FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

LEITH - BAYSHORE ROAD

MUNICIPALITY OF MEAFORD
GREY COUNTY

PREPARED FOR:

DON & DAPHNE MCCULLOGH

PREPARED BY:

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NOVEMBER 2021

CFCA FILE NO. 903-3780

CROZIER &ASSOCIATES
Consulting Engineers

Revision Number	Date	Comments
Rev. 0	July 28, 2020	Issued for Client Review
Rev. 1	September 9, 2020	Issued for 1st Submission
Rev. 2	November 19, 2021	Issued for 2nd Submission

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1.0 INTRODUCTION

C.F. Crozier & Associates Inc. (Crozier) was retained by Don and Daphne McCullough (the proponent) to prepare a Functional Servicing & Stormwater Management Report to support the Severance Application to create five (5) new lots in the Municipality of Meaford, County of Grey. The 4.97 ha property is bound by Bayshore Road to the west, Sideroad 23 to the south, and rural residential land uses to the east and north. Figure 1 illustrates the Site Location.

2.0 BACKGROUND

The proponent owns a parcel of land that fronts onto Bayshore Road north of the Village of Leith (ROLL # 42-10510-004-07110-000); however, there is currently no vehicle access to this property from Bayshore Road. Based on consultations with the Municipality and Grey Sauble Conservation Authority (GSCA) it was deemed to be unreasonable and infeasible to pursue the required approvals and permits for driveway access from Bayshore Road due to the slope feature along the frontage of the Site which takes up approximately 0.58 ha.

To the south and west of the proponent's property, there was an existing unopened municipal road allowance that is connected to 23rd Sideroad. In December 2014 the proponent applied for permission from the Municipality to use this unopened road allowance to access their property, and in the summer of 2015, the Municipality authorized the potential sale of this road allowance through a severance application. The proponent purchased the full 20m road allowance fronting their property (approximately 275m) and a 10m portion from the southern limit of the property to Side Road 23 (approximately 140m) for the potential future construction of a permanent driveway to their property. In support of this application, our office provided input on the required engineering issues associated with this driveway and its associated design constraints.

Following the severance and sale of the road allowance, our office issued a Terms of Reference (TOR) to the Municipality of Meaford to outline the scope of work required to sever the parcel into five (5) lots. The approved TOR included the preparation of a Grading and Drainage Plan for the proposed lots, which detail the on-site services (i.e. well and septic), proposed driveway alignment, high-level grading, and stormwater management (SWM) strategies for the site.

A Scoped Environmental Impact Study (EIS) was prepared by our office to assess the impacts of the proposed development on the natural heritage features and functions and to recommend any warranted mitigation measures. The results of this study was used to prepare the Development Concept, refer to Figure 2.

3.0 EXISTING SITE CONDITIONS

The existing site conditions are outlined in the following sections and provide an overview of the land uses, pre-development drainage conditions, groundwater, and soil conditions affecting stormwater management and septic servicing.

3.1 Pre-Development Hydrology

The existing topographic survey prepared by Van Harten Surveying and Engineering (dated February 2019) and available aerial photography were used to determine the hydrologic parameters for the site. We have outlined the runoff coefficients and associated catchment areas for pre-development conditions in Table 1 below.

Table 1: Pre-Development Catchment Areas and Runoff Coefficients

Catchment Area	Pervious Area (ha) (RC = 0.25)	Impervious Area (ha) (RC = 0.90)	Total Area (ha)	Weighted Runoff Coefficient
101	0.43	0.00	0.43	0.25
102	0.78	0.00	0.78	0.25
103	2.43	0.00	2.43	0.25
104	0.67	0.00	0.67	0.25
105	0.08	0.00	0.08	0.25
Total	**4.39**	**0.00**	**4.39**	**0.25**

The site is completely pervious under existing conditions with a runoff coefficient of approximately 0.25. The pervious areas consist of meadow vegetation with sparse trees.

3.2 Pre-Development Drainage Conditions

Based on field reconnaissance conducted by Crozier staff and a review of the topographic survey, the site has been divided into five pre-development catchment areas to characterize the existing drainage conditions and outlets. Please refer to Figure 3 for the Pre-Development Drainage Plan.

Catchment 101 is located at the north end of the site and drains towards the north property line where it outlets down the ridge via a defined channel on the neighbouring property. Catchment 102 drains toward Drainage Feature #1 (DF1). A majority of the site is within Catchment 103, which drains via sheet flow toward Drainage Feature #2 (DF2). A portion of Drainage Feature #3 (DF3) runs through Catchment 104, which then combines with another small watercourse from the neighbouring property before outletting over the ridge through the defined channel south of the Subject Site. Catchment 105 is split by Drainage Feature #4 (DF4), which outlets to the roadside ditch on Sideroad 23.

3.3 Stormwater / Drainage Infrastructure

All existing surface drainage on the site is conveyed via sheet flow to its respective drainage outlet. To our knowledge, there is currently no existing stormwater management implemented across any of the subject lands.

4.0 PROPOSED SITE CONDITIONS

The following subsections provide an analysis of the servicing strategy for the proposed sanitary sewage system, potable water supply, and utilities for the proposed residential development.

4.1 Servicing Options Statement

Preliminary design concepts for the site have proposed private septic and well for sanitary and water servicing for each lot. A Servicing Options Statement has been prepared per the Ministry of Environment, Conservation and Parks (MECP) guideline, entitled D-5-3 Servicing Options Statement, to justify the type of proposed services.

4.1.1 Proximity to Municipal Services

Full municipal services are typically the preferred method of servicing for new developments. The location of the proposed residential development is in an unserviced area in the Municipality of Meaford and does not have existing Municipal sanitary sewer within a reasonable distance to the development, as the nearest sewage treatment plant is located in the City of Owen Sound.

Existing residential dwellings adjacent to the Subject Site are serviced via private septic and well and there are no communal services in the general area.

The Municipality of Meaford does have existing Municipal sanitary services. However, the Municipality is large and primarily surrounded by agricultural land with dispersed small communities, which do not have Municipal sanitary services. It is not anticipated that Municipal sanitary services will be introduced to the community, or within the surrounding area at an attainable distance to the proposed development in the upcoming future. We do not anticipate a large amount of development in this area in the near future.

4.1.2 Environmental Suitability

Grey County soils mapping show that the site is comprised of Leith Silty Clay Loam, which is a well-draining soil of Hydrologic Soil Group A. Groundwater monitoring has not been completed for the site at this time and will be required for the individual lot grading plans to establish the maximum elevation of the underside of footing. Ontario well records in the area do not indicate that shallow bedrock is present on site.

The existing topography of the site generally falls from east to west with a ridge at the western limits of the Subject Site. There are three existing drainage channels running from east to west that collect drainage from the site and convey it down the ridge. Proposed grading will direct flows to these existing drainage features.

The development is proposing five (5) lots across the 4.9 ha property. All proposed lots are greater than 7,400 m^2 in area and therefore can support the implementation of private septic and wells for Residential lots with full private services.

4.1.3 Servicing Suitability

Municipal Services

The proposed development is in a relatively undeveloped area consisting of a small residential community and agricultural land. Existing residences in the vicinity of the site are serviced by private septic and wells. There are no active Municipal sewers or watermain within the Leith and the adjacent communities, and large-scale developments near the subject site are not anticipated in the near future. Therefore, municipal services are not a recommended servicing option for this development.

Communal Services

The proposed lots are planned to be developed on an individual basis. Servicing the development with communal services could result in few lots contributing to a septic system sized for the entire development, which is not recommended.

Private Services

The existing residential dwellings near the subject site are serviced via private septic and well. The proposed servicing strategy is consistent with the servicing in the general area and will facilitate a staggered build-out of the five (5) proposed lots. As Municipal services are not readily available and communal services introduce increased maintenance requirements for the Municipality, private services have been proposed as the most feasible approach.

The proposed lots are an acceptable size to host a private septic system and well. Each residence will have individual septic and a well that will be designed and installed on a per-lot basis.

4.2 Post-Development Hydrology

The post-development catchment areas will not alter the pre-development drainage patterns but will include the increased impervious area from the proposed shared private driveway and five (5) proposed homes. Table 2 outlines the runoff coefficients and associated catchment areas for post-development conditions. Refer to the Post-Development Drainage information on Figure 3.

Table 2: Post-Development Catchment Areas and Runoff Coefficients

Catchment Area	**Pervious Area** (ha) (RC = 0.25)	**Impervious Area** (ha) (RC = 0.90)	**Total Area** (ha)	**Weighted Runoff Coefficient**
201	0.43	0.00	0.43	0.25
202	0.71	0.07	0.78	0.31
203	2.28	0.15	2.43	0.29
204	0.59	0.08	0.67	0.33
205	0.03	0.05	0.08	0.66
Total	**4.04**	**0.35**	**4.39**	**0.30**

4.3 Post-Development Drainage Conditions

The Severance application is for five (5) estate residential homes proposed across the site. The post-development drainage conditions will generally mimic the existing drainage patterns. This development will be constructed with a modified rural road section with roadside ditches on either side of the private roadway.

4.3.1 Culvert Design

The proposed culvert crossings have been designed to convey drainage from external properties to the east of the Subject Site, as well as the increased runoff from the proposed private roadway. Upon review of the Ontario Flow Assessment Tool (OFAT) and aerial imaging, it appears that the Subject Site is located just outside the Waterton Creek watershed which made it possible to estimate the total external drainage area that is conveyed through the Site. Based on the available contour mapping, it was estimated that a total of 50.5 ha drain through the Subject Site via the existing drainage features on site, refer to Appendix A for the estimated external catchment areas.

Based on the delineated external catchments, the 100-year peak flow rate was calculated using the Rational Method. Refer to Table 3 below for the peak flow rates for each catchment.

Table 3: External Catchment - Rational Method Calculations

Catchment	Area (ha)	Runoff Coefficient	100-Year Peak Flow Rate (m^3/s)
Ext. #1	16	0.25	0.88
Ext. #2	13	0.25	0.72
Ext. #3	8.8	0.25	0.49
Ext. #4	8	0.25	0.43
Ext. #5	4.25	0.25	0.22

The proposed culverts have been sized to convey drainage from external catchments and the proposed roadway up to and including the peak flow rates during the 100-year storm event. Since overtopping is not anticipated for any of the culvert crossings, safe access to the proposed lots will be provided via the shared private driveway. Refer to Table 4 below for the culvert sizing summary:

Table 4: Culvert Sizing Summary

Culvert Number	Diameter (mm)	Slope	External Catchment	100-Year Peak Flow Rate (m^3/s)	Headwater (m)	Overtopping Depth (m)
Culvert #1	600 (Twin)	1.0%	Ext. #1	0.92	0.82	0
Culvert #2	600 (Twin)	4.4%	Ext. #2	0.79	0.76	0
*Culvert #3	450	4.3%	Ext. #3	0.53	0.25	0
*Culvert #4	450	2.7%	Ext. #3	0.53	0.88	0.07
Culvert #5	600 (Twin)	5.8%	Ext. #4	0.46	0.54	0
Culvert #6	450	0.5%	Ext. #5	0.22	0.65	0

*Culvert #3 and #4 were conservatively modelled using the entire 100-year peak flow rate from Ext. #3, even though it will be divided between Culvert #3 and #4.

Overtopping may occur at Culvert #4 during the 100-year storm event; however, the depth of flooding is less than 0.3m with the resulting maximum velocity being less than 3.0 m/s. Therefore, safe access is provided based on GSCA Hazard Guidelines. Refer to the Culvert Master output files within Appendix A.

The driveway culverts for the proposed lots will be a 400mm diameter culvert, which is in conformance with the Municipality of Meaford's Engineering Standards for rural residential entrances. A 400mm diameter culvert could not be modelled in CulvertMaster; however, to demonstrate that the culverts are sized sufficiently, a 375mm diameter culvert was modelled at minimal slope with the anticipated 100-year peak flow rate to confirm that the proposed size is sufficient.

Refer to Appendix A for the sizing calculations and Culvert Master model output files.

4.3.2 Roadway Ditches & Overland Drainage Channels

Similar to the proposed culvert crossings, the overland flow routes have been sized to convey up to and including the 100-year peak flow rate. A Flow Master model has been prepared to confirm that the roadside ditches and overland drainage channels on site have sufficient capacity.

Refer to Appendix B for the Flow Master model output files.

4.4 Stormwater Management Criteria and Objectives

Stormwater management (SWM) for the proposed development must comply with the policies and standards of various agencies including the Municipality of Meaford and the Ministry of the Environment, Conservation and Parks (MECP). The site is also located within a regulated area of the Grey Sauble Conservation Authority (GSCA).

The recommended stormwater management strategy for the proposed development is included below:

- Water Quantity Control
    - Control of the post-development peak flow rates up to the 100-year storm to the pre-development peak flow rates

- Water Quality Control
    - Provide an Enhanced Level of Protection (80% TSS removal)

- Erosion Control
    - Capture and retain the quality (25mm) storm event on-site and release over 24 hours

Due to the relatively low density of the development, Low Impact Development (LID) strategies have been considered to meet the quantity and quality control requirements for the site.

4.5 Water Quantity Control

To assess the quantity control requirements for the site, modified rational method calculations were completed to determine the minimum storage volumes required to reduce peak flows to pre-development conditions. IDF parameters for the site were determined using Owen Sound IDF Curve Parameters. The characteristics of the site under pre-and post-development conditions and the storage requirements have been summarized in 5. Refer to Appendix C for the modified rational method calculations.

Table 5: Site Drainage Characteristics

Pre-Development					
Characteristic	**101**	**102**	**103**	**104**	**105**
Area (ha)	0.43	0.78	2.43	0.67	0.08
Composite Runoff Coefficient / 100-year Adjusted Runoff Coefficient	0.25/ 0.31	0.25/ 0.31	0.25/ 0.31	0.25/ 0.31	0.25/ 0.31
100-year Peak Flow (m^3/s)	0.07	0.12	0.38	0.11	0.01
Post-Development (Uncontrolled)					
Characteristic	**201**	**202**	**203**	**204**	**205**
Area (ha)	0.43	0.78	2.43	0.67	0.08
Composite Runoff Coefficient / 100-year Adjusted Runoff Coefficient	0.25/ 0.31	0.31/ 0.40	0.29/ 0.36	0.33/ 0.41	0.66/ 0.82
100-year Uncontrolled Peak Flow (m^3/s)	0.07	0.15	0.44	0.14	0.03
Minimum Required Quantity Control Storage Volume (m^3)	0.00	17.1	36.6	19.5	12.5

Per Table 5, approximately 85.7 m^3 of storage is required for Drainage Areas 202 to 205 to control flows to pre-development flow rates.

Infiltration trenches are proposed to provide the required storage based on the modified rational method calculations. Based on the MECP guidelines, infiltration trenches can be implemented for small drainage areas (less than 2 ha) which is consistent with the catchments requiring quantity control.

Table 6 below summarizes the proposed trench dimensions in each catchment and the amount of storage provided. Refer to Appendix C for the trench sizing calculations.

Table 6: Infiltration Trench Characteristics

	Infiltration Trenches			
Characteristic	**Trench #1**	**Trench #2**	**Trench #3**	**Trench #4**
Drainage Catchment	204	204	203	202
Total Length (m)	15.0	15.0	75.0	35
Width (m)	2.0	2.0	3.0	2.0
Depth (m)	1.0	1.0	1.0	1.0
Storage Volume (m^3)	12.0	12.0	90.0	28
Exfiltration (L/s)	0.2	0.2	0.75	0.23
100-Year Drawdown Time – Quantity Control (hrs)	33.33	33.33	33.33	33.33

Per Table 6 above, a total of 142 m^3 of storage is provided which exceeds the minimum requirements to provide quantity control.

4.6 Water Quality Control

Quality control for the site is provided through a treatment train approach consisting of enhanced grass swales and infiltration trenches. Stormwater from the roadways will sheet to the roadside ditches and then be treated via the infiltration trenches before reaching the existing drainage features.

Minimum water quality volumes for the infiltration facilities in catchments 202 to 205 were calculated per MOE Table 3.2 for an enhanced level of protection (i.e. 25 cubic meters per hectare). Table 5 below summarizes the volume to be infiltrated in each catchment.

Table 5: Volume to Infiltrate for Quality Control

	Post-Development Catchment			
Characteristic	**202**	**203**	**204**	**205**
Catchment Area (ha)	0.78	2.43	0.67	0.08
Storage Volume Required (m^3)	19.5	60.8	16.8	2.8
Storage Volume Provided (m^3)	28.0	90.0	24.0	0
Drawdown Time – Quality (hrs)	23.21	22.50	23.26	N/A

Infiltration trenches will retain the quality event and will infiltrate the volume within 24 hours, as demonstrated in the infiltration trench calculations in Appendix D.

As shown in Table 5 above, the proposed infiltration trenches provide more than the minimum storage volumes to meet quality control requirements. Due to the limited space within the 10m Right-of-Way in catchment 205, an infiltration trench is not practical to install. However, since catchment 205 represents a very small catchment (0.08 ha in size) and has the opportunity to flow over grassed ditches on Side Road 23 and Bayshore Road before reaching the ultimate receiver (Georgian Bay) no further quality control measures are required.

Due to the existing grades within the proposed lots, runoff from the driveways will not drain towards the private roadway and may require separate storage for quality control only. The size and location of the driveways will be determined during the Building Permit stage. Since the proposed lots are large, runoff from the proposed lots will have an opportunity to flow over grassed swales before leaving the site, which should provide sufficient quality controls. If additional quality controls are required at the lot level, these will be addressed in the individual Building Permit applications.

5.0 INDIVIDUAL LOT SERVICING

5.1 Septic System

All lots located within the development will be serviced with private septic systems. The details, size and locations of the septic systems will ultimately be determined once individual house designs and building permit applications are prepared. However, it is assumed that the five (5) lots will be developed into estate homes with the following features:

- 3,500 square feet (325 square meters);
- Five (5) bedrooms;
- Four (4) three-piece bathrooms; and
- 35 total fixture units.

Per the Ontario Building Code (OBC) Table 8.2.1.3.(1) the design flow for each lot would be 3,800 L/day. For residential uses, Section 8.2.2.3.(1)(a.) of the OBC states that a septic tank shall be sized for twice the daily design sewage flow which would require a 7,600 L (minimum) septic tank for each lot. Refer to Appendix E for the full calculations.

At the time this report is being prepared, there have been no geotechnical investigations on-site to determine the soil characteristics. However, based on the Grey County Soils Mapping the site is comprised entirely of Leith Silty Clay Loam (Les) which has moderate infiltration. To be conservative we have assumed a Percolation Time (T-Time) of 50 minutes/centimetre.

The individual lot design and preliminary site grading have conservatively allowed a larger footprint area of 633 m^2 for a conventional raised filter bed and minimum setback requirements. Refer to DWG C101 for the Master Drainage & Servicing Plan.

