Miller Boyington Pit #3
Stormwater Management Report

Miller Paving Ltd.

P/N 10 – 2412 | March 2019

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

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Township of Uxbridge
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Table of Contents

Page

Appendices

Appendix A

Drawings

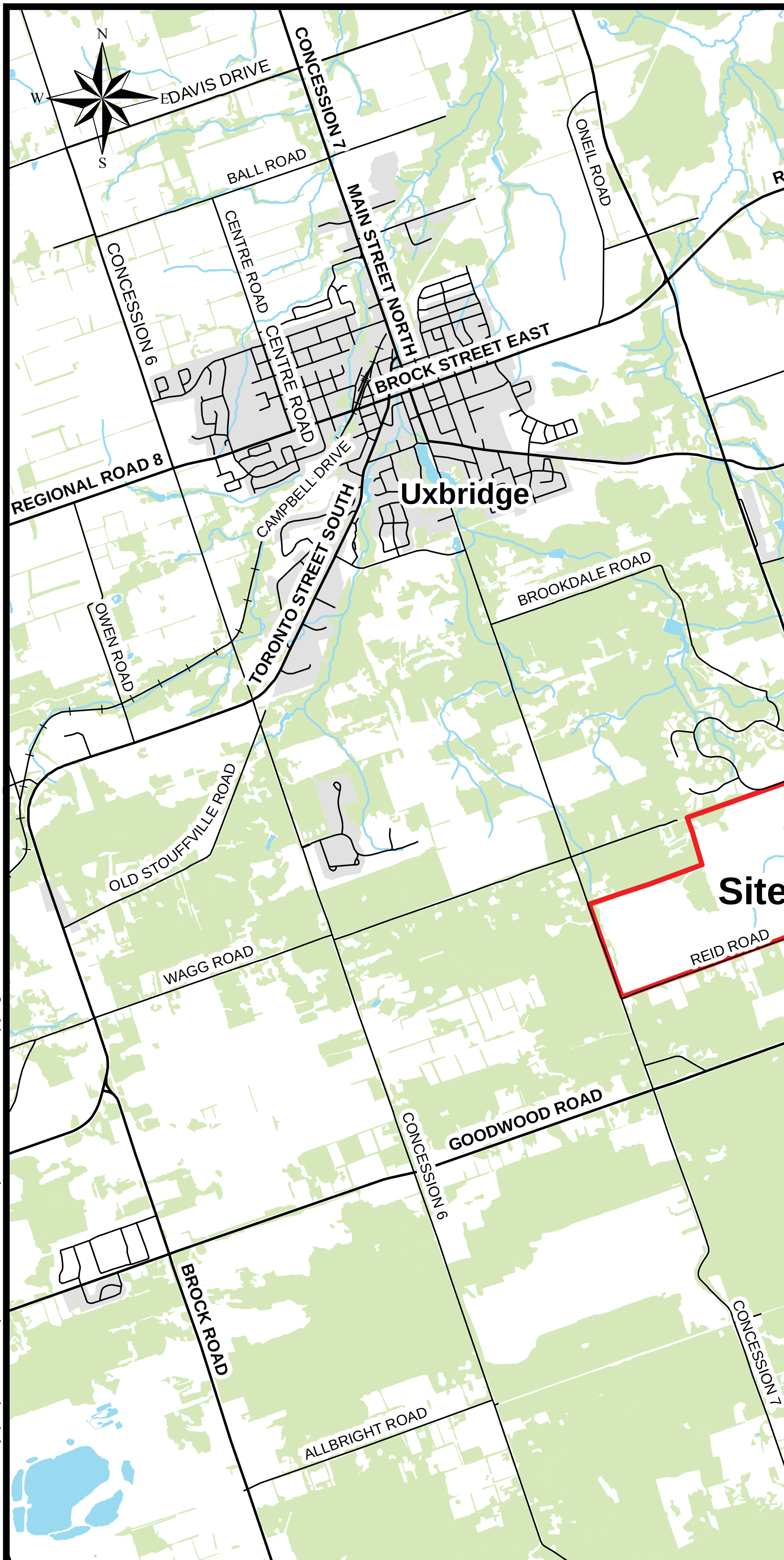
1.0 Introduction

Skelton, Brumwell & Associates Inc. (SBA) have been retained by Miller Paving Ltd. (Miller) to provide consulting engineering and planning services for Boyington Pit #3, located at the northeast corner of the intersection of Concession Road 7 and Reid Road in the Township of Uxbridge, and as shown on Figure #1. The property is legally described as Lot 18, Lot 19, and Part of Lot 20, Concession 20, Geographic Township of Uxbridge, now in the Township of Uxbridge, Region of Durham.

The property is currently licensed under the Aggregate Resources Act (ARA) as a Class “A” Pit, License #6578, with a total licensed area of +/- 196 hectares, and an annual extraction tonnage of 816,000 tonnes. The site is currently zoned M3, which permits use as a pit; M3–1, which permits uses including an asphalt plant; and M5–1, which permits uses including a contractors’ yard. The M3 zone comprises an area of +/- 170 hectares, the M3–1 zone comprises an area of +/- 13.4 hectares, and the M5–1 zone comprises an area of +/- 12.6 hectares.

Miller is currently proposing to remove an area of +/- 36.8 hectares of land from the existing ARA license in order to allow the importation of fill to match the grade of the surrounding lands, allow for construction of a rehabilitation slope, an also to allow for the construction of an approximately 40,000 square foot (3,716 m^2) building for equipment storage. This land includes the existing M3–1 and M5–1 lands, plus buffer lands to the north and east.

