

SERVICING AND STORMWATER MANAGEMENT REPORT



Project No.: OCP-17-0381

6776 Rothbourne Road – Metro Towing Warehouse

Prepared for:

Metro Towing
2759 Lancaster Road
Ottawa, ON K1B 4V8

Prepared by:

McIntosh Perry Consulting Engineers
115 Walgreen Road
Carp ON K0A 1L0

Revision 1: July 17, 2019

Executive Summary

Developing a site within the City of Ottawa requires meeting a predefined set of requirements outlined in the City of Ottawa Sewer Design Guidelines (SDG) - 2012 along with meeting the local conservation authority requirements (Mississippi Valley Conservation Authority - MVCA) and provincial requirements (Ministry of Environmental, Conservation and Parks - MECP). Site specific requirements are discussed and outlined in the pre-consultation meeting with the City of Ottawa before the detailed design process is initiated.

This report describes an innovative and cost-efficient design solution for the site servicing (water, sanitary, and storm) and stormwater management (SWM) requirements in order to develop this site. The Mississippi Valley Conservation Authority (MVCA) an enhanced level of treatment for runoff. A Stormceptor unit is proposed to provide the required amount of quality control requested.

Evaluation of the proposed site plan in addition to a review of the site grading and soil characteristics was completed. Our review identified that grassed swales and ponding areas with restricted flows provided the optimal design solution to meet the stormwater management requirements. During storm events the stormwater will be retained within the enhanced grassed swales and ponding area until the storm event subsides and flows reduce. These design elements will ensure that water quality and quantity concerns are addressed at all stages of development.

The evaluation of the proposed development, existing site characteristics and surrounding municipal infrastructure suggests that the SWM design elements consisting of grass swales and pond areas will be a possible design solution to the site constraints. The proposed septic and well will service the development. Therefore, it is our professional opinion that this site located at 6776 Rothbourne Road is able to be developed to accommodate the proposed Metro Towing Building and parking area.

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1.0 PROJECT DESCRIPTION

1.1 Purpose

McIntosh Perry (MP) has been retained by Metro Towing to prepare this Servicing and Stormwater Management Report in support of the Site Plan Control process for the proposed development located at 6776 Rothbourne Road within the City of Ottawa.

The main purpose of this report is to present a servicing design for the development in accordance with the recommendations and guidelines provided by the City of Ottawa (City), the Mississippi Valley Conservation Authority (MVCA), and the Ministry of the Environment, Conservation and Parks (MECP). It should be noted that a stormwater management plan had been previously approved for the existing development on the south portion of the site, however there are currently no existing measures in place. As such, this report will include a comprehensive stormwater management design that will be completed to address the existing and proposed development on the site.

This report should be read in conjunction with the following drawing:

- CP-17-0381, C101 – Lot Grading, Drainage, Sediment and Erosion Control Plan.

1.2 Site Description

The property is located at 6776 Rothbourne Road. It is described as Part of Lot 18, Concession 12, City of Ottawa, Ontario (see Appendix 'A' for Key Plan). The land in question covers approximately 10.08 ha. The property currently has an existing wetland in addition to Hazeldean Municipal Drain running through the site. The northern portion of the site is currently developed with a building fronting Rothbourne Road and a gravel parking area. There is an existing berm currently constructed at the south side of the existing development area and north of the wetland area. The wetland and drain are located within the middle section of the site. The rear portion of the site is currently undeveloped.

The proposed development consists of a 969 m², one-storey warehouse with gravel parking at the rear portion of the site. An access road will be constructed through the middle wetland portion of the site. Swales are proposed adjacent to existing berms at the south side of the site for stormwater management purposes.

2.0 BACKGROUND STUDIES

Background studies that have been completed for the site include review of a topographical survey of the site, a geotechnical report, a Phase I Environmental Site Assessment (ESA) and a Servicing Brief for the existing development.

A topographic survey of the site was completed on June 17, 2019 by MPSI and can be found under separate cover.

The following reports have previously been completed and are available under separate cover:

- Geotechnical Investigation completed by McIntosh Perry dated June 2019.
- Phase I ESA completed by McIntosh Perry dated July 2019.
- Servicing Brief completed by McIntosh Perry dated May 2, 2007.

3.0 PRE-CONSULTATION SUMMARY

City of Ottawa Staff and MVCA have been pre-consulted regarding this proposed development. Specific design parameters to be incorporated within this design include the following:

- Pre-development and post-development flows shall be calculated using a time of concentration (T_c) of 20 minutes and 10 minutes, respectively.
- Control 5 through 100-year post-development flows to the 5 and 100-year pre-development flows with a combined C value to a maximum of 0.50.
- Update stormwater management calculations and facilities for the existing development.
- Enhanced (80% TSS removal) is required.

Correspondence can be found in Appendix 'B'.

4.0 EXISTING SERVICES

There are no underground services available within the Rothbourne Road right-of-way though overhead wires are present along the frontage of the site. There is a well and septic located near the existing building.

The existing Servicing Brief completed for the existing development at the south of the site indicates there were proposed stormwater management facilities (swale and ponding area), however after a review of the topographic survey it appears there are currently no stormwater management measures in place.

5.0 SERVICING PLAN

5.1 Proposed Servicing Overview

The proposed building will not require water and sanitary services. Fire tanks are proposed within 90m of the building for firefighting.

The stormwater for the northern area of the site (existing development) will continue to be conveyed by sheet flow towards the south and into proposed swales along the north side of the existing berm prior to being discharged.

The stormwater for the south area of the site (proposed development) will be conveyed by sheet flow towards the north and into proposed ponding area along the south side of the proposed berm prior to being discharged.

5.2 Proposed Water Design

Fire protection will be provided on site via concrete water storage tanks. The minimum supply of water was calculated per the Ontario Building Code and is 135,000L (35,663 gal). Four 10,000gal concrete water tanks have been proposed for the fire protection water supply for the proposed building. Refer to Appendix 'C' for calculations.

5.3 Proposed Storm Design (Conveyance and Management)

The site has been described as three areas. The south area being the proposed development, the middle area being the wetland, and the north area being the existing development. For calculation purposes, it will be assumed that the north area is currently undeveloped. There will be an increase in stormwater runoff due to the change in impermeable surface area. To manage the increase in stormwater runoff, grassed swales, ponds, and outlets equipped with orifice plates and earth weirs have been designed to convey and restrict stormwater runoff.

Stormwater runoff will be conveyed to the swales and pond via overland flow. The storage during the 5 through 100-year storm events shall be provided by swales and pond. The combined restricted flow from the swales and pond will not exceed the pre-development flows for the respective storm events. The outlet pipes have been sized for 5-year flows and equipped with an orifice plate to control the flows. The pond has also been equipped with a trapezoidal earth weir. The stormwater management design will be further detailed in Section 6.0.

5.4 Site Utilities

The proposed building at the rear of the site will not require utilities.

6.0 PROPOSED STORMWATER MANAGEMENT

6.1 Design Criteria and Methodology

The northern portion of the site is currently developed however no stormwater management facilities are currently in place. Swales with an orifice at the outlet will be proposed to provide the required restriction and storage for the developed area. The drainage pattern for this portion of the site will remain as it currently is in its developed state. Emergency overland flow will be directed towards the adjacent ditch and ultimately the wetland area.

Stormwater management for the south portion will be maintained through positive drainage away from the proposed building and be conveyed by way of overland sheet flow to the north where a ponding area equipped with an earth weir and orifice are proposed to restrict the runoff and provide storage. The emergency overland flow will be directed towards the wetland area. The quantitative and qualitative properties of the storm runoff for both the pre- and post-development flows are further detailed below.

Stormwater Best Management Practices (SWM BMP's) will be implemented at the "Lot level", "Conveyance" and "End of Pipe" locations. These concepts will be explained further in Section 6.3.

