Appendix B.7
Geotechnical
Hamilton Rapid Transit
Preliminary Design and Feasibility Study

B-LINE

GEOTECHNICAL DESIGN BRIEF
Version:1.0
Hamilton Rapid Transit Preliminary Design and Feasibility Study

B-LINE

GEOTECHNICAL DESIGN BRIEF
Version: 1.0

September 2011
# Table of Contents

1.0 INTRODUCTION

2.0 PROJECT DESCRIPTION

3.0 PHYSIOGRAPHIC AND GEOLOGIC SETTING

4.0 SUMMARY OF GEOTECHNICAL CONDITIONS

## 4.1 MAIN STREET WEST

### 4.1.1 EXISTING PAVEMENT STRUCTURE

### 4.1.2 FILL

### 4.1.3 NATIVE SOILS

### 4.1.4 GROUNDWATER

## 4.2 HIGHWAY 403 CROSSING

### 4.2.1 FILL

### 4.2.2 NATIVE SOILS

### 4.2.3 BEDROCK

### 4.2.4 GROUNDWATER

## 4.3 KING STREET WEST

### 4.3.1 EXISTING PAVEMENT STRUCTURE

### 4.3.2 FILL

### 4.3.3 NATIVE SOILS

### 4.3.4 BEDROCK

### 4.3.5 GROUNDWATER

## 4.4 KING STREET EAST

### 4.4.1 EXISTING PAVEMENT STRUCTURE

### 4.4.2 FILL

### 4.4.3 NATIVE SOILS

### 4.4.4 GROUNDWATER

## 4.5 MAIN STREET EAST

### 4.5.1 EXISTING PAVEMENT STRUCTURE

### 4.5.2 FILL

### 4.5.3 NATIVE SOILS

### 4.5.4 GROUNDWATER

## 4.6 QUEENSTON ROAD

### 4.6.1 EXISTING PAVEMENT STRUCTURE

### 4.6.2 FILL
Geotechnical Evaluation and Preliminary Recommendations

5.0 GEOTECHNICAL EVALUATION AND PRELIMINARY RECOMMENDATIONS ..........11
5.1 TRACK BED DESIGN ..................................................................................11
5.2 STOP FOUNDATIONS ................................................................................13
5.3 CATENARY POLE FOUNDATIONS ...............................................................14
5.4 HIGHWAY 403 STRUCTURE FOUNDATIONS .................................................14
5.5 RELOCATION OF UNDERGROUND UTILITIES .............................................14
5.5.1 TRENCH EXCAVATION .........................................................................14
5.5.2 PIPE BEDDING AND BACKFILL .............................................................15
5.6 PAVEMENT RESTORATION ........................................................................15
5.7 ENVIRONMENTAL CONSIDERATIONS .......................................................16
5.8 RECOMMENDATIONS FOR FURTHER INVESTIGATION ..............................16

APENDIX A: SUMMARY OF AVAILABLE BOREHOLES
APENDIX B: RECORD OF BOREHOLE SHEETS
APENDIX C: BOREHOLE LOCATION PLANS AND INFERRED STRATIGRAPHIC PROFILE
APENDIX D: STATEMENT OF GENERAL CONDITIONS
1.0 Introduction

The City of Hamilton is working to implement rapid transit, with a long-term vision encompassing five corridors across the City. At present, the focus is on the undertaking of the Environmental Assessment and Preliminary Design of a Light Rail Transit (LRT) system along the B-Line corridor, following Main Street, King Street and Queenston Road between McMaster University and Eastgate Square. As part of the implementation process, a preliminary review of the geotechnical conditions along the B-Line corridor has been carried out by Thurber Engineering Ltd., a sub-consultant of SNC-Lavalin Inc. SNC-Lavalin Inc. is the prime sub-consultant for the Engineering and Environmental Assessment to Steer Davies Gleave (SDG), the prime consultant to the City of Hamilton.

This report presents a summary of the anticipated geotechnical conditions along the B-Line corridor, based on published geologic data and review of existing geotechnical information obtained from the City of Hamilton. Based on the available information, preliminary recommendations regarding track bed design, platform foundations, bridge structures and other associated facilities are provided.

The evaluations and conclusions contained in this report are based on available existing information given to Thurber Engineering Ltd. The conditions of the validity of the Geotechnical Review, as well as the preliminary geotechnical recommendations for the B-Line alignment are as per the General Statement of Conditions shown in Appendix D.

2.0 Project Description

The subject section of the B-Line corridor extends from McMaster University at the west limit to Eastgate Square at the east limit, a distance of 14 km. In general, the LRT line will follow existing roadways, as follows:

- Within the McMaster University campus to Main Street West (0.6 km)
- Main Street West from McMaster Medical Centre to the bridge over Highway 403 (1.3 km)
- The Bridge over Highway 403 (0.9 km)
- King Street West from bridge over Highway 403 to James Street (1.9 km)
- King Street East from James Street to Main Street East (4.1 km)
- Main Street East from King Street East to Queenston Road (2.0 km)
- Queenston Road from Main Street East to Eastgate Square (3.2 km)

The section of corridor within the McMaster campus is not included in this report as no geotechnical information of the campus was provided at the time of writing this assessment. The preliminary alignment is shown in Figure 2.1, and will be addressed in the next design phase.

The line required to access a maintenance and storage depot will be assessed separately once a site is chosen in the next design phase.

The LRT will cross Highway 403 and the Red Hill Valley Parkway, which are situated within valleys below the level of the adjacent table lands. Construction of an elevated guideway structure is currently being considered to carry the LRT over the Highway 403 interchange and transition between Main Street West and King Street West. The LRT will cross over the Red Hill Valley Parkway on the existing Queenston Road Bridge.
Figure 2.1: Preliminary Configuration at McMaster University
At present, 18 stop platforms are proposed, at the following locations:

<table>
<thead>
<tr>
<th>Stop No</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>McMaster University</td>
</tr>
<tr>
<td>2</td>
<td>McMaster Medical Centre</td>
</tr>
<tr>
<td>3</td>
<td>Longwood</td>
</tr>
<tr>
<td>4</td>
<td>Dundurn</td>
</tr>
<tr>
<td>5</td>
<td>Queen</td>
</tr>
<tr>
<td>6</td>
<td>MacNab</td>
</tr>
<tr>
<td>7</td>
<td>Walnut</td>
</tr>
<tr>
<td>8</td>
<td>First Place</td>
</tr>
<tr>
<td>9</td>
<td>Wentworth</td>
</tr>
<tr>
<td>10</td>
<td>Sherman</td>
</tr>
<tr>
<td>11</td>
<td>Scott Park</td>
</tr>
<tr>
<td>12</td>
<td>Delta</td>
</tr>
<tr>
<td>13</td>
<td>Ottawa</td>
</tr>
<tr>
<td>14</td>
<td>Kenilworth</td>
</tr>
<tr>
<td>15</td>
<td>Stratheame</td>
</tr>
<tr>
<td>16</td>
<td>Parkdale</td>
</tr>
<tr>
<td>17</td>
<td>Nash</td>
</tr>
<tr>
<td>18</td>
<td>Eastgate</td>
</tr>
</tbody>
</table>

### 3.0 Physiographic and Geologic Setting

The proposed LRT B-Line alignment is situated on the Iroquois Plain physiographic region, bordered on the north by Lake Ontario and on the south by the Niagara Escarpment. The region consists of a lowland formerly inundated by glacial Lake Iroquois.

The near surface soils generally consist of lacustrine sands and silts deposited on the former lakebed. Locally between approximately Highway 403 and James Street, the alignment crosses a deposit of partially cemented gravel deposited as a beach along the former lake shoreline. The sand and gravel are generally underlain by silty clay to clayey silt till of the Halton Till formation. East of Ottawa Street, the sand is less prevalent and the near surface soils typically consist of the Halton Till.

Red shale bedrock of the Queenston Formation underlies the entire corridor. The shale is anticipated at depths in approximately the order of 20 to 25 m between the McMaster Medical Centre and Dundurn Street, increasing to approximately 30 m in the vicinity of Queen Street atop the gravel bar, then decreasing towards the east to less than 4 m depth between Ottawa Street and the Red Hill Valley. The depth to bedrock increases to 10 to 15 m east of the Red Hill Valley.
4.0 Summary of Geotechnical Conditions

Existing borehole data from the vicinity of the B-Line corridor was provided by the City of Hamilton to establish the geotechnical conditions pertinent to design of the LRT track bed and associated facilities. A listing of the boreholes reviewed and considered applicable to the LRT assignment is provided in Table A1, Appendix A. The borehole logs are reproduced in Appendix B.

A Borehole Plan and Stratigraphic Profile along the corridor, showing the approximate locations of the boreholes and the generalized soil stratigraphy derived from the existing subsurface data, is provided on Sheets 1 to 17, in Appendix C.

Based on the existing borehole data, a generalized description of the subsurface conditions along each section of the corridor is presented below. The available information is suitable only for preliminary planning purposes and is not considered adequate for detailed design of the facilities.

It should be recognized that soil conditions may vary between and beyond the borehole locations. The pavement types/thicknesses and subgrade conditions, summarized below are based on a limited number of boreholes previously drilled at selected locations during earlier geotechnical investigations. The data does not necessarily reflect the conditions along all sections of the LRT alignment, and conditions may vary both along the alignment and across the width of the roadway. Further, the current pavement structure and subgrade may differ from that encountered in the boreholes, due to subsequent utility installation and roadway reconstruction or rehabilitation carried out after drilling of the boreholes. Additional site specific investigation will be required at the next design phase to confirm and further define the current conditions along the alignment and at facility locations.

In general, the subsurface stratigraphy encountered along the corridor consists of a surficial pavement structure and/or fill layer, overlying sands, silts and clays in the western sections (McMaster Medical Centre to Highway 403), sands in the central areas, and silty clay till in the eastern sections (east of Sherman Avenue). More detailed descriptions of the individual strata are provided below.

4.1 Main Street West

4.1.1 Existing Pavement Structure

The pavement structure encountered in boreholes drilled on Main Street West between McMaster University and Highway 403 typically comprised of a composite structure with 125 to 150 mm of asphalt over 125 to 250 mm of concrete, placed directly on the subgrade or on 25 to 150 mm of sand and gravel. A flexible structure was documented in two boreholes, consisting of 250 mm of asphalt over 200 mm of sand and gravel, and 190 mm of asphalt placed directly on the subgrade.

4.1.2 Fill

Fill was encountered surficially or below the pavement structure in 14 of 21 boreholes reviewed in this section. The fill typically consisted of silty sand to sandy silt adjacent to McMaster Medical Centre and clayey silt to silty clay in the remainder of the section. The fill thickness generally ranged from 1.1 to 2.9 m with a lower boundary at depths of 1.1 to 3.1 m.

SPT N-values in the fill ranged from 1 to 17 blows/0.3 m (very loose to compact) in the cohesionless sand/silt and from 11 to 23 blows/0.3 m (stiff to very stiff) in the cohesive silt/clay. Moisture contents varied from 18 to 28%.

4.1.3 Native Soils

The native deposits underlying the pavement structure and fill in the area of Main Street West generally consist of interbedded silts, sands and clays. Locally in the central part of this section, a layer of coarse sand to sand and gravel was encountered within or below these deposits. The boreholes were terminated at depths of 2.3 to 9.6 m, 23.3 m in one borehole.
Along the west half of this section, the upper 2 to 3 m of the silt/sand/clay was very loose to compact/ﬁrm to very stiff, with SPT N-values ranging from 3 to 21 blows/0.3 m. Towards the east end, the loose to compact conditions (N-values of 9 to 25) extended to 5.2 m depth. Where exploration was extended below this level, these deposits became compact to very dense with N-values of 26 to 66 blows/0.3 m.

In the central area, clayey silt was predominant. The clayey silt was described as soft to stiff, however SPT N-values were not recorded.

Moisture contents ranged from 3 to 30%.

4.1.4 Groundwater

Piezometers were installed in ﬁve boreholes drilled along this section of the LRT. The depth to groundwater measured in the piezometers ranged from 1.9 to 7.2 m (Elev. 92.2 to 96.6 m). In addition, the soils were described as very wet to saturated below 5.5 and 5.8 m depth (Elev. 93.8 m) in two boreholes at the west end of the section, and the clayey silt in the central area was described as wet at various depths.

4.2 Highway 403 Crossing

4.2.1 Fill

The ravine through which Highway 403 was constructed was formerly used as a city landfill, and relatively thick deposits of ﬁll consisting of sand, ashes, cinders, domestic refuse, wood and foundry sand were encountered in nearly all boreholes drilled in this area. A clay cap appears to be present over the ﬁll on the east side of the ravine. The ﬁll extends to depths of 0.9 to 11.6 m (Elev. 74.8 to 85.9 m).

SPT N-values recorded in the ﬁll ranged from 3 to 37 blows/0.3 m. Moisture contents ranged from 6 to 61%.

4.2.2 Native Soils

The native soil in the Highway 403 ravine generally consisted of alluvial deposits overlying a relatively thick layer of silty clay.

The alluvial deposits primarily consisted of silty clay with organics and occasional sand, gravel, wood and peat were encountered below the ﬁll or surficially in eight boreholes drilled within the Highway 403 valley. These deposits were 2.1 to 10.7 m thick. SPT N-values of 1 to 10 blows/0.3 m were recorded in the alluvial material, indicating a very soft to stiff consistency. Moisture contents ranged from 21 to 45%.

At four locations on the east side of the valley, a 1.6 to 4.3 m thick layer of sand and silt was encountered surficially or below the ﬁll. SPT N-values in this layer ranged from 4 to 17 blows/0.3 m (loose to compact), and moisture contents ranged from 7 to 21%.

The underlying silty clay layer was 5.2 to 19.8 m thick and was encountered below the ﬁll and alluvial deposits in all but one borehole. SPT N-values in the silty clay varied widely from about 6 to 40 blows/0.3 m (ﬁrm to hard) with several values of up to 90 blows/0.3 m, possibly indicating the presence of cobbles or shale fragments. Moisture contents ranged from 12 to 32%, typically about 16 to 24%.

4.2.3 Bedrock

Shale bedrock was contacted below the silty clay at depths of 16.2 to 27.5 m in all but two boreholes. The bedrock surface generally rises towards the east, from Elevation 57.0 m at the Main Street/Highway 403 structure to Elevation 75.2 m at the King Street connection.

4.2.4 Groundwater

The depth to groundwater measured in eight boreholes ranged from 1.2 to 19.5 m. The groundwater level varied from Elevation 64.6 to 83.1 m, typically Elevation 79.8 to 81.5 m.
4.3 King Street West

4.3.1 Existing Pavement Structure

In boreholes drilled between Bay and MacNab Streets, a composite structure consisting of 430 to 550 mm of asphalt over concrete combined, placed directly over the subgrade. The component asphalt and concrete thicknesses were not defined.