Preliminary consultation has been undertaken between SBA and staff from both the Township of Uxbridge and the Lake Simcoe Region Conservation Authority (LSRCA). As the application includes the construction of a building in excess of 500 m^2, the application is considered to be a “major development” under the Lake Simcoe Protection Plan (LSPP) and the Oak Ridges Moraine Conservation Plan (ORMCP), which requires a Stormwater Management Plan and Report to be prepared. This Stormwater Management Report was also prepared in the context of Policy 1.6.6.7 of the Provincial Policy Statement (PPS), Section 3.2.7 of the Growth Plan, and the LSRCA Technical Guidelines for Stormwater Management Submissions (2016).



Scoped Natural Heritage Evaluation
Miller Boyington Pit #3
Township of Uxbridge

Figure 1
Location

1:50,000

P/N 10-2412 | Date: 21/02/2019

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G:\Projects-1\2400\2412\GIS 2412\2412 - Figure 1 - Location.mxd

2.0 Existing Drainage Conditions

As noted previously, the site is currently licensed as a Class “A” Pit and includes an asphalt plant, outdoor equipment storage area, and several large stockpiles of granular material. Internal haul routes for the site are found within this area, and the west side of the site also includes a corrugated metal shop, block garage, and silos. Refer to drawing 2412–1 of 11 for existing conditions.

A large area of land along the south side of the property is grassed and treed, while the remainder of the property to be removed from the license has been disturbed as part of the aggregate operations. Onsite drainage is generally overland from the south to the north, while an area along the east side of the development drains from west to east. All drainage is conveyed overland to the active pit area where it infiltrates into the ground.

The site is located within the Uxbridge Brook Watershed, as summarized in the Uxbridge Brook Watershed Plan, LSRCA 1998. The watershed is generally characterized as having extremely low runoff volumes and high groundwater infiltration capability, which results from the areas sandy and sandy loam soils.

3.0 Golder Associates Ltd. Hydrogeological Assessment

A hydrogeological assessment, titled “*Hydrogeological Assessment, Boyington Pit #3, 4499 to 4589 Concession Road 7, Uxbridge, Ontario*”, dated January 2019, was undertaken by Golder Associates Ltd. (Golder). The purpose of the report was to review and evaluate groundwater conditions at the site, including advancing four (4) boreholes (Denoted as MW17–1 to MW17–4, respectively) and installing monitoring wells in each, completing private well surveys, and completing groundwater level measurements.

Soil infiltration rate testing was also undertaken by Golder in order to determine the hydraulic conductivity of surficial soils within the areas of the proposed infiltration. The summary of infiltration rate testing results are as follows:

Infiltration Basin	Estimated Infiltration Rate (mm/hr)	Applied Safety Correction Factor	Design Infiltration Rate (mm/hr)
1	140	2.5	55
2	130	2.5	53
3	140	2.5	55
4	73	2.5	29
5	140	2.5	55
6	150	2.5	60
7	69	2.5	28
8	110	2.5	44

9	57	2.5	23
10	150	2.5	60
11	240	2.5	96

Based on the estimated infiltration rates, the original Basin #9 did not meet the Ministry of the Environment (MOE) minimum infiltration rate of 60 mm/hr. This basin was consolidated with Basin #8 to improve infiltration capabilities.

4.0 Stormwater Management Requirements

4.1 Quality Control

A pre–consultation meeting was undertaken on April 26, 2018, between Jay Clark, P. Eng., and Landon Black, OALA, both of SBA, as well as Stephen Troan and Lisa–Beth Bulford of the LSRCA, in order to discuss the proposed stormwater management design. The stormwater management design is required to meet MOE Enhanced Quality Control standards, with 80% removal of Total Suspended Solids (TSS). In addition, the design is required to account for total phosphorous (TP) removal. No winter salt will be stored on site.

4.2 Quantity Control

4.2.1 Volume Control

During the pre–consultation meeting LSRCA staff advised that the detailed design of the site must account for volume controls, as well as conveyance of both the major (100–year) and minor (5–year) storm events.

New development volume control requires post–development runoff volume be captured and retained on site from a 25 mm rainfall event. As specified by LSRCA staff during the April 26, 2018 pre–consultation meeting, infiltration credit can be applied to the site for volume controls.

Based on the LSRCA Design Guidelines, the infiltration credit for each infiltration basin is 100% of the design infiltration amount to a maximum of 25 mm, and calculated as follows:

Infiltration Basin	Drainage Area (ha)	Depth Credit (mm)	Volume Credit (m^3)
1	3.63	25	907.5
2	3.35	25	837.5
3	2.82	25	705.0
4	2.45	25	612.5
5	3.69	25	922.5
6	3.53	25	882.5
7	1.59	25	397.5

8	1.66	25	415.0
9	1.12	25	280.0
10	1.38	25	345.0
11	0.59	25	147.5
Total	25.81	25	6,452.5

The conveyance of both the major (100–year) and minor (5–year) storm events is provided by the perimeter grass swale and connecting riprap channels discharging down the 3:1 fill slope to the infiltration basins. The riprap channel shape, dimensions and stone size plus stilling basin hydraulic jump height and length are found in Table #1.

4.2.2 Peak Flow Control

During the pre–consultation meeting LSRCA staff advised that peak flow controls and conveyance of the regulatory storm event is not required.

4.3 Site Grading

The proposed development of the property will consist of the importation of approximately 1,039,000 cubic metres of fill to allow for construction of an outdoor storage area and rehabilitation slopes. In addition, Miller is also proposing to construct a 40,000 square foot enclosed warehouse for high–tech equipment storage. The outdoor storage area surrounding the proposed building will consist of compacted granular material, which will have a similar imperviousness to asphalt. Roof drain downspouts will discharge at grade onto the compacted gravel surface.