5.2 Potable Water Supply

The site is situated in an area that uses individual domestic wells for groundwater supply. Well records indicate that local wells yield sufficient supply for single-family residences. Refer to the Well Record in Appendix F. The record demonstrates that proposed wells will be sustainable and will meet the OBC and MECP requirements. Therefore, it is proposed to have private drilled wells for water supply to each lot.

Refer to DWG C101 for the Master Drainage & Servicing Plan. Well locations will be determined at the time of site-specific design. The proposed drilled wells must maintain a 15 m separation from existing and proposed septic systems. Well design will be undertaken during detailed design. If wells are dug, a 30 m separation must be maintained from existing and proposed septic systems.

6.0 ROADWAY AND GRADING

Access to the five (5) lots will be provided via a connection to Sideroad 23 through the unopened Municipal road allowance. The portion of the road allowance is 10 m wide south of Lot 5 and then widens to 20 m along Lots 1 – 5. The connection at Sideroad 23 will be made with a shared private driveway.

The 10 m wide shared private driveway will include the following parameters:

- 4 m super-elevated driveway with 2% cross fall
- 1.0 m granular shoulders
- Ditching on the east side of the driveway
- Pre-cast retaining wall at the entrance from Sideroad 23

Along Lots 1 – 5, where the road allowance widens to 20 m, the shared private driveway will include the following parameters:

- 4.0 m crowned driveway with 2% cross fall
- 1.0 m granular shoulders
- Ditching on either side of the shared private driveway
- Infiltration trenches for stormwater management

Detailed grading has been prepared for the proposed shared private driveway on DWG C101.

7.0 UTILITIES

Utility providers will be contacted once the severance application has been approved and building designs are confirmed for the lots. The residences located around the perimeter of the site are serviced by propane tanks and overhead hydro and telephone lines along Bayshore Road.

Our office has reached out to Hydro One and confirmed that the proposed development can be serviced using the available infrastructure located on Side Road 23 and Bayshore Road. At this stage, Hydro One has suggested that an underground utility trench would be extended to the lots via the proposed shared private driveway.

8.0 EROSION & SEDIMENT CONTROLS

Erosion and sediment controls will be installed before beginning any construction activities. They will be maintained until the site is stabilized or as directed by the Site Engineer and/or the Municipality of Meaford. The Preliminary Erosion & Sediment Control Plan (DWG C104) identifies the location of the recommended controls. Controls will be inspected after each significant rainfall event and maintained in proper working condition. The following erosion and sediment controls will be included during construction on the site:

Heavy Duty Silt Fencing

Silt fencing will be installed on the perimeter of the site to intercept sheet flow. Additional silt fence may be added based on field decisions by the Site Engineer and Owner, before, during and after construction.

Rock Mud Mat

A rock mud mat will be installed at the entrance to the construction zone to prevent mud tracking from the site onto surrounding lands and the perimeter roadway network. All construction traffic will be restricted to this access only.

Flow Check Dams

Temporary straw bale and rock check dams will be installed within the onsite swales and overland flow outlets. The check dams are intended to reduce flow velocity thereby reducing the erosion of the outlet channel and promote settling of sediment from the runoff. Locations of the straw bale and rock check dams are shown in DWG C104. The need for additional flow check dams will be based on the field condition at the discretion of the Engineer and Owners and implemented as necessary.

9.0 CONCLUSIONS & RECOMMENDATIONS

It is concluded that the proposed development can readily meet the servicing and stormwater management objectives of the Municipality and the MECP with the proposed servicing, grading and stormwater management scheme as outlined in this report. As such, we support the Severance Application for the subject lands. Should you have any questions regarding the enclosed material, please do not hesitate to contact the undersigned.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.

George Cooper, P.Eng.
Project Engineer

C.F. CROZIER & ASSOCIATES INC.

Rebecca Alexander, P. Eng.
Project Manager

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APPENDIX A

Culvert Sizing Calculations

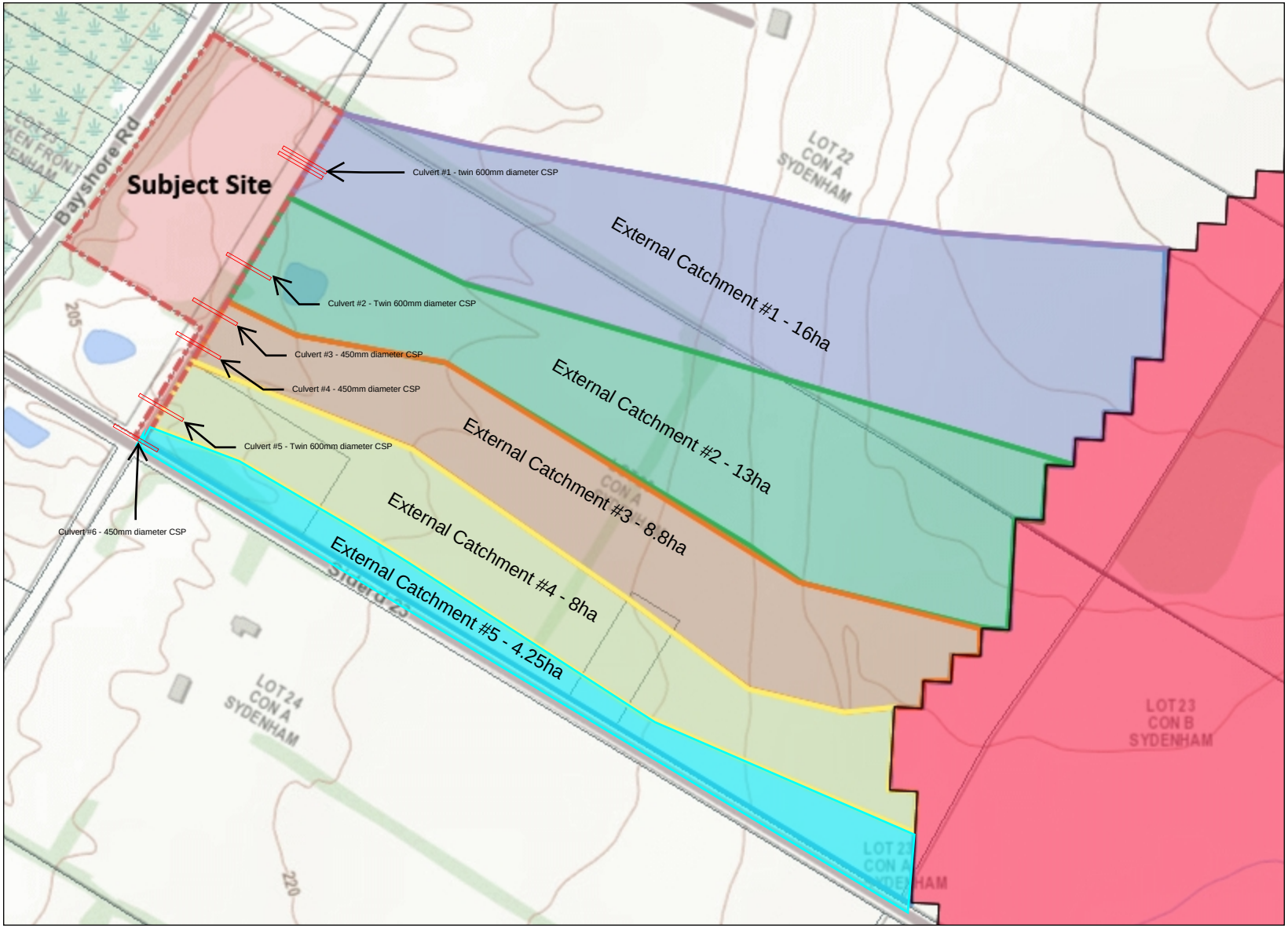
Ontario

MINISTRY OF NATURAL RESOURCES AND FORESTRY

Ontario Flow Assessment Tools

External Drainage Catchments - Topography

Notes:



Legend

- Assessment Parcel
- Secondary Watershed
- Tertiary Watershed
- Quaternary Watershed
- Great Lakes - St. Lawrence Basin
- Hudson - James Bay Basin
- Nelson River Basin
- Diversions
- Waterbody Outlet
- Conservation Authority Dam
- Provincial Dam
- Federal Dam
- OPG Dam
- Other Dam
- HYDAT Gauge
- HYDAT Gauge (RHBN)
- Virtual Flow Segment

Land Cover Compilation

- Other
- Cloud/Shadow
- Clear Open Water
- Turbid Water
- Shoreline
- Mudflats
- Marsh
- Swamp
- Fen
- Bog
- Heath
- Sparse Treed
- Treed Upland
- Deciduous Treed
- Mixed Treed
- Coniferous Treed
- Plantations - Treed Cultivated
- Hedge Rows
- Disturbance
- Open Cliff and Talus
- Alvar
- Sand Barren and Dune
- Open Tallgrass Prairie
- Tallgrass Savannah
- Tallgrass Woodland
- Sand/Gravel/Mine Tailings/Extraction
- Bedrock
- Community/Infrastructure
- Agriculture and Undifferentiated Rural Land Use

0.3 0 km 0.16 0.3

Scale: 1 : 6,422

Projection: Web Mercator

Time of Concentration Calculations

External Catchment - 1

Drainage Area:	16	ha
RC:	0.25	
Upsteam Elevation:	245	
Downsteam Elevation:	212.6	
Distance:	920	m

Time to Peak Inputs				Airport
Flow Path Description	Length (m)	Drop (m)	Slope (%)	Tc (hr)
Sheet	100	3.5	3.52%	0.92
Channel	820	28.9	3.52%	

External Catchment - 2

Drainage Area:	13	ha
RC:	0.25	
Upsteam Elevation:	240	
Downsteam Elevation:	209.7	
Distance:	890	m

Time to Peak Inputs				Airport
Flow Path Description	Length (m)	Drop (m)	Slope (%)	Tc (hr)
Sheet	100	3.4	3.40%	0.92
Channel	790	26.9	3.40%	

External Catchment - 3

Drainage Area:	8.8	ha
RC:	0.25	
Upsteam Elevation:	238	
Downsteam Elevation:	208.4	
Distance:	880	m

Time to Peak Inputs				Airport
Flow Path Description	Length (m)	Drop (m)	Slope (%)	Tc (hr)
Sheet	100	3.4	3.36%	0.92
Channel	780	26.2	3.36%	

External Catchment - 4

Drainage Area:	8	ha
RC:	0.25	
Upsteam Elevation:	235	
Downsteam Elevation:	206.6	
Distance:	910	m

Time to Peak Inputs				Airport
Flow Path Description	Length (m)	Drop (m)	Slope (%)	Tc (hr)
Sheet	100	3.1	3.12%	0.96
Channel	810	25.3	3.12%	

External Catchment - 5

Drainage Area:	4.25	ha
RC:	0.25	
Upsteam Elevation:	233	
Downsteam Elevation:	205.3	
Distance:	950	m

Time to Peak Inputs				Airport
Flow Path Description	Length (m)	Drop (m)	Slope (%)	Tc (hr)
Sheet	100	2.9	2.92%	1.00
Channel	850	24.8	2.92%	

LEITH - BAYSHORE ROAD - RATIONAL METHOD CALCULATIONS

CROZIER CONSULTING ENGINEERS

FREQUENCY **100 YEARS - Owen Sound IDF**
Coef. A= 47.7 **Coef. B= -0.738**

PROJECT: Leith-Bayshore
PROJECT No.: 903-3780
DATE: 11/19/2021
Design: GC

MANNINGS " 0.024

Culvert #	Catchments	AREA (A) Ha	RUN-OFF COEFF	A x C	Cummul. A x C	TIME OF CONC. min	I mm/hr	Qcummulative L/s
Culvert 1 (Twin)	EXT - 1	16.00	0.31	6.25	6.250	55	50.54	**878.16**
	Road Drainage	0.15	0.56	0.11	0.105	15.00	132.69	**38.91**
	TOTAL							**917.06**
Culvert 2	EXT - 2	13.00	0.31	5.08	5.078	55	50.74	**716.35**
	Road Drainage	0.28	0.56	0.20	0.197	15.00	132.69	**72.62**
	TOTAL							**788.98**
Culvert 3 & Culvert 4	EXT - 3	8.80	0.31	3.44	3.438	55	50.81	**485.51**
	Road Drainage	0.16	0.65	0.13	0.130	15.00	132.69	**47.95**
	TOTAL							**533.47**
Culvert 5	EXT - 4	8.00	0.31	3.13	3.125	57	49.27	**428.07**
	Road Drainage	0.08	0.83	0.08	0.083	15.00	132.69	**30.43**
	TOTAL							**458.50**
Culvert 6	EXT - 5	4.25	0.31	1.66	1.660	60.00	47.70	**220.16**

Culvert Analysis Report
Culvert-1
Culvert #1

Culvert Summary					
Computed Headwater Eleva	213.51	m	Discharge	0.9171	m³/s
Inlet Control HW Elev.	213.48	m	Tailwater Elevation	N/A	m
Outlet Control HW Elev.	213.51	m	Control Type	Outlet Control	
Headwater Depth/Height	1.35				

Grades					
Upstream Invert	212.69	m	Downstream Invert	212.56	m
Length	11.30	m	Constructed Slope	0.011504	m/m

Hydraulic Profile					
Profile	M2		Depth, Downstream	0.44	m
Slope Type	Mild		Normal Depth	N/A	m
Flow Regime	Subcritical		Critical Depth	0.44	m
Velocity Downstream	2.02	m/s	Critical Slope	0.022748	m/m

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	0.61	m
Section Size	600 mm		Rise	0.61	m
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	213.51	m	Upstream Velocity Head	0.13	m
Ke	0.90		Entrance Loss	0.12	m

Inlet Control Properties					
Inlet Control HW Elev.	213.48	m	Flow Control	N/A	
Inlet Type	Projecting		Area Full	0.6	m²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Analysis Report
Culvert-1
Culvert #2

Culvert Summary					
Computed Headwater Eleva	210.89	m	Discharge	0.7900	m³/s
Inlet Control HW Elev.	210.82	m	Tailwater Elevation	N/A	m
Outlet Control HW Elev.	210.89	m	Control Type	Entrance Control	
Headwater Depth/Height	1.24				

Grades					
Upstream Invert	210.13	m	Downstream Invert	209.54	m
Length	13.30	m	Constructed Slope	0.044361	m/m

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.32	m
Slope Type	Steep		Normal Depth	0.32	m
Flow Regime	Supercritical		Critical Depth	0.41	m
Velocity Downstream	2.55	m/s	Critical Slope	0.020583	m/m

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	0.61	m
Section Size	600 mm		Rise	0.61	m
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	210.89	m	Upstream Velocity Head	0.18	m
Ke	0.90		Entrance Loss	0.16	m

Inlet Control Properties					
Inlet Control HW Elev.	210.82	m	Flow Control	N/A	
Inlet Type	Projecting		Area Full	0.6	m²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Analysis Report
Culvert-1
Culvert #3

Culvert Summary					
Computed Headwater Eleva	N/A	m	Discharge	0.0000	m³/s
Inlet Control HW Elev.	N/A	m	Tailwater Elevation	N/A	m
Outlet Control HW Elev.	N/A	m	Control Type	Inlet Control	
Headwater Depth/Height	0.00				

Grades					
Upstream Invert	209.09	m	Downstream Invert	208.57	m
Length	11.80	m	Constructed Slope	0.044068	m/m

Hydraulic Profile					
Profile	Dry		Depth, Downstream	0.00	m
Slope Type	Dry		Normal Depth	0.00	m
Flow Regime	Subcritical		Critical Depth	0.00	m
Velocity Downstream	0.00	m/s	Critical Slope	0.000000	m/m

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	0.46	m
Section Size	450 mm		Rise	0.46	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	N/A	m	Upstream Velocity Head	0.00	m
Ke	0.90		Entrance Loss	101.06	m

Inlet Control Properties					
Inlet Control HW Elev.	N/A	m	Flow Control	N/A	
Inlet Type	Projecting		Area Full	0.2	m²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Analysis Report
Culvert-2
Culvert #4

Culvert Summary					
Computed Headwater Elev	209.08	m	Discharge	0.3083	m³/s
Inlet Control HW Elev.	209.08	m	Tailwater Elevation	N/A	m
Outlet Control HW Elev.	209.02	m	Control Type	Inlet Control	
Headwater Depth/Height	1.93				

Grades					
Upstream Invert	208.20	m	Downstream Invert	208.00	m
Length	7.30	m	Constructed Slope	0.027397	m/m

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	0.39	m
Slope Type	Mild		Normal Depth	N/A	m
Flow Regime	Subcritical		Critical Depth	0.39	m
Velocity Downstream	2.09	m/s	Critical Slope	0.034916	m/m

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	0.46	m
Section Size	450 mm		Rise	0.46	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	209.02	m	Upstream Velocity Head	0.18	m
Ke	0.90		Entrance Loss	0.16	m

Inlet Control Properties					
Inlet Control HW Elev.	209.08	m	Flow Control	N/A	
Inlet Type	Projecting		Area Full	0.2	m²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Analysis Report
Weir
Culvert #4 - Overtopping

Hydraulic Component(s): Roadway

Discharge	0.2223	m³/s	Allowable HW Elevation	209.08	m
Roadway Width	6.00	m	Overtopping Coefficient	1.40	SI
Low Point	209.00	m	Headwater Elevation	209.08	m
Discharge Coefficient (Cr)	2.54		Submergence Factor (Kt)	1.00	
Tailwater Elevation	-3,047.70	m			

Sta (m)	Elev. (m)
120.00	209.44
125.00	209.24
130.00	209.10
135.00	209.02
138.13	209.00
140.00	209.01
145.00	209.07
150.00	209.20
154.18	209.32

Culvert Analysis Report
Culvert-1
Culvert #5

Culvert Summary					
Computed Headwater Eleva	207.37	m	Discharge	0.4600	m³/s
Inlet Control HW Elev.	207.29	m	Tailwater Elevation	N/A	m
Outlet Control HW Elev.	207.37	m	Control Type	Entrance Control	
Headwater Depth/Height	0.89				

Grades					
Upstream Invert	206.83	m	Downstream Invert	206.14	m
Length	11.90	m	Constructed Slope	0.057983	m/m

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.22	m
Slope Type	Steep		Normal Depth	0.22	m
Flow Regime	Supercritical		Critical Depth	0.31	m
Velocity Downstream	2.44	m/s	Critical Slope	0.016718	m/m

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	0.61	m
Section Size	600 mm		Rise	0.61	m
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	207.37	m	Upstream Velocity Head	0.12	m
Ke	0.90		Entrance Loss	0.11	m

Inlet Control Properties					
Inlet Control HW Elev.	207.29	m	Flow Control	N/A	
Inlet Type	Projecting		Area Full	0.6	m²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Analysis Report
Culvert-1
Culvert #6

Culvert Summary					
Computed Headwater Elev	205.93	m	Discharge	0.2200	m³/s
Inlet Control HW Elev.	205.87	m	Tailwater Elevation	N/A	m
Outlet Control HW Elev.	205.93	m	Control Type	Outlet Control	
Headwater Depth/Height	1.42				

Grades					
Upstream Invert	205.28	m	Downstream Invert	205.24	m
Length	7.00	m	Constructed Slope	0.005714	m/m