6.2 Runoff Calculations

Runoff calculations presented in this report are derived using the Rational Method, given as:

$$Q = 2.78CIA \text{ (L/s)}$$

Where C = Runoff coefficient
 I = Rainfall intensity in mm/hr (City of Ottawa IDF curves)
 A = Drainage area in hectares

It is recognized that the rational method tends to overestimate runoff rates. As a by-product of using extremely conservative prediction method, any facilities that are sized using these results are expected to function as intended in real world conditions.

The following coefficients were used to develop an average C for each area:

Table 1: Average Runoff Coefficients (C)

Roofs/Concrete/Asphalt	0.90
Gravel	0.60
Undeveloped and Grass	0.20

As per the City of Ottawa Sewer Design Guidelines, the 5-year balanced 'C' value must be increased by 25% for a 100-year storm event to a maximum of 1.0.

The time of concentration (Tc) used for pre-development and post-development flows shall be calculated using a time of concentration (Tc) of 20 and 10 minutes, respectively.

6.2.1 Pre-Development Drainage

The existing site has been demonstrated as drainage areas A1, A2, and A3. Drainage area A1 represents the north site area that is currently developed. Pre-development calculations will assume the area is vegetated as it was prior to development. Drainage area A2 is the middle portion of the site consisting of a wetland and the Hazeldean Municipal Drain. Drainage area A3 is the south portion of the site and is currently undeveloped with vegetation. Drawing CP-17-0381 PRE (Appendix 'D') indicates the limits of the drainage areas. Table 2 demonstrates the existing flow rates in pre-development conditions.

Table 2: Pre-Development Runoff Summary

Area ID	Drainage Area (ha)	Runoff Coefficient (5-year)	Runoff Coefficient (100-year)	T _c (min)	Unrestricted 5-year Peak Flow (L/s)	Unrestricted 100-year Peak Flow (L/s)
A1	2.87	0.20	0.25	20	112.09	239.23
A2	2.95	0.20	0.25	20	115.08	245.62
A3	4.27	0.20	0.25	20	166.73	355.85
Total	10.08				393.89	840.69

(See Appendix 'F' for Calculations)

6.2.2 Post-Development Drainage

The post-development drainage plan was designed to retain runoff generated by a 5 and 100-year storm event onsite. Stormwater exceeding this amount is directed to the wetland area. The post-development flows have been restricted to match the pre-development flows for the entire site. The proposed drainage and overland flow directions are indicated on drawing CP-17-0381 POST (Appendix 'E'). Table 3 below displays the post-development runoff generated by the proposed site.

Table 3: Post-Development Runoff Summary

Area ID	Drainage Area (ha)	Runoff Coefficient (5-year)	Runoff Coefficient (100-year)	T _c (min)	Unrestricted 5-year Peak Flow (L/s)	Unrestricted 100-year Peak Flow (L/s)
B1	2.27	0.60	0.75	10	396.20	847.49
B2	0.60	0.39	0.49	10	68.73	146.49
B3	0.85	0.28	0.34	10	68.08	142.83
B4	3.42	0.60	0.75	10	598.21	1278.46
B5	2.95	0.22	0.28	20	128.63	274.54
Total	10.08				1259.86	2689.81

(See Appendix 'F' for Calculations)

Areas B1 and B2 make up the front northern portion of the site that is currently developed. Area B5 is the middle portion of the site consisting of the wetland and Hazelden Municipal Drain. Area B3 and B4 make up the rear southern portion of the site which will be the new development. Areas B2, B3, and B5 will be unrestricted areas. Runoff from areas B1 and B4 will be restricted before outletting to the wetland area. The restrictions will make up for the increased impermeable surface of the site as well as the unrestricted runoff leaving the site. See Appendix 'F' for calculations. This restriction and quality runoff control will be further detailed in Sections 6.3 and 6.4.

6.3 Quantity Control

The post-development runoff for this site has been restricted to match the 5 and 100-year pre-development flow rates with a calculated C value of 0.20 and 0.25, respectively. Reducing site flows will be achieved using flow restrictions and will create the need for onsite storage. Runoff from areas B1 and B4 will be restricted as detailed in Table 5 below.

Table 4: Post-Development Restricted Runoff Calculations

Area ID	Post-Development Unrestricted (L/s)		Post-Development (Restricted) (L/s)		
	5-yr	100-yr	5-yr	100-yr	
B1	396.20	847.49	11.41	13.16	Restricted
B2	68.73	146.49	68.73	146.49	Unrestricted
B3	68.08	142.83	68.08	142.83	Unrestricted
B4	598.21	1278.46	69.80	262.62	Restricted
B5	128.63	274.54	128.63	274.54	Unrestricted Wetland
Total	1259.86	2689.81	346.66	839.63	

(See Appendix 'F' for Calculations)

Runoff from Area B1 will be restricted at the outlet by a 80 mm diameter orifice plug within the 600 mm diameter outlet pipe. This orifice plug will restrict the 5 and 100-year storm event flows to 11.41 L/s and 13.16 L/s creating a water surface elevations (WSEL) of 131.62 and 131.86. The storage for this area will be provided within the grassed swale before being outlet to the adjacent ditch and ultimately to the wetland.

Runoff from area B4 will be restricted at the outlet by a 210 mm diameter orifice plug within the 600 mm diameter outlet pipe as well as a trapezoidal earth weir with a bottom dimension of 1.60 m and 3:1 side slopes. This orifice plug will restrict area B4 to 69.80 L/s for the 5-year storm event creating a water surface elevation (WSEL) of 131.23. The 100-year storm event flows will be restricted by both the orifice plug and trapezoidal earth weir restricting the flows to 262.62 L/s creating a WSEL of 131.50. The storage for this area will be provided within the grassed ponding area. Table 6 below details the amount of required and provided storage before outletting to the wetland.

Table 5: Site Storage Summary

Area	Depth of Ponding (m) for 5-yr storm	5-year required storage (m ³)	5-year available storage (m ³)	Depth of Ponding (m) for 100-yr storm	100-year required storage (m ³)	100-year available storage (m ³)
B1	0.77	375.80	384.70	1.01	719.30	720.40
B4	0.61	441.30	458.70	0.88	720.90	724.10

(See Appendix 'F' for Calculations)

6.4 Quality Control

The development of this lot will employ Best Management Practices (BMP's) wherever possible. The intent of implementing stormwater BMP's is to ensure that water quality and quantity concerns are addressed at all stages of development. Lot level BMP's typically include temporary retention of the parking lot runoff, minimizing ground slopes and maximizing landscaped areas. Some of these BMP's cannot be provided for this site due to site constraints and development requirements. The grassed swale and ponding area have a variant cross-slope and a drainage conveyance slope of 0.5% to slow down the stormwater which creates an opportunity for infiltration and removal of total suspended solids. It is suggested that the grassed swale be evaluated yearly to determine if the amount of suspended solid accumulation requires removal. The site requires enhanced quality control (80% TSS removal). A Stormceptor unit within MH2 has been proposed to achieve the requirement.

7.0 SEDIMENT EROSION CONTROL

The site-grading contractor is responsible for ensuring sediment control structures are installed in accordance with the Site Grading and Drainage Plan as indicated. Silt fences shall be installed on site before construction or earth-moving operations begin, as shown on the Site Grading and Drainage Plan.

The Contractor, at their discretion or at the instruction of the City, the Conservation Authority or the Contract Administrator shall increase the quantity of erosion and sediment controls on-site to ensure that the site is operating as intended and no additional sediment finds its way into the ditches on site. The straw bales & silt fences shall be inspected weekly and after rainfall events. Care shall be taken to properly remove sediment from the fences and check dams as required.

Work through winter months shall be closely monitored for erosion along sloped areas. Should erosion be noted, the Contractor shall be alerted and shall take all necessary steps to rectify the situation. Should the Contractor's efforts fail at remediating the eroded areas, the Contractor shall contact the Conservation Authority to review the site conditions and determine the appropriate course of action. As the ground begins to thaw, the Contractor shall place silt fencing at all required locations as soon as ground conditions both warrant and permit.

