROL

To meet the requirements of the SVCA and the MOECC, stormwater quality control will be provided for the proposed development. The MOE SWMP&D Manual recommends that the required level of protection be associated with the habitat sensitivity of the receiving watercourse. The ultimate receiving watercourse for this development is the Saugeen River. For the purposes of this report, a 'Normal' 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 300 mm sumps respectively which will assist in removing a portion of the sediment contained in the runoff from the street.

7.3 END-OF-PIPE CONTROL MEASURES

The use of a wetland or wet pond for this development was selected as an 'end of pipe' control measure. The basic function of a wetland or wet pond is to remove pollutants from runoff through detention. A wet pond was selected for this development.

The wet pond facility will have a forebay that will be the primary location for sediment removal. The forebay will be designed during the detailed design stages in conformance with the MOE design guidelines to achieve an "Normal" Level of protection.

7.3.1 EXTENDED DETENTION

The MOE guidelines require that extended detention SWM facility's provide quality treatment of 40m³/ha and discharge it over a minimum of 24 hours. Having an extended detention component in the quality ponds provides settlement of suspended solids.

The following table summarizes the volume requirements based the MOE Guidelines.

Table 7.1 - Water Quality Requirements

POST DEV DRAINAGE AREA (ha)	MOE VOLUME REQUIREMENT FOR NORMAL PROTECTION BASED ON 66% IMPERVIOUS (125.73 m³/ha)	MOE EXTENDED DETENTION (40 m³/ha)	PERMANENT POOL REQUIRED (m³)
11.47 ha	1,442 m ³	459 m ³	983 m ³

The wet pond will provide 10,500 m³ of total active storage volume. The outlet configuration will release the 25mm storm event over more than 24 hours. The pond will provide a permanent pool volume of 2,940 m³. The SWM facility will feature a forebay as well as an outlet that draws from the bottom to limit the thermal variations of the SWM facility water discharging into the natural environment. The Forebay sizing calculations have been provided in Appendix F.

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.
- The stormwater management pond should be constructed first to act as a sedimentation pond during construction;
- 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 ditches.

8.2 LOT DEVELOPMENT

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

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

9. CONCLUSIONS & RECOMMENDATIONS

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

1. Stormwater quantity control will be provided via a wet pond with an outlet configuration as described previously.
2. Stormwater quantity control for the development will maintain or lower pre-development flows at all discharge points.
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.

End-of-pipe control will be provided by a Forebay in the wet pond.

All three levels of the treatment train approach will be used for the development to provide an "Normal" 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 SVCA, Municipality of West Grey and County of Grey as part of the Draft Plan of Subdivision Application.

Sincerely,

Cobide Engineering Inc.



Travis Burnside, P. Eng.