4.3.2 Fill

Fill was encountered to depths of 1.5 to 4.9 m in 8 of 19 boreholes reviewed along the King Street West section. The fill typically consisted of sand. Demolition debris with sand, gravel and ashes, apparently used to backfill former building basements, was in several boreholes located between Bay and MacNab Streets.

SPT N-values recorded in the fill ranged from 2 to 25 blows/0.3 m, indicating a very loose to compact condition. Moisture contents ranged from 9 to 21%.

4.3.3 Native Soils

The pavement structure and fill in this section is underlain primarily by silty fine-grained to fine to medium-grained sand, overlying a layer of coarser sand and gravel. Towards the west end of this section (west of Strathcona Avenue), the sand is overlain or interbedded with silts and clays, similar to the stratigraphy documented to the west of Highway 403. Silty clay to silty clay/clayey silt till was encountered below the sand and gravel in several deeper boreholes drilled near the east end of this section.

The interbedded clays, sands and silts encountered near the west end of the section extended to depths of 3.9 to 6.7 m. SPT N-values in these deposits ranged from 4 to 5 blows/0.3m in the non-cohesive sands/silts, and from 7 to 15 blows/0.3 m (firm to stiff) in the cohesive clays/silts. Moisture contents of 12 to 25% were measured in the sands/silts and 19 to 29% in the clayey silts/clays.

The predominant silty fine-grained to fine to medium-grained sand layer ranged in thickness from 1.2 m to greater than 5.5 m. In general, the sand is very loose to compact (N-values of 2 to 28 blows/0.3 m) with dense to very dense zones. Moisture contents varied from 2 to 21%.

The coarser sand and gravel layer underlying the fine to medium-grained sand was typically dense to very dense with SPT N-values ranging from 31 to greater than 100 blows/0.3 m. Compact zones with N-values of 10 to 30 blows/0.3 m were also present. Moisture contents varied from 3 to 24%, with the higher values measured in samples obtained from below the groundwater level. The majority of the boreholes were terminated in the sand and gravel layer. Where defined, this layer was 3.8 to 5.6 m thick.

Silty clay to silty clay/clayey silt till was encountered below the sand and gravel at 13.7 m depth in one borehole near the west end of this section and at 9.5 to 10.1 m depth in four boreholes near the east limit. The clay/silt layer was 8.5 m thick at the west location and extended below the maximum exploration depth of 29.9 m in the east boreholes. SPT N-values varied from 8 to 90 blows/0.3 m (stiff the hard) and moisture contents ranged from 11 to 28%. Moisture contents ranged from 9 to 14%.

4.3.4 Bedrock

Shale bedrock was contacted in one borehole located near the west limit of this section. The bedrock surface was at 22.2 m depth (Elev. 76.8 m).

4.3.5 Groundwater

Groundwater was observed in three boreholes and measured in two piezometers at depths of 7.1 to 10.8 m (Elev. 88.2 to 91.2 m). This water was generally encountered within the sand and gravel above the underlying silty clay. Water was also observed at 1.6 to 2.9 m depth in two boreholes, perched in the layered clays, silts and sands at the west end of the section and within fill at the east end.
4.4 King Street East

4.4.1 Existing Pavement Structure

The existing pavement structure varied between a flexible and composite design. The flexible structure consisted of 150 to 200 mm of asphalt over 250 to 860 mm of sand and gravel. The composite structure consisted of 100 to 150 mm of asphalt over 150 to 380 mm of concrete placed directly on the subgrade or on 150 mm of sand and gravel.

4.4.2 Fill

Fill was encountered to depths of 0.8 to 3.4 m in 14 of 23 boreholes reviewed along the King Street East section. The fill typically consisted of silty sand to sandy silt. SPT N-values recorded in the fill typically ranged from 4 to 18 blows/0.3 m, indicating a loose to compact condition. Moisture contents generally ranged from 8 to 20%.

4.4.3 Native Soils

A stratum of sands, silty sands and sandy silts was encountered below the pavement structure and fill in all boreholes located along King Street East between James Street and Wentworth Street. Where defined, the thickness of this layer ranged from 1.0 to 3.7 m. SPT N-values recorded in the sand/silt typically ranged from 4 to 35 blows/0.3 m, indicating a loose to dense condition. Very dense zones were encountered locally, as evidenced by N-values of up to 90 blows/0.3 m. Moisture contents varied from 5 to 30%, typically 10 to 16%.

Sand and gravel was encountered below the sand/silt in five boreholes located between James Street and Walnut Street. This layer was 1.8 to 4.5 m thick where the lower boundary was defined. The sand and gravel was compact to very dense with N-values of 27 to 60 blows/0.3 m. Moisture contents of 9 to 21% were measured.

The thickness of the sands/silts/gravel generally decreased towards the east from 8.5 m to 2.6 m, below which depth silty clay till was encountered. East of Sherman Avenue, the silty clay/till was encountered directly below the pavement structure and fill. SPT N-values in the clay till typically ranged from 10 to 28 blows/0.3 m, indicating a stiff to very stiff consistency. Moisture contents generally varied from 15 to 21%. The boreholes were terminated in the clay till where contacted.

4.4.4 Groundwater

Groundwater was measured at depths of 3.6 to 5.5 m (Elev. 82.1 to 89.6 m, rising to the west) in five boreholes drilled along this section. Perched water was also encountered locally in the surficial fill.

4.5 Main Street East

4.5.1 Existing Pavement Structure

No data was available on the existing pavement structure along Main Street East.

4.5.2 Fill

Fill was encountered to depths of 1.5 to 2.6 m in 3 of 6 boreholes reviewed along the Main Street East section. The fill typically consisted of silty clay/clayey silt. SPT N-values recorded in the fill ranged from 6 to 12 blows/0.3 m, indicating a firm to stiff condition. Moisture contents ranged from 7 to 22%.

4.5.3 Native Soils

The native soils in the vicinity of Main Street East generally comprised silty clay till locally overlain by an approximate 1.5 m thick layer of loose sandy silt to silty sand. The clay till was stiff to hard, typically very stiff, with SPT N-values ranging from 10 to 33 blows/0.3 m. N-values in excess of 100 were recorded at one location. Moisture contents ranged from 10 to 19%.
4.5.4 Groundwater
Groundwater was observed at 1.0 m depth in one borehole; this water appears to be perched in fill overlying clay till. Groundwater was not observed in the remaining boreholes.

4.6 Queenston Road

4.6.1 Existing Pavement Structure
In boreholes drilled between Parkdale Avenue and Adair Avenue, a composite structure consisting of 75 to 100 mm of asphalt over 165 to 255 mm of concrete was encountered directly over the subgrade or up to 255 mm of sand and gravel.

4.6.2 Fill
Fill was encountered in 4 of 9 boreholes reviewed along the Queenston Road section. The fill typically consisted of silty clay to clayey silt. The fill extended to depths of 4.2 and 1.0 m in single boreholes located to the west and east of the Red Hill Valley, respectively. Two boreholes drilled from the road embankment crossing the Red Hill Valley encountered fill to depths of 10.3 and 10.8 m (Elev. 81.2 and 81.8 m).

SPT N-values recorded in the fill typically ranged from 3 to 22 blows/0.3 m, indicating a soft to very stiff condition. Moisture contents generally ranged from 15 to 23%.

4.6.3 Native Soils
Silty clay/clayey silt till was encountered in three boreholes drilled on the table lands in this section. SPT N-values in the till ranged from 9 to 58 blows/0.3 m (stiff to hard). Moisture contents ranged from 12 to 20%.

In two boreholes located east of Parkdale Avenue, shale bedrock was contacted directly below the pavement structure and fill.

In four boreholes drilled either at the base of the Red Hill Creek Valley or through embankment fill crossing the valley, creek deposits comprising clayey silt, silty sand, and sand and gravel were encountered over bedrock. These deposits were 1.1 to 2.5 m thick.

4.6.4 Bedrock
Shale bedrock was contacted at depths of 0.3 to 4.2 m (Elev. 94.9 to 99.2 m) in three boreholes drilled just east of Parkdale Avenue. Within the Red Hill Creek Valley, shale was contacted at depths of 1.4 to 11.9 m (Elev. 80.1 to 81.0 m).

4.6.5 Groundwater
At the Red Hill Creek Valley, groundwater was measured at depths of 1.1 m below the valley base to 10.4 m below the Queenston Road embankment. The groundwater elevation was 81.1 to 82.8 m. Groundwater was not observed in the boreholes drilled on the table lands.
Hamilton LRT
Geotechnical Report

5.0 Geotechnical Evaluation and Preliminary Recommendations

This section provides preliminary geotechnical recommendations pertinent to track bed design, platform foundations, and bridge structures required for planning of the Hamilton LRT B-Line.

The recommendations are based on the subsurface soil and groundwater conditions documented in available information provided by the City of Hamilton, and are suitable only for preliminary planning purposes. The existing data and associated recommendations are not considered adequate for detailed design of the facilities. The soil conditions may vary between and beyond the borehole locations, and accordingly additional investigation will be required to confirm and define the conditions along the alignment and at specific facility locations.

5.1 Track Bed Design

Preliminary design of the typical cross sections for the LRT indicate that the minimum track design will consist of 200 mm of reinforced concrete (second pour) over approximately 250 mm thick slab of levelling concrete (first pour), placed over a minimum of 300 mm of compacted granular fill. The portions of the guideway cross-section outside the range of the tracks (approximately 2.2 m) will be filled with compacted Granular ’A’ fill (See Figure 1).

The thickness of the granular layers may be modified in the next design phase once the actual subgrade conditions are provided.

Based on the available borehole data, the native subgrade soils along the corridor, as per the sampled locations, are expected to consist predominantly of the following:

- interbedded sands, silts and clays along the western section (McMaster Medical Centre to approximate Strathcona Avenue);
- silty sand and fine to medium-grained sand in the central section (Strathcona Avenue to Sherman Avenue); and
- silty clay till along the east section (Sherman Avenue to Eastgate Square).

Throughout the alignment, fill materials are present as a result of past roadway construction, underground utility/service installation, and possible localized basement backfill. With the exception of the landfill in the Highway 403 ravine and embankment fill across the Red Hill Creek Valley, the fill encountered in the boreholes does not appear to be related to bulk filling operations for land and road development. Therefore the presence, thickness and quality of the fill can be expected to vary over short distances, and delineation of specific limits of fill over the length of the corridor is not possible from the available information.

Track bed subgrade preparation should include compaction and proofrolling of the exposed subgrade with a heavy roller and examination to identify any areas of unstable subgrade. Any soft/wet areas identified should be subexcavated and replaced with approved material within 2% of optimum moisture content and compacted to at least 98% of SPMDD.

Loose to very loose conditions were identified in the upper 1 to 2 m of the fill and native soil subgrade, primarily in the western half of the corridor. Allowance should be made for possible subexcavation and recompaction/replacement of some material below the track bed sub-ballast to improve the uniformity of support over these areas.

The silts in the interbedded deposits west of Highway 403 may be particularly susceptible to changes in moisture content, and a rolling, unstable subgrade may be encountered if construction is carried out during wet seasons or rainy periods. Subgrade preparation considerations should also include allowance for replacement of wet silts with imported granular material.

The compacted subgrade should be graded with a crossfall of 3% to promote drainage towards subdrains. Minimum 100 mm diameter perforated subdrains, placed in a clear stone trench wrapped with geotextile as per OPSD 216.021, should be installed below the edges of the track bed to provide drainage of the sub-ballast. The subdrains should have frost free outlets draining into catchbasin structures.
Provided the subgrade is properly prepared, the modulus of subgrade reaction recommended for preliminary design of the track slab along each section of the alignment are as follows:

Table 5.1: Track Slab Subgrade Modulus

<table>
<thead>
<tr>
<th>Stationing</th>
<th>Primary Subgrade Material</th>
<th>Modulus of Subgrade Reaction (MN/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0+000 to 3+000</td>
<td>Interbedded silts, sands and clays; loose to compact/ firm to very stiff</td>
<td>15</td>
</tr>
<tr>
<td>3+000 to 6+500</td>
<td>Silty/ fine to medium sand; very loose to compact</td>
<td>25</td>
</tr>
<tr>
<td>6+500 to 13+500</td>
<td>Silty clay till; stiff to hard</td>
<td>35</td>
</tr>
<tr>
<td>–</td>
<td>Granular engineered fill</td>
<td>50</td>
</tr>
</tbody>
</table>

The silts and silty sands at the subgrade level in some of the west and central sections of the alignment could be frost susceptible. To minimize the potential for heaving of the track slab due to frost action, it is recommended that these soils be removed from within the frost depth (1.2 m) and be replaced with non-frost susceptible granular material. It is recommended that these sections be identified during a detailed geotechnical investigation prior to the detailed design phase.

Figure 5.1: Track Bed Typical Cross-Section
5.2 Stop Foundations

Stop platforms are planned for 18 locations along the B-Line corridor. It is envisioned that the platforms will consist of prefabricated concrete slabs supported on point footings or augered caissons.

Based on the existing borehole data, it is anticipated that spread footings or shallow augered piers (essentially circular spread footings) founded on the native soils will be suitable for support of the stop platforms. However, in many cases, it may be necessary to extend the footings or caissons below the normal depth for frost protection (1.2 m) to penetrate fill and very loose soils.

The footings should be founded a minimum 1.2 m below finished grade as protection against frost action (See Figure 5.2).

Figure 5.2: Typical Stop Platform Detail
5.3 Catenary Pole Foundations

Based on the available borehole data, it is anticipated that conventional catenary pole foundation design consisting of short augered caissons will be suitable. Lengthening of the caissons to penetrate poor quality fills or very loose deposits may be necessary locally. During augering for pole foundation installation, the potential will exist for encountering obstructions, such as demolition rubble in the fill and cobbles/boulders in the native sand/gravel and clay till.

5.4 Highway 403 Structure Foundations

Conceptual plans call for the LRT to cross the Highway 403 interchange on an elevated guideway supported on a new 11-span structure linking Main Street West with King Street West.

The subsurface stratigraphy along the structure alignment generally comprises a relatively thick fill layer and thin alluvial deposits overlying a thick stratum of very soft to very stiff silty clay, underlain by shale bedrock. The bedrock surface was contacted at depths of 16.2 to 27.5 m, rising towards the east from Elevation 57.0 m at the Main Street/Highway 403 crossing to Elevation 75.2 m at the King Street connection.

In anticipation of relatively heavy structural loads, the geotechnically preferred foundation system is augered caissons (drilled piers) socketed into shale bedrock. The information available regarding the soundness/quality of the shale at the site is limited and will need to be investigated to confirm foundation design parameters for the rock sockets.

Steel liners will be required to support the sidewalls of caissons during installation, particularly where the shafts will extend through landfill and wet alluvial deposits.

Steel H-piles driven to refusal in the shale bedrock may also be considered. For preliminary design purposes, HP 310x110 piles driven to refusal in shale should be designed using the following geotechnical resistances:

- Factored Geotechnical Resistance at ULS 1,600 kN
- Geotechnical Resistance at SLS 1,200 kN

The pile tips should be reinforced to provide protection from damage while driving into the bedrock.