8.0 SUMMARY

- A new 969 m² warehouse and gravel parking will be constructed within the rear portion of the site located at 6776 Rothbourne Road.
- The existing development at the front portion of the site will remain with proposed stormwater management features applied.
- A new access roadway will be constructed through the wetland portion of the site to access the rear property development.
- The proposed building will not require water and sanitary services. Fire tanks are proposed within 90m of the building for firefighting.
- Stormwater runoff for the existing development area will be directed by overland sheet flow to the proposed swale and will be restricted before outletting.
- Stormwater runoff for the new development area will be directed by overland sheet flow to the proposed ponding area and will be restricted before outletting.
- As discussed with the City of Ottawa staff, the stormwater management design will ensure that the post-development flow rates are restricted to the 5-year and 100-year pre-development flow rate respectively, with a calculated maximum C value of 0.50.
- The stormceptor unit will account for 80% total suspended solid removal per the Mississippi Valley Conservation Authorities requirements.

9.0 RECOMMENDATIONS

Based on the information presented in this report, we recommend that City of Ottawa approve this Servicing and Stormwater Management Report in support of the proposed development on Rothbourne Road.

The sediment and erosion control plan outlined in Section 7.0 and detailed in the Grading and Drainage Plan notes are to be implemented by the contractor.

This report is respectfully being submitted for approval.



Ryan Kennedy, P.Eng.
Practice Area Lead, Land Development
McIntosh Perry Consulting Engineers
T: 613.903.5766
E: r.kennedy@mcintoshperry.com

A handwritten signature in blue ink that reads "C. Hampel".

Charissa Hampel, EIT
Engineering Intern, Land Development
McIntosh Perry Consulting Engineers
T: 613.714.4625
E: c.hampel@mcintoshperry.com

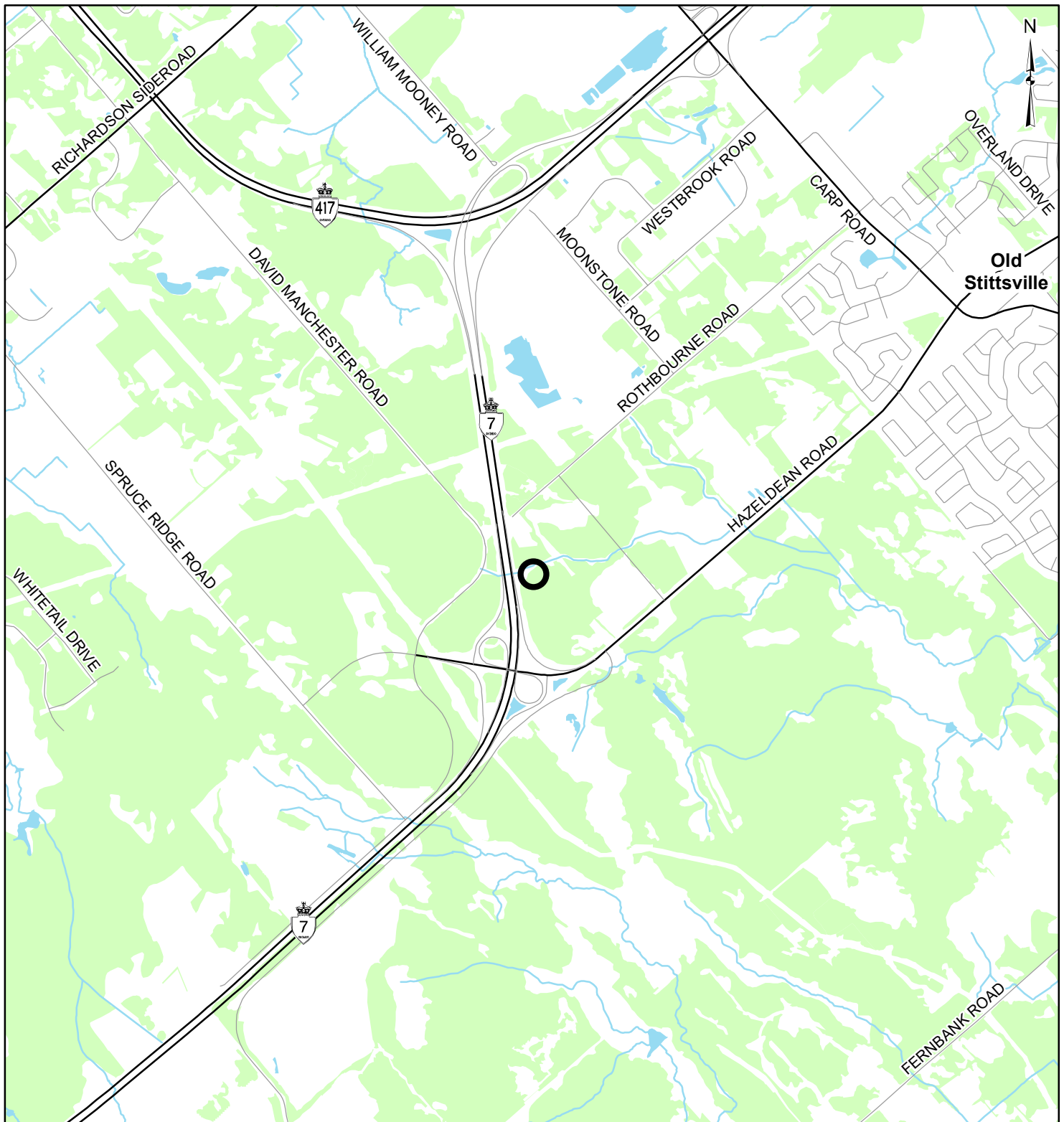
10.0 STATEMENT OF LIMITATIONS

This report was produced for the exclusive use of Metro Towing. The purpose of the report is to assess the existing stormwater management system and provide recommendations and designs for the post-construction scenario that comply with the guidelines and standards from the Ministry of the Environment, Conservation and Parks, City of Ottawa and local approval agencies. McIntosh Perry reviewed the site information and background documents listed in Section 2.0 of this report. While the previous data was reviewed by McIntosh Perry and site visits were performed, no field verification/measures of any information were conducted.

Any use of this review by a third party, or any reliance on decisions made based on it, without a reliance report is the responsibility of such third parties. McIntosh Perry accepts no responsibility for damages, if any, suffered by any third party as a result of decisions or actions made based on this review.







The findings, conclusions and/or recommendations of this report are only valid as of the date of this report. No assurance is made regarding any changes in conditions subsequent to this date. If additional information is discovered or becomes available at a future date, McIntosh Perry should be requested to re-evaluate the conclusions presented in this report, and provide amendments, if required.

APPENDIX A: KEY PLAN



0 375 750 1,500
Scale 1:30,000 Metres

LEGEND

-  Site Location
-  Watercourse
-  Local Road
-  Waterbody
-  Major Road
-  Wooded Area

REFERENCE

GIS data provided by the Ontario Ministry of Natural Resources and Forestry, 2019.
Note: Property and severance boundaries are approximate.

CLIENT:		METRO TOWING	
PROJECT:		6776 ROTHBORNE ROAD	
TITLE:		SITE LOCATION	
McINTOSH PERRY 115 Walgreen Road, RR3, Carp, ON K0A1L0 Tel: 613-836-2184 Fax: 613-836-3742 www.mcintoshperry.com		PROJECT NO: CP-17-0381	FIGURE:
		Date	Jul., 09, 2019
		GIS	LC
		Checked By	CH
		1	

APPENDIX B:
PRE-CONSULTATION NOTES

Pre-Application Consultation Notes

Date: August 30, 2017

Subject Address: 6776 Rothbourne Road

Attendees: Natalie Persaud, City, Planner
Matthew Hayley, City, Environmental Planner
Amira Shehata, City, Transportation
Kevin Hall, City, Infrastructure
Cheryl McWilliams, City, Sr. Planner
Nick Stow, City, Sr. Policy Planner (Natural Systems)
Andy Moore, MVCA, Regulations Officer
Benjamin Clare, McIntosh Perry, Planner
Heather Lunn, McIntosh Perry, Biologist
Ack Wehbe, Metro Towing

Existing Use: Automobile Salvage Yard
City of Ottawa, Emergency/Protective Services uses site for training purposes.

