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# Table of Contents

EXECUTIVE SUMMARY .................................................................................................................. I

1.0 INTRODUCTION ................................................................................................................... 1.1

2.0 SITE DESCRIPTION .................................................................................................................. 2.1
2.1 GENERAL LAYOUT .................................................................................................................. 2.1
2.2 TOPOGRAPHY ......................................................................................................................... 2.1
2.3 SITE SURVEY .......................................................................................................................... 2.3
2.4 EXISTING DRAINAGE CONDITIONS ...................................................................................... 2.3
2.4.1 On-site Drainage ............................................................................................................... 2.3
2.4.2 Off-site Drainage .............................................................................................................. 2.3
2.4.3 Site Discharge .................................................................................................................. 2.5

2.5 HYDROLOGIC MODELING ................................................................................................... 2.7
2.5.1 Model Set-up .................................................................................................................... 2.7
2.5.2 Modeling Results ............................................................................................................. 2.8

3.0 STORMWATER MANAGEMENT ........................................................................................... 3.1
3.1 APPROACH .............................................................................................................................. 3.1
3.1.1 On-Site Improvements ...................................................................................................... 3.1
3.1.2 Off-Site Improvements ..................................................................................................... 3.2
3.2 PRE VS. POST ......................................................................................................................... 3.2
3.3 GROUNDWATER AND HYDROGEOLOGY ........................................................................ 3.3
3.4 WATER QUALITY .................................................................................................................... 3.6
3.5 SNOW MELT .......................................................................................................................... 3.7
3.5.1 Meltwater Quality and Quantity Control ........................................................................ 3.7
3.5.2 Quality Control Features ................................................................................................ 3.8
3.6 CONCEPTUAL SWM FACILITY DESIGN ........................................................................... 3.10

4.0 CONCLUSIONS & RECOMMENDATIONS .......................................................................... 4.1

5.0 CLOSURE ................................................................................................................................. 5.1
LIST OF TABLES

Table 1: Design Criteria on Key Storm Components ................................................................ 3.2
Table 2: Site Outlet Pre vs. Post Discharges ............................................................................ 3.3
Table 3: Past Snow Dump Concentrations ............................................................................... 3.6

LIST OF FIGURES

Figure 1: Vicinity Map ............................................................................................................... 1.2
Figure 2: Site Layout ................................................................................................................ 2.2
Figure 3: Drainage Plan – Existing Conditions ....................................................................... 2.4
Figure 4: Area Map .................................................................................................................. 2.6
Figure 5: Drainage Plan – Proposed Conditions ..................................................................... 3.4
Figure 6: Groundwater Elevation Map (Overburden) ............................................................... 3.5
Figure 7: Conceptual Site Layout ............................................................................................. 3.9
Executive Summary

Stantec Consulting Ltd. (Stantec) was retained by the City of Ottawa to conduct a Storm water assessment and feasibility for the proposed snow disposal facility (SDF) located at 2125 Carp Road in Ottawa’s West End (southwest corner of highway 417 and Carp Road). The proposed development will include a SDF with an estimated disposal capacity of 357,000m³, and potential for other municipal facilities (permitting to other restrictions).

This assessment evaluates the existing and proposed on-site and off-site drainage patterns based on 2-yr, 5-yr, 10-yr, 50-yr and 100-yr 3-hour Chicago storm events, while considering the existing 600mm CSP culvert capacity discharging to the 417 roadside ditch.

The existing upstream invert of the existing culvert must be lowered by approximately 0.5m in order for the conceptual design to remain feasible. To minimize any net impact of downstream hydraulic characteristics, the construction of an above grade storm water management (SWM) pond with a 4-5ha footprint will be required to attenuate on-site and off-site storm runoff to predevelopment flow rates. A permanent pool shall be proposed within the SWM pond in order to provide water quality assurances for total suspended solids and other treatable contaminants. This permanent basin may also serve as a reservoir for the dilution of the spring freshet runoff from the SDF while chloride levels are above 1000mg/L. The City will be required to maintain a monitoring program for surface water quality during peak melting periods which vary seasonally.

In order to improve upstream drainage issues, the capacity of the 5-600mm CSP culverts crossing Westbrook Road on-site will require upsizing to lower the upstream hydraulic grade line (HGL). Other off-site improvements are flagged for Westbrook Road, Willowlea Road and Walgreen road, as many of the existing culverts may require replacement and upsizing based on requirements set as part of the Municipal Class Environmental Assessment (MCEA) and current City Standards.

The SDF will also require a snow melt pond (SMP) for water quality and quantity assurances. Snow melt shall be retained for a 24-hr period prior to discharging to the proposed swale which “mixes” with available flows from the SWM pond. The SMP has been sized for both retaining a peak snow melt and attenuating the runoff from the SDF based off a 100-year storm event.