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	0.33	m
Slope Type	Mild		Normal Depth	N/A	m
Flow Regime	Subcritical		Critical Depth	0.33	m
Velocity Downstream	1.74	m/s	Critical Slope	0.024754	m/m

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	0.46	m
Section Size	450 mm		Rise	0.46	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	205.93	m	Upstream Velocity Head	0.09	m
Ke	0.90		Entrance Loss	0.08	m

Inlet Control Properties					
Inlet Control HW Elev.	205.87	m	Flow Control	N/A	
Inlet Type	Projecting		Area Full	0.2	m²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Analysis Report
Culvert-1
Driveway Culvert

Culvert Summary					
Computed Headwater Elev	212.98	m	Discharge	0.0300	m³/s
Inlet Control HW Elev.	212.97	m	Tailwater Elevation	N/A	m
Outlet Control HW Elev.	212.98	m	Control Type	Entrance Control	
Headwater Depth/Height	0.47				

Grades					
Upstream Invert	212.80	m	Downstream Invert	212.72	m
Length	9.00	m	Constructed Slope	0.008889	m/m

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.10	m
Slope Type	Steep		Normal Depth	0.10	m
Flow Regime	Supercritical		Critical Depth	0.12	m
Velocity Downstream	1.20	m/s	Critical Slope	0.004448	m/m

Section			
Section Shape	Circular	Mannings Coefficient	0.012
Section Material	Corrugated HDPE (Smooth Interior)	Span	0.38 m
Section Size	375 mm	Rise	0.38 m
Number Sections	1		

Outlet Control Properties					
Outlet Control HW Elev.	212.98	m	Upstream Velocity Head	0.04	m
Ke	0.20		Entrance Loss	0.01	m

Inlet Control Properties					
Inlet Control HW Elev.	212.97	m	Flow Control	Unsubmerged	
Inlet Type	Groove end projecting		Area Full	0.1	m²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

APPENDIX B

Flow Master Model Reports

Worksheet for Section A-A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.03200	m/m
Left Side Slope	3.00	m/m (H:V)
Right Side Slope	3.00	m/m (H:V)
Discharge	0.92	m³/s

Results

Normal Depth	0.40	m
Flow Area	0.47	m²
Wetted Perimeter	2.50	m
Hydraulic Radius	0.19	m
Top Width	2.38	m
Critical Depth	0.45	m
Critical Slope	0.01553	m/m
Velocity	1.96	m/s
Velocity Head	0.20	m
Specific Energy	0.59	m
Froude Number	1.40	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.40	m
Critical Depth	0.45	m
Channel Slope	0.03200	m/m
Critical Slope	0.01553	m/m

Worksheet for Section B-B

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00700	m/m
Left Side Slope	3.00	m/m (H:V)
Right Side Slope	3.00	m/m (H:V)
Discharge	0.79	m^3/s

Results

Normal Depth	0.50	m
Flow Area	0.74	m^2
Wetted Perimeter	3.15	m
Hydraulic Radius	0.24	m
Top Width	2.98	m
Critical Depth	0.43	m
Critical Slope	0.01585	m/m
Velocity	1.06	m/s
Velocity Head	0.06	m
Specific Energy	0.56	m
Froude Number	0.68	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.50	m
Critical Depth	0.43	m
Channel Slope	0.00700	m/m
Critical Slope	0.01585	m/m

Worksheet for Section C-C (E)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.05600	m/m
Left Side Slope	2.00	m/m (H:V)
Right Side Slope	2.00	m/m (H:V)
Discharge	0.22	m^3/s

Results

Normal Depth	0.25	m
Flow Area	0.12	m^2
Wetted Perimeter	1.10	m
Hydraulic Radius	0.11	m
Top Width	0.99	m
Critical Depth	0.30	m
Critical Slope	0.01925	m/m
Velocity	1.81	m/s
Velocity Head	0.17	m
Specific Energy	0.41	m
Froude Number	1.65	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.25	m
Critical Depth	0.30	m
Channel Slope	0.05600	m/m
Critical Slope	0.01925	m/m

Worksheet for Section D-D (E)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.05800	m/m
Left Side Slope	2.00	m/m (H:V)
Right Side Slope	2.00	m/m (H:V)
Discharge	0.46	m³/s

Results

Normal Depth	0.32	m
Flow Area	0.21	m²
Wetted Perimeter	1.44	m
Hydraulic Radius	0.14	m
Top Width	1.29	m
Critical Depth	0.40	m
Critical Slope	0.01745	m/m
Velocity	2.21	m/s
Velocity Head	0.25	m
Specific Energy	0.57	m
Froude Number	1.76	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.32	m
Critical Depth	0.40	m
Channel Slope	0.05800	m/m
Critical Slope	0.01745	m/m

Worksheet for Section E-E (E)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02700	m/m
Left Side Slope	3.00	m/m (H:V)
Right Side Slope	3.00	m/m (H:V)
Discharge	0.79	m³/s

Results

Normal Depth	0.39	m
Flow Area	0.45	m²
Wetted Perimeter	2.44	m
Hydraulic Radius	0.18	m
Top Width	2.32	m
Critical Depth	0.43	m
Critical Slope	0.01585	m/m
Velocity	1.77	m/s
Velocity Head	0.16	m
Specific Energy	0.55	m
Froude Number	1.28	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.39	m
Critical Depth	0.43	m
Channel Slope	0.02700	m/m
Critical Slope	0.01585	m/m

Worksheet for Section F-F (E)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.03700	m/m
Left Side Slope	3.00	m/m (H:V)
Right Side Slope	4.00	m/m (H:V)
Discharge	0.92	m^3/s

Results

Normal Depth	0.36	m
Flow Area	0.46	m^2
Wetted Perimeter	2.64	m
Hydraulic Radius	0.17	m
Top Width	2.54	m
Critical Depth	0.43	m
Critical Slope	0.01558	m/m
Velocity	2.00	m/s
Velocity Head	0.20	m
Specific Energy	0.57	m
Froude Number	1.50	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.36	m
Critical Depth	0.43	m
Channel Slope	0.03700	m/m
Critical Slope	0.01558	m/m

Worksheet for Section E-E (W)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.04400	m/m
Left Side Slope	3.00	m/m (H:V)
Right Side Slope	3.00	m/m (H:V)
Discharge	0.03	m^3/s

Results

Normal Depth	0.10	m
Flow Area	0.03	m^2
Wetted Perimeter	0.65	m
Hydraulic Radius	0.05	m
Top Width	0.62	m
Critical Depth	0.12	m
Critical Slope	0.02451	m/m
Velocity	0.94	m/s
Velocity Head	0.04	m
Specific Energy	0.15	m
Froude Number	1.32	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.10	m
Critical Depth	0.12	m
Channel Slope	0.04400	m/m
Critical Slope	0.02451	m/m

Worksheet for Section F-F (W)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.04000	m/m
Left Side Slope	3.00	m/m (H:V)
Right Side Slope	3.00	m/m (H:V)
Discharge	0.02	m^3/s

Results

Normal Depth	0.08	m
Flow Area	0.02	m^2
Wetted Perimeter	0.51	m
Hydraulic Radius	0.04	m
Top Width	0.49	m
Critical Depth	0.09	m
Critical Slope	0.02688	m/m
Velocity	0.76	m/s
Velocity Head	0.03	m
Specific Energy	0.11	m
Froude Number	1.20	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.08	m
Critical Depth	0.09	m
Channel Slope	0.04000	m/m
Critical Slope	0.02688	m/m

APPENDIX C

Modified Rational Method Calculations

CROZIER
CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
FILE: Modified Rational Method
DATE: 11/19/2021
DESIGN: GC
CHECK: RA

Owen Sound IDF Curve Parameters		
Storm Event	**A**	**B**
2	22.3	-0.714
5	29.1	-0.724
10	33.6	-0.729
25	39.3	-0.734
50	43.5	-0.736
100	47.7	-0.738

Total Site Area = 0.43 ha

Catchment 101

Surface	Pre-development		Post-development	
	Area (ha)	Runoff Coefficient	Area (ha)	Runoff Coefficient
Landscapes	0.43	0.25	0.430	0.25
Asphalt	0.00	0.90	0.00	0.90
Building	0.00	0.90	0.00	0.90
Total *	0.43	0.25	0.43	0.25

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (2-Year Storm)

Peak Flow

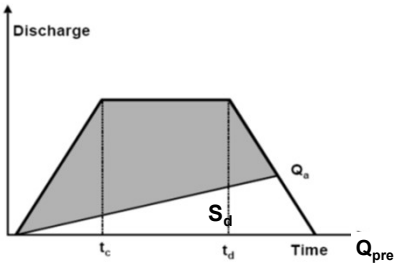
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	80.15
Return Period	2 yr		
Time of Concentration (min)	10		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (Unadjusted)	0.25	Flow (m^3/s)	0.024
Area (ha)	0.43		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	80.15
Return Period	2 yr		
Time of Concentration (min)	10		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (unadjusted)	0.25	Uncont. Flow (m^3/s)	0.024
Area (ha)	0.43		

Target Flow (m^3/s)	0.024

REQUIRED STORAGE VOLUME:	**0.0**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	80.15	600	0.024	0.0
15	60.00	900	0.018	-1.8
20	48.86	1200	0.015	-4.1
25	41.67	1500	0.013	-6.5
30	36.58	1800	0.011	-9.1
35	32.77	2100	0.010	-11.9
40	29.79	2400	0.009	-14.7
45	27.38	2700	0.008	-17.6
50	25.40	3000	0.008	-20.5
55	23.73	3300	0.007	-23.5
60	22.30	3600	0.007	-26.5
65	21.06	3900	0.006	-29.6
70	19.98	4200	0.006	-32.6
75	19.02	4500	0.006	-35.8
80	18.16	4800	0.005	-38.9
85	17.39	5100	0.005	-42.1

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (5-Year Storm)

Peak Flow

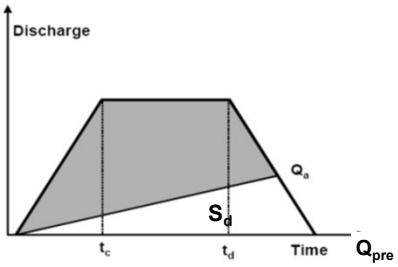
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	106.48
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (Unadjusted)	0.25	Flow (m^3/s)	0.032
Area (ha)	0.43		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	106.48
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (unadjusted)	0.25	Uncont. Flow (m^3/s)	0.032
Area (ha)	0.43		

Target Flow (m^3/s)	0.032

REQUIRED STORAGE VOLUME:	**0.0**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	106.48	600	0.032	0.0
15	79.39	900	0.024	-2.5
20	64.47	1200	0.019	-5.6
25	54.85	1500	0.017	-8.9
30	48.07	1800	0.014	-12.4
35	42.99	2100	0.013	-16.1
40	39.03	2400	0.012	-19.9
45	35.84	2700	0.011	-23.8
50	33.21	3000	0.010	-27.7
55	30.99	3300	0.009	-31.7
60	29.10	3600	0.009	-35.8
65	27.46	3900	0.008	-39.9
70	26.03	4200	0.008	-44.0
75	24.76	4500	0.007	-48.2
80	23.63	4800	0.007	-52.4
85	22.61	5100	0.007	-56.6

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (10-Year Storm)

Peak Flow

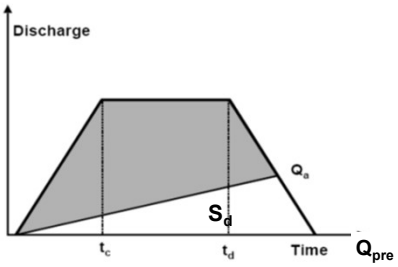
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	124.05
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (unadjusted)	0.25	Flow (m^3/s)	0.037
Area (ha)	0.43		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	124.05
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (unadjusted)	0.25	Uncont. Flow (m^3/s)	0.037
Area (ha)	0.43		

Target Flow (m^3/s)	0.037

REQUIRED STORAGE VOLUME:	**0.0**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	124.05	600	0.037	0.0
15	92.31	900	0.028	-3.0
20	74.84	1200	0.023	-6.6
25	63.61	1500	0.019	-10.5
30	55.69	1800	0.017	-14.6
35	49.77	2100	0.015	-18.9
40	45.16	2400	0.014	-23.4
45	41.44	2700	0.012	-27.9
50	38.38	3000	0.012	-32.6
55	35.80	3300	0.011	-37.3
60	33.60	3600	0.010	-42.0
65	31.70	3900	0.010	-46.8
70	30.03	4200	0.009	-51.7
75	28.56	4500	0.009	-56.5
80	27.24	4800	0.008	-61.5
85	26.07	5100	0.008	-66.4

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (25-Year Storm)

Peak Flow

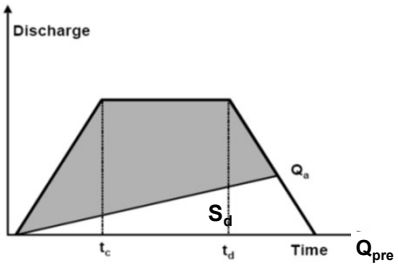
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	146.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (Adjusted)	0.28	Flow (m^3/s)	0.048
Area (ha)	0.43		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	146.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (Adjusted)	0.28	Uncont. Flow (m^3/s)	0.048
Area (ha)	0.43		

Target Flow (m^3/s)	0.048

REQUIRED STORAGE VOLUME:	**0.0**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	146.40	600	0.048	0.0
15	108.72	900	0.036	-4.0
20	88.02	1200	0.029	-8.7
25	74.73	1500	0.025	-13.8
30	65.37	1800	0.022	-19.2
35	58.37	2100	0.019	-24.9
40	52.92	2400	0.018	-30.7
45	48.54	2700	0.016	-36.6
50	44.93	3000	0.015	-42.6
55	41.89	3300	0.014	-48.8
60	39.30	3600	0.013	-55.0
65	37.06	3900	0.012	-61.2
70	35.10	4200	0.012	-67.5
75	33.36	4500	0.011	-73.9
80	31.82	4800	0.011	-80.3
85	30.43	5100	0.010	-86.8

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CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (50-Year Storm)

Peak Flow

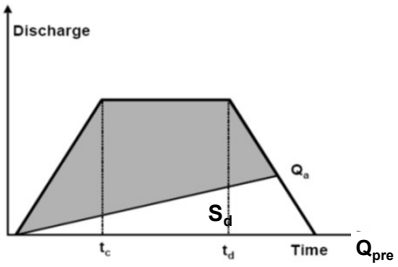
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	162.63
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (Adjusted)	0.30	Flow (m^3/s)	0.059
Area (ha)	0.43		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	162.63
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (Adjusted)	0.30	Uncont. Flow (m^3/s)	0.059
Area (ha)	0.43		

Target Flow (m^3/s)	0.059

REQUIRED STORAGE VOLUME:	**0.0**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	162.63	600	0.059	0.0
15	120.67	900	0.044	-4.8
20	97.65	1200	0.035	-10.5
25	82.86	1500	0.030	-16.8
30	72.45	1800	0.026	-23.4
35	64.68	2100	0.023	-30.2
40	58.63	2400	0.021	-37.3
45	53.76	2700	0.019	-44.5
50	49.75	3000	0.018	-51.8
55	46.38	3300	0.017	-59.3
60	43.50	3600	0.016	-66.8
65	41.01	3900	0.015	-74.4
70	38.83	4200	0.014	-82.1
75	36.91	4500	0.013	-89.8
80	35.20	4800	0.013	-97.6
85	33.66	5100	0.012	-105.4

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: GC
CHECK: KM

Modified Rational Method Storage Sizing (100-Year Storm)

Peak Flow

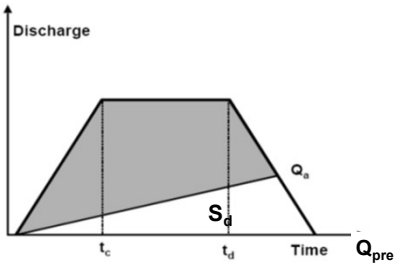
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	178.98
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (Adjusted)	0.31	Flow (m^3/s)	0.067
Area (ha)	0.43		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	178.98
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (Adjusted)	0.31	Uncont. Flow (m^3/s)	0.067
Area (ha)	0.43		

Target Flow (m^3/s)	0.067

REQUIRED STORAGE VOLUME:	**0.0**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	178.98	600	0.067	0.0
15	132.69	900	0.050	-5.6
20	107.31	1200	0.040	-12.2
25	91.02	1500	0.034	-19.3
30	79.56	1800	0.030	-26.9
35	71.00	2100	0.027	-34.8
40	64.34	2400	0.024	-42.9
45	58.98	2700	0.022	-51.2
50	54.57	3000	0.021	-59.6
55	50.86	3300	0.019	-68.2
60	47.70	3600	0.018	-76.8
65	44.96	3900	0.017	-85.5
70	42.57	4200	0.016	-94.3
75	40.46	4500	0.015	-103.2
80	38.58	4800	0.015	-112.1
85	36.89	5100	0.014	-121.1

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CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
FILE: Modified Rational Method
DATE: 11/19/2021
DESIGN: GC
CHECK: RA

Owen Sound IDF Curve Parameters		
Storm Event	**A**	**B**
2	22.3	-0.714
5	29.1	-0.724
10	33.6	-0.729
25	39.3	-0.734
50	43.5	-0.736
100	47.7	-0.738

Total Site Area = 0.78 ha

Catchment 102

Surface	Pre-development		Post-development	
	Area (ha)	Runoff Coefficient	Area (ha)	Runoff Coefficient
Landscapes	0.78	0.25	0.71	0.25
Asphalt	0.00	0.90	0.05	0.90
Building	0.00	0.90	0.02	0.90
Total *	0.78	0.25	0.78	0.31

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (2-Year Storm)

Peak Flow

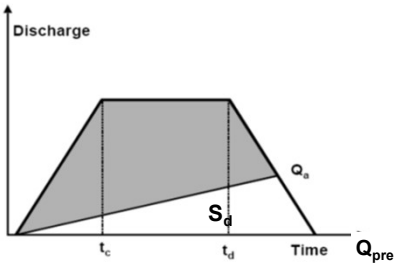
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	80.15
Return Period	2 yr		
Time of Concentration (min)	10		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (Unadjusted)	0.25	Flow (m^3/s)	0.044
Area (ha)	0.78		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	80.15
Return Period	2 yr		
Time of Concentration (min)	10		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (unadjusted)	0.31	Uncont. Flow (m^3/s)	0.054
Area (ha)	0.78		

Target Flow (m^3/s)	0.044

REQUIRED STORAGE VOLUME:	**6.1**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	80.15	600	0.054	6.1
15	60.00	900	0.040	3.5
20	48.86	1200	0.033	0.1
25	41.67	1500	0.028	-3.9
30	36.58	1800	0.025	-8.2
35	32.77	2100	0.022	-12.7
40	29.79	2400	0.020	-17.5
45	27.38	2700	0.018	-22.4
50	25.40	3000	0.017	-27.5
55	23.73	3300	0.016	-32.6
60	22.30	3600	0.015	-37.8
65	21.06	3900	0.014	-43.2
70	19.98	4200	0.013	-48.5
75	19.02	4500	0.013	-54.0
80	18.16	4800	0.012	-59.5
85	17.39	5100	0.012	-65.0