Existing Policies:

Zoning: Dual zoned, RG1 and EP3
Rural General Industrial, Subzone 1, permits for storage yard
EP3 does not permit this landuse

Official Plan: Schedule A, Rural Policy Plan
General Rural Area
Significant Wetlands

Proposed Use:

It is proposed to construct a drive aisle across the portion of the lands zoned EP3 (Significant Wetlands), to access the rear section of the site zoned RG1, for the purpose of additional area for storage of salvaged vehicles.

No mechanic or body work is being conducted at the site nor is proposed, and the site is currently used by the City of Ottawa Emergency & Protective Services for training purposes, using vehicles on site.

Comments:

Planning
Natalie.Persaud@ottawa.ca
(613) 580-2424 Ext. 12681

At minimum, an application to revise the existing site plan and a zoning bylaw amendment will be required for the proposal. It is based on whether or not the lands affected are considered

wetlands. The City will not support alterations to the wetland. The notes that follow provide information pertaining to the preparation of plans and studies related to any application for the proposed development, however, do note, that it is provided on the basis that the lands are not wetlands.

Do confirm that first and then we can proceed. A full list of required plans is studies is not included. But can be should you wish to know generally what would be expected.

Engineering

Kevin.Hall@ottawa.ca
(613) 580-2424 Ext. 27824

Application submission will require,

- Updated engineering drawings showing what has changed from what has been approved. Drawings for the new area as well.
- Updated stormwater report for existing site and the new area.
- Geotechnical report
- Ministry of Environment and Climate Change (MOECC) application for Environment Compliance Approval will be required.

Environment

Matthew.Hayley@ottawa.ca
(613) 580-2424 Ext. 23358

Planning application in support of this development will require the submission of an Environmental Impact Statement (EIS).

The wetland boundary needs to be confirmed and is done so with a qualified Ontario Wetland Evaluation System evaluator. The wetland is the Goulbourn Wetland Complex.

With regards to the EIS:

- discuss the wetland boundary
- Blanding's turtle habitat mapping, and other Endangered and Threatened Species
- Consult with the Ministry of Natural Resources and Forestry (MNRF) for habitat and approvals.
- Watercourse setbacks and crossings
- Fish Habitat through the Department of Fisheries and Ocean (DFO) self-assessment process
- Terms of Reference (which the City can review ahead of time).

The watercourse is a municipal drain. Consult with the City's drain's group for further information (David Ryan, David.Ryan@ottawa.ca, 613-580-2424 ext. 25106).

Traffic
Amira.Shehata@ottawa.ca
(613) 580-2424 Ext. 27737

Consult with the Ministry of Transportation due to proximity of Highway 7.

No Traffic Impact Study will be required by the City.
The minimum width of a driveway is 6 metres

**Mississippi Valley
Conservation Authority**
Andy Moore
amoore@mvc.on.ca

613 253 0006 ext. 257

History

- The wrecking yard was originally expanded sometime between 2008 & 2011 (differs from what is shown on the site plan, historical air photos below). This expansion was conducted within the 120 metre regulation limit of the PSW; however no action was taken by the MVCA at that time as it was not discovered by the MVCA until too late and we had no timeline of when the expansion actually occurred. A fence was also constructed along the southern edge of the expanded yard area
- In late 2013, we observed the further expansion of the wrecking yard to the south of the aforementioned fence on the property. This expansion encroached further into the 120m adjacent lands, and into the boundaries of the PSW itself. We laid charges for the unauthorized works in 2015. Through deliberations and working with the landowner, we agreed to have them remove all fill material from within the wetland and 20m of the wetland boundary. They also had to construct a clay berm along that setback to prevent contaminants from entering the wetland, but to also limit any future encroachment into the PSW. The landowners completed the works and we ended up withdrawing the charges in 2016.

New Proposal

- The MVCA would require that a wetland evaluator conduct an assessment of the currently mapped PSW on the property. This will ground truth the wetland boundaries, as Nick referred to in this morning's meeting, and determine the wetland's provincial significant designation. This in reality needs to be done before we can provide a clear direction as to how to proceed further. Should the wetland boundaries remain similar to what they currently are, we cannot support the proposal for crossing the wetland, either for a *Planning Act* application or at a staff level for a permit application under our regulation. In terms of our permit application and policies, proposals that cannot be approved at a staff level require a hearing of MVCA's Regulation Committee. The

Regulations Committee would make the decision as to whether or not the MVCA would grant approval.

- Beyond the wetland evaluation, an Environmental and Hydrologic Impact Assessment would also be required. The assessment would need to demonstrate the anticipated impacts on the ecological and hydrological function of the wetland and how these impacts are to be mitigated.

Submission Requirements

To be provided upon determination of application types.

From: Hall, Kevin <Kevin.Hall@ottawa.ca>
Sent: June 20, 2019 10:23 AM
To: Sean Leflar
Cc: Tyler Ferguson; Benjamin Clare; Wang, Anne; McWilliams, Cheryl
Subject: RE: 6776 Rothbourne Road: SWM Criteria & Pre-Con Clarification

Sean

My answers are in red below.

Kevin Hall, C.E.T.

Project Manager, Infrastructure Approvals
Development Review - Rural Services
Gestionnaire de projet, Approbation des demandes d'infrastructure
Examen des demandes d'aménagement (Services ruraux)
City of Ottawa | Ville d'Ottawa
☎ 613.580.2424 ext./poste 27824
Fax 613.580.2576
ottawa.ca/planning / ottawa.ca/urbanisme

From: Sean Leflar <s.leflar@mcintoshperry.com>
Sent: June 19, 2019 10:25 AM
To: Hall, Kevin <Kevin.Hall@ottawa.ca>
Cc: Tyler Ferguson <t.ferguson@mcintoshperry.com>; Benjamin Clare <b.clare@mcintoshperry.com>
Subject: 6776 Rothbourne Road: SWM Criteria & Pre-Con Clarification

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getting ready to start up the civil design for the site located at 6776 Rothbourne Road within the City of Ottawa (location map attached for your reference). Currently the site is occupied by Metro Towing & Recovery office and storage yard. The development consist of adding a new building in the southwest corner as well as a new gravel storage yard on the south portion of the site outside the environmental feature setback including a clay berm between the municipal drain and the gravel yard.

When you have a moment can you correct any of the assumptions regarding the SWM criteria below:

- ▮ 5&100-year post-development flows will be restricted to the 5&100-year pre-development flows, respectively. **Yes**
- ▮ Treated and restricted stormwater will discharge into the Municipal Drain that flows through the site. **It depends on the topography of the site. What are the existing drainage patterns of the site?**
- ▮ A calculated C value will be used to a maximum of 0.5 for Pre-development flows. **The pre-development c values will have to go back to before the site was developed. C of 0.5 would be quite high.**
- ▮ A time of concentration for pre-development flows shall be 20min or as calculated using the FAA Method. **I would us the FAA method.**
- ▮ A time of concentration for post-development flows shall be 10min. **Sure unless you want to calculate the new value.**
- ▮ The existing and new area shall be considered independent SWM areas for calculation of flows, discharge and quality control. **Not exactly. We need a comprehensive SWM for the entire site. If the existing area is working as designed then the rear of the site can be designed independently.**

Secondly, could you possibly clarify a few points from the pre-con notes from August 30, 2017:

- ▮ Comment: *"Updated engineering drawings showing what has changed from what has been approved. Drawings for the new area as well."*
MP Question: We are aware that previous the SWM has been removed from the original approved plans. Will it suffice to propose remedial modification on the drawings for the new area that revert the SWM for the existing site to the previously approved criteria? Can you please confirm that the previously approved plan is by McIntosh Perry, revision 4 dated September 12, 2007? **I can't confirm the report. As mentioned above, we need a comprehensive SWM design for the entire site.**
- ▮ Comment: *"Updated stormwater report for existing site and the new area."*
MP Question: Similar to the question above, are we able to provide a section within the new site servicing and stormwater management report illuminating the remedial works and the associated calculations? Can you please confirm that the previously approved report is by McIntosh Perry, Job# P-06-297, dated May 2, 2007, revised August 15, 2007? **I can't confirm he reports at this time. I don't have access to the files. I think it would be best to provide a new report with sections in it to address any past issues as required.**

Lastly, it has come to our attention that the property adjacent to the subject site (6736 Rothbourne Road) is to revert completed works regarding the municipal drain to its original state. Are you able to provide further details and how this would effect our site? The topographic survey conducted for this development was completed after the alteration to the municipal drain was applied. **I don't have any information on this site.**

If you have any questions or concerns, please feel free to get in contact.

Thank you for your time, I look forward to hearing from you.

Sean Leflar

Civil Engineering Technologist

115 Walgreen Road, R.R. 3, Carp, ON K0A 1L0

T. 613.903.5790 | F. 613.836.3742

s.leflar@mcintoshperry.com | www.mcintoshperry.com

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From: Andy Moore <amoore@mvc.on.ca>
Sent: June 24, 2019 2:20 PM
To: Sean Leflar; Matt Craig
Cc: Tyler Ferguson; Benjamin Clare
Subject: RE: 6776 Rothbourne Road: Stormwater Quality Criteria

Hi Sean,

There should not be any impacts to the site at 6776 Rothbourne Road. They have essentially been ordered to return the property to the state that it was in prior to the works commencing in 2012.

Thanks,

Andy

From: Sean Leflar [<mailto:s.leflar@mcintoshperry.com>]
Sent: Monday, June 24, 2019 1:24 PM
To: Andy Moore <amoore@mvc.on.ca>; Matt Craig <mcraig@mvc.on.ca>
Cc: Tyler Ferguson <t.ferguson@mcintoshperry.com>; Benjamin Clare <b.clare@mcintoshperry.com>
Subject: RE: 6776 Rothbourne Road: Stormwater Quality Criteria

Hello Andy,

Thank you for your reply.

Just to make sure we are on the same page. The required wetlands to be restored by the adjacent property will not have any effects on our site and our topographic survey will suffice for the development of our site (attached for your reference).

Please let me know if any of the above is erroneous.

Regards,

Sean Leflar

Civil Engineering Technologist
115 Walgreen Road, R.R. 3, Carp, ON K0A 1L0
T. 613.903.5790 | F. 613.836.3742
s.leflar@mcintoshperry.com | www.mcintoshperry.com

From: Andy Moore <amoore@mvc.on.ca>
Sent: June 24, 2019 12:37 PM
To: Sean Leflar <s.leflar@mcintoshperry.com>; Matt Craig <mcraig@mvc.on.ca>
Cc: Tyler Ferguson <t.ferguson@mcintoshperry.com>; Benjamin Clare <b.clare@mcintoshperry.com>
Subject: RE: 6776 Rothbourne Road: Stormwater Quality Criteria

Hello Sean,

The restoration order that has been issued for 6736 Rothbourne Road applies to the wetlands that were removed from the property only. The realigned channel of the Municipal Drain was not included in the court ordered restoration and will remain in its current location. The said wetlands that are required to be restored are located to the north of the municipal drain.

Thanks,

Andy

Andy Moore | Regulations Officer | Mississippi Valley Conservation Authority
www.mvc.on.ca | t. 613 253 0006 ext. 257 | f. 613 253 0122 | amoore@mvc.on.ca



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From: Sean Leflar [<mailto:s.leflar@mcintoshperry.com>]
Sent: Monday, June 24, 2019 9:03 AM
To: Matt Craig <mcraig@mvc.on.ca>; Andy Moore <amoore@mvc.on.ca>
Cc: Tyler Ferguson <t.ferguson@mcintoshperry.com>; Benjamin Clare <b.clare@mcintoshperry.com>
Subject: RE: 6776 Rothbourne Road: Stormwater Quality Criteria

Good Morning,

My apologies for my delayed response. Thank you for clarifying the quality control requirements.

One further question. It has come to our attention that the property adjacent to the subject site (6736 Rothbourne Road) is to revert completed works regarding the municipal drain to its original state. Are you able to provide further details and how this would effect our site? The topographic survey conducted for this development was completed after the alteration to the municipal drain was applied.

We look forward to hearing from you.

Thanks,

Sean Leflar

Civil Engineering Technologist

115 Walgreen Road, R.R. 3, Carp, ON K0A 1L0

T. 613.903.5790 | F. 613.836.3742

s.leflar@mcintoshperry.com | www.mcintoshperry.com

From: Matt Craig <mcraig@mvc.on.ca>

Sent: June 20, 2019 8:11 AM

To: Andy Moore <amoore@mvc.on.ca>

Cc: Tyler Ferguson <t.ferguson@mcintoshperry.com>; Benjamin Clare <b.clare@mcintoshperry.com>; Sean Leflar <s.leflar@mcintoshperry.com>

Subject: RE: 6776 Rothbourne Road: Stormwater Quality Criteria

Good Morning,

The Poole Creek and Upper Poole Creek Sub watershed study both state that enhanced level of treatment is required. Please call me if you would like to discuss.

Regards

Matt Craig | Manager of Planning and Regulations | Mississippi Valley Conservation Authority

www.mvc.on.ca | t. 613 253 0006 ext. 226 | f. 613 253 0122 | mcraig@mvc.on.ca

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From: Andy Moore

Sent: June 19, 2019 9:29 AM

To: Matt Craig <mcraig@mvc.on.ca>

Subject: Fwd: 6776 Rothbourne Road: Stormwater Quality Criteria

FYI

Sent from my iPhone

Begin forwarded message:

From: Sean Leflar <s.leflar@mcintoshperry.com>

Date: June 19, 2019 at 9:21:02 AM EDT

To: "amoore@mvc.on.ca" <amoore@mvc.on.ca>

Cc: Tyler Ferguson <t.ferguson@mcintoshperry.com>, Benjamin Clare <b.clare@mcintoshperry.com>

Subject: 6776 Rothbourne Road: Stormwater Quality Criteria

Good Morning,

I am getting ready to start up the Civil design for the site located at 6776 Rothbourne Road within the City of Ottawa and would like to inquire about the quality control the MVCA would require. The development includes a new 969.4m² building in the southwest corner and a gravel storage yard outside of the wetland setback including a clay berm between the municipal drain and the new gravel yard.

On other sites in the area we have provided 70% TSS removal for the stormwater runoff. Will this level of treatment be sufficient for this site?

If you require any further information or have any questions or concerns, please feel free to get in contact.

Thank you for your time,

Sean Leflar

Civil Engineering Technologist

115 Walgreen Road, R.R. 3, Carp, ON K0A 1L0

T. 613.903.5790 | F. 613.836.3742

s.leflar@mcintoshperry.com | www.mcintoshperry.com

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APPENDIX C: FIRE PROTECTION CALCULATIONS

July 17, 2019

Re: Rural Fire Protection Tank Calculations

1.0 BUILDING OCCUPANCY

From Table 3.1.2.1. Volume 1 of the National Building Code – Major Occupancy Classification:

- Group F Division 3

2.0 BUILDINGS REQUIRING ON-SITE WATER SUPPLY

From Div. B 3.2.5.7. of the Ontario Building Code. And the 'Fire Protection Water Supply Guideline':

$Q = K * V * S_{tot}$ Where:

$K = 19$ (from Table 1 pg 10 of the guideline)

$V = 8,269 \text{ m}^3$ (NOTE: The volume was calculated using total final volume of the building)

$S_{tot} = 1.00$ (from Figure 1 pg 11 of the guideline)

- Therefore, $Q = (19) * (8,269 \text{ m}^3) * (1.00) = 157,110 \text{ L}$ (~ 41,504 gal)

3.0 MINIMUM REQUIRED WATER SUPPLY

From Div. B 3.2.5.7., Table 2, Volume 2 of the 'Fire Protection Water Supply Guideline' – Required Minimum Water Supply Flow Rate (L/min)

- 4500 L/min (if $Q > 135,000 \text{ L} < 162,000 \text{ L}$)

From 3. (c) 4500 L/min for 30 min = 135,000 L (~35,663 gal)

Due to the excessive amount of water required from the equation above, the minimum supply required for 30 minutes will be used for this site. Therefore the proposed underground fire protection tanks will be 4 – 37,854 L (10,000 gal) tanks.

