Technical Memorandum

To: **Ken Szekely, Quantum Realty Management**

From: Dirka Prout. P.Eng. / Mauro Cortes, P.Eng.

Date: April 27, 2023

File: WW21012079.CO1.2000-TM1

Re: **Topsoil Fertility Report**
1450 King Road SWM Facility Works
Burlington, ON

This technical memorandum has been prepared to document the fertility of the topsoil at the above-noted site in accordance with Task 4: Topsoil Fertility Testing, as described in WSP E&I Canada Limited (WSP) Proposal WW21012079 dated February 17, 2023.

GOVERNING SPECIFICATIONS

The applicable topsoil specifications for this project are:

- Ontario Provincial Standard Specification (OPSS).MUNI 802 – Construction Specification for Topsoil, November 2019
- Item J.4 Topsoil & Sod, Section J – Landscaping & Private Property Works, City of Burlington Standard Specifications, Revised February 2022. This modifies OPSS.802.05.

The combined materials requirements from both specifications are that topsoil shall:

- Be a fertile, friable natural loam material, free of admixtures of subsoil, clay lumps, roots, vegetation, debris such as stones or clods of a size (greater than 25 millimetres (mm) in size) and quantity that prevents proper placement of the topsoil, and any other extraneous matter;
- Have an organic content between 7% and 11% by weight, according to ASTM D2974. Further the City of Burlington (City) requires an organic content of not less than 4% for clay loams and not less than 2% for sandy loams.
- Have a pH from 6.0 to 7.5 according to ASTM D4972; and
- Be capable of sustaining vigorous plant growth.

The City's specification notes that if the topsoil does not meet the above-noted requirements, then either it should not be used or mixed with important material to attain the specification.

201 King Street, 4th Floor
London, ON N6A 1C9
+1 519 681-2400
www.wsp.com

WSP E&I Canada Limited

SAMPLING AND TESTING PROCEDURES

A geotechnical technician from WSP attended the site on March 9, 2023 and collected samples using a shovel. At the time of the visit, the ground was snow covered. The temperature was reported by Environment Canada[1] to be approximately 1° Celsius. Due to the prevailing weather conditions, the ground was frozen and it was not possible to hand-excavate the topsoil to the full depth at all sample locations. Samples were taken from the top 4.5 to 8 centimetres (cm) of topsoil.

Samples were obtained only from the 0.7-hectare area designated for the proposed stormwater management pond (SWMP). A total of eighteen (18) sub-samples were taken from the site, half from the west (W) and half from the east (E) side. The nine sub-samples from the west side were thoroughly mixed to form a composite sample denoted as SWMP-W. The remaining samples were combined in a similar manner and were denoted as SWMP-E. Sub-sample locations are documented in Table 1. Photographs of the composite samples are provided below.



Photo 1 Sample SWMP-W



Photo 2 Sample SWMP-E

[1] Government of Canada 2023. Hourly Data Report for March 09, 2023, Burlington Piers (AUT), Ontario. Hourly Data Report for March 09, 2023 - Climate - Environment and Climate Change Canada (weather.gc.ca) accessed March 30, 2023.

Table 1 Summary of Sub-Sample Locations

SAMPLE SWMP-W	LOCATION		DEPTH OF SAMPLING	SAMPLE SWMP-E	LOCATION		DEPTH OF SAMPLING
SUB-SAMPLE	EASTING	NORTHING	(CM)	SUB-SAMPLE	EASTING	NORTHING	DEPTH
1	593684	480157	6	1	598397	480157	5
2	593687	480157	5	2	598399	480179	4
3	598404	480157	5	3	598404	480157	8
4	593648	480157	4.5	4	598399	480157	6.5
5	598400	480157	6	5	598402	480157	5
6	598402	480157	7	6	598404	480157	6
7	593625	480157	8	7	598400	480156	6
8	593600	480157	5.5	8	598401	480157	6
9	593607	480157	6	9	598396	480157	8

To qualitatively assess the capability of the topsoil to sustain 'vigorous plant growth' as it pertains to soil fertility, the composite samples were sent to SGS Agrifood Laboratories' (SGS) Guelph Laboratory for soil fertility analysis and screening for the chlorinated herbicide Atrazine. As a participant in the Agronomic Lab Accreditation Program, SGS has met the requirements of the Ontario Ministry of Agriculture, Food and Rural Affairs.

