Appendix H

Desktop Geotechnical Letter Report
Dear Sir:

1. INTRODUCTION

This letter report presents the findings of a desk-top geotechnical study undertaken on behalf of Hatch Mott MacDonald (HMM), in connection with their Municipal Class Environmental Assessment for the Canadian Pacific Rail (CP Rail) crossing at New Coronation Road in the Town of Whitby.

The study was undertaken further to HMM’s, letter of engagement to SPL dated May 5, 2014.

The purpose of the study was to review available geotechnical and hydrogeological data and to provide an interpretation as to how these conditions might affect the design/construction of the following alternatives for the road/rail crossing:

- An at-grade (level) crossing;
- Grade-separated – road over rail (overpass);
- Grade-separated – road under rail (underpass).
2. BACKGROUND

The Town of Whitby is planning for New Coronation Road, which will be located west of existing Coronation Road a distance of approximately 350m. Between Rossland Road West and Taunton Road, New Coronation Road will transect CP Rail. CP Rail is contemplating a widening of the rail line to accommodate a second track at some time in the future.

A Key Plan of the crossing location is provided below.

![Key Plan – CP Rail / Coronation Road Crossing Site](image)

The site area is presently undeveloped, consisting of agricultural fields and some wooded areas. A tributary of Lynde Creek flows southeasterly just east of New Coronation Road.

The Class EA currently being undertaken by HMM is assessing alternatives for the CP Rail crossing of New Coronation Road. As mentioned in the introduction, these options include an at-grade crossing or a grade-separated crossing. New Coronation Road is to ultimately have a 4-lane urbanized, 30m wide cross section with flanking boulevards, sidewalk and multi-use pathway.

For the at-grade alternative, there would be no change to the existing CP Rail track-bed grade. Construction of New Coronation Road would involve filling, with a grade raise of between 3m and 5m to bring the road grade up to match the rail grade (rail grade is at approx. Elev. 103m at the proposed crossing site). Refer to Drawing No. 1 (attached).
Based on conceptual plan/profile drawings provided by HMM, we understand that the road-over-rail alternative would consist of a 4 lane overpass structure with sidewalks (total width 23.5m) supported by CPCI girders, likely in a single span. The new road approach fill heights would be approximately 13m at the abutments. These approach fills would taper out over distances of approximately 250m north of and 250m south of the CP Rail corridor. Refer to Drawing No. 2 (blue line).

The concept for the rail-over-road alternative (road underpass) would involve a single ~24m span rail bridge. This option would require a cut of about 7m in depth to depress the re-aligned Coronation Road (approx. road grade elev. 96m). Refer to Drawing No. 2 (red line).

3. GEOTECHNICAL / HYDROGEOLOGICAL SOURCES REVIEWED

The following sources were reviewed as part of this assignment:


iii. Ontario Ministry of Environment, Water Well Database.

4. GEOLOGIC CONDITIONS

4.1 Regional Geology

Figure 1 depicts the surficial geology of the general site area. The approximate overburden thickness is contoured in Figure 2.

The area geology is complex. There is a northwest to southeast directionality associated with the overburden geology in this area, owing to the direction of ice-advance during the Wisconsinan glaciation, resulting in considerable variability in soil conditions in the west east direction over relatively short distances. The surficial drainage pattern follows this same northwest-southeast alignment.

The site area is dominated by a drumlinized till plain with intervening glaciolacustrine deposits. Ordovician shale of the Whitby Formation lies at relatively shallow depth beneath the glacial till and glaciolacustrine soils. Ontario Geologic Survey overburden thickness mapping is provided in Figure 2 which suggests the depth to bedrock is approximately 10m in the vicinity of the crossing.
Drumlins are elongated tear-drop shaped hills, comprised of a well-graded matrix of sand, silt, clay, cobbles and boulders, generally in an overconsolidated condition (i.e. very dense state of packing). The drumlins are aligned in the direction of glacial advance. The lower ground between the drumlins was deposited with finer grained silts and clays (glaciolacustine soils) which are often poorly consolidated (i.e. compressible) and may have high water content. Narrow bands of modern alluvial deposits (silt, sand) have also been deposited by the surface water tributaries.