The depth of frost penetration in Hamilton is 1.2 m. The base of pile caps should be placed a minimum 1.2 m below finished grade as protection against frost action.

5.5 Relocation of Underground Utilities

We understand that underground utilities and municipal services below the track slab will be abandoned and relocated under the adjacent roadway. In constrained areas, a cast-in-place concrete utility tunnel is proposed to carry the utilities.

5.5.1 Trench Excavation

Excavation for open cut installation of underground utilities will primarily extend through the roadway pavement structure and fill layers, and into native silts/sands/clays in the west part of the corridor, sands in the central section, and silty clay till in the eastern part. Shale bedrock may be encountered along Queenston Road.

All temporary excavations must be carried out in accordance with the current Occupational Health and Safety Act (OHSA) of Ontario and local regulations. In general, the fill and native soils within the relatively shallow excavation depths anticipated for utility installations are classified as a Type 3 soil under OHSA. Where space restrictions preclude excavation of inclined slopes, service installation may be carried out using a trench box or temporary shoring.

Where the trench depth exceeds 6 m in fill or till, the support system must be designed specifically for this project. The design of the support system should include the effects of surcharge loads such as those imposed by construction equipment, roadway traffic, adjacent buildings and other facilities.
Use of a hydraulic excavator should be suitable for trench excavation. Provision should be made for handling and removal of the pavement materials, possible obstructions in the fill, and cobbles, boulders or chunks of shale and limestone in the till soils during excavation.

Excavation in the upper 1 to 3 m of the Queenston shale formation should be possible using heavy excavation equipment and rippers, supplemented by pneumatic rock breakers where thick layers of hard material are encountered. The shale below this depth is harder and less weathered, and intensive use of pneumatic/hydraulic breakers or other methods of loosening the bedrock will likely be required. Near vertical sidewalls may be employed in shale bedrock.

Water was measured at depths of 1.2 to 19.5 m in previous boreholes drilled along the corridor. Localized zones of perched water were also encountered in the fill or seams/layers of more permeable sands within layered deposits. In general, removal of seepage entering trenches should be feasible using sumps and pumps where excavation depths are less than about 4 m and for excavations in silty clay till (east part of corridor). Where the trench depths in sands and silts exceed about 4 m, the potential increases that excavation will encounter groundwater and more extensive dewatering will be required. The impacts of groundwater in areas of deeper excavation, if planned, must be further assessed.

5.5.2 Pipe Bedding and Backfill

Pipe bedding materials, compaction and cover should follow OPSD and/or City of Hamilton specifications. In areas where a less competent subgrade is encountered, it may be necessary to increase the bedding thickness.

Trench backfill materials should be placed in loose lift thicknesses not exceeding 200 mm and compacted to at least 98% of its SPMDD. To minimize the potential for post-construction settlement of the track and roadway surface, it is recommended that OPSS Granular A or B material, or unshrinkable fill, be employed to backfill the trenches.

If reuse of the excavated materials as trench backfill is contemplated to reduce costs, the potential for settlement and the need for re-establishing the roadway surface over trenches must be accepted.

In general, the predominant sands in the central section of the corridor and the clay till in the eastern section are considered suitable for reuse, provided they meet environmental requirements, are free of organics, debris and other deleterious materials, and the placement moisture content is within about 2% of the optimum moisture content for efficient compaction. The clay till must be adequately broken down and compacted in the trench. Fill containing demolition rubble and other debris, such as that encountered in boreholes between Bay and MacNab Streets, should not be reused.

The interbedded silts, sands and clays in the west section of the corridor along the grass medians (west of Dundurn Street) appear to be typically wet of the optimum moisture content for efficient compaction. Reuse of these materials as trench backfill is not recommended. Reuse of excavated shale is not recommended.

5.6 Pavement Restoration

The existing pavement structure documented in the available boreholes is highly variable and comprises areas of both flexible and composite design. Establishing recommendations for restoration of the existing pavement thickness over backfilled trenches is therefore not practical at this stage, and generalized guidelines are presented below.

Main Street, King Street and Queenston Road are classified as major arterial roadways. The minimum pavement structure typically specified by the City of Hamilton for this type of roadway is as follows:

- HL-1 Surface Course Asphalt: 40 mm
- HL-8 (HS) Binder Course Asphalt: 120 mm
- OPSS Granular A Base: 150 mm
- OPSS Granular B Type II Sub-base: 450 mm
The required pavement thickness should be assessed during detailed design when traffic volumes and additional borehole information is available. For preliminary planning purposes, we recommend that an increased Granular B sub-base thickness of 600 mm be assumed. Further, the use of premium hot mixes (DFC, HDBC) and Superpave mix design should be considered to reduce rutting in heavily travelled sections.

Acceptance, placement and compaction of the pavement materials should be carried out in accordance with the applicable City of Hamilton or OPS specifications. The pavement granular material should be compacted to 100% of SPMDD.

5.7 Environmental Considerations

The soil descriptions provided on the borehole logs were reviewed for indications of potential environmental impact. The following potential areas of concern were identified based on this review:

- Pockets of grey and black silt were documented within a sand layer in one borehole located in front of McMaster Medical Centre;
- Clayey silt fill encountered in three boreholes between Newton Avenue and Paisley Avenue were described as mottled reddish brown and black or containing black clay seams;
- Boreholes were drilled in association with underground storage tank removal at a service station located on the northwest corner of Longwood Road and Main Street West;
- Deep deposits of refuse fill are present in the Highway 403 valley;
- Ashes, cinders and demolition rubble were present within the fills between Bay Street and MacNab Street; and
- Pavement granular materials between Walnut and Wellington Streets contain slag.

Chemical analysis of soil samples was carried out during several investigations conducted along the corridor. In general, these results indicated elevated values of Electrical Conductivity (EC) and Sodium Adsorption Ratio (SAR). The EC and SAR values are believed to reflect the effects of road de-icing salt, and may impact vegetation growth if reused in applications near the ground surface. Concentrations of metals such as cadmium, beryllium and zinc exceeded anticipated background levels at isolated locations.

Due to the inherent variability of subsurface conditions, detailed investigation and testing will be required to evaluate the quality of the excess excavated soils and establish soil management procedures. The need for off-site disposal of landfill materials from the Highway 403 corridor, demolition rubble from the Bay-MacNab Street area, and other localized materials should be anticipated. Acceptance criteria stipulated by individual receivers may vary, and some receivers may not accept this material.

5.8 Recommendations for Further Investigation

A number of gaps have been identified in the existing subsurface data for which additional investigation is recommended for preliminary design. To advance in the next design phase, it is recommended that the supplementary geotechnical investigations include:
At least one borehole at each stop platform location;

At least three boreholes including bedrock coring within the Highway 403 valley to evaluate the quality of the underlying shale bedrock and assess parameters for design of caissons to support the guideway structure;

In the order of 15 additional boreholes at locations between stops where existing information is not available, primarily in the section east of Victoria Avenue;

Investigation of the foundation conditions at the proposed maintenance and storage yard to assess the presence and quality of any fill on site and determine foundation requirements for buildings and track slabs;

Installation of piezometers to further assess the groundwater levels along the corridor; and

Supplemental chemical testing of soil samples recovered from the boreholes.

Further geotechnical investigation will be required during the detailed design stage to provide detailed recommendations for design and construction of the proposed facilities. As a minimum, this investigation should include an additional borehole at each stop location, at least one borehole with bedrock coring at each pier and abutment of the guideway structure over Highway 403 (in accordance with MTO investigation requirements), boreholes along the track alignment conceptually at a spacing in the order of 100 m, and foundation investigation for the maintenance and storage facility.
Disclaimer

This document contains the expression of the professional opinion of Steer Davies Gleave North America Inc. ("SDG") as to the matters set out herein, using its professional judgment and reasonable care. It is to be read in the context of the agreement (the “Agreement”) between SDG and the City of Hamilton (the “Client”) for the Rapid Transit Preliminary Design and Feasibility Study (reference C11-12-10), and the methodology, procedures and techniques used, SDG’s assumptions, and the circumstances and constrains under which its mandate was performed. This document is written solely for the purpose stated in the Agreement, and for the sole and exclusive benefit of the Client, whose remedies are limited to those set out in the Agreement. This document is meant to be read as a whole, and sections or parts thereof should thus not be read or relied upon out of context.

SDG has, in preparing the Agreement outputs, followed methodology and procedures, and exercised due care consistent with the intended level of accuracy, using its professional judgment and reasonable care.

However, no warranty should be implied as to the accuracy of the Agreement outputs, forecasts and estimates. This analysis is based on data supplied by the client/collected by third parties. This has been checked whenever possible, however SDG cannot guarantee the accuracy of such data and does not take responsibility for estimates in so far as they are based on such data.

SDG disclaims any liability to the Client and to third parties in respect of the publication, reference, quoting, or distribution of this report or any of its contents to and reliance thereon by any third party.
APPENDIX A

TABLES
### TABLE A1

**SUMMARY OF AVAILABLE BOREHOLES**

<table>
<thead>
<tr>
<th>Section</th>
<th>Approximate Stationing</th>
<th>Borehole Designations</th>
<th>Year Drilled</th>
<th>Consultant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Street West</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0+110 to -0+130</td>
<td>91-5B, 6B</td>
<td>1966</td>
<td>E.M. Peto Associates Ltd.</td>
</tr>
<tr>
<td></td>
<td>-0+080 to 0+200</td>
<td>GTR_1019-1, 4, 5, 7, 8</td>
<td>2004</td>
<td>Soil-Mat Engineers &amp; Consultants Ltd.</td>
</tr>
<tr>
<td></td>
<td>0+290 to 0+450</td>
<td>GTR_1153-1, 2</td>
<td>2005</td>
<td>Landtek Limited</td>
</tr>
<tr>
<td></td>
<td>0+640</td>
<td>625-1B</td>
<td>1991</td>
<td>Warnock Hersey Professional Services Ltd.</td>
</tr>
<tr>
<td></td>
<td>0+830 to 1+630</td>
<td>580-1, 2, 3, 4, 5, 6, 7, 8, 580A-21</td>
<td>1990</td>
<td>Trow</td>
</tr>
<tr>
<td></td>
<td>1+370 to 1+400</td>
<td>MW-204, 211</td>
<td>2004</td>
<td>Jacques Whitford Environmental Limited</td>
</tr>
<tr>
<td><strong>Highway 403</strong></td>
<td>2+070 to 2+130</td>
<td>029-4, 5</td>
<td>1959</td>
<td>Department of Highways</td>
</tr>
<tr>
<td></td>
<td>2+070 to 2+290</td>
<td>030-H3, H4, H5, H7, H9, H10, J12B</td>
<td>1960</td>
<td>Department of Highways</td>
</tr>
<tr>
<td></td>
<td>2+330 to 2+470</td>
<td>870-02, 03, 04, 05, 20, 21</td>
<td>1994</td>
<td>Mountainview Geotechnical</td>
</tr>
<tr>
<td><strong>King Street West</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2+590</td>
<td>565A-2</td>
<td>1962</td>
<td>E.M. Peto Associates Ltd.</td>
</tr>
<tr>
<td></td>
<td>2+750 to 3+930</td>
<td>94A-1, 2, 3, 4, 5, 6, 7, 8, 9</td>
<td>1977</td>
<td>Peto MacCallum Ltd.</td>
</tr>
<tr>
<td></td>
<td>3+380 to 3+540</td>
<td>765ORG-20, 21</td>
<td>1995</td>
<td>Mountainview Geotechnical</td>
</tr>
<tr>
<td></td>
<td>4+080 to 4+230</td>
<td>500-4P, 5, 6P, 7</td>
<td>1973</td>
<td>Peto Associates Ltd.</td>
</tr>
<tr>
<td></td>
<td>3+980 to 4+250</td>
<td>111A-3, 5, 6</td>
<td>1971</td>
<td>Racey, MacCallum and Bluteau Ltd.</td>
</tr>
<tr>
<td><strong>King Street East</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4+370</td>
<td>908-1</td>
<td>2001</td>
<td>Trow Consulting Engineers</td>
</tr>
<tr>
<td></td>
<td>4+440</td>
<td>283A-1</td>
<td>2001</td>
<td>Trow Consulting Engineers</td>
</tr>
<tr>
<td></td>
<td>4+520</td>
<td>GTR1076-16</td>
<td>2004</td>
<td>Shaheen and Peaker</td>
</tr>
<tr>
<td></td>
<td>4+540 to 4+620</td>
<td>736-C, D</td>
<td>1994</td>
<td>Golder Associates</td>
</tr>
<tr>
<td></td>
<td>4+750</td>
<td>430-5</td>
<td>1986</td>
<td>Sitest Engineering</td>
</tr>
<tr>
<td></td>
<td>4+850 to 4+960</td>
<td>845-A, B</td>
<td>1999</td>
<td>AGRA Earth and Environmental</td>
</tr>
<tr>
<td></td>
<td>4+930</td>
<td>999-3</td>
<td>2002</td>
<td>Terraprobe Ltd.</td>
</tr>
<tr>
<td><strong>King Street East</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4+960 to 5+250</td>
<td>832A-1, 2, 3</td>
<td>1998</td>
<td>Trow Consulting Engineers</td>
</tr>
<tr>
<td></td>
<td>5+280</td>
<td>749-7</td>
<td>1995</td>
<td>Golder Associates</td>
</tr>
</tbody>
</table>
# TABLE A1
## SUMMARY OF AVAILABLE BOREHOLES

<table>
<thead>
<tr>
<th>Section</th>
<th>Approximate Stationing</th>
<th>Borehole Designations</th>
<th>Year Drilled</th>
<th>Consultant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5+280</td>
<td>GTR1031B-6-1</td>
<td>2003</td>
<td>Soil-Mat Engineers and Consultants Ltd.</td>
<td></td>
</tr>
<tr>
<td>5+490</td>
<td>181A-2</td>
<td>1969</td>
<td>Peto Associates Ltd</td>
<td></td>
</tr>
<tr>
<td>5+900</td>
<td>528-3</td>
<td>1989</td>
<td>Sitest Engineering</td>
<td></td>
</tr>
<tr>
<td>6+150</td>
<td>898-1</td>
<td>2001</td>
<td>Trow Consulting Engineers</td>
<td></td>
</tr>
<tr>
<td>7+050 to 7+520</td>
<td>29-1, 4, 6</td>
<td>1976</td>
<td>Peto MacCallum Ltd.</td>
<td></td>
</tr>
<tr>
<td>7+920 to 8+250</td>
<td>517-1, 2, 3</td>
<td>1989</td>
<td>Sitest Engineering</td>
<td></td>
</tr>
<tr>
<td><strong>Main Street East</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8+960</td>
<td>993-1</td>
<td>2002</td>
<td>Peto MacCallum Ltd.</td>
<td></td>
</tr>
<tr>
<td>9+050</td>
<td>GTR1059-1</td>
<td>2003</td>
<td>Terraprobe Ltd.</td>
<td></td>
</tr>
<tr>
<td>9+130</td>
<td>462-1</td>
<td>1987</td>
<td>Sitest Engineering</td>
<td></td>
</tr>
<tr>
<td>9+460</td>
<td>319A-1</td>
<td>1982</td>
<td>Trow Consulting Engineers</td>
<td></td>
</tr>
<tr>
<td>9+870</td>
<td>80-1</td>
<td>1986</td>
<td>Trow Consulting Engineers</td>
<td></td>
</tr>
<tr>
<td>10+130</td>
<td>675-1-3</td>
<td>1992</td>
<td>Warnock Hersey</td>
<td></td>
</tr>
<tr>
<td><strong>Queenston Road</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10+550</td>
<td>853-2</td>
<td>1999</td>
<td>Landtek Ltd.</td>
<td></td>
</tr>
<tr>
<td>11+320 to 11+470</td>
<td>616-1, 2, 3</td>
<td>1991</td>
<td>Mountainview Geotechnical</td>
<td></td>
</tr>
<tr>
<td>11+870</td>
<td>562A-22</td>
<td>1962</td>
<td>E.M. Peto Associates Ltd</td>
<td></td>
</tr>
<tr>
<td>11+990 to 12+090</td>
<td>963-304, 308</td>
<td>1989</td>
<td>Golder Associates</td>
<td></td>
</tr>
<tr>
<td>12+050</td>
<td>GTR1268-Q5</td>
<td>1998</td>
<td>Peto MacCallum Ltd</td>
<td></td>
</tr>
<tr>
<td>12+940</td>
<td>124-1</td>
<td>1970</td>
<td>Peto Associates Ltd</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B

RECORD OF BOREHOLE SHEETS
MAIN STREET WEST
# LOG OF BOREHOLE NO. 1

**BORING DATE:** September 24, 2003  
**CLIENT:** The City of Hamilton  
**LOCATION:** Edgemont Street  
**ELEVATION DATUM:** Geodetic  
**SAMPLER HAMMER:** 63.5kg; DROP: 760mm

<table>
<thead>
<tr>
<th>SOIL PROFILE</th>
<th>DESCRIPTION</th>
<th>depth (m)</th>
<th>ELECTRICAL RESISTIVITY (Ω·m)</th>
<th>PENETRATION RESISTANCE (kN/m)</th>
<th>WATER CONTENT (%)</th>
<th>SHEAR STRENGTH (%V)</th>
<th>INSTALLATION INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURFACE</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAD</td>
<td></td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GRAVEL</td>
<td></td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>2.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
<td>3.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>3.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
<td>3.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>4.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
<td>4.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>5.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>5.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
<td>5.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>6.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>6.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
<td>6.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>6.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
<td>7.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>7.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
<td>7.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>8.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
<td>8.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltstone</td>
<td></td>
<td>8.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**  
- Benchmark dry upon completion of testing.
1. Borehole was moist and open to 5 metres on completion.
2. Borehole was backfilled on completion of the fieldwork.
BOREHOLE LOG

PROJECT: Proposed Sewer Installation
LOCATION: 3 Intersections, Hamilton, Ontario

SOIL DESCRIPTION

DATA SHEET

1. Borehole advanced uncased by continuous flight auger equipment to termination at 21 1/2 feet depth on Sept. 7/86 by S.O.I.L.

2. Water Log Records:
   
   ELAPSED TIME W.L.(ft) TO DRY COMPLETION

NOTES:

HOLE LOCATION AND DATUM SEE DRAWING NO. 1

William Trow Associates
Hamilton, Ont.
QUEENSTON ROAD
LANDTEK LIMITED
LOG OF BOREHOLE NO. 2
Consulting Engineers

Project #: 99075
Client: Region of Hamilton-Wentworth
Drilling Date: 20-Jul-99
Drawing No.: 3
Drilling Method: [X] solid stem continuous flight
[ ] hollow stem
[ ] diamond drill

Location: Rail Avenue, Hamilton
Bench Mark: Geodetic
Contract Drilling Co: Geo-Environmental Drilling

SOIL DESCRIPTION

STANDARD PENETRATION TEST

SOIL MOISTURE PROFILE

DATA & COMMENTS

Notes:
1. Borehole was dry and open to 3.0 m on completion.

MOUNTAINVIEW GEOTECHNICAL LTD.

Auger Sample: [X] Natural Moisture
SPT (N Value): [O] Plastic and Liquid Limit
Dynamic Cone Test: [O] Undrained Triaxial Test
Shore Tube: [O] Overburden Pressure
Point Vane Test: [O] Freeze Test
Lab Vane Test:

Project: Proposed Storm Sewer
Dwg No.: 2
Queenston Road
Borehole No.: 1
Hamilton
Project No.: 30145

Soil Description:
- 203 mm sand and gravel
- 165 mm Concrete
- 75 mm of Asphalt
- 3 mm of Gravel
- TILL (Halton Formation)
silty clay, gravel sizes, brown, red
shale fragments, grey fractures,
red-brown, mould
(Stiff to Very Stiff)

Shale - weathered
changing to sound Shale at
4.5m, Silstone layers, red
(hard)

End of Borehole

Notes:
1. Borehole advanced on
April 2/91 using
continuous Flight Solid
Auger Equipment
2. Borehole open to full
depth and dry on completion.
End of Borehole

Notes:
1) Borehole advanced on April 2/91 using continuous Flight Solid Stem Auger Equipment
2) Borehole open to full depth and dry on completion.
**RECORD OF BOREHOLE 304**

**LOCATION**

**SOLDERING DATE**

**SAMPLE NUMBER**

**PRE-CORED STAMPS INSTALLATION**

**SOIL NATURE**

**DESCRIPTION**

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.S.</td>
<td>AUGER SAMPLE</td>
</tr>
<tr>
<td>C.S.</td>
<td>CORE SAMPLE</td>
</tr>
<tr>
<td>S.S.</td>
<td>3&quot; STANDARD SPLIT TUBE SAMPLE</td>
</tr>
<tr>
<td>S.P.</td>
<td>SPLIT BARREL WITH LINERS</td>
</tr>
<tr>
<td>T.S.</td>
<td>TRENCHED SHELBY TUBE SAMPLE</td>
</tr>
<tr>
<td>K.S.</td>
<td>KALAMIAN CHART</td>
</tr>
</tbody>
</table>

**SAMPLE CONDITION**

<table>
<thead>
<tr>
<th>Sample Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNDISTURBED</td>
<td></td>
</tr>
<tr>
<td>FAIR</td>
<td></td>
</tr>
<tr>
<td>DISTURBED</td>
<td></td>
</tr>
</tbody>
</table>

**SOIL DESCRIPTION**

- **GOLDEN SAND - ORGANIC**
  - Colour: Red brown
  - Texture: Fine
  - Layer: 1'-4'
  - Water level 1' below ground surface
  - Remarks: Very moist

- **CLAYY SILT - TYPICAL SAND**
  - Colour: Red brown
  - Texture: Fine
  - Layer: 1'-4'
  - Water level 1' below ground surface
  - Remarks: Very moist

- **DARK SILT**
  - Colour: Red brown
  - Texture: Fine
  - Layer: 1'-4'
  - Water level 1' below ground surface
  - Remarks: Saturated

- **QUICK-BOTTOMED SHALE**
  - Colour: Red brown
  - Texture: Fine
  - Layer: 1'-4'
  - Water level 1' below ground surface
  - Remarks: Blist pocket at 0 level

- **THICK SAND**
  - Colour: Red brown
  - Texture: Fine
  - Layer: 1'-4'
  - Water level 1' below ground surface
  - Remarks: Recovery 100%

- **SAND TO SILL**
  - Colour: Red brown
  - Texture: Fine
  - Layer: 1'-4'
  - Water level 1' below ground surface
  - Remarks: Recovery 100%

- **FILL**
  - Description: Fine to stiff, gray silty clay, trace to some sand and gravel, trace organics (bed and peat) fill
  - Remarks: Filled trench 10'-20'

**WATER CONDITIONS**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Depth</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 16/62</td>
<td>6'</td>
<td>4'-6'</td>
<td>Hose should be at 8 ft. no page from here</td>
</tr>
<tr>
<td>Jan. 16/62</td>
<td>10:30 a.m.</td>
<td>8'</td>
<td>Unable to pump - W.I. native 8'-10' by building</td>
</tr>
<tr>
<td></td>
<td>10:30 a.m.</td>
<td>8'</td>
<td>8'</td>
</tr>
<tr>
<td></td>
<td>12:30 p.m.</td>
<td>8'</td>
<td>8'</td>
</tr>
</tbody>
</table>

**CONTINUED ON SHEET 2**

**DEPT SCALE**

1: 00

**LOGGED BY**

Golder Associates

**CHECKED BY**

ASP
### Record of Borehole 308

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
</tr>
</thead>
</table>
| 0         | Ground surface, compact gray sand and gravel.
| 0.5       | Stiff gray-brown silty clay, some sand and gravel, upper 5 ft depth, field.
| 1         | Stiff to very stiff, red-brown clay, some gravel, weathered abraded, all soil, field.
| 2         | Mixture of very stiff, red-brown clay, some sand and gravel, and dense granite.
| 3         | Very stiff, silty clay, some sand, field.

**Hydraulic Conductivity**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Conductivity (ft/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

**Penetration Resistance**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Resistance (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

---

**Groundwater Level**

Water level is 80 ft below ground surface at 80 ft NWS from the borehole.
# LOG OF BOREHOLE NO. Q5 & Q6

**PROJECT:** NORTH-SOUTH SECTION OF FREDERICK PROJECT
**LOCATION:** Glenora Drive to Barton Street, Hamilton, Ontario

**DATE:** March 31, 1998
**ENGINEER:** M. Anderson
**TECHNICIAN:** L. Watson

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BOREHOLE Q5</strong></td>
<td><strong>GROUNDS ELEVATION 83.65</strong></td>
</tr>
<tr>
<td>0.00</td>
<td>TOPSOIL: Dark brown sandy soil, trace of clay, low organic content</td>
</tr>
<tr>
<td>0.25</td>
<td>TOPSOIL: Dark brown sandy soil, trace of clay, low organic content</td>
</tr>
<tr>
<td>1.30</td>
<td>SAND: Medium grey and reddish brown sandy and clayey silts, and gravel</td>
</tr>
<tr>
<td>1.50</td>
<td><strong>BOREHOLE TERMINATED AT 2.50m</strong></td>
</tr>
<tr>
<td><strong>BOREHOLE Q6</strong></td>
<td><strong>GROUNDS ELEVATION 82.03</strong></td>
</tr>
<tr>
<td>0.00</td>
<td>TOPSOIL: Dark brown sandy soil, trace of clay, low organic content</td>
</tr>
<tr>
<td>0.30</td>
<td>SAND: Medium grey and reddish brown sandy and clayey silts, and gravel</td>
</tr>
<tr>
<td>0.40</td>
<td><strong>BOREHOLE TERMINATED UPON RETURN TO AQUA AT 1.50m</strong></td>
</tr>
</tbody>
</table>

**SHEET 1 OF 4**

---

**RECORD OF BOREHOLE No. 1**

**JOB NO.:** 702154
**JOB NAME:** Watermain - Main Road, Mississaug, Ontario
**TECHNICIAN:** D.P.
**CLIENT:** Corporation of the City of Hamilton
**ENGINEER:** GDE/FE

**GROUND ELEV.:** Unrecorded
**BOREHOLE TYPE:** 4" Flight Auger

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.16</td>
<td>FILT-LAY, high in organic content, very moist, dark brown</td>
</tr>
<tr>
<td>3.16</td>
<td>CLAYEY SILT &amp; FILT-brown fine, moist, mainly fine gravel with occasional medium gravel</td>
</tr>
</tbody>
</table>

**PLASTIC LIMIT:** 34%
**WATER CONTENT:** 6%

**REMARKS:** At completion dry, 1 hr. later damp
### Record of Borehole: 6-D

**Job No.:** 65329  
**Job Name:** King Street West Relocation  
**Client:** Corporation of the City of Hamilton  
**Engineer:** JN  
**Technician:** JF  
**Boring Date:** Jan 7-86  
**Ground Elevation:** 326.86  
**Borehole Type:** Standard Rig  
**Type of Sampling:** Typing by HP

#### Soil Profile

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
<th>Number</th>
<th>Type</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Standard</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.86</td>
<td>CLAY, reddish brown, fine sandy clay, V. wet</td>
<td>2</td>
<td>82</td>
<td>18.9 33.4</td>
</tr>
<tr>
<td>3.56</td>
<td>CONTACT TO LOOSE</td>
<td>3</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>3.56</td>
<td>BANU, reddish brown, clayey fine sand</td>
<td>4</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>4.50</td>
<td>CONTACT</td>
<td>5</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>5.60</td>
<td>BANU, reddish brown, silty clayey very fine sand</td>
<td>6</td>
<td>80</td>
<td>17.0 13.2</td>
</tr>
<tr>
<td>6.80</td>
<td>SATURATED</td>
<td>7</td>
<td>80</td>
<td>16.9 29.4</td>
</tr>
<tr>
<td>7.50</td>
<td>DENSE</td>
<td>8</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>9.50</td>
<td>DENSE</td>
<td>9</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>11.6</td>
<td>Hole terminated at 31° 6’</td>
<td>10</td>
<td>80</td>
<td></td>
</tr>
</tbody>
</table>

### Dynamic Cone Penetration

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
<th>Number</th>
<th>Type</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Standard</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.86</td>
<td>CLAY, reddish brown, sandy clay</td>
<td>1</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>3.56</td>
<td>V. M.T. 70% H. S. I.</td>
<td>2</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>4.50</td>
<td>LOOSE TO DENSE</td>
<td>3</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>5.60</td>
<td>BANU, reddish brown, clayey sand</td>
<td>4</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>7.50</td>
<td>BANU, reddish brown, clayey silty sandy sand</td>
<td>5</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>9.50</td>
<td>DENSE</td>
<td>6</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>11.6</td>
<td>Hole terminated at 31° 6’</td>
<td>7</td>
<td>85</td>
<td></td>
</tr>
</tbody>
</table>

### Shear Strength (lb/ft)

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
<th>Number</th>
<th>Type</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Standard</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.86</td>
<td>CLAY, reddish brown, sandy clay</td>
<td>1</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>3.56</td>
<td>V. M.T. 70% H. S. I.</td>
<td>2</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>4.50</td>
<td>LOOSE TO DENSE</td>
<td>3</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>5.60</td>
<td>BANU, reddish brown, clayey sand</td>
<td>4</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>7.50</td>
<td>BANU, reddish brown, clayey silty sandy sand</td>
<td>5</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>9.50</td>
<td>DENSE</td>
<td>6</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>11.6</td>
<td>Hole terminated at 31° 6’</td>
<td>7</td>
<td>85</td>
<td></td>
</tr>
</tbody>
</table>
### Log of Borehole No. 1

**Borehole Location:** See Drawing No. 1

**Project Manager:** Ian Shaw, B. Eng., EIT

#### Subsurface Profile

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Soil Type</th>
<th>Description</th>
<th>Elevation</th>
<th>Type</th>
<th>Number</th>
<th>Blow/300mm</th>
<th>UC (%)</th>
<th>Rejection</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Ground Surface</td>
<td></td>
<td>0.00</td>
<td>22</td>
<td>1</td>
<td>-0.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.00</td>
<td>Asphalitic Concrete</td>
<td>Approximately 40 millimetres</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.00</td>
<td>Granular Base</td>
<td>Approximately 200 millimetres</td>
<td></td>
<td>2</td>
<td>9</td>
<td>-1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Silty Sand/Sandy Silt</td>
<td>Brown, medium to coarse grained, compact</td>
<td></td>
<td>3</td>
<td>7</td>
<td>-2.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td>End of Borehole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
1. Borehole advanced using solid stem continuous flight auger equipment on February 11, 2004 to a depth of 2.3 metres.
2. No free groundwater present at the completion of drilling. Borehole backfilled with auger cuttings.
3. Soil samples will be discarded after three months unless otherwise directed by the client.

**Drill Method:** Solid Stem Auger
**SOIL-MAT ENGINEERS & CONSULTANTS LTD.**
**Date:** Feb 11, 2004
**Datum:** Ground Surface
**Printed and Checked:** IS
**Hole Size:** 100mm

---

### Log of Borehole No. 4

**Borehole Location:** See Drawing No. 1

**Project Manager:** Ian Shaw, B. Eng., EIT

#### Subsurface Profile

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Soil Type</th>
<th>Description</th>
<th>Elevation</th>
<th>Type</th>
<th>Number</th>
<th>Blow/300mm</th>
<th>UC (%)</th>
<th>Rejection</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Ground Surface</td>
<td></td>
<td>0.00</td>
<td>12</td>
<td>1</td>
<td>-0.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Topsoil</td>
<td>Approximately 50 millimetres</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.20</td>
<td>Silty Sand and Gravel Fill</td>
<td>Brown, medium to coarse grained, compact</td>
<td></td>
<td>17</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Silty Sand/Sandy Silt</td>
<td>Brown, layered/stratified, occasional</td>
<td></td>
<td>3</td>
<td>3</td>
<td>-2.30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
1. Borehole advanced using solid stem continuous flight auger equipment on February 11, 2004 to a depth of 2.3 metres.
2. No free groundwater present at the completion of drilling. Borehole backfilled with auger cuttings.
3. Soil samples will be discarded after three months unless otherwise directed by the client.

**Drill Method:** Solid Stem Auger
**SOIL-MAT ENGINEERS & CONSULTANTS LTD.**
**Date:** Feb 11, 2004
**Datum:** Ground Surface
**Printed and Checked:** IS
**Hole Size:** 100mm

---
### Log of Borehole No. 5

**Project:** Watermain Replacement  
**Location:** Main Street West, Hamilton  
**Client:** Sutton & Associates  
**Project Manager:** Ian Shew, B.Eng., EIT

#### SUBSURFACE PROFILE

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Substratum Description</th>
<th>Elevation</th>
<th>Type</th>
<th>Number</th>
<th>Blow/300mm</th>
<th>USC/WC (%)</th>
<th>Recovery</th>
<th>Standard Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Topsoil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.00</td>
<td>Silty Sand Fill</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.00</td>
<td>Silty Sand/Sandy Silt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-1.10</td>
<td>Silty Sand/Sandy Silt</td>
<td>SS</td>
<td>1</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2.30</td>
<td>Silty Sand/Sandy Silt</td>
<td>SS</td>
<td>3</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of Borehole</td>
<td>NOTES:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 1. Borehole advanced using solid stem continuous flight auger equipment on February 11, 2004 to a depth of 2.3 metres.  
2. No free groundwater present at the completion of drilling. Borehole backfilled with auger cuttings.  
3. Soil samples will be discarded after three months unless otherwise directed by the client. |

#### SAMPLE

**Drill Method:** Solid Stem Auger  
**Drill Date:** Feb 11, 2004  
**Hole Size:** 100mm  
**Datum:** Ground Surface  
**Checked by:** IS

---

### Log of Borehole No. 7

**Project:** Watermain Replacement  
**Location:** Main Street West, Hamilton  
**Client:** Sutton & Associates  
**Project Manager:** Ian Shew, B.Eng., EIT

#### SUBSURFACE PROFILE

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Substratum Description</th>
<th>Elevation</th>
<th>Type</th>
<th>Number</th>
<th>Blow/300mm</th>
<th>USC/WC (%)</th>
<th>Recovery</th>
<th>Standard Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>End of Borehole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.35</td>
<td>Asphaltic Concrete</td>
<td>SS</td>
<td>1</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-1.10</td>
<td>Granular Base</td>
<td>SS</td>
<td>2</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2.30</td>
<td>Silty Sand/Sandy Silt</td>
<td>SS</td>
<td>3</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### SAMPLE

**Drill Method:** Solid Stem Auger  
**Drill Date:** Feb 11, 2004  
**Hole Size:** 100mm  
**Datum:** Ground Surface  
**Checked by:** IS
**Log of Borehole No. 8**

**Location:** Main Street West, Hamilton

**Client:** Sutton & Assosciates

**Project Manager:** Ian Shaw, B. Eng., EIT

---

### SUBSURFACE PROFILE

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Ground Surface</td>
</tr>
<tr>
<td>1.10</td>
<td>Silty Sand/Sandy Silt</td>
</tr>
<tr>
<td>2.70</td>
<td>Sand and Gravel Fill</td>
</tr>
<tr>
<td>4.50</td>
<td>Asphalthic Concrete</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Borehole advanced using solid stem continuous flight auger equipment on February 11, 2004 to a depth of 2.3 metres.
2. No free groundwater present at the completion of drilling. Borehole backfilled with auger cuttings.
3. Soil samples will be discarded after three months unless otherwise directed by the client.

---

### SAMPLE

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Type</th>
<th>Number</th>
<th>PP (g/cm²)</th>
<th>LML (mm)</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.10</td>
<td>SS</td>
<td>1</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.70</td>
<td>SS</td>
<td>2</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.50</td>
<td>SS</td>
<td>3</td>
<td>9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**End of Borehole**

---

### Geotechnical

<table>
<thead>
<tr>
<th>Material Description</th>
<th>Depth</th>
<th>SPT &quot;N&quot; Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Surface</td>
<td>100</td>
<td>0.0</td>
</tr>
<tr>
<td>100 mm Asphalthic</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>150 mm Concrete</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>75 mm Gravel</td>
<td>0.15</td>
<td></td>
</tr>
</tbody>
</table>

---

**BOREHOLE TERMINATED**

---

**Drill Method:** Solid Stem Auger

**Drill Date:** Feb 11, 2004

**Datum:** Ground Surface

**Hole Size:** 100mm
**LOG OF BOREHOLE NO. 2**

**Project No.:** 03151  
**Drill Date:** December 2, 2005  
**Project:** GTR-1103, Watermain & Roads Reconstruction Projects  
**Drill Method:** 2 solid stern; 4 hollow stern  
**Geologic:** Vibriatory

### Material Description

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Type</th>
<th>Soil Moisture (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>Ground Surface</td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>50 mm Asphalt</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>100 mm Concrete</td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>73 mm Gravel</td>
<td></td>
</tr>
</tbody>
</table>

### Stratigraphy

**99.92 Road Surface**

- **1.15 Road Surface**  
  - Description: Loose to Compact  
  - Notes: Brown Sandy Silt  
  - Tests: SS1 (6)

**Borehole Terminated at 2.6 m**

**5.79 End of Borehole**

- Borehole Dry at Completion

---

**Notes:**
1. On completion, borehole upper 2.6 m and dry.

**Abbreviations:**
- B: boring point
- S: sample
- P: plasticity index
- F: fine value
- M: modified
- B: borehole
- G: geology
- V: geotechnical
- C: construction
- S: sample
- D: ground surface
- D: depth
- S: sample
- B: borehole
### Log of Borehole 1

**Auger Sample**
- **SPT N Value**
- **NATURAL MOISTURE**
- **PLASTIC LIMIT**
- **Liquidity Index**
- **DYNAMIC CONE TEST**
- **SHALEY TUBE**
- **FIELD VIEW TEST**

**Soil Description**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
<th>Depth Range</th>
<th>Soil Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.00</td>
<td>Gravelly till, brown, cohesion clay, sandstone, silt, clay, silt, clay, sand</td>
<td>57.3</td>
<td>Soft</td>
</tr>
<tr>
<td>34.00</td>
<td>Gravelly till, brown, cohesion clay, sandstone, silt, clay, silt, clay, sand</td>
<td>87.8</td>
<td>Soft</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Borehole advanced unsacon by solid stem auger to termination at 67.9 m depth, on January 19, 1990, by Drilltech.
2. **Water Level Data:***
   - Depth: 67.9 m
   - Elevation: +0.4 m
3. **Drill-reaming:**
   - Time: 30 minutes
   - Drilled: 67.9 m

---

### Log of Borehole 2

**Auger Sample**
- **SPT N Value**
- **NATURAL MOISTURE**
- **PLASTIC LIMIT**
- **Liquidity Index**
- **DYNAMIC CONE TEST**
- **SHALEY TUBE**
- **FIELD VIEW TEST**

**Soil Description**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
<th>Depth Range</th>
<th>Soil Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.00</td>
<td>Gravelly till, brown, cohesion clay, sandstone, silt, clay, silt, clay, sand</td>
<td>57.3</td>
<td>Soft</td>
</tr>
<tr>
<td>34.00</td>
<td>Gravelly till, brown, cohesion clay, sandstone, silt, clay, silt, clay, sand</td>
<td>87.8</td>
<td>Soft</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Borehole advanced unsacon by solid stem auger to termination at 67.9 m depth, on January 19, 1990, by Drilltech.

---

NOTE: BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.
### Log of Borehole

**Project Proposed Store Sewer**

**Deg. No. 13**

**Region of Hamilton - Wentworth, Main St. at Bond St.**

**Hamilton, Ontario**

**Project No. 1051256**

**Soil Description**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>125 ft</td>
<td>Very dense clay, grey, fine to medium gravel, silty.</td>
</tr>
<tr>
<td>126 ft</td>
<td>Soft to very dense clay, grey, fine to medium gravel, silty.</td>
</tr>
<tr>
<td>127 ft</td>
<td>Very dense clay, grey, fine to medium gravel, silty.</td>
</tr>
</tbody>
</table>

**NOTES:**

- Borehole advanced using by soil type augers to approximately 1.8 m, depth, on January 30, 1960, by 901-1111A.
- Standpipe installed.
- Water level recorded: Standpipe placed at 3.0 m, 45° to 3.0 m.

---

**Log of Borehole**

**Project Proposed Store Sewer**

**Deg. No. 12**

**Region of Hamilton - Wentworth, Main St. at Longwood Dr.**

**Hamilton, Ontario**

**Project No. 1051256**

**Soil Description**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>125 ft</td>
<td>Very soft to firm clay, silty clay, grey, fine to medium gravel, silty.</td>
</tr>
<tr>
<td>126 ft</td>
<td>Very soft to firm clay, silty clay, grey, fine to medium gravel, silty.</td>
</tr>
<tr>
<td>127 ft</td>
<td>Very soft to firm clay, silty clay, grey, fine to medium gravel, silty.</td>
</tr>
</tbody>
</table>

**NOTES:**

- Borehole advanced using by soil type augers to approximately 1.8 m, depth, on January 30, 1960, by 901-1111A.
- Standpipe installed.
- Water level recorded: Standpipe placed at 3.0 m, 45° to 3.0 m.

**NOTE:** Borehole data requires interpretation assistance from Trow before use by others.
### Log of Borehole

#### Region of Hamilton - Wentworth, Main St. at Paradise Rd.

**Project No.:** HO170-G

<table>
<thead>
<tr>
<th>Soil Description</th>
<th>ELEV.</th>
<th>N Value</th>
<th>Natural Moisture Content</th>
<th>Natural Use Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>179 m concrete cap</td>
<td>56.00</td>
<td>0.10</td>
<td>S30% Dry Weight</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>178 m concrete</td>
<td>56.00</td>
<td>0.10</td>
<td>S30% Dry Weight</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
1. Boronite advanced upward by solid auger to termination at 2.0 m depth. On January 10, 1990, by Grade A.
2. Standpipe installed.
3. Water level recorded - Standpipe ploughed at 2.0 m, dry to 2.0 m.

**NOTE:** BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.
Log of Borehole 21

Soil Description:
- Full fine dark brown silt clay, with occasional rootlets.
- Coarse to very coarse sand, with occasional rootlets, grading into a dense silt clay below 3.36 m.
- Composed of dense reddish brown, fine to medium sand with occasional layers of grey silt clay.

Natural Moisture Content (% by Weight):
- 23.1
- 18.4
- 16.9
- 18.5
- 20.0
- 19.7
- 20.2
- 20.5
- 21.3

NOTE: BOREHOLE DATA REQUIRE INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.
HIGHWAY 403 CROSSING
DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS AND RESEARCH SECTION

**W.P. 231-59-3**  BORE HOLE NO. 3

**JOB: 59-E-125**  STATION 12400 A RAMP H.

**DATUM**  G.S.C.  COMPILED BY  B.R.

**BORING DATE**  Jan 25/60  CHECKED BY  J.B.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Groundlevel</td>
</tr>
<tr>
<td></td>
<td>2620</td>
</tr>
</tbody>
</table>

Grey-brown silty clay with decayed organic matter.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grey silty clay with layers of sand and gravel.</td>
</tr>
<tr>
<td></td>
<td>2320</td>
</tr>
</tbody>
</table>

Stiff grey silty clay.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shale, weathered at surface.</td>
</tr>
<tr>
<td></td>
<td>2010</td>
</tr>
</tbody>
</table>

End of borehole

Penetration resistance profile obtained by driving a 2\(^\text{nd}\) dia. cone from groundlevel to depth, noted with an energy of 350 ft. lb. per blow.

**LEGEND**

- (Q\text{d}) unconfined compression (lbf/sq in.)
- Vane test(s) and sensitivity(s)
- Natural moisture and liquidity index
- Liquid limit
- Plastic limit

<table>
<thead>
<tr>
<th>CONSISTENCY</th>
<th>SAMPLE</th>
<th>NATURAL UNIT WT.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>P.C.F.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S1 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S2 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S3 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S4 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S5 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S6 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S7 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S8 - 96.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T8 - 93.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T9 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S10 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S11 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S12 -</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Groundlevel</td>
</tr>
<tr>
<td></td>
<td>2630</td>
</tr>
</tbody>
</table>

Clayey mixture of sand, W.L. 2350. grained gravel and ashes.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Soft brown silty clay with decayed organic matter.</td>
</tr>
<tr>
<td></td>
<td>2550</td>
</tr>
</tbody>
</table>

Brown sandy clay with decayed organic matter & some ash.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Brown to grey silty clay with layers of sand &amp; gravel.</td>
</tr>
<tr>
<td></td>
<td>2360</td>
</tr>
</tbody>
</table>

Stiff grey silty clay, sandy near bedrock.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fine sand.</td>
</tr>
<tr>
<td></td>
<td>2010</td>
</tr>
</tbody>
</table>

End of borehole

**LEGEND**

- (Q\text{d}) unconfined compression (lbf/sq in.)
- Vane test(s) and sensitivity(s)
- Natural moisture and liquidity index
- Liquid limit
- Plastic limit

<table>
<thead>
<tr>
<th>CONSISTENCY</th>
<th>SAMPLE</th>
<th>NATURAL UNIT WT.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>P.C.F.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S1 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S2 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S3 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S4 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S5 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S6 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S7 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S8 -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S9 - 124.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S10 -</td>
</tr>
</tbody>
</table>

**FORM OB-MC-126 (REV. 1959) - 19-86**

**DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS AND RESEARCH SECTION**

**W.P. 231-58-3**  BORE HOLE NO. A

**JOB: 59-E-125**  STATION 12400 A RAMP H.

**DATUM**  G.S.C.  COMPILED BY  B.R.

**BORING DATE**  Feb 9/60  CHECKED BY  J.B.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Groundlevel</td>
</tr>
<tr>
<td></td>
<td>2610</td>
</tr>
</tbody>
</table>

Clayey mixture of sand, W.L. 2350. gravel and ashes.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Soft brown silty clay with decayed organic matter.</td>
</tr>
<tr>
<td></td>
<td>2510</td>
</tr>
</tbody>
</table>

Brown sandy clay with decayed organic matter & some ash.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Brown to grey silty clay with layers of sand &amp; gravel.</td>
</tr>
<tr>
<td></td>
<td>2360</td>
</tr>
</tbody>
</table>

Stiff grey silty clay, sandy near bedrock.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fine sand.</td>
</tr>
<tr>
<td></td>
<td>2010</td>
</tr>
</tbody>
</table>

End of borehole
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 231-58-1 BORE HOLE NO. 5
JOB 59-P-125 STATION 20/00 & 800 H.
DATUM G.S.C. COMPILITED BY B.E.
BORING DATE Jan. 29/50 CHECKED BY J.B.

LEGEND
1/2 UNCONFINED COMPRESSION (QU) O
VANE TEST (AND SENSITIVITY) +
NATURAL MOISTURE AND LIQUIDITY INDEX X
LIQUID LIMIT
PLASTIC LIMIT

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
<th>ELEV. FT.</th>
<th>DEPTH FEET</th>
<th>STRENGTH AND PENETRATION RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1000 2000 3000 4000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25 50 75 100</td>
</tr>
<tr>
<td>4 G</td>
<td>Groundlevel</td>
<td>2600</td>
<td>38</td>
<td>s1 s2 s3 s4 s5 s6 s7 s8 s9</td>
</tr>
<tr>
<td></td>
<td>Heterogeneous mixture W.L. = 25%</td>
<td>2550</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brown sandy clay</td>
<td>2510</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>4 W</td>
<td>Well grained sand &amp; gravel</td>
<td>2350</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stiff grey silty clay with scattered shale fragments</td>
<td>2340</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>End of borehole</td>
<td>1937</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Penetration resistance profile shown obtained by driving a 2" dia. cone from groundlevel to depth noted with an energy of 190 ft. lb. per blow.

---

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 231-59-1 BORE HOLE NO. 7
JOB 59-P-125 STATION 20/00 & 800 H.
DATUM G.S.C. COMPILITED BY B.E.
BORING DATE Feb. 21/50 CHECKED BY J.B.

LEGEND
1/2 UNCONFINED COMPRESSION (QU) O
VANE TEST (AND SENSITIVITY) +
NATURAL MOISTURE AND LIQUIDITY INDEX X
LIQUID LIMIT
PLASTIC LIMIT

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
<th>ELEV. FT.</th>
<th>DEPTH FEET</th>
<th>STRENGTH AND PENETRATION RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1000 2000 3000 4000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25 50 75 100</td>
</tr>
<tr>
<td>4 G</td>
<td>Groundlevel</td>
<td>2740</td>
<td>38</td>
<td>s1 s2 s3 s4 s5 s6 s7 s8 s9</td>
</tr>
<tr>
<td></td>
<td>Brown clay with sand, gravel &amp; rubble</td>
<td>2710</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Well graded gravelly sand with rubble</td>
<td>2690</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>4 W</td>
<td>Gravelly sand with wood</td>
<td>2680</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soft brown sandy clay with decayed vegetation</td>
<td>2110</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>End of borehole</td>
<td>1937</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Penetration resistance profile shown obtained by driving a 2" dia. cone from groundlevel to depth noted with an energy of 190 ft. lb. per blow.
### LOG OF BOREHOLE NO. 2

**MOUNTAINVIEW GEOTECHNICAL LTD.**
**CONSULTING ENGINEERS**

**M/N PROJECT NO.:** S0520
**DRILLING DATE:** MAY 10, 1994
**CLIENT:** REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

**PROJECT NAME:** PROPOSED CST TANK
**LOCATION:** CATHEDRAL PARK, MAIN ST. @ HWY 403, HAMILTON

**SOIL DESCRIPTION**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Sample Type</th>
<th>Soil Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>75.7</td>
<td>SS 11</td>
<td>SILTY CLAY: layer with silt and sand seams, vertical fissures, red shale fragments, trace of gravel, oxidized brown to unoxidized grey below 10.9 m, moist to very moist. (VERY STIFF TO STIFF)</td>
</tr>
<tr>
<td>88.5</td>
<td>SS 17.2</td>
<td>SHALE: (Queenston Formation) layered with grey siltstone seams, weathered, reddish brown, moist, (HARD)</td>
</tr>
</tbody>
</table>

**BOREHOLE TERMINATED**

**BOREHOLE OPEN TO 16.3 m ON COMPLETION.**

**WATER LEVEL AT 12.5 ON COMPLETION.**

---

### LOG OF BOREHOLE NO. 3

**MOUNTAINVIEW GEOTECHNICAL LTD.**
**CONSULTING ENGINEERS**

**M/N PROJECT NO.:** S0720
**DRILLING DATE:** MAY 10, 1994
**CLIENT:** REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

**PROJECT NAME:** PROPOSED CST TANK
**LOCATION:** CATHEDRAL PARK, MAIN ST. @ HWY 403, HAMILTON

**SOIL DESCRIPTION**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Sample Type</th>
<th>Soil Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>87.3</td>
<td>SS 11</td>
<td>FILL: Grass and superficial vegetation</td>
</tr>
<tr>
<td>86.4</td>
<td>SS 11</td>
<td>FILL: Silty clay with silt and sand, dark brown to brown, rootlets and organics, moist</td>
</tr>
<tr>
<td>85.9</td>
<td>SS 11</td>
<td>FILL: Ash, cinders, sand, organics, decayed plant fibres and wood, pieces of porcelain and glass, generally grey to black (LOSE TO VERY LOOSE)</td>
</tr>
<tr>
<td>82.3</td>
<td>SS 11</td>
<td>SAND AND SILT: fine sand sizes, slightly clayey, oxidized brown, clay seams @ 4.0 m (COMPACT)</td>
</tr>
<tr>
<td>80.4</td>
<td>SS 17.0</td>
<td>BOREHOLE TERMINATED</td>
</tr>
</tbody>
</table>

**BOREHOLE CONTINUED ON NEXT PAGE**
### LOG OF BOREHOLE NO. 3

**Consulting Engineers:** Mountainview Geotechnical Ltd.

**M.G. PROJECT NO.:** S0520

**Drilling Date:** May 10, 1994

**Location:** Cathedral Park, Main St. @ I-403, Hamilton

**Elev. Datum:** Geodetic

**Drilling Method:** K & E Drilling

**Soil Description:**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Sample</th>
<th>Type</th>
<th>Blows per 300 mm (N Value)</th>
<th>MC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>SS</td>
<td>11</td>
<td>14.9%</td>
<td></td>
</tr>
<tr>
<td>20-40</td>
<td>SS</td>
<td>12.5</td>
<td>21.7%</td>
<td></td>
</tr>
<tr>
<td>40-60</td>
<td>SS</td>
<td>14</td>
<td>21.3%</td>
<td></td>
</tr>
<tr>
<td>60-80</td>
<td>SS</td>
<td>17.1</td>
<td>20.9%</td>
<td></td>
</tr>
</tbody>
</table>

**Shale (Queenston Formation)**

**Notes:**
1. Borehole opened to 20.5 m on completion.
2. Borehole was dry upon completion.

### LOG OF BOREHOLE NO. 4

**Consulting Engineers:** Mountainview Geotechnical Ltd.

**M.G. PROJECT NO.:** S0520

**Drilling Date:** May 10, 1994

**Location:** Cathedral Park, Main St. @ I-403, Hamilton

**Elev. Datum:** Geodetic

**Drilling Method:** K & E Drilling

**Soil Description:**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Sample</th>
<th>Type</th>
<th>Blows per 300 mm (N Value)</th>
<th>MC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>SS</td>
<td>1.1</td>
<td>33.0%</td>
<td></td>
</tr>
<tr>
<td>20-40</td>
<td>SS</td>
<td>1.8</td>
<td>31.2%</td>
<td></td>
</tr>
<tr>
<td>40-60</td>
<td>SS</td>
<td>2.6</td>
<td>30.4%</td>
<td></td>
</tr>
<tr>
<td>60-80</td>
<td>SS</td>
<td>3.4</td>
<td>29.0%</td>
<td></td>
</tr>
<tr>
<td>80-100</td>
<td>SS</td>
<td>4.1</td>
<td>37.6%</td>
<td></td>
</tr>
</tbody>
</table>

**Fill:**

- Silty clay with silt and sand, dark brown to brown, rootless and organic, moist
- Ash, cinders, sand, organic, decayed plant fibres and wood, pieces of porcelain and glass, generally grey to black, possible asphalt shingles @ 5m, black cemented foundry sand @ 6 m, wet below 7 m (LOOSE TO VERY LOOSE)

**Shale (Queenston Formation)**

**Notes:**
1. Borehole continued on next page.
### LOG OF BOREHOLE NO. 20

#### CLIENT: REGIONAL MUNICIPALITY OF HAMILTON—WENTWORTH

#### PROJECT NAME: PROPOSED CSG TANK

#### LOCATION: CATHEDRAL PARK, MAIN ST. @ HWY 403, HAMILTON

#### ELEV. DATUM: GROSFIDIC

#### DRILLER: K. & S. DRILLING

<table>
<thead>
<tr>
<th>SOIL DESCRIPTION</th>
<th>N</th>
<th>SAMPLE</th>
<th>TYPE</th>
<th>DEPTH</th>
<th>BLOWES FOR 300 mm (N VALUE)</th>
<th>CU / UNIT WT</th>
</tr>
</thead>
<tbody>
<tr>
<td>74.1 Continued from previous page</td>
<td>10.0</td>
<td>0-10</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>80</td>
</tr>
</tbody>
</table>

Silty Clay

Layered with silt and sand seams, vertical fissures, red shale fragments, trace of gravel, desiccated and oxidized brown becoming unoxidized grey below 2.6 m.

(STIFF TO FIRM)

<table>
<thead>
<tr>
<th>SOIL DESCRIPTION</th>
<th>N</th>
<th>SAMPLE</th>
<th>TYPE</th>
<th>DEPTH</th>
<th>BLOWES FOR 300 mm (N VALUE)</th>
<th>CU / UNIT WT</th>
</tr>
</thead>
<tbody>
<tr>
<td>84.1 Fill</td>
<td>0.0</td>
<td>0-20</td>
<td>40</td>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

Silty Clay

Layered with silt and sand seams, vertical fissures, red shale fragments, trace of gravel, desiccated and oxidized brown becoming unoxidized grey below 2.6 m.

(STIFF TO FIRM)

### DYNAMIC CONE PENETRATION TEST NEAR BOREHOLE NO. 20

#### CLIENT: REGIONAL MUNICIPALITY OF HAMILTON—WENTWORTH

#### PROJECT NAME: PROPOSED CSG TANK

#### LOCATION: CATHEDRAL PARK, MAIN ST. @ HWY 403, HAMILTON

#### ELEV. DATUM: GROSFIDIC

#### DRILLER: K. & S. DRILLING

<table>
<thead>
<tr>
<th>SOIL DESCRIPTION</th>
<th>N</th>
<th>SAMPLE</th>
<th>TYPE</th>
<th>DEPTH</th>
<th>BLOWES FOR 300 mm (N VALUE)</th>
<th>CU / UNIT WT</th>
</tr>
</thead>
<tbody>
<tr>
<td>85.1 Fill</td>
<td>0.0</td>
<td>0-20</td>
<td>40</td>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

Shale

(Queenston Formation)

Layered with grey silty sandstone seams, weathered, red

<table>
<thead>
<tr>
<th>SOIL DESCRIPTION</th>
<th>N</th>
<th>SAMPLE</th>
<th>TYPE</th>
<th>DEPTH</th>
<th>BLOWES FOR 300 mm (N VALUE)</th>
<th>CU / UNIT WT</th>
</tr>
</thead>
<tbody>
<tr>
<td>85.2 Fill</td>
<td>0.0</td>
<td>0-20</td>
<td>40</td>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

Shale

(Queenston Formation)

Layered with grey silty sandstone seams, weathered, red

(STIFF TO FIRM)
KING STREET WEST
### Logan Hole No. 20

**Project:** Logan Hole No. 20  
**Client:** The Region of Hamilton-Wentworth  
**Location:** Market Street, Hamilton  
**Drilling:** 
- **Type:** Provisional Watermain & Sewer Installation  
- **Method:** 
  - [X] Hollow Stem  
  - [ ] Diamond Drill  
  - [ ] NX or [ ] BX  
**Borehole Terminated:** 3.5  
**Soil Description:**  
- **85.5:** FILL, sand with some silt, medium to coarse grained, clayey, brown, moist.  
  - **5:** SS  
  - **7:** SS  
- **86.5:** SAND AND GRAVEL, medium to coarse grained sand, medium gravel sizes, brown, moist.  
  - **>35:** SS  
- **85:** BOREHOLE TERMINATED  

**NOTES:**  
1. Borehole open to 2.9 m on completion.  
2. Borehole was dry on completion.

### Logan Hole No. 21

**Project:** Logan Hole No. 21  
**Client:** The Region of Hamilton-Wentworth  
**Location:** Market Street, Hamilton  
**Drilling:** 
- **Type:** Provisional Watermain & Sewer Installation  
- **Method:** 
  - [X] Hollow Stem  
  - [ ] Diamond Drill  
  - [ ] NX or [ ] BX  
**Borehole Terminated:** 3.5  
**Soil Description:**  
- **93:** FILL, sand with some silt, medium to coarse grained, clayey, brown, moist.  
  - **3:** SS  
- **93.2:** SAND AND GRAVEL, medium to coarse grained sand, medium gravel sizes, brown, moist.  
  - **9:** SS  
- **93:** BOREHOLE TERMINATED  

**NOTES:**  
1. Borehole open to 2.7 m on completion.  
2. Borehole was dry on completion.
### Table: Engineering Data Sheet for Borehole 3

<table>
<thead>
<tr>
<th>Symbol</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asphalt &amp; Conc. Base</td>
</tr>
<tr>
<td></td>
<td>Conglomerate layer at approx. 20 ft. depth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ELEV. FEET</th>
<th>DEPTH FEET</th>
<th>STRENGTH AND PENETRATION RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>320.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>297</td>
<td></td>
<td></td>
</tr>
<tr>
<td>289.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

1. Borehole advanced using flight auger equipment.
2. On completion, hole open to approx. 23 ft. depth.
3. Layer of conglomerate gravel encountered at 20 ft. depth; difficult to penetrate by auger.

### Table: Engineering Data Sheet for Borehole 5

<table>
<thead>
<tr>
<th>Symbol</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asphalt &amp; Conc. Base</td>
</tr>
<tr>
<td></td>
<td>Refusal on conglomerate layer of sand and gravel</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ELEV. FEET</th>
<th>DEPTH FEET</th>
<th>STRENGTH AND PENETRATION RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>323.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>304</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Borehole advanced to 19'6" using flight auger equipment.
2. Refusal to auger encountered at approx. 19'6" depth.
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Elevation</th>
<th>Depth</th>
<th>Strength and Penetration Resistance</th>
<th>Sample Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asphalts &amp; Concrete Base</td>
<td>325.4</td>
<td>0.2</td>
<td>20 40 60 80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sand-loose: fine to medium; reddish brown; moist</td>
<td>324</td>
<td>1.0</td>
<td>20 40 60 80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Layer of conglomerate black sand and gravel; approx. 9&quot; thick at 17 ft. depth; underlain by sand &amp; gravel.</td>
<td>317</td>
<td>2.0</td>
<td>20 40 60 80</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Borehole advanced to 17 ft. depth using flight auger equipment together with conventional wash boring technique for breaking through the conglomerate layer.
2. On completion, hole dry and open to 21 ft. depth.
KING STREET WEST
Log of Borehole 1

Project No.: HASE-0001596-A
Project: Geotechnical Investigation - Proposed Sewer and Watermain Construction
Location: James Street (King Street to Wilson Street), Hamilton, Ontario

Date Drilled: May 12, 2001
Deli Type: Truck Mount

Soil Description:
- 0.00-0.04 m: Asphalt - 200 mm thick
- 0.04-0.06: Fill: Sand and gravel, brown, dark, 100 mm thick
- 0.06-0.09: Reddish brown, fine grained, some clay, very loose to loose
- 0.09-0.134: Light brown, fine grained, grayed, silty sand seams, moist, compact to dense
- 0.134-0.202: Underlying strata

Borehole Terminated:
1. Borehole was advanced by solid stem auger equipment to a termination depth of 2.5 m on May 12, 2001.
2. Upon completion of drilling, no core, no water.
3. In hole mudstone reading using MSA expander - 0% methane.
4. Upon completion of drilling, 19 mm (3/4") diameter P.V.C. standpipe extended to 2.0 m depth, screened portion 7.6 to 2.0 m in depth and asphalt patch from 0 to 0.2 m depth.

Trow Consulting Engineers Ltd.
420 Milsom Road
Stoney Creek, Ontario, L8E 3N9
Telephone: 905-664-3300
Fax: 905-662-4144
E-Mail: hamilton@trow.com
Log of Borehole BH16

Project No: SB6481-3
Project: Geo-environmental Investigation
Location: Hughson St. N., King St. E. to King William St., City of Hamilton, Ontario

Date Drilled: Sept 2, 2004
Dirt Type: Hollow Stem Augers
Datum: Geodetic

Soil Description:

- ASPHALTIC CONCRETE: 150 mm thick
- CONCRETE: 200 mm, granular base 60 mm, crushed stone
- FILL: silty sand to sandy silt, brown, moist, compact
- SAND: coarse to medium grained, some silt, silty, brown, moist, very dense

End of Borehole

S & P
Shaheen & Peaker Consulting Engineers

Borehole BH16
RECORD OF BOREHOLE BH-D

SOIL PROFILE

Depth | Description |
--- | --- |
0.00 | GROUND SURFACE |
0.10 | Semi-Natural Stone |
0.30 | Dense, brown, sandy silt (FLS) |
0.70 | Loose to compact, brown, silty sand, some gravel (granule FLS) |
1.10 | Loose, reddish-brown, sandy silt (FLS) |
1.50 | Loose, brown, fine to medium silty sand |
2.00 | Compact, brown, fine to medium sand, some silt, occasional gravel |
2.50 | Dense, brown, sand and gravel |
2.70 | END OF BOREHOLE |

INSTALLATIONS

DATA SHEET FOR BOREHOLE

NOTES:
- Semi-Natural Stone
- Loose, reddish-brown, sandy silt (FLS)
- Loose, brown, fine to medium silty sand
- Compact, brown, fine to medium sand, some silt, occasional gravel
- Dense, brown, sand and gravel

END OF BOREHOLE TERMINATED 68.02 6.55

DEPTH SCALE (ALONG HOLE)

Golder Associates

LOADED: K.A.
CHECKED: J.O.M.

1 to 50

SITE TEST ENGINEERING

Access:
1. Free water encountered at 6.5m. Level observed at 5.0m on completion.
2. Borehole was backfilled on completion of fieldwork.
Borehole #: A

Project No: T89003G
Project: Storm Sewer Construction
Location: King & Walnut St., Hamilton
Client: Reg. Min. of Hamilton Wentworth
Prepared By: M. Letich

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Symbol</th>
<th>Description</th>
<th>Number</th>
<th>Standard Penetration Test Blowes/30 cm</th>
<th>Moisture Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td></td>
<td>Ground Surface</td>
<td></td>
<td>94.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PAVEMENT STRUCTURE</td>
<td>1</td>
<td>85 7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>85 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>85 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>85 5</td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td></td>
<td>BROWN SAND FILL</td>
<td>1</td>
<td>85 7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>85 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>85 4</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td></td>
<td></td>
<td>4</td>
<td>85 5</td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td></td>
<td></td>
<td>5</td>
<td>85 22</td>
<td></td>
</tr>
</tbody>
</table>

Borehole Terminated

Drilled by: Elke Drilling
Drill Method: Solid Stem Augers
Drill Date: 99.02.04
AGRA Earth and Environmental
505 Woodward Avenue
Hamilton, Ontario L8H 6N6
Hole Size: 150 mm
Datum: Geodetic
Upon Completion: Caved and wet at 4.4 m.

Borehole #: B

Project No: T89003G
Project: Storm Sewer Construction
Location: King & Walnut St., Hamilton
Client: Reg. Min. of Hamilton Wentworth
Prepared By: M. Letich

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Symbol</th>
<th>Description</th>
<th>Number</th>
<th>Standard Penetration Test Blowes/30 cm</th>
<th>Moisture Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td></td>
<td>Ground Surface</td>
<td></td>
<td>92.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PAVEMENT STRUCTURE</td>
<td>1</td>
<td>85 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>85 7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>85 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>85 30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>85 33</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SAND AND GRAVEL</td>
<td>1</td>
<td>85 27</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>85 27</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>85 27</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>85 27</td>
<td></td>
</tr>
</tbody>
</table>

Borehole Terminated

Drilled by: Elke Drilling
Drill Method: Solid Stem Augers
Drill Date: 99.02.04
AGRA Earth and Environmental
505 Woodward Avenue
Hamilton, Ontario L8H 6N6
Hole Size: 150 mm
Datum: Geodetic
Upon Completion: Caved and wet at 4.4 m.
**LOG OF BOREHOLE 3**

**BORING DATE:** November 26, 2002  
**ELEVATION DATUM:** Geodetic  
**SAMPLER HAMMER:** 63.6kg; DROP, 760mm

<table>
<thead>
<tr>
<th>SOIL PROFILE</th>
<th>SAMPLES</th>
<th>PENETRATION RESISTANCE (pF)</th>
<th>WATER CONTENT (%)</th>
<th>INSTALLATION INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESCRIPTION</td>
<td>ELEV. (ft)</td>
<td>SITE DES.</td>
<td>TYPE</td>
<td>VALUE</td>
</tr>
<tr>
<td>GROUND SURFACE</td>
<td>0</td>
<td>H47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONCRETE</td>
<td>1</td>
<td>65</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>FILL</td>
<td>2</td>
<td>82</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td>3</td>
<td>58</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td>4</td>
<td>82</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**GLEAM**

- 1. Borehole data requires interpretation assistance from Trow before use by others.
- 2. Upon completion of drilling, soil core, no free water.
- 3. Borehole verified and signed upon completion of drilling.
### LOG OF BOREHOLE 2

**Auger Sample**: D<br>**SPT(N) Value**: 0 0 3<br>**Dynamic Cone Test**: D D D<br>**Shelby Tube**: N N N<br>**Field Vane Test**: + 6<br>**Natural Moisture**: X<br>**Plastic and Liquid Limit**: X<br>**Penetrometer**: X<br>

**Soil Description**<br>
- **Asphaltic Concrete - 150 mm thick**
- **FILL: Sand and gravel, some slag, grey, moist**
- **Silty Sand: Reddish brown, trace of clay and gravel, moist, compact to dense**
- Becoming brown from 3.2 to 3.5 m depth

**Depth**<br>
- 0.5 m<br>- 1 m<br>- 1.5 m<br>- 2 m<br>- 2.5 m<br>- 3 m<br>- 3.5 m<br>- 4 m

**N Value**<br>
- 22<br>- 35<br>- 24<br>- 18<br>- 35<br>- 12<br>- 35

**Natural Moisture Content % Dry Weight**<br>
- 10<br>- 20<br>- 30

**Sample**<br>
- 100 m²

**NOTE**: BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.
1. Borehole advanced by solid stem auger to a termination depth of 3.5 m on March 18, 1986 by Landed Drilling Ltd.
2. Upon completion of drilling, no core, no free water.
3. Borehole backfilled and packed upon completion of drilling.

### LOG OF BOREHOLE 3

**Auger Sample**: D D D<br>**SPT(N) Value**: 0 0 3<br>**Dynamic Cone Test**: D D D<br>**Shelby Tube**: N N N<br>**Field Vane Test**: + 6<br>**Natural Moisture**: X<br>**Plastic and Liquid Limit**: X<br>**Penetrometer**: X

**Soil Description**<br>
- **Asphaltic Concrete - 200 mm thick**
- **FILL: Sand and gravel, some slag, brown, damp**
- **Silty Sand: Reddish Brown, trace of clay and gravel, moist, compact to dense**
- - with trace rootlets from 1.5 to 2.0 m depth
- - brown cemented sand seams from 3.4 to 3.5 m depth

**Depth**<br>
- 0.5 m<br>- 1 m<br>- 1.5 m<br>- 2 m<br>- 2.5 m<br>- 3 m<br>- 3.5 m<br>- 4 m

**N Value**<br>
- 0.5<br>- 12<br>- 14<br>- 0.5<br>- 12<br>- 0.5<br>- 12

**Natural Moisture Content % Dry Weight**<br>
- 10<br>- 20<br>- 30

**Sample**<br>
- 100 m²

**NOTE**: BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.
1. Borehole advanced by solid stem auger to a termination depth of 3.5 m on March 18, 1986 by Landed Drilling Ltd.
2. Upon completion of drilling, no core, no free water.
3. Standpipe monitoring wall installed to a 3.3 m depth (visited from 0.3 to 3.3 m depth), March 25, 1986 - Water Level: Dry
4. Borehole backfilled, sealed and packed upon completion of drilling.
Log of Borehole No. 6-1

Project: Proposed Road Reconstruction - Phase II
Location: Hamilton, Ontario

Client: Sutton & Associates
Project Manager: Ian Shaw, B.Eng., E.I.T.

Moisture Content

Ground Surface
Asphaltic Concrete
Approximately 75mm
Portland Cement Concrete
Approximately 200mm
Granular Base
Approximately 150mm
Silty Sand Fill
Brown, trace of fine gravel, moist, compact.
Sand
Brown, medium to fine grained, trace of to some silt, occasional thin layering, moist, compact.
Silty Clay
Grey, trace fine gravel, moist, very stiff.

End of Borehole
80.09

NOTES:
1. Borehole advanced using solid stem continuous flight auger equipment on October 23, 2003 to a depth of 5.2 metres.
3. Soil samples will be discarded after three months unless otherwise directed by the client.

Drill Method: Solid Stem Auger
SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8V 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca
Hole Size: 150mm
Datum: Geodetic
Drill Date: October 23, 2003
Checked by: IS
Sheet: 1 of 1
# RECORD OF BOREHOLE NO. 2

**JOB NO:** 59966  **JOB NAME:** East Avenue Storm sewer
**CLIENT:** Proctor and Marsh Ltd.  **ENGINEER:** JH

---

## SOIL PROFILE

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
<th>Samples</th>
<th>Standard Penetration Test (SPT) B</th>
<th>Dynamic Penetration Resistance (N/cm²)</th>
<th>Liquid Limit (LL)</th>
<th>Plastic Limit (PL)</th>
<th>Water Content (%)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.46</td>
<td>Fill, dark brown sandy silt, fill</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6.24</td>
<td>Loose brown sandy silt, fill</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>11.75</td>
<td>Red/brown, brown interbedded sandy</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and silty sand, moist compact</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>13.87</td>
<td>Silt, grey fine to medium sand,</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>moist</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>18.20</td>
<td>Compact</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fill, grey clayey silt, fill</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>25.74</td>
<td>Water</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>36.84</td>
<td>Compact</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Terminated at 36.84</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

---

## SITE TEST ENGINEERING DATA SHEET FOR BOREHOLE

<table>
<thead>
<tr>
<th>Field Tests</th>
<th>Laboratory Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Project No.** 0011  **Location:** Beaver Street
**Project:** Proctor & Marsh  **Work:** Beaver Street
**Date:** July 4, 1969  **Test:** Penetrometer

---

**NOTES:**
1. Borehole was missed and open to 4.1 metres on completion.
2. Borehole was backfilled on completion of the fieldwork.
Log of Borehole 1

**Geotechnical Investigation - Proposed Sewer and Watermain Construction**

**Location:** Wentworth Street (King Street to Barton Street), Hamilton, Ontario

**Date Drilled:** April 29, 2001

**Drill Type:** Truck Mount

**Notes:**
1. Borehole advanced by solid stem auger equipment to a termination depth of 3.5 m on April 29, 2001.
2. Upon completion of drilling, cave at 3.4 m depth, no water.
3. In hole method reading using MSA equipment: 0% methane.
4. Upon completion of drilling, 10 m (33 ft) diameter P.V.C. casing installed to 3.4 m depth, bented pipe 2.1 to 3.4 m depth, terramite seal 0.2 to 1.1 m depth and asphalt patch from 0.2 to 2.1 m depth.
**LOG OF BOREHOLE No. 4**

**JOB NO.** 76 P 153
**LOCATION** Halton, Ontario
**BORED DATE** July 13/76
**ENGINEER** T.P.

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>DESCRIPTION</th>
<th>SAMPLES</th>
<th>DENS. DENSITY</th>
<th>GRADE LIMIT</th>
<th>WATER CONTENT</th>
<th>GRADE</th>
<th>BARE SPT</th>
<th>CORRELATIVE (\text{SPT} \times \text{R.C.}-\text{VALUE})</th>
<th>CORRELATIVE (\text{SPT} \times \text{R.C.}-\text{RATIO})</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>DRAINAGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VACUUM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td>Sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.00</td>
<td>Sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.00</td>
<td>Sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.00</td>
<td>Sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.00</td>
<td>Sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:**
- Borehole located 50' south of anticipated location due to previous works.
- Borehole vacated 60' west of anticipated location due to packed area.

**COMPLETE**

**CHIEF ENGR.**

---

**LOG OF BOREHOLE No. 6**

**JOB NO.** 76 P 153
**LOCATION** Halton, Ontario
**BORED DATE** July 13/76
**ENGINEER** T.P.

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>DESCRIPTION</th>
<th>SAMPLES</th>
<th>DENS. DENSITY</th>
<th>GRADE LIMIT</th>
<th>WATER CONTENT</th>
<th>GRADE</th>
<th>BARE SPT</th>
<th>CORRELATIVE (\text{SPT} \times \text{R.C.}-\text{VALUE})</th>
<th>CORRELATIVE (\text{SPT} \times \text{R.C.}-\text{RATIO})</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>DRAINAGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VACUUM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td>Sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.00</td>
<td>Sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.00</td>
<td>Sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.00</td>
<td>Sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.00</td>
<td>Sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:**
- Borehole vacated 60' west of anticipated location due to packed area.

**COMPLETE**

**CHIEF ENGR.**
1. WATER LEVEL OBSERVED AT 5.5 METRES 1/2 HOUR AFTER COMPLETION OF BOREHOLE.
2. BOREHOLE WAS BACKFILLED ON COMPLETION.
3. BOREHOLE WAS RELOCATED TO THE SOUTHEAST CORNER OF KING/GAGE.
4. ACTUAL ELEVATIONS ARE SLIGHTLY LOWER THAN SHOWN.

1. BOREHOLE WAS MOIST AND OPEN TO 6.0 METRES ON COMPLETION OF BOREHOLE.
2. BOREHOLE WAS BACKFILLED ON COMPLETION.
3. BOREHOLE WAS RELOCATED TO THE SOUTHWEST CORNER OF KING/EASTEND.
4. ACTUAL ELEVATIONS ARE SLIGHTLY LOWER THAN SHOWN.
## DATA SHEET FOR BOREHOLE

### Project Information
- **Project Name:** PROPOSED SEWER
- **Location:** KING STREET & GLENDALE
- **City:** HAMILTON, ONTARIO

### Key Details
- **Date Created:** APR 07, 1992
- **Drawing No.:** 1
- **Diameter:** GEOGRAPHIC 90.076 METRES

### Soil Layer Data

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>SILTY CLAY</td>
</tr>
<tr>
<td>0.25</td>
<td>MOTTLED BROWN/GRAY</td>
</tr>
<tr>
<td>1.40</td>
<td>SILTY CLAY TILL</td>
</tr>
<tr>
<td>4.95</td>
<td>BOREHOLE TERMINATED</td>
</tr>
</tbody>
</table>

### Borehole Depth
- Depth to groundwater: 5.03 meters
- Water table elevation: 5.03 meters
- Water table elevation uncertainty: 0.50 meters

### Notes
1. BOREHOLE WAS MOIST AND OPEN TO 4.5 METRES ON COMPLETION OF BOREHOLE.
2. BOREHOLE WAS BACKFILLED ON COMPLETION.
3. BOREHOLE WAS RELOCATED TO THE SOUTHWEST CORNER OF KING/GLENDALE.
4. ACTUAL ELEVATIONS ARE SLIGHTLY LOWER THAN SHOWN.
MAIN STREET EAST
APPENDIX B

RECORD OF BOREHOLE SHEETS
MAIN STREET WEST
LOG OF BOREHOLE 1

Boring Date: September 24, 2003
Location: Edgerton Street

<table>
<thead>
<tr>
<th>Soil Profile</th>
<th>Description</th>
<th>Elevation (ft)</th>
<th>Penetration Resistance (kPa)</th>
<th>Shear Strength (kPa)</th>
<th>Water Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 3.00</td>
<td>Wetted surface</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.01 - 6.00</td>
<td>Silt clay, very stiff, clay</td>
<td>3.01</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.01 - 9.00</td>
<td>Silt clay, very stiff, clay, back fill</td>
<td>6.01</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>9.01 - 12.00</td>
<td>Oily clay, very stiff, clay, back fill</td>
<td>9.01</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>12.01 - 15.00</td>
<td>Oily clay, very stiff, clay, back fill</td>
<td>12.01</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>15.01 - END</td>
<td>Oily clay, very stiff, clay, back fill</td>
<td>15.01</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>
### Borehole Log

**Project:** Sewer Construction

**Location:** Wexford and Monterey Avenues

**Borehole No.:** 1

**Hamilton, Ontario**

**Project No.:** 10408-1-1

**Sheet No.:** 1

**Description:**

- **Soil Description:**
  - **Elev:** 10.00
  - **Unit Weight:** 106.2 kN/m³
  - **Natural Moisture:** 70.8%

**Notes:**

1. Borehole put down uncased with continuous flight auger equipment on September 28, 1982.
2. Water level at 1 m depth on completion.
**SOIL DESCRIPTION**

- 105.0 - 283.9 ft

- SAND: fine to medium, silty, occ. gravel sizes, red-brown to brown, soft to firm, (compact)
- SILT CLAY TILL: sand and gravel sizes, horizontally layered, some silt pockets, grey, moist to very moist, (very stiff)
- TERMINATED at 283.9 ft

**NOTES:**
1. Borehole advanced uncased by continuous flight auger equipment to termination at 215 feet depth on Sept. 17/86 by S.O.I.L.
2. Water Level Records: ELAPSED DEPTH TO HOLE OPEN TIME W.L.(ft) D TO (ft) on completion 19.5

**BORING LOG**

- GROUND SURFACE
  - ASSAULT 90
  - CRESCENT 750
  - SAND AND GRAVEL 370

- VERY STIFF TO HARD BROWN TO GREY BROWN SILTY CLAY
- TRACE SAND AND GRAVEL

- HARD RED BROWN, AND GREY SILT LAYERED
- TRACE SAND AND GRAVEL

- END OF BOREHOLE
  - BOREHOLE DRY UPON COMPLETION
QUEENSTON ROAD
LANDTEK LIMITED

LOG OF BOREHOLE NO. 2

Consulting Engineers

Project # 99075  Drawing No. 3
Date 20-Jul-90

Client Region of Hamilton-Wentworth

Drilling Method [x] solid stem continuous flight

Project Proposed Wastewater Construction

Location: Reel Avenue, Hamilton

Bench Mark: Geodetic

Contracting Co.: Geo-Environmental Drilling

SOIL DESCRIPTION

STANDARD PENETRATION TEST

SOIL MOISTURE PROFILE

DATA & COMMENTS

59.0

75 mm of Asphalt over 125 mm Concrete

6.0

TILL (Halton Formation)
silty clay, gravel sizes, brown, red
shale fragments, grey fractures,
red-brown, mild
(Stiff to Very Stiff)

BOREHOLE TERMINATED

3.5

Notes: 1. Borehole was dry and open to 3.0 m on completion.

MOUNTAINVIEW GEOTECHNICAL LTD.

Auger Sample [x] Natural Moisture
SPT (N) Value [ ] Plastic and Liquid Limit
Dynamic Cone Test [ ] Undrained Triaxial
Silty Tube Shear Test
Pond Tube Test
Lab Vane Test

Elevation

0.0

Queenston Road

Project: Proposed Storm Sewer

Dwg No. 2

Borehole No. 1

Height

8.0

Hamilton

Project No. 80145

Soil Description

Cemented Sand 203 mm hand and gravel

Fill - silty clay, gravel sizes, cobbles & Boulders,
Shale fragments, organic
Pockets, reddish-brown,
moss, (soft to firm)

Shale - weathered,
changing to sound Shale at
4.5m, Silstone layers, red
(hard)

End of Borehole

Notes:

1) Borehole advanced on

2) Borehole open to full

April 2/91 using

depth and dry on

continuous Flight Solid

Auger Equipment

completion.
**Soil Description**

- 76mm Asphalt
- 23mm Concrete
- Shale - weathered to clay consistency, gravel size, Silts and sand, moist, changing to sound Shale at 3.4m, Red, (hard)

**Notes:**
1. Borehole advanced on April 2/91 using continuous Flight Solid Stem Auger Equipment
2. Borehole open to full depth and dry on completion.
# Record of Borehole

**Job Name:** Redhill Creek Sewer

**Soil Engineering Service - Toronto, Ontario**

**Borehole Log**

---

### Sample Condition

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.S. Auger Sample</td>
<td>S.D. Site Description Sample</td>
</tr>
<tr>
<td>C.S. Core Sample</td>
<td>C. Core Sample</td>
</tr>
<tr>
<td>S.S. Split Sample</td>
<td>S. Split Sample</td>
</tr>
<tr>
<td>T.S. Trench Sample</td>
<td>T. Trench Sample</td>
</tr>
</tbody>
</table>

**Sample Descriptions**

- **Soil Description:**
  - **Fifty Fine Sand - Organic**
  - **Clayey Silt - Tiny Sand**
  - **R.C. Rock Core**

**Ground Surface:**

- **Soil Description:**
  - Red brown
  -展 View the Diagram for soil layer details.

**Water Level:**

- **Soil Description:**
  - Very moist
  - Moist

**Tests:**

- **Soil Description:**
  - Very moist
  - Moist

**Remarks:**

- **Soil Description:**
  - Wet pocket at 3 level

**Recovery:**

- **Soil Description:**
  - 100%

**Other Details:**

- **Soil Description:**
  - Soft seams or fissures at 25'5".

---

### Water Conditions

- **Date:** Jan. 16/92
- **Depth:** 4'4" 3'7"
- **Remarks:** Hole should be at 3 ft. water level.

- **Date:** Jan. 17/92
- **Time:** 10:30 a.m., 10:31 a.m., 10:32 a.m., 10:33 a.m., 12:30 p.m.
- **Depth:** 5' 5' 5' 5' 5'
- **Remarks:** Unable to lower W.I. below 5' by building.

---

**Diagram:**

- **Location:** On figure 2
- **Groundwater Table:**
- **Soil Description:**
- **Water Level:**
- **Sand:**

---

**Golder Associates**

**Checked by:** GHA

**Date:** 16/92

---

**Log:**

- **Sheet 1 of 2**
- **Logged to:**
- **Checked by:**

---
**LOG OF BOREHOLE NO. Q5 & Q6**

**PROJECT** North-South Section of Freeway Project

**LOCATION** Dixie Road to Borton Street, Mississauga, Ontario

**BORING DATE** March 31, 1998

**ENGINEER** M. Anderson

**TECHNICIAN** L. Watson

---

### SOIL PROFILE

<table>
<thead>
<tr>
<th>DEPTH (M)</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30</td>
<td>Dark brown sandy silt, trace of clay, low organic content</td>
</tr>
<tr>
<td>1.35</td>
<td>Soft silty brown sandy silt, some sand and gravel, very moist, dark brown</td>
</tr>
<tr>
<td>2.45</td>
<td>Weathered red shale</td>
</tr>
</tbody>
</table>

**BOREHOLE TERMINATED AT 2.85m**

Upon completion of boring, no tree water, no core.

---

### SOIL SAMPLES

<table>
<thead>
<tr>
<th>DEPTH (M)</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30</td>
<td>Dark brown sandy silt, trace of clay, low organic content</td>
</tr>
<tr>
<td>1.35</td>
<td>Soft silty brown sandy silt, some sand and gravel, very moist, dark brown</td>
</tr>
<tr>
<td>2.45</td>
<td>Weathered red shale</td>
</tr>
</tbody>
</table>

**BOREHOLE TERMINATED AT 2.85m**

Upon completion of boring, no tree water, no core.

---

### RECORD OF BOREHOLE NO. 1

**JOB NO.** 702134

**JOB NAME** Watermain - Mississauga, Ontario

**CLIENT** City of Mississauga

**ENGINEER** GDF/GE

**TECHNICIAN** L. Watson

**GROUND ELEV.** 82.03

**BORING DATE** Dec. 31/79

**TECHNICAL** L. Watson

---

### DYNAMIC CONE PENETRATION REPORT

<table>
<thead>
<tr>
<th>DEPTH (M)</th>
<th>SOIL TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30</td>
<td>Fill-clayey, very moist, dark brown</td>
</tr>
<tr>
<td>1.35</td>
<td>Clayey silt till-brown fine, moist, mainly fine gravel with occasional medium gravel</td>
</tr>
</tbody>
</table>

**REMARKS**

- At completion B1 open end dry
- 1 hr. later same

---

**SOIL PROFILE**

- **SOIL PROFILE**
  - Description
  - Type
  - Soil Classification

**SAMPLES**

- **SAMPLES**
  - Type
  - Soil Classification

**REMARKS**

- **REMARKS**
  - Description
  - Type
  - Soil Classification

---

**NOTES:** Refer to Drawing 1d for location.
RECORD OF BOREHOLE NO. E-R
JOB NO. 65329
JOB NAME: King Street West Relocation
TECHNICIAN: JF
BORING DATE: Jan. 7/66
CLIENT: Corporation of the City of Hamilton
ENGINEER: JH
GROUND ELEV: 326.86
BOREHOLE TYPE: Standard Rig

SOIL PROFILE
DEPTH ELEV. 180'
DESCRIPTION
CLAY, reddish brown, fine sandy clay, V. wet
COMPACT TO LOOSE
BAND, reddish brown, clayey fine sand, Saturated
COMPACT
BAND, reddish brown, silty clayey very fine sand
SATURATED
DENSE
HOLE TERMINATED AT 31 1/2'

DYNAMIC LORE PENETRATION
SAMPLES
DEPTH PENETRATION TEST
10 20 30 40 50
SHEAR STRENGTH C, PSF
WATER CONTENT
Remarks

CLAY, reddish brown, sandy clay
1 88 9
V. WET TO MOIST
2 88 9
LOOSE TO DENSE
3 88 31
DENSE
4 88 28
SAND, reddish brown, clayey sand
5 88 55
SAND, brown fine