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FOUNDATION INVESTIGATION AND DESIGN REPORT GROUND-MOUNTED SIGNS HIGHWAY 115 AND COUNTY ROAD 28 INTERCHANGE NORTHBOUND PETERBOROUGH, ONTARIO W.P. 249-99-00

Submitted to:

Ministry of Transportation, Ontario
Eastern Region Geotechnical Section
1355 John Counter Boulevard
Kingston, Ontario
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PART A

FOUNDATION INVESTIGATION REPORT
GROUND-MOUNTED SIGNS
HIGHWAY 115 AND COUNTY ROAD 28
INTERCHANGE NORTHBOUND
PETERBOROUGH, ONTARIO
W.P. 249-99-00

Golder Associates

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for three new ground-mounted signs (GMS) along Highway 115 approaching the County Road. 28 interchange in Peterborough, Ontario. A foundation investigation has been carried out to assess the subsurface conditions in the vicinity of each of the proposed ground-mounted signs at the following locations:

- **GMS 1:** Highway 115 Northbound, Station 25+180.
- **GMS 2:** Highway 115 Northbound, Station 24+860
- **GMS 3:** Highway 115 Northbound, Station 23+990

The terms of reference and scope of work for the foundation engineering services are outlined in MTO's Appendix 3: Assignment Order form, Agreement No. 4005-E-0025/26, Assignment No. 10, issued on February 15, 2008.

2.0 SITE DESCRIPTION

The proposed three ground-mounted signs are located over a distance of approximately 1.2 km along Highway 115 northbound lanes, extending from about 57 m to 1.25 km south of the Highway 115 overpass at Highway 7/County Road 28 in Peterborough, Ontario.

The site at each sign location generally consists of the approximately 1.5 m high highway embankment, having gently sloping side-slopes to approximately 2H:1V slopes near of the overpass at County Road 28. Based on the General Arrangement drawings provided by EarthTech entitled "Hwy. 115 New Construction", dated April 2004, the existing Highway 115 grade between Station 24+500 and 25+200 varies from approximately Elevation 196.0 m to Elevation 204.7 m.

3.0 INVESTIGATION PROCEDURES

A subsurface investigation was carried out for the proposed ground-mounted signs between February 28 and March 4, 2008, during which a total of three boreholes were drilled in the vicinity of each proposed GMS location. Borehole BH-1 was drilled along the existing embankment toe in the vicinity of the proposed GMS 1, approximately 12 m from the edge of the Highway 115 pavement. Boreholes BH-2 and BH-3 were drilled in the vicinity of the proposed GMS 2 and GMS 3, respectively, about 15 m and 6 m from the edge of pavement. The approximate borehole locations are shown on Drawing 1.

The field investigation was carried out using a track-mounted Geoprobe-6620 drill rig, supplied and operated by Strata Soil Sampling Inc. of Richmond Hill, Ontario. The boreholes were advanced to a depth of 6.7 m using 108 mm internal diameter (I.D.) hollow stem augers. Soil samples were obtained at 0.75 m to 1.5 m intervals of depth using 50 mm outside diameter (O.D.) split-spoon samplers driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedure. The groundwater conditions in the open boreholes were observed during and following completion of the drilling operations, and a standpipe piezometer was installed in Borehole BH-2 to permit monitoring of the groundwater level. The piezometer consists of a 50 mm diameter PVC pipe with a 1.5 m long slotted screen installed within a 3 m long sand filter pack. Upon completion of drilling, the boreholes and annulus surrounding the piezometer pipe above the sand filter pack were backfilled to the ground surface with bentonite pellets in accordance with Ontario Regulation (O.Reg.) 903.

The field work was monitored on a full-time basis by a member of Golder's technical staff who located the boreholes in the field, cleared the site of buried utility services, directed the sampling and in situ testing operations, and logged the boreholes. The soil samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Mississauga for further examination and geotechnical testing. Index and classification tests (water content determinations, Atterberg limits and grain size distribution) as well as an organic content test were carried out on selected soil samples. In addition, chemical analyses were conducted on one soil sample, found to be irritant to touch while being examined at the laboratory; this sample was submitted to Maxxam Analytics Inc. in Mississauga, Ontario for analyses of inorganics including chlorides and sulphates, pH, volatile organic compounds (VOC's), and semi-volatile organic compounds (SVOC's), in accordance with O.Reg. 153.

The borehole locations were measured in the field by a member of Golder's technical staff, relative to the locations staked by Earth Tech, as indicated below and shown on Drawing 1. The borehole northing and easting coordinates and ground surface elevations, however, are not available at this time; survey of the as-drilled borehole locations is suggested prior to finalization of this report.

Borehole Number	***GMS Location***
BH-1	GMS 1 Hwy 115 Northbound, Station 25+180
BH-2	GMS 2 Hwy 115 Northbound, Station 24+860
BH-3	GMS 3 Hwy 115 Northbound, Station 23+990

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geological Conditions

The location of the proposed ground-mounted signs lies within the Peterborough Drumlin Field, which stretches between the Oak Ridges Moraine and the area of shallow overburden on limestone bedrock of the Gull River Formation, as delineated in *The Physiography of Southern Ontario* [1].

The Peterborough Drumlin Field is typically composed of highly calcareous till containing great quantities of angular limestone rubble which are replaced by boulders of Precambrian origin to the east of Peterborough. Towards the south of Peterborough and north of the Oak Ridges Moraine, the glacial till consist of sand plains that are characterized by a thin layer of sand overlying a deposit of clay and/or Otonabee loam. The topography of the drumlin field gently slopes from northeast to southwest.

4.2 Subsoil Conditions

As part of the subsurface investigation, a total of three boreholes were was advanced in the vicinity of each proposed GMS location as shown on Drawing 1. The detailed subsurface soil and groundwater conditions encountered in the boreholes and the results of in situ and laboratory testing are given on the attached Record of Borehole sheets and on Figures 1 to 6 following the text of this report.

The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests (SPTs). These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change and the subsurface conditions will vary between and beyond the borehole locations.

In summary, the subsoil conditions encountered in the boreholes generally consist of surficial layers of fill materials underlain by a deposit of clayey silt extending to depths ranging from 6.1 m 6.7 m below the existing ground surface. A deposit of silt and sand till was encountered below the clayey silt in Borehole BH-1, and extends from a depth of 6.1 m to the termination depth of the borehole at 6.7 m. Additionally, a 0.8 m thick layer of organic silt was encountered immediately below the fill materials in Borehole BH-2. The following subsections provide a more detailed description of the subsoil and groundwater conditions encountered in the boreholes.

[1]Chapman, L.J. and Putnam, D.F. *The Physiography of Southern Ontario*, Ontario Geological Survey Special Volume 2, Third edition, 1984. Accompanied by Map P.2715, Scale 1:600,000.

4.2.1 Topsoil

A layer of topsoil was encountered at the ground surface in Borehole BH-1. The topsoil was measured to be about 100 mm thick.

4.2.2 Fill Materials

Fill materials associated with the existing Highway 115 embankment were encountered below the thin layer of topsoil in Borehole BH-1 and immediately at the ground surface at the other two borehole locations. The fill typically consists of silty sand and gravel and silty sand to sandy silt, containing trace to some clay, rootlets and trace organic matter.

The Standard Penetration Test (SPT) "N" values measured within the fill materials range from 2 to 35 blows per 0.3 m of penetration, indicating that the fill has a very loose to dense relative density.

The results of grain size distribution tests carried out on selected samples of the fill are provided on Figures 1 and 2. The gradation results indicate a relatively broadly graded fill ranging from sand and gravel to silty sand some gravel to sandy silt. The measured natural water content on samples of the silty sand and gravel to silty sand fill materials varied from about 5 percent to 28 percent.

4.2.3 Organic Silt

A layer of organic silt containing sand seams and trace gravel was encountered below the fill materials in Borehole BH-2; this layer is approximately 0.8 m thick and extended from a depth of 2.3 m to 3.1 m below the existing ground surface.

One SPT "N" value of 3 blows per 0.3 m of penetration was measured within the organic silt layer, indicating has a soft consistency.

An organic content test carried out on a sample of this layer yielded an organic content of 23 percent. The natural water content of this sample was measured to be about 88 percent.

4.2.4 Clayey Silt

A deposit of brown to grey, clayey silt containing trace to some sand and gravel was encountered below the fill or organic silt in all of the boreholes. The surface of the clayey silt deposit was encountered at a depth ranging from 1.5 m and 3.1 m below the existing ground surface and

extends to depths ranging from 6.1 m in Borehole BH-1 to the termination depth of 6.7 m in Boreholes BH-2 and BH-3.

SPT 'N' values measured within the clayey silt deposit range from 0 (weight of hammer) to 18 blows per 0.3 m of penetration. One in situ 'N' size field vane test performed within the softer portion of this deposit yielded an undisturbed shear strength of 42 kPa. These results indicate that the clayey silt deposit has firm to very stiff consistency.

The natural water content measured on selected samples of the clayey silt deposit varied from about 15 percent to 24 percent. The results of three grain size distribution tests are show on Figure 3. Atterberg limits tests carried out on four samples of the clayey silt deposit yielded plastic limits ranging from 12 to 16 percent, liquid limits between 19 and 34, and corresponding plasticity indices between about 7 and 18 percent. The results, plotted on Figure 4, confirm that the deposit is classified as a clayey silt of low to intermediate plasticity.

4.2.5 Silt and Sand Till

A deposit of silt and sand till, containing trace to some clay and gravel was encountered below the clayey silt deposit in Borehole BH-1. The surface of the silt and sand till was encountered at a depth of 6.1 m below the existing surface and extended to the termination depth of the borehole at a depth of 6.7 m.

One SPT 'N' value of 41 blows per 0.3 m of penetration was measured within the silt and sand till, indicating a dense relative density.

One natural water content measured on the sample collected form this deposit was about 7 percent and the results of one grain size distribution test are shown on Figure 5.

4.3 Groundwater Conditions

Based on the observed soil moisture conditions, changes in colour from brown to grey, and the observed water levels in the open boreholes following completion of drilling and piezometer installed in Borehole BH-2, the estimated or measured groundwater depths at the GMS sites are as follows:

- In Borehole BH-1 at the site of GMS 1, wet cohesive soils were encountered at a depth of 4.6 m, but the open borehole was observed to be dry upon completion of drilling.

- In Borehole BH-2 at the site of GMS 2, wet cohesive soils were encountered below a depth of 3.1 m. The groundwater level measured in the piezometer on March 17, 2008 was at a depth of 1.6 m below the ground surface.

- In Borehole BH-3 at the site of GMS 3, the clayey silt deposit encountered at a depth of 3.4 m was wet, and the water level observed in the open borehole was at a depth of 5.5 m on completion of drilling.

It should be noted that the observed water levels in Boreholes BH-1 and BH-3 were recorded during or immediately following completion of drilling and may not represent the stabilized groundwater level; the actual groundwater level may be higher than noted above. In addition, the groundwater levels at these locations are expected to fluctuate seasonally and should be expected to rise during the spring and other wet periods of the year.

5.0 CLOSURE

This Foundation Investigation Report was prepared by Ms. Veronica Olatunji and reviewed by Ms. Houda Jadi, P.Eng., a Geotechnical Engineer with Golder. Mr. Jorge M. A. Costa, P.Eng., a Designated MTO Contact and Principal with Golder conducted an independent technical review and quality control of the report.

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PART B

FOUNDATION DESIGN REPORT
GROUND-MOUNTED SIGNS
HIGHWAY 115 AND COUNTY ROAD 28
INTERCHANGE NORTHBOUND
PETERBOROUGH, ONTARIO
W.P. 249-99-00

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6.0 ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides foundation design recommendations for the proposed ground-mounted signs. The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the subsurface investigation for this project. The interpretation and recommendations provided are intended to provide the designers with sufficient information to design the proposed sign foundations. Where comments are made on construction, they are provided in order to highlight those aspects which could affect the planning of the project, and for which special provisions or operational constraints may be required during construction. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods, scheduling and the like.

6.2 Caisson Foundations

Caisson foundations for the sign supports should be designed in accordance with the requirements in MTO's *Sign Support Manual*. The *Sign Support Manual* includes a standard caisson foundation design (Section 4.5 and Standard Drawings SS118-6, SS118-7 and SS118-8), in which the caisson is extended 5 m below the design frost depth (i.e. a total length of 6.2 m below grade for this project), except where bedrock is encountered within this depth. The standard design is based on the following minimum soil conditions:

- **Case 1 (Cohesionless Soils):** Sand with a friction angle of 28 degrees surrounding the upper two-thirds of the portion of the caisson foundation below the frost depth, and sand with a friction angle of 30 degrees surrounding the lower third of the portion of the caisson below the design frost depth.

- **Case 2 (Cohesive Soils):** Soft clay with an undrained shear strength of 25 kPa surrounding the upper two-thirds of the portion of the caisson foundation below the frost depth, and "soft" clay with an undrained shear strength of 50 kPa surrounding the lower third of the portion of the caisson below the design frost depth.

The standard foundation design provided in MTO's *Sign Support Manual* does not apply to sites where extensive poor fill materials or materials softer than those of Case 2 are present. For such subsurface conditions, a site-specific design is required.