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (5-Year Storm)

Peak Flow

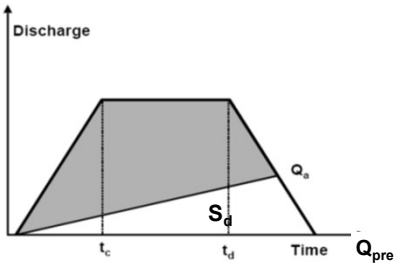
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	106.48
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (Unadjusted)	0.25	Flow (m^3/s)	0.058
Area (ha)	0.78		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	106.48
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (unadjusted)	0.31	Uncont. Flow (m^3/s)	0.072
Area (ha)	0.78		

Target Flow (m^3/s)	0.058

REQUIRED STORAGE VOLUME:	**8.1**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	106.48	600	0.072	8.1
15	79.39	900	0.053	4.5
20	64.47	1200	0.043	-0.2
25	54.85	1500	0.037	-5.6
30	48.07	1800	0.032	-11.5
35	42.99	2100	0.029	-17.7
40	39.03	2400	0.026	-24.1
45	35.84	2700	0.024	-30.8
50	33.21	3000	0.022	-37.6
55	30.99	3300	0.021	-44.5
60	29.10	3600	0.020	-51.5
65	27.46	3900	0.018	-58.7
70	26.03	4200	0.018	-65.9
75	24.76	4500	0.017	-73.2
80	23.63	4800	0.016	-80.6
85	22.61	5100	0.015	-88.0

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (10-Year Storm)

Peak Flow

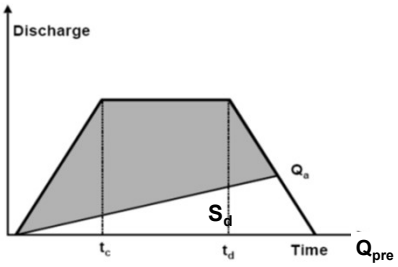
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	124.05
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (unadjusted)	0.25	Flow (m^3/s)	0.068
Area (ha)	0.78		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	124.05
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (unadjusted)	0.31	Uncont. Flow (m^3/s)	0.084
Area (ha)	0.78		

Target Flow (m^3/s)	0.068

REQUIRED STORAGE VOLUME:	**9.5**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	124.05	600	0.084	9.5
15	92.31	900	0.062	5.1
20	74.84	1200	0.050	-0.5
25	63.61	1500	0.043	-6.9
30	55.69	1800	0.038	-13.8
35	49.77	2100	0.034	-21.1
40	45.16	2400	0.030	-28.6
45	41.44	2700	0.028	-36.4
50	38.38	3000	0.026	-44.4
55	35.80	3300	0.024	-52.5
60	33.60	3600	0.023	-60.8
65	31.70	3900	0.021	-69.2
70	30.03	4200	0.020	-77.6
75	28.56	4500	0.019	-86.2
80	27.24	4800	0.018	-94.8
85	26.07	5100	0.018	-103.5

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (25-Year Storm)

Peak Flow

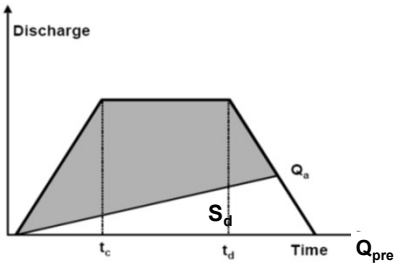
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	146.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (Adjusted)	0.28	Flow (m^3/s)	0.088
Area (ha)	0.78		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	146.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (Adjusted)	0.34	Uncont. Flow (m^3/s)	0.108
Area (ha)	0.78		

Target Flow (m^3/s)	0.088

REQUIRED STORAGE VOLUME:	**12.3**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	146.40	600	0.108	12.3
15	108.72	900	0.081	6.5
20	88.02	1200	0.065	-0.9
25	74.73	1500	0.055	-9.3
30	65.37	1800	0.048	-18.4
35	58.37	2100	0.043	-27.9
40	52.92	2400	0.039	-37.8
45	48.54	2700	0.036	-48.0
50	44.93	3000	0.033	-58.4
55	41.89	3300	0.031	-69.1
60	39.30	3600	0.029	-79.9
65	37.06	3900	0.027	-90.8
70	35.10	4200	0.026	-101.8
75	33.36	4500	0.025	-113.0
80	31.82	4800	0.024	-124.3
85	30.43	5100	0.023	-135.6

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (50-Year Storm)

Peak Flow

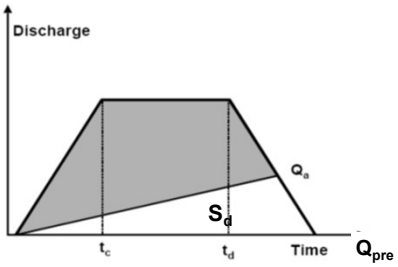
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	162.63
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (Adjusted)	0.30	Flow (m^3/s)	0.107
Area (ha)	0.78		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	162.63
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (Adjusted)	0.37	Uncont. Flow (m^3/s)	0.131
Area (ha)	0.78		

Target Flow (m^3/s)	0.107

REQUIRED STORAGE VOLUME:	**14.9**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	162.63	600	0.131	14.9
15	120.67	900	0.098	7.8
20	97.65	1200	0.079	-1.2
25	82.86	1500	0.067	-11.5
30	72.45	1800	0.059	-22.5
35	64.68	2100	0.052	-34.1
40	58.63	2400	0.047	-46.1
45	53.76	2700	0.043	-58.5
50	49.75	3000	0.040	-71.2
55	46.38	3300	0.037	-84.1
60	43.50	3600	0.035	-97.2
65	41.01	3900	0.033	-110.5
70	38.83	4200	0.031	-123.9
75	36.91	4500	0.030	-137.5
80	35.20	4800	0.028	-151.2
85	33.66	5100	0.027	-165.0

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: GC
CHECK: KM

Modified Rational Method Storage Sizing (100-Year Storm)

Peak Flow

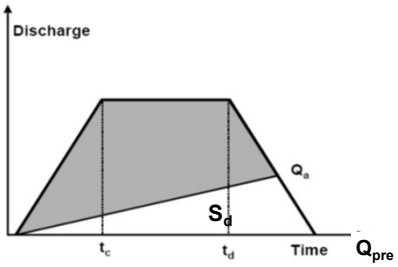
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	178.98
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (Adjusted)	0.31	Flow (m^3/s)	0.122
Area (ha)	0.78		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	178.98
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (Adjusted)	0.39	Uncont. Flow (m^3/s)	0.151
Area (ha)	0.78		

Target Flow (m^3/s)	0.122

REQUIRED STORAGE VOLUME:	**17.1**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	178.98	600	0.151	17.1
15	132.69	900	0.112	8.9
20	107.31	1200	0.090	-1.5
25	91.02	1500	0.077	-13.3
30	79.56	1800	0.067	-26.0
35	71.00	2100	0.060	-39.4
40	64.34	2400	0.054	-53.2
45	58.98	2700	0.050	-67.5
50	54.57	3000	0.046	-82.1
55	50.86	3300	0.043	-96.9
60	47.70	3600	0.040	-112.0
65	44.96	3900	0.038	-127.2
70	42.57	4200	0.036	-142.7
75	40.46	4500	0.034	-158.2
80	38.58	4800	0.032	-173.9
85	36.89	5100	0.031	-189.8

CROZIER
CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
FILE: Modified Rational Method
DATE: 11/19/2021
DESIGN: GC
CHECK: RA

Owen Sound IDF Curve Parameters		
Storm Event	**A**	**B**
2	22.3	-0.714
5	29.1	-0.724
10	33.6	-0.729
25	39.3	-0.734
50	43.5	-0.736
100	47.7	-0.738

Total Site Area = 2.43 ha

Catchment 103

Surface	Pre-development		Post-development	
	Area (ha)	Runoff Coefficient	Area (ha)	Runoff Coefficient
Landscapes	2.43	0.25	2.28	0.25
Asphalt	0.00	0.90	0.09	0.90
Building	0.00	0.90	0.06	0.90
Total *	2.43	0.25	2.43	0.29

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (2-Year Storm)

Peak Flow

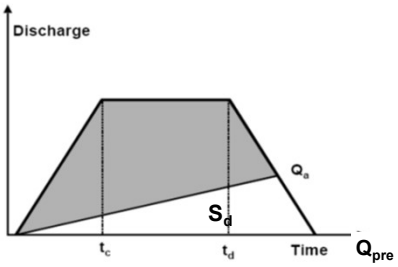
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	80.15
Return Period	2 yr		
Time of Concentration (min)	10		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (Unadjusted)	0.25	Flow (m^3/s)	0.136
Area (ha)	2.43		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	80.15
Return Period	2 yr		
Time of Concentration (min)	10		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (unadjusted)	0.29	Uncont. Flow (m^3/s)	0.158
Area (ha)	2.43		

Target Flow (m^3/s)	0.136

REQUIRED STORAGE VOLUME:	**13.1**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	80.15	600	0.158	13.1
15	60.00	900	0.118	4.4
20	48.86	1200	0.096	-7.0
25	41.67	1500	0.082	-19.8
30	36.58	1800	0.072	-33.6
35	32.77	2100	0.065	-48.2
40	29.79	2400	0.059	-63.4
45	27.38	2700	0.054	-79.0
50	25.40	3000	0.050	-95.0
55	23.73	3300	0.047	-111.3
60	22.30	3600	0.044	-127.8
65	21.06	3900	0.042	-144.6
70	19.98	4200	0.039	-161.6
75	19.02	4500	0.038	-178.7
80	18.16	4800	0.036	-196.0
85	17.39	5100	0.034	-213.5

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (5-Year Storm)

Peak Flow

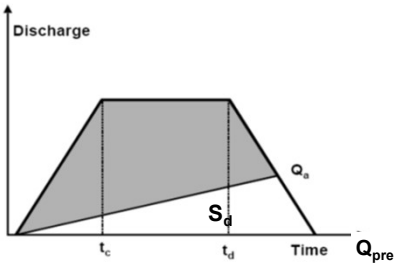
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	106.48
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (Unadjusted)	0.25	Flow (m^3/s)	0.181
Area (ha)	2.43		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	106.48
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (unadjusted)	0.29	Uncont. Flow (m^3/s)	0.210
Area (ha)	2.43		

Target Flow (m^3/s)	0.181

REQUIRED STORAGE VOLUME:	**17.4**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	106.48	600	0.210	17.4
15	79.39	900	0.157	5.2
20	64.47	1200	0.127	-10.3
25	54.85	1500	0.108	-27.8
30	48.07	1800	0.095	-46.6
35	42.99	2100	0.085	-66.3
40	39.03	2400	0.077	-86.8
45	35.84	2700	0.071	-107.8
50	33.21	3000	0.066	-129.4
55	30.99	3300	0.061	-151.3
60	29.10	3600	0.057	-173.6
65	27.46	3900	0.054	-196.1
70	26.03	4200	0.051	-218.9
75	24.76	4500	0.049	-241.9
80	23.63	4800	0.047	-265.2
85	22.61	5100	0.045	-288.5

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (10-Year Storm)

Peak Flow

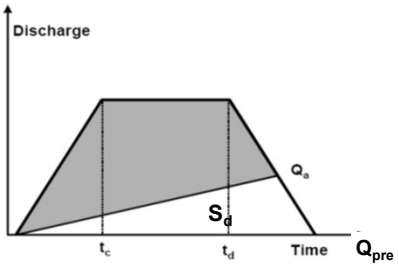
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	124.05
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (unadjusted)	0.25	Flow (m^3/s)	0.211
Area (ha)	2.43		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	124.05
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (unadjusted)	0.29	Uncont. Flow (m^3/s)	0.245
Area (ha)	2.43		

Target Flow (m^3/s)	0.211

REQUIRED STORAGE VOLUME:	**20.3**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	124.05	600	0.245	20.3
15	92.31	900	0.182	5.7
20	74.84	1200	0.148	-12.6
25	63.61	1500	0.126	-33.2
30	55.69	1800	0.110	-55.3
35	49.77	2100	0.098	-78.5
40	45.16	2400	0.089	-102.6
45	41.44	2700	0.082	-127.3
50	38.38	3000	0.076	-152.6
55	35.80	3300	0.071	-178.3
60	33.60	3600	0.066	-204.4
65	31.70	3900	0.063	-230.8
70	30.03	4200	0.059	-257.5
75	28.56	4500	0.056	-284.4
80	27.24	4800	0.054	-311.6
85	26.07	5100	0.051	-339.0

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (25-Year Storm)

Peak Flow

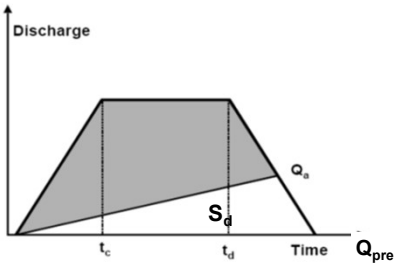
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	146.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (Adjusted)	0.28	Flow (m^3/s)	0.274
Area (ha)	2.43		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	146.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (Adjusted)	0.32	Uncont. Flow (m^3/s)	0.318
Area (ha)	2.43		

Target Flow (m^3/s)	0.274

REQUIRED STORAGE VOLUME:	**26.4**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	146.40	600	0.318	26.4
15	108.72	900	0.236	7.0
20	88.02	1200	0.191	-17.2
25	74.73	1500	0.162	-44.2
30	65.37	1800	0.142	-73.2
35	58.37	2100	0.127	-103.6
40	52.92	2400	0.115	-135.1
45	48.54	2700	0.105	-167.4
50	44.93	3000	0.098	-200.4
55	41.89	3300	0.091	-234.0
60	39.30	3600	0.085	-268.1
65	37.06	3900	0.080	-302.5
70	35.10	4200	0.076	-337.4
75	33.36	4500	0.072	-372.5
80	31.82	4800	0.069	-408.0
85	30.43	5100	0.066	-443.7

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (50-Year Storm)

Peak Flow

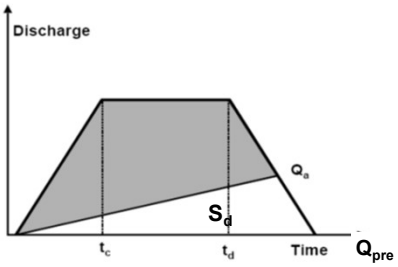
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	162.63
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (Adjusted)	0.30	Flow (m^3/s)	0.332
Area (ha)	2.43		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	162.63
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (Adjusted)	0.35	Uncont. Flow (m^3/s)	0.385
Area (ha)	2.43		

Target Flow (m^3/s)	0.332

REQUIRED STORAGE VOLUME:	**32.0**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	162.63	600	0.385	32.0
15	120.67	900	0.286	8.3
20	97.65	1200	0.231	-21.2
25	82.86	1500	0.196	-54.2
30	72.45	1800	0.172	-89.4
35	64.68	2100	0.153	-126.4
40	58.63	2400	0.139	-164.7
45	53.76	2700	0.127	-203.9
50	49.75	3000	0.118	-244.0
55	46.38	3300	0.110	-284.8
60	43.50	3600	0.103	-326.2
65	41.01	3900	0.097	-368.0
70	38.83	4200	0.092	-410.4
75	36.91	4500	0.087	-453.1
80	35.20	4800	0.083	-496.1
85	33.66	5100	0.080	-539.4

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: GC
CHECK: KM

Modified Rational Method Storage Sizing (100-Year Storm)

Peak Flow

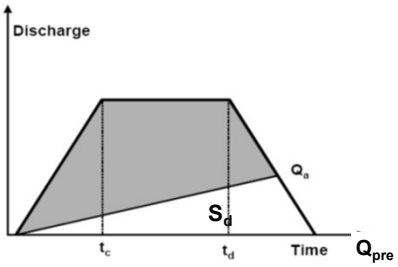
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\,(T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\,(T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	178.98
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (Adjusted)	0.31	Flow (m^3/s)	0.381
Area (ha)	2.43		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	178.98
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (Adjusted)	0.36	Uncont. Flow (m^3/s)	0.442
Area (ha)	2.43		

Target Flow (m^3/s)	0.381

REQUIRED STORAGE VOLUME:	**36.6**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	178.98	600	0.442	36.6
15	132.69	900	0.327	9.3
20	107.31	1200	0.265	-24.8
25	91.02	1500	0.225	-62.7
30	79.56	1800	0.196	-103.3
35	71.00	2100	0.175	-145.8
40	64.34	2400	0.159	-189.8
45	58.98	2700	0.146	-234.9
50	54.57	3000	0.135	-281.0
55	50.86	3300	0.126	-327.9
60	47.70	3600	0.118	-375.4
65	44.96	3900	0.111	-423.5
70	42.57	4200	0.105	-472.1
75	40.46	4500	0.100	-521.2
80	38.58	4800	0.095	-570.6
85	36.89	5100	0.091	-620.4

CROZIER
CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
FILE: Modified Rational Method
DATE: 11/19/2021
DESIGN: GC
CHECK: RA

Owen Sound IDF Curve Parameters		
Storm Event	**A**	**B**
2	22.3	-0.714
5	29.1	-0.724
10	33.6	-0.729
25	39.3	-0.734
50	43.5	-0.736
100	47.7	-0.738

Total Site Area = 0.67 ha

Catchment 104

Surface	Pre-development		Post-development	
	Area (ha)	Runoff Coefficient	Area (ha)	Runoff Coefficient
Landscapes	0.67	0.25	0.59	0.25
Asphalt	0.00	0.90	0.06	0.90
Building	0.00	0.90	0.02	0.90
Total *	0.67	0.25	0.67	0.33

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (2-Year Storm)

Peak Flow

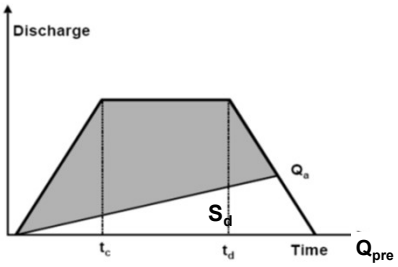
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	80.15
Return Period	2 yr		
Time of Concentration (min)	10		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (Unadjusted)	0.25	Flow (m^3/s)	0.038
Area (ha)	0.67		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	80.15
Return Period	2 yr		
Time of Concentration (min)	10		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (unadjusted)	0.33	Uncont. Flow (m^3/s)	0.049
Area (ha)	0.67		