Bedrock consists of black, slightly bituminous, Ordovician shale of the Whitby Formation. This is typically a medium strong, slightly weathered to fresh, horizontally bedded shale, with minor stronger limestone interbeds. The Whitby shale is gassy owing to its bitumen content.

**4.2 Site-Specific Borehole Data**

From the sources of geo-data cited in Section 3, we have plotted available borehole data in plan and section on Drawings 1 and 2. Please note the 10x vertical exaggeration.

The closest borehole to the crossing site is SPL BH 11-4 which was drilled on centerline of New Coronation Road just south of the CP Rail corridor to a depth of 8.2m below grade. This boring reveals generally favourable soil conditions including a thin (1.1m thick) veneer of silty clay fill soil overlying stiff to hard silty clay (to 2.3m depth/elev. 96.7m) which in turn overlies hard clayey silt glacial till. Perched groundwater was found in the fill (depth 0.2m/elev. 98.8m).

SPL BH 11-5 was also drilled near the future centerline of New Coronation Road but lies near the north end of the proposed grade separation cut/fill (about 600m north of the crossing). Different soil types were found in this boring, consisting of more granular and likely non-plastic (i.e. non-cohesive) glacial till deposits (sandy silt till and silty sand till with thin clay till capping). The relative density of the granular tills appears to increase with increasing depth from compact to very dense. The groundwater table measured in a monitoring well installed in BH 11-5 was at elevation 100.9m (depth 1.4m) at the time of measurement.

SPL BH RRS2, advanced about 400m southeast of the proposed crossing (at Rossland Road) found altogether different soils from those described above. This boring was taken to 12.2m depth. Thicker fill deposits, extending to 2.3m below grade were found including granular fill over an organic layer. Glaciolacustrine soils underlie the fill, extending to 6.6m (elev. 92.3m) below grade. The glaciolacustrine soils are laminated silty clay, generally in a firm consistency (SPT ‘N’ values of 4 to 7 blows per 300mm). Beneath these weak cohesive soils, a sequence of very stiff clayey silt till overlies very dense sandy silt till. The groundwater table observed in the installed monitoring well was measured at elev. 98.3m or 0.6m below grade.
The two (2) available borings available from the Ontario Geological Survey (OGS) database (OGS831933 and OGS831934) provide only general stratigraphic information. They do, however, indicate that shale bedrock of the Whitby Formation lies 10.2m to 11.4m below grade (i.e. elev. 93.4m – 91.1m) in the study area. Overburden in both borings appears to consist sandy silt/silty sand glacial till with intervening layers of clay or silty sand. Groundwater levels are indicated to lie at elev. 94.7 (5.1m bgl) and elev. 102.9m (0.7m bgl), although it is not clear if these are observations taken in monitoring wells or short-term unstabilized levels in the open boreholes.

4.3 MOE Water Well Inventory Data

On the attached Figure 3 we have plotted the locations of Ministry of Environment registered water wells located within 750m of the crossing site. Within the study area there are only three (3) MOE-registered wells listed as water supply wells. These are labeled on Figure 3 and the installation details are provided on Table 1. These three wells appear to lie within farm properties and all are located within 500m of the crossing.

The three listed wells are domestic water supply wells drilled between 1987 and 2004, ranging in depth from 9.4m to 19.8m. Well 1908852 appears to be screened in bedrock while the other two are screened in sand layers in overburden. The reported static water level ranged from Elev. 90.6m to 100.4m.

There may be additional (unregistered) wells located within the study area. A mailed questionnaire and door-to-door inventory would be required to establish whether or not additional wells exist.