To prevent contamination of nearby groundwater wells, the meltwater pond and the snow stockpile and snow dump pad base will be provided with a liner to prevent mixing of meltwater with groundwater. This stormwater assessment report was prepared considering storm related by-laws and guidelines from the City of Ottawa and Ministry of the Environment.

Based off the conceptual design layout, site restrictions and assumptions, this assessment indicates that off-site and on-site drainage patterns may be attenuated to existing flow rates at the site outlet.
1.0 Introduction

The City of Ottawa (herein referred to as the City) retained Stantec Consulting Ltd. (Stantec) to investigate the feasibility of developing the property located at 2125 Carp Road (the Site/Property, see Figure 1) on the southwest corner of Carp Road and the 417 Highway in Ottawa, Ontario for future use as a Snow Disposal Facility (SDF) and potential municipal yard.

A Phase 1 Municipal Class Environmental Assessment (MCEA) report dated January 2013 was prepared by Stantec and submitted to various agencies and the City for comment. Review comments received during the consultation process identified problems with off-site drainage that the planning process should address in addition to the on-site drainage concerns. The Ministry of the Environment requested that the City obtain an approval for the proposed drainage works.

Upstream (off-site) drainage issues have been reported for the surrounding area along Westbrook Road, Willowlea Road and Walgreen Road, which directs stormwater towards and through the property. Drainage downstream of the site is accomplished through a single culvert discharging on to the 417 highway roadside ditch and from there towards Feedmill Creek.

In addition, the property has been classified as a Significant Groundwater Recharge Area (SGRA) by the Mississippi Valley Conservation Authority (MVCA) however, a hydrological report completed by Stantec July 2013 titled “Hydrogeological Assessment - Proposed Snow Disposal Facility at 2125 Carp Road, Ottawa, Ontario” and concludes that:

“Although hydrogeological data indicate that some of degree of groundwater recharge is possible at the site...the hydrogeological analysis suggests that the site does not meet the characteristics of an SGRA”

However, infiltration and recharge will be encouraged and implemented.

High chloride and total suspended solids (TSS) concentrations are expected due to the nature of SDFs. As part of the proposed development, water quality will be modeled and analyzed to meet MOE target concentrations.

The following report describes the existing drainage conditions off-site and on-site for the property, current and expected infiltration rates, and a conceptual design for stormwater management and water quality on-site.
Figure 1: Vicinity Map
2.0 Site Description

2.1 GENERAL LAYOUT

The drainage for the site was assessed in two portions. One portion (on-site) comprises the property located at 2125 Carp Road (SW corner of Carp Road and the 417 highway) and a second (off-site) portion comprising the drainage tributary along Westbrook Road, Willowlea Road, and Walgreen.

Figure 2 illustrates the separation of on-site and off-site boundaries.

2.2 TOPOGRAPHY

The topography of the site is generally flat with overland slopes being generally less than 2%. The highest portion of the Site is in the northeastern quadrant at an elevation of approximately 129 m above sea level and slopes south towards the central portion of the Site (an elevation of approximately 127 m above sea level). In the east-central section of the Site, a man-made pond with an approximate area of 0.5 hectares was created by removal of surficial material and is now partially filled with water. The southeastern quadrant of the Site, an area of approximately 2.5 hectares, has been filled with coarse gravel and rubble and is raised several meters above the adjacent lands to the west. A gravel road entrance from Westbrook Road exists at the southeastern corner of the Site.

The western half of the Site can be described as a low-lying area with minimal slopes and featuring persistent ponding of water between elevations of 126.55m to 126.68m. The ground in this area is approximately at an elevation of 127m while the western and northern limits are at an approximate elevation of 128m above sea level. A smaller fill area, consisting of coarse gravel and rubble, exists at the southwestern corner of the Site along with an entrance from Westbrook road.

The majority of the Site, excluding fill areas, is well-vegetated with tall grass, brush, and in certain areas, mature trees.
2.3 SITE SURVEY

The City provided topographic mapping to Stantec however, the mapping did not extend to the limits of the contributing drainage areas for the existing site. To define the limits of the catchment area, Stantec completed additional topographical survey including road cross sections along Westbrook Road, Willowlea Road and Walgreen Roads. Survey also established where general high points, low points, inverts for existing culverts, and general property grading to delineate the limits of the drainage boundaries of the Westbrook area. Confirmation of existing culvert inverts, obverts and sizes, along with a detailed survey of the existing “linear” pond between Walgreen and Westbrook, and the on-site pond were undertaken.

The survey data was combined with the existing City topographic information and used in the stormwater model to simulate the existing conditions.