Target Flow (m^3/s)	0.038

REQUIRED STORAGE VOLUME:	**7.0**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	80.15	600	0.049	7.0
15	60.00	900	0.037	5.0
20	48.86	1200	0.030	2.2
25	41.67	1500	0.026	-1.1
30	36.58	1800	0.022	-4.6
35	32.77	2100	0.020	-8.5
40	29.79	2400	0.018	-12.4
45	27.38	2700	0.017	-16.6
50	25.40	3000	0.016	-20.8
55	23.73	3300	0.015	-25.2
60	22.30	3600	0.014	-29.6
65	21.06	3900	0.013	-34.1
70	19.98	4200	0.012	-38.7
75	19.02	4500	0.012	-43.3
80	18.16	4800	0.011	-47.9
85	17.39	5100	0.011	-52.6

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (5-Year Storm)

Peak Flow

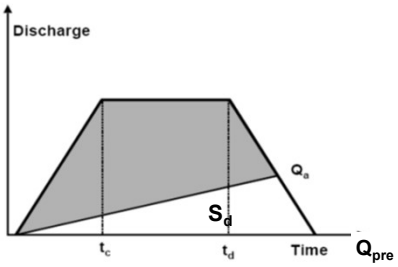
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	106.48
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (Unadjusted)	0.25	Flow (m^3/s)	0.050
Area (ha)	0.67		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	106.48
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (unadjusted)	0.33	Uncont. Flow (m^3/s)	0.065
Area (ha)	0.67		

Target Flow (m^3/s)	0.050

REQUIRED STORAGE VOLUME:	**9.3**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	106.48	600	0.065	9.3
15	79.39	900	0.049	6.5
20	64.47	1200	0.040	2.6
25	54.85	1500	0.034	-1.9
30	48.07	1800	0.030	-6.8
35	42.99	2100	0.026	-11.9
40	39.03	2400	0.024	-17.3
45	35.84	2700	0.022	-22.9
50	33.21	3000	0.020	-28.7
55	30.99	3300	0.019	-34.5
60	29.10	3600	0.018	-40.5
65	27.46	3900	0.017	-46.5
70	26.03	4200	0.016	-52.7
75	24.76	4500	0.015	-58.9
80	23.63	4800	0.015	-65.1
85	22.61	5100	0.014	-71.4

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (10-Year Storm)

Peak Flow

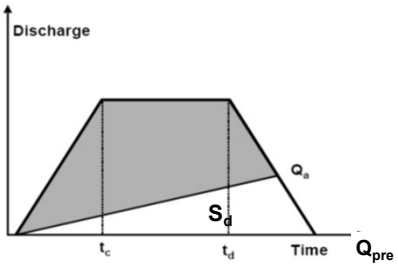
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	124.05
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (unadjusted)	0.25	Flow (m^3/s)	0.058
Area (ha)	0.67		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	124.05
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (unadjusted)	0.33	Uncont. Flow (m^3/s)	0.076
Area (ha)	0.67		

Target Flow (m^3/s)	0.058

REQUIRED STORAGE VOLUME:	**10.8**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	124.05	600	0.076	10.8
15	92.31	900	0.057	7.4
20	74.84	1200	0.046	2.8
25	63.61	1500	0.039	-2.5
30	55.69	1800	0.034	-8.2
35	49.77	2100	0.031	-14.3
40	45.16	2400	0.028	-20.7
45	41.44	2700	0.025	-27.2
50	38.38	3000	0.024	-34.0
55	35.80	3300	0.022	-40.8
60	33.60	3600	0.021	-47.8
65	31.70	3900	0.019	-54.9
70	30.03	4200	0.018	-62.1
75	28.56	4500	0.018	-69.4
80	27.24	4800	0.017	-76.7
85	26.07	5100	0.016	-84.1

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (25-Year Storm)

Peak Flow

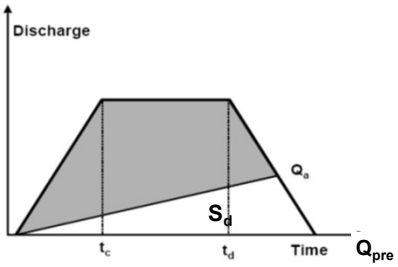
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	146.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (Adjusted)	0.28	Flow (m^3/s)	0.076
Area (ha)	0.67		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	146.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (Adjusted)	0.36	Uncont. Flow (m^3/s)	0.099
Area (ha)	0.67		

Target Flow (m^3/s)	0.076

REQUIRED STORAGE VOLUME:	**14.1**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	146.40	600	0.099	14.1
15	108.72	900	0.074	9.5
20	88.02	1200	0.060	3.4
25	74.73	1500	0.051	-3.5
30	65.37	1800	0.044	-11.1
35	58.37	2100	0.039	-19.1
40	52.92	2400	0.036	-27.4
45	48.54	2700	0.033	-36.0
50	44.93	3000	0.030	-44.8
55	41.89	3300	0.028	-53.8
60	39.30	3600	0.027	-63.0
65	37.06	3900	0.025	-72.2
70	35.10	4200	0.024	-81.6
75	33.36	4500	0.023	-91.1
80	31.82	4800	0.022	-100.7
85	30.43	5100	0.021	-110.3

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (50-Year Storm)

Peak Flow

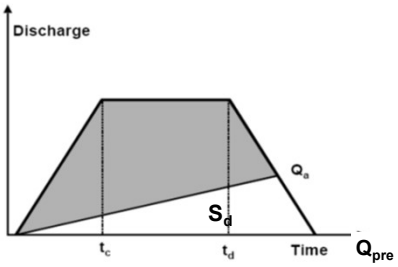
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	162.63
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (Adjusted)	0.30	Flow (m^3/s)	0.092
Area (ha)	0.67		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	162.63
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (Adjusted)	0.39	Uncont. Flow (m^3/s)	0.120
Area (ha)	0.67		

Target Flow (m^3/s)	0.092

REQUIRED STORAGE VOLUME:	**17.0**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	162.63	600	0.120	17.0
15	120.67	900	0.089	11.5
20	97.65	1200	0.072	4.0
25	82.86	1500	0.061	-4.4
30	72.45	1800	0.053	-13.7
35	64.68	2100	0.048	-23.4
40	58.63	2400	0.043	-33.5
45	53.76	2700	0.040	-44.0
50	49.75	3000	0.037	-54.7
55	46.38	3300	0.034	-65.6
60	43.50	3600	0.032	-76.7
65	41.01	3900	0.030	-88.0
70	38.83	4200	0.029	-99.4
75	36.91	4500	0.027	-110.9
80	35.20	4800	0.026	-122.5
85	33.66	5100	0.025	-134.2

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: GC
CHECK: KM

Modified Rational Method Storage Sizing (100-Year Storm)

Peak Flow

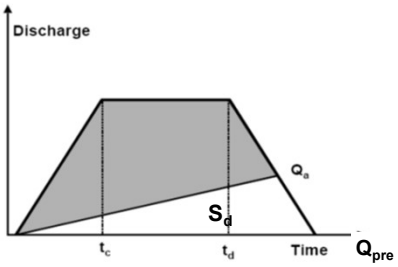
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	178.98
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (Adjusted)	0.31	Flow (m^3/s)	0.105
Area (ha)	0.67		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	178.98
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (Adjusted)	0.41	Uncont. Flow (m^3/s)	0.137
Area (ha)	0.67		

Target Flow (m^3/s)	0.105

REQUIRED STORAGE VOLUME:	**19.5**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	178.98	600	0.137	19.5
15	132.69	900	0.102	13.1
20	107.31	1200	0.082	4.5
25	91.02	1500	0.070	-5.3
30	79.56	1800	0.061	-15.9
35	71.00	2100	0.055	-27.1
40	64.34	2400	0.049	-38.8
45	58.98	2700	0.045	-50.8
50	54.57	3000	0.042	-63.1
55	50.86	3300	0.039	-75.7
60	47.70	3600	0.037	-88.4
65	44.96	3900	0.035	-101.4
70	42.57	4200	0.033	-114.5
75	40.46	4500	0.031	-127.7
80	38.58	4800	0.030	-141.0
85	36.89	5100	0.028	-154.5

CROZIER
CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
FILE: Modified Rational Method
DATE: 11/19/2021
DESIGN: GC
CHECK: RA

Owen Sound IDF Curve Parameters		
Storm Event	**A**	**B**
2	22.3	-0.714
5	29.1	-0.724
10	33.6	-0.729
25	39.3	-0.734
50	43.5	-0.736
100	47.7	-0.738

Total Site Area = 0.08 ha

Catchment 105

Surface	Pre-development		Post-development	
	Area (ha)	Runoff Coefficient	Area (ha)	Runoff Coefficient
Landscapes	0.08	0.25	0.03	0.25
Asphalt	0.00	0.90	0.05	0.90
Building	0.00	0.90	0.00	0.90
Total *	0.08	0.25	0.08	0.66

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (2-Year Storm)

Peak Flow

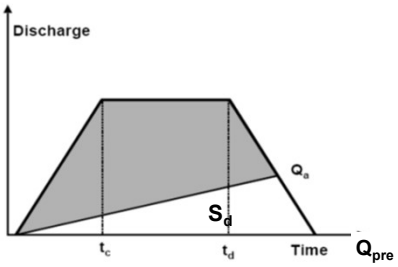
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	80.15
Return Period	2 yr		
Time of Concentration (min)	10		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (Unadjusted)	0.25	Flow (m^3/s)	0.004
Area (ha)	0.08		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	80.15
Return Period	2 yr		
Time of Concentration (min)	10		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (unadjusted)	0.66	Uncont. Flow (m^3/s)	0.012
Area (ha)	0.08		

Target Flow (m^3/s)	0.004

REQUIRED STORAGE VOLUME:	**4.6**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	80.15	600	0.012	4.4
15	60.00	900	0.009	4.6
20	48.86	1200	0.007	4.6
25	41.67	1500	0.006	4.5
30	36.58	1800	0.005	4.3
35	32.77	2100	0.005	4.1
40	29.79	2400	0.004	3.8
45	27.38	2700	0.004	3.5
50	25.40	3000	0.004	3.1
55	23.73	3300	0.003	2.8
60	22.30	3600	0.003	2.4
65	21.06	3900	0.003	2.0
70	19.98	4200	0.003	1.6
75	19.02	4500	0.003	1.1
80	18.16	4800	0.003	0.7
85	17.39	5100	0.003	0.2

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (5-Year Storm)

Peak Flow

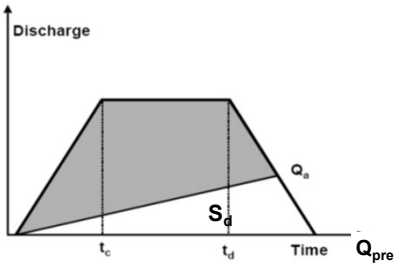
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	106.48
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (Unadjusted)	0.25	Flow (m^3/s)	0.006
Area (ha)	0.08		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	106.48
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (unadjusted)	0.66	Uncont. Flow (m^3/s)	0.016
Area (ha)	0.08		

Target Flow (m^3/s)	0.006

REQUIRED STORAGE VOLUME:	**6.0**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	106.48	600	0.016	5.8
15	79.39	900	0.012	6.0
20	64.47	1200	0.009	6.0
25	54.85	1500	0.008	5.8
30	48.07	1800	0.007	5.6
35	42.99	2100	0.006	5.2
40	39.03	2400	0.006	4.8
45	35.84	2700	0.005	4.4
50	33.21	3000	0.005	3.9
55	30.99	3300	0.005	3.4
60	29.10	3600	0.004	2.9
65	27.46	3900	0.004	2.3
70	26.03	4200	0.004	1.8
75	24.76	4500	0.004	1.2
80	23.63	4800	0.003	0.6
85	22.61	5100	0.003	0.0

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (10-Year Storm)

Peak Flow

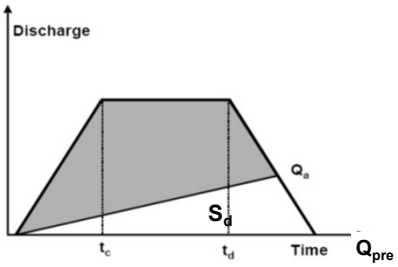
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	124.05
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (unadjusted)	0.25	Flow (m^3/s)	0.007
Area (ha)	0.08		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	124.05
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (unadjusted)	0.66	Uncont. Flow (m^3/s)	0.018
Area (ha)	0.08		

Target Flow (m^3/s)	0.007

REQUIRED STORAGE VOLUME:	**7.0**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	124.05	600	0.018	6.8
15	92.31	900	0.014	7.0
20	74.84	1200	0.011	7.0
25	63.61	1500	0.009	6.7
30	55.69	1800	0.008	6.4
35	49.77	2100	0.007	6.0
40	45.16	2400	0.007	5.5
45	41.44	2700	0.006	5.0
50	38.38	3000	0.006	4.4
55	35.80	3300	0.005	3.8
60	33.60	3600	0.005	3.2
65	31.70	3900	0.005	2.5
70	30.03	4200	0.004	1.9
75	28.56	4500	0.004	1.2
80	27.24	4800	0.004	0.5
85	26.07	5100	0.004	-0.3

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (25-Year Storm)

Peak Flow

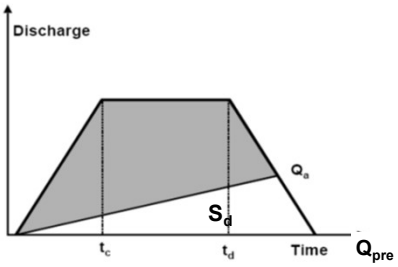
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	146.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (Adjusted)	0.28	Flow (m^3/s)	0.009
Area (ha)	0.08		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	146.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (Adjusted)	0.72	Uncont. Flow (m^3/s)	0.024
Area (ha)	0.08		

Target Flow (m^3/s)	0.009

REQUIRED STORAGE VOLUME:	**9.1**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	146.40	600	0.024	8.8
15	108.72	900	0.018	9.1
20	88.02	1200	0.014	9.0
25	74.73	1500	0.012	8.7
30	65.37	1800	0.011	8.2
35	58.37	2100	0.009	7.6
40	52.92	2400	0.009	7.0
45	48.54	2700	0.008	6.3
50	44.93	3000	0.007	5.6
55	41.89	3300	0.007	4.8
60	39.30	3600	0.006	3.9
65	37.06	3900	0.006	3.1
70	35.10	4200	0.006	2.2
75	33.36	4500	0.005	1.3
80	31.82	4800	0.005	0.3
85	30.43	5100	0.005	-0.6

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: AN
CHECK: GC

Modified Rational Method Storage Sizing (50-Year Storm)

Peak Flow

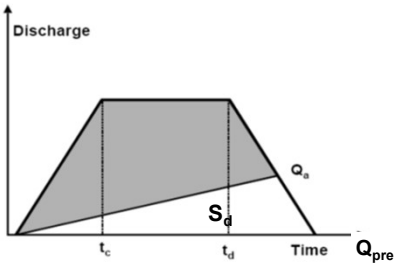
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	162.63
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (Adjusted)	0.30	Flow (m^3/s)	0.011
Area (ha)	0.08		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	162.63
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (Adjusted)	0.79	Uncont. Flow (m^3/s)	0.029
Area (ha)	0.08		

Target Flow (m^3/s)	0.011

REQUIRED STORAGE VOLUME:	**11.0**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	162.63	600	0.029	10.7
15	120.67	900	0.021	11.0
20	97.65	1200	0.017	10.8
25	82.86	1500	0.015	10.4
30	72.45	1800	0.013	9.9
35	64.68	2100	0.011	9.2
40	58.63	2400	0.010	8.4
45	53.76	2700	0.009	7.6
50	49.75	3000	0.009	6.7
55	46.38	3300	0.008	5.7
60	43.50	3600	0.008	4.7
65	41.01	3900	0.007	3.6
70	38.83	4200	0.007	2.5
75	36.91	4500	0.007	1.4
80	35.20	4800	0.006	0.3
85	33.66	5100	0.006	-0.9

CROZIER CONSULTING ENGINEERS

PROJECT: McCULLOUGH
PROJECT No.: 903-3780
DATE: 11/19/2021
DESIGN: GC
CHECK: KM

Modified Rational Method Storage Sizing (100-Year Storm)

Peak Flow

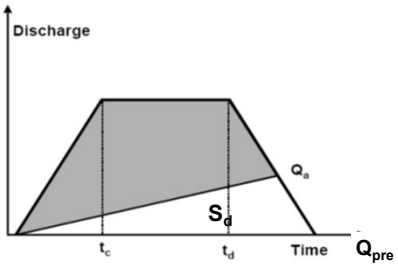
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(Td)} \cdot A$$

Intensity

$$i_{(Td)} = A\ (T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\ (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	178.98
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (Adjusted)	0.31	Flow (m^3/s)	0.013
Area (ha)	0.08		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	178.98
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (Adjusted)	0.82	Uncont. Flow (m^3/s)	0.033
Area (ha)	0.08		

Target Flow (m^3/s)	0.013

REQUIRED STORAGE VOLUME:	**12.5**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
10	178.98	600	0.033	12.2
15	132.69	900	0.024	12.5
20	107.31	1200	0.020	12.4
25	91.02	1500	0.017	11.9
30	79.56	1800	0.015	11.3
35	71.00	2100	0.013	10.5
40	64.34	2400	0.012	9.6
45	58.98	2700	0.011	8.6
50	54.57	3000	0.010	7.5
55	50.86	3300	0.009	6.4
60	47.70	3600	0.009	5.2
65	44.96	3900	0.008	4.0
70	42.57	4200	0.008	2.8
75	40.46	4500	0.007	1.5
80	38.58	4800	0.007	0.2
85	36.89	5100	0.007	-1.1

APPENDIX D

Infiltration Trench Sizing Calculations

PROJ. NO:	903-3780
PROJECT:	McCullough
DESIGN:	GC
FILE:	Infiltration Trenches
DATE:	November 19, 2021

Infiltration Trench Sizing Calculations

Site Characteristics - Catchment 204

Total Controlled Area	0.67	ha
Soil Infiltration Rate *	12	mm/hr
Storage Volume Required (minimum	22	m^3

* Conservative Assumption

Proposed Trench Dimensions

Width	2	m
Depth	1	m
Total Length	30	m
Total Volume =	60.0	m^3
Total Surface Area =	60.0	m^2

(including stone)

Trench Storage Characteristics

Stone Storage	
Total Stone Volume	60.0 m^3
Stone Void Ratio	0.4
Storage Volume Provided	**24.0 m^3**

Infiltration Calculations

Design Infiltration Rate	12	mm/hr
Volume to Infiltrate (quality)	16.8	m^3
Volume to Infiltrate (100-year)	24.0	m^3
Trench Surface Area	60.0	m^2
Drawdown Time (quality)	24	hours
Required Total Drawdown Time	48	hours

per MOE Table 3.2 (25m^3/ha)

Exfiltration Rate: 0.0002 m^3/s = 0.2 L/s

$$Q_{exfiltration} = \frac{I}{A_{trench}}$$

Drawdown Time (25mm): 23.26 hours

Drawdown Time (100-year): 33.33 hours

$$t_{drawdown} = \frac{V}{A_{trench} \cdot i}$$

PROJ. NO:	903-3780
PROJECT:	McCullough
DESIGN:	GC
FILE:	Infiltration Trenches
DATE:	November 19, 2021