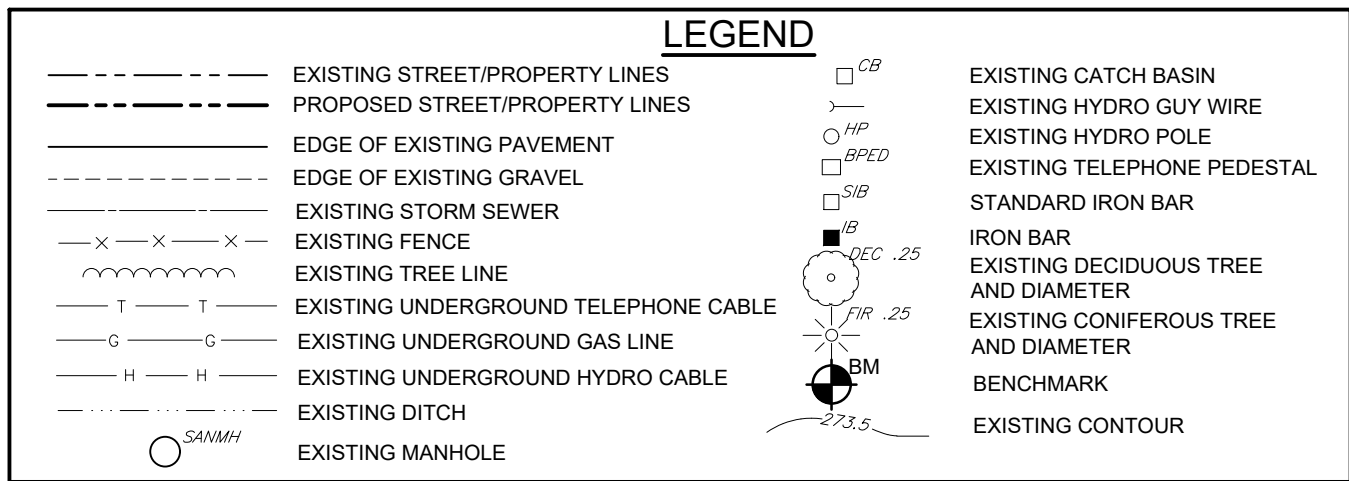


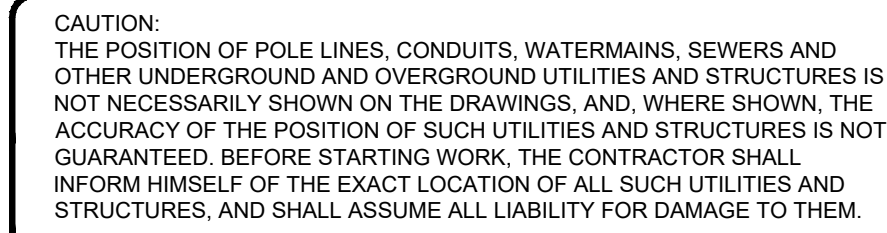
Appendix A

DRAWINGS

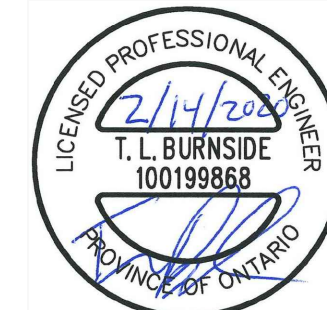
STORMWATER MANAGEMENT REPORT

**SARAH PROPERTIES DURHAM SUBDIVISION
MUNICIPALITY OF WEST GREY**





---	EXISTING STREET/PROPERTY LINES
---	PROPOSED STREET/PROPERTY LINES
----	EDGE OF EXISTING PAVEMENT
----	EDGE OF EXISTING GRASS
----	EXISTING STORM SEWER
-X-X-X-	EXISTING FENCE
~~~~~	EXISTING TREE LINE
-T-T-	EXISTING UNDERGROUND TELEPHONE CABLE
-G-G-	EXISTING UNDERGROUND GAS LINE
-H-H-	EXISTING UNDERGROUND HYDRO CABLE
----	EXISTING DITCH
○ SANMH	EXISTING MANHOLE
□ CB	EXISTING CATCH BASIN
○ HP	EXISTING HYDRO GUY WIRE
□ BED	EXISTING HYDRO POLE
□ BIP	EXISTING TELEPHONE PEDESTAL
□ BI	STANDARD IRON BAR
○ DEC 25	IRON BAR
○ DEC 25	EXISTING DECIDUOUS TREE
○ DEC 25	AND DIAMETER
○ DEC 25	EXISTING CONIFEROUS TREE
○ DEC 25	AND DIAMETER
● BM	BENCHMARK
○ 7-7.5	EXISTING CONTOUR
102	CATCHMENT ID
4.95	CATCHMENT AREA

[illegible]

Title: SARAH PROPERTIES - SUBDIVISION  
Municipality of West Grey  
PRE DEVELOPMENT CATCHMENT AREAS

Client:		SARAH PROPERTIES LTD.	
Design:	TLB	Scale:	1:750
Drawn:	TLB	Approved:	
Checked:	TLB		
Date:	OCT 2019		
DRAWING No.		01840-SWM1	





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



**LEGEND**

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

**202**  
0.72

**201**  
11.47

**203**  
0.17

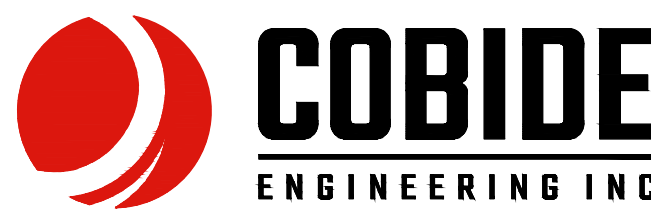
**204**  
0.12

**205**  
1.30

Benchmark Information

No.	DATE	DESCRIPTION	BY	APPD
0	FEB 14/20	FIRST SUBMISSION	TLB	TLB
REVISION / ISSUE				

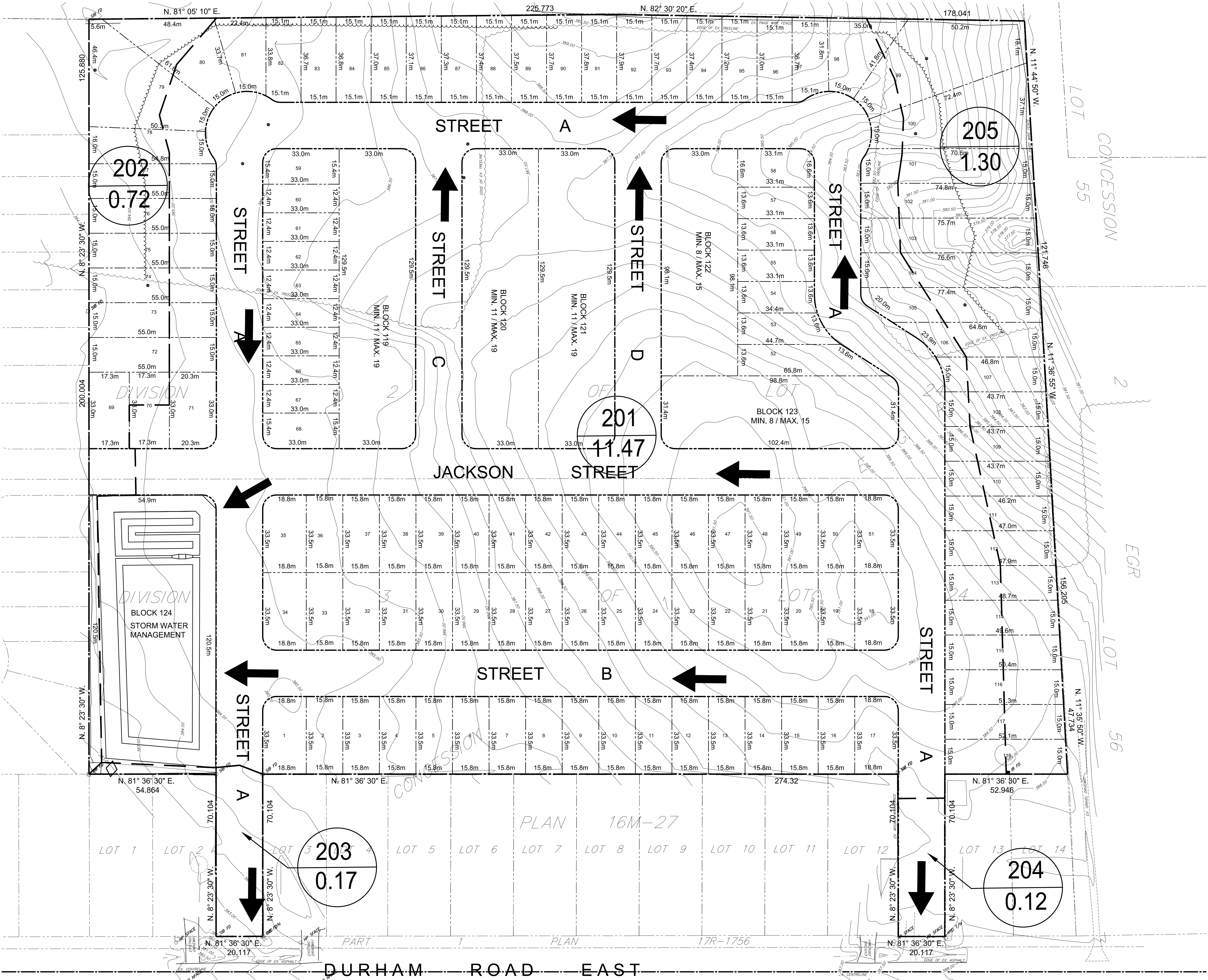
Seal not valid unless signed and dated



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Telephone: (519) 506-5959  
www.cobideeng.com

Title: SARAH PROPERTIES - SUBDIVISION  
Municipality of West Grey  
POST DEVELOPMENT CATCHMENT AREAS

Client:	SARAH PROPERTIES LTD.		
Design:	TLB	Scale:	1:750
Drawn:	TLB	Approved:	
Checked:	TLB		
Date:	OCT 2019		Design Engineer
Drawing No.	01840-SWM2		







# Appendix B

**PRE-CONSULTATION**

**STORMWATER MANAGEMENT REPORT**

**SARAH PROPERTIES DURHAM SUBDIVISION  
MUNICIPALITY OF WEST GREY**



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**Broos Subdivision****01840**

**Date:** November 27, 2018      **Project:** 01840  
**Time:** 10:30 am      **Location:** West Grey Municipal Office  
**Attendees:** Mr. Mark Turner, Municipality of West Grey  
Mr. Brent Glasier, Municipality of West Grey  
Mr. Ron Davidson, Municipality of West Grey  
Mr. Scott Taylor, County of Grey  
Mr. Erik Downing, Saugeen Valley Conservation Authority  
Ms. Emily Payton, Saugeen Valley Conservation Authority  
Mr. Walter Broos, Developer  
Ms. Krystin Rennie, Georgian Planning Solutions  
Mr. Travis Burnside, P. Eng., Cobide Engineering Inc.  
**Purpose:** Pre- Consultation Meeting  
**Distribution:** All Present, Mr. Dan Reeves (WSP Canada Inc.), Ms. Jaclyn Rodo (WSP Canada Inc.)  
**Prepared By:** Travis Burnside

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On November 27, 2018 a pre-consultation meeting was held to review the submission requirements related to the Broos Subdivision project. The following is a review of items discussed.

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**1.0 OVERVIEW OF PROPERTY**

The proposed subdivision concept will consist of mixed density residential lots. A copy of the initial concept plan has been included for reference

The Municipality raised a concern with the offset intersections of Street A/ Jackson Street with Street C/ Jackson Street. It was requested that the alignment be shifted to meet at a four-way intersection.

**Action:**  
**Broos**

A concern was raised with the narrow frontage proposed for single family lots rather than semi-detached lots. Examples of projects completed in the past will be presented to the Municipality and County for discussion and consideration

**Action:**  
**Broos/  
Rennie**

**2.0 OFFICIAL PLAN**

According to the Municipality of West Grey Official Plan, the land use designation of the property is 'Residential.' An Official Plan Amendment (OPA) will not be required.

### 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 development of the property. It was discussed that the Zoning By-Law amendment and Draft Plan Approval application be submitted at the same time. Only one public meeting will be required if both applications are submitted at the same time.

**Action:**  
**Rennie/  
Cobide**

A Planning Justification report will be required as part of the Zoning By-Law Amendment and Plan of Subdivision application submissions.

The density requirement for the site will be a minimum of 20 units per net hectare. This excludes all roads and other undevelopable areas. The current plan shows a density of 21.7 units/ ha.

The development is encouraged to have a mix of unit types.

### 4.0 ENVIRONMENTAL IMPACT STUDY (EIS)

An EIS will be required to assess the impact of the development on the Significant Woodland that is located in the north side of the site as well as Species at Risk. The EIS should provide a general overview of all Natural Heritage features. The EIS will need to provide comment on impacts if any on the fish habitat on adjacent properties.

**Action:**  
**Cobide/  
WSP**

There are no Regulatory Areas on the property.

WSP Canada Inc. has been retained to complete the EIS in support of the development. WSP to contact SVCA to ensure their Scope of Work covers everything that the SVCA expects.

**Action:**  
**WSP**

### 5.0 STORMWATER MANAGEMENT

A stormwater management report will be required to address the impacts of the development and include grading and erosion control requirements.

**Action:**  
**Cobide**

Quantity Control will be required to control post development peak flows to pre development levels for the 2, 5, 10, 25, 50 and 100 year peak flows.

A discussion regarding a direct outlet to the Saugeen River to eliminate the need for stormwater management however due to the location and the number of properties between the development and the river it was decided it would be unlikely that this would work however, it was left up to Cobide Engineering to determine if a direct outlet could be made to work.

**Action:**  
**Cobide**

Any downstream improvements required as a result of this would be the responsibility of the developer.

SVCA confirmed that normal level of treatment will be required for quality control if peak flows are controlled to pre-development levels. At this time, quality control is proposed to be achieved via a forebay on the pond.

**Action:**  
**Cobide**

If a direct outlet to the Saugeen River is proposed the development will require an enhanced level of treatment.



## 6.0 TRAFFIC IMPACT STUDY

A Traffic Impact Study will be required to address the impacts of the development particularly on the Durham Road East and Highway 6 intersection.

*Action:  
Cobide*

## 7.0 OTHER REQUIRED REPORTS

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

*Action:  
Cobide*

- Archeological Assessment
- Functional Servicing Report
  - Will address the sanitary sewer capacity, watermain capacity and pressure, as well as servicing from various utilities (Hydro One, Bell, Eastlink, Eh-Tel, Union Gas)

## 8.0 SITE SERVICING

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

*Action:  
Cobide*

The sanitary sewer will connect to the existing sanitary sewers located on Durham Road East.

*Action:  
Cobide*

The watermain distribution system will be installed along each street and connected to the system proposed on Jackson Street as part of the Sunvale Homes development as well as Durham Road East at both Street A and G.

*Action:  
Cobide*

There are concerns regarding the water pressure along Durham Road East. West Grey will have the water model reviewed to ensure there is adequate pressure to service this development

*Action:  
West  
Grey*

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. Sidewalk may only be required on certain roads.

*Action:  
Cobide*

LED lights manufactured by Cree Lighting are to be used with concrete poles. Cree is to complete a photometric analysis to determine the pole spacing.

*Action:  
Cobide*

The Municipality was open to the idea of decorative streetlights or decorative poles with traditional cobrahead style LED fixtures.

## 9.0 PARKLAND DEDICATION

The Municipality will discuss the option of taking the treed area as parkland dedication for the development of a trail system.

*Action:  
Cobide/  
Rennie*

The development team will need to make a formal request to Council to determine if they will want 5% cash in lieu or a dedicated parkland area.