2.4 EXISTING DRAINAGE CONDITIONS

2.4.1 On-site Drainage

A registry search conducted by Stantec identified that a drainage easement is registered against Part 4 of Plan 4R-3563. Drainage, as shown in Figure 2 is directed northward through the central portion of the Site and drains into the Highway 417 roadside ditch through a 600mm culvert at the northern property limit. The drainage flow is shallow and narrow towards its southern reach and is poorly defined in the low-lying areas towards the southern and central portions of the Site. In these areas, significant ponding of water has been observed from site visits. Generally, all stormwater enters the Site through roadside ditches/culverts and overland flow and is retained on-site because the outlet culvert invert is higher than the elevation of the low laying central area. The eastern and western which are part of the portions of the Site drain laterally towards this central flooding area and the north-flowing ditch which is part of the easement.

From examining contour data, it was believed that the man-made pond on the eastern portion of the Site is not hydraulically connected to the drainage ditch and that the pond is replenished by groundwater or runoff from higher ground.

2.4.2 Off-site Drainage

The land surrounding the site consists of commercial and industrial properties along Westbrook Road, Walgreen Road and Willowea Road. These properties contribute a large amount of stormwater which flows on site via culverts, ditches or swales. This upstream stormwater tributary is believed to cause flooding on-site despite the presence of an attenuating linear storm pond. Figure 3 illustrates the overall existing drainage area for the property.
The majority of the drainage from Walgreen Road and portions of Westbrook Road is collected within a 300m long “linear Pond” located between Westbrook Road and Walgreen Road. The linear pond provides stormwater attenuation and improves water quality for the downstream “on-site” area. The outlet of the linear pond consists of five (5) 600mm culverts that run beneath Westbrook Road and discharge into the southern portion of the Site (typically flooded). Since these discharge culverts are perched, the pond is filled with water throughout the year. During drier seasons, the water level of the linear pond was found to be below the invert elevation of the culverts but still high, providing permanent storage of water within the pond. The remaining tributary from Westbrook Road drains towards the site via roadside ditches and natural swales, whereas the tributary from Willowlea drains in the same fashion between the rear of the eastern properties and the western limit of the site.

2.4.3 Site Discharge

Stormwater from the linear pond discharges from a series of five (5) 600mm culverts beneath Westbrook at an elevation of 126.7m (through the drainage easement on site). The outlet to the Highway 417 roadside ditch culvert (approximately 400m north of the culverts at Westbrook Road) discharges at an elevation of 126.69m. In order for discharge to the 417 outlet culvert to occur, the site has to be inundated, thus attenuating storm events. Downstream from the site, the 417 Highway roadside ditch water flows to the east across the Carp Road overpass and continues for approximately 1.9 km along the Highway 417 corridor and discharges to Feedmill Creek. The Feedmill Creek then flows approximately 2 km to the east to discharge into the Carp River. Portions of the Feedmill Creek are classified as a cool water stream. Although some realignment of the highway roadside ditch is anticipated due to the current expansion of the 417, the quantity of stormwater from the site is anticipated to match existing drainage discharge. Figure 4 illustrates the drainage of the Westbrook Community Development until its discharge to the Carp River.
2.5 HYDROLOGIC MODELING

2.5.1 Model Set-up

A review of topographic data from the Site and surrounding area was undertaken to delineate the total catchment area of the Site and to subdivide sub-catchment areas. The boundaries of the total catchment area delineated through this exercise generally agreed with the drainage divides identified in the larger-scale 2005 report by CH2M Hill, “Existing Conditions: Flow Characterization and Flood Level Analysis – Carp River, Feedmill Creek, and Poole Creek”. This data, along with data from the survey completed by Stantec, was imported into Autodesk® Civil 3D software to create a virtual “3-dimensional surface” of the existing grounds. From this surface, the existing drainage patterns, and ponding volumes in the study area could be determined.

The hydrologic modeling software Autodesk® Storm and Sanitary Analysis 2011 (SSA) was chosen as a suitable modeling program since it is capable of analyzing hydraulics and provides compatibility with Civil 3D. It can also run larger-scale simulations over longer durations, which would be practical in analyzing snowmelt scenarios. The model was used to analyze the Site hydrology during various rainfall events and determine peak flows and storage volumes. Particular locations of interest include:

- the linear pond;
- the five culverts discharging from the pond;
- the flooding area on site;
- the culvert discharging into the Highway 417 ditch; and
- the man-made pond on site.

The sub-catchment areas from the Civil 3D surface were imported into SSA. Aerial imagery and site photography was used to determine impervious and pervious areas in order to determine an acceptable preliminary weighted runoff coefficient for the sub-catchment areas. A runoff coefficient (C) of 0.75 is currently being used within the modeling for off-site commercial properties, and was also confirmed using AutoCAD.