Infiltration Trench Sizing Calculations

Site Characteristics - Catchment 203

Total Controlled Area	2.43	ha
Soil Infiltration Rate *	12	mm/hr
Storage Volume Required (minimum	37	m^3

* Conservative Assumption

Proposed Trench Dimensions

Width	3	m
Depth	1	m
Total Length	75	m
Total Volume =	225.0	m^3 (including stone)
Total Surface Area =	225.0	m^2

Trench Storage Characteristics

Stone Storage		
Total Stone Volume	225.0	m^3
Stone Void Ratio	0.4	
Storage Volume Provided	**90.0**	**m^3**

Infiltration Calculations

Design Infiltration Rate	12	mm/hr	
Volume to Infiltrate (quality)	60.8	m^3	per MOE Table 3.2 (25m^3/ha)
Volume to Infiltrate (100-year)	90.0	m^3	
Trench Surface Area	225.0	m^2	
Drawdown Time (quality)	24	hours	
Required Total Drawdown Time	48	hours	

Exfiltration Rate: 0.0008 m^3/s = 0.75 L/s

$$Q_{exfiltration} = \frac{I}{A_{trench}}$$

Drawdown Time (25mm): 22.50 hours

Drawdown Time (100-year): 33.33 hours

$$t_{drawdown} = \frac{V}{A_{trench} \cdot i}$$

PROJ. NO:	903-3780
PROJECT:	McCullough
DESIGN:	GC
FILE:	Infiltration Trenches
DATE:	November 19, 2021

Infiltration Trench Sizing Calculations

Site Characteristics - Catchment 202

Total Controlled Area	0.78	ha
Soil Infiltration Rate *	12	mm/hr
Storage Volume Required (minimum	18	m^3

* Conservative Assumption

Proposed Trench Dimensions

Width	2	m
Depth	1	m
Total Length	35	m
Total Volume =	70.0	m^3 (including stone)
Total Surface Area =	70.0	m^2

Trench Storage Characteristics

Stone Storage	
Total Stone Volume	70.0 m^3
Stone Void Ratio	0.4
Storage Volume Provided	**28.0 m^3**

Infiltration Calculations

Design Infiltration Rate	12	mm/hr
Volume to Infiltrate (quality)	19.5	m^3 per MOE Table 3.2 (25m^3/ha)
Volume to Infiltrate (100-year)	28.0	m^3
Trench Surface Area	70.0	m^2
Drawdown Time (quality)	24	hours
Required Total Drawdown Time	48	hours

Exfiltration Rate: 0.0002 m^3/s = 0.233333 L/s

$$Q_{exfiltration} = \frac{I}{A_{trench}}$$

Drawdown Time (25mm): 23.21 hours

Drawdown Time (100-year): 33.33 hours

$$t_{drawdown} = \frac{V}{A_{trench} \cdot i}$$

APPENDIX E

Septic Calculations

CROZIER & ASSOCIATES
Consulting Engineers

ONSITE SEWAGE SYSTEM RESIDENTIAL CALCULATION SHEET

Project Name: McCullough
Project Number: 903-3780
Date: 9-Nov-21
Designed By: GC
Checked By: RA

input required

House Details: 5 bedroom
325 m2

References

Description		Number of Units	Additional Flow per Unit (L)	Total Flow (L/day)
Base Flow				2500
Additional Flow				
i) Each bedroom over 5		0	500	0
ii) Area over 200m^2				
A) Each 10m^2 over 200m^2 to 400m^2		13	100	1300
B) Each 10m^2 over 400m^2 to 600m^2		0	75	0
C) Each 10m^2 over 600m^2		0	50	0
	Total Additional Sewage Flow from Area			1300
iii) Fixture Units over 20		15	50	750
			Addition flow (greatest of i,ii,iii)	**1300**
			Total Daily Design Sanitary Sewage Flow (L/day):	**3800**

Pre-Treatment Options

Required septic tank size = 7600 L minimum

Propose Level IV Treatment (Y/N): N

Native Percolation time, T = 50 min/cm

Imported Sand Percolation time = 10 min/cm

Option #1 - In Ground Absorption Trench

Length of distribution pipe required = 950.0 m 1520 m^2

Length of runs = 50 m
Number of runs = 19 runs
Length of distribution pipe provided = 950 m

Option #2 -Raised Absorption Trench

Length of distribution pipe required = 190.0 m

Length of runs = 50 m
Number of runs = 4 runs
Length of distribution pipe provided = 200 m

Maximum loading rate = 6 L/m^2/day

Minimum loading area = 633 m^2

Option #3 - Filter Bed			
Minimum required contact area =	76	m^2	
Required extended contact area =	224	m^2	
Maximum loading rate =	6	$L/m^2/day$	
Minimum loading area =	633	m^2	
Option #3 - Type A Dispersal Bed			
Stone area required =	76	m^2	
Sand area required =	475	m^2	
Option #5 - Shallow Buried Trench			
Length of distribution pipe required =	76	m	152 m^2
Length of runs =	20	m	
Number of runs =	4	runs	
Length of distribution pipe provided =	80	m	

APPENDIX F

Well Records

MINISTRY OF THE ENVIRONMENT

The Ontario Water Resources Act

WATER WELL RECORD

Ontario

91A/10West

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 — 2505270 — MUNICIP. 25016 — CON. CON BF

COUNTY OR DISTRICT: Grey — TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: Sydenham — CON., BLOCK, TRACT, SURVEY, ETC.: CON B? — LOT 25-27: 023

[redacted] Owen Sound, Ontario

DATE COMPLETED 48-53: DAY 11 MO. 06 YR. 76

RC. ELEVATION RC. BASIN CODE II III IV

2505270 17 512088 4944754 4 650 5 22 AUG 16, 1976 197 47

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
	Blue	Shale		0	90
		Plastic Liner 50ft. - 40-90			

31 — 0090317

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND	WATER
0080	2 TY	4 X MINERAL
	1 FRESH 3 SULPHUR	
	2 SALTY 4 MINERAL	
	1 FRESH 3 SULPHUR	
	2 SALTY 4 MINERAL	
	1 FRESH 3 SULPHUR	
	2 SALTY 4 MINERAL	
	1 FRESH 3 SULPHUR	
	2 SALTY 4 MINERAL	

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
05 5/16	1 STEEL	.188	0	0050
	2 GALVANIZED			
	3 CONCRETE			
	4 OPEN HOLE			
05 4½	1 STEEL #5	4/10 IN.	50	0090
	2 GALVANIZED			
	3 CONCRETE			
	4 OPEN HOLE PLASTIC			
	1 STEEL			
	2 GALVANIZED			
	3 CONCRETE			
	4 OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
10-13	14-17	
18-21	22-25	
26-29	30-33	

71 PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
1 ☐ PUMP 2 ☑ BAILER	0005 GPM	02 HOURS 00 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
020 FEET	070 FEET	1 ☑ PUMPING 2 ☐ RECOVERY	070 FEET	FEET	FEET	FEET

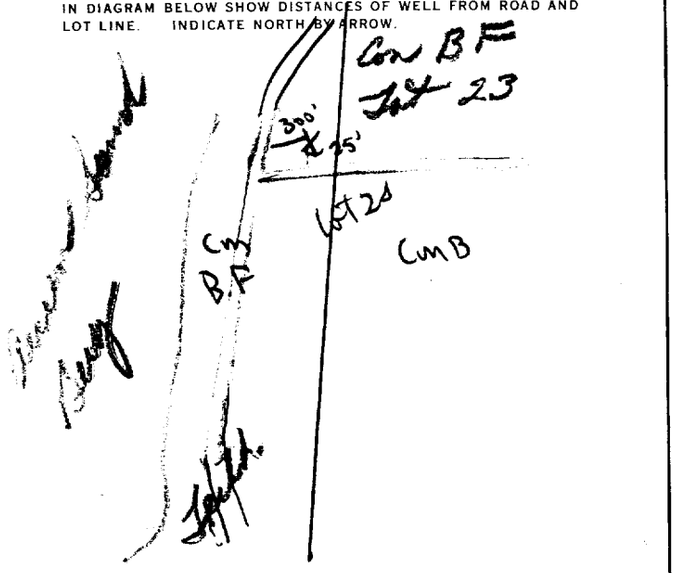
IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	60 FEET	1 ☑ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☑ DEEP	060 FEET	0003 GPM.

000.1 GPM./FT. SPECIFIC CAPACITY

LOCATION OF WELL 1244

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL 1

1 ☑ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED

WATER USE 01

1 ☑ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF DRILLING 4

1 ☐ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☑ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: Wm. Stright Well Drilling — LICENCE NUMBER: 5507

ADDRESS: Stepworth, Ont.

NAME OF DRILLER OR BORER: Bert Stright — LICENCE NUMBER: 5503

SIGNATURE OF CONTRACTOR: William Wright — SUBMISSION DATE: DAY ____ MO. ____ YR. ____

OFFICE USE ONLY

DATA SOURCE 1 — CONTRACTOR 5507 — DATE RECEIVED 290975

DATE OF INSPECTION 6/11/75 — INSPECTOR

REMARKS: PB, N.V

P TO

WMD

MINISTRY OF THE ENVIRONMENT COPY

FORM 7 MOE 07-091

Ministry of the Environment
Ontario

The Ontario Water Resources Act
WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 | 2512914 | MUNICIP 25016 | CON. B.F.

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT 25-27
[redacted]		Broken front Con.	22

[redacted] R. 2, Annan, Ont. N0H 1B0

DATE COMPLETED 48-53: DAY 13 MO 07 YR 95

ELEVATION | RC | BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
	top soil			0	1
brown	sandy clay			1	45
gray	clay	sand & gravel		45	57

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
10-13	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
15-18	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
20-23	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
25-28	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
30-33	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
6¼	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	1.88	0	54'7"
6¼	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☒ PLASTIC		54'7"	57
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.) | DIAMETER INCHES | LENGTH FEET
MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
		WELL CAPPED ALUMINUM CAP

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☐ BAILER | PUMPING RATE GPM | DURATION OF PUMPING HOURS MINS

STATIC LEVEL FEET | WATER LEVEL END OF PUMPING FEET | WATER LEVELS DURING 1 ☐ PUMPING 2 ☐ RECOVERY: 15 MINUTES FEET | 30 MINUTES FEET | 45 MINUTES FEET | 60 MINUTES FEET

IF FLOWING GIVE RATE GPM | PUMP INTAKE SET AT FEET | WATER AT END OF TEST: 1 ☐ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☐ DEEP | RECOMMENDED PUMP SETTING FEET | RECOMMENDED PUMPING RATE GPM

FINAL STATUS OF WELL

1 ☐ WATER SUPPLY
2 ☐ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☒ UNFINISHED
☐ DEWATERING

WATER USE

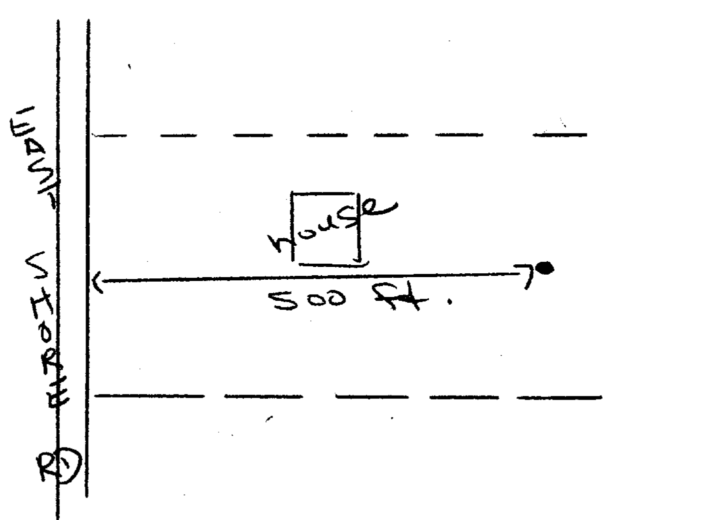
1 ☐ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☐ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☒ CABLE TOOL
2 ☐ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☐ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING
☐ DIGGING
☐ OTHER

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS

131945

CONTRACTOR

NAME OF WELL CONTRACTOR: JIM CLARKE WELL DRILLING LIMITED | WELL CONTRACTOR'S LICENCE NUMBER: 1565

ADDRESS: R. R. 2, Meaford, Ont. N4L 1W6

NAME OF WELL TECHNICIAN: Jim Clarke | WELL TECHNICIAN'S LICENCE NUMBER: T-0104

SIGNATURE OF TECHNICIAN/CONTRACTOR: [signature] | SUBMISSION DATE: DAY 17 MO 07 YR 95

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 1565 | DATE RECEIVED SEP 29 1995

DATE OF INSPECTION | INSPECTOR

REMARKS

CSS.ES

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

LIST OF FIGURES & DRAWINGS

Legend

= SUBJECT LANDS

Project

LEITH BAYSHORE ROAD
THE COUNTY OF GREY

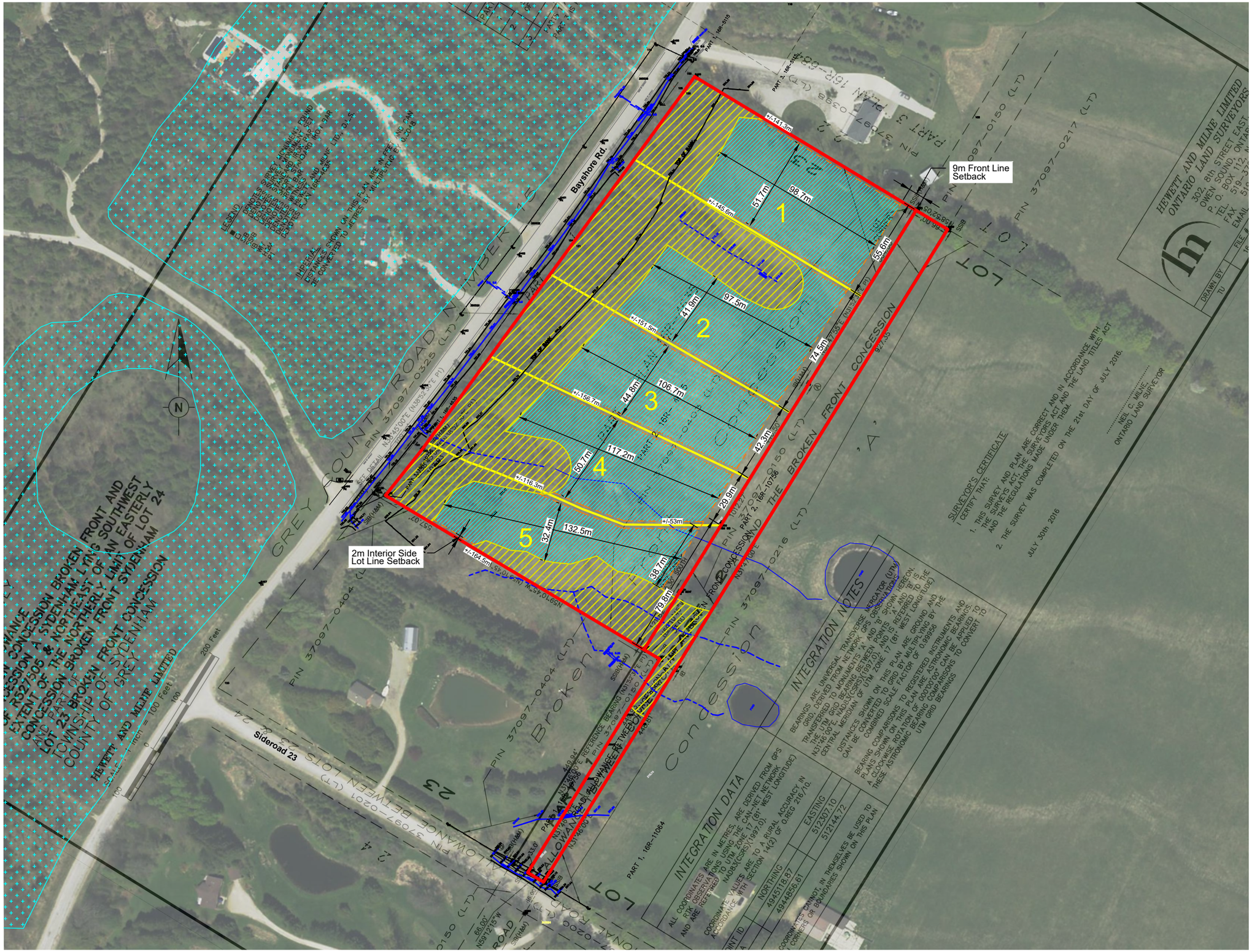
Drawing

SITE LOCATION

CROZIER CONSULTING ENGINEERS
Admiral Building
1 First Street, Suite 200
Collingwood, ON, L9Y 1A1
705-446-3510 T
705-446-3520 F
www.cfcrozier.ca
info@cfcrozier.ca

Drawn By	Design By	Project
N.L.	N.L./G.C.	903-3780

Scale	Date	Check By	Drawing
N.T.S.	06/30/2020	G.C.	FIG. 1



KEY PLAN
SCALE: N.T.S.