## **10.0 SUBDIVISION AGREEMENT**

The Municipality's standard agreement is to be provided by the Municipality once the subdivision is close to being registered.

## **11.0 OTHER BUSINESS**

Land Titles Absolute process will be started in the near future

Due to capacity concerns in the existing sanitary sewer, the developer will be responsible for a portion of the costs to upgrade the sewer only on Durham Road. The moneys are for the pipe only and not the urbanizing of the roadway.

It is expected that the developer will be expected to contribute approximately \$30,000 for this work.

The meeting adjourned at 11:30 am.

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.

**COBIDE ENGINEERING INC.**



Travis Burnside, P. Eng.  
Director

H:\Broos\01840 - Broos Property - Durham\Correspondence\Meeting_Notes\2018-12-20 Pre-Consultation Meeting Summary 01840.doc

# Appendix C

**IDF RAINFALL DATA**

**STORMWATER MANAGEMENT REPORT**

**SARAH PROPERTIES DURHAM SUBDIVISION  
MUNICIPALITY OF WEST GREY**



Environment and Climate Change Canada  
Environnement et Changement climatique Canada

Short Duration Rainfall Intensity-Duration-Frequency Data  
Données sur l'intensité, la durée et la fréquence des chutes  
de pluie de courte durée

Gumbel - Method of moments/Méthode des moments

2019/02/27

=====

MOUNT FOREST (AUT) ON 6145504

Latitude: 43 59'N Longitude: 80 45'W Elevation/Altitude: 414 m

Years/Années : 1962 - 2016 # Years/Années : 38

=====

*****

Table 1 : Annual Maximum (mm)/Maximum annuel (mm)

*****

Year Année	5 min	10 min	15 min	30 min	1 h	2 h	6 h	12 h	24 h
1962	10.4	14.7	18.0	18.0	19.6	23.9	33.0	38.9	45.0
1963	14.0	15.2	21.1	31.7	43.7	49.3	51.3	54.9	61.0
1964	10.4	12.2	14.7	25.7	28.4	29.5	35.3	37.6	61.2
1965	10.2	14.5	17.0	22.6	31.5	32.3	33.0	33.5	33.5
1966	9.9	15.2	19.3	21.1	24.6	27.2	28.2	38.1	56.1
1967	11.2	12.7	13.7	17.3	22.9	24.6	36.3	49.8	50.0
1968	8.4	13.5	17.8	28.7	43.4	52.1	74.4	74.7	83.8
1969	6.1	10.4	12.4	18.0	20.1	20.1	35.1	37.6	39.6
1970	8.6	13.2	13.5	15.7	19.0	20.1	36.8	53.6	56.9
1971	12.7	15.0	15.7	16.0	17.8	20.3	26.2	27.2	34.0
1972	6.9	10.2	13.0	18.0	22.4	33.3	45.2	47.5	50.3
1973	5.6	9.4	11.2	13.2	15.2	18.0	23.1	24.4	32.5
1974	5.3	7.1	9.7	19.0	35.6	40.6	42.7	42.7	42.7
1975	6.3	8.4	9.7	18.0	21.1	28.4	36.1	47.5	51.1
1976	9.1	13.5	16.5	19.0	27.7	33.8	35.8	35.8	43.4
1977	11.7	17.0	18.8	20.1	27.7	41.1	69.1	81.3	81.3
1978	14.8	15.4	18.0	21.2	21.6	25.6	40.3	43.7	52.5
1979	10.5	11.1	11.1	14.4	16.6	32.4	40.5	53.4	64.5
1980	8.9	16.3	19.3	25.4	34.3	43.5	48.3	49.4	49.4
1981	7.7	8.8	10.8	12.7	13.4	17.2	31.0	35.8	41.4
1982	6.9	10.9	13.9	18.6	24.6	29.6	30.4	30.6	32.6

1983	7.9	13.7	15.8	31.4	37.2	38.2	38.2	42.0	43.3
1984	6.8	9.2	11.2	14.6	14.6	20.2	25.2	32.8	33.0
1985	8.8	16.4	22.0	38.6	49.2	53.9	56.2	56.2	64.4
1986	8.2	12.7	15.7	22.7	27.2	39.8	46.8	64.4	93.3
2003	9.2	15.8	18.0	23.6	29.2	34.6	37.0	37.0	40.2
2004	8.4	13.0	16.0	20.0	22.4	25.0	39.0	39.4	39.4
2005	5.6	9.2	12.0	20.0	26.8	32.2	32.2	32.4	40.0
2006	8.6	15.2	20.0	21.0	23.2	34.0	48.8	55.2	55.4
2007	11.4	19.0	22.6	30.0	33.8	35.8	35.8	43.4	55.4
2008	9.8	12.8	14.0	19.0	23.2	33.4	47.0	53.0	78.4
2009	12.4	17.6	18.8	24.6	25.2	28.0	38.6	44.4	56.6
2010	8.0	11.6	12.2	17.6	22.8	31.4	59.2	64.8	65.4
2012	6.8	7.8	8.2	12.4	17.0	20.8	34.8	45.4	53.8
2013	8.2	11.2	15.0	26.0	28.4	42.4	65.2	67.2	67.8
2014	9.8	15.4	18.0	25.4	28.0	29.2	33.2	40.2	40.6
2015	8.2	10.2	10.8	12.6	17.6	20.0	29.0	30.6	31.4
2016	9.0	12.0	15.8	24.4	44.4	51.2	52.2	53.8	54.2
-----									
# Yrs. Années	38	38	38	38	38	38	38	38	38
Mean Moyenne	9.0	12.8	15.3	21.0	26.4	31.9	40.8	45.8	52.0
Std. Dev. Écart-type	2.3	2.9	3.7	5.9	8.8	9.9	12.0	12.9	15.3
Skew. Dissymétrie	0.58	-0.05	0.05	0.85	0.91	0.56	1.12	0.81	0.83
Kurtosis	3.38	2.46	2.39	4.02	3.57	2.89	4.15	3.69	3.59

*-99.9 Indicates Missing Data/Données manquantes

*****

Table 2a : Return Period Rainfall Amounts (mm)  
Quantité de pluie (mm) par période de retour

*****

Duration/Durée	2	5	10	25	50	100	#Years Années
	yr/ans	yr/ans	yr/ans	yr/ans	yr/ans	yr/ans	
5 min	8.6	10.6	12.0	13.6	14.9	16.1	38
10 min	12.3	14.9	16.7	18.8	20.4	22.0	38
15 min	14.7	17.9	20.1	22.8	24.8	26.8	38
30 min	20.0	25.3	28.7	33.1	36.3	39.5	38
1 h	24.9	32.7	37.8	44.3	49.1	53.9	38
2 h	30.3	39.0	44.8	52.1	57.5	62.9	38
6 h	38.8	49.4	56.4	65.3	71.9	78.4	38
12 h	43.7	55.1	62.7	72.3	79.4	86.4	38
24 h	49.5	63.0	71.9	83.2	91.5	99.9	38

*****

Table 2b :

Return Period Rainfall Rates (mm/h) - 95% Confidence limits

Intensité de la pluie (mm/h) par période de retour - Limites de confiance de 95%

*****

Duration/Durée	2	5	10	25	50	100	#Years
	yr/ans	yr/ans	yr/ans	yr/ans	yr/ans	yr/ans	Années
5 min	103.8	127.8	143.6	163.7	178.6	193.4	38
	+/- 7.9	+/- 13.3	+/- 18.0	+/- 24.3	+/- 29.1	+/- 33.9	38
10 min	74.1	89.6	99.9	113.0	122.6	132.2	38
	+/- 5.1	+/- 8.7	+/- 11.7	+/- 15.8	+/- 18.9	+/- 22.0	38
15 min	58.8	71.8	80.4	91.3	99.3	107.3	38
	+/- 4.3	+/- 7.2	+/- 9.8	+/- 13.2	+/- 15.8	+/- 18.4	38
30 min	40.1	50.5	57.4	66.1	72.6	79.0	38
	+/- 3.4	+/- 5.8	+/- 7.8	+/- 10.6	+/- 12.6	+/- 14.7	38
1 h	24.9	32.7	37.8	44.3	49.1	53.9	38
	+/- 2.6	+/- 4.3	+/- 5.8	+/- 7.9	+/- 9.4	+/- 10.9	38
2 h	15.1	19.5	22.4	26.0	28.8	31.4	38
	+/- 1.4	+/- 2.4	+/- 3.3	+/- 4.4	+/- 5.3	+/- 6.2	38
6 h	6.5	8.2	9.4	10.9	12.0	13.1	38
	+/- 0.6	+/- 1.0	+/- 1.3	+/- 1.8	+/- 2.1	+/- 2.5	38
12 h	3.6	4.6	5.2	6.0	6.6	7.2	38
	+/- 0.3	+/- 0.5	+/- 0.7	+/- 1.0	+/- 1.2	+/- 1.3	38
24 h	2.1	2.6	3.0	3.5	3.8	4.2	38
	+/- 0.2	+/- 0.3	+/- 0.4	+/- 0.6	+/- 0.7	+/- 0.8	38

*****

Table 3 : Interpolation Equation / Équation d'interpolation:  $R = A \cdot T^B$

R = Interpolated Rainfall rate (mm/h)/Intensité interpolée de la pluie (mm/h)

RR = Rainfall rate (mm/h) / Intensité de la pluie (mm/h)

T = Rainfall duration (h) / Durée de la pluie (h)

*****

Statistics/Statistiques	2	5	10	25	50	100
	yr/ans	yr/ans	yr/ans	yr/ans	yr/ans	yr/ans
Mean of RR/Moyenne de RR	36.5	45.3	51.0	58.3	63.7	69.1
Std. Dev. /Écart-type (RR)	35.7	43.5	48.7	55.3	60.2	65.0
Std. Error/Erreur-type	8.4	10.6	12.1	14.1	15.5	17.0
Coefficient (A)	21.9	27.5	31.2	35.9	39.4	42.9
Exponent/Exposant (B)	-0.701	-0.693	-0.689	-0.686	-0.683	-0.682
Mean % Error/% erreur moyenne	9.3	10.4	11.1	11.8	12.2	12.5





# Appendix D

**PRE DEVELOPMENT MODEL PARAMETERS AND OUTPUT**

**STORMWATER MANAGEMENT REPORT**

**SARAH PROPERTIES DURHAM SUBDIVISION  
MUNICIPALITY OF WEST GREY**



**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.)
Durham Road	101	South side of Property	5.14	450	114	3.0	0.0	100%	0.14	77.7
Eastern Property	102	East Side of Property	4.95	325	152	12.0	0.0	100%	0.18	75.8
Ravine	103	Northwest Corner of Property	3.69	200	184	2.0	0.0	100%	0.29	71.4

**Table A.2 Site Soils: (as per Ontario Soil Survey Report No. 15 for Grey County)**

**Soil Type**  
Harriston Silt Loam

**Hydrologic Soil Group**  
BC

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

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

HYDROLOGIC SOIL TYPE (%) - Existing Conditions								
Catchment	Hydrologic Soil Type							TOTAL
	A	AB	B	BC	C	CD	D	
101	0	0	0	100	0	0	0	100
102	0	0	0	100	0	0	0	100
103	0	0	0	100	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	0	5	0	0.0	95.0	0	0.0	0.0	100
102	0	20	0	0	0	80	0	0.0	0.0	100
103	0	60	0	0	0	40	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	65	67	72	77	70.5	78	89	77	90	77.7	0.14
102	65	67.0	72	77	71	78	89	77	90	75.8	0.18
103	65	67	72	77	70.5	78	89	77	90	71.4	0.29

**Table A.3: Impervious Area Determination for Subcatchment 101 - 102**

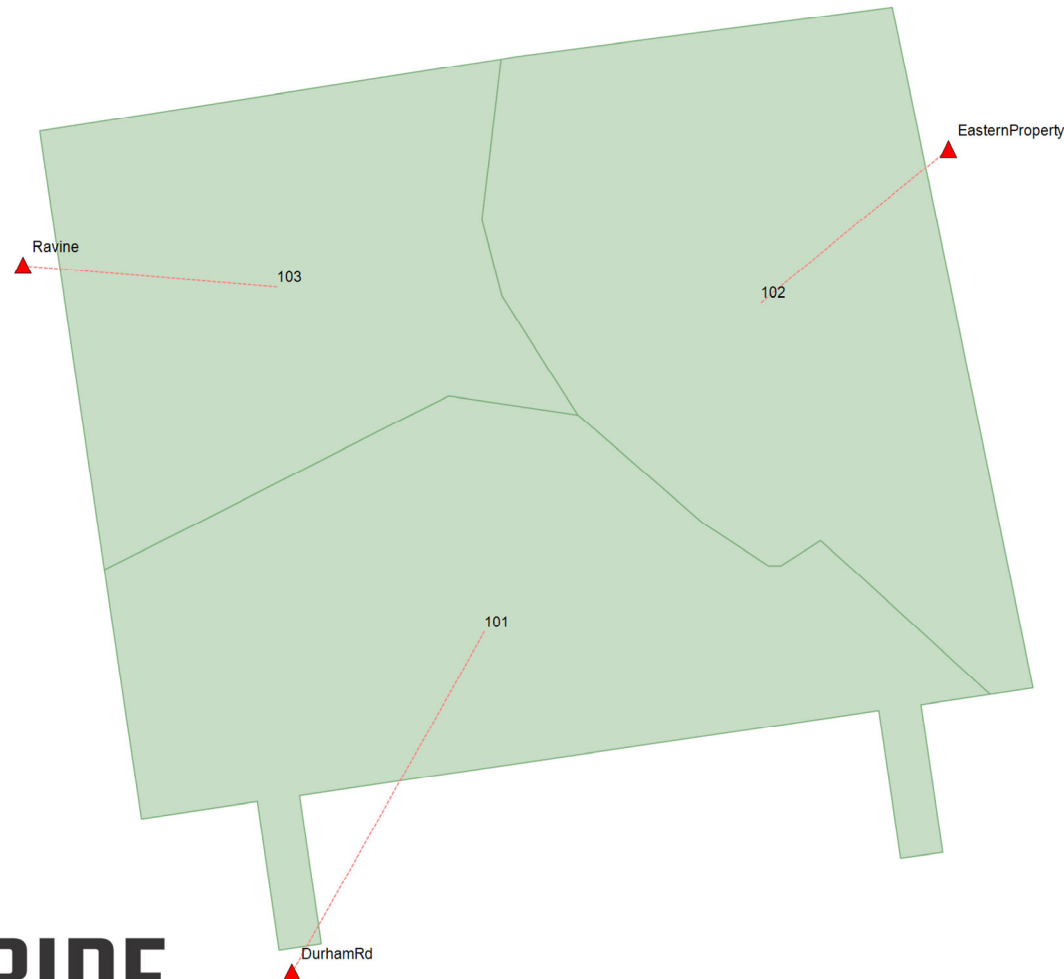
**Existing Conditions**

Area of Concern	Total Area (ha)	Impervious Area Connected		Impervious Area Not Connected (Rooftops)		Total (%)
		(ha)	(%)	(ha)	(%)	
101	5.14	0.00	0.0	0.00	0.0	0.0
102	4.95	0.00	0.0	0.00	0.0	0.0
103	3.69	0.00	0.0	0.00	0.0	0.0

**Table A.3 - Impervious Area Determination for Existing Catchments 101-102**

					<b>Imperv. Area</b>	<b>Imperv %</b>
101	0	m of	20	m wide ROW @ 45% imperv.	0.00 ha	0.0 %
	0	Impervious Area	814	m ² @ 100% imperv.	0.00 ha	0.0 %
	0	Roof Area	220	m ² @ 100% imperv.	0.00 ha	0.0 %
					<b>0.00 ha</b>	
102	0	m of	10	m wide ROW @ 50% imperv.	0.00 ha	0.0 %
	0	Impervious Area	3490	m ² @ 100% imperv.	0.00 ha	0.0 %
	0	Roof Area	220	m ² @ 100% imperv.	0.00 ha	0.0 %
					<b>0.00 ha</b>	
103	0	m of	20	m wide ROW @ 45% imperv.	0.00 ha	0.0 %
	0	Impervious Area	1826	m ² @ 100% imperv.	0.00 ha	0.0 %
	0	Roof Area	2025	m ² @ 100% imperv.	0.00 ha	0.0 %
					<b>0.00 ha</b>	

# Sarah Properties Durham Subdivision - Pre Development Model Schematic



## Legend

- ▲ Outfalls
- Subcatchments



100 m



**COBIDE**  
ENGINEERING INC





## Sarah Properties Subdivision – Pre Development Model Details

### [TITLE]

### [OPTIONS]