It was observed during site investigations that most of the culverts along these ditches were perched above the ditch bottom. The modeling accounts for culverts inverts to include storage within the roadside ditches. Culvert data was therefore imported from Civil 3D as “junction nodes” at their geodetic locations. Roadside ditches were then input in the model between the culverts and each sub-catchment was then connected to an appropriate upstream junction node. To be conservative, each junction node was also given a “ponded area” relevant to the top surface area of the adjacent ditch to ensure that water that flooded above the maximum elevation of the nodes was still accounted for in the system, and not lost after the ditches flooded.
The majority of sub-catchment areas were assumed to be commercial properties with drainage directed towards the servicing roadways. However, one area in particular, the Canada Bread industrial property at the northeast corner of Willowlea Road (116 Willowlea Rd), was inspected in more detail due to the presence of a storm discharge pipe at the entrance to that property. A “Site Servicing Plan” dated March 9, 2011 prepared by McIntosh Perry was reviewed and indicated that the majority of stormwater from the site is directed to a retention facility (assumed to be a small wet well or sump pit) beneath one of the multi-tenant buildings. The plan drawing identified an outflow from this facility of 120.9L/s, thus this site was modeled using a “storage node” and a pump discharging at a constant flow rate. The time of concentration for this pump was unknown so a conservative time of concentration was calculated based on the available surface grading, pipe lengths and slopes. The wet well was considered to be of minimal volume and discharged with little lag to maintain the conservative nature of this analysis.

A total of five storage nodes were input into the model:

- the linear pond;
- the man-made pond on site;
- the estimated site flooding area;
- the wet well for the Canada Bread site; and
- a small local retention pond along a north-south ditch running immediately west of the Site.

It was assumed that the linear pond has a permanent pool and is constantly filled to the lowest invert elevation of the culverts so that active storage is only modeled above this elevation. The outlets of the man-made pond and the local retention pond were not as well defined so these were assumed to be filled to water levels identified in the site survey, but the man-made pond is understood to be hydraulically separated from the site discharge. It was assumed that the contour data provided for the Site already indicated the ponding levels so no initial water surface was assumed for this flooding area.

Since no information was available on the water levels in the Highway 417 ditch during various storms, the discharge from the Site was assumed to flow freely, with no hydraulic effects from backwater.

### 2.5.2 Modeling Results

The SSA model was run to simulate the 2-year, 5-year, 10-year, 25-year, 50-year and 100-year 3hr Chicago Storm event specific to the Ottawa area. The notable results of the model 100-year simulation are presented below by location of interest.
2.5.2.1 Linear Pond

It was found that the maximum hydraulic gradeline (HGL) elevation reached in the linear pond was 127.43m. Although this did not overtop the banks of the pond, it did cause backflow into upstream ditches.

The maximum storage volume in this pond (above the permanent pool assumed at the lowest culvert invert) was found to be approximately 2,600m$^3$ without flooding surrounding properties or roadways. Should it become necessary to remove the linear pond, an equivalent ditch sized to accommodate the 100-year event should be sized on site. While this could remove the permanent pool of water in the linear pond and would improve the conveyance of stormwater, it would require that the capacity of culverts across Westbrook Road be increased to convey the 100-year event.

2.5.2.2 Culverts at Linear Pond Outlet

The combined full-flowing existing capacity of these five culverts was calculated as approximately 1,500L/s. However due to the HGL level in the pond, the culverts were surcharged and discharged at a peak rate of approximately 1,900L/s.

2.5.2.3 On-Site Flooding Area

It was found that the maximum hydraulic gradeline (HGL) elevation reached in the flooding zone on site was 127.38m. The maximum volume of stormwater stored in this area was found to be approximately 22,000m$^3$. It should be noted that this elevation was not enough to cause spillover into the man-made pond on site. This further confirms the assumption that the pond is hydraulically disconnected from the rest of the site.

2.5.2.4 Discharge Culvert at 417 Ditch

It was found that the existing peak discharge rate from the Site into the Highway 417 ditch was approximately 404L/s. This is less than half of the full-flowing capacity of the culvert, which was calculated as approximately 825L/s.

2.5.2.5 Other Observations

Almost all roadside ditches and culverts contributing to the Site were either flooded or surcharged, respectively; as expected, as roadside ditches and culverts are typically not sized to accommodate a 100-year storm.
3.0 Stormwater Management

3.1 APPROACH

3.1.1 On-Site Improvements

The general approach to managing stormwater at the proposed site was to limit post development flows to predevelopment rates. A stormwater pond is planned to be constructed on-site to attenuate and maintain the existing discharge rates of 404L/s at the 417 Highway roadside ditch. In this way, no anticipated downstream impacts would be expected if post-condition discharge values matched pre-condition values. The existing site discharge culvert is a 600mm corrugated steel pipe with a slope of 2.4% and a calculated capacity of 825L/s. It was unclear at this time of this report how the culvert or downstream ditches were designed/sized. Therefore, as a conservative approach, the existing 100-yr event flow rate modeled (404L/s) was used as our discharge target, where an additional 51% pipe capacity remains available.

Hydrologic models were created using the Autodesk® Storm and Sanitary Analysis 2011 (SSA) software to analyze existing and proposed drainage conditions of the on-site and off-site properties. From the model, the site discharge rate and total volume of flooding that occurs on-site and off-site could be estimated for a given storm event (e.g. 10yr, 25yr, 50yr, 100yr storms). To correct the existing flooding issues off-site and on-site, the total flooding volume currently attenuated prior to discharging to the 417 highway culvert outlet would need to be stored in a designated stormwater management (SWM) facility which is designed to control post development discharge to the existing modeled rates.

As mentioned above, an alternative approach would be to control site discharge to the capacity of the existing culvert at the north end of the site. This would assume that this culvert was originally sized based on a complete assessment of contributing areas and the downstream receiving ditches are designed to anticipate the full flow of the existing culvert. However, since no such information has been found, and considering the persisting drainage issues in the area, this is not believed to be the case.

It should be noted, at the time of this report, this stormwater management assessment did not consider any post-development conditions for the development of the City Yard Facility. However, it is anticipated that additional capacity within the proposed SWM pond will be available to the City to meet and maintain the current discharge objective. The City facility will require having its own water quality assurances to mitigate contaminants from the worksyard from entering the SWM pond and potentially affecting the groundwater or downstream receiving waterway and natural habitats. To this end, the stormwater management requirements identified in this report should be considered as requirements to correct existing issues on and off-site and for the SDF development.
**Figure 5** illustrates the results of the proposed storm water model, and improvements to on-site and off-site components.

### 3.1.2 Off-Site Improvements

The model created to simulate existing conditions showed that several off-site culverts flood during rain fall events, further flooding the road and surrounding properties. Currently, the majority of the off-site culverts have either buried inverts, perched inverts, or are laid with sedimentation and are generally undersized (below the City of Ottawa 500mm minimum culvert standard) to convey the design storms for their roadway classification, as described in the City of Ottawa 2012 Sewer Guidelines (*Section 6.4.2 Culvert Design*). The following table describes the design criteria for roadway culverts and key components within the system:

<table>
<thead>
<tr>
<th>Key Storm Components</th>
<th>Classification</th>
<th>Design Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westbrook Rd Culverts</td>
<td>Collector</td>
<td>50-yr</td>
</tr>
<tr>
<td>Willowlea Rd Culverts</td>
<td>Local Rural</td>
<td>25-yr</td>
</tr>
<tr>
<td>Walgreen Rd Culverts</td>
<td>Local Rural</td>
<td>25-yr</td>
</tr>
<tr>
<td>Linear Pond Discharge Culverts</td>
<td>N/A</td>
<td>100-yr</td>
</tr>
<tr>
<td>SWM Pond</td>
<td>N/A</td>
<td>100-yr &amp; Discharge Constraint</td>
</tr>
<tr>
<td>On-site Discharge Culvert(s)</td>
<td>N/A</td>
<td>100-yr (Existing Condition)</td>
</tr>
</tbody>
</table>

Off-site improvements are expected to increase the storm runoff contributing to the site and discharge from the linear pond. The proposed development should consider the on and off-site improvements to the existing culvert capacities to meet the guidelines as set out by the City and improve the conveyance of the roadway ditches. The total volume of the SWM pond is not anticipated to increase as the volume of the storm event will not increase but the rate at which the proposed storm water management pond fills up will increase.

### 3.2 PRE VS. POST

Due to the existing elevation constraint at the site outlet of 126.69m and the outlet of the 5-600mm culverts from the linear pond at 126.7m, it was determined that the only feasible way to provide a functional concept was to drop the upstream invert of the on-site outlet (MTO culvert) to 126.19m. At this elevation, and over a length of 440m, positive drainage would be provided at 0.1% from the linear pond outlet to the site outlet. Between which, an “at-grade” SWM pond would be installed with berms above existing grade. While dropping the upstream invert of the outlet culvert will allow for better drainage, the downstream invert will remain at the same elevation and thus reduce the capacity of the culvert. With this in mind, it is suggested that a new pipe be installed alongside the existing dropped culvert to both provide the required outlet elevation and maintain the existing flow capacity effectively providing no net change to the hydraulic characteristics of this outlet to the MTO roadside ditch. MTO approval for the lowering and installation of new culvert(s) is essential for this concepts feasibility.
The following table describes the flow rates for various storm return periods at the site outlet as compared between pre-development and post-development:

<table>
<thead>
<tr>
<th>Storm Event (Chicago 3-hr)</th>
<th>Peak Site Discharge Rate (L/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2yr</td>
</tr>
<tr>
<td>Pre-Development</td>
<td>231</td>
</tr>
<tr>
<td>Post-Development</td>
<td>106</td>
</tr>
</tbody>
</table>

### 3.3 GROUNDWATER AND HYDROGEOLOGY

A draft Hydrogeological Assessment was issued by Stantec July 3rd, 2013. A number of monitoring wells were drilled and monitored during spring conditions to date and it was found that during spring conditions, ground water elevations can range from 127.8m in the north east section (where ground is higher) to 127.2m at the drainage easement limit. Figure 6 illustrates the location of monitoring wells and the anticipated groundwater elevation.

The SWM pond is proposed to contain a permanent pool between elevations 125.69m and 126.19m and above this elevation, storage would be available to attenuate the 100-yr event to the existing 100-yr discharge value calculated.

During the spring, when water levels are highest, we would expect groundwater seepage into the SWM pond berms and bottom and produce a groundwater recharge base flow ranging from 5L/s to 12L/s. There is a significant level of uncertainty associated with these values due to variations resulting from seasonal groundwater fluctuations. Summer months may yield lower baseflow values; however, remaining conservative, this base flow has been accounted for in relation to the available capacity at the outlet (however minimal).

Although this area is classified as a Significant Groundwater Recharge Area (SGRA) by the MVCA, it should be expected that exfiltration, rather than infiltration, will occur in the SWM pond and provide recharge to the site. It should be noted that infiltration will remain due to the presence of the permanent pond, but the minimal base flow from seasonal groundwater elevations should be expected.
Legend
- Bedrock Monitoring Well
- Overburden Monitoring Well
- Waste Management Monitoring Well
- Borehole
- Proposed Percolation Test Location
- Flow Net Direction
- Overburden Groundwater Contours (m) (04/04/2013)
- Property Boundary
- Dilch
- Path
- Lot Lines
- Building
- Fill
- Pond
- Provincially Significant Wetland (Evaluated)
- Unevaluated Wetland
- Wetland

Notes
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2010.

Figure 6: Groundwater Elevation Map (Overburden)
3.4 WATER QUALITY

The quality of water discharging to the outlet of the site is of particular concern when considering the addition of seasonal snow melt from a SDF. SDF water quality has differing results dependent of the snow removal servicing area and seasonal fluctuations with the amount of snow removed, products used for winter road maintenance, and temperatures during spring.

The following table describes an anticipated range of concentrations for typical SDF snow melt as referenced by the report titled “Urban Snow Dump Quality and Pollutant Reduction in Snowmelt by Sedimentation” by R.L. Droste May 1991.

<table>
<thead>
<tr>
<th>Substance/Component</th>
<th>Lower Limit (mg/L)</th>
<th>Upper Limit (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloride (Cl-)</td>
<td>100</td>
<td>9,060</td>
</tr>
<tr>
<td>TSS</td>
<td>2,310</td>
<td>10,900</td>
</tr>
<tr>
<td>Oil &amp; Grease</td>
<td>1.3</td>
<td>13</td>
</tr>
</tbody>
</table>

The seasonal values for the proposed Carp Road SDF water quality will require seasonal monitoring. The values modeled are anticipated values found in the reference material.

In consultation with the MVCA, it was suggested that a target base chloride concentration of 1000mg/L should be met where possible during spawning season (typically during late March to April). It should be noted that chloride concentrations typically are highest during the spring freshet or initial spring thaw, and can exceed limits of 9,000mg/L if no water quality measures are provided, but these concentration then begin to drop exponentially.

As part of the development of the SDF, a snow melt pond (SMP) shall be provided in order to attenuate the inundated snow melt from the stored snow pack. The snow melt (based on typical climatic data as described in Section 3.4) will be retained for a duration of 24 hours prior to discharging.

During the presence of snow melt, the SMP will discharge through a weir and converge with the discharge (storm water and/or groundwater baseflow) from the SWM pond (just south of the site outlet). This will effectively provide additional dilution from the flow produced from the SWM pond (based on wet or dry conditions). During dry spring conditions, it is expected that a base flow from the SWM pond and snow melt from the on-site and off-site tributary will provide dilution to the chloride levels. During wet conditions the snow melt will be diluted with the storm runoff from the SWM pond.

After complete melt of the snow pack, storm water will run off the impermeable SDF pad and require attenuation to meet post condition discharges at the outlet.
The SMP has been sized to contain both the 24-hour snow melt based on average climatic data and the 100-yr 3-hr storm event. The stormwater from the SMP will outlet in the same fashion as melt water. However, should the stormwater or snow melt pond need to be drained, a discharge pipe and valve will be available to drain the system through the SWM pond.

### 3.5 SNOW MELT

A separate report has been prepared by Stantec for the topic relating to the SDF snow melt. The report titled “Carp Snow Disposal Facility – Melt Water Management Report” dated July 2013 is available for review. The following excerpt provides general information on the operation and concept of the SDF.

During peak melting season, typically April to June, the SDF can be expected to generate large volumes of meltwater at an accelerated rate due to its large, unshaded surface area.

To accommodate the additional meltwater flows, a meltwater pond will be included in the site design, controlling for both meltwater quality and quantity. The pond would feature a permanent pool to retain the snow melt for 24 hours for water quality control. Since melting rates fluctuate throughout the day, an active storage volume would be required above the permanent pool level. Effluent from the pond would be conveyed directly to the outlet of the site to minimize infiltration into the ground.

A preliminary analysis of the melting rates and storage requirements of the SDF was conducted based on calculations used by Robinson Consultants for the design of the Strandherd facility. Local climatology data such as wind speed and temperature was collected for various stages of snow melt over 5 year intervals from 1970 to 1990. The peak, average and minimum hourly heat flux and radiation throughout the day was computed from the data and used to calculate peak, average and minimum melting rates. The average melting rate was used to determine the permanent pool volume required to retain the melt for 24 hours.

### 3.5.1 Meltwater Quality and Quantity Control

The meltwater pond design was based on a critical meltoff scenario and a 50-year snow disposal volume of 357,000m$^3$. Quality control standards generally limit the minimum depth of retention pond forebays to 1.5m, and 1-2m for the permanent pool (MOE SWM Manual, 2003). At a depth of 1.5m, the total pond footprint would be approximately 2,300m$^2$ with grading.

From the data, the volume of active storage was calculated based on the peak hourly melting rates. This was found to be approximately 3,500m$^3$. Thus, the total pond capacity required was found to be approximately 6,500m$^3$. It is anticipated that a volume greater than 6,500m$^3$ can be provided within the allotted 1.6ha (includes 3000 cubic metres for permanent storage) footprint at the current conceptual design stage for the permanent snow melt pond and active storage.

The design above is a preliminary estimate, although a more detailed analysis is currently underway to more accurately model the snow melt from the SDF and base flows from the surrounding area.
More extensive climatology data is being compiled to conduct a continuous modeling exercise over the entire melting season to analyze the system over a typical melt period.

### 3.5.2 Quality Control Features

The meltwater pond design was based on a critical meltoff scenario and a 50-year snow disposal volume of 357,000m$^3$. It was found that the average daily melting rate during peak season for the 50-year event was approximately 30 L/s, requiring a permanent pool volume of approximately 3,000m$^3$ for 24 hour retention. Quality control standards generally limit the minimum depth of retention pond forebays to 1.5m, and 1 to 2m for the permanent pool (MOE SWM Manual, 2003). A vegetative strip, oil/grit separator, sediment fore bay and a wet pond should be included to improve water quality prior to discharge via the MTO ditches into Feedmill Creek.

*The vegetative strip* provides a BMP method of removing the heavier sediments and any oil and grease that may adhere to both the sediment and vegetation.

The *oil and grit separator* shall consist of a deep sump manhole with a “snout” on the outlet pipe. Oil and grease will float on the surface and the heavy grit will settle in the chamber. Some oil may settle with the grit. The sump should be inspected frequently and cleaned as required (i.e. when the grit depth exceeds 600mm).

The *forebay* will provide a second chamber with the weir acting as baffle and with most of the flow through the inverted pipes provided at the weir. Oil and grease trapped in this area will float on the water and eventually the oil and grease will attach to the sediment and settle out.
City of Ottawa
Carp Road Snow Disposal Facility
Drainage Report

Legend
- CULVERT
- SNOW DISPOSAL FACILITY (SDF)
- SNOW MELT POND (SMP)
- SNOW DUMP & PUSH LOCATION
- STORMWATER MANAGEMENT POND

Notes
SCALE 1:2800

Figure No.

Conceptual Site Layout
3.6 CONCEPTUAL SWM FACILITY DESIGN

The on-site topography and drainage characteristics present a challenging situation in order to viably develop this site for a SDF while both improving flooding issues on-site and off-site and maximizing the available land for a potential City Facility.

As stated earlier, the site floods during a rainfall event and does not discharge to the 417 highway ditch until the flooded area reaches an elevation equal to the outlet invert. In order to match 100-yr discharge rates at the outlet to the 417 ditch and limit any downstream impacts, an appropriately sized SWM pond will be required to attenuate storm events to the existing site discharge rates. Based on results from the SSA model, it was determined that the pond must hold a minimum of 22,000m³ in order to match discharge rates.

The low elevation difference between the culverts at the north and south end of the Site (<1cm) over a distance of 420m± poses a large challenge in order to provide a dry free draining stormwater management pond. With such a low grade separation, shallow groundwater, and the fact this area is continuously wet, an above-ground pond would need to be constructed in order drain the pond by gravity after an event and avoid permanent pooling. This above ground pond would need to be located immediately north of the culverts outleting from the linear pond. Placing the pond directly adjacent to Westbrook Road allows us to easily use the road structure (or other) to “dam” the water within the pond. It is anticipated that the proposed upgrade to the five (5) Westbrook culverts discharging on-site will improve off-site drainage issues.