Agronomy laboratories do not use ASTM procedures for organic matter (ASTM D2974-Method A) or pH (ASTM D4972). Therefore, one sample each from SWMP-W and SWMP-E to be tested for pH and a combined SWMP-W/SWMP-E sample to be tested for organic matter was submitted to WSP's geotechnical laboratory for compliance with the OPSS.MUNI 802.

LABORATORY RESULTS

Visual examination indicated that the samples were dark brown with brown and grey clay lumps. No debris or clay lumps were noted that were greater than 25 mm in size.

Agronomy Laboratory

The results of the soil fertility analyses and Atrazine testing are presented in Appendix A.

Geotechnical Laboratory

The results of organic content determination and pH determinations are presented in Appendix B.

DISCUSSION AND RECOMMENDATIONS

The agronomic analyses indicated both samples SWMP-W and SWMP-E generally met the OPSS.MUNI 802 requirements as modified by the City's standard. The results are summarized as follows:

Table 2 Summary of Agronomic Analyses

SAMPLE	TEXTURE	ORGANIC MATTER (%)	PH	
REQUIREMENTS	NATURAL LOAM	>4% CLAY LOAM; 7% TO 11% OVERALL	6.0 TO 7.5	COMMENTS[2]
SWMP-W	Clay Loam	7.4	7.5	Organic content and pH meet City's requirements. All the agronomic parameters tested are within the typical guidelines except calcium.
SWMP-E	Silty Clay Loam	5.2	**7.8**	Organic content meets City's requirements. All the agronomic parameters tested are within the typical guidelines except calcium and pH.

Notes: 1. Exceedances with respect to OPSS.MUNI 802, as amended by the City, are **bolded**.
2. Typical guidelines characteristic of sandy loam to loam textured topsoil as presented in SGS reports.

The geotechnical testing for pH and organic content according to ASTM standards indicated that SWMP-W, SWMP-E and the composite SWMP-W/SWMP-E samples generally met the OPSS.MUNI 802 requirements as modified by the City's standard. The results are summarized as follows:

Table 3 Summary of Geotechnical Tests

SAMPLE	ORGANIC MATTER (%)	PH (TEST WATER)	PH ($CaCl_2$)	WATER CONTENT (%)	
REQUIREMENTS	>4% CLAY LOAM; 7% TO 11% OVERALL	6.0 TO 7.5			COMMENTS[2]
SWMP-W	-	**7.6**	7.2	-	pH as per ASTM D4972 meets City's requirements for testing in a calcium chloride solution only.

SAMPLE	ORGANIC MATTER (%)	PH (TEST WATER)	PH ($CaCl_2$)	WATER CONTENT (%)	
REQUIREMENTS	>4% CLAY LOAM; 7% TO 11% OVERALL	6.0 TO 7.5			COMMENTS[2]
SWMP-E	-	7.3	7.0	-	pH as per ASTM D4972 meets City's requirements.
SWMP-W & SWMP-E (composite sample)	7.0	**-**		33.0	Organic content as per ASTM D2974 meets City's requirements.

Notes: 1. Exceedances with respect to OPSS.MUNI 802, as amended by the City, are **bolded**.

The soil analyses reports did not identify any barriers to plant growth. The concentration of Atrazine was below 0.05 parts per million (ppm) for both samples. The results of the pH and organic content tests carried out according to ASTM standards by WSP's geotechnical laboratory confirmed the findings of the agronomy lab.

According to SGS, the pH minor exceedances are not detrimental to vegetation growth. The SGS laboratory results noted that:

> *"Most adapted species will establish at this pH, which is common for calcareous Ontario soil and not detrimental. The addition of 9 lbs of elemental sulphur per 1000 sq feet, thoroughly incorporated into the root zone, may help to lower pH and enhance root growth."*

Based on review of the agronomy reports, the topsoil is suitable for re-use on site. The soil generally meets City's pH and organic content requirements for topsoil, based on the results of the geotechnical testing.

Soil modification recommendations along with general fertility guidelines for turf grass and nursery stock are presented in the agronomic analysis reports.