LEGEND

- SUBJECT LANDS BOUNDARY (Ref: July 30,2016 Survey)
- ENVIRONMENTAL PROTECTED / HAZARD AREAS (Ref: 15m Setback from Surveyed Top of Bank and Surveyed Swales)
- DEVELOPMENT ENVELOPE AREAS (Ref: 9m Front Lot Line Setback / 2m Interior Side Lot Line Setback)
- UNEVALUATED WETLANDS
- INTERMITTENT / EPHEMERAL SWALES
- PROPOSED LOT LINES

Total Lot Area / Lot Development Envelope Area:

Lot 1
7999.8m² / 5111.9m²
Lot 2
11282.9m² / 4801.5m²
Lot 3
7482.7m² / 4639.7m²
Lot 4
8102m² / 4454m²
Lot 5
8159.7m² / 3814m²

N

0 10 20 40 60 80 m

1 : 2000

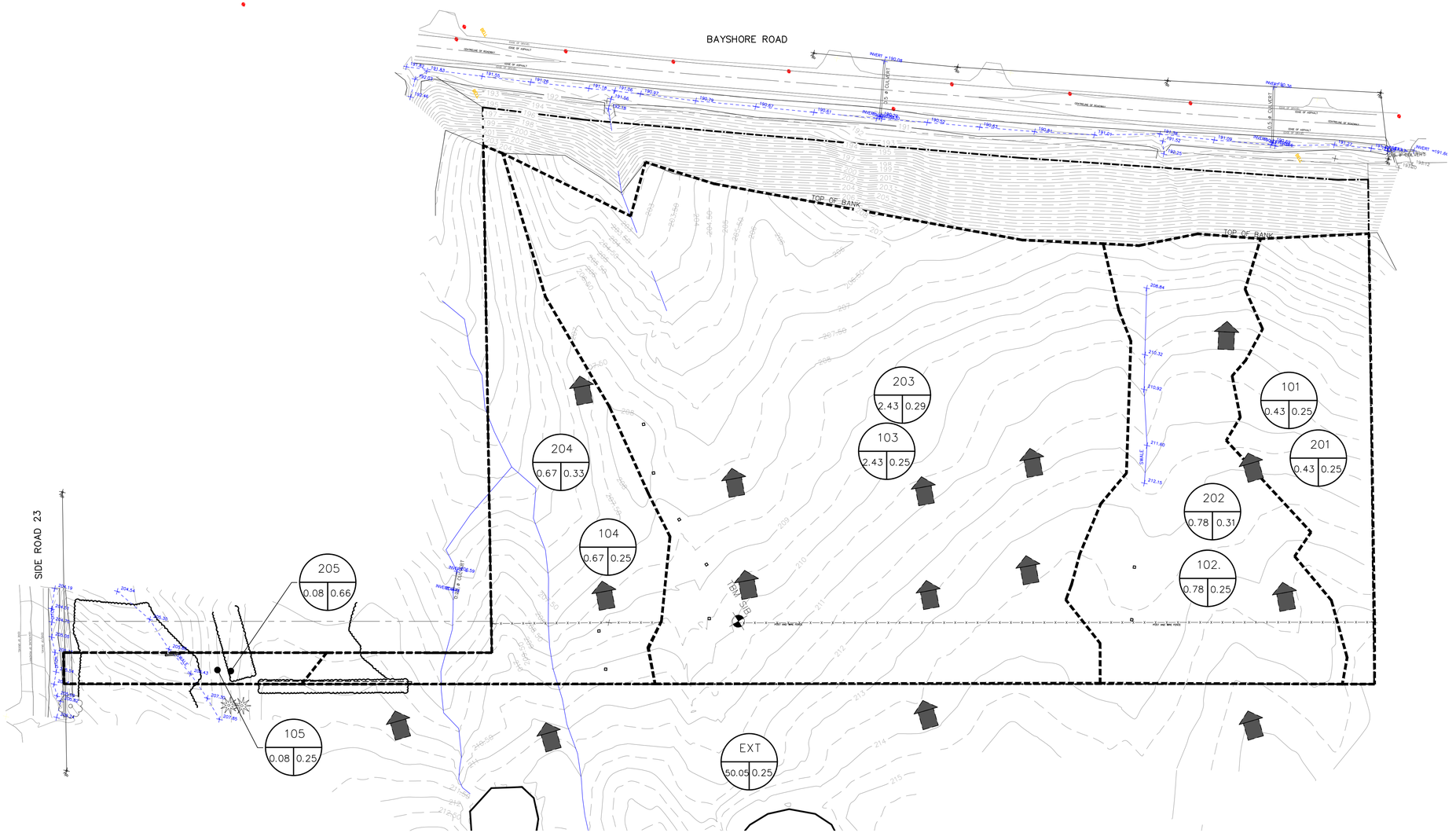
Project
CON BF PT LOT 23
COUNTY OF GREY, ONTARIO

Title
DEVELOPMENT OPPORTUNITIES AND CONSTRAINTS

CROZIER CONSULTING ENGINEERS
The HarbourEdge Building, 40 Huron Street, Suite 301, Collingwood, ON L9Y 4R3
705 446-3510 T
705 446-3520 F
www.CFCrozier.ca
info@CFCrozier.ca

Drawn By	Design By	Project	
D.C.	M.H.	CR-EIS-McC	
Date	Check By	Scale	Drawing
2020/02/20	M.H.	1:2000	Figure 5

Date Plotted: February 20, 2020



LEGEND

- 198 — X-ELEVATION
- PROPERTY BOUNDARY
- OVERLAND FLOW ARROW
- CATCHMENT ID (PRE-DEVELOPMENT) / RUN OFF COEFFICIENT
- CATCHMENT AREA (ha)
- CATCHMENT ID (POST-DEVELOPMENT) / RUN OFF COEFFICIENT
- CATCHMENT AREA (ha)
- DRAINAGE CATCHMENT AREA
- EXISTING DRAINAGE FEATURE

15 0m 15 30 45 60
SCALE: 1:750

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TEMPORARY BENCHMARKS

TBM#1- SQUARE IRON BAR (SIB), ELEVATION = 210.299
SURVEY COMPLETED BY VAN HARTEN ON JANUARY 29TH 2019

Town

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Engineer: LICENSED PROFESSIONAL ENGINEER — G.F. COOPER — 100532614 — Nov. 19, 2021 — PROVINCE OF ONTARIO

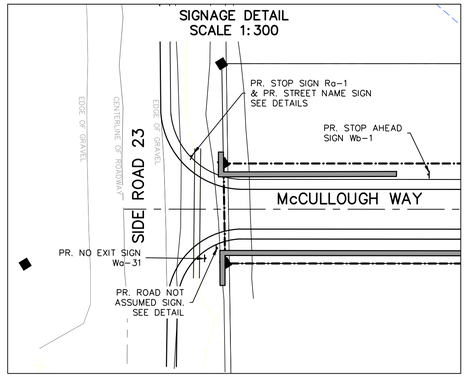
Project: LEITH-BAYSHORE ROAD
MUNICIPALITY OF MEAFORD

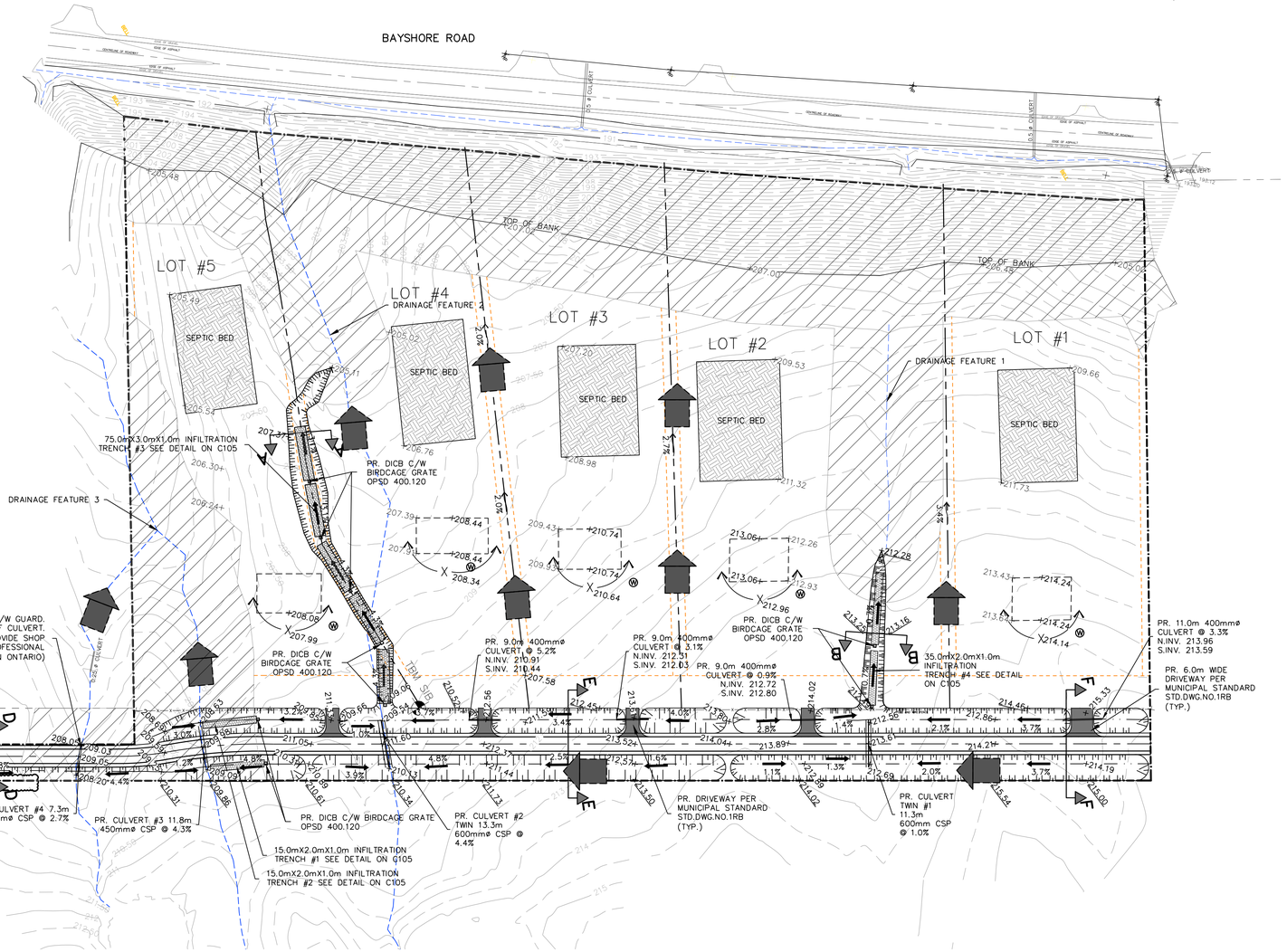
Drawing: PRE AND POST-DEVELOPMENT DRAINAGE PLAN

CROZIER CONSULTING ENGINEERS
Admiral Building
1 First Street, Suite 200
Collingwood, ON, L9Y 1A1
705-446-3510 T
705-446-3520 F
www.cfcrozier.ca
info@cfcrozier.ca

Drawn By	Design By	Project	
N.L.	N.L./G.C.		903-3780
Check By	Check By	Scale	Drawing
G.C.	R.A.	1:750	FIG . 3

J:\900\903 - McCullough\3780 - Leith Bayshore Rd\CAD\C3D\SHEETS\3780_C100-C103_(With Retaining Wall).dwg, 2021-11-19 3:27:59 PM, DWG To PDF.pc3





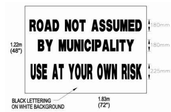
LEGEND

- PROPOSED BUILDING ENVELOPE
- PROPOSED WELL LOCATION
- ENVIRONMENTAL PROTECTED/HAZARD AREAS
- INFILTRATION TRENCH
- PROPOSED CONVENTIONAL SEPTIC DISPOSAL AREA (633m²)
- PROPOSED RESIDENCE (325m²)
- 2.5% — PROPOSED SWALE
- +213.05 — EXISTING GRADE
- +213.05 — PROPOSED GRADE
- +212.89 — PROPOSED GRADE (MATCH EXISTING)
- PROPOSED OVERLAND FLOW DIRECTION
- INTERCEPTOR SWALE
- RETAINING WALL
- RIP RAP

SIGN DETAILS

60cmx60cm
Ra-1 STOP SIGN

75cmx75cm
Wb-1 STOP AHEAD SIGN



ROAD NOT ASSUMED SIGN

STREET NAME SIGN

45cmX45cm
Wa-31 NO EXIT SIGN

15 0m 15 30 45 60
SCALE: 1:750

GENERAL GRADING NOTES:

1. REFER TO DRAWING C102 FOR CROSS-SECTION DETAILS
2. PROPOSED INFILTRATION TRENCHES HAVE BEEN DESIGNED TO PROVIDE THE REQUIRED QUANTITY CONTROLS FOR FULL BUILD-OUT OF THE DEVELOPMENT AND QUALITY FOR THE PROPOSED ROADWAY. QUALITY CONTROLS FOR INDIVIDUAL LOTS TO BE DESIGNED BY OTHERS AT BUILDING PERMIT STAGE (IF REQUIRED)
3. 150mmø RIP RAP (300mm DEEP) TO BE PROVIDED IN DITCHES THAT EXCEED A SLOPE OF 5.0%

GENERAL SERVICING NOTES:

1. DETAILED SEPTIC DESIGN AND LOCATION, AND WELL LOCATION TO BE CONFIRMED AT TIME OF DETAILED LOT DESIGN/BUILDING PERMIT.
2. SEPTIC BEDS TO MAINTAIN MINIMUM 15m SEPARATION FROM PROPOSED WELLS AND INFILTRATION FACILITIES.
3. SEPTIC BEDS TO MAINTAIN MINIMUM 3m SEPARATION FROM PROPERTY LINES.

TEMPORARY BENCHMARKS

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SURVEY COMPLETED BY VAN HARTEN ON JANUARY 29TH 2019

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Engineer: LICENSED PROFESSIONAL ENGINEER — G.F. COOPER — 100532614 — Nov. 18, 2021 — PROVINCE OF ONTARIO

Project: LEITH-BAYSHORE ROAD
MUNICIPALITY OF MEAFORD

Drawing: MASTER SERVICING & GRADING PLAN

CROZIER CONSULTING ENGINEERS
ADMIRAL BUILDING
1 FIRST STREET, SUITE 200
COLLINGWOOD, ON, L9Y 1A1
705-446-3510 T
705-446-3520 F
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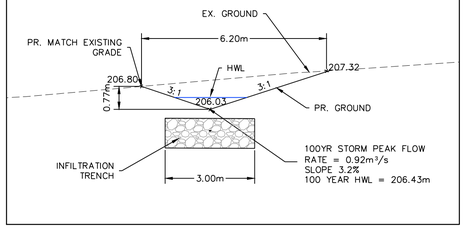
INFO@CFCROZIER.CA

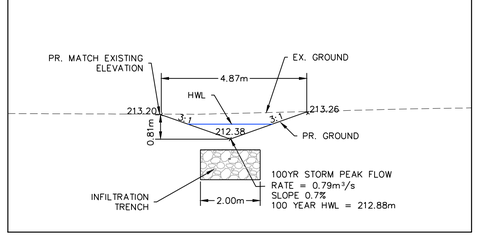
Drawn By	Design By	Project	
N.L.	N.L./G.C.		903-3780
Check By	Check By	Scale	Drawing
G.C.	R.A.	1:750	C101

J:\900\903 - McCullough\3780 - Leith Bayshore Rd\CAD\C3D\SHEETS\3780_C100-C103_(With Retaining Wall).dwg, 2021-11-18 4:43:14 PM, _AutoCAD PDF (General Documentation).pc3

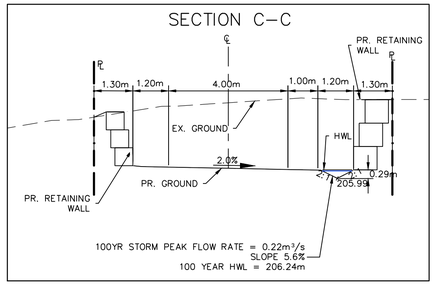
SECTION A–A



SECTION B–B



SECTION C–C



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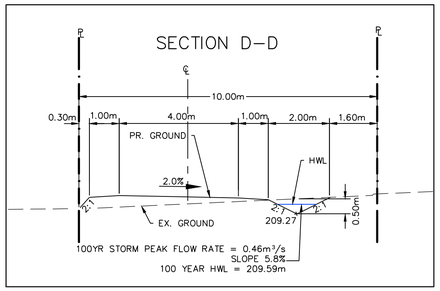
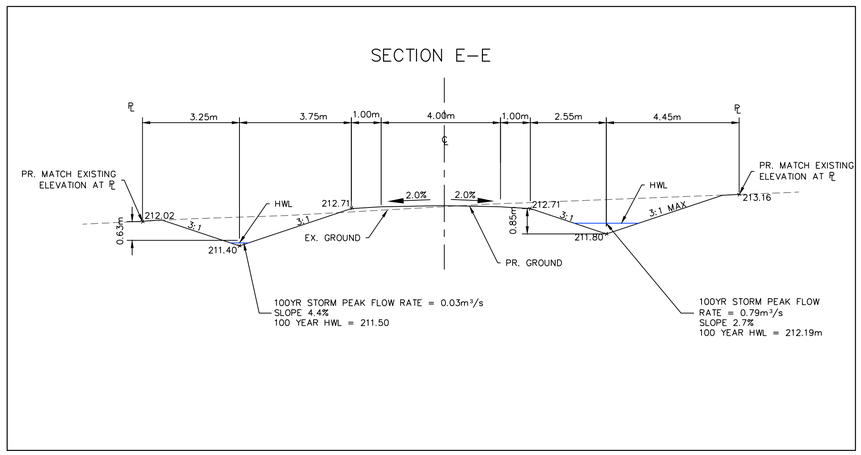
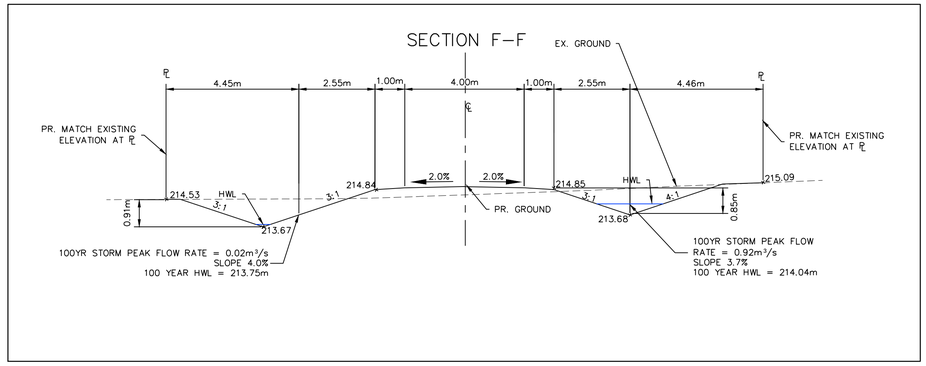


SECTION E–E



SECTION F–F



2 0m 2 4 6 8
SCALE: 1:100

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TEMPORARY BENCHMARKS

TBM#1– SQUARE IRON BAR (SIB), ELEVATION = 210.299
SURVEY COMPLETED BY VAN HARTEN ON JANUARY 29TH 2019

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Engineer: LICENSED PROFESSIONAL ENGINEER — G.F. COOPER — 100532614 — Nov. 18, 2021 — PROVINCE OF ONTARIO