The Site has been designated as part of a groundwater recharge zone by the Mississippi Valley Conservation Authority; as such the pond bottom should not be lined with an impermeable barrier to allow infiltration to occur. As noted in the Draft Hydrogeological Report dated July 3rd, 2013 by Stantec, the groundwater level at the Site is approximately 1m below existing ground level. With such little clearance to the groundwater in the preferred SWM pond location (central portion of site), the stormwater pond would need to be constructed mainly above ground level. Without considering additional area requirements for grading and setbacks, the proposed stormwater facility will provide for 22,000m³ of capacity. Depending of the presence of the groundwater and the ability to drop the upstream invert of the outleting culvert to the 417 roadside ditch, it is anticipated that an effective storage depth between 0.5-1.0m could be attained within the SWM pond. The area required to contain 22,000m³ over a depth of 0.5m is approximately 44,000m², or 4.4ha.
Figure 7 illustrates the proposed design layout for the SWM pond and SDF in accordance with the 2003 Stormwater Management Planning and Design Manual.

The design of the SWM pond will have its inlet at the existing or modified culverts from Westbrook Road and have a 300mm (or greater) discharge pipe providing a constant gravity outlet and an overtopping weir to outlet the appropriate attenuated flows.

As noted previously, we are recommending that the upstream invert of the 417 culvert be lowered by 0.5m to approximate elevation 126.19m. Since the downstream invert (126.16m) is only slightly above the bottom of the highway ditch, the downstream invert could not be lowered much more. Reducing the slope of the existing culvert also reduces the flow capacity of the culvert, and will be accommodated by excavating the portion of the culvert within the site to achieve the required drop in invert.
4.0 Conclusions & Recommendations

Our understanding of the hydraulics and hydrology of the general vicinity of the site, we conclude that this site has some significant challenges to development. To improve drainage deficiencies from prior development, a large SWM pond would be required to attenuate the tributary area draining through the site so that post development flows can match pre-development flows. The ponding issues on site and vulnerabilities upstream of the site present many challenges to the design of a functional stormwater management and water quality facility.

To control peak discharge rates from the site to existing conditions, a storage volume of approximately 22,000m$^3$ would have to be provided to attenuate storm events. This would require a footprint of approximately 4-5ha of land due to the site constraints and maximum active ponding depth of 0.5m to 0.6m. A permanent pool of water approximately 1.0 to 1.5 m deep will be maintained beneath the active ponding/storage. The high groundwater table and the reportedly persistent flooding issues upstream limit the maximum depth for an SWM pond to approximately 0.6m. Lowering the existing outlet to the Highway 417 roadside ditch is critical to achieving a positive grade through the site. The lowering of this culvert and installation of additional culverts (to match existing culvert capacity) is proposed. If lowering of this culvert’s upstream invert is not viable, it would not be possible to correct off-site drainage deficiencies using gravity drainage. It would still be possible to develop the site for an SDF but a pump station would be required.

The site is classified as a significant ground water recharge area by the MVCA. The hydrogeological report by Stantec identified the surficial soils on site as having a weak downward gradient and a hydraulic conductivity of $10^{-5}$cms/sec – thus while the site is a recharge zone, it would not be interpreted as being significant. Due to the elevation restriction for the SWM pond, groundwater exfiltration during spring can be expected at a rate of 5 to 12L/s. A permanent pool within the SWM pond will provide for water quality improvement.

Additional improvements would be required off-site to meet the City of Ottawa’s Sewer Guidelines and requirements required for the MCEA. These improvements include upgrading upstream (off-site) ditches, culverts and other improvements to the applicable 25yr, 50yr or 100yr storm.

Water quality during initial snow melt freshet will be highly variable and is a function of the volume of the snow pack, snow removal practices, the servicing area and amount of deicing material used in a season. Chloride concentrations beyond the spring freshet are expected to be below the MVCA target concentrations of 1000 mg/L but may exceed this level during peak melt period.

Target concentrations for meltwater discharge to outlet ditch to be 40mg/L for TSS.
The main components of the site development include:

1. Lower upstream invert of the existing culvert at the Highway 417 outlet to invert elevation 126.19m;
2. Increase capacity of culverts crossing Westbrook to 100-yr level;
3. Construct a SWM pond with a footprint of approximately 4ha;
4. Construct a SDF with a 357,000m³ snow pack capacity and provide a GCL or geomembrane liner beneath dump pad to protect groundwater quality;
5. Construct a snow meltwater pond (with bottom and sides lined with a GCL or geomembrane) for quality control including an oil/grease interceptor;
6. Off-site improvements to roadside ditches, and culverts.
7. Monitoring program for surface water quality during the melt period.
5.0 Closure

This report has been prepared for the sole benefit of the City of Ottawa (City). The report may not be used by any other person or entity without the express written consent of Stantec and the City. Any use that a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report. The information contained in this report are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Discussions, and recommendations presented in this report should not be construed as legal advice.

The discussions presented in this report represent the best technical judgment of Stantec based on the data obtained. It should be noted that the results of the stormwater modeling included in this report are generated based on available data and assumptions that were applied to create the model.