Attachments: Appendix A – Agronomic Analysis Reports
Appendix B – Geotechnical Laboratory Results

DUP/MC/dup
W:\CA\BRL\PROJECT\2021\Projects\WW21012079 - Quantum SWMF Redevelopment\04 EngTech\Tps Fert\Final\WW21012079-TM01 2023 04 27 (FINAL) Topsoil Fertility Report mc.docx

APPENDIX

A AGRONOMIC ANALYSIS REPORTS

Analysis Report

GS23-00502.001

WSP E&I CANADA LIMITED
201 KING STREET, 4TH FLOOR
LONDON ON N6A 1C9
CANADA

Received: 10-Mar-2023
Sample ID: WW2102079 [SWMP-W]
Order Reference: Dirka - PO#WW21012079

Completed: 17-Mar-2023

Test Description	Analysis	Typical Guidelines	Within Range (Y/N)
pH	7.5	5.5 - 7.5	Y
Buffer pH	-		
Organic Matter (%)	7.4	4 - 15	Y
Total Salts (mmhos/cm)	0.48	< 1.5	Y
Phosphorus (ppm)	28	10 - 60	Y
Potassium (ppm)	161	80 - 250	Y
Calcium (ppm)	5580	1000 - 4000	N
Magnesium (ppm)	226	100 - 300	Y
Sodium (ppm)	45	< 200	Y
Sodium Adsorption Ratio	0.3	< 15	Y
Chloride (ppm)	40.0	< 100	Y
CEC (meq/100g)	31.4		
Base Sat. K (%)	1.3		
Base Sat. Mg (%)	6.0		
Base Sat. Ca (%)	88.9		
Texture	Clay Loam	Loam/Sandy Loam	
Sand (%)	20	20 - 75	Y
Silt (%)	50	5 - 50	Y
Clay (%)	30	5 - 30	Y

The ranges in the Typical Guidelines are for comparative purposes and are characteristic of a Sandy Loam to Loam textured topsoil. These are considered to be optimal ranges for these soil types, and test results are compared to these ranges in the Within Range column with Yes/No designation. However, an N does not necessarily suggest a soil will not support growth, and some project specifications may differ from these Typical Guidelines. Soil modification recommendations are provided where possible or necessary to amend soil test values that fall beyond these optimal ranges.

General Fertility Guidelines for Turf Grass: Before seeding or sodding, apply 20-20-20 at 3 lbs per 1000 sq feet and incorporate into the rootzone.

General Fertility Guidelines for Nursery Stock: Apply 20-20-20 at an equivalent rate to supply 4 lbs per 1000 sq feet at the drip line of trees and incorporate to half rootball depth. Do not apply fertilizers containing high nitrogen after August, before winter dormancy.

Recommendations	N	P205	K2O	Mg	Lime (te/ha)
turf grass					
(lb/ac)	27	36	18		
(lb/1000 sq.ft)	0.63	0.83	0.42		
(kg/100 sq.m)	0.30	0.40	0.20		
nursery stock, new					
(lb/ac)	36	36	18		
(lb/1000 sq.ft)	0.84	0.83	0.42		
(kg/100 sq.m)	0.40	0.40	0.20		

Signed and dated in Guelph, ON
On 22-Mar-2023

For and on behalf of SGS Canada Inc., Agriculture and Food

Jack Legg, CCA-ON, 4R NMS
Branch Manager, Agronomist

Report File Reference Number: 0000259245

The analysis report above refers to the time and place of testing, and strictly to the supplied sample(s) only, without reference to any other matter. This report does not evidence or refer to any consignment or shipment or/and SGS sampling and inspection.
This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/en/terms-and-conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Analysis Report
GS23-00502.002

WSP E&I CANADA LIMITED
201 KING STREET, 4TH FLOOR
LONDON ON N6A 1C9
CANADA

Received: 10-Mar-2023
Sample ID: SWMP-E
Order Reference: Dirka - PO#WW21012079

Completed: 17-Mar-2023

Test Description	Analysis	Typical Guidelines	Within Range (Y/N)
pH	7.8	5.5 - 7.5	N
Buffer pH	-		
Organic Matter (%)	5.2	4 - 15	Y
Total Salts (mmhos/cm)	0.40	< 1.5	Y
Phosphorus (ppm)	11	10 - 60	Y
Potassium (ppm)	188	80 - 250	Y
Calcium (ppm)	5130	1000 - 4000	N
Magnesium (ppm)	206	100 - 300	Y
Sodium (ppm)	55	< 200	Y
Sodium Adsorption Ratio	0.3	< 15	Y
Chloride (ppm)	42.0	< 100	Y
CEC (meq/100g)	29.0		
Base Sat. K (%)	1.7		
Base Sat. Mg (%)	5.9		
Base Sat. Ca (%)	88.3		
Texture	Silty Clay Loam	Loam/Sandy Loam	
Sand (%)	14	20 - 75	N
Silt (%)	48	5 - 50	Y
Clay (%)	38	5 - 30	N