Based on the review of the subsurface information, the subsurface soils at the three proposed ground-mounted sign sites have friction angles and/or undrained shear strengths that exceed the minimum soil conditions outlined above. Therefore, the standard caisson foundation design (i.e., a 6.2 m long caisson) is suitable for the support of the signs at the three locations.

The standard design can be checked and optimized by the structural designer, if desired, using the recommendations provided below and the geotechnical parameters provided in Table 1 following the text of this report.

$$P_p = K_p \gamma d_w \quad \text{above the groundwater table, and}$$
$$P_p = K_p \gamma d_w + K_p \gamma' (d - d_w) \quad \text{below the groundwater table,}$$

where K_p is the passive earth pressure coefficient;
γ is the bulk unit weight of the soil (kN/m^3);
γ' is the effective unit weight of the soil below the groundwater level (kN/m^3);
d is the depth below the ground surface (m); and
d_w is the depth to the groundwater level (m).

In the design of the foundations, the passive resistance within the upper 1.2 m below ground surface should be neglected to account for frost action. The unfactored lateral resistance should be calculated assuming an equivalent width equal to three times the caisson diameter. A resistance factor of 0.5 should be applied to the unfactored lateral resistance to obtain the factored lateral geotechnical resistance at Ultimate Limit States (ULS).

Where an undrained shear strength, s_u, is provided for a cohesive soil layer in Table 1, the capacity of the caisson should be checked to determine whether the drained (effective stress) or undrained case will govern. For the undrained case, the lateral resistance for the length of the caisson within the cohesive soil should be calculated assuming an internal angle of friction, $\varphi' = 0$ degrees and an unfactored passive lateral pressure distribution varying from $2\ s_u$ at the ground surface to $9\ s_u$ at and below a depth equivalent to three caisson diameters, acting over the actual width of the caisson. A resistance factor of 0.5 should be applied to this calculated lateral resistance in order to obtain the factored lateral geotechnical resistance at ULS.

6.3 Results of Chemical Analyses

During routine visual examination and geotechnical testing of a soil sample collected in Borehole BH-3, the sample was noted to irritate the skin as a result of handling and affecting the nitrile glove being used by the laboratory technician. This sample was submitted to Maxxam Analytics for chemical testing consisting of pH, inorganics including chlorides and sulphates, VOC's and SVOC's after receipt of approval to proceed with this testing from the MTO. The purpose of the testing was to assess for the presence of potential contaminant(s) in this soil sample and determine the potential for soil aggressiveness to buried concrete.

The results of the tests, provided in Appendix A, indicate that the sample has a pH of 7.42 with VOC's and SVOC's below the reportable detection limits. It should be noted however, that prior

to the chemical testing the sample was exposed to air during the routine visual examination. The results of sulphate analysis are presented below:

Sample No.	Depth Interval (m)	Medium	Parameters Analysed/Results	
			Sulfates (SO_4^{2-}) (μg/g)	PH
BH-3, SA #2	0.9 – 1.3	Sandy Silt Fill	34	7.42

According to CSA Standard A23.1-04/A23.2-04, Sulfate concentrations in soil should not exceed 1,000 μg/g; above this concentration, concrete is subject to potential degradation. The results show that the soil samples tested yield Sulfate concentrations below the CSA Standard A23.1-04 criteria, indicating that the relative degree of soil aggressiveness to concrete is negligible.

6.4 Construction Considerations

It is recommended that a Non-Standard Special Provision (NSSP) be included in the Contract Documents to warn the Contractor of the following item which is expected to affect the installation of the caisson foundations for the sign supports:

- **Control of overburden soils and groundwater:** Excavations for the sign foundations will be advanced through cohesionless and cohesive soils, which should be expected to be unstable below the groundwater level. Appropriate construction procedures and equipment will be required to address these conditions and facilitate excavation and caisson construction. For example, it should be anticipated that the caisson holes will have to be advanced using a temporary liner to minimize ground loss during drilling and concrete placement; in addition, it may be necessary to place concrete for the caisson foundations using the tremie method, with the hose outlet maintained below the surface of the concrete throughout the pumping operation.

A sample NSSP to address the above item is provided in Appendix B.

7.0 CLOSURE

This Foundation Design Report was prepared by Ms. Veronica Olatunji and reviewed by Ms. Houda Jadi, P.Eng., a Geotechnical Engineer with Golder. Mr. Jorge M. A. Costa, P.Eng., a Designated MTO Contact and Principal with Golder conducted an independent review and provided quality control of the report.

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TABLE 1

GEOTECHNICAL DESIGN PARAMETERS FOR GROUND-MOUNTED SIGN FOUNDATIONS HIGHWAY 115 AND COUNTY ROAD 28 INTERCHANCE NORTHBOUND W.P. 249-99-00

Sign Location	Borehole No.	Stratum	Depth [1] (m)	Groundwater Depth (m)	c_u	φ'	γ	γ'	K_p
GMS 1 (STA. 25+180)	BH-1	Very loose to compact silty sand and gravel fill	Above 1.5	3.1 (estimated)	-	28	20	-	2.8
		Stiff clayey silt	1.5 – 6.1		75	30	21	11	3.0
		Dense silt and sand till	Below 6.1		-	35	22	12	3.7
GMS 2 (STA 24+860)	BH-2	Dense to loose silty sand and gravel to silty sand, some gravel fill	Above 3.1	1.6	-	28	20	10	2.8
		Firm clayey silt	3.1 – 4.6		40	28	19	9	2.8
		Stiff clayey silt	Below 4.6		75	30	21	11	3.3
GMS 3 (STA 33+990)	BH-3	Very loose to loose silty sand and gravel to sandy silt fill	Above 2.1	5.5	-	28	20	-	2.8
		Firm clayey silt	2.1 – 6.2		40	28	19	9	3.0
		Very stiff clayey silt	Below 6.2		100	30	21	11	3.3

Prepared By: VO Reviewed By: HJ/JMAC

NOTES:

1. Depths are given for the borehole location; the ground surface elevation at the borehole location when surveyed should be compared to the ground surface elevation at the actual sign support location, and the depths of the soil strata adjusted accordingly.
2. Design parameters: c_u = undrained shear strength (kPa);
   φ' = effective friction angle (degrees);
   γ = bulk unit weight (kN/m^3);
   γ' = effective unit weight below the groundwater level (kN/m^3); and
   K_p = passive earth pressure coefficient.
3. Although the passive resistance in the upper 1.2 m should be neglected to account for frost action, φ' and K_p parameters are given in the event that the ground surface elevation varies significantly between the borehole and sign support locations.

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; N_d:

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	c_u, s_u kPa	c_u, s_u psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. General

π	3.1416
in x,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
F	factor of safety
V	volume
W	weight

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
v	poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1+\sigma_2+\sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s/\rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l	liquid limit
w_p	plastic limit
I_p	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p)/I_p$
I_C	consistency index = $(w_l - w)/I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e)/(e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_a	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation pressure
OCR	over-consolidation ratio = σ'_p/σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 + \sigma_3)/2$ or $(\sigma'_1 + \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 + \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan\phi'$

2 shear strength = (compressive strength)/2

* density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

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RECORD OF BOREHOLE No BH-1

1 OF 1 **METRIC**

PROJECT 08-1111-0006 | W.P. 249-99-00 | DIST ____ HWY 115 | DATUM Geodetic

LOCATION Sta. 25 + 180 | BOREHOLE TYPE Geoprobe, 108 mm I.D. Hollow Stem Augers | DATE March 4, 2008

ORIGINATED BY GD | COMPILED BY VO | CHECKED BY VO/HJ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	GROUND SURFACE										
0.0	TOPSOIL										
0.1	Silty sand and gravel, trace clay (FILL) Very loose Brown Moist		1	SS	3				○		28 47 21 4
0.8	Silty sand, trace to some clay and gravel (FILL) Compact moist		2	SS	11				○		
1.5	CLAYEY SILT, trace sand, trace gravel Stiff Brown to grey Moist to wet		3	SS	13						
			4	SS	14				⊢○⊣		
			5	SS	15				⊢○⊣		6 5 56 33
			6	SS	12				○		
6.1	SILT and SAND, trace to some clay and gravel (TILL) Dense Grey Dry		7	SS	41				○		9 38 45 8
6.7	END OF BOREHOLE										

NOTES:

1. Wet soils encountered during drilling at a depth of 4.6 m.

2. Open borehole dry upon completion of drilling.

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No BH-2

1 OF 1 **METRIC**

PROJECT 08-1111-0006 | W.P. 249-99-00 | DIST ____ HWY 115 | DATUM Geodetic

LOCATION Sta. 24 + 860 | BOREHOLE TYPE Geoprobe, 108 mm I.D. Hollow Stem Augers | DATE March 4, 2008

ORIGINATED BY GD | COMPILED BY VO | CHECKED BY VO/HJ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	GROUND SURFACE										
0.0	Silty sand and gravel, trace clay (FILL) Dense to compact Brown Moist		1	SS	35				○		
			2	SS	14						
1.5	Silty sand, some gravel, trace to some clay, containing grass, rootlets and organic matter (FILL) Loose Brown Moist		3	SS	9	▽			○		20 52 21 7
2.3	Organic SILT, trace gravel, containing sand seam Soft Black Moist		4	SS	3				○ 88.2		OC = 23
3.1	CLAYEY SILT, trace sand and gravel Firm to stiff Grey Wet		5	SS	WH			× +	○		
			6	SS	11				○		1 5 64 30
			7	SS	15				○		
6.7	END OF BOREHOLE NOTES: 1. Wet soils encountered during drilling at a depth of 3.1 m. 2. Open borehole dry upon completion of drilling. 3. Water level measured in piezometer on March 17, 2008 at a depth of 1.6 m below ground surface.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ $^{3\%}$ STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No BH-3

1 OF 1 **METRIC**

PROJECT 08-1111-0006 | W.P. 249-99-00 | LOCATION Sta. 23 + 990 | ORIGINATED BY GD
DIST ____ HWY 115 | BOREHOLE TYPE Geoprobe, 108 mm I.D. Hollow Stem Augers | COMPILED BY VO
DATUM Geodetic | DATE February 28, 2008 | CHECKED BY VO/HJ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	GROUND SURFACE Silty sand and gravel, trace clay (FILL) Very loose Dark brown Moist		1	SS	2						
0.9	Sandy silt, trace organic, some silty clay seams (FILL) Loose Brown Moist		2	SS	8						
			3	SS	6						0 22 62 16
2.1	CLAYEY SILT, trace to some sand Firm to very stiff Brown to grey Moist to wet		4	SS	15						
			5	SS	8						
			6	SS	6	▽					
			7	SS	18						0 10 68 22
6.7	END OF BOREHOLE NOTES: 1. Wet soils encountered during drilling at a depth of 3.4 m. 2. Water level in open borehole at a depth of 5.5 m below ground surface upon completion of drilling.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION, ONTARIO

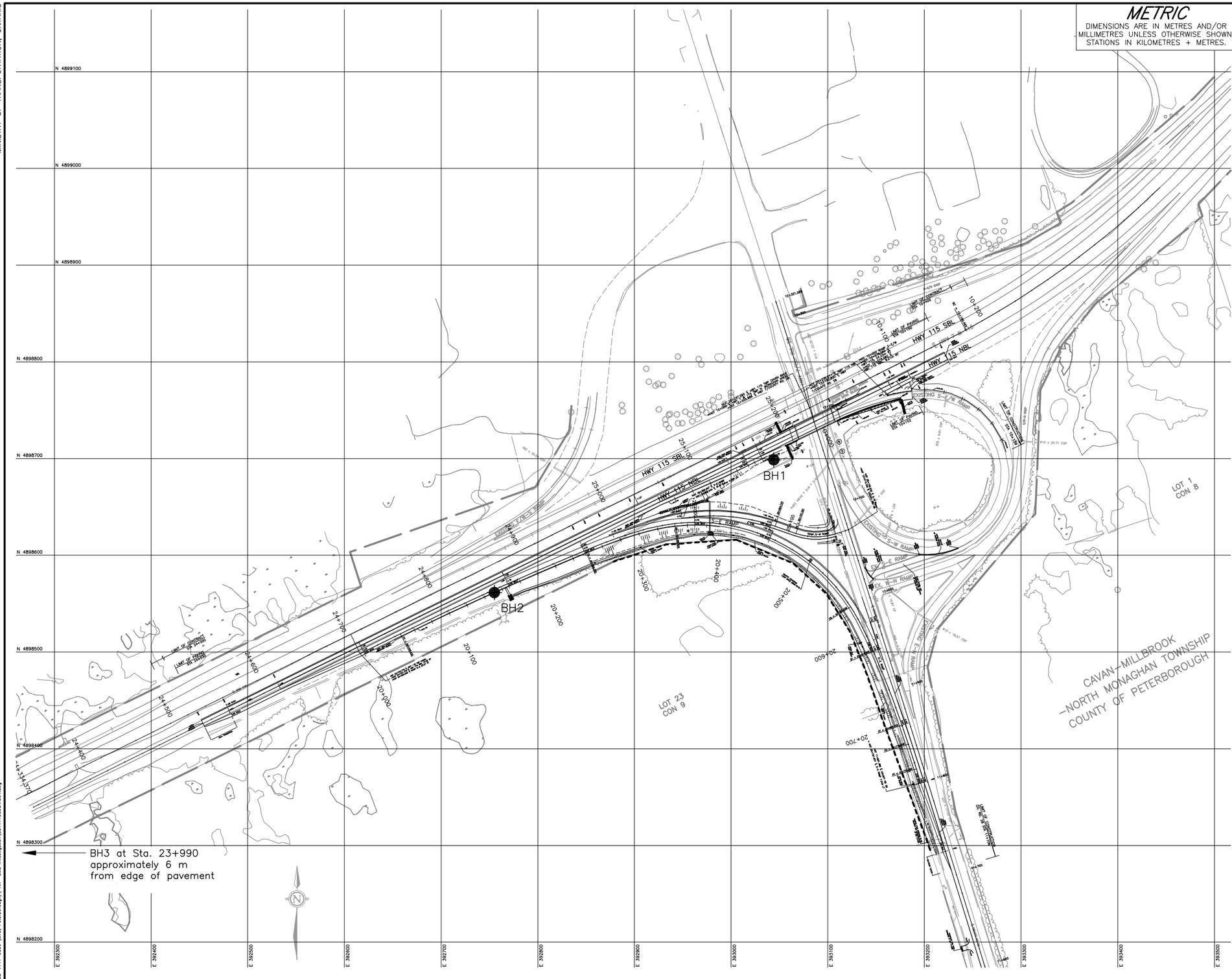
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 249-99-00