Grading of the property will generally be from south to north, with flows generally conveyed overland through a bio–retention strip to a perimeter drainage swale at the top of the rehabilitation slope. The swale is intersected by a number of riprap lined channels to convey drainage to the base of the rehabilitation slope where flow will enter infiltration basins. An interim drainage swale is also proposed to be constructed midway up the rehabilitation slope to allow for conveyance of flow during the construction of the slope. Refer to drawing 2412–2 of 11 for the proposed site design.

Miller Boyington Pit #3 - Fill Project
30-Nov-18
Table #1 - Stone Paved Sloping Channel
Minor Drainage System (5 Yr rainfall event)
Major Drainage System (100 Yr rainfall event)

Basin #	Rational Method Design Flow								Stone Paved Sloping Channel																		
	Area (ha)	Composite Runoff Coefficient C		Time Concentration T_c (minutes)	Rainfall Intensity I (mm/hr)		Design Flow Q (m^3/s)		Shape	Side Slopes H:V	Invert Width (m)	Depth (m)	Slope Length (m)	Slope (%)	Rip Rap Median Size Dm (m)	Mannings N	Flow Depth d_1 (m)		Flow Velocity V_1 (m/s)		100 Yr Free-board (m)	Hydraulic Jump Height d_2 (m)		100 Yr Stilling Basin Min Length (m)	5 Yr Rip Rap layer		
		5 Yr	100 Yr		5 Yr	100 Yr	5 Yr	100 Yr									5 Yr	100 Yr	5 Yr	100 Yr		5 Yr	100 Yr		Layer (m)	Volume (m^3)	Weight (tonne)
1	3.63	0.80	0.90	15.6	61.0	102.8	0.50	0.94	Trap	2 to 1	1.5	0.5	58.0	26.1	0.287	0.040	0.110	0.158	2.66	3.23	0.342	0.347	0.506	3.0	0.431	98	260
2	3.35	0.82	0.91	15.6	61.0	102.8	0.47	0.88	Trap	2 to 1	1.5	0.5	59.0	26.8	0.289	0.040	0.108	0.152	2.63	3.21	0.348	0.340	0.494	3.0	0.434	101	266
3	2.82	0.81	0.91	14.2	64.4	109	0.41	0.78	Trap	2 to 1	1.5	0.5	63.0	27.4	0.269	0.039	0.098	0.141	2.47	2.95	0.359	0.304	0.435	2.6	0.403	99	262
4	2.45	0.72	0.81	14.2	64.4	109	0.32	0.61	Trap	2 to 1	1.5	0.5	63.0	26.2	0.236	0.039	0.090	0.134	2.44	3.09	0.366	0.289	0.448	2.7	0.354	87	230
5	3.69	0.69	0.78	19.2	57.8	89.3	0.41	0.72	Trap	2 to 1	1.5	0.5	70.0	28.8	0.276	0.040	0.096	0.128	2.50	2.97	0.372	0.305	0.420	2.5	0.415	112	298
6	3.53	0.67	0.76	19.2	57.8	89.3	0.38	0.67	Trap	2 to 1	1.5	0.5	75.0	23.7	0.225	0.038	0.095	0.128	2.50	2.97	0.372	0.304	0.420	2.5	0.338	98	259
7	1.59	0.64	0.72	6.7	102.1	176.2	0.29	0.56	Trap	2 to 1	1.0	0.5	38.0	23.2	0.227	0.038	0.098	0.143	2.82	3.08	0.357	0.353	0.459	2.8	0.341	45	119
8	1.66	0.63	0.72	6.7	102.1	176.2	0.30	0.59	Trap	2 to 1	1.0	0.5	34.0	17.9	0.195	0.037	0.109	0.155	2.92	3.09	0.345	0.384	0.477	2.9	0.293	35	93
9	1.12	0.78	0.88	9.4	81.6	138.4	0.20	0.38	Trap	2 to 1	1.0	0.5	34.0	17.9	0.166	0.036	0.093	0.132	2.37	2.89	0.368	0.283	0.413	2.5	0.250	29	78
8 & 9	2.78	0.63	0.72	9.4	81.6	138.4	0.40	0.78																			
10	1.38	0.83	0.93	9.4	81.6	138.4	0.26	0.50	Trap	2 to 1	1.0	0.5	23.0	17.5	0.165	0.036	0.094	0.137	2.37	2.86	0.363	0.284	0.414	2.5	0.247	20	54
11	0.59	0.82	0.91	8.6	87.6	149.3	0.12	0.22	Trap	2 to 1	0.5	0.5	13.0	6.0	0.150	0.036	0.105	0.146	1.70	2.02	0.354	0.202	0.283	1.7	0.225	9	24
Total																											1,943

Note:

1. Rational Equation Q = 0.0028 CIA, where:
   Composite C5yr = runoff coefficient for 5 yr storm event (existing roads & proposed gravel storage areas C= 0.90/woodland,hilly & open sand C=0.18/pasture, rolling & silt loam C=0.35); and C100yr add 25% up to maximum of 0.95,
   (LSRCA Technical Guidelines for SWM Submissions, Appendix C Pages C6, C27 & C28),
   I = rainfall intensity mm/hr (MTO Design Chart 1.01 (g) : District 7 Port Hope (applicable to basins south of Lindsay) IDF Curves, and
   A = drainage area (ha)
2. Mannings Calculation for Trapezoidal Channels Spreadsheet utilzed for flow depth and velocity.
3. C.D. Smith, Hydraulic Structures, Chapter VI Drop Structures, E. Stone Paved Sloping Channel Pg. 192
   Shields Method was utilized for determining Rip Rap size required to protect the stone sloped channel during the 5 Year rainfall event.
   D_m = 10*d5*S where: D_m = 50% size by weight; d5 = 5 Yr channel flow depth; S= slope m/m; minimum D_m set at 0.150 m.
   Mannings 'N' for rip rap is equivalent to 0.049 D_m**0.166.
   Hydraulic Jump Stilling Basin: Hydraulic Jump Height d_2 = ((2 x v1^2 x d_1/g + (d_1^2)/4))^0.5 -d_1/2; Basin minimum Length L = 6 x d_2.
4. Mannings Calculation for Trapezoidal and V-Shaped Channels was completed with a computer program (copies of printouts in project file).
5. Freeboard Allowance is the distance above the 100 Year depth of flow to the top of channel.
6. Rip Rap unit weight set at 2.65 tonnes /m^3.
7. Filter Fabric shall be place beneath the rip rap material. It shall be Terrafix 270R or approved equivalent.
8. The Perimeter grass channel shall have a Filtrexx PetroLoxx sock check dam and Rock check dam (OPSD 219.211) installed immediately upstream and downstream of each stone paved sloping channel entrance, respectively.

5.0 Proposed Drainage Conditions

5.1 Stormwater Management Quantity Control Results

LSRCA staff advised that water balance calculations are required to be undertaken as part of the proposed design works to show how changes will be minimized. The calculations were undertaken as part of the Hydrogeological Assessment Report prepared by Golder. Average Annual Water Balance results for existing conditions, post–development conditions and post–development with SWM features are found in the Golder report.

5.2 Stormwater Management Quality Control Results

LSRCA staff advised that phosphorous balance calculations are required to be undertaken as part of the proposed design works. The calculations must demonstrate that post–development conditions meet or reduce the pre–development infiltration capacity phosphorous levels. The calculations were undertaken as part of a Golder memorandum, dated December 7, 2018.

The Golder memorandum indicates that the Total Phosphorous (TP) loading during existing conditions is 5.3 kg/year. TP removal is provided by the proposed vegetative filter strip (bio–retention strip) infiltration basins and natural sand filter reducing the post–development mitigated TP to 0.2 kg/year. The infiltration basins meet the MOE SWM design for enhanced protection with 80 % TSS removal.

The spill management plan (discussed under Section 7.0) specifies the use of PetroLoxx Sock check dams for removal of potential hydrocarbons.

5.3 Stormwater Conveyance

5.3.1 Major and Minor Drainage Systems

As noted previously, conveyance of stormwater runoff will be by overland flow to a perimeter drainage swale system at the top of the rehabilitation slope, with riprap lined channels then conveying drainage to infiltration basins at the base of the slope. The rainfall intensity and design flow for each drainage area were determined for both the 1 in 5–year (minor) and 1 in 100–year (major) storm events utilizing the rainfall Intensity–Duration–Frequency (IDF) curve for District 7 Port Hope, as found in the Ministry of Transportation (MTO) Design Chart 1.01 (g). The attached drawing 2412–3 of 11 identifies the minor drainage system, and drawing 2412–4 of 11 identifies the major drainage system.

The riprap lined channels were designed with 2H:1V side slopes utilizing the design flows, which were calculated using the Rational method. The riprap was sized utilizing the Shields Method, while the channel freeboard was set at the distance above the 100–year flow depth to the top of the proposed channel. The flow depth and velocity were also calculated and used to determine the hydraulic jump height and corresponding minimum infiltration basin length. The flow and riprap calculations are included in Table #1 and Appendix A.

5.3.2 Regulatory Storm Event

Stormwater conveyance for the regulatory storm even is not required, as specified during the pre–consultation meeting with LSRCA staff on April 26, 2018.

5.4 Infiltration Basin Design

LSRCA staff advised that they would accept the results of Guelph Permeameter testing for the design of the infiltration basins, and also that they would accept the use of the MOE Stormwater Management Planning and Design Manual (March 2003) for the purposes of the site stormwater management design. LSRCA staff also advised that infiltration basins typically are not permitted for providing volume control, therefore the credits must be addressed as per the LSRCA Technical Guidelines for Stormwater Management Submissions (September 2016).

The proposed infiltration basins were designed utilizing the infiltration rates and safety correction factors as determined by the Golder report. The soil infiltration rates ranged from 57 mm/hr to 240 mm/hr, and a safety factor of 2.5 was utilized. The drainage areas were determined based on the existing and proposed topography of the area, and a total of eleven (11) catchments were determined. The area of each catchment was determined to be less than 5.0 ha, while the depth to bedrock and the groundwater table was determined to be greater than 1.0 m.

Based on the design impervious area, the bottom area of the infiltration basins was calculated using Manning's equation with a porosity of 0.1 (10% of the total soil volume). The length and width of the infiltration basins was then set ensuring a 3:1 length to width ratio, and a storage depth of 600 mm was utilized for each infiltration basin in order to minimize the compaction of soil within the basin. A storage volume for each basin was then calculated and compared to the minimum volume required in order to ensure adequate capacity is available. In addition, the recharge rate for each infiltration basin was also calculated, and all were found to be less than 24 hours.

The infiltration basins were also designed incorporating an emergency spillway weir consisting of a clay berm overlaying a riprap channel. See SBA Table #2 and SBA Table #3 for the detailed design of each of the infiltration basins and emergency spillway. The design of the infiltration basins, riprap channels, and spillway are shown on drawings 2412–5 of 11, 2412–6 of 11, 2412–7 of 11, and 2412–8 of 11.

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30-Nov-18
Table #2 - Infiltration Basin Design

Catchment #	Drainage Area		Natural Soil					Depth to Groundwater			Depth to Bedrock	Water Quality Storage Requirements																	Recharge			Emergency Spillway	
													Bioretention (Bio)				Landscape		Infiltration Basin														
	Size	Min.						Basin	GW	GW	Min.		Area	L	W				Basin Invert					Storage							Time		
	ha	< 5 ha	USG	Permeability (cm/s)	Soil Infiltration (mm/hr)	Safety Factor	Design Infiltration (mm/hr)	mASL	mASL	> 1m	> 1m	Impervious Area (ha)	ha	m	m	Imp/ Bio Range from 5:1 to 15:1	Type	Infiltration Basin Type	Min. Area (m^2)	L (m)	W (m)	Area (m^2)	L/W >= 3:1	Imp (%)	% TSS Removal	Runoff Volume (m^3/ha) for Imp (%)	Minimum Volume Required (m^3)	Storage Volume (m^3)	Available Depth (mm)	Design Infiltration (mm/hr)	hr	100 Year Flow (m3/s)	Avg. Weir Length (m) @ H = 0.1 m
1	3.63	Yes	SP/GP	0.0070	**140**	2.5	**55**	+/-332	+/- 312	+/- 20	+/-40m	2.904	0.189	105	18	15	grass/sedge	Recharge to GW	1026	57	19	**1083**	3.00	80	80	37.3	135.4	792	600	55	**10.9**	0.94	4.2
2	3.35	Yes	SP/GP	0.0060	**130**	2.5	**53**	+/-332	+/- 312	+/- 20	+/-40m	2.747	0.186	81	23	15	grass/sedge	Recharge to GW	1009	57	19	**1083**	3.00	82	80	38.3	128.3	792	600	53	**11.3**	0.88	4.2
3	2.82	Yes	SP/GW	0.0070	**140**	2.5	55	+/-330	+/- 312	+/- 18	+/-40m	2.284	0.141	67	21	16	grass/sedge	Recharge to GW	797	51	17	**867**	3.00	81	80	37.3	105.2	648	600	55	**10.9**	0.78	3.4
4	2.45	Yes	SP/GW	0.0008	**73**	2.5	29	+/-331	+/- 312	+/- 19	+/-40m	1.764	0.136	62	22	13	grass/sedge	Recharge to GW	1267	66	22	**1452**	3.00	72	80	36.0	88.2	1035	600	29	**20.7**	0.61	3.4
5	3.69	Yes	SP/GW	0.0070	**140**	2.5	55	+/-332	+/- 312	+/- 20	+/-40m	2.546	0.163	86	19	16	grass/sedge	Recharge to GW	998	57	19	**1083**	3.00	69	80	35.7	131.7	792	600	55	**10.9**	0.72	3.2
6	3.53	Yes	SP/GW	0.0100	**150**	2.5	60	+/-331	+/- 312	+/- 19	+/-40m	2.365	0.155	111	14	15	grass/sedge	Recharge to GW	901	54	18	**972**	3.00	67	80	33.7	119.0	718	600	60	**10.0**	0.67	3.2
7	1.59	Yes	SP	0.0006	**69**	2.5	28	+/-335	+/- 312	+/- 23	+/-40m	1.018	0.063	70	9	16	grass/sedge	Recharge to GW	781	49	17	**833**	2.88	64	80	33.0	52.5	624	600	28	**21.4**	0.56	2.5
8	1.66	Yes	SP/GP	0.0030	**110**	2.5	44	+/-335	+/- 312	+/- 23	+/-40m	1.046	0.066	66	10	16	grass/sedge	Recharge Basin						63									
9	1.12	Yes	SP	0.0002	57 < 60	2.5	23	+/-346	+/- 312	+/- 34	+/-40m	0.874	0.084	93	9	10	grass/sedge	Recharge Basin						78									
8 & 9	2.78	Yes	SP/GP	0.0030	110	2.5	44	+/-335	+/- 312	+/- 23	+/-40m	1.919	0.15	159	8	13	grass/sedge	Recharge Basin	903	54	18	**972**	3.00	63	80	34.3	95.4	718	600	44	**13.6**	0.78	4.2
10	1.38	Yes	sand	0.0400	**150**	2.5	60	+/-339	+/- 312	+/- 27	+/-40m	1.145	0.067	95	7	17	grass/sedge	Recharge to GW	348	33	11	**363**	3.00	83	80	36.3	50.1	302	600	60	**10.0**	0.50	2.2
11	0.59	Yes	sand	0.0100	**240**	2.5	96	+/-345	+/- 312	+/- 33	+/-40m	0.484	0.063	90	7	8	grass/sedge	Recharge to GW	92	18	6	**108**	3.00	82	80	36.0	21.2	113	600	96	**6.3**	0.22	1.0

Note:

1. Infiltration Basins design guidelines are provided in Table 4.9 of the MOE, SWM Planning & Design Manual, March 2003.
   Drainage areas are less than 5 ha.
   Runoff Volume to be treated via infiltration is identified in Table 3.2.
   Infiltration basins are suitable where the precolation rate of natural soil is >= 60 mm/hr (Table 4.4).
   Depth to groundwater table and bedrock is greater than 1.0 m.
   Basin length to width ratio is 3:1 or greater.
   Storage depth is less than 0.6 m in order to minimize compaction of soil within the basin.
   Pre-treatment requires impervious area to bioretention strip area 15:1 min (TRCA, LID SWP Planning and Design Guide, 2010).
   Overflow Spillway is required for infrequent storms.
   Maintenance access is required for light discing equipment to till the basin bottom.
   A landscape plan has been completed to enhance infiltration and increase porosity.
2. Infiltration Rates & Safety Correction Factor were provided in the Hydrogeological Report prepared by Golder & Assoc.
3. The approximate mimimum bottom area A of the infiltration basin is calaculated from MOE SWM Planning & Design Manual Equation 4.3 with porosity (n) set at 0.1.
   A = 1000*RV/(p*n*RT): where RV = runoff volume (m3) from Table 3.2 (Enhanced Protection);
   P = Infiltration rate (mm/hr)
   n = porosity = 0.1 (10% of total soil volume)
   RT = Retention Time = 24 hrs
4. Runoff Coefficient C per LSRCA Page C6, C27 and C28.
   Gravel surface assumed impervious (such as asphalt) with C_{5yr} = 0.90 & C_{100yr} = 0.95 i.e. top of interior roads & outdoor equipment storage areas; Woodland with hilly topography on open sand C = 0.18 i.e. natural treed areas; and Pasture with rolling topography on silt loam C = 0.35.
5. Recharge Times for a maximum storage depth of 600 mm are less than 24 hr.
6. Broadcrested Weir - Infiltration Basin Spillway (LSRCA Technical Guidelines for SWM, Appendix I, Page I9)
   Equation: Q = C*A*(2*g*h)^1.5 = 1.7*A*(2*9.81*h)^0.5 = 1.7*A*(19.62*h)^0.5

Miller Boyington Pit #3 - Fill Project
20-Jul-18
Table #3 - Infiltration Basin Dimensions

Infiltration Basin #	Basin Bottom			Top of Water Storage Level				Clay Berm							Emergency Spillway			
								Top	Side Slope		Top	Base	Cut-off		Base	Side Slope	Top	
	L	W	A	D	Side Slope	L	W	H	U.S.	D.S.	W	W	D	W	W		H	W
1	57	19	1083	0.5	5:1	62	24	0.5	3:1	2:1	2.5	5.0	0.5	1.0	3.9	3:1	0.5	6.9
2	57	19	1083	0.5	5:1	62	24	0.5	3:1	2:1	2.5	5.0	0.5	1.0	3.9	3:1	0.5	6.9
3	51	17	867	0.5	5:1	56	22	0.5	3:1	2:1	2.5	5.0	0.5	1.0	3.1	3:1	0.5	6.1
4	66	22	1452	0.5	5:1	71	27	0.5	3:1	2:1	2.5	5.0	0.5	1.0	3.1	3:1	0.5	6.1
5	57	19	1083	0.5	5:1	62	24	0.5	3:1	2:1	2.5	5.0	0.5	1.0	2.9	3:1	0.5	5.9
6	54	18	972	0.5	5:1	59	23	0.5	3:1	2:1	2.5	5.0	0.5	1.0	2.9	3:1	0.5	5.9
7	49	17	833	0.5	5:1	54	22	0.5	3:1	2:1	2.5	5.0	0.5	1.0	2.2	3:1	0.5	5.2
8 & 9	54	18	972	0.5	5:1	59	23	0.5	3:1	2:1	2.5	5.0	0.5	1.0	3.9	3:1	0.5	6.9
10	33	11	363	0.5	5:1	38	16	0.5	3:1	2:1	2.5	5.0	0.5	1.0	1.9	3:1	0.5	4.9
11	18	6	108	0.5	5:1	23	11	0.5	3:1	2:1	2.5	5.0	0.5	1.0	0.7	3:1	0.5	3.7

Note:
1. Infiltration Basin design guidelines are provided in Table 4.9 of the MOE, SWM Planning & Design Manual, March 2003.
2. Soil Conservation Services, Engineering Field Manual, Chapter 11. Ponds and Reservoirs, April 1975.

5.5 Bioretention Strip

The proposed design includes a 14 m wide bioretention strip along the perimeter of the top of the rehabilitated slope at the north side of the site, and a 6 m wide bioretention strip along the perimeter of the top of rehabilitated slope at the east side of the site. Runoff will be conveyed overland to the bioretention strips to promote infiltration and provide quality pre–treatment and/or evaporation before runoff reaches the perimeter drainage swale at the top of the slope.

The bioretention strip will consist of 150 mm of topsoil and seed mix. A site planting plan is included as drawing 2412–10 of 11, and detailed planting information for the bioretention strip is included on drawing 2412–11 of 11.

5.6 Water Balance

The water balance calculations prepared by Golder show that under pre–development conditions the infiltration was estimated at 54,430 m^3/year and the runoff was estimated at 74,480 m^3/year. Under post–development conditions, including the use of infiltration systems, the infiltration was estimated at 88,920 m^3/year and the runoff was estimated at 30,420 m^3/year. This yields an increase in infiltration of 34,490 m^3/year, or 63%, and a decrease in runoff of 44,060 m^3/year, or –59% as compared to existing conditions.

Refer to the Golder report for the detailed water balance calculations.

5.7 Phosphorous Balance

The phosphorous balance calculations prepared by Golder show that under pre–development conditions the site generates a Total Phosphorous load of approximately 5.3 kg/year, while under post–development conditions, including the use of infiltration systems and the bioretention strips, the annual Total Phosphorous load is reduced to approximately 0.2 kg/year.

Refer to the Golder report for the detailed phosphorous balance calculations.

5.8 Winter Salt

As noted previously, their will be no winter salt storage on site.

6.0 Erosion and Sediment Controls

The construction phase of this development, specifically the construction of the rehabilitation slope, provides the most significant risk of erosion and sedimentation in downstream receivers. In order to mitigate the risks, siltation fencing is to be installed adjacent to the fill importation areas. The fencing will prevent the migration of sediment while allowing drainage to pass through the fabric.

All siltation controls are to be inspected on a weekly basis while fill is being imported, and Miller will be required to have a supply of additional silt control materials on hand at all times in order to immediately address any required maintenance issues. Any silt controls that are used are to remain in place throughout fill importation works, and until all fill slopes have been vegetated.

The importation of fill may result in mud being tracked onto local area roads by vehicles exiting the site. Miller shall be responsible for sweeping area roads as necessary.

Enhanced vegetated grass swales, infiltration basin berms, bio-retention strips and discontinuous uniform fill slopes consisting of an upper and lower 3:1 slope with a mid slope bench shall provide permanent erosion and sediment control.

Refer to drawing 2412–9 of 11 and 2412–11 of 11 for details on the erosion and sediment controls.

7.0 Spill Management Plan

The outdoor construction equipment storage area shall be constructed of imported fill complete with a gravel surface that is compacted, making it equivalent to an asphalt surface. The equipment storage area shall be sloped at 1% with sheet flow drainage passing through a bio – retention strip and then into a perimeter ditch. The perimeter ditch shall collect runoff directing it to multiple riprap channels running down the 3:1 sloped embankment into infiltration basins.

Any potential fuel/oil spill would not infiltrate through the equipment storage area into the groundwater as the surface is impermeable.

The perimeter ditching shall include PetroLoxx Sock check dams for hydrocarbon removal, which provide up to 99% removal of hydrocarbons. The check dams shall be placed upgradient of each riprap channel to prevent fuel/oil from reaching the infiltration basins. The PetroLoxx product removes 99% of all diesel and motor oil, and 80% of all gasoline.

No winter salt is stored on site, therefore there are no concerns related to spill management or contamination as a result of salt storage.

8.0 Recommendations

Based on the preceding analysis, the proposed fill importation and stormwater management works at the Miller Boyington Pit #3 should consist of the following:

1. Importation of approximately 1,039,000 cubic metres of fill to allow for construction of a compacted granular outdoor equipment storage area, rehabilitation slopes within the existing licensed area.

2. Construction of a 3,716 m^2 (40,000 square foot) enclosed warehouse for high–tech equipment storage. Roof drain downspouts will discharge at grade onto the compacted granular surface, which shall be graded to the proposed perimeter grassed swale and conveyed to an infiltration basin.

3. Construction of a bioretention strip and perimeter drainage swale system at mid–slope (interim) and the top of the rehabilitation slope (permanent) to allow for collection of overland flow, complete with PetroLoxx Sock and riprap check dams.

4. Construction of riprap lined channels at slopes of 2H:1V for conveyance of the 100–year design flow to the base of the rehabilitation slope(s).

5. Construction of infiltration basins at the base of each riprap lined channel to promote infiltration of runoff into the pit floor.

9.0 Conclusions

The report conclusions are as follows:

1. The subject lands are not regulated under Ontario Regulation 179/06 under the Conservation Authorities Act. Therefore, a permit from the LSRCA will not be required prior to site alteration or development.

2. The application is considered a Major Development under the Lake Simcoe Protection Plan (LSPP) and the Oak Ridges Moraine Conservation Plan (ORMCP), as the proposed 3,716 m^2 (40,000 square foot) building has a footprint greater than 500 m^2. Accordingly, the proposed stormwater management plan including bio-retention strips, grassed perimeter swales and multiple infiltration basins is in accordance with Designated Policy 4.8 of the Lake Simcoe Protection Plan.

a. The changes in water balance between pre–development and post–development have been minimized by directing runoff from impervious surfaces to infiltration basins.

b. The changes in phosphorus loadings between pre–development and post–development have been reduced. Golder Associates have demonstrated that the Total Phosphorous (TP) loading during existing conditions is 5.3 kg/year. TP removal is provided by the proposed vegetative filter strips (bio–retention strips), infiltration basins and natural sand filter reducing the post–development mitigated TP to 0.2 kg/year, as shown in the Golder memorandum.

3. The subject lands are within the Wellhead Protection Area (WDPA-Q2) and part of site is within an area of high aquifer vulnerability (ORMCP) of the South Georgian Bay Lake Simcoe Source Protection Plan Policy LUP-12. A Hydrogeological Assessment was prepared by Golder Associates Ltd. which demonstrates pre– to post–development water balance.

4. The infiltration basins meet the MOE SWM design for enhanced protection with 80% TSS removal.

5. Enhanced vegetated grass swales, infiltration basin berms, bio-retention strips and discontinuous uniform fill slopes consisting of an upper and lower 3:1 slope with a mid slope bench shall provide permanent erosion and sediment control.

6. The perimeter ditching shall include PetroLoxx Sock check dams which provide up to 99% removal of hydrocarbons.

10.0 Disclaimer of Responsibilities to Third Parties

This report was prepared by Skelton, Brumwell & Associates Inc. for the account of Miller Paving Ltd.

The material in it reflects Skelton, Brumwell & Associates Inc.'s best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

Skelton, Brumwell & Associates Inc. accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions based on this report.

All of which is respectfully submitted,

SKELTON, BRUMWELL & ASSOCIATES INC.

Per:

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Per:

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Senior Environmental Engineer

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Appendix A

Manning Calculation for Rectangular Channels, Basins #1 –#11 (5–Year and 100–Year Events)

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[MANCHAN] 06-Dec-18

MANNING CALCULATION FOR RECTANGULAR CHANNELS

Basin #1 Channel

A) 5 Year Event		B) 100 Year Event	
N	0.040	N	0.040
DEPTH	0.110 m	DEPTH	0.158 m
SLOPE	26.1 %	SLOPE	26.1 %
SIDESLOPE	2 : 1	SIDESLOPE	2 : 1
BOTTOM WIDTH	1.5 m	BOTTOM WIDTH	1.5 m
A	0.189 sq.m.	A	0.287 sq.m.
Wp	1.992 m	Wp	2.207 m
Rh	0.095 m	Rh	0.130 m
V	2.659 m/s	V	3.278 m/s
Q	0.503 cms	Q	0.941 cms

Basin #2 Channel

A) 5 Year Event		B) 100 Year Event	
N	0.040	N	0.040
DEPTH	0.108 m	DEPTH	0.152 m
SLOPE	26.1 %	SLOPE	26.1 %
SIDESLOPE	2 : 1	SIDESLOPE	2 : 1
BOTTOM WIDTH	1.5 m	BOTTOM WIDTH	1.5 m
A	0.185 sq.m.	A	0.274 sq.m.
Wp	1.983 m	Wp	2.180 m
Rh	0.093 m	Rh	0.126 m
V	2.630 m/s	V	3.207 m/s
Q	0.487 cms	Q	0.879 cms

Basin #3 Channel

	A) 5 Year Event		B) 100 Year Event
N	0.039	N	0.039
DEPTH	0.098 m	DEPTH	0.141 m
SLOPE	25.2 %	SLOPE	25.2 %
SIDESLOPE	2 : 1	SIDESLOPE	2 : 1
BOTTOM WIDTH	1.5 m	BOTTOM WIDTH	1.5 m
A	0.166 sq.m.	A	0.251 sq.m.
Wp	1.938 m	Wp	2.131 m
Rh	0.086 m	Rh	0.118 m
V	2.503 m/s	V	3.095 m/s
Q	0.416 cms	Q	0.778 cms

Basin #4 Channel

	A) 5 Year Event		B) 100 Year Event
N	0.038	N	0.038
DEPTH	0.090 m	DEPTH	0.134 m
SLOPE	25.2 %	SLOPE	25.2 %
SIDESLOPE	2 : 1	SIDESLOPE	2 : 1
BOTTOM WIDTH	1.5 m	BOTTOM WIDTH	1.5 m
A	0.151 sq.m.	A	0.237 sq.m.
Wp	1.902 m	Wp	2.099 m
Rh	0.079 m	Rh	0.113 m
V	2.442 m/s	V	3.085 m/s
Q	0.369 cms	Q	0.731 cms

Basin #5 Channel

	A) 5 Year Event		B) 100 Year Event
N	0.039	N	0.039
DEPTH	0.096 m	DEPTH	0.128 m
SLOPE	26 %	SLOPE	26 %
SIDESLOPE	2 : 1	SIDESLOPE	2 : 1
BOTTOM WIDTH	1.5 m	BOTTOM WIDTH	1.5 m
A	0.162 sq.m.	A	0.225 sq.m.
Wp	1.929 m	Wp	2.072 m
Rh	0.084 m	Rh	0.108 m
V	2.511 m/s	V	2.973 m/s
Q	0.408 cms	Q	0.668 cms

Basin #6 Channel

A) 5 Year Event		B) 100 Year Event	
N	0.039	N	0.039
DEPTH	0.095 m	DEPTH	0.128 m
SLOPE	26 %	SLOPE	26 %
SIDESLOPE	2 : 1	SIDESLOPE	2 : 1
BOTTOM WIDTH	1.5 m	BOTTOM WIDTH	1.5 m
A	0.161 sq.m.	A	0.225 sq.m.
Wp	1.925 m	Wp	2.072 m
Rh	0.083 m	Rh	0.108 m
V	2.496 m/s	V	2.973 m/s
Q	0.401 cms	Q	0.668 cms

Basin #7 Channel

A) 5 Year Event		B) 100 Year Event	
N	0.039	N	0.039
DEPTH	0.098 m	DEPTH	0.143 m
SLOPE	26.1 %	SLOPE	26.1 %
SIDESLOPE	2 : 1	SIDESLOPE	2 : 1
BOTTOM WIDTH	1 m	BOTTOM WIDTH	1 m
A	0.117 sq.m.	A	0.184 sq.m.
Wp	1.438 m	Wp	1.640 m
Rh	0.081 m	Rh	0.112 m
V	2.462 m/s	V	3.047 m/s
Q	0.289 cms	Q	0.560 cms

Basin #8 Channel

A) 5 Year Event		B) 100 Year Event	
N	0.037	N	0.037
DEPTH	0.109 m	DEPTH	0.155 m
SLOPE	17.6 %	SLOPE	17.6 %
SIDESLOPE	2 : 1	SIDESLOPE	2 : 1
BOTTOM WIDTH	1 m	BOTTOM WIDTH	1 m
A	0.133 sq.m.	A	0.203 sq.m.
Wp	1.487 m	Wp	1.693 m
Rh	0.089 m	Rh	0.120 m
V	2.265 m/s	V	2.757 m/s
Q	0.301 cms	Q	0.560 cms

Basin #9 Channel

	A) 5 Year Event	B) 100 Year Event
N	0.036	0.036
DEPTH	0.093 m	0.132 m
SLOPE	17.6 %	17.6 %
SIDESLOPE	2 : 1	2 : 1
BOTTOM WIDTH	1 m	1 m
A	0.110 sq.m.	0.167 sq.m.
Wp	1.416 m	1.590 m
Rh	0.078 m	0.105 m
V	2.126 m/s	2.592 m/s
Q	0.234 cms	0.433 cms

Basin #10 Channel

	A) 5 Year Event	B) 100 Year Event
N	0.038	0.038
DEPTH	0.094 m	0.137 m
SLOPE	23.2 %	23.2 %
SIDESLOPE	2 : 1	2 : 1
BOTTOM WIDTH	1 m	1 m
A	0.112 sq.m.	0.175 sq.m.
Wp	1.420 m	1.613 m
Rh	0.079 m	0.108 m
V	2.326 m/s	2.879 m/s
Q	0.260 cms	0.502 cms

Basin #11 Channel

	A) 5 Year Event	B) 100 Year Event
N	0.036	0.036
DEPTH	0.105 m	0.146 m
SLOPE	10.1 %	10.1 %
SIDESLOPE	2 : 1	2 : 1
BOTTOM WIDTH	0.5 m	0.5 m
A	0.075 sq.m.	0.116 sq.m.
Wp	0.970 m	1.153 m
Rh	0.077 m	0.100 m
V	1.596 m/s	1.906 m/s
Q	0.119 cms	0.220 cms