```
;;Options      Value
;;-----
FLOW_UNITS      LPS
INFILTRATION     CURVE_NUMBER
FLOW_ROUTING     DYNWAVE
START_DATE       2/10/2020
START_TIME       00:00
REPORT_START_DATE 2/10/2020
REPORT_START_TIME 00:00
END_DATE         2/11/2020
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_38.8mm_2yr INTENSITY 0:05    1.0    TIMESERIES SCS_6h_38.8mm_2yr
SCS_6h_49.4mm_5yr INTENSITY 0:05    1.0    TIMESERIES SCS_6h_49.4mm_5yr
SCS_6h_65.3mm_25yr INTENSITY 0:05    1.0    TIMESERIES SCS_6h_65.3mm_25yr
SCS_6h_71.9mm_50yr INTENSITY 0:05    1.0    TIMESERIES SCS_6h_71.9mm_50yr
SCS_6h_78.4mm_100yr INTENSITY 0:05    1.0    TIMESERIES SCS_6h_78.4mm_100yr
```

### [SUBCATCHMENTS]

```
;;      Total      Pcnt.      Pcnt.      Curb      Snow
;;Name      Raingage      Outlet      Area      Imperv      Width      Slope      Length      Pack
;;-----
101          SCS_6h_78.4mm_100yr DurhamRd      5.138744 0      450      3      0
102          SCS_6h_78.4mm_100yr EasternProperty 4.953939 0      325      12      0
103          SCS_6h_78.4mm_100yr Ravine      3.687781 0      200      2      0
```

### [SUBAREAS]

```
;;Subcatchment  N-Imperv  N-Perv  S-Imperv  S-Perv  PctZero  RouteTo  PctRouted
;;-----
101          0.01      0.14      0.05      0.05      25      OUTLET
102          0.01      0.18      0.05      0.05      25      OUTLET
103          0.01      0.29      0.05      0.05      25      OUTLET
```

### [INFILTRATION]

```
;;Subcatchment  CurveNum  HydCon  DryTime
;;-----
101          77.7      0.5      7
```

## Sarah Properties Subdivision – Pre Development Model Details

102	75.8	0.5	7
103	71.4	0.5	7

### [OUTFALLS]

;;Name	Invert Elev.	Outfall Type	Stage/Table Time Series	Tide Gate Route To
;;-----	-----	-----	-----	-----
DurhamRd	0	FREE		NO
EasternProperty	0	FREE		NO
Ravine	0	FREE		NO

### [TIMESERIES]

;;Name	Date	Time	Value
;;-----	-----	-----	-----
;SCS_6h_38.8mm design storm, total rainfall = 38.8 mm, rain units = mm/hr.			
SCS_6h_38.8mm_2yr			
;SCS_6h_49.4mm design storm, total rainfall = 49.4 mm, rain units = mm/hr.			
SCS_6h_49.4mm_5yr			
;SCS_6h_65.3mm design storm, total rainfall = 65.3 mm, rain units = mm/hr.			
SCS_6h_65.3mm_25yr			
;SCS_6h_71.9mm design storm, total rainfall = 71.9 mm, rain units = mm/hr.			
SCS_6h_71.9mm_50yr			
;SCS_6h_78.4mm design storm, total rainfall = 78.4 mm, rain units = mm/hr.			
SCS_6h_78.4mm_100yr			

### [REPORT]

INPUT YES  
 CONTROLS NO  
 SUBCATCHMENTS ALL  
 NODES ALL  
 LINKS ALL

### [TAGS]

### [MAP]

DIMENSIONS	514873.051740987 4892206.74367417 515393.593369892 4892704.53124312
UNITS	Meters

# Sarah Properties Subdivision – Pre Development 2 Year Design Storm Event

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

*****  
Element Count  
*****

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

*****  
Raingage Summary  
*****

Name	Data Source	Data Type	Recording Interval
SCS_6h_38.8mm_2yr	SCS_6h_38.8mm_2yr	INTENSITY	5 min.
SCS_6h_49.4mm_5yr	SCS_6h_49.4mm_5yr	INTENSITY	5 min.
SCS_6h_65.3mm_25yr	SCS_6h_65.3mm_25yr	INTENSITY	5 min.
SCS_6h_71.9mm_50yr	SCS_6h_71.9mm_50yr	INTENSITY	5 min.
SCS_6h_78.4mm_100yr	SCS_6h_78.4mm_100yr	INTENSITY	5 min.

*****  
Subcatchment Summary  
*****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	5.14	450.00	0.00	3.0000	SCS_6h_38.8mm_2yr	DurhamRd
102	4.95	325.00	0.00	12.0000	SCS_6h_38.8mm_2yr	EasternProperty
103	3.69	200.00	0.00	2.0000	SCS_6h_38.8mm_2yr	Ravine

*****  
Node Summary  
*****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
DurhamRd	OUTFALL	0.00	0.00	0.0	
EasternProperty	OUTFALL	0.00	0.00	0.0	
Ravine	OUTFALL	0.00	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 ..... 02/10/2020 00:00:00

Ending Date ..... 02/11/2020 00:00:00

Antecedent Dry Days ..... 0.0

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

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

## Sarah Properties Subdivision – Pre Development 2 Year Design Storm Event

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

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	0.535	38.807
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.376	27.302
Surface Runoff .....	0.156	11.297
Final Storage .....	0.003	0.208
Continuity Error (%) .....	-0.001	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.156	1.557
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.156	1.557
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.000	

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

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
101	38.81	0.00	0.00	25.77	12.91	0.66	65.92	0.333
102	38.81	0.00	0.00	26.58	12.11	0.60	62.52	0.312
103	38.81	0.00	0.00	30.40	7.96	0.29	17.49	0.205

Analysis begun on: Wed Feb 19 10:49:52 2020  
Analysis ended on: Wed Feb 19 10:49:52 2020  
Total elapsed time: < 1 sec

# Sarah Properties Subdivision – Pre Development 5 Year Design Storm Event

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

*****  
Element Count  
*****

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

*****  
Raingage Summary  
*****

Name	Data Source	Data Type	Recording Interval
SCS_6h_38.8mm_2yr	SCS_6h_38.8mm_2yr	INTENSITY	5 min.
SCS_6h_49.4mm_5yr	SCS_6h_49.4mm_5yr	INTENSITY	5 min.
SCS_6h_65.3mm_25yr	SCS_6h_65.3mm_25yr	INTENSITY	5 min.
SCS_6h_71.9mm_50yr	SCS_6h_71.9mm_50yr	INTENSITY	5 min.
SCS_6h_78.4mm_100yr	SCS_6h_78.4mm_100yr	INTENSITY	5 min.

*****  
Subcatchment Summary  
*****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	5.14	450.00	0.00	3.0000	SCS_6h_49.4mm_5yr	DurhamRd
102	4.95	325.00	0.00	12.0000	SCS_6h_49.4mm_5yr	EasternProperty
103	3.69	200.00	0.00	2.0000	SCS_6h_49.4mm_5yr	Ravine

*****  
Node Summary  
*****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
DurhamRd	OUTFALL	0.00	0.00	0.0	
EasternProperty	OUTFALL	0.00	0.00	0.0	
Ravine	OUTFALL	0.00	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 ..... 02/10/2020 00:00:00

Ending Date ..... 02/11/2020 00:00:00

Antecedent Dry Days ..... 0.0

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

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

## Sarah Properties Subdivision – Pre Development 5 Year Design Storm Event

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

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	0.681	49.408
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.442	32.100
Surface Runoff .....	0.236	17.098
Final Storage .....	0.003	0.211
Continuity Error (%) .....	-0.001	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.236	2.356
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.236	2.356
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.000	

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

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
101	49.41	0.00	0.00	30.06	19.22	0.99	118.27	0.389
102	49.41	0.00	0.00	31.19	18.10	0.90	112.17	0.366
103	49.41	0.00	0.00	36.17	12.79	0.47	30.07	0.259

Analysis begun on: Wed Feb 19 10:50:29 2020  
Analysis ended on: Wed Feb 19 10:50:30 2020  
Total elapsed time: 00:00:01

# Sarah Properties Subdivision – Pre Development 25 Year Design Storm Event

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

*****  
Element Count  
*****

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

*****  
Raingage Summary  
*****

Name	Data Source	Data Type	Recording Interval
SCS_6h_38.8mm_2yr	SCS_6h_38.8mm_2yr	INTENSITY	5 min.
SCS_6h_49.4mm_5yr	SCS_6h_49.4mm_5yr	INTENSITY	5 min.
SCS_6h_65.3mm_25yr	SCS_6h_65.3mm_25yr	INTENSITY	5 min.
SCS_6h_71.9mm_50yr	SCS_6h_71.9mm_50yr	INTENSITY	5 min.
SCS_6h_78.4mm_100yr	SCS_6h_78.4mm_100yr	INTENSITY	5 min.

*****  
Subcatchment Summary  
*****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	5.14	450.00	0.00	3.0000	SCS_6h_65.3mm_25yr	DurhamRd
102	4.95	325.00	0.00	12.0000	SCS_6h_65.3mm_25yr	EasternProperty
103	3.69	200.00	0.00	2.0000	SCS_6h_65.3mm_25yr	Ravine

*****  
Node Summary  
*****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
DurhamRd	OUTFALL	0.00	0.00	0.0	
EasternProperty	OUTFALL	0.00	0.00	0.0	
Ravine	OUTFALL	0.00	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 ..... 02/10/2020 00:00:00

Ending Date ..... 02/11/2020 00:00:00

Antecedent Dry Days ..... 0.0

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

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

## Sarah Properties Subdivision – Pre Development 25 Year Design Storm Event

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

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	0.900	65.310
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.523	37.974
Surface Runoff .....	0.374	27.123
Final Storage .....	0.003	0.213
Continuity Error (%) .....	-0.001	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.374	3.738
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.374	3.738
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.000	

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

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
101	65.31	0.00	0.00	35.23	29.95	1.54	219.90	0.459
102	65.31	0.00	0.00	36.84	28.36	1.40	208.49	0.434
103	65.31	0.00	0.00	43.33	21.52	0.79	54.23	0.330

Analysis begun on: Wed Feb 19 10:51:19 2020  
Analysis ended on: Wed Feb 19 10:51:19 2020  
Total elapsed time: < 1 sec



# Sarah Properties Subdivision – Pre Development 50 Year Design Storm Event

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

*****  
Element Count  
*****

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

*****  
Raingage Summary  
*****

Name	Data Source	Data Type	Recording Interval
SCS_6h_38.8mm_2yr	SCS_6h_38.8mm_2yr	INTENSITY	5 min.
SCS_6h_49.4mm_5yr	SCS_6h_49.4mm_5yr	INTENSITY	5 min.
SCS_6h_65.3mm_25yr	SCS_6h_65.3mm_25yr	INTENSITY	5 min.
SCS_6h_71.9mm_50yr	SCS_6h_71.9mm_50yr	INTENSITY	5 min.
SCS_6h_78.4mm_100yr	SCS_6h_78.4mm_100yr	INTENSITY	5 min.

*****  
Subcatchment Summary  
*****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	5.14	450.00	0.00	3.0000	SCS_6h_71.9mm_50yr	DurhamRd
102	4.95	325.00	0.00	12.0000	SCS_6h_71.9mm_50yr	EasternProperty
103	3.69	200.00	0.00	2.0000	SCS_6h_71.9mm_50yr	Ravine

*****  
Node Summary  
*****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
DurhamRd	OUTFALL	0.00	0.00	0.0	
EasternProperty	OUTFALL	0.00	0.00	0.0	
Ravine	OUTFALL	0.00	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 ..... 02/10/2020 00:00:00

Ending Date ..... 02/11/2020 00:00:00

Antecedent Dry Days ..... 0.0

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

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

## Sarah Properties Subdivision – Pre Development 50 Year Design Storm Event

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

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	0.991	71.911
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.552	40.048
Surface Runoff .....	0.436	31.650
Final Storage .....	0.003	0.214
Continuity Error (%) .....	-0.001	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.436	4.362
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.436	4.362
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.000	

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

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
101	71.91	0.00	0.00	37.04	34.74	1.79	268.56	0.483
102	71.91	0.00	0.00	38.83	32.97	1.63	254.61	0.458
103	71.91	0.00	0.00	45.88	25.57	0.94	66.54	0.356

Analysis begun on: Wed Feb 19 10:51:55 2020  
Analysis ended on: Wed Feb 19 10:51:55 2020  
Total elapsed time: < 1 sec

# Sarah Properties Subdivision – Pre Development 100 Year Design Storm Event

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

*****  
Element Count  
*****

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

*****  
Raingage Summary  
*****

Name	Data Source	Data Type	Recording Interval
SCS_6h_38.8mm_2yr	SCS_6h_38.8mm_2yr	INTENSITY	5 min.
SCS_6h_49.4mm_5yr	SCS_6h_49.4mm_5yr	INTENSITY	5 min.
SCS_6h_65.3mm_25yr	SCS_6h_65.3mm_25yr	INTENSITY	5 min.
SCS_6h_71.9mm_50yr	SCS_6h_71.9mm_50yr	INTENSITY	5 min.
SCS_6h_78.4mm_100yr	SCS_6h_78.4mm_100yr	INTENSITY	5 min.

*****  
Subcatchment Summary  
*****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	5.14	450.00	0.00	3.0000	SCS_6h_78.4mm_100yr	DurhamRd
102	4.95	325.00	0.00	12.0000	SCS_6h_78.4mm_100yr	EasternProperty
103	3.69	200.00	0.00	2.0000	SCS_6h_78.4mm_100yr	Ravine

*****  
Node Summary  
*****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
DurhamRd	OUTFALL	0.00	0.00	0.0	
EasternProperty	OUTFALL	0.00	0.00	0.0	
Ravine	OUTFALL	0.00	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 ..... 02/10/2020 00:00:00  
Ending Date ..... 02/11/2020 00:00:00  
Antecedent Dry Days ..... 0.0  
Report Time Step ..... 00:01:00  
Wet Time Step ..... 00:05:00

## Sarah Properties Subdivision – Pre Development 100 Year Design Storm Event

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

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation .....	1.081	78.413
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.578	41.917
Surface Runoff .....	0.500	36.282
Final Storage .....	0.003	0.215
Continuity Error (%) .....	-0.001	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.500	5.000
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.500	5.000
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.000	0.000
Continuity Error (%) .....	0.000	

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

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
101	78.41	0.00	0.00	38.65	39.63	2.04	319.48	0.505
102	78.41	0.00	0.00	40.63	37.67	1.87	302.85	0.480
103	78.41	0.00	0.00	48.20	29.75	1.10	79.44	0.379

Analysis begun on: Wed Feb 19 10:52:31 2020  
Analysis ended on: Wed Feb 19 10:52:31 2020  
Total elapsed time: < 1 sec

# Appendix E

**POST DEVELOPMENT MODEL PARAMETERS AND OUTPUT**

**STORMWATER MANAGEMENT REPORT**

**SARAH PROPERTIES DURHAM SUBDIVISION  
MUNICIPALITY OF WEST GREY**



**Table B.1 Parameter Summary Table**

<b>Proposed Conditions</b>										
<b>Outlet Location</b>	<b>Model Catchment ID</b>	<b>Description</b>	<b>Area (ha)</b>	<b>Drainage Channel (m)</b>	<b>Flow Length (m)</b>	<b>Gradient (%)</b>	<b>Total Imperv. (%)</b>	<b>Not Connected Imperv. (%)</b>	<b>Manning's 'n' (Perv.)</b>	<b>CN (Perv.)</b>
Durham Road	201	Majority of Subdivision	11.47	3500	33	4.0	64.5	43.7	0.26	76.4
Ravine	202	Northwest Corner of Subdivision	0.72	200	36	2.0	18.7	100.0	0.32	72.1
Durham Road	203	Westerly Entrance Road	0.17	20	84	4.0	55.3	0.0	0.25	77.0
Durham Road	204	Easterly Entrance Road	0.12	20	60	4.0	55.0	0.0	0.25	77.0
Eastern Property	205	Eastern Side of Development	1.30	320	41	8.0	17.3	100.0	0.30	73.6

**Table B.2 Site Soils: (as per Ontario Soil Survey Report No. 15 for Grey County)**

**Soil Type**  
Harriston Silt Loam

**Hydrologic Soil Group**  
BC

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

continuous grass

forests

natural, not maintained

maintained

farm pasture

farm land

idle farm land (bare)

Lawns Proposed

HYDROLOGIC SOIL TYPE (%) - Proposed Conditions								
Catchment	Hydrologic Soil Type							TOTAL
	A	AB	B	BC	C	CD	D	
201	0	0	0	100	0	0	0	100
202	0	0	0	100	0	0	0	100
203	0	0	0	100	0	0	0	100
204	0	0	0	100	0	0	0	100
205	0	0	0	100	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	2	0	34	0	0	0	28.1	36.3	100
202	0	40	0	41	0	0	0	18.7	0.0	100
203	0	0	0	45	0	0	0	0.0	55.3	100
204	0	0	0	45	0	0	0	0.0	55.0	100
205	0	28	0	55	0	0	0	17.3	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	64.5	67	72	77	70.5	78	89	77	90	76.4	0.26
202	64.5	67.0	72	77	70.5	78	89	77	90	72.1	0.32
203	64.5	67	72	77	70.5	78	89	77	90	77.0	0.25
204	64.5	67	72	77	70.5	78	89	77	90	77.0	0.25
205	64.5	67	72	77	70.5	78	89	77	90	73.6	0.30



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

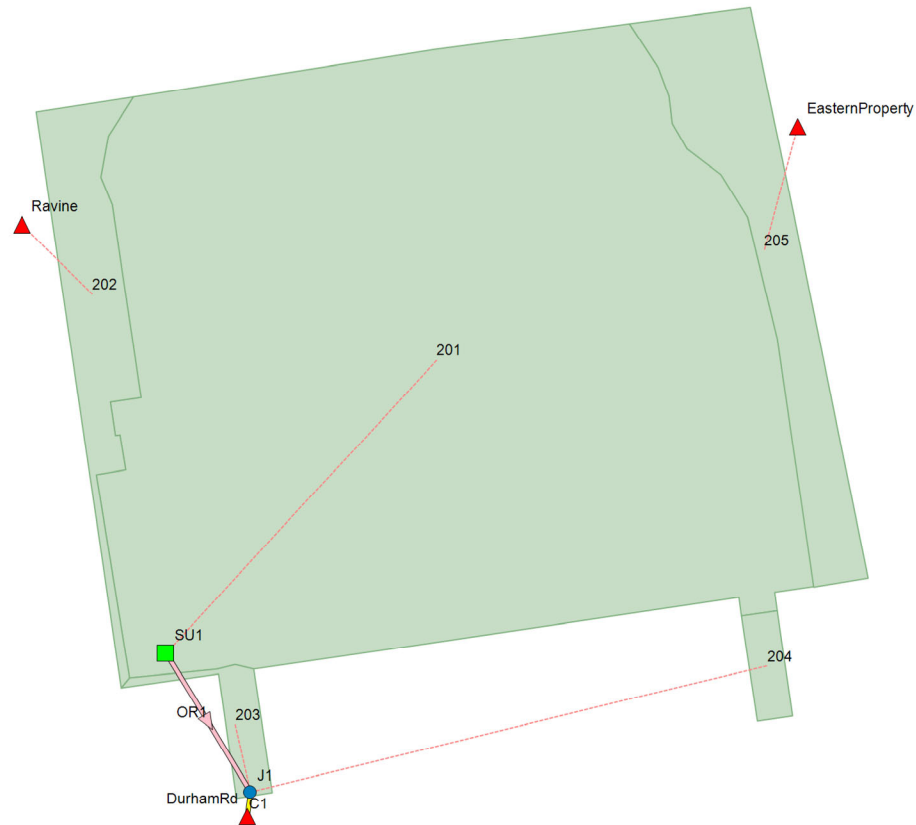
**Proposed Conditions**

Area of Concern	Total Area (ha)	Impervious Area Connected		Impervious Area Not Connected (Rooftops)		Total (%)
		(ha)	(%)	(ha)	(%)	
201	11.47	4.17	36.3	3.23	28.1	64.5
202	0.72	0.00	0.0	0.14	18.7	18.7
203	0.17	0.09	55.3	0.00	0.0	55.3
204	0.12	0.07	55.0	0.00	0.0	55.0
205	1.30	0.00	0.0	0.23	17.3	17.3

**Table B.3 - Impervious Area Determination for Proposed Catchments 201 - 205**

Catchment				Imperv. Area	Imperv %	
201	1750	m of	20	m wide ROW @ 55% imperv.	1.93 ha	16.8 %
	210	driveways @	90	m ² @ 100% imperv.	1.89 ha	16.5 %
	85	single res. homes with roof area of		225 m ²	1.91 ha	16.7 %
	17	single res. homes with roof area of		200 m ²	0.34 ha	3.0 %
	13	Multi-family Blocks with roof area of		750 m ²	0.98 ha	8.5 %
		Multi-family Blocks with Impervious Area of		5000 m ²	0.00 ha	0.0 %
	1	Permanent Pool		3500 m ²	0.35 ha	3.1 %
				<b>7.39 ha</b>		
202		m of	20	m wide ROW @ 55% imperv.	0.00 ha	0.0 %
		driveways @	90	m ² @ 100% imperv.	0.00 ha	0.0
	6	single res. homes with roof area of		225 m ²	0.14 ha	18.7
		single res. homes with roof area of		200 m ²	0.00 ha	0.0
		Multi-family Blocks with roof area of		750 m ²	0.00 ha	0.0
				<b>0.00 ha</b>		
203	84	m of	20	m wide ROW @ 55% imperv.	0.09 ha	55.3 %
		driveways @	1826	m ² @ 100% imperv.	0.00 ha	0.0 %
		single res. homes with roof area of		2025 m ²	0.00 ha	0.0 %
		Duplex unit with roof area of		200 m ²	0.00 ha	0.0 %
		Multi-family Blocks with roof area of		750 m ²	0.00 ha	0.0 %
				<b>0.09 ha</b>		
204	60	m of	20	m wide ROW @ 55% imperv.	0.07 ha	55.0 %
		driveways @	80	m ² @ 100% imperv.	0.00 ha	0.0 %
		driveways @	60	m ² @ 100% imperv.	0.00 ha	0.0 %
		single res. homes with roof area of		225 m ²	0.00 ha	0.0 %
		Duplex unit with roof area of		125 m ²	0.00 ha	0.0 %
		Multi-family Blocks with roof area of		120 m ²	0.00 ha	0.0 %
				<b>0.07 ha</b>		
205		m of	20	m wide ROW @ 55% imperv.	0.00 ha	0.0 %
		driveways @	80	m ² @ 100% imperv.	0.00 ha	0.0 %
		driveways @	60	m ² @ 100% imperv.	0.00 ha	0.0 %
	10	single res. homes with roof area of		225 m ²	0.23 ha	17.3 %
		single res. homes with roof area of		200 m ²	0.00 ha	0.0 %
		Multi-family Blocks with Impervious Area of		1000 m ²	0.00 ha	0.0 %
				<b>0.23 ha</b>		

# Sarah Properties - Durham Subdivision - Post Development Model Schematic



## Legend

- Junctions
- ▲ Outfalls
- Storages
- Conduits
- Orifices
- Subcatchments



150 m



## Sarah Properties Subdivision – Post Development Model Details

### [TITLE]

### [OPTIONS]

```

;;Options      Value
;;-----
FLOW_UNITS      LPS
INFILTRATION    CURVE_NUMBER
FLOW_ROUTING    DYNWAVE
START_DATE      2/10/2020
START_TIME      00:00
REPORT_START_DATE 2/10/2020
REPORT_START_TIME 00:00
END_DATE        2/11/2020
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    ELEVATION
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_25mm      INTENSITY 0:05      1.0      TIMESERIES SCS_6h_25mm
SCS_6h_38.8mm_2yr INTENSITY 0:05      1.0      TIMESERIES SCS_6h_38.8mm_2yr
SCS_6h_49.4mm_5yr INTENSITY 0:05      1.0      TIMESERIES SCS_6h_49.4mm_5yr
SCS_6h_65.3mm_25yr INTENSITY 0:05      1.0      TIMESERIES SCS_6h_65.3mm_25yr
SCS_6h_71.9mm_50yr INTENSITY 0:05      1.0      TIMESERIES SCS_6h_71.9mm_50yr
SCS_6h_78.4mm_100yr INTENSITY 0:05      1.0      TIMESERIES SCS_6h_78.4mm_100yr

```

### [SUBCATCHMENTS]

```

;;      Total      Pcnt.      Pcnt.      Curb      Snow
;;Name      Raingage      Outlet      Area      Imperv      Width      Slope      Length      Pack
;;-----
201      SCS_6h_25mm      SU1      11.47      64.5      3500      4      0
202      SCS_6h_25mm      Ravine      0.72325      18.7      200      2      0
203      SCS_6h_25mm      J1      0.167149      55.3      20      4      0
204      SCS_6h_25mm      J1      0.12007      55      20      4      0
205      SCS_6h_25mm      EasternProperty 1.3      17.3      320      8      0

```

### [SUBAREAS]