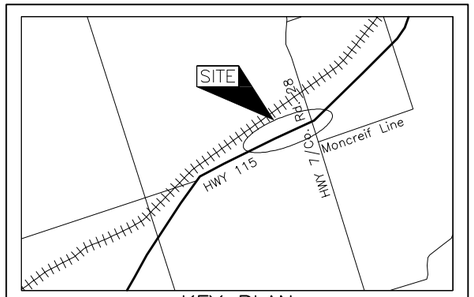
HIGHWAY 115 AND COUNTY ROAD 28 INTERCHANGE NORTH BOUND
Ground - Mounted Signs
BOREHOLE LOCATIONS

SHEET

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



PLAN
SCALE
40 0 40 80 m



KEY PLAN
NOT TO SCALE

LEGEND

Borehole - Current Investigation

No.	STATION NO.	ELEVATION	CO-ORDINATES	
			NORTHING	EASTING
BH1	25+180			
BH2	24+860			
BH3	23+990			

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

DRAFT

REFERENCE

Base plans provided in digital format by Earthtech, drawing file nos. 01508-Final Plan.dwg and 01508-Basemap.dwg, received March 18, 08.

NO.	DATE	BY	REVISION

Geocres No.

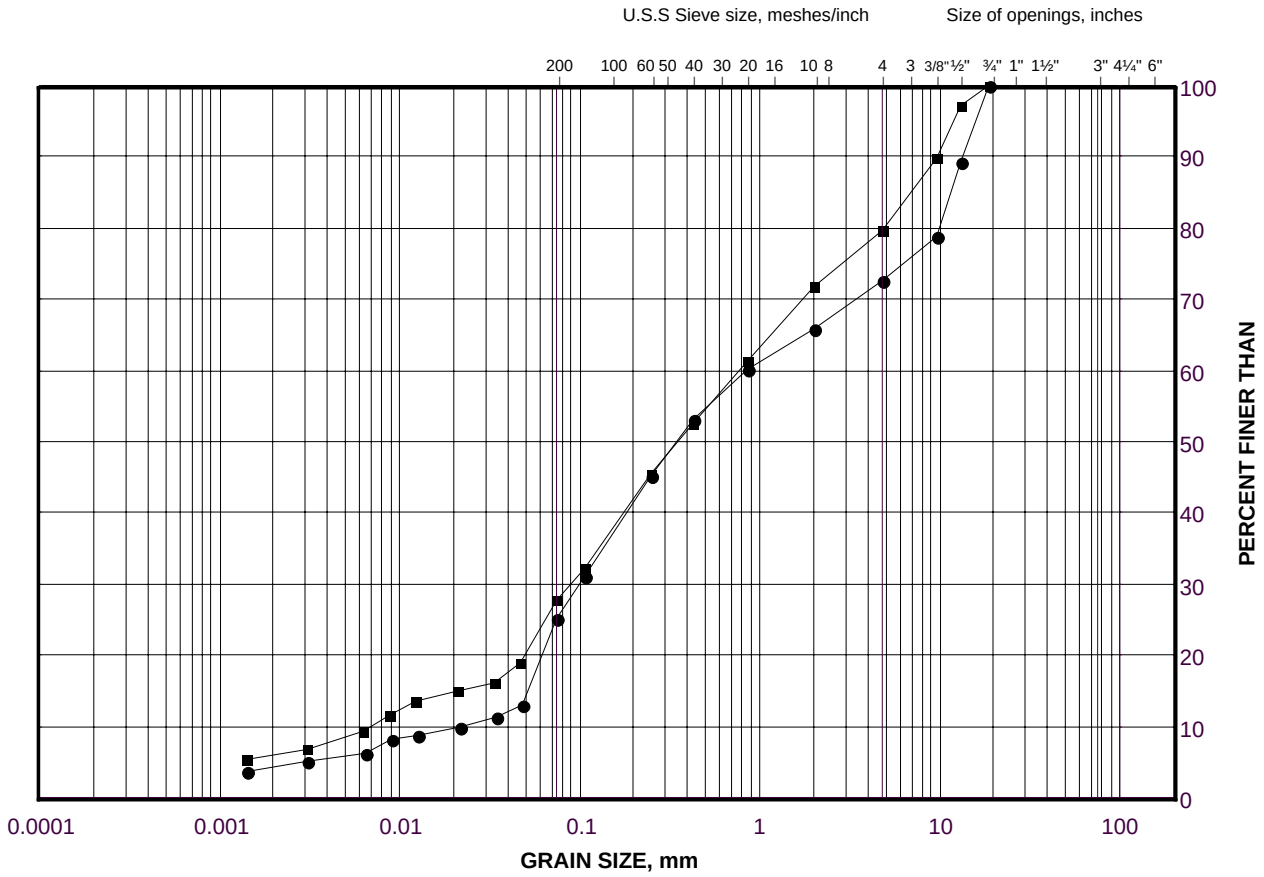
HWY. 115	PROJECT NO. 08-1111-0006		DIST.
SUBM'D. VO	CHKD.	DATE: Apr. 7, 2008	SITE:
DRAWN: DD	CHKD. VO	APPD. HJ/JMAC	DWG. 1

PLOT DATE: April 7, 2008
FILENAME: I:\Projects\2008\08-1111-0006 (MTO, Peterborough)\-AA- EMS Investigation\08111100064001.dwg

GRAIN SIZE DISTRIBUTION

Silty Sand and Gravel to Silty Sand, some gravel (Fill)

FIGURE 1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	1	1	0.00 - 0.60
■	2	3	1.50 - 2.10

Project Number: 08-1111-0006

Checked By: _____

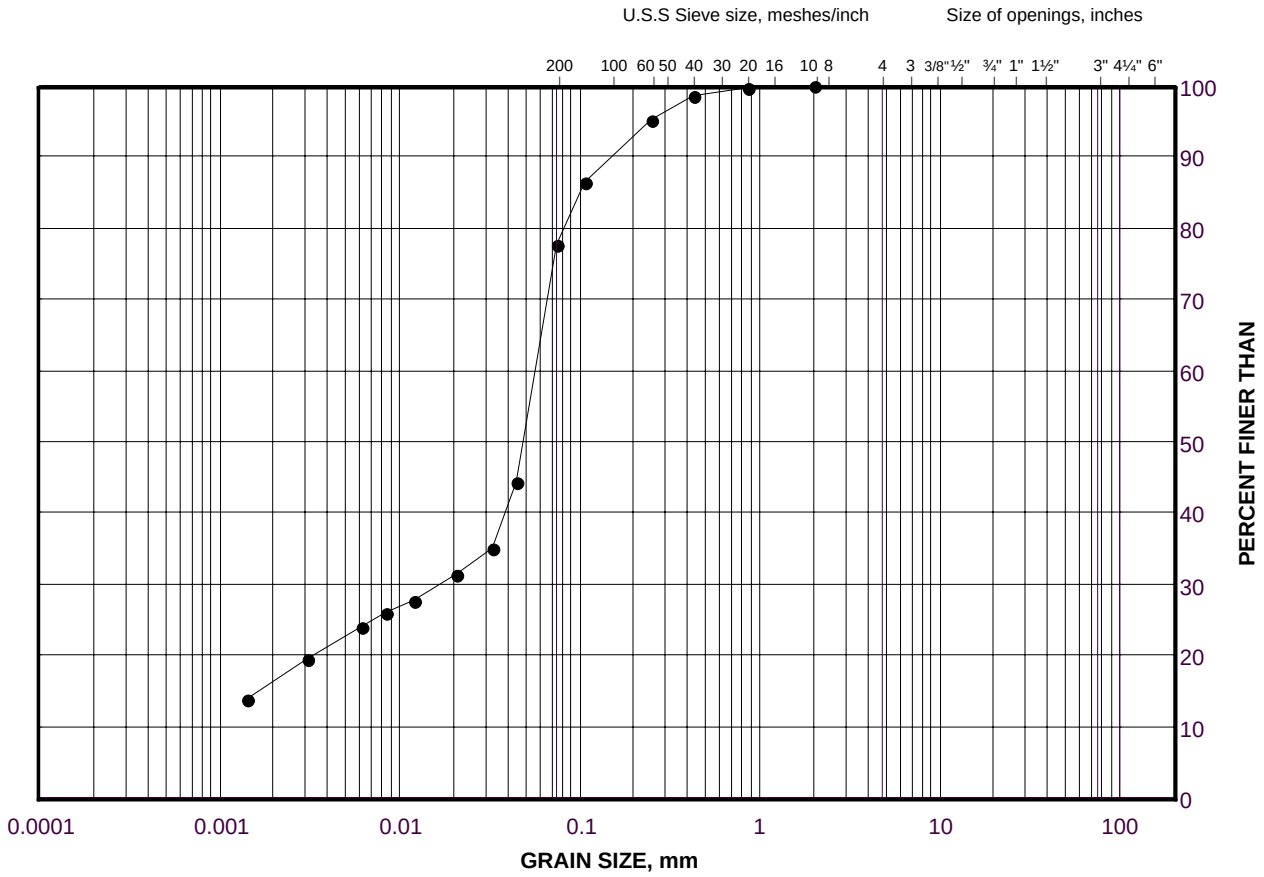
Golder Associates

Date: 07-Apr-08

GRAIN SIZE DISTRIBUTION

Sandy Silt (Fill)

FIGURE 2



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	3	3	1.50 - 2.10

Project Number: 08-1111-0006

Checked By: _____

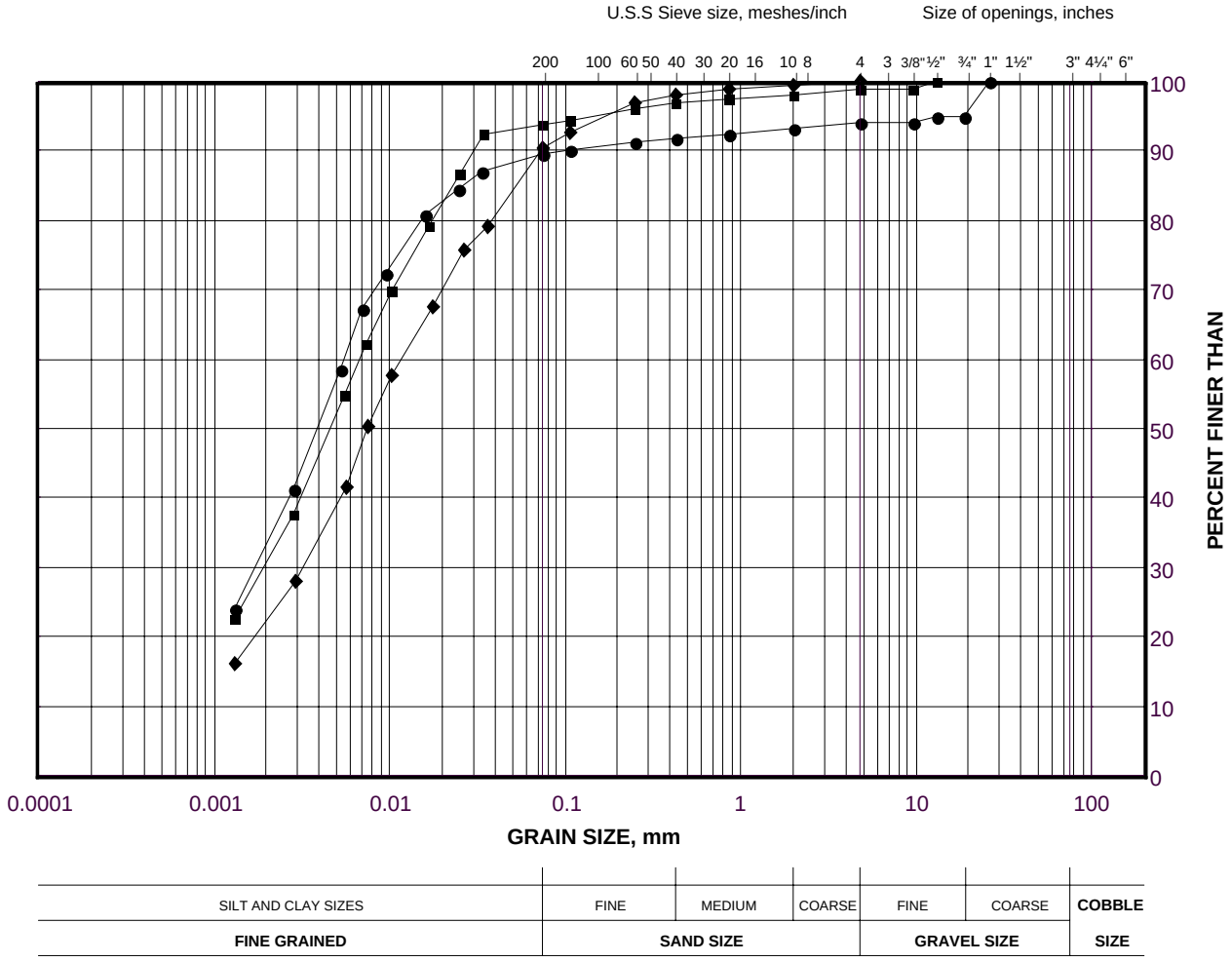
Golder Associates

Date: 07-Apr-08

GRAIN SIZE DISTRIBUTION

Clayey Silt

FIGURE 3



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	1	5	3.00 - 3.70
■	2	6	4.60 - 5.20
◆	3	7	6.10 - 6.70

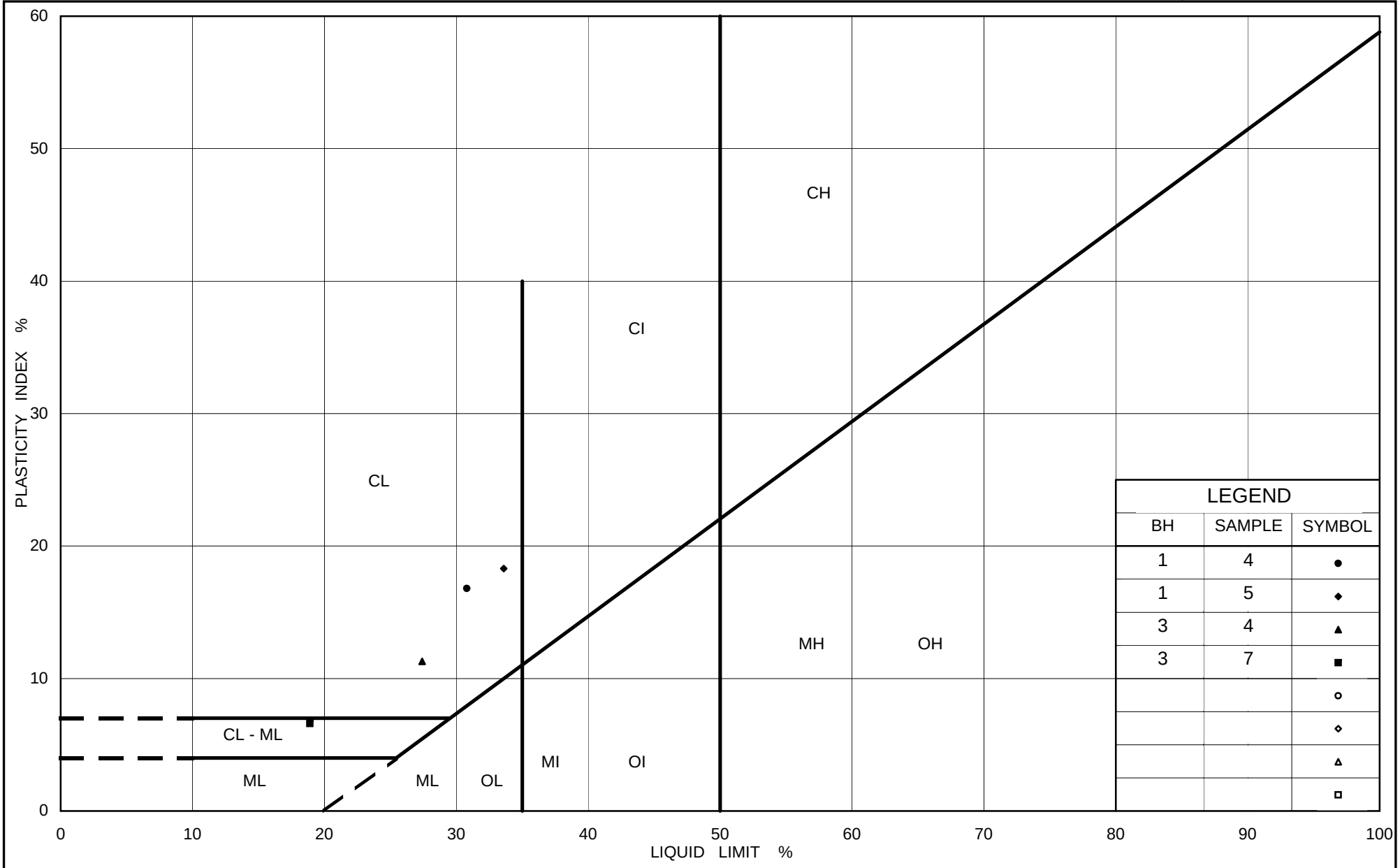
Project Number: 08-1111-0006

Checked By: _____

Golder Associates

Date: 07-Apr-08

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART
Clayey Silt

Figure No. 4

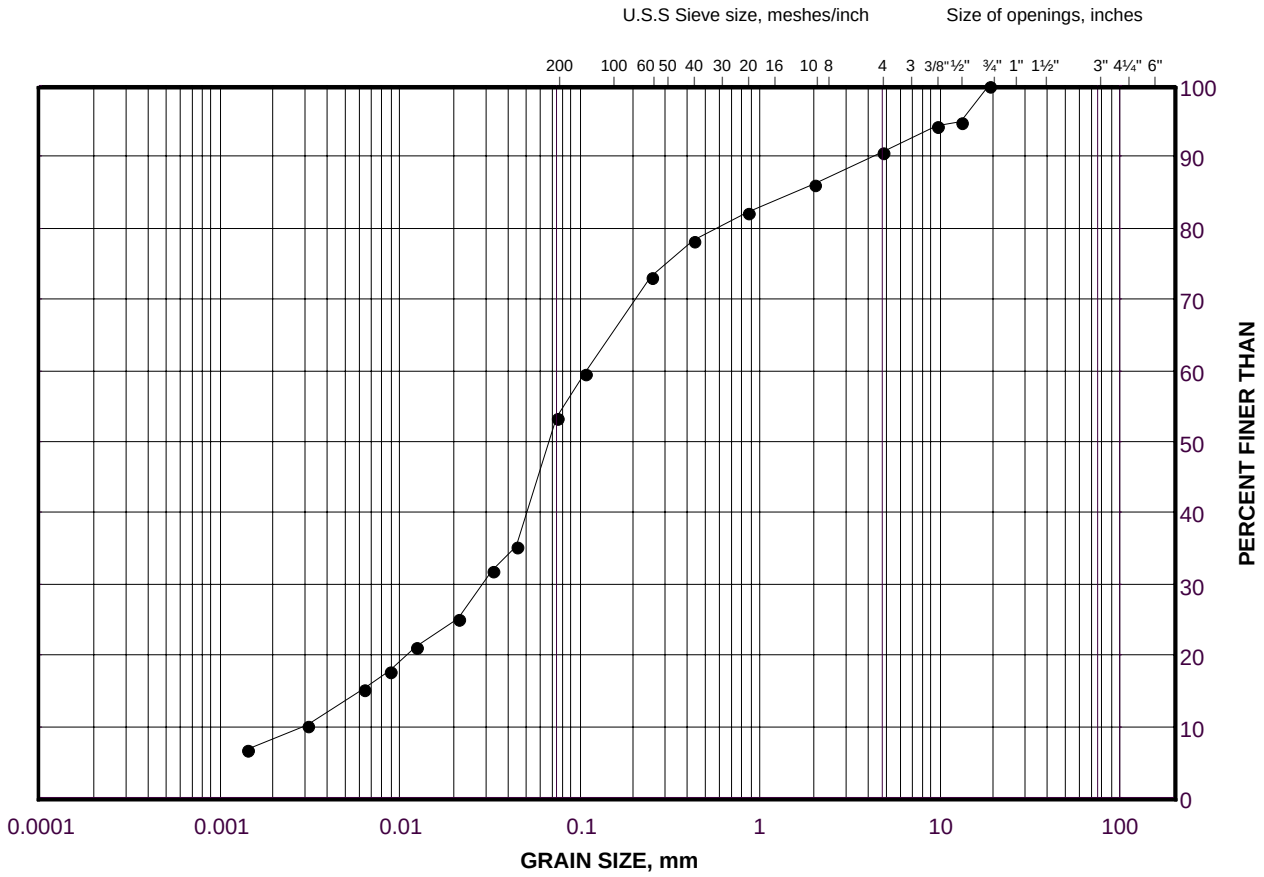
Project No. 08-1111-0006

Checked By:

GRAIN SIZE DISTRIBUTION

Silt and Sand Till

FIGURE 5



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	1	7	6.10 - 6.70

Project Number: 08-1111-0006

Checked By: _____

Golder Associates

Date: 07-Apr-08

APPENDIX A

CERTIFICATES OF ANALYSES
MAXXAM ANALYTICS INC.

Your Project #: 08.1111.0006
Site:PETERBOROUGH
Your C.O.C. #: 00543886

Attention: Veronica Olatunji
Golder Associates Ltd
Mississauga - Standing Offer
2390 Argentia Rd
Mississauga, ON
L5N 5Z7

Report Date: 2008/03/13

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: A823510
Received: 2008/03/11, 10:50

Sample Matrix: Soil
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
ABN Compounds in soil by GC/MS	1	N/A	2008/03/12	CAM SOP-00303	EPA 8270 (modified)
Chloride (20:1 extract)	1	N/A	2008/03/13	CAM SOP-00463	
MOISTURE	1	N/A	2008/03/12	Ont SOP-0114	MOE HANDBOOK(1983)
Nitrate (NO3) and Nitrite (NO2) in Soil	1	N/A	2008/03/13	CAM SOP-00440	SM 4500 NO3 I
pH CaCl2 EXTRACT	1	N/A	2008/03/13	Ont SOP-0067	4500-H+B
Orthophosphate Analysis	1	N/A	2008/03/13	CAM SOP-00461	Based on EPA 365.1
Sulphate (20:1 Extract)	1	N/A	2008/03/13	CAM SOP-00464	EPA 375.4
Volatile Organic Compounds in Soil	1	N/A	2008/03/12	CAM SOP-00226	EPA 8260 modified

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

KRISTEN BURMEISTER, Project Manager
Email: Kristen.Burmeister@maxxamanalytics.com
Phone# (905) 817-5700 Ext:5816

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CAEAL have approved this reporting process and electronic report format.

For Service Group specific validation please refer to the Validation Signature Page

Total cover pages: 1

Maxxam Job #: A823510
Report Date: 2008/03/13

Golder Associates Ltd
Client Project #: 08.1111.0006
Project name: PETERBOROUGH
Sampler Initials:

O'REG 153 VOLATILE ORGANICS (SOIL)

Maxxam ID		X54566		
Sampling Date		2008/02/28		
COC Number		00543886		
	Units	**BH3 SA#2**	**RDL**	**QC Batch**
Inorganics				
Moisture	%	16	0.2	1473194
Volatile Organics				
Acetone (2-Propanone)	ug/g	<0.1	0.1	1473104
Benzene	ug/g	<0.002	0.002	1473104
Bromodichloromethane	ug/g	<0.002	0.002	1473104
Bromoform	ug/g	<0.002	0.002	1473104
Bromomethane	ug/g	<0.003	0.003	1473104
Carbon Tetrachloride	ug/g	<0.002	0.002	1473104
Chlorobenzene	ug/g	<0.002	0.002	1473104
Chloroform	ug/g	<0.002	0.002	1473104
Dibromochloromethane	ug/g	<0.002	0.002	1473104
1,2-Dichlorobenzene	ug/g	<0.002	0.002	1473104
1,3-Dichlorobenzene	ug/g	<0.002	0.002	1473104
1,4-Dichlorobenzene	ug/g	<0.002	0.002	1473104
1,1-Dichloroethane	ug/g	<0.002	0.002	1473104
1,2-Dichloroethane	ug/g	<0.002	0.002	1473104
1,1-Dichloroethylene	ug/g	<0.002	0.002	1473104
cis-1,2-Dichloroethylene	ug/g	<0.002	0.002	1473104
trans-1,2-Dichloroethylene	ug/g	<0.002	0.002	1473104
1,2-Dichloropropane	ug/g	<0.002	0.002	1473104
cis-1,3-Dichloropropene	ug/g	<0.002	0.002	1473104
trans-1,3-Dichloropropene	ug/g	<0.002	0.002	1473104
Ethylbenzene	ug/g	<0.002	0.002	1473104
Ethylene Dibromide	ug/g	<0.002	0.002	1473104
Methylene Chloride(Dichloromethane)	ug/g	<0.003	0.003	1473104
Methyl Isobutyl Ketone	ug/g	<0.025	0.025	1473104
Methyl Ethyl Ketone (2-Butanone)	ug/g	<0.025	0.025	1473104
Methyl t-butyl ether (MTBE)	ug/g	<0.002	0.002	1473104
Styrene	ug/g	<0.002	0.002	1473104
1,1,1,2-Tetrachloroethane	ug/g	<0.002	0.002	1473104
1,1,2,2-Tetrachloroethane	ug/g	<0.002	0.002	1473104
Tetrachloroethylene	ug/g	<0.002	0.002	1473104

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel: 905-817-5700 Toll free:800-563-6266 Fax: 905-817-5777

Maxxam Job #: A823510
Report Date: 2008/03/13

Golder Associates Ltd
Client Project #: 08.1111.0006
Project name: PETERBOROUGH
Sampler Initials:

O'REG 153 VOLATILE ORGANICS (SOIL)

Maxxam ID		X54566		
Sampling Date		2008/02/28		
COC Number		00543886		
	Units	**BH3 SA#2**	**RDL**	**QC Batch**
Toluene	ug/g	<0.002	0.002	1473104
1,1,1-Trichloroethane	ug/g	<0.002	0.002	1473104
1,1,2-Trichloroethane	ug/g	<0.002	0.002	1473104
Trichloroethylene	ug/g	<0.002	0.002	1473104
Vinyl Chloride	ug/g	<0.002	0.002	1473104
p+m-Xylene	ug/g	<0.002	0.002	1473104
o-Xylene	ug/g	<0.002	0.002	1473104
Xylene (Total)	ug/g	<0.002	0.002	1473104
Surrogate Recovery (%)				
4-Bromofluorobenzene	%	84		1473104
D4-1,2-Dichloroethane	%	107		1473104
D8-Toluene	%	118		1473104

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel: 905-817-5700 Toll free:800-563-6266 Fax: 905-817-5777

Maxxam Job #: A823510
Report Date: 2008/03/13

Golder Associates Ltd
Client Project #: 08.1111.0006
Project name: PETERBOROUGH
Sampler Initials:

RESULTS OF ANALYSES OF SOIL

Maxxam ID		X54566		
Sampling Date		2008/02/28		
COC Number		00543886		
	Units	**BH3 SA#2**	**RDL**	**QC Batch**
Inorganics				
Soluble (20:1) Chloride (Cl)	ug/g	200	20	1473522
Orthophosphate (P)	ug/g	0.7	0.2	1473714
Available (CaCl2) pH	pH	7.42		1474257
Soluble (20:1) Sulphate (SO4)	ug/g	34	20	1473716
Nitrate (N)	ug/g	<2	2	1473709

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel: 905-817-5700 Toll free:800-563-6266 Fax: 905-817-5777

Maxxam Job #: A823510
Report Date: 2008/03/13

Golder Associates Ltd
Client Project #: 08.1111.0006
Project name: PETERBOROUGH
Sampler Initials:

SEMI-VOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		X54566		
Sampling Date		2008/02/28		
COC Number		00543886		
	Units	**BH3 SA#2**	**RDL**	**QC Batch**
Semivolatile Organics				
Acenaphthene	ug/g	<0.1	0.1	1473581
Acenaphthylene	ug/g	<0.1	0.1	1473581
Anthracene	ug/g	<0.1	0.1	1473581
Benzo(a)anthracene	ug/g	<0.1	0.1	1473581
Benzo(a)pyrene	ug/g	<0.1	0.1	1473581
Benzo(b/j)fluoranthene	ug/g	<0.1	0.1	1473581
Benzo(g,h,i)perylene	ug/g	<0.1	0.1	1473581
Benzo(k)fluoranthene	ug/g	<0.1	0.1	1473581
1-Chloronaphthalene	ug/g	<1	1	1473581
2-Chloronaphthalene	ug/g	<0.1	0.1	1473581
Chrysene	ug/g	<0.1	0.1	1473581
Dibenz(a,h)anthracene	ug/g	<0.1	0.1	1473581
Fluoranthene	ug/g	<0.1	0.1	1473581
Fluorene	ug/g	<0.1	0.1	1473581
Indeno(1,2,3-cd)pyrene	ug/g	<0.1	0.1	1473581
1-Methylnaphthalene	ug/g	<0.1	0.1	1473581
2-Methylnaphthalene	ug/g	<0.1	0.1	1473581
Naphthalene	ug/g	<0.1	0.1	1473581
Perylene	ug/g	<0.2	0.2	1473581
Phenanthrene	ug/g	<0.1	0.1	1473581
Pyrene	ug/g	<0.1	0.1	1473581
Quinoline	ug/g	<0.2	0.2	1473581
1,2-Dichlorobenzene	ug/g	<0.1	0.1	1473581
1,3-Dichlorobenzene	ug/g	<0.1	0.1	1473581
1,4-Dichlorobenzene	ug/g	<0.1	0.1	1473581
Hexachlorobenzene	ug/g	<0.2	0.2	1473581
Pentachlorobenzene	ug/g	<0.2	0.2	1473581
1,2,3,4-Tetrachlorobenzene	ug/g	<0.2	0.2	1473581
1,2,3,5-Tetrachlorobenzene	ug/g	<0.2	0.2	1473581
1,2,4,5-Tetrachlorobenzene	ug/g	<0.2	0.2	1473581
1,2,3-Trichlorobenzene	ug/g	<0.2	0.2	1473581
1,2,4-Trichlorobenzene	ug/g	<0.2	0.2	1473581

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel: 905-817-5700 Toll free:800-563-6266 Fax: 905-817-5777

Maxxam Job #: A823510
Report Date: 2008/03/13

Golder Associates Ltd
Client Project #: 08.1111.0006
Project name: PETERBOROUGH
Sampler Initials:

SEMI-VOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		X54566		
Sampling Date		2008/02/28		
COC Number		00543886		
	Units	**BH3 SA#2**	**RDL**	**QC Batch**
1,3,5-Trichlorobenzene	ug/g	<0.2	0.2	1473581
2-Chlorophenol	ug/g	<0.1	0.1	1473581
4-Chloro-3-Methylphenol	ug/g	<0.1	0.1	1473581
m/p-Cresol	ug/g	<0.2	0.2	1473581
o-Cresol	ug/g	<0.2	0.2	1473581
2,3-Dichlorophenol	ug/g	<0.1	0.1	1473581
2,4-Dichlorophenol	ug/g	<0.1	0.1	1473581
2,5-Dichlorophenol	ug/g	<0.1	0.1	1473581
2,6-Dichlorophenol	ug/g	<0.1	0.1	1473581
3,4-Dichlorophenol	ug/g	<0.1	0.1	1473581
3,5-Dichlorophenol	ug/g	<0.1	0.1	1473581
2,4-Dimethylphenol	ug/g	<0.1	0.1	1473581
2,4-Dinitrophenol	ug/g	<0.2	0.2	1473581
4,6-Dinitro-2-methylphenol	ug/g	<0.5	0.5	1473581
2-Nitrophenol	ug/g	<0.5	0.5	1473581
4-Nitrophenol	ug/g	<0.5	0.5	1473581
Pentachlorophenol	ug/g	<0.2	0.2	1473581
Phenol	ug/g	<0.2	0.2	1473581
2,3,4,5-Tetrachlorophenol	ug/g	<0.1	0.1	1473581
2,3,4,6-Tetrachlorophenol	ug/g	<0.1	0.1	1473581
2,3,5,6-Tetrachlorophenol	ug/g	<0.1	0.1	1473581
2,3,4-Trichlorophenol	ug/g	<0.1	0.1	1473581
2,3,5-Trichlorophenol	ug/g	<0.1	0.1	1473581
2,3,6-Trichlorophenol	ug/g	<0.1	0.1	1473581
2,4,5-Trichlorophenol	ug/g	<0.1	0.1	1473581
2,4,6-Trichlorophenol	ug/g	<0.1	0.1	1473581
3,4,5-Trichlorophenol	ug/g	<0.1	0.1	1473581
Benzyl butyl phthalate	ug/g	<0.2	0.2	1473581
Bis(2-chloroethoxy)methane	ug/g	<0.1	0.1	1473581
Bis(2-chloroisopropyl)ether	ug/g	<0.1	0.1	1473581
Bis(2-ethylhexyl)phthalate	ug/g	<0.5	0.5	1473581
4-Bromophenyl phenyl ether	ug/g	<0.1	0.1	1473581
p-Chloroaniline	ug/g	<0.2	0.2	1473581

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel: 905-817-5700 Toll free:800-563-6266 Fax: 905-817-5777

Maxxam Job #: A823510
Report Date: 2008/03/13

Golder Associates Ltd
Client Project #: 08.1111.0006
Project name: PETERBOROUGH
Sampler Initials:

SEMI-VOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		X54566		
Sampling Date		2008/02/28		
COC Number		00543886		
	Units	**BH3 SA#2**	**RDL**	**QC Batch**
4-Chlorophenyl phenyl ether	ug/g	<0.1	0.1	1473581
3,3'-Dichlorobenzidine	ug/g	<0.5	0.5	1473581
Diethyl phthalate	ug/g	<0.2	0.2	1473581
Di-N-butyl phthalate	ug/g	<0.2	0.2	1473581
Di-N-octyl phthalate	ug/g	<0.5	0.5	1473581
2,4-Dinitrotoluene	ug/g	<0.1	0.1	1473581
2,6-Dinitrotoluene	ug/g	<0.1	0.1	1473581
Dimethyl phthalate	ug/g	<0.2	0.2	1473581
Biphenyl	ug/g	<0.1	0.1	1473581
Bis(2-chloroethyl)ether	ug/g	<0.2	0.2	1473581
Hexachlorobutadiene	ug/g	<0.1	0.1	1473581
Hexachlorocyclopentadiene	ug/g	<0.5	0.5	1473581
Hexachloroethane	ug/g	<0.1	0.1	1473581
Isophorone	ug/g	<0.1	0.1	1473581
Nitrobenzene	ug/g	<0.1	0.1	1473581
Nitrosodiphenylamine/Diphenylamine	ug/g	<0.2	0.2	1473581
N-Nitroso-di-n-propylamine	ug/g	<0.1	0.1	1473581
Surrogate Recovery (%)				
2,4,6-Tribromophenol	%	82		1473581
2-Fluorobiphenyl	%	82		1473581
2-Fluorophenol	%	72		1473581
D14-Terphenyl	%	96		1473581
D5-Nitrobenzene	%	64		1473581
D5-Phenol	%	75		1473581

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Package 1	17.7°C

Each temperature is the average of up to three cooler temperatures taken at receipt

GENERAL COMMENTS

Results relate only to the items tested.

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Golder Associates Ltd
Attention: Veronica Olatunji
Client Project #: 08.1111.0006
P.O. #:
Project name: PETERBOROUGH

Quality Assurance Report

Maxxam Job Number: MA823510

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1473104	RZH	MATRIX SPIKE	4-Bromofluorobenzene	2008/03/12		89	%	60 - 140
			D4-1,2-Dichloroethane	2008/03/12		97	%	60 - 140
			D8-Toluene	2008/03/12		98	%	60 - 140
			Acetone (2-Propanone)	2008/03/12		90	%	24 - 171
			Benzene	2008/03/12		99	%	39 - 137
			Bromodichloromethane	2008/03/12		94	%	45 - 131
			Bromoform	2008/03/12		96	%	44 - 131
			Bromomethane	2008/03/12		91	%	20 - 146
			Carbon Tetrachloride	2008/03/12		113	%	40 - 139
			Chlorobenzene	2008/03/12		99	%	45 - 140
			Chloroform	2008/03/12		97	%	48 - 128
			Dibromochloromethane	2008/03/12		86	%	52 - 135
			1,2-Dichlorobenzene	2008/03/12		105	%	39 - 145
			1,3-Dichlorobenzene	2008/03/12		126	%	38 - 158
			1,4-Dichlorobenzene	2008/03/12		123	%	35 - 159
			1,1-Dichloroethane	2008/03/12		101	%	48 - 131
			1,2-Dichloroethane	2008/03/12		87	%	43 - 123
			1,1-Dichloroethylene	2008/03/12		132	%	50 - 134
			cis-1,2-Dichloroethylene	2008/03/12		97	%	45 - 136
			trans-1,2-Dichloroethylene	2008/03/12		106	%	45 - 138
			1,2-Dichloropropane	2008/03/12		97	%	51 - 130
			cis-1,3-Dichloropropene	2008/03/12		103	%	39 - 143
			trans-1,3-Dichloropropene	2008/03/12		95	%	33 - 135
			Ethylbenzene	2008/03/12		128	%	46 - 150
			Ethylene Dibromide	2008/03/12		85	%	48 - 136
			Methylene Chloride(Dichloromethane)	2008/03/12		96	%	47 - 124
			Methyl Isobutyl Ketone	2008/03/12		95	%	48 - 133
			Methyl Ethyl Ketone (2-Butanone)	2008/03/12		105	%	39 - 160
			Methyl t-butyl ether (MTBE)	2008/03/12		100	%	37 - 150
			Styrene	2008/03/12		91	%	27 - 148
			1,1,1,2-Tetrachloroethane	2008/03/12		93	%	51 - 140
			1,1,2,2-Tetrachloroethane	2008/03/12		85	%	46 - 128
			Tetrachloroethylene	2008/03/12		110	%	45 - 154
			Toluene	2008/03/12		100	%	30 - 158
			1,1,1-Trichloroethane	2008/03/12		107	%	44 - 136
			1,1,2-Trichloroethane	2008/03/12		87	%	56 - 135
			Trichloroethylene	2008/03/12		104	%	39 - 146
			Vinyl Chloride	2008/03/12		93	%	34 - 136
			p+m-Xylene	2008/03/12		128	%	29 - 161
			o-Xylene	2008/03/12		128	%	45 - 150
		Spiked Blank	4-Bromofluorobenzene	2008/03/12		97	%	60 - 140
			D4-1,2-Dichloroethane	2008/03/12		103	%	60 - 140
			D8-Toluene	2008/03/12		93	%	60 - 140
			Acetone (2-Propanone)	2008/03/12		102	%	60 - 140
			Benzene	2008/03/12		93	%	60 - 140
			Bromodichloromethane	2008/03/12		99	%	60 - 140
			Bromoform	2008/03/12		109	%	60 - 140
			Bromomethane	2008/03/12		78	%	60 - 140
			Carbon Tetrachloride	2008/03/12		95	%	60 - 140
			Chlorobenzene	2008/03/12		91	%	60 - 140
			Chloroform	2008/03/12		95	%	60 - 140
			Dibromochloromethane	2008/03/12		90	%	60 - 140
			1,2-Dichlorobenzene	2008/03/12		90	%	60 - 140
			1,3-Dichlorobenzene	2008/03/12		100	%	60 - 140
			1,4-Dichlorobenzene	2008/03/12		101	%	60 - 140

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Client Project #: 08.1111.0006
P.O. #:
Project name: PETERBOROUGH

Quality Assurance Report (Continued)

Maxxam Job Number: MA823510

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value		Recovery	Units	QC Limits
1473104	RZH	Spiked Blank	1,1-Dichloroethane	2008/03/12			96	%	60 - 140
			1,2-Dichloroethane	2008/03/12			95	%	60 - 140
			1,1-Dichloroethylene	2008/03/12			106	%	60 - 140
			cis-1,2-Dichloroethylene	2008/03/12			97	%	60 - 140
			trans-1,2-Dichloroethylene	2008/03/12			99	%	60 - 140
			1,2-Dichloropropane	2008/03/12			96	%	60 - 140
			cis-1,3-Dichloropropene	2008/03/12			107	%	60 - 140
			trans-1,3-Dichloropropene	2008/03/12			108	%	60 - 140
			Ethylbenzene	2008/03/12			101	%	60 - 140
			Ethylene Dibromide	2008/03/12			93	%	60 - 140
			Methylene Chloride(Dichloromethane)	2008/03/12			99	%	60 - 140
			Methyl Isobutyl Ketone	2008/03/12			114	%	60 - 140
			Methyl Ethyl Ketone (2-Butanone)	2008/03/12			113	%	60 - 140
			Methyl t-butyl ether (MTBE)	2008/03/12			109	%	60 - 140
			Styrene	2008/03/12			84	%	60 - 140
			1,1,1,2-Tetrachloroethane	2008/03/12			87	%	60 - 140
			1,1,2,2-Tetrachloroethane	2008/03/12			94	%	60 - 140
			Tetrachloroethylene	2008/03/12			90	%	60 - 140
			Toluene	2008/03/12			90	%	60 - 140
			1,1,1-Trichloroethane	2008/03/12			94	%	60 - 140
			1,1,2-Trichloroethane	2008/03/12			89	%	60 - 140
			Trichloroethylene	2008/03/12			96	%	60 - 140
			Vinyl Chloride	2008/03/12			70	%	60 - 140
			p+m-Xylene	2008/03/12			105	%	60 - 140
			o-Xylene	2008/03/12			103	%	60 - 140
		Method Blank	4-Bromofluorobenzene	2008/03/12			101	%	60 - 140
			D4-1,2-Dichloroethane	2008/03/12			125	%	60 - 140
			D8-Toluene	2008/03/12			100	%	60 - 140
			Acetone (2-Propanone)	2008/03/12	<0.1			ug/g	
			Benzene	2008/03/12	<0.002			ug/g	
			Bromodichloromethane	2008/03/12	<0.002			ug/g	
			Bromoform	2008/03/12	<0.002			ug/g	
			Bromomethane	2008/03/12	<0.004	(1)		ug/g	
			Carbon Tetrachloride	2008/03/12	<0.002			ug/g	
			Chlorobenzene	2008/03/12	<0.002			ug/g	
			Chloroform	2008/03/12	<0.002			ug/g	
			Dibromochloromethane	2008/03/12	<0.002			ug/g	
			1,2-Dichlorobenzene	2008/03/12	<0.002			ug/g	
			1,3-Dichlorobenzene	2008/03/12	<0.002			ug/g	
			1,4-Dichlorobenzene	2008/03/12	<0.002			ug/g	
			1,1-Dichloroethane	2008/03/12	<0.002			ug/g	
			1,2-Dichloroethane	2008/03/12	<0.002			ug/g	
			1,1-Dichloroethylene	2008/03/12	<0.002			ug/g	
			cis-1,2-Dichloroethylene	2008/03/12	<0.002			ug/g	
			trans-1,2-Dichloroethylene	2008/03/12	<0.002			ug/g	
			1,2-Dichloropropane	2008/03/12	<0.002			ug/g	
			cis-1,3-Dichloropropene	2008/03/12	<0.002			ug/g	
			trans-1,3-Dichloropropene	2008/03/12	<0.002			ug/g	
			Ethylbenzene	2008/03/12	<0.002			ug/g	
			Ethylene Dibromide	2008/03/12	<0.002			ug/g	
			Methylene Chloride(Dichloromethane)	2008/03/12	<0.003			ug/g	
			Methyl Isobutyl Ketone	2008/03/12	<0.025			ug/g	
			Methyl Ethyl Ketone (2-Butanone)	2008/03/12	<0.025			ug/g	
			Methyl t-butyl ether (MTBE)	2008/03/12	<0.002			ug/g	
			Styrene	2008/03/12	<0.002			ug/g	

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Client Project #: 08.1111.0006
P.O. #:
Project name: PETERBOROUGH

Quality Assurance Report (Continued)

Maxxam Job Number: MA823510

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1473104	RZH	Method Blank	1,1,1,2-Tetrachloroethane	2008/03/12	<0.002		ug/g	
			1,1,2,2-Tetrachloroethane	2008/03/12	<0.002		ug/g	
			Tetrachloroethylene	2008/03/12	<0.002		ug/g	
			Toluene	2008/03/12	<0.002		ug/g	
			1,1,1-Trichloroethane	2008/03/12	<0.002		ug/g	
			1,1,2-Trichloroethane	2008/03/12	<0.002		ug/g	
			Trichloroethylene	2008/03/12	<0.002		ug/g	
			Vinyl Chloride	2008/03/12	<0.002		ug/g	
			p+m-Xylene	2008/03/12	<0.002		ug/g	
			o-Xylene	2008/03/12	<0.002		ug/g	
			Xylene (Total)	2008/03/12	<0.002		ug/g	
		RPD	Acetone (2-Propanone)	2008/03/12	NC		%	50
			Benzene	2008/03/12	NC		%	50
			Bromodichloromethane	2008/03/12	NC		%	50
			Bromoform	2008/03/12	NC		%	50
			Bromomethane	2008/03/12	NC		%	50
			Carbon Tetrachloride	2008/03/12	NC		%	50
			Chlorobenzene	2008/03/12	NC		%	50
			Chloroform	2008/03/12	NC		%	50
			Dibromochloromethane	2008/03/12	NC		%	50
			1,2-Dichlorobenzene	2008/03/12	NC		%	50
			1,3-Dichlorobenzene	2008/03/12	NC		%	50
			1,4-Dichlorobenzene	2008/03/12	NC		%	50
			1,1-Dichloroethane	2008/03/12	NC		%	50
			1,2-Dichloroethane	2008/03/12	NC		%	50
			1,1-Dichloroethylene	2008/03/12	NC		%	50
			cis-1,2-Dichloroethylene	2008/03/12	NC		%	50
			trans-1,2-Dichloroethylene	2008/03/12	NC		%	50
			1,2-Dichloropropane	2008/03/12	NC		%	50
			cis-1,3-Dichloropropene	2008/03/12	NC		%	50
			trans-1,3-Dichloropropene	2008/03/12	NC		%	50
			Ethylbenzene	2008/03/12	NC		%	50
			Ethylene Dibromide	2008/03/12	NC		%	50
			Methylene Chloride(Dichloromethane)	2008/03/12	NC		%	50
			Methyl Isobutyl Ketone	2008/03/12	NC		%	50
			Methyl Ethyl Ketone (2-Butanone)	2008/03/12	NC		%	50
			Methyl t-butyl ether (MTBE)	2008/03/12	NC		%	50
			Styrene	2008/03/12	NC		%	50
			1,1,1,2-Tetrachloroethane	2008/03/12	NC		%	50
			1,1,2,2-Tetrachloroethane	2008/03/12	NC		%	50
			Tetrachloroethylene	2008/03/12	NC		%	50
			Toluene	2008/03/12	NC		%	50
			1,1,1-Trichloroethane	2008/03/12	NC		%	50
			1,1,2-Trichloroethane	2008/03/12	NC		%	50
			Trichloroethylene	2008/03/12	NC		%	50
			Vinyl Chloride	2008/03/12	NC		%	50
			p+m-Xylene	2008/03/12	NC		%	50
			o-Xylene	2008/03/12	NC		%	50
			Xylene (Total)	2008/03/12	NC		%	50
1473194	BCA	RPD	Moisture	2008/03/12	5.5		%	50
1473522	JDE	MATRIX SPIKE	Soluble (20:1) Chloride (Cl)	2008/03/13		99	%	75 - 125
		Spiked Blank	Soluble (20:1) Chloride (Cl)	2008/03/13		99	%	80 - 120
		Method Blank	Soluble (20:1) Chloride (Cl)	2008/03/13	<20		ug/g	
		RPD	Soluble (20:1) Chloride (Cl)	2008/03/13	0.9		%	35
1473581	MA	MATRIX SPIKE [X54566-01]	2,4,6-Tribromophenol	2008/03/12		74	%	10 - 130

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Quality Assurance Report (Continued)

Maxxam Job Number: MA823510

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1473581	MA	MATRIX SPIKE						
		[X54566-01]	2-Fluorobiphenyl	2008/03/12		84	%	30 - 130
			2-Fluorophenol	2008/03/12		68	%	10 - 130
			D14-Terphenyl	2008/03/12		99	%	30 - 130
			D5-Nitrobenzene	2008/03/12		65	%	30 - 130
			D5-Phenol	2008/03/12		36	%	10 - 130
			Acenaphthene	2008/03/12		86	%	30 - 130
			Acenaphthylene	2008/03/12		102	%	30 - 130
			Anthracene	2008/03/12		87	%	30 - 130
			Benzo(a)anthracene	2008/03/12		86	%	30 - 130
			Benzo(a)pyrene	2008/03/12		87	%	30 - 130
			Benzo(b/j)fluoranthene	2008/03/12		92	%	30 - 130
			Benzo(g,h,i)perylene	2008/03/12		64	%	30 - 130
			Benzo(k)fluoranthene	2008/03/12		102	%	30 - 130
			1-Chloronaphthalene	2008/03/12		104	%	30 - 130
			2-Chloronaphthalene	2008/03/12		85	%	30 - 130
			Chrysene	2008/03/12		89	%	30 - 130
			Dibenz(a,h)anthracene	2008/03/12		69	%	30 - 130
			Fluoranthene	2008/03/12		91	%	30 - 130
			Fluorene	2008/03/12		90	%	30 - 130
			Indeno(1,2,3-cd)pyrene	2008/03/12		67	%	30 - 130
			1-Methylnaphthalene	2008/03/12		76	%	30 - 130
			2-Methylnaphthalene	2008/03/12		77	%	30 - 130
			Naphthalene	2008/03/12		98	%	30 - 130
			Perylene	2008/03/12		87	%	30 - 130
			Phenanthrene	2008/03/12		92	%	30 - 130
			Pyrene	2008/03/12		100	%	30 - 130
			Quinoline	2008/03/12		70	%	30 - 130
			1,2-Dichlorobenzene	2008/03/12		83	%	30 - 130
			1,3-Dichlorobenzene	2008/03/12		82	%	30 - 130
			1,4-Dichlorobenzene	2008/03/12		86	%	30 - 130
			Hexachlorobenzene	2008/03/12		91	%	30 - 130
			Pentachlorobenzene	2008/03/12		104	%	30 - 130
			1,2,3,4-Tetrachlorobenzene	2008/03/12		99	%	30 - 130
			1,2,3,5-Tetrachlorobenzene	2008/03/12		100	%	30 - 130
			1,2,4,5-Tetrachlorobenzene	2008/03/12		106	%	30 - 130
			1,2,3-Trichlorobenzene	2008/03/12		83	%	30 - 130
			1,2,4-Trichlorobenzene	2008/03/12		80	%	30 - 130
			1,3,5-Trichlorobenzene	2008/03/12		99	%	30 - 130
			2-Chlorophenol	2008/03/12		90	%	10 - 130
			4-Chloro-3-Methylphenol	2008/03/12		98	%	10 - 130
			m/p-Cresol	2008/03/12		87	%	10 - 130
			o-Cresol	2008/03/12		78	%	10 - 130
			2,3-Dichlorophenol	2008/03/12		103	%	10 - 130
			2,4-Dichlorophenol	2008/03/12		71	%	10 - 130
			2,5-Dichlorophenol	2008/03/12		93	%	10 - 130
			2,6-Dichlorophenol	2008/03/12		90	%	10 - 130
			3,4-Dichlorophenol	2008/03/12		114	%	10 - 130
			3,5-Dichlorophenol	2008/03/12		99	%	10 - 130
			2,4-Dimethylphenol	2008/03/12		85	%	10 - 130
			2,4-Dinitrophenol	2008/03/12		34	%	10 - 130
			4,6-Dinitro-2-methylphenol	2008/03/12		77	%	10 - 130
			2-Nitrophenol	2008/03/12		88	%	10 - 130
			4-Nitrophenol	2008/03/12		102	%	10 - 130
			Pentachlorophenol	2008/03/12		71	%	10 - 130

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Quality Assurance Report (Continued)

Maxxam Job Number: MA823510

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1473581	MA	MATRIX SPIKE						
		[X54566-01]	Phenol	2008/03/12		39	%	10 - 130
			2,3,4,5-Tetrachlorophenol	2008/03/12		77	%	10 - 130
			2,3,4,6-Tetrachlorophenol	2008/03/12		103	%	10 - 130
			2,3,5,6-Tetrachlorophenol	2008/03/12		86	%	10 - 130
			2,3,4-Trichlorophenol	2008/03/12		118	%	10 - 130
			2,3,5-Trichlorophenol	2008/03/12		120	%	10 - 130
			2,3,6-Trichlorophenol	2008/03/12		133 (2)	%	10 - 130
			2,4,5-Trichlorophenol	2008/03/12		85	%	10 - 130
			2,4,6-Trichlorophenol	2008/03/12		71	%	10 - 130
			3,4,5-Trichlorophenol	2008/03/12		102	%	10 - 130
			Benzyl butyl phthalate	2008/03/12		89	%	30 - 130
			Bis(2-chloroethoxy)methane	2008/03/12		66	%	30 - 130
			Bis(2-chloroisopropyl)ether	2008/03/12		63	%	30 - 130
			Bis(2-ethylhexyl)phthalate	2008/03/12		81	%	30 - 130
			4-Bromophenyl phenyl ether	2008/03/12		80	%	30 - 130
			p-Chloroaniline	2008/03/12		84	%	30 - 130
			4-Chlorophenyl phenyl ether	2008/03/12		78	%	30 - 130
			3,3'-Dichlorobenzidine	2008/03/12		66	%	30 - 130
			Diethyl phthalate	2008/03/12		75	%	30 - 130
			Di-N-butyl phthalate	2008/03/12		82	%	30 - 130
			Di-N-octyl phthalate	2008/03/12		95	%	30 - 130
			2,4-Dinitrotoluene	2008/03/12		83	%	30 - 130
			2,6-Dinitrotoluene	2008/03/12		82	%	30 - 130
			Dimethyl phthalate	2008/03/12		72	%	30 - 130
			Biphenyl	2008/03/12		124	%	30 - 130
			Bis(2-chloroethyl)ether	2008/03/12		65	%	30 - 130
			Hexachlorobutadiene	2008/03/12		68	%	30 - 130
			Hexachlorocyclopentadiene	2008/03/12		60	%	30 - 130
			Hexachloroethane	2008/03/12		72	%	30 - 130
			Isophorone	2008/03/12		83	%	30 - 130
			Nitrobenzene	2008/03/12		74	%	30 - 130
			Nitrosodiphenylamine/Diphenylamine	2008/03/12		114	%	30 - 130
			N-Nitroso-di-n-propylamine	2008/03/12		93	%	30 - 130
		Spiked Blank	2,4,6-Tribromophenol	2008/03/12		92	%	10 - 130
			2-Fluorobiphenyl	2008/03/12		99	%	30 - 130
			2-Fluorophenol	2008/03/12		88	%	10 - 130
			D14-Terphenyl	2008/03/12		98	%	30 - 130
			D5-Nitrobenzene	2008/03/12		87	%	30 - 130
			D5-Phenol	2008/03/12		90	%	10 - 130
			Acenaphthene	2008/03/12		101	%	30 - 130
			Acenaphthylene	2008/03/12		121	%	30 - 130
			Anthracene	2008/03/12		97	%	30 - 130
			Benzo(a)anthracene	2008/03/12		94	%	30 - 130
			Benzo(a)pyrene	2008/03/12		93	%	30 - 130
			Benzo(b/j)fluoranthene	2008/03/12		88	%	30 - 130
			Benzo(g,h,i)perylene	2008/03/12		96	%	30 - 130
			Benzo(k)fluoranthene	2008/03/12		92	%	30 - 130
			1-Chloronaphthalene	2008/03/12		117	%	30 - 130
			2-Chloronaphthalene	2008/03/12		99	%	30 - 130
			Chrysene	2008/03/12		98	%	30 - 130
			Dibenz(a,h)anthracene	2008/03/12		102	%	30 - 130
			Fluoranthene	2008/03/12		98	%	30 - 130
			Fluorene	2008/03/12		105	%	30 - 130
			Indeno(1,2,3-cd)pyrene	2008/03/12		98	%	30 - 130

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Golder Associates Ltd
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Client Project #: 08.1111.0006
P.O. #:
Project name: PETERBOROUGH

Quality Assurance Report (Continued)

Maxxam Job Number: MA823510

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1473581	MA	Spiked Blank	1-Methylnaphthalene	2008/03/12		97	%	30 - 130
			2-Methylnaphthalene	2008/03/12		98	%	30 - 130
			Naphthalene	2008/03/12		93	%	30 - 130
			Perylene	2008/03/12		95	%	30 - 130
			Phenanthrene	2008/03/12		102	%	30 - 130
			Pyrene	2008/03/12		99	%	30 - 130
			Quinoline	2008/03/12		92	%	30 - 130
			1,2-Dichlorobenzene	2008/03/12		109	%	30 - 130
			1,3-Dichlorobenzene	2008/03/12		108	%	30 - 130
			1,4-Dichlorobenzene	2008/03/12		113	%	30 - 130
			Hexachlorobenzene	2008/03/12		101	%	30 - 130
			Pentachlorobenzene	2008/03/12		120	%	30 - 130
			1,2,3,4-Tetrachlorobenzene	2008/03/12		115	%	30 - 130
			1,2,3,5-Tetrachlorobenzene	2008/03/12		116	%	30 - 130
			1,2,4,5-Tetrachlorobenzene	2008/03/12		115	%	30 - 130
			1,2,3-Trichlorobenzene	2008/03/12		110	%	30 - 130
			1,2,4-Trichlorobenzene	2008/03/12		107	%	30 - 130
			1,3,5-Trichlorobenzene	2008/03/12		119	%	30 - 130
			2-Chlorophenol	2008/03/12		113	%	10 - 130
			4-Chloro-3-Methylphenol	2008/03/12		119	%	10 - 130
			m/p-Cresol	2008/03/12		101	%	10 - 130
			o-Cresol	2008/03/12		101	%	10 - 130
			2,3-Dichlorophenol	2008/03/12		119	%	10 - 130
			2,4-Dichlorophenol	2008/03/12		81	%	10 - 130
			2,5-Dichlorophenol	2008/03/12		115	%	10 - 130
			2,6-Dichlorophenol	2008/03/12		114	%	10 - 130
			3,4-Dichlorophenol	2008/03/12		131 (3)	%	10 - 130
			3,5-Dichlorophenol	2008/03/12		123	%	10 - 130
			2,4-Dimethylphenol	2008/03/12		109	%	10 - 130
			2,4-Dinitrophenol	2008/03/12		48	%	10 - 130
			4,6-Dinitro-2-methylphenol	2008/03/12		103	%	10 - 130
			2-Nitrophenol	2008/03/12		114	%	10 - 130
			4-Nitrophenol	2008/03/12		100	%	10 - 130
			Pentachlorophenol	2008/03/12		93	%	10 - 130
			Phenol	2008/03/12		114	%	10 - 130
			2,3,4,5-Tetrachlorophenol	2008/03/12		114	%	10 - 130
			2,3,4,6-Tetrachlorophenol	2008/03/12		104	%	10 - 130
			2,3,5,6-Tetrachlorophenol	2008/03/12		115	%	10 - 130
			2,3,4-Trichlorophenol	2008/03/12		128	%	10 - 130
			2,3,5-Trichlorophenol	2008/03/12		133 (3)	%	10 - 130
			2,3,6-Trichlorophenol	2008/03/12		167 (2)	%	10 - 130
			2,4,5-Trichlorophenol	2008/03/12		93	%	10 - 130
			2,4,6-Trichlorophenol	2008/03/12		95	%	10 - 130
			3,4,5-Trichlorophenol	2008/03/12		115	%	10 - 130
			Benzyl butyl phthalate	2008/03/12		94	%	30 - 130
			Bis(2-chloroethoxy)methane	2008/03/12		87	%	30 - 130
			Bis(2-chloroisopropyl)ether	2008/03/12		85	%	30 - 130
			Bis(2-ethylhexyl)phthalate	2008/03/12		96	%	30 - 130
			4-Bromophenyl phenyl ether	2008/03/12		95	%	30 - 130
			p-Chloroaniline	2008/03/12		83	%	30 - 130
			4-Chlorophenyl phenyl ether	2008/03/12		94	%	30 - 130
			3,3'-Dichlorobenzidine	2008/03/12		68	%	30 - 130
			Diethyl phthalate	2008/03/12		85	%	30 - 130
			Di-N-butyl phthalate	2008/03/12		90	%	30 - 130
			Di-N-octyl phthalate	2008/03/12		92	%	30 - 130

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Client Project #: 08.1111.0006
P.O. #:
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Quality Assurance Report (Continued)

Maxxam Job Number: MA823510

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1473581	MA	Spiked Blank	2,4-Dinitrotoluene	2008/03/12		96	%	30 - 130
			2,6-Dinitrotoluene	2008/03/12		96	%	30 - 130
			Dimethyl phthalate	2008/03/12		85	%	30 - 130
			Biphenyl	2008/03/12		143 (3)	%	30 - 130
			Bis(2-chloroethyl)ether	2008/03/12		84	%	30 - 130
			Hexachlorobutadiene	2008/03/12		94	%	30 - 130
			Hexachlorocyclopentadiene	2008/03/12		102	%	30 - 130
			Hexachloroethane	2008/03/12		98	%	30 - 130
			Isophorone	2008/03/12		106	%	30 - 130
			Nitrobenzene	2008/03/12		95	%	30 - 130
			Nitrosodiphenylamine/Diphenylamine	2008/03/12		130 (3)	%	30 - 130
			N-Nitroso-di-n-propylamine	2008/03/12		116	%	30 - 130
		Method Blank	2,4,6-Tribromophenol	2008/03/12		84	%	10 - 130
			2-Fluorobiphenyl	2008/03/12		103	%	30 - 130
			2-Fluorophenol	2008/03/12		90	%	10 - 130
			D14-Terphenyl	2008/03/12		97	%	30 - 130
			D5-Nitrobenzene	2008/03/12		81	%	30 - 130
			D5-Phenol	2008/03/12		91	%	10 - 130
			Acenaphthene	2008/03/12	<0.1		ug/g	
			Acenaphthylene	2008/03/12	<0.1		ug/g	
			Anthracene	2008/03/12	<0.1		ug/g	
			Benzo(a)anthracene	2008/03/12	<0.1		ug/g	
			Benzo(a)pyrene	2008/03/12	<0.1		ug/g	
			Benzo(b/j)fluoranthene	2008/03/12	<0.1		ug/g	
			Benzo(g,h,i)perylene	2008/03/12	<0.1		ug/g	
			Benzo(k)fluoranthene	2008/03/12	<0.1		ug/g	
			1-Chloronaphthalene	2008/03/12	<1		ug/g	
			2-Chloronaphthalene	2008/03/12	<0.1		ug/g	
			Chrysene	2008/03/12	<0.1		ug/g	
			Dibenz(a,h)anthracene	2008/03/12	<0.1		ug/g	
			Fluoranthene	2008/03/12	<0.1		ug/g	
			Fluorene	2008/03/12	<0.1		ug/g	
			Indeno(1,2,3-cd)pyrene	2008/03/12	<0.1		ug/g	
			1-Methylnaphthalene	2008/03/12	<0.1		ug/g	
			2-Methylnaphthalene	2008/03/12	<0.1		ug/g	
			Naphthalene	2008/03/12	<0.1		ug/g	
			Perylene	2008/03/12	<0.2		ug/g	
			Phenanthrene	2008/03/12	<0.1		ug/g	
			Pyrene	2008/03/12	<0.1		ug/g	
			Quinoline	2008/03/12	<0.2		ug/g	
			1,2-Dichlorobenzene	2008/03/12	<0.1		ug/g	
			1,3-Dichlorobenzene	2008/03/12	<0.1		ug/g	
			1,4-Dichlorobenzene	2008/03/12	<0.1		ug/g	
			Hexachlorobenzene	2008/03/12	<0.2		ug/g	
			Pentachlorobenzene	2008/03/12	<0.2		ug/g	
			1,2,3,4-Tetrachlorobenzene	2008/03/12	<0.2		ug/g	
			1,2,3,5-Tetrachlorobenzene	2008/03/12	<0.2		ug/g	
			1,2,4,5-Tetrachlorobenzene	2008/03/12	<0.2		ug/g	
			1,2,3-Trichlorobenzene	2008/03/12	<0.2		ug/g	
			1,2,4-Trichlorobenzene	2008/03/12	<0.2		ug/g	
			1,3,5-Trichlorobenzene	2008/03/12	<0.2		ug/g	
			2-Chlorophenol	2008/03/12	<0.1		ug/g	
			4-Chloro-3-Methylphenol	2008/03/12	<0.1		ug/g	
			m/p-Cresol	2008/03/12	<0.2		ug/g	
			o-Cresol	2008/03/12	<0.2		ug/g	