\\192.168.1.3\MPDOCUMENTS\01 PROJECT - PROPOSALS\2017 JOBS\CP\0CP-17-0381 METRO TOWING_6776 ROTHBORNE ROAD\03 - SERVICING\WATER\CP-XX-XXX - FIRE TANKS.DOCX

Fire Tank Design Sheet

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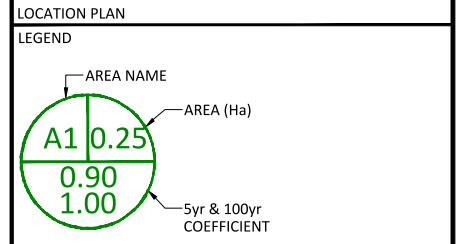
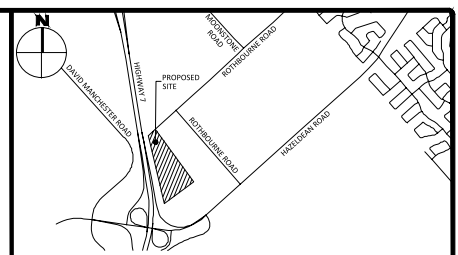
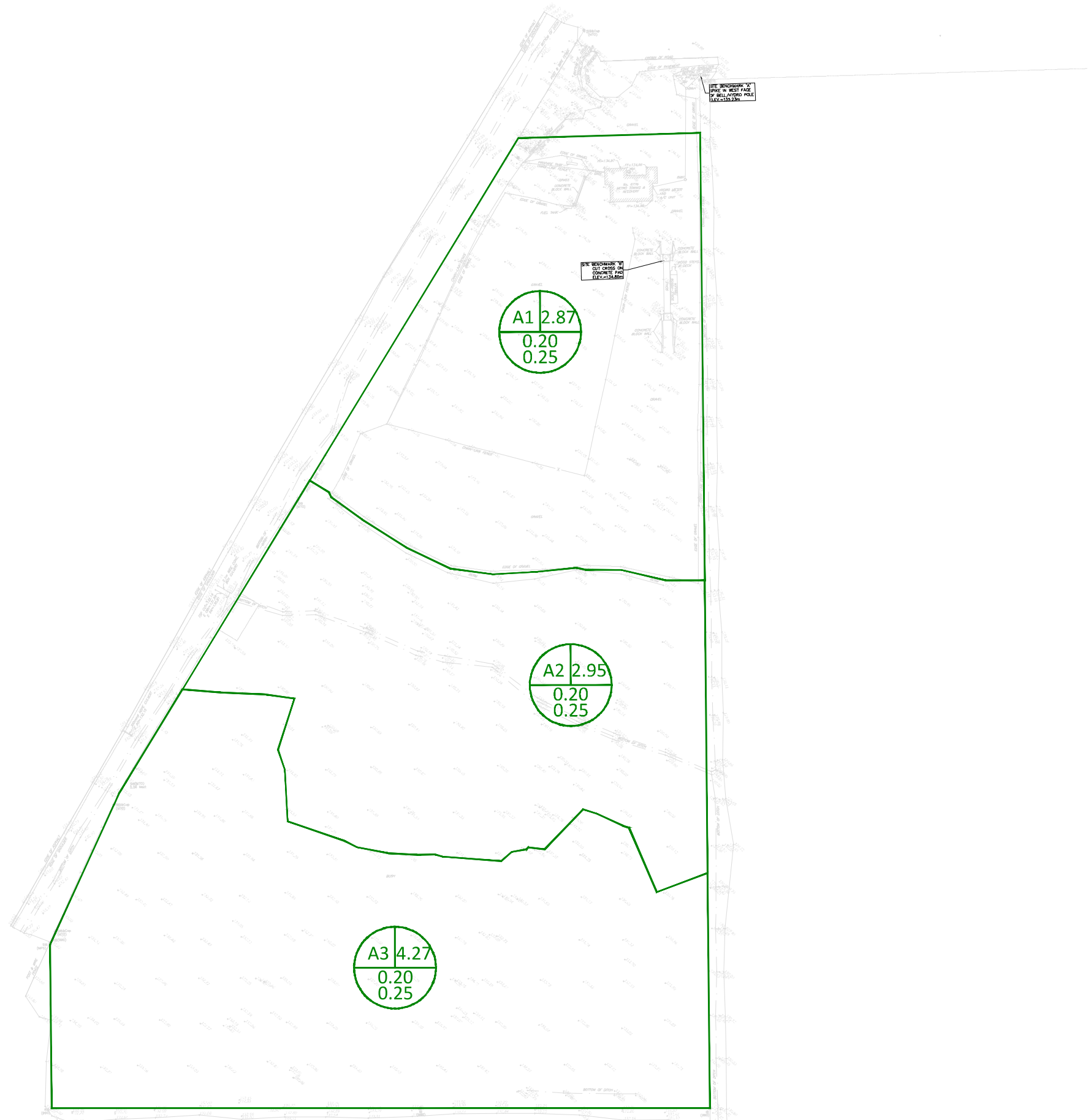
Project: Metro Towing
 Project No.: CP-17-0381
 Designed By: CDH
 Checked By: RPK
 Date: July 17, 2019

Tank Size	(10,000 L)	132.4	m	Existing Top of Grade
	<i>Mac Gregor Concrete</i>	133.8	m	Proposed Top of Grade
	= 20' X 10' X 10' 4 1/2"	0.9	m	Groundwater Depth
	= 6.1m X 3.05m X 3.16m	6.1	m	Length
Volume		3.05	m	Height
	<i>Exterior</i>	3.16	m	Width
	$V_{\text{EXTERIOR}} = (6.1) \times (3.05) \times (3.16)$	2400	Kg/m ³	Density of Concrete
	= 58.79 m ³	1600	Kg/m ³	Density of Soil
	<i>Interior</i>	1000	Kg/m ³	Density of water
	$V_{\text{INTERIOR}} = (5.8) \times (2.75) \times (2.86)$			
	= 45.62 m ³			
	<u>Total</u>			
	$V_{\text{TOTAL}} = (58.79) - (45.62)$			
	= 13.17 m ³			
Force Down				
	<i>Tank</i>			
	$F_{\text{TANK}} = (13.17) \times (2400) \times (9.81)$			
	= 310.19 kN ↓			
	<i>Soil</i>			
	$V_{\text{SOIL}} = (6.1) \times (3.16) \times (0.6)$			
	= 11.57 m ³			
	$F_{\text{SOIL}} = (11.57) \times (1600) \times (9.81)$			
	= 181.53 kN ↓			
	<u>Total</u>			
	$F_{\text{TOTAL}} = (310.19) + (181.53)$			
	= 491.72 kN ↓			
Force Up				
	<i>Tank Bottom</i>			
	T/G			Width * Without 1' Concrete Slab
	= (133.8) - (0.6) - (3.16)			
	= 130.04 m			
	<i>Ground Water Elevation</i>			
	= (132.4) - (0.9) * Per MP Geotechnical Report			
	= 131.50 m			
	<i>Depth of Water</i>			
	= (131.50) - (130.04)			
	= 1.46 m			
	<i>Volume</i>			
	= (1.46) × (3.16) × (6.1)			
	= 28.14 m ³			
	<u>Force Up</u>			
	= (28.14) × (1000) × (9.81)			
	= 276.08 kN ↑			
	= (276.08) × (1.5) Safety Factor			
	= 414.12 kN ↑			
Force Comparison				
	= 414.12 kN ↑ - 491.72 kN ↓			
	= -77.60 kN ↑			
	= 77.60 kN ↓			

Therefore force down will be sufficient without the use of a concrete slab

APPENDIX D:
PRE-DEVELOPMENT DRAINAGE PLAN

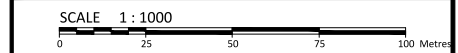
\\F:\MAME\1\102_166_1_1\mcdocument\01 Project - Proposal\2017 jobs\CP\CP-17-0381 Metro Towing_0776 Rothbourne Road\1.5 - Drawings\CP-17-0381 - Presentation.dwg
LAST SAVED: Monday, July 22, 2019 1:51:45 PM
LAST USER: S:\AMER\BPC\champer
LAST PLOT: Monday, July 22, 2019 1:51:45 PM



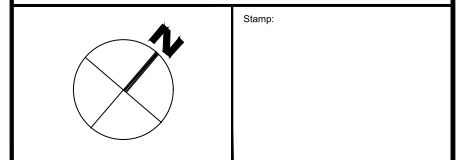
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1	ISSUED FOR SITE PLAN CONTROL	JULY 17, 2019
No.	Revisions	Date

Check and verify all dimensions before proceeding with the work. Do not scale drawings.



McINTOSH PERRY
115 Walgreen Road, RR3, Carp, ON K0A 1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com



Client:

METRO TOWING
2759 LANCASTER ROAD
OTTAWA, ON K1B 4V8

Project:

**METRO TOW TRUCK
WAREHOUSE BUILDING**
6776 ROTHBOURNE RD.
OTTAWA, ON

Drawing Title:

**PRE-DEVELOPMENT
DRAINAGE AREA PLAN**

Scale:	1:1000	Project Number:	CP-17-0381
Drawn By:	S.V.L.		
Checked By:	R.P.K.	Drawing Number:	
Designed By:	S.V.L.		

PRE

D07-12--XX-XXXX

#XXXXXX

APPENDIX E:
POST-DEVELOPMENT DRAINAGE PLAN

APPENDIX F:
STORMWATER MANAGEMENT CALCULATIONS

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CP-17-0381 - 6776 ROTHBOURNE ROAD - RUNOFF CALCULATIONS

1 of 5

Pre-Development Runoff Coefficient

Drainage Area	Area (ha)	Impervious Area (m ²)	C	Gravel Area (m ²)	C	Pervious Area (m ²)	C	Average C (5-Year)	Average C (100-Year)
A1	2.87	0.00	0.90	0.00	0.60	28696.12	0.20	0.20	0.25
A2	2.95	0.00	0.90	0.00	0.60	29462.50	0.20	0.20	0.25
A3	4.27	0.00	0.90	0.00	0.60	42685.37	0.20	0.20	0.25

10.08

Pre-Development Runoff Calculations

Drainage Area	Area (ha)	C (5-Year)	C (100-Year)	Tc (min)	I (mm/hr)		Q (L/s)		
					5-Year	100-Year	5-Year	100-Year	
A1	2.87	0.20	0.25	20	70.3	120.0	112.09	239.23	NORTH OF WETLAND
A2	2.95	0.20	0.25	20	70.3	120.0	115.08	245.62	EXISTING WETLAND
A3	4.27	0.20	0.25	20	70.3	120.0	166.73	355.85	SOUTH OF WETLAND
Total	10.08						393.89	840.69	

Post-Development Runoff Coefficient

Drainage Area	Area (ha)	Impervious Area (m ²)	C	Gravel Area (m ²)	C	Pervious Area (m ²)	C	Average C (5-Year)	Average C (100-Year)
B1	2.27	200.00	0.90	22497.23	0.60	0.00	0.20	0.60	0.75
B2	0.60	121.33	0.90	2706.80	0.60	3198.37	0.20	0.39	0.49
B3	0.85	484.70	0.90	787.50	0.60	7207.80	0.20	0.28	0.34
B4	3.42	484.70	0.90	33693.69	0.60	0.00	0.20	0.60	0.75
B5	2.95	0.00	0.90	1735.00	0.60	27727.50	0.20	0.22	0.28

Post-Development Runoff Calculations

Drainage Area	Area (ha)	C (5-Year)	C (100-Year)	Tc (min)	I (mm/hr)		Q (L/s)	
					5-Year	100-Year	5-Year	100-Year
B1	2.27	0.60	0.75	10	104.2	178.6	396.20	847.49
B2	0.60	0.39	0.49	10	104.2	178.6	68.73	146.49
B3	0.85	0.28	0.34	10	104.2	178.6	68.08	142.83
B4	3.42	0.60	0.75	10	104.2	178.6	598.21	1278.46
B5	2.95	0.22	0.28	20	70.3	120.0	128.63	274.54
Total	10.08						1259.86	2689.81

Post-Development Restricted Runoff Calculations

Drainage Area	Unrestricted Flow (L/s)		Restricted Flow (L/s)		Storage Required (m ³)		Storage Provided (m ³)		
	5-Year	100-Year	5-Year	100-Year	5-Year	100-Year	5-Year	100-Year	
B1	396.20	847.49	11.41	13.16	375.84	719.26	384.73	720.39	RESTRICTED
B2	68.73	146.49	68.73	146.49	-	-	-	-	UNRESTRICTED
B3	68.08	142.83	68.08	142.83	-	-	-	-	UNRESTRICTED
B4	598.21	1278.46	69.80	262.62	441.31	720.87	458.72	724.07	RESTRICTED
B5	128.63	274.54	128.63	274.54					EXISTING WETLAND
Total	1259.86	2689.81	346.66	839.63	817.15	1440.13	458.72	1444.46	

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CP-17-0381 - 6776 ROTHBOURNE ROAD - STORAGE REQUIREMENTS

2 of 5

Storage Requirements for Area B1

5-Year Storm Event

Tc (min)	I (mm/hr)	B1 Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m ³)
10	104.2	396.20	11.41	384.79	230.87
15	83.6	317.73	11.41	306.32	275.69
20	70.3	267.14	11.41	255.72	306.87
25	60.9	231.56	11.41	220.15	330.22
30	53.9	205.06	11.41	193.65	348.57
35	48.5	184.49	11.41	173.08	363.46
40	44.2	168.01	11.41	156.60	375.84

Maximum Storage Required 5-Year (m³) = 375.84

100-Year Storm Event

Tc (min)	I (mm/hr)	B1 Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m ³)
10	178.6	847.68	13.16	834.53	500.72
15	142.9	678.24	13.16	665.09	598.58
16	137.5	652.61	13.16	639.46	613.88
17	132.6	629.36	13.16	616.20	628.52
18	128.1	608.00	13.16	594.84	642.43
19	123.9	588.06	13.16	574.91	655.39
20	120.0	569.55	13.16	556.40	667.67
21	116.3	551.99	13.16	538.83	678.93
22	112.9	535.85	13.16	522.70	689.96
23	109.7	520.67	13.16	507.51	700.36
24	106.7	506.43	13.16	493.27	710.31
25	103.8	492.66	13.16	479.51	719.26

Maximum Storage Required 100-Year (m³) = 719.26

5-Year Storm Event Storage Summary

Water Elev. (m) =	131.62		
INV. (out)	Area (m ²)	Depth (m)	Volume (m ³)
130.85		0.77	

Storage Available (m³) = 384.7

Storage Required (m³) = 375.8

100-Year Storm Event Storage Summary

Water Elev. (m) =	131.86		
INV. (out)	Area (m ²)	Depth (m)	Volume (m ³)
130.85		1.01	

Storage Available (m³) = 720.4

Storage Required (m³) = 719.3

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CP-17-0381 - 6776 ROTHBOURNE ROAD - RUNOFF CALCULATIONS

3 of 5

LOCATION: NORTH

For Orifice Flow, C= 0.6
For Weir Flow, C= 3.33

	Orifice 1	Orifice 2	Weir 1	Weir 2
invert elevation	130.85			
center of crest elevation	130.89			
orifice width / weir length	80 mm			
orifice height				
orifice area (m ²)	0.005	0.000		

Elevation Discharge Table - Storm Routing

Elevation	Orifice 1		Orifice 2		Weir 1		Weir 2		Total Q [l/s]
	H [m]	Q [m ³]	H [m]	Q [m ³]	H [m]	Q [m ³]	H [m]	Q [m ³]	
130.85	x	x							0.00
131.50	0.61	0.010							10.43
131.51	0.62	0.011							10.52
131.52	0.63	0.011							10.60
131.53	0.64	0.011							10.69
131.54	0.65	0.011							10.77
131.55	0.66	0.011							10.85
131.56	0.67	0.011							10.93
131.57	0.68	0.011							11.02
131.58	0.69	0.011							11.10
131.59	0.70	0.011							11.18
131.60	0.71	0.011							11.26
131.61	0.72	0.011							11.34
131.62	0.73	0.011							11.41
131.63	0.74	0.011							11.49
131.64	0.75	0.012							11.57
131.65	0.76	0.012							11.65
131.66	0.77	0.012							11.72
131.67	0.78	0.012							11.80
131.68	0.79	0.012							11.87
131.69	0.80	0.012							11.95
131.70	0.81	0.012							12.02
131.71	0.82	0.012							12.10
131.72	0.83	0.012							12.17
131.73	0.84	0.012							12.24
131.74	0.85	0.012							12.32
131.75	0.86	0.012							12.39
131.76	0.87	0.012							12.46
131.77	0.88	0.013							12.53
131.78	0.89	0.013							12.60
131.79	0.90	0.013							12.67
131.80	0.91	0.013							12.74
131.81	0.92	0.013							12.81
131.82	0.93	0.013							12.88
131.83	0.94	0.013							12.95
131.84	0.95	0.013							13.02
131.85	0.96	0.013							13.09
131.86	0.97	0.013							13.16
131.87	0.98	0.013							13.22
131.88	0.99	0.013							13.29
131.89	1.00	0.013							13.36
131.90	1.01	0.013							13.43

- Notes: 1. For Orifice Flow, User is to Input an Elevation Higher than Crown of Orifice.
2. Orifice Equation: $Q = cA(2gh)^{1/2}$
3. Weir Equation: $Q = CLH^{3/2}$
4. These Computations Do Not Account for Submergence Effects Within the Pond Riser.
5. H for orifice equations is depth of water above the centroide of the orifice.
6. H for weir equations is depth of water above the weir crest.

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Storage Requirements for Area B3

5-Year Storm Event

Tc (min)	I (mm/hr)	B4 Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m ³)
10	104.2	598.21	69.80	528.41	317.05
15	83.6	479.73	69.80	409.93	368.94
20	70.3	403.34	69.80	333.54	400.24
25	60.9	349.63	69.80	279.83	419.74
30	53.9	309.62	69.80	239.82	431.67
35	48.5	278.56	69.80	208.76	438.39
40	44.2	253.68	69.80	183.88	441.31

Maximum Storage Required 5-Year (m³) = 441.31

100-Year Storm Event

Tc (min)	I (mm/hr)	B4 Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m ³)
10	178.6	1278.75	262.62	1016.14	609.68
15	142.9	1023.15	262.62	760.53	684.48
20	120.0	859.19	262.62	596.57	715.88
25	103.8	743.20	262.62	480.58	720.87
30	91.9	657.99	262.62	395.38	711.68
35	82.6	591.41	262.62	328.79	690.46
40	75.1	537.71	262.62	275.09	660.22

Maximum Storage Required 100-Year (m³) = 720.87

5-Year Storm Event Storage Summary

Water Elev. (m) =	131.23		
INV. (out)	Area (m ²)	Depth (m)	Volume (m ³)
130.62		0.61	

Storage Available (m³) = 458.7
Storage Required (m³) = 441.3

100-Year Storm Event Storage Summary

Water Elev. (m) =	131.50		
INV. (out)	Area (m ²)	Depth (m)	Volume (m ³)
130.62		0.88	

Storage Available (m³) = 724.1
Storage Required (m³) = 720.9

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LOCATION: SOUTH

For Orifice Flow, C= 0.6
For Weir Flow, C= 3.33

	Orifice 1	Orifice 2	Weir 1	Weir 2
invert elevation	130.55		131.35	
center of crest elevation	130.66			
orifice width / weir length	210 mm		1.60 m	
orifice height				
orifice area (m ²)	0.035	0.000		

Elevation Discharge Table - Storm Routing

Elevation	Orifice 1		Orifice 2		Weir 1		Weir 2		Total Q [l/s]
	H [m]	Q [m ³]	H [m]	Q [m ³]	H [m]	Q [m ³]	H [m]	Q [m ³]	
130.55	x	x							0.00
131.08	0.42	0.060			x	x			60.01
131.09	0.43	0.061			x	x			60.71
131.10	0.44	0.061			x	x			61.41
131.11	0.45	0.062			x	x			62.09
131.12	0.46	0.063			x	x			62.77
131.13	0.47	0.063			x	x			63.44
131.14	0.48	0.064			x	x			64.11
131.15	0.49	0.065			x	x			64.76
131.16	0.50	0.065			x	x			65.41
131.17	0.51	0.066			x	x			66.06
131.18	0.52	0.067			x	x			66.70
131.19	0.53	0.067			x	x			67.33
131.20	0.54	0.068			x	x			67.96
131.21	0.55	0.069			x	x			68.58
131.22	0.56	0.069			x	x			69.19
131.23	0.57	0.070			x	x			69.80
131.24	0.58	0.070			x	x			70.41
131.25	0.59	0.071			x	x			71.00
131.26	0.60	0.072			x	x			71.60
131.27	0.61	0.072			x	x			72.19
131.28	0.62	0.073			x	x			72.77
131.29	0.63	0.073			x	x			73.35
131.30	0.64	0.074			x	x			73.93
131.31	0.65	0.074			x	x			74.50
131.32	0.66	0.075			x	x			75.07
131.33	0.67	0.076			x	x			75.63
131.34	0.68	0.076			x	x			76.19
131.35	0.69	0.077			x	x			76.74
131.36	0.70	0.077			0.01				77.29
131.37	0.71	0.078			0.02				77.84
131.38	0.72	0.078			0.03				78.38
131.39	0.73	0.079			0.04				78.92
131.40	0.74	0.079			0.05				79.45
131.41	0.75	0.080			0.06				79.98
131.42	0.76	0.081			0.07				80.51
131.43	0.77	0.081			0.08				81.04
131.44	0.78	0.082			0.09				81.56
131.45	0.79	0.082			0.10				82.08
131.46	0.80	0.083			0.11				82.59
131.47	0.81	0.083			0.12				83.10
131.48	0.82	0.084			0.13				83.61
131.49	0.83	0.084			0.14				84.12
131.50	0.84	0.085			0.15	0.18			262.62

- Notes: 1. For Orifice Flow, User is to Input an Elevation Higher than Crown of Orifice.
2. Orifice Equation: $Q = cA(2gh)^{1/2}$
3. Weir flow calculated in Bentley's FlowMaster - Trapezoidal Channel at 0.1%, 3:1 side slopes, roughness coeff. Of 0.035
4. These Computations Do Not Account for Submergence Effects Within the Pond Riser.
5. H for orifice equations is depth of water above the centroid of the orifice.
6. H for weir equations is depth of water above the weir crest.

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[illegible]