The ranges in the Typical Guidelines are for comparative purposes and are characteristic of a Sandy Loam to Loam textured topsoil. These are considered to be optimal ranges for these soil types, and test results are compared to these ranges in the Within Range column with Yes/No designation. However, an N does not necessarily suggest a soil will not support growth, and some project specifications may differ from these Typical Guidelines. Soil modification recommendations are provided where possible or necessary to amend soil test values that fall beyond these optimal ranges.

Most adapted species will establish at this pH, which is common for calcareous Ontario soil and not detrimental. The addition of 9 lbs of elemental sulphur per 1000 sq feet, thoroughly incorporated into the root zone, may help to lower pH and enhance root growth.

Soil Texture is a Silty Clay Loam, a productive soil. However, refrain from moving this soil under saturated conditions to avoid compaction and smearing that will damage soil structure and decrease drainage.
If a lighter texture is required, mix 65% of this soil with 35% coarse sand, which will adjust the sand-silt-clay percentages to 44-31-25 respectively, and the texture to Loam.

General Fertility Guidelines for Turf Grass: Before seeding or sodding, apply 10-20-5 at 7 lbs per 1000 sq feet and incorporate into the rootzone.

General Fertility Guidelines for Nursery Stock: Apply 10-20-5 at an equivalent rate to supply 9 lbs per 1000 sq feet at the drip line of trees and incorporate to half rootball depth. Do not apply fertilizers containing high nitrogen after August, before winter dormancy.

Recommendations	N	P205	K2O	Mg	Lime (te/ha)
turf grass					
(lb/ac)	30	63			
(lb/1000 sq.ft)	0.70	1.45			
(kg/100 sq.m)	0.34	0.70			
nursery stock, new					
(lb/ac)	40	85			
(lb/1000 sq.ft)	0.93	1.97			
(kg/100 sq.m)	0.45	0.95			

Signed and dated in Guelph, ON
On 22-Mar-2023

For and on behalf of SGS Canada Inc., Agriculture and Food

Jack Legg, CCA-ON, 4R NMS
Branch Manager, Agronomist

Report File Reference Number: 0000259245

The analysis report above refers to the time and place of testing, and strictly to the supplied sample(s) only, without reference to any other matter. This report does not evidence or refer to any consignment or shipment or/and SGS sampling and inspection.
This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/en/terms-and-conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Analysis Report
GS23-00503

WSP E&I CANADA LIMITED
201 KING STREET, 4TH FLOOR
LONDON ON N6A 1C9
CANADA

Received : 10-Mar-2023
Completed : 22-Mar-2023
Order Reference : Dirka - PO# WW21012079

Laboratory ID:	GS23-00503.001	GS23-00503.002
Client Sample #:	SWMP-W	SWMP-E
Description:	WW2102079	
Atrazine (ppm)	<0.05	<0.05

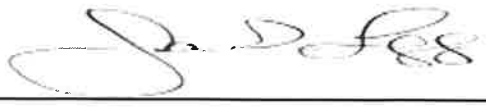
REMARKS:
Triazine Residue - Injury and Crop Information
< 0.05 ppm - Generally no injury except to very susceptible vegetables (i.e. cucumbers) and cash crops (i.e. tobacco) planted in sandy soil during warm, dry weather.
0.05 - 0.10 ppm - Slight injury or stunted growth may be expected to susceptible plants (see above) in sandy loam at normal weather conditions. Tomatoes, oats, alfalfa and lawn grass seed may be affected.
0.10 - 0.20 ppm - Tomatoes, red beets, tobacco, oats and vegetables should not be planted. Beans (soya, kidney white) and barley may be affected. Exception is soils with high organic matter content (12%).
0.20 - 0.30 ppm - Injury to most crops except corn, flax, sorghum and grass sodding.
> 0.30 ppm - Severe injury can occur on all susceptible crops except triazine resistant canola (i.e. OAC Triton).
Increased organic matter content in soil reduces injury. Dry and warm weather accentuates triazine activity.
Atrazine testing performed by SGS Lakefield.

NOTE:
The analysis report above refers to the time and place of testing, and strictly to the supplied sample(s) only, without reference to any other matter. This report does not evidence or refer to any consignment or shipment or/and SGS sampling and inspection.

Report File Reference Number: 0000259247

Signed and dated in Guelph, ON
On 22-Mar-2023

For and on behalf of SGS Canada Inc., Agriculture and Food



Jack Legg, CCA-ON, 4R NMS
Branch Manager, Agronomist

This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/en/terms-and-conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

APPENDIX

B GEOTECHNICAL LABORATORY RESULTS

MOISTURE & ORGANIC CONTENT TEST REPORT

Standard Test Method for Moisture, Ash and Organic Material of Peat and Other Organic Soil ASTM D 2974

CLIENT:	Astra Realty Management Inc.	**DATE REPORTED:**	April 13, 2023
PROJECT NO:	WW21012079	**DATE RECEIVED:**	March 31, 2023
PROJECT:	Astra Realty Management Incorporate	**SAMPLED BY:**	SC
		CONTRACTOR:	n/a
SAMPLE ID:	SWMP-E & SWMP-W combined	**TESTED BY:**	OL
SOIL DESCRIPTION:	Soil		

TEST RESULTS

WATER CONTENT DETERMINATION *(Test Method A)*

SAMPLE #:	S100-S101					
BORE HOLE #:						
STATION:						
DEPTH:						
TARE & WET SAMPLE *(g):*	130.48					
TARE & DRY SAMPLE *(g):*	118					
MOISTURE *(g):*	12.48					
TARE WEIGHT *(g)* :	80.19					
SAMPLE DRY WEIGHT *(g):*	37.81					
WATER CONTENT *(% oven-dried basis):*	**33.0**					
WATER CONTENT *(% as-received basis):*	**24.8**					

ASH CONTENT DETERMINATION *(Test Method A)*

TARE & DRY SAMPLE *(g):*	102.32					
TARE & ASH *(g):*	99.66					
ORGANIC MATTER WEIGHT *(g)* :	2.66					
TARE WEIGHT *(g)* :	64.47					
ASH WEIGHT *(g)* :	35.19					
FURNACE TEMPERATURE (^{0} C):						
TEST DURATION *(hours)*	3'15"					
ASH CONTENT *(%):*	**93.0**					
ORGANIC MATERIAL CONTENT *(%):*	**7.0**					

Note:

Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request.

Prepared by: K. Hand
Reviewed by: O. Lazic

WSP E&I Canada Limited
3450 Harvester Road, Suite 100, Burlington, ON L7N 3W5

pH TEST REPORT

Standard Test Method for pH of Soils - ASTM D4972

CLIENT:	Astra Realty Management Inc.	**DATE REPORTED:**	21-Apr-23
PROJECT NO:	WW21012079	**DATE RECEIVED:**	31-Mar-23
PROJECT:	Astra Realty Management Incorporate	**DATE TESTED:**	19-Apr-23
SAMPLED BY:	SC	**TESTED BY:**	FG
FIELD SAMPLE ID:	SWMP-E & SWMP-W	**WSP LAB ID #**	S100-23, S101-23
SAMPLE DESCRIPTION:	Soil		

TEST RESULTS

pH DETERMINATION

WSP LAB ID #:	**S100-23**	**S101-23**				
WSP FIELD ID #:	SWMP-E	SWMP-W				
pH IN TEST WATER:	**7.3**	**7.6**				
pH IN $CaCl_2$:	**7.0**	**7.2**				
METHOD USED:	A	A				
TEMPERATURE (°C):	23.0	23.0				
BALANCE ID #:	Scout Pro / SP 4001/ '7125151531					
pH METER / ELECTRODE ID #:	HI 8424 / 08249302					
THERMOMETRIC DEVICE ID #:	Mastercraft / I-24689					

Notes: Minor amounts of coarse aggregate removed from sample during preparation

Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request.

Prepared by: F. Grivich
Reviewed by: K. Hand

WSP E&I Canada Limited
3450 Harvester Road, Suite 100, Burlington, ON L7N 3W5