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Quality Assurance Report (Continued)

Maxxam Job Number: MA823510

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1473581	MA	Method Blank	2,3-Dichlorophenol	2008/03/12	<0.1		ug/g	
			2,4-Dichlorophenol	2008/03/12	<0.1		ug/g	
			2,5-Dichlorophenol	2008/03/12	<0.1		ug/g	
			2,6-Dichlorophenol	2008/03/12	<0.1		ug/g	
			3,4-Dichlorophenol	2008/03/12	<0.1		ug/g	
			3,5-Dichlorophenol	2008/03/12	<0.1		ug/g	
			2,4-Dimethylphenol	2008/03/12	<0.1		ug/g	
			2,4-Dinitrophenol	2008/03/12	<0.2		ug/g	
			4,6-Dinitro-2-methylphenol	2008/03/12	<0.5		ug/g	
			2-Nitrophenol	2008/03/12	<0.5		ug/g	
			4-Nitrophenol	2008/03/12	<0.5		ug/g	
			Pentachlorophenol	2008/03/12	<0.2		ug/g	
			Phenol	2008/03/12	<0.2		ug/g	
			2,3,4,5-Tetrachlorophenol	2008/03/12	<0.1		ug/g	
			2,3,4,6-Tetrachlorophenol	2008/03/12	<0.1		ug/g	
			2,3,5,6-Tetrachlorophenol	2008/03/12	<0.1		ug/g	
			2,3,4-Trichlorophenol	2008/03/12	<0.1		ug/g	
			2,3,5-Trichlorophenol	2008/03/12	<0.1		ug/g	
			2,3,6-Trichlorophenol	2008/03/12	<0.1		ug/g	
			2,4,5-Trichlorophenol	2008/03/12	<0.1		ug/g	
			2,4,6-Trichlorophenol	2008/03/12	<0.1		ug/g	
			3,4,5-Trichlorophenol	2008/03/12	<0.1		ug/g	
			Benzyl butyl phthalate	2008/03/12	<0.2		ug/g	
			Bis(2-chloroethoxy)methane	2008/03/12	<0.1		ug/g	
			Bis(2-chloroisopropyl)ether	2008/03/12	<0.1		ug/g	
			Bis(2-ethylhexyl)phthalate	2008/03/12	<0.5		ug/g	
			4-Bromophenyl phenyl ether	2008/03/12	<0.1		ug/g	
			p-Chloroaniline	2008/03/12	<0.2		ug/g	
			4-Chlorophenyl phenyl ether	2008/03/12	<0.1		ug/g	
			3,3'-Dichlorobenzidine	2008/03/12	<0.5		ug/g	
			Diethyl phthalate	2008/03/12	<0.2		ug/g	
			Di-N-butyl phthalate	2008/03/12	<0.2		ug/g	
			Di-N-octyl phthalate	2008/03/12	<0.5		ug/g	
			2,4-Dinitrotoluene	2008/03/12	<0.1		ug/g	
			2,6-Dinitrotoluene	2008/03/12	<0.1		ug/g	
			Dimethyl phthalate	2008/03/12	<0.2		ug/g	
			Biphenyl	2008/03/12	<0.1		ug/g	
			Bis(2-chloroethyl)ether	2008/03/12	<0.2		ug/g	
			Hexachlorobutadiene	2008/03/12	<0.1		ug/g	
			Hexachlorocyclopentadiene	2008/03/12	<0.5		ug/g	
			Hexachloroethane	2008/03/12	<0.1		ug/g	
			Isophorone	2008/03/12	<0.1		ug/g	
			Nitrobenzene	2008/03/12	<0.1		ug/g	
			Nitrosodiphenylamine/Diphenylamine	2008/03/12	<0.2		ug/g	
			N-Nitroso-di-n-propylamine	2008/03/12	<0.1		ug/g	
		RPD [X54566-01]	Acenaphthene	2008/03/12	NC		%	50
			Acenaphthylene	2008/03/12	NC		%	50
			Anthracene	2008/03/12	NC		%	50
			Benzo(a)anthracene	2008/03/12	NC		%	50
			Benzo(a)pyrene	2008/03/12	NC		%	50
			Benzo(b/j)fluoranthene	2008/03/12	NC		%	50
			Benzo(g,h,i)perylene	2008/03/12	NC		%	50
			Benzo(k)fluoranthene	2008/03/12	NC		%	50
			1-Chloronaphthalene	2008/03/12	NC		%	50
			2-Chloronaphthalene	2008/03/12	NC		%	50

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Quality Assurance Report (Continued)

Maxxam Job Number: MA823510

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1473581	MA	RPD [X54566-01]	Chrysene	2008/03/12	NC		%	50
			Dibenz(a,h)anthracene	2008/03/12	NC		%	50
			Fluoranthene	2008/03/12	NC		%	50
			Fluorene	2008/03/12	NC		%	50
			Indeno(1,2,3-cd)pyrene	2008/03/12	NC		%	50
			1-Methylnaphthalene	2008/03/12	NC		%	50
			2-Methylnaphthalene	2008/03/12	NC		%	50
			Naphthalene	2008/03/12	NC		%	50
			Perylene	2008/03/12	NC		%	50
			Phenanthrene	2008/03/12	NC		%	50
			Pyrene	2008/03/12	NC		%	50
			Quinoline	2008/03/12	NC		%	50
			1,2-Dichlorobenzene	2008/03/12	NC		%	50
			1,3-Dichlorobenzene	2008/03/12	NC		%	50
			1,4-Dichlorobenzene	2008/03/12	NC		%	50
			Hexachlorobenzene	2008/03/12	NC		%	50
			Pentachlorobenzene	2008/03/12	NC		%	50
			1,2,3,4-Tetrachlorobenzene	2008/03/12	NC		%	50
			1,2,3,5-Tetrachlorobenzene	2008/03/12	NC		%	50
			1,2,4,5-Tetrachlorobenzene	2008/03/12	NC		%	50
			1,2,3-Trichlorobenzene	2008/03/12	NC		%	50
			1,2,4-Trichlorobenzene	2008/03/12	NC		%	50
			1,3,5-Trichlorobenzene	2008/03/12	NC		%	50
			2-Chlorophenol	2008/03/12	NC		%	50
			4-Chloro-3-Methylphenol	2008/03/12	NC		%	50
			m/p-Cresol	2008/03/12	NC		%	50
			o-Cresol	2008/03/12	NC		%	50
			2,3-Dichlorophenol	2008/03/12	NC		%	50
			2,4-Dichlorophenol	2008/03/12	NC		%	50
			2,5-Dichlorophenol	2008/03/12	NC		%	50
			2,6-Dichlorophenol	2008/03/12	NC		%	50
			3,4-Dichlorophenol	2008/03/12	NC		%	50
			3,5-Dichlorophenol	2008/03/12	NC		%	50
			2,4-Dimethylphenol	2008/03/12	NC		%	50
			2,4-Dinitrophenol	2008/03/12	NC		%	50
			4,6-Dinitro-2-methylphenol	2008/03/12	NC		%	50
			2-Nitrophenol	2008/03/12	NC		%	50
			4-Nitrophenol	2008/03/12	NC		%	50
			Pentachlorophenol	2008/03/12	NC		%	50
			Phenol	2008/03/12	NC		%	50
			2,3,4,5-Tetrachlorophenol	2008/03/12	NC		%	50
			2,3,4,6-Tetrachlorophenol	2008/03/12	NC		%	50
			2,3,5,6-Tetrachlorophenol	2008/03/12	NC		%	50
			2,3,4-Trichlorophenol	2008/03/12	NC		%	50
			2,3,5-Trichlorophenol	2008/03/12	NC		%	50
			2,3,6-Trichlorophenol	2008/03/12	NC		%	50
			2,4,5-Trichlorophenol	2008/03/12	NC		%	50
			2,4,6-Trichlorophenol	2008/03/12	NC		%	50
			3,4,5-Trichlorophenol	2008/03/12	NC		%	50
			Benzyl butyl phthalate	2008/03/12	NC		%	50
			Bis(2-chloroethoxy)methane	2008/03/12	NC		%	50
			Bis(2-chloroisopropyl)ether	2008/03/12	NC		%	50
			Bis(2-ethylhexyl)phthalate	2008/03/12	NC		%	50
			4-Bromophenyl phenyl ether	2008/03/12	NC		%	50
			p-Chloroaniline	2008/03/12	NC		%	50

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Quality Assurance Report (Continued)

Maxxam Job Number: MA823510

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1473581	MA	RPD [X54566-01]	4-Chlorophenyl phenyl ether	2008/03/12	NC		%	50
			3,3'-Dichlorobenzidine	2008/03/12	NC		%	50
			Diethyl phthalate	2008/03/12	NC		%	50
			Di-N-butyl phthalate	2008/03/12	NC		%	50
			Di-N-octyl phthalate	2008/03/12	NC		%	50
			2,4-Dinitrotoluene	2008/03/12	NC		%	50
			2,6-Dinitrotoluene	2008/03/12	NC		%	50
			Dimethyl phthalate	2008/03/12	NC		%	50
			Biphenyl	2008/03/12	NC		%	50
			Bis(2-chloroethyl)ether	2008/03/12	NC		%	50
			Hexachlorobutadiene	2008/03/12	NC		%	50
			Hexachlorocyclopentadiene	2008/03/12	NC		%	50
			Hexachloroethane	2008/03/12	NC		%	50
			Isophorone	2008/03/12	NC		%	50
			Nitrobenzene	2008/03/12	NC		%	50
			Nitrosodiphenylamine/Diphenylamine	2008/03/12	NC		%	50
			N-Nitroso-di-n-propylamine	2008/03/12	NC		%	50
1473709	CCI	MATRIX SPIKE	Nitrate (N)	2008/03/13		88	%	75 - 125
		Spiked Blank	Nitrate (N)	2008/03/13		93	%	80 - 120
		Method Blank	Nitrate (N)	2008/03/13	<2		ug/g	
		RPD	Nitrate (N)	2008/03/13	10.1		%	25
1473714	JDE	MATRIX SPIKE [X54566-02]	Orthophosphate (P)	2008/03/13		95	%	75 - 125
		Spiked Blank	Orthophosphate (P)	2008/03/13		100	%	80 - 120
		Method Blank	Orthophosphate (P)	2008/03/13	<0.2		ug/g	
		RPD [X54566-02]	Orthophosphate (P)	2008/03/13	NC		%	25
1473716	JDE	MATRIX SPIKE	Soluble (20:1) Sulphate (SO4)	2008/03/13		NC (4)	%	75 - 125
		Spiked Blank	Soluble (20:1) Sulphate (SO4)	2008/03/13		103	%	80 - 120
		Method Blank	Soluble (20:1) Sulphate (SO4)	2008/03/13	<20		ug/g	
		RPD	Soluble (20:1) Sulphate (SO4)	2008/03/13	0.005		%	35

NC = Non-calculable
RPD = Relative Percent Difference
SPIKE = Fortified sample
(1) Detection limit was raised due to background interferences.
(2) The recovery was above the upper control limit. This may represent a high bias in some results for flagged analytes. For results that were not detected (ND), this potential bias has no impact.
(3) Please refer to General Comments page for specific clarification.
(4) The recovery in the matrix spike was not calculated (NC). Because of the high concentration of this analyte in the parent sample, the relative difference between the spiked and unspiked concentrations is not sufficiently significant to permit a reliable recovery calculation.

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Validation Signature Page

Maxxam Job #: A823510

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

CHRISTINA NERVO, Scientific Services

FLOYD MAYEDE,

TROY CARRIERE, B.Sc., C.Chem, Scientific Specialist

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CAEAL have approved this reporting process and electronic report format.

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APPENDIX B

NON-STANDARD SPECIAL PROVISIONS

CONTROL OF OVERBURDEN SOILS AND GROUNDWATER DURING GMS FOUNDATION INSTALLATION - Item No.

Special Provision

Excavations for the GMS foundations will be advanced through cohesionless fill materials, into cohesive and cohesionless soils. The cohesionless fill and native soil deposits should be expected to be unstable below the groundwater level. Where cohesionless soil deposits, layers or lenses are encountered, appropriate construction procedures and equipment will be required to minimize ground loss during drilling and concrete placement.

Basis of Payment

Payment at the lump sum contract price for this tender item shall be full compensation for all labour, equipment and materials for completion of the work.

END OF SECTION