Project: LEITH–BAYSHORE ROAD
MUNICIPALITY OF MEAFORD

Drawing: CROSS SECTIONS

CROZIER CONSULTING ENGINEERS
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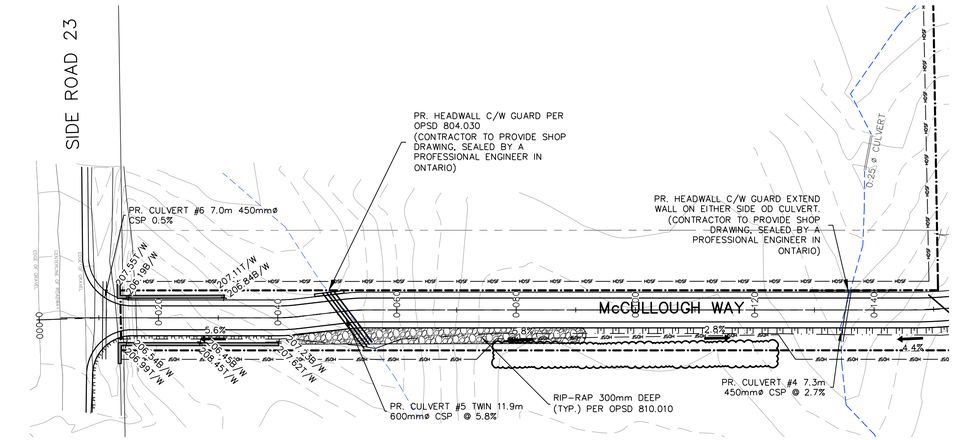
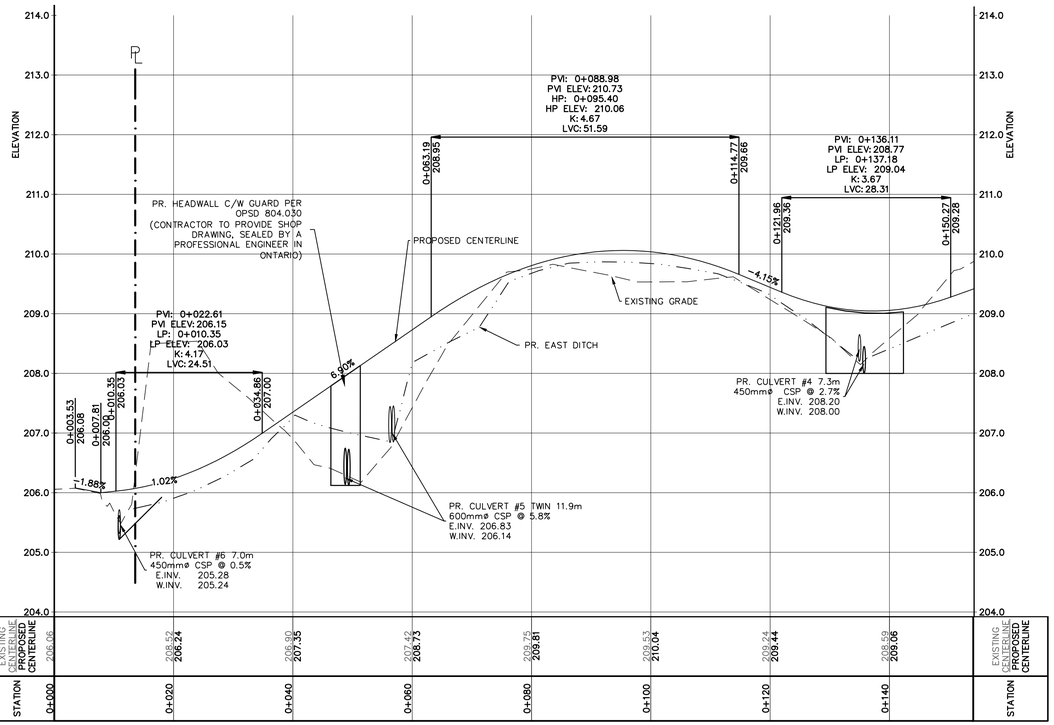
1 First Street, Suite 200
Collingwood, ON, L9Y 1A1
705-446-3510 T
705-446-3520 F
www.cfcrozier.ca
info@cfcrozier.ca

Drawn By	Design By	Project
N.L.	N.L./G.C.	903–3780
Check By	Check By	Scale / Drawing
G.C.	R.A.	1:100 / C102



LEGEND

- PROPOSED WEST DITCH
- PROPOSED EAST DITCH
- PROPOSED CENTER LINE
- TOP SLOPE
- EXISTING GRADE
- PROPOSED DRIPLINE
- PROPERTY BOUNDARY
- PR. HEAVY DUTY SILT FENCE
- X.X% PR. SLOPE & DIRECTION
- PR. RIP-RAP



10 0m 10 20 30 40
SCALE: 1:500

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Engineer: LICENSED PROFESSIONAL ENGINEER — G.F. COOPER — 100532614 — Nov. 18, 2021 — PROVINCE OF ONTARIO

Project: LEITH-BAYSHORE ROAD
MUNICIPALITY OF MEAFORD

Drawing: PLAN & PROFILE (STA. 0+000 TO 0+154)

CROZIER CONSULTING ENGINEERS
ADMIRAL BUILDING
1 FIRST STREET, SUITE 200
COLLINGWOOD, ON, L9Y 1A1
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705-446-3520 F
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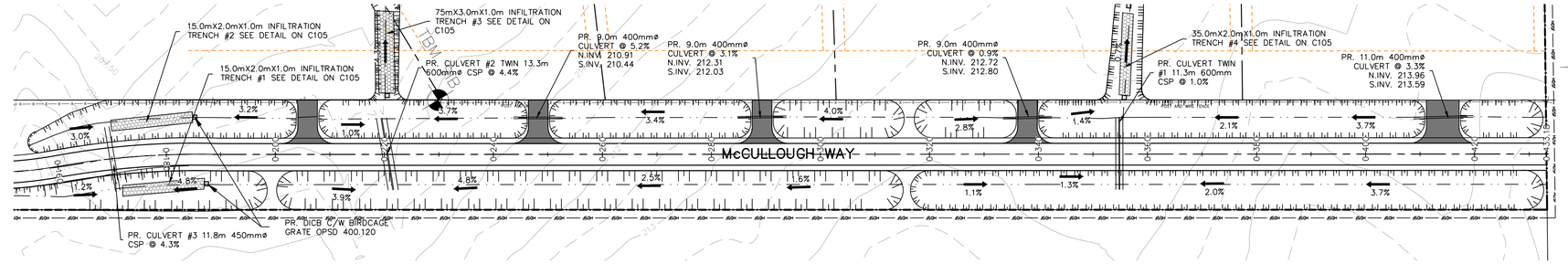
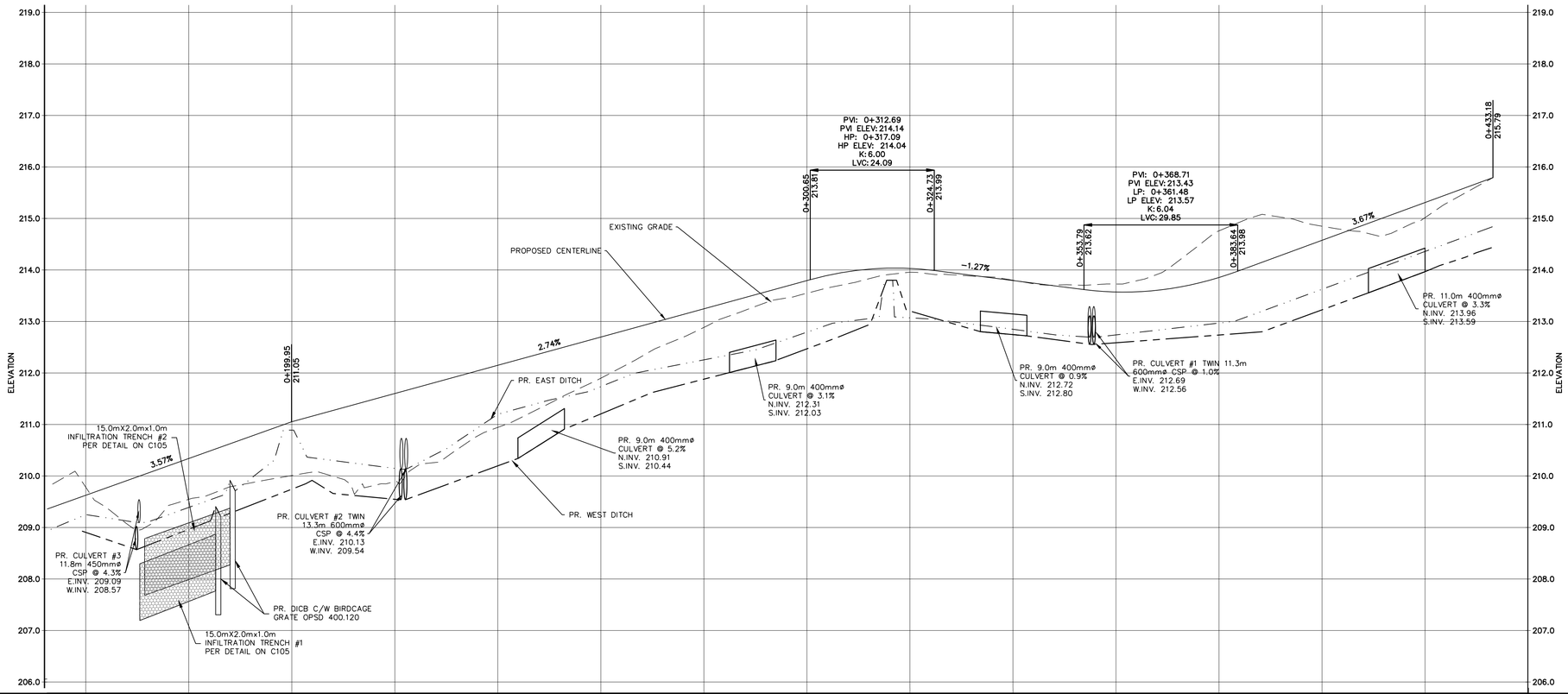
Drawn By	Design By	Project	
N.L.	N.L./G.C.		903-3780
Check By	Check By	Scale	Drawing
G.C.	R.A.	1:500	C103 A



LEGEND

- PROPOSED WEST DITCH
- PROPOSED EAST DITCH
- PROPOSED CENTER LINE
- TOP SLOPE
- EXISTING GRADE
- PROPOSED DRIPLINE
- PROPERTY BOUNDARY
- PR. HEAVY DUTY SILT FENCE
- X.X% PR. SLOPE & DIRECTION



STATION	0+160	0+180	0+200	0+220	0+240	0+260	0+280	0+300	0+320	0+340	0+360	0+380	0+400	0+420	0+440
EXISTING CENTERLINE	209.78	209.55	210.01	209.88	210.94	211.00	212.88	213.16	213.86	213.88	213.73	214.26	214.85	215.07	
PROPOSED CENTERLINE	209.63	210.34	211.05	211.60	212.15	212.70	213.25	213.79	214.03	213.79	213.57	213.85	214.58	215.31	

10 0m 10 20 30 40
SCALE: 1:500

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Engineer: LICENSED PROFESSIONAL ENGINEER G.F. COOPER 100532614 Nov. 18, 2021 PROVINCE OF ONTARIO

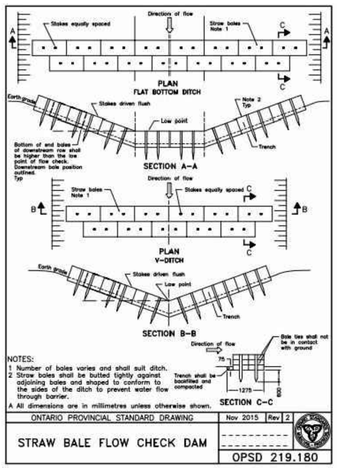
Project: LEITH–BAYSHORE ROAD
MUNICIPALITY OF MEAFORD

Drawing: PLAN & PROFILE (STA. 0+154 TO 0+440)

CROZIER CONSULTING ENGINEERS
ADMIRAL BUILDING
1 FIRST STREET, SUITE 200
COLLINGWOOD, ON, L9Y 1A1
705-446-3510 T
705-446-3520 F
WWW.CFCROZIER.CA
INFO@CFCROZIER.CA

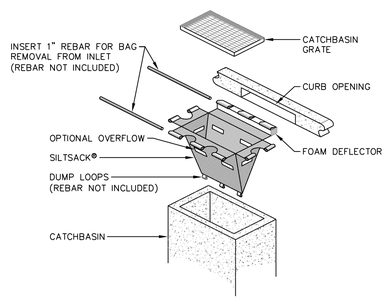
Drawn By	Design By	Project	
N.L.	N.L./G.C.		903–3780
Check By	Check By	Scale	Drawing
G.C.	R.A.	1:500	C103 B

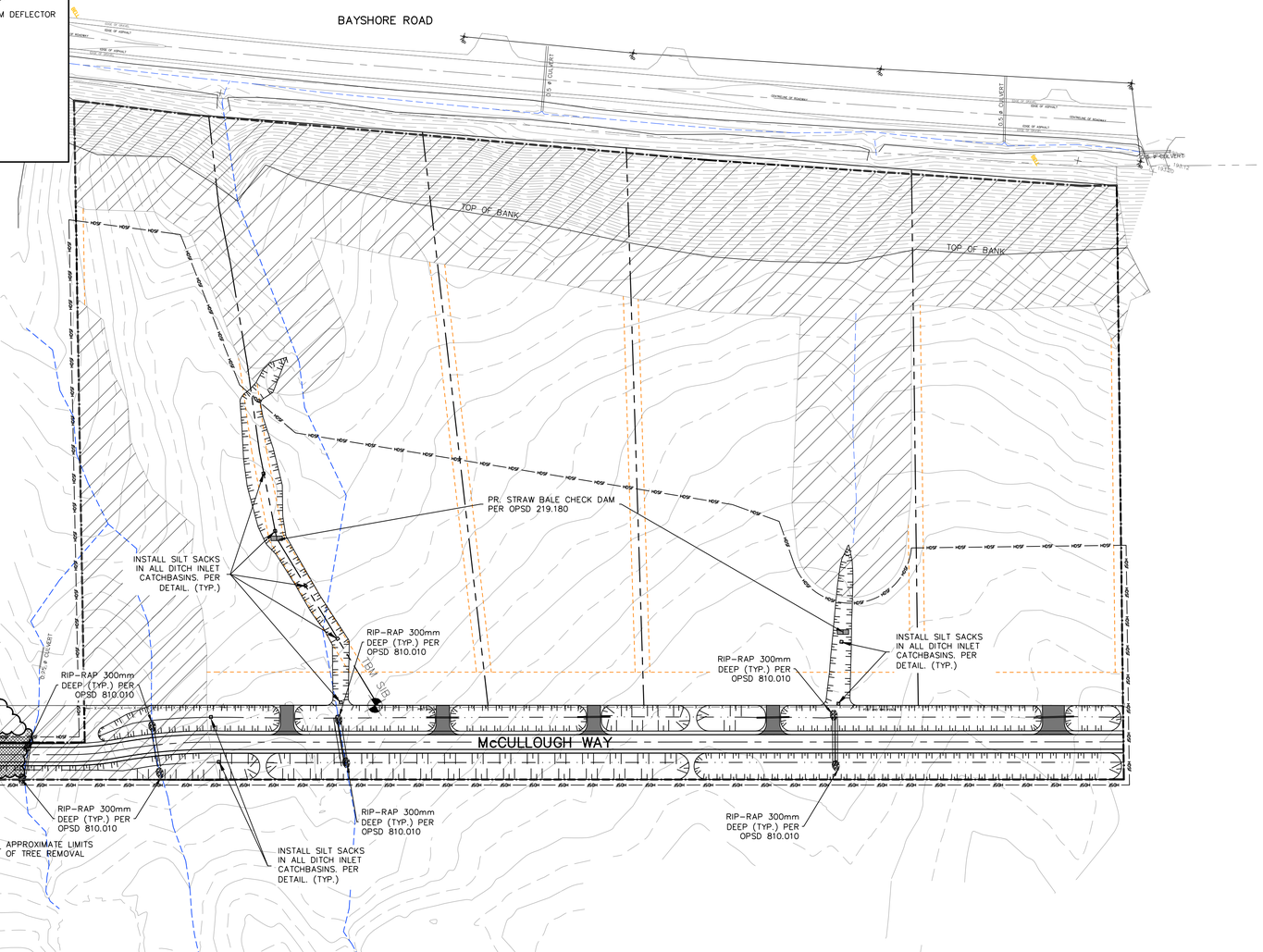
J:\900\903 - McCullough\3780 - Leith Bayshore Rd\CAD\C3D\SHEETS\3780_C100-C103_(With Retaining Wall).dwg, 2021-11-18 4:43:46 PM, _AutoCAD PDF (General Documentation).pc3



'SILT SACK' DETAIL

SCALE: N.T.S.



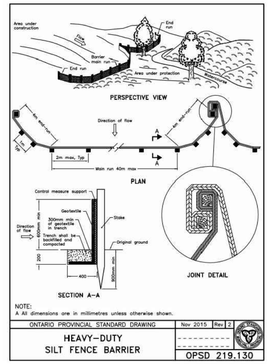


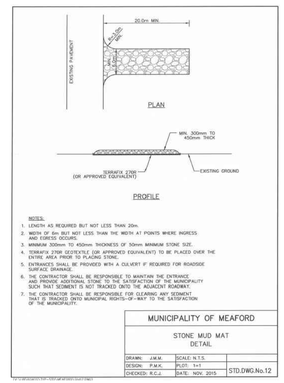
15 0m 15 30 45 60

SCALE: 1:750

LEGEND

- ENVIRONMENTAL PROTECTED/HAZARD AREAS
- INFILTRATION TRENCH
- 2.5% PROPOSED SWALE
- RETAINING WALL
- HDSF HDSF HDSF HEAVY DUTY SILT FENCE
- TREE REMOVAL AREA





NOTE:
THE HEAVY DUTY SILT FENCE HAS BEEN SHOWN OFF-SET OF THE PROPERTY LINE FOR VISUAL PURPOSES; HOWEVER, DURING CONSTRUCTION THE SILT FENCE WILL BE INSTALLED INSIDE THE PROPERTY

1. THIS DRAWING IS THE EXCLUSIVE PROPERTY OF C.F. CROZIER & ASSOCIATES INC. AND THE REPRODUCTION OF ANY PART WITHOUT PRIOR WRITTEN CONSENT OF THIS OFFICE IS STRICTLY PROHIBITED.
2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, LEVELS, AND DATUMS ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO THIS OFFICE PRIOR TO CONSTRUCTION.
3. THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER PLANS AND DOCUMENTS APPLICABLE TO THIS PROJECT.
4. DO NOT SCALE THE DRAWINGS.
5. ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

TEMPORARY BENCHMARKS

TBM#1– SQUARE IRON BAR (SIB), ELEVATION = 210.299
SURVEY COMPLETED BY VAN HARTEN ON JANUARY 29TH 2019

Town

No.	ISSUE	DATE: MM/DD/YYYY
0	ISSUED FOR CLIENT REVIEW	07/28/2020
1	RE-ISSUED FOR CLIENT REVIEW	08/18/2021
2	ISSUED FOR SECOND SUBMISSION	11/18/2021

Engineer: LICENSED PROFESSIONAL ENGINEER R.A. ALEXANDER 100213093 PROVINCE OF ONTARIO November 15, 2021

Engineer: LICENSED PROFESSIONAL ENGINEER G.F. COOPER 100532614 PROVINCE OF ONTARIO Nov. 18, 2021

Project: LEITH–BAYSHORE ROAD
MUNICIPALITY OF MEAFORD

Drawing: EROSION & SEDIMENT CONTROL PLAN

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Check By G.C.	Check By R.A.	Scale 1:750	

J:\900\903 - McCullough\3780 - Leith Bayshore Rd\CAD\C3D\SHEETS\3780_C100-C103_(With Retaining Wall).dwg, 2021-11-18 4:43:54 PM, _AutoCAD PDF (General Documentation).pc3