5. INTERPRETATION OF GROUND AND GROUNDWATER CONDITIONS

5.1 General

As is evident from the surficial geology map provided in Figure 1, the road/rail crossing will transect a varied and complex geologic terrain. The soil types anticipated to be encountered have wide ranging compressibility and load bearing properties that range from favorable (hard clayey silt glacial tills; dense to very dense sandy silt glacial tills; shale bedrock) to unfavourable (laminated, firm glaciolacustrine silts/clays).

The groundwater table is expected to be very high across the study area, lying typically about one metre or less below existing grade. The hydraulic conductivity (permeability) of the subsoils is also expected to be extremely variable across the study area, ranging from clay soils of extremely low
permeability to silty glacial tills of intermediate permeability, to sands of moderately high permeability. As such, groundwater control will be required in excavations and trenches. An underpass alternative would likely require the construction of and permanent operation of a subdrainage system and associated pumping station.

There is a low probability that bedrock will be encountered within excavations for the project, including the road-under-rail alternative. The available data suggests that the bedrock elevation lies between elev. 91m and 94m in this part of Whitby.

*The above issues reinforce the need for advancing a pattern of very closely spaced boreholes (say 50m c/c) as part of the detailed design phase work at this site.*

### 5.2 At-Grade Crossing Alternative

This alternative involves no grade separation structures; however, a 3m to 5m high grade raise is required to bring New Coronation Road grade up to the rail grade at the crossing site. This filling will extend several hundred metres beyond the crossing site, both to the north and south.

On the basis of the SPL BH 11-4 and 11-5 data, where glacial till soils predominate, no global stability or major settlement issues are anticipated for grade raises of this magnitude. Settlements should be less than 30mm, the majority of which will occur during the construction period.

It is possible, however, based on the regional geologic mapping and SPL BH RRS2, that further south of the crossing, glaciolacustrine soils may be present, with properties which are much less favourable than the overconsolidated till soils north of the crossing. Depending on the required filling height above existing grade, areas underlain by soils representative of BH RRS2 would have acceptable global stability for embankments with 2:1V side slopes but are expected to undergo settlements in the 60mm to 90mm range. Preloading and surcharging of the embankment fills would be needed to mitigate the magnitude of post-construction settlements in such areas. Oedometer testing is necessary to more precisely predict the magnitude and duration of settlements.

This alternative has the fewest geotechnical issues and presents no hydrogeological impacts.

### 5.3 Road-Over-Rail Grade-Separated Crossing Alternative

Given the anticipated structure span, it is likely that deep foundation elements will be needed to support the bridge abutments. Integral abutments would typically be supported on driven steel H-piles such as HP310 by 110 sections, driven to refusal on shale bedrock, which is believed to lie at about elevation 91m plus or minus 3m. There would be some downdrag forces on these piles owing to
settlement of the native soils beneath the approach fills. Non-integral abutments could, alternatively be supported on caissons augered into sound shale. Caissons would require full linings to maintain the bores open and stable prior to concrete placement. Care and monitoring for the presence of combustible gas in the shale and the overburden are needed when advancing the caissons. Augering in the stoney silty/sandy glacial tills will be slow and labored. Cobbles and boulders will be encountered.

High approach fills, estimated to be 13m in height above existing grade and extending some 250m north and south of the rail crossing are required for this option. Settlement of the fills themselves, in addition to settlement of the subgrade below will occur under this imposed pressure. Settlement of the cohesionless glacial till deposits such as were found in BH 11-5 would be fairly rapid (elastic) with minimal post-construction settlement. The very stiff to hard cohesive glacial till deposits such as found in BH11-4 might undergo 50mm of settlement, the duration of which might lag completion of the roadway.

Of greater importance, as discussed in the foregoing Section 5.2, would be areas of the site underlain by glaciolacustrine clays similar to those encountered within BH RRS2, south of the crossing. Depending on the fill heights placed over such soils, significantly greater settlements, exceeding 100mm could be experienced and the global embankment stability would require more detailed analysis. Preloading and surcharges would likely be needed in such scenario.

Detailed design-phase geotechnical investigation borings, laboratory testing and analyses are required to make more in-depth design and construction recommendations.