```

;;Subcatchment      N-Imperv      N-Perv      S-Imperv      S-Perv      PctZero      RouteTo      PctRouted
;;-----
201      0.01      0.26      0.05      0.05      25      OUTLET
202      0.01      0.32      0.05      0.05      25      OUTLET
203      0.01      0.25      0.05      0.05      25      OUTLET
204      0.01      0.25      0.05      0.05      25      OUTLET
205      0.01      0.3      0.05      0.05      25      OUTLET

```

## Sarah Properties Subdivision – Post Development Model Details

### [INFILTRATION]

;;Subcatchment	CurveNum	HydCon	DryTime
;;-----			
201	76.4	0.5	7
202	72.1	0.5	7
203	77	0.5	7
204	77	0.5	7
205	73.6	0.5	7

### [JUNCTIONS]

;;	Invert	Max.	Init.	Surcharge	Ponded
;;Name	Elev.	Depth	Depth	Depth	Area
;;-----					
J1	380.5	1	0	0	0

### [OUTFALLS]

;;	Invert	Outfall	Stage/Table	Tide
;;Name	Elev.	Type	Time Series	Gate Route To
;;-----				
DurhamRd	380	FREE		NO
EasternProperty	0	FREE		NO
Ravine	0	FREE		NO

### [STORAGE]

;;	Invert	Max.	Init.	Storage	Curve		Ponded	Evap.
;;Name	Elev.	Depth	Depth	Curve	Params		Area	Frac.
Infiltration parameters								
;;-----								
SU1	381	3.3	1	TABULAR	Pond		0	0

### [CONDUITS]

;;	Inlet	Outlet		Manning	Inlet	Outlet	Init.	Max.
;;Name	Node	Node	Length	N	Offset	Offset	Flow	Flow
;;-----								
C1	J1	DurhamRd	14.22	0.013	380.5	380	0	0

### [ORIFICES]

;;	Inlet	Outlet	Orifice	Crest	Disch.	Flap	Open/Close
;;Name	Node	Node	Type	Height	Coeff.	Gate	Time
;;-----							
OR1	SU1	J1	SIDE	382	0.65	NO	0

### [XSECTIONS]

;;Link	Shape	Geom1	Geom2	Geom3	Geom4	Barrels
;;-----						
C1	TRIANGULAR	1	6	0	0	1
OR1	CIRCULAR	0.15	0	0	0	

### [LOSSES]

;;Link	Inlet	Outlet	Average	Flap Gate	SeepageRate
;;-----					

### [CURVES]

;;Name	Type	X-Value	Y-Value
;;-----			
Pond	Storage	0	2375
Pond		1	3500
Pond		3.3	5665

### [TIMESERIES]

;;Name	Date	Time	Value
;;-----			
;SCS_6h_25mm design storm, total rainfall = 25 mm, rain units = mm/hr.			
SCS_6h_25mm			
;SCS_6h_38.8mm design storm, total rainfall = 38.8 mm, rain units = mm/hr.			
SCS_6h_38.8mm_2yr			
;SCS_6h_49.4mm design storm, total rainfall = 49.4 mm, rain units = mm/hr.			
SCS_6h_49.4mm_5yr			

## Sarah Properties Subdivision – Post Development Model Details

```
;SCS_6h_65.3mm design storm, total rainfall = 65.3 mm, rain units = mm/hr.  
SCS_6h_65.3mm_25yr
```

```
;SCS_6h_71.9mm design storm, total rainfall = 71.9 mm, rain units = mm/hr.  
SCS_6h_71.9mm_50yr
```

```
;SCS_6h_78.4mm design storm, total rainfall = 78.4 mm, rain units = mm/hr.  
SCS_6h_78.4mm_100yr
```

### [REPORT]

```
INPUT      YES  
CONTROLS   NO  
SUBCATCHMENTS ALL  
NODES      ALL  
LINKS      ALL
```

### [TAGS]

### [MAP]

```
DIMENSIONS      514873.051740987 4892206.74367417 515393.593369892 4892704.53124312  
UNITS            Meters
```





# Sarah Properties Subdivision – Post Development 2 Year Design Storm Event

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

*****

Element Count

*****

Number of rain gages ..... 6  
 Number of subcatchments ... 5  
 Number of nodes ..... 5  
 Number of links ..... 2  
 Number of pollutants ..... 0  
 Number of land uses ..... 0

*****

Raingage Summary

*****

Name	Data Source	Data Type	Recording Interval
SCS_6h_25mm	SCS_6h_25mm	INTENSITY	5 min.
SCS_6h_38.8mm_2yr	SCS_6h_38.8mm_2yr	INTENSITY	5 min.
SCS_6h_49.4mm_5yr	SCS_6h_49.4mm_5yr	INTENSITY	5 min.
SCS_6h_65.3mm_25yr	SCS_6h_65.3mm_25yr	INTENSITY	5 min.
SCS_6h_71.9mm_50yr	SCS_6h_71.9mm_50yr	INTENSITY	5 min.
SCS_6h_78.4mm_100yr	SCS_6h_78.4mm_100yr	INTENSITY	5 min.

*****

Subcatchment Summary

*****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
201	11.47	3500.00	64.50	4.0000	SCS_6h_38.8mm_2yr	SU1
202	0.72	200.00	18.70	2.0000	SCS_6h_38.8mm_2yr	Ravine
203	0.17	20.00	55.30	4.0000	SCS_6h_38.8mm_2yr	J1
204	0.12	20.00	55.00	4.0000	SCS_6h_38.8mm_2yr	J1
205	1.30	320.00	17.30	8.0000	SCS_6h_38.8mm_2yr	EasternProperty

*****

Node Summary

*****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	380.50	1.00	0.0	
DurhamRd	OUTFALL	380.00	1.00	0.0	
EasternProperty	OUTFALL	0.00	0.00	0.0	
Ravine	OUTFALL	0.00	0.00	0.0	
SU1	STORAGE	381.00	3.30	0.0	

*****

Link Summary

*****

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J1	DurhamRd	CONDUIT	14.2	3.5184	0.0130
OR1	SU1	J1	ORIFICE			

*****

Cross Section Summary

*****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	TRIANGULAR	1.00	3.00	0.47	6.00	1	26329.00

## Sarah Properties Subdivision – Post Development 2 Year Design Storm Event

*****  
 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 ..... 02/10/2020 00:00:00  
 Ending Date ..... 02/11/2020 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 .....	0.535	38.807
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.155	11.232
Surface Runoff .....	0.380	27.551
Final Storage .....	0.001	0.049
Continuity Error (%) .....	-0.065	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.380	3.798
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.297	2.970
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.294	2.937
Final Stored Volume .....	0.377	3.765
Continuity Error (%) .....	-0.001	

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

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

*****

## Sarah Properties Subdivision – Post Development 2 Year Design Storm Event

### 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	38.81	0.00	0.00	9.22	29.57	3.39	705.77	0.762
202	38.81	0.00	0.00	22.80	15.92	0.12	16.73	0.410
203	38.81	0.00	0.00	11.51	27.28	0.05	8.78	0.703
204	38.81	0.00	0.00	11.55	27.23	0.03	6.43	0.702
205	38.81	0.00	0.00	22.51	16.24	0.21	34.75	0.419

*****

### 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	0.08	0.09	380.59	0 02:25	0.09
DurhamRd	OUTFALL	0.08	0.09	380.09	0 02:25	0.09
EasternProperty	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
Ravine	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
SU1	STORAGE	1.45	1.73	382.73	0 06:01	1.73

*****

### 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	15.21	44.47	0 02:25	0.0783	2.64	0.007
DurhamRd	OUTFALL	0.00	44.48	0 02:25	0	2.64	0.000
EasternProperty	OUTFALL	34.75	34.75	0 02:25	0.211	0.211	0.000
Ravine	OUTFALL	16.73	16.73	0 02:25	0.115	0.115	0.000
SU1	STORAGE	705.77	705.77	0 02:25	3.39	6.33	0.001

*****

### Node Surcharge Summary

*****

No nodes were surcharged.

*****

### Node Flooding Summary

*****

No nodes were flooded.

*****

## Sarah Properties Subdivision – Post Development 2 Year Design Storm Event

### Storage Volume Summary

*****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
SU1	4.625	34	0	0	5.728	43	0 06:01	41.07

*****

### Outfall Loading Summary

*****

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
DurhamRd	99.81	30.65	44.48	2.643
EasternProperty	59.02	4.13	34.75	0.211
Ravine	61.18	2.17	16.73	0.115
System	73.34	36.95	95.92	2.970

*****

### 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	44.48	0 02:25	1.78	0.00	0.09
OR1	ORIFICE	41.07	0 06:01			1.00

*****

### Flow Classification Summary

*****

Conduit	Adjusted /Actual Length	----- Up Dry		Down Dry		Sub Crit		Sup Crit		Fraction of Time in Flow Class Up Down Norm Inlet Crit Crit Ltd Ctrl	
C1	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00

*****

### Conduit Surcharge Summary

*****

No conduits were surcharged.

Analysis begun on: Wed Feb 19 09:59:33 2020

Analysis ended on: Wed Feb 19 09:59:34 2020

Total elapsed time: 00:00:01

# Sarah Properties Subdivision – Post Development 5 Year Design Storm Event

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

-----

*****

Element Count

*****

Number of rain gages ..... 6  
 Number of subcatchments ... 5  
 Number of nodes ..... 5  
 Number of links ..... 2  
 Number of pollutants ..... 0  
 Number of land uses ..... 0

*****

Raingage Summary

*****

Name	Data Source	Data Type	Recording Interval
SCS_6h_25mm	SCS_6h_25mm	INTENSITY	5 min.
SCS_6h_38.8mm_2yr	SCS_6h_38.8mm_2yr	INTENSITY	5 min.
SCS_6h_49.4mm_5yr	SCS_6h_49.4mm_5yr	INTENSITY	5 min.
SCS_6h_65.3mm_25yr	SCS_6h_65.3mm_25yr	INTENSITY	5 min.
SCS_6h_71.9mm_50yr	SCS_6h_71.9mm_50yr	INTENSITY	5 min.
SCS_6h_78.4mm_100yr	SCS_6h_78.4mm_100yr	INTENSITY	5 min.

*****

Subcatchment Summary

*****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
201	11.47	3500.00	64.50	4.0000	SCS_6h_49.4mm_5yr	SU1
202	0.72	200.00	18.70	2.0000	SCS_6h_49.4mm_5yr	Ravine
203	0.17	20.00	55.30	4.0000	SCS_6h_49.4mm_5yr	J1
204	0.12	20.00	55.00	4.0000	SCS_6h_49.4mm_5yr	J1
205	1.30	320.00	17.30	8.0000	SCS_6h_49.4mm_5yr	EasternProperty

*****

Node Summary

*****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	380.50	1.00	0.0	
DurhamRd	OUTFALL	380.00	1.00	0.0	
EasternProperty	OUTFALL	0.00	0.00	0.0	
Ravine	OUTFALL	0.00	0.00	0.0	
SU1	STORAGE	381.00	3.30	0.0	

*****

Link Summary

*****

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J1	DurhamRd	CONDUIT	14.2	3.5184	0.0130
OR1	SU1	J1	ORIFICE			

*****

Cross Section Summary

*****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	TRIANGULAR	1.00	3.00	0.47	6.00	1	26329.00

## Sarah Properties Subdivision – Post Development 5 Year Design Storm Event

*****  
 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 ..... 02/10/2020 00:00:00  
 Ending Date ..... 02/11/2020 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 .....	0.681	49.408
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.181	13.165
Surface Runoff .....	0.499	36.223
Final Storage .....	0.001	0.049
Continuity Error (%) .....	-0.059	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.499	4.993
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.366	3.664
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.294	2.937
Final Stored Volume .....	0.427	4.266
Continuity Error (%) .....	-0.001	

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

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

*****

## Sarah Properties Subdivision – Post Development 5 Year Design Storm Event

### 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	49.41	0.00	0.00	10.76	38.63	4.43	931.17	0.782
202	49.41	0.00	0.00	27.07	22.26	0.16	24.60	0.451
203	49.41	0.00	0.00	13.47	35.92	0.06	11.74	0.727
204	49.41	0.00	0.00	13.50	35.90	0.04	8.63	0.727
205	49.41	0.00	0.00	26.56	22.80	0.30	51.96	0.461

### 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	0.08	0.10	380.60	0 02:25	0.10
DurhamRd	OUTFALL	0.08	0.10	380.10	0 02:25	0.10
EasternProperty	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
Ravine	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
SU1	STORAGE	1.62	1.94	382.94	0 06:02	1.94

### 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	20.37	54.38	0 02:25	0.103	3.21	0.007
DurhamRd	OUTFALL	0.00	54.38	0 02:25	0	3.21	0.000
EasternProperty	OUTFALL	51.96	51.96	0 02:25	0.296	0.296	0.000
Ravine	OUTFALL	24.60	24.60	0 02:25	0.161	0.161	0.000
SU1	STORAGE	931.17	931.17	0 02:25	4.43	7.37	0.002

### Node Surcharge Summary

*****

No nodes were surcharged.

### Node Flooding Summary

*****

No nodes were flooded.

*****

## Sarah Properties Subdivision – Post Development 5 Year Design Storm Event

### Storage Volume Summary

*****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
SU1	5.299	39	0	0	6.665	49	0 06:02	47.46

*****

### Outfall Loading Summary

*****

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
DurhamRd	99.84	37.18	54.38	3.207
EasternProperty	59.55	5.75	51.96	0.296
Ravine	61.59	3.02	24.60	0.161
System	73.66	45.95	130.90	3.664

*****

### 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	54.38	0 02:25	1.87	0.00	0.10
OR1	ORIFICE	47.46	0 06:02			1.00

*****

### Flow Classification Summary

*****

Conduit	Adjusted /Actual Length	----- Up Dry		Down Dry		Sub Crit		Sup Crit		Fraction of Time in Flow Class ----- Up Down Norm Inlet	
C1	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00

*****

### Conduit Surcharge Summary

*****

No conduits were surcharged.

Analysis begun on: Wed Feb 19 10:00:00 2020

Analysis ended on: Wed Feb 19 10:00:00 2020

Total elapsed time: < 1 sec



# Sarah Properties Subdivision – Post Development 25 Year Design Storm Event

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

*****

Element Count

*****

Number of rain gages ..... 6  
 Number of subcatchments ... 5  
 Number of nodes ..... 5  
 Number of links ..... 2  
 Number of pollutants ..... 0  
 Number of land uses ..... 0

*****

Raingage Summary

*****

Name	Data Source	Data Type	Recording Interval
SCS_6h_25mm	SCS_6h_25mm	INTENSITY	5 min.
SCS_6h_38.8mm_2yr	SCS_6h_38.8mm_2yr	INTENSITY	5 min.
SCS_6h_49.4mm_5yr	SCS_6h_49.4mm_5yr	INTENSITY	5 min.
SCS_6h_65.3mm_25yr	SCS_6h_65.3mm_25yr	INTENSITY	5 min.
SCS_6h_71.9mm_50yr	SCS_6h_71.9mm_50yr	INTENSITY	5 min.
SCS_6h_78.4mm_100yr	SCS_6h_78.4mm_100yr	INTENSITY	5 min.

*****

Subcatchment Summary

*****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
201	11.47	3500.00	64.50	4.0000	SCS_6h_65.3mm_25yr	SU1
202	0.72	200.00	18.70	2.0000	SCS_6h_65.3mm_25yr	Ravine
203	0.17	20.00	55.30	4.0000	SCS_6h_65.3mm_25yr	J1
204	0.12	20.00	55.00	4.0000	SCS_6h_65.3mm_25yr	J1
205	1.30	320.00	17.30	8.0000	SCS_6h_65.3mm_25yr	EasternProperty

*****

Node Summary

*****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	380.50	1.00	0.0	
DurhamRd	OUTFALL	380.00	1.00	0.0	
EasternProperty	OUTFALL	0.00	0.00	0.0	
Ravine	OUTFALL	0.00	0.00	0.0	
SU1	STORAGE	381.00	3.30	0.0	

*****

Link Summary

*****

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J1	DurhamRd	CONDUIT	14.2	3.5184	0.0130
OR1	SU1	J1	ORIFICE			

*****

Cross Section Summary

*****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	TRIANGULAR	1.00	3.00	0.47	6.00	1	26329.00

## Sarah Properties Subdivision – Post Development 25 Year Design Storm Event

*****  
 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 ..... 02/10/2020 00:00:00  
 Ending Date ..... 02/11/2020 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 .....	0.900	65.310
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.214	15.539
Surface Runoff .....	0.686	49.757
Final Storage .....	0.001	0.049
Continuity Error (%) .....	-0.053	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.686	6.859
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.461	4.614
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.294	2.937
Final Stored Volume .....	0.518	5.183
Continuity Error (%) .....	0.000	

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

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

*****

## Sarah Properties Subdivision – Post Development 25 Year Design Storm Event

### 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	65.31	0.00	0.00	12.65	52.65	6.04	1283.85	0.806
202	65.31	0.00	0.00	32.33	32.90	0.24	39.01	0.504
203	65.31	0.00	0.00	15.82	49.49	0.08	16.54	0.758
204	65.31	0.00	0.00	15.86	49.45	0.06	12.15	0.757
205	65.31	0.00	0.00	31.60	33.67	0.44	82.50	0.515

### 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	0.09	0.11	380.61	0 02:25	0.11
DurhamRd	OUTFALL	0.09	0.11	380.11	0 02:25	0.11
EasternProperty	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
Ravine	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
SU1	STORAGE	1.88	2.27	383.27	0 06:03	2.27

### 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	28.69	68.84	0 02:25	0.142	3.94	0.007
DurhamRd	OUTFALL	0.00	68.84	0 02:25	0	3.94	0.000
EasternProperty	OUTFALL	82.50	82.50	0 02:25	0.438	0.438	0.000
Ravine	OUTFALL	39.01	39.01	0 02:25	0.238	0.238	0.000
SU1	STORAGE	1283.85	1283.85	0 02:25	6.04	8.98	0.003

### Node Surcharge Summary

*****

No nodes were surcharged.

### Node Flooding Summary

*****

No nodes were flooded.

*****

## Sarah Properties Subdivision – Post Development 25 Year Design Storm Event

### Storage Volume Summary *****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
SU1	6.407	48	0	0	8.141	60	0 06:03	55.63

### ***** Outfall Loading Summary *****

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
DurhamRd	99.86	45.64	68.84	3.938
EasternProperty	60.10	8.42	82.50	0.438
Ravine	62.59	4.39	39.01	0.238
System	74.19	58.45	190.32	4.614

### ***** 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	68.84	0 02:25	1.98	0.00	0.11
OR1	ORIFICE	55.63	0 06:03			1.00

### ***** Flow Classification Summary *****

Conduit	Adjusted /Actual Length	----- Up Dry	Down Dry	Fraction of Time in Flow Class Sub Dry Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C1	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.01

### ***** Conduit Surcharge Summary *****

No conduits were surcharged.

Analysis begun on: Wed Feb 19 10:00:34 2020  
Analysis ended on: Wed Feb 19 10:00:34 2020  
Total elapsed time: < 1 sec

# Sarah Properties Subdivision – Post Development 50 Year Design Storm Event

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

*****

Element Count

*****

Number of rain gages ..... 6  
 Number of subcatchments ... 5  
 Number of nodes ..... 5  
 Number of links ..... 2  
 Number of pollutants ..... 0  
 Number of land uses ..... 0

*****

Raingage Summary

*****

Name	Data Source	Data Type	Recording Interval
SCS_6h_25mm	SCS_6h_25mm	INTENSITY	5 min.
SCS_6h_38.8mm_2yr	SCS_6h_38.8mm_2yr	INTENSITY	5 min.
SCS_6h_49.4mm_5yr	SCS_6h_49.4mm_5yr	INTENSITY	5 min.
SCS_6h_65.3mm_25yr	SCS_6h_65.3mm_25yr	INTENSITY	5 min.
SCS_6h_71.9mm_50yr	SCS_6h_71.9mm_50yr	INTENSITY	5 min.
SCS_6h_78.4mm_100yr	SCS_6h_78.4mm_100yr	INTENSITY	5 min.

*****

Subcatchment Summary

*****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
201	11.47	3500.00	64.50	4.0000	SCS_6h_71.9mm_50yr	SU1
202	0.72	200.00	18.70	2.0000	SCS_6h_71.9mm_50yr	Ravine
203	0.17	20.00	55.30	4.0000	SCS_6h_71.9mm_50yr	J1
204	0.12	20.00	55.00	4.0000	SCS_6h_71.9mm_50yr	J1
205	1.30	320.00	17.30	8.0000	SCS_6h_71.9mm_50yr	EasternProperty

*****

Node Summary

*****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	380.50	1.00	0.0	
DurhamRd	OUTFALL	380.00	1.00	0.0	
EasternProperty	OUTFALL	0.00	0.00	0.0	
Ravine	OUTFALL	0.00	0.00	0.0	
SU1	STORAGE	381.00	3.30	0.0	

*****

Link Summary

*****

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J1	DurhamRd	CONDUIT	14.2	3.5184	0.0130
OR1	SU1	J1	ORIFICE			

*****

Cross Section Summary

*****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	TRIANGULAR	1.00	3.00	0.47	6.00	1	26329.00

## Sarah Properties Subdivision – Post Development 50 Year Design Storm Event

*****  
 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 ..... 02/10/2020 00:00:00  
 Ending Date ..... 02/11/2020 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 .....	0.991	71.911
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.226	16.389
Surface Runoff .....	0.765	55.510
Final Storage .....	0.001	0.049
Continuity Error (%) .....	-0.052	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.765	7.652
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.498	4.982
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.294	2.937
Final Stored Volume .....	0.561	5.608
Continuity Error (%) .....	0.000	

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

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

*****

## Sarah Properties Subdivision – Post Development 50 Year Design Storm Event

### 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	71.91	0.00	0.00	13.32	58.59	6.72	1434.07	0.815
202	71.91	0.00	0.00	34.28	37.56	0.27	45.80	0.522
203	71.91	0.00	0.00	16.66	55.25	0.09	18.62	0.768
204	71.91	0.00	0.00	16.71	55.20	0.07	13.68	0.768
205	71.91	0.00	0.00	33.45	38.42	0.50	96.50	0.534

### 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	0.09	0.11	380.61	0 02:25	0.11
DurhamRd	OUTFALL	0.09	0.11	380.11	0 02:25	0.11
EasternProperty	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
Ravine	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
SU1	STORAGE	1.98	2.40	383.40	0 06:03	2.40

### Node Inflow Summary

*****

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	32.30	74.75	0 02:25	0.159	4.21	0.007
DurhamRd	OUTFALL	0.00	74.75	0 02:25	0	4.21	0.000
EasternProperty	OUTFALL	96.50	96.50	0 02:25	0.5	0.5	0.000
Ravine	OUTFALL	45.80	45.80	0 02:25	0.272	0.272	0.000
SU1	STORAGE	1434.07	1434.07	0 02:25	6.72	9.66	0.003

### Node Surcharge Summary

*****

No nodes were surcharged.

### Node Flooding Summary

*****

No nodes were flooded.

*****

## Sarah Properties Subdivision – Post Development 50 Year Design Storm Event

### Storage Volume Summary

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
SU1	6.893	51	0	0	8.772	65	0 06:03	58.64

### Outfall Loading Summary

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
DurhamRd	99.87	48.80	74.75	4.211
EasternProperty	60.09	9.61	96.50	0.500
Ravine	62.57	5.02	45.80	0.272
System	74.18	63.43	217.01	4.982

### 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	74.75	0 02:25	2.03	0.00	0.11
OR1	ORIFICE	58.64	0 06:03			1.00

### Flow Classification Summary

Conduit	Adjusted /Actual Length	----- Up Dry		Down Dry		Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C1	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00

### Conduit Surcharge Summary

No conduits were surcharged.

Analysis begun on: Wed Feb 19 10:01:09 2020  
 Analysis ended on: Wed Feb 19 10:01:09 2020  
 Total elapsed time: < 1 sec



# Sarah Properties Subdivision – Post Development 100 Year Design Storm Event

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

*****

Element Count

*****

Number of rain gages ..... 6  
 Number of subcatchments ... 5  
 Number of nodes ..... 5  
 Number of links ..... 2  
 Number of pollutants ..... 0  
 Number of land uses ..... 0

*****

Raingage Summary

*****

Name	Data Source	Data Type	Recording Interval
SCS_6h_25mm	SCS_6h_25mm	INTENSITY	5 min.
SCS_6h_38.8mm_2yr	SCS_6h_38.8mm_2yr	INTENSITY	5 min.
SCS_6h_49.4mm_5yr	SCS_6h_49.4mm_5yr	INTENSITY	5 min.
SCS_6h_65.3mm_25yr	SCS_6h_65.3mm_25yr	INTENSITY	5 min.
SCS_6h_71.9mm_50yr	SCS_6h_71.9mm_50yr	INTENSITY	5 min.
SCS_6h_78.4mm_100yr	SCS_6h_78.4mm_100yr	INTENSITY	5 min.

*****

Subcatchment Summary

*****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
201	11.47	3500.00	64.50	4.0000	SCS_6h_78.4mm_100yr	SU1
202	0.72	200.00	18.70	2.0000	SCS_6h_78.4mm_100yr	Ravine
203	0.17	20.00	55.30	4.0000	SCS_6h_78.4mm_100yr	J1
204	0.12	20.00	55.00	4.0000	SCS_6h_78.4mm_100yr	J1
205	1.30	320.00	17.30	8.0000	SCS_6h_78.4mm_100yr	EasternProperty

*****

Node Summary

*****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	380.50	1.00	0.0	
DurhamRd	OUTFALL	380.00	1.00	0.0	
EasternProperty	OUTFALL	0.00	0.00	0.0	
Ravine	OUTFALL	0.00	0.00	0.0	
SU1	STORAGE	381.00	3.30	0.0	

*****

Link Summary

*****

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J1	DurhamRd	CONDUIT	14.2	3.5184	0.0130
OR1	SU1	J1	ORIFICE			

*****

Cross Section Summary

*****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	TRIANGULAR	1.00	3.00	0.47	6.00	1	26329.00

## Sarah Properties Subdivision – Post Development 100 Year Design Storm Event

*****  
 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 ..... 02/10/2020 00:00:00  
 Ending Date ..... 02/11/2020 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 .....	1.081	78.413
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.236	17.151
Surface Runoff .....	0.844	61.252
Final Storage .....	0.001	0.049
Continuity Error (%) .....	-0.050	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.844	8.444
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.533	5.334
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.294	2.937
Final Stored Volume .....	0.605	6.047
Continuity Error (%) .....	0.000	

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

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

*****

## Sarah Properties Subdivision – Post Development 100 Year Design Storm Event

### 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	78.41	0.00	0.00	13.92	64.49	7.40	1583.73	0.822
202	78.41	0.00	0.00	36.05	42.29	0.31	52.87	0.539
203	78.41	0.00	0.00	17.40	61.02	0.10	20.72	0.778
204	78.41	0.00	0.00	17.45	60.96	0.07	15.21	0.777
205	78.41	0.00	0.00	35.06	43.31	0.56	110.92	0.552

### 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	0.10	0.11	380.61	0 02:25	0.11
DurhamRd	OUTFALL	0.10	0.11	380.11	0 02:25	0.11
EasternProperty	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
Ravine	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
SU1	STORAGE	2.09	2.53	383.53	0 06:03	2.53

### 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	35.93	80.52	0 02:25	0.175	4.47	0.007
DurhamRd	OUTFALL	0.00	80.52	0 02:25	0	4.46	0.000
EasternProperty	OUTFALL	110.92	110.92	0 02:25	0.563	0.563	0.000
Ravine	OUTFALL	52.87	52.87	0 02:25	0.306	0.306	0.000
SU1	STORAGE	1583.73	1583.73	0 02:25	7.4	10.3	0.003

### Node Surcharge Summary

*****

No nodes were surcharged.

### Node Flooding Summary

*****

No nodes were flooded.

*****

## Sarah Properties Subdivision – Post Development 100 Year Design Storm Event

### Storage Volume Summary

*****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
SU1	7.384	55	0	0	9.404	70	0 06:03	61.43

*****

### Outfall Loading Summary

*****

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
DurhamRd	99.87	51.74	80.52	4.465
EasternProperty	60.33	10.80	110.92	0.563
Ravine	62.46	5.66	52.87	0.306
System	74.22	68.20	244.27	5.334

*****

### 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	80.52	0 02:25	2.06	0.00	0.11
OR1	ORIFICE	61.43	0 06:03			1.00

*****

### Flow Classification Summary

*****

Conduit	Adjusted /Actual Length	----- Up Dry		Down Dry		Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C1	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.01	0.00

*****

### Conduit Surge Summary

*****

No conduits were surcharged.

Analysis begun on: Wed Feb 19 10:01:38 2020

Analysis ended on: Wed Feb 19 10:01:38 2020

Total elapsed time: < 1 sec

# Sarah Properties Subdivision – Post Development 25mm Water Quality Storm Event

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

*****

Element Count

*****

Number of rain gages ..... 6  
 Number of subcatchments ... 5  
 Number of nodes ..... 5  
 Number of links ..... 2  
 Number of pollutants ..... 0  
 Number of land uses ..... 0

*****

Raingage Summary

*****

Name	Data Source	Data Type	Recording Interval
SCS_6h_25mm	SCS_6h_25mm	INTENSITY	5 min.
SCS_6h_38.8mm_2yr	SCS_6h_38.8mm_2yr	INTENSITY	5 min.
SCS_6h_49.4mm_5yr	SCS_6h_49.4mm_5yr	INTENSITY	5 min.
SCS_6h_65.3mm_25yr	SCS_6h_65.3mm_25yr	INTENSITY	5 min.
SCS_6h_71.9mm_50yr	SCS_6h_71.9mm_50yr	INTENSITY	5 min.
SCS_6h_78.4mm_100yr	SCS_6h_78.4mm_100yr	INTENSITY	5 min.

*****

Subcatchment Summary

*****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
201	11.47	3500.00	64.50	4.0000	SCS_6h_25mm	SU1
202	0.72	200.00	18.70	2.0000	SCS_6h_25mm	Ravine
203	0.17	20.00	55.30	4.0000	SCS_6h_25mm	J1
204	0.12	20.00	55.00	4.0000	SCS_6h_25mm	J1
205	1.30	320.00	17.30	8.0000	SCS_6h_25mm	EasternProperty

*****

Node Summary

*****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	380.50	1.00	0.0	
DurhamRd	OUTFALL	380.00	1.00	0.0	
EasternProperty	OUTFALL	0.00	0.00	0.0	
Ravine	OUTFALL	0.00	0.00	0.0	
SU1	STORAGE	381.00	3.30	0.0	

*****

Link Summary

*****

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J1	DurhamRd	CONDUIT	14.2	3.5184	0.0130
OR1	SU1	J1	ORIFICE			

*****

Cross Section Summary

*****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	TRIANGULAR	1.00	3.00	0.47	6.00	1	26329.00

## Sarah Properties Subdivision – Post Development 25mm Water Quality Storm Event

*****  
 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 ..... 02/10/2020 00:00:00  
 Ending Date ..... 02/11/2020 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 .....	0.345	25.004
Evaporation Loss .....	0.000	0.000
Infiltration Loss .....	0.112	8.160
Surface Runoff .....	0.232	16.814
Final Storage .....	0.001	0.049
Continuity Error (%) .....	-0.074	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
*****	-----	-----
Dry Weather Inflow .....	0.000	0.000
Wet Weather Inflow .....	0.232	2.318
Groundwater Inflow .....	0.000	0.000
RDII Inflow .....	0.000	0.000
External Inflow .....	0.000	0.000
External Outflow .....	0.194	1.939
Flooding Loss .....	0.000	0.000
Evaporation Loss .....	0.000	0.000
Exfiltration Loss .....	0.000	0.000
Initial Stored Volume ....	0.294	2.937
Final Stored Volume .....	0.332	3.316
Continuity Error (%) .....	-0.001	

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

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

*****

## Sarah Properties Subdivision – Post Development 25mm Water Quality Storm Event

### 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	25.00	0.00	0.00	6.73	18.25	2.09	429.19	0.730
202	25.00	0.00	0.00	16.21	8.72	0.06	8.80	0.349
203	25.00	0.00	0.00	8.41	16.56	0.03	5.27	0.662
204	25.00	0.00	0.00	8.46	16.51	0.02	3.84	0.660
205	25.00	0.00	0.00	16.23	8.72	0.11	17.18	0.349

### 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	0.07	0.08	380.58	0 05:25	0.08
DurhamRd	OUTFALL	0.07	0.08	380.08	0 05:25	0.08
EasternProperty	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
Ravine	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
SU1	STORAGE	1.25	1.45	382.45	0 05:41	1.45

### 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	9.11	32.10	0 05:25	0.0475	1.76	0.006
DurhamRd	OUTFALL	0.00	32.10	0 05:25	0	1.76	0.000
EasternProperty	OUTFALL	17.18	17.18	0 02:25	0.113	0.113	0.000
Ravine	OUTFALL	8.80	8.80	0 02:25	0.063	0.063	0.000
SU1	STORAGE	429.19	429.19	0 02:25	2.09	5.03	0.001

### Node Surcharge Summary

*****

No nodes were surcharged.

### Node Flooding Summary

*****

No nodes were flooded.

*****

## Sarah Properties Subdivision – Post Development 25mm Water Quality Storm Event

### Storage Volume Summary

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
SU1	3.859	29	0	0	4.589	34	0 05:41	30.96

### Outfall Loading Summary

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
DurhamRd	99.75	20.45	32.10	1.762
EasternProperty	57.27	2.28	17.18	0.113
Ravine	59.73	1.21	8.80	0.063
System	72.25	23.94	56.78	1.939

### Link Flow Summary

Link	Type	Maximum  Flow  LPS	Time of Max Occurrence days hr:min	Maximum  Veloc  m/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	32.10	0 05:25	1.64	0.00	0.08
OR1	ORIFICE	30.96	0 05:41			1.00

### Flow Classification Summary

Conduit	Adjusted /Actual Length	----- Up Dry		Down Dry		Sub Crit		Sup Crit		Fraction of Time in Flow Class ----- Up Down Norm Inlet	
C1	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00

### Conduit Surcharge Summary

No conduits were surcharged.

Analysis begun on: Wed Feb 19 10:02:10 2020  
 Analysis ended on: Wed Feb 19 10:02:10 2020  
 Total elapsed time: < 1 sec



# Appendix F

**FOREBAY SIZING**

**STORMWATER MANAGEMENT REPORT**

**SARAH PROPERTIES DURHAM SUBDIVISION  
MUNICIPALITY OF WEST GREY**



## Forebay Sizing

### Settling

Dist	$\sqrt{rQ/V}$	r = length to w ratio	r=	8.75
	= 18.3	Q = peak outflow for quality storm	Q=	0.0115
		V=settling velocity fo 0.15mm particles (m/s)	V=	0.0003

### Dispersion Length

Dist	$8Q/dv$	Q= 5 yr inlet flow (m3/s)	Q=	0.931
	= 14.9	d = depth of permanent pool in forebay (m)	d=	1
		v = desired velocity in forebay (m/s)	v=	0.5

### Velocity

Vel	$Q/A$	Q= 5 yr inlet flow (m3/s)	Q=	0.931
	= 0.155	A=cross sectional area (m2)	A=	6
		Target Velocity = 0.15	Vtarg=	0.15

### Minimum Width

width	$dist/8$
=	2.3