5.4 Road-Under-Rail Grade-Separated Crossing Alternative

In this alternative, CP Rail is carried over a depressed New Coronation Road. The roadway grade will be cut down a maximum of about 7m below the existing track grade.

The rail bridge and retaining walls could be caisson-supported, with caissons socketed into sound shale and designed for SLS resistances on the order of 4MPa and factored ULS resistances of about 6 MPa. Rock coring would be needed as part of detailed design phase investigation work to confirm this capacity. The caisson bores will encounter hard drilling conditions, labored augering as well as frequent cobbles and occasional boulders.

The depressed roadway would lie some 6m below the groundwater table at its deepest point. As such, a series of closely spaced subdrains would be required below the roadway, discharging to a deep sewer or to a small pumping station if no deep sewer exists. Operation of a pump would trigger the need for an MOE Permit to Take Water for this drainage system. There would be a local and
permanent lowering of the groundwater table in the vicinity of the grade separation. The radius of
influence of the groundwater lowering might be on the order of 200m. The potential for interference
to registered water wells is thus low to moderate. More detailed hydrogeologic testing is needed to
better predict the drawdown radius.

The cut slopes would be stable in very stiff or hard cohesive glacial till soils at inclinations of 2H:1V.
Flatter cut slopes may be required in non-cohesive glacial tills and weak glaciolacustrine clay soils. To
mitigate the potential for sloughing and erosion of the cut slopes, rip rap sheeting will be required to
be placed on the slope face. Where coarser lenses or layers of sand exist, there may be a need for
localized counterfort drains cut into the face of the bank.

Despite the presence of subdrains at the base of the depressed roadway cut, the cohesionless
silty/sandy glacial tills may perform poorly as subgrade material. They may be prone to dilation
(loosening) and will lose considerable strength once unconfined and subjected to traffic vibration.
Frost heave will also be problematic in such soils. A very thick pavement structure will be required.

If the underpass excavation encounters zones of weak glaciolacustrine soils, the granular road base will
require substantial thickening and/or use of geogrid reinforcement.

Subgrade performance on very stiff to hard clayey silt till will be more favorable and no special
measures are expected to be required.

The rail-over-road alternative, based on the data available at this time, appears to the most
gotechnically complex option. Temporary construction dewatering and permanent groundwater
lowering are required for this option. Permanent operation of a small pumping station is needed to
pump subdrainage water to a sewer at higher level. There is a small probability for third party water
well interference due to operation of the subdrainage system. The long-term performance and
maintenance of the roadway pavements within the depressed grade separation are expected to be less
favorable relative to an overpass option owing to greater frost heave potential and loss of subgrade
strength due to dilation of silty subgrade material. A heavier-than-standard pavement section is
required.
6. CLOSURE

Thank you for the opportunity to prepare this report. Should you have any questions, please do not hesitate to contact this office.

SPL Consultants Limited

Prepared by:
Scott Peaker, M.A.Sc., P.Eng.

Reviewed by:
Ivan Lieszkowsky, FEIC, P.Eng.

Attach: Figures 1 to 3
Drawing Nos. 1 and 2
Table 1
Logs of Boreholes
DESKTOP STUDY CP RAIL CROSSING AT RE-ALIGNED CORONATION RD, WHITBY, ON

Client: Hatch Mott MacDonald
Project No: 10000391
Figure No: 1
Title: SURFICIAL GEOLOGY

Drawn: NS
Approved: SP
Date: May 2014
Scale: As shown
Original Size: Tabloid
Rev: 0

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community


Stream

MOE Water Wells

Legend:
- Subject Site
- 500m Zone
- Stream
- MOE Water Wells

- 9c - Coarse-textured glaciolacustrine deposits: sand, gravel, minor silt & clay
- 19 - Modern alluvial deposits: clay, silt, sand, gravel
- 8a - Fine-textured glaciolacustrine massive to well laminated deposits: silt & clay, minor sand & gravel
- 8b - Fine-textured glaciolacustrine deposits: interbedded silt & clay and gritty, pebbly flow till & rainout deposits
- 5b - Stone-poor, sandy silt to silty sand-textured till
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# LOG OF BOREHOLE BH11-4

**PROJECT:** Master Study - Water & Wastewater Servicing  
**CLIENT:** The Municipal Infrastructure Group Ltd.  
**PROJECT LOCATION:** West Whitby Development Area - Region of Durham  
**DATUM:** Geodetic  
**BH LOCATION:** See BH location plan N 4861980.259 E 661810.4153  

### DRILLING DATA
- **Method:** Solid Stem Augers  
- **Diameter:** 115mm  
- **Date:** Jan 25, 2012  
- **REF. NO.:** 539-1001  
- **ENCL. NO.:** C4

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<td>98.7</td>
<td>CLAYEY SILT TILL: sandy, some gravel, grey, moist, very stiff to hard.</td>
<td>SS 16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>300mm silty sand at 3.9m</td>
<td>SS 27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sand</td>
<td>SS 48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Screen</td>
<td>SS 45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>92.5</td>
<td>SS 60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>91.0</td>
<td>SS 35</td>
<td></td>
</tr>
</tbody>
</table>

### DYNAMIC CONE PENETRATION RESISTANCE PLOT
- **SHEAR STRENGTH (kPa):**  
  - **UNCONFINED:**  
  - **FIELD VANE:** & Sensitivity  
  - **QUICK TRIAXIAL:**  
  - **LAB VANE**  
- **WATER CONTENT (%):**  
  - 10  
  - 20  
  - 30  
- **GRAIN SIZE DISTRIBUTION (%):**  
  - **GR**  
  - **SA**  
  - **SI**  
  - **CL**

### END OF BOREHOLE
- **Notes:**  
  1) 50mm dia. monitoring well installed.  
  Water Level Readings:  
  - **Date:** Dec 28/11  
  - **W. L., Depth (m):** 0.17m

**GROUNDWATER ELEVATIONS**
- **Measurement:** V, V, V, V

**NOTES:** **x 3**, Numbers refer to Sensitivity  
- **x 3**  
- **6 = 3%** Strain at Failure
**LOG OF BOREHOLE BH11-5**

**PROJECT:** Master Study - Water & Wastewater Servicing  
**CLIENT:** The Municipal Infrastructure Group Ltd.  
**PROJECT LOCATION:** West Whitby Development Area - Region of Durham  
**DATUM:** Geodetic  
**BH LOCATION:** See BH location plan N 4662578.108 E 661605.6645

---

**SOIL PROFILE**

<table>
<thead>
<tr>
<th>ELEV</th>
<th>DESCRIPTION</th>
<th>STRATA PLOT</th>
<th>SAMPLES</th>
<th>DYNAMIC CONE PENETRATION RESISTANCE PLOT</th>
<th>SHEAR STRENGTH (kPa)</th>
<th>REMARKS AND GRAIN SIZE DISTRIBUTION (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102.3</td>
<td>TOPSOIL: 330mm</td>
<td>1 SS 3</td>
<td></td>
<td>Casing 100</td>
<td>0</td>
<td>GR 6 54 33 7</td>
</tr>
<tr>
<td>101.0</td>
<td>FILL: silty sand to clayey silt, trace rootlets, trace topsoil, brown, moist, very loose.</td>
<td>2 SS 11</td>
<td>101 101.9 Hole plug</td>
<td>0</td>
<td>100.9 m Dec 28, 2011</td>
<td></td>
</tr>
<tr>
<td>100.9</td>
<td>CLAYEY SILT TO SILTY CLAY: trace gravel, occ. sand seams, brownish grey, very moist, stiff to very stiff.</td>
<td>3 SS 18</td>
<td>0.9</td>
<td>100.9 m Dec 28, 2011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100.6</td>
<td>SANDY SILT TILL: trace to some clay, trace gravel, trace to some rock fragments, moist, compact to dense.</td>
<td>4 SS 32</td>
<td>0 99</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100.3</td>
<td></td>
<td></td>
<td>0 99</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97.7</td>
<td>SILTY SAND TILL: trace clay, trace gravel and rock fragments, grey, moist, dense.</td>
<td>5 SS 19</td>
<td>97 99</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>96.2</td>
<td></td>
<td></td>
<td>97 99</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.1</td>
<td>SANDY SILT TILL: trace gravel and rock fragments, trace to some clay, dark grey, moist, very dense.</td>
<td>8 SS 55</td>
<td>0</td>
<td>8.1 8.6</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>8.1</td>
<td></td>
<td></td>
<td>95 99</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>94.6</td>
<td>CLAYEY SILT TILL: sandy, trace gravel and shale fragments, occ. sand seams, grey, wet, hard.</td>
<td>9 SS 55</td>
<td>94.6</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**END OF BOREHOLE**

Notes:  
1) 50mm dia. monitoring well installed.  
2) Water Level Readings: Date: W, L, Depth (m) Dec 28/11 1.40m

---

**GROUNDWATER ELEVATIONS**

Measurement:  
- **+** 5, **×** 3, Numbers refer to Sensitivity  
- **6-3%** Strain at Failure
<table>
<thead>
<tr>
<th>STRATA</th>
<th>DESCRIPTION</th>
<th>SAMPLES</th>
<th>SOIL PROFILE</th>
<th>DRILLING DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>99.0</td>
<td>ASPHALT: 125mm</td>
<td>1 SS 82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97.6</td>
<td>GRANULAR BASE: sand and gravel, some silt, brown, damp, very dense.</td>
<td>2 SS 51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>96.6</td>
<td>FILL: organic clayey silt, some sand pockets, trace rootlets, black, moist to firm. (topsoil like)</td>
<td>3 SS 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>93.3</td>
<td>SILTY CLAY: trace sand, trace gravel, laminated, brown to brownish grey, moist to wet, very soft to firm.</td>
<td>4 SS 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>92.3</td>
<td></td>
<td>5 SS 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>91.7</td>
<td></td>
<td>6 SS 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90.7</td>
<td></td>
<td>7 SS 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90.1</td>
<td>CLAYEY Silt TILL: some sand, trace to some gravel and shake fragments, dark grey to grey, moist, very stiff.</td>
<td>9 SS 29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>89.7</td>
<td></td>
<td>10 SS 50/50mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SOIL PROFILE**

**SAMPLES**

**DRILLING DATA**

- Method: Stem Augers
- Diameter: 115mm
- Ref. No.: 539-1001
- Date: Oct/12/2011
- Encl. No.: 87
## LOG OF BOREHOLE RRS2

**PROJECT:** Master Study - Water & Wastewater Servicing  
**CLIENT:** The Municipal Infrastructure Group Ltd.  
**PROJECT LOCATION:** West Whitby Development Area - Region of Durham  
**DATUM:** Geodetic  
**BH LOCATION:** See BH location plan N 4961562.007 E 662088.9334  
**METHOD:** Solid Stem Augers  
**DATE:** Oct/12/2011  
**REF. NO.:** 530-1001  
**ENCL NO.:** B7

### SOIL PROFILE

<table>
<thead>
<tr>
<th>ELEV (m)</th>
<th>DESCRIPTION</th>
<th>STRATA PLOT</th>
<th>STRATA NO.</th>
<th>MOISTURE CONTENT</th>
<th>PLASTIC LIMIT</th>
<th>LIQUID LIMIT</th>
<th>DYNAMIC CONE PENETRATION RESISTANCE PLOT</th>
<th>SHEAR STRENGTH (kPa)</th>
<th>REMARKS AND GRAIN SIZE DISTRIBUTION (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>86.2</td>
<td>SILTY SAND TILL: trace to some clay, trace gravel, grey, saturated, very dense. (Continued)</td>
<td>97</td>
<td>1</td>
<td>Screen</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.7</td>
<td>CLAYEY SILT TILL: some sand to sandy, trace to some gravel, grey, moist, hard.</td>
<td>62</td>
<td>11</td>
<td>88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>spoon bounding</td>
</tr>
<tr>
<td>87.7</td>
<td>CLAYEY SILT TILL/SHALE COMPLEX: some sand to sandy, some gravel and shale fragments, grey to dark grey, moist, hard.</td>
<td>87</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>88.7</td>
<td>WITISTY FORMATION: shale occasionally with shaly limestone, grey to black.</td>
<td>85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**END OF BOREHOLE**

**NOTES:**
1) 50mm dia monitoring well installed.  
2) Water Level Readings:  
   Date: W. L. Depth (m)  
   Dec. 29/11 Freeze  
   Feb. 01/12 0.57

---

**GROUNDWATER ELEVATIONS**

Shallow/singe Installation  
Deep/Dual installation  

**GRAPH NOTES**

+3 x3 Numbers refer to Sensitivity  
O =< 3% Strain at Failure
LOG OF BOREHOLE OGS831933

PROJECT: Master Study - Water & Wastewater Servicing
CLIENT: The Municipal Infrastructure Group Ltd.
PROJECT LOCATION: West Whitby Development Area - Region of Durham
DATUM: Geodetic
BH LOCATION: N 4861760 E 681719

DRILLING DATA
Method: done in 1993
Diameter:
Date:
REF. NO.: 539-1001
ENCL NO.: 

SOIL PROFILE

<table>
<thead>
<tr>
<th>ELEV (m)</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>till, silt, sand, gravel, very dense</td>
</tr>
<tr>
<td>4.4</td>
<td>clay, sand, silt, stiff</td>
</tr>
<tr>
<td>9.6</td>
<td>till, silt, sand, gravel, very stiff</td>
</tr>
<tr>
<td>10.4</td>
<td>sand, shale, silt, very dense</td>
</tr>
<tr>
<td>11.4</td>
<td>Whitby Formation: shale occasionally with shaly limestone, grey to black</td>
</tr>
<tr>
<td>12.3</td>
<td>END OF BOREHOLE</td>
</tr>
</tbody>
</table>

END OF BOREHOLE
Notes:
1) Borehole drilled in 1993, water level at 5.1m in record.
2) Geotechnical Borehole record downloaded from Google Earth-Ontario Geological Survey. Each well provides information on the Geological Stratum identified down hole as well as the depths.
3) This database should not be relied on as a precise indicator of borehole locations.

GROUNDWATER ELEVATIONS
Measurement

GRAPH NOTES
+33 < 33: Numbers refer to Sensitivity
63: Strain at Failure
PROJECT: Master Study - Water & Wastewater Servicing
CLIENT: The Municipal Infrastructure Group Ltd.
PROJECT LOCATION: West Whitby Development Area - Region of Durham
DATUM: Geodetic
BH LOCATION: N 4862059 E 661624

SOIL PROFILE

<table>
<thead>
<tr>
<th>(m) ELEV.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>till, silt, sand, gravel, very stiff</td>
</tr>
<tr>
<td>0.7</td>
<td>silt, sand, compact</td>
</tr>
<tr>
<td>5.3</td>
<td>till, silt, sand, gravel, very stiff</td>
</tr>
<tr>
<td>10.2</td>
<td>Whitby Formation: shale occasionally with shaly limestone, grey to black</td>
</tr>
<tr>
<td>11.1</td>
<td>End of Borehole</td>
</tr>
</tbody>
</table>

Notes:
1) Borehole drilled in 1993, water level at 0.7 m in record.
2) Geotechnical Borehole record downloaded from Google Earth-Ontario Geological Survey. Each well provides information on the Geological Stratum identified down hole as well as the depths.
3) This database should not be relied on as a precise indicator of borehole locations.

DRILLING DATA
Method: done in 1993
Diameter: 
Date: 
REF. NO.: 538-1001
ENCL NO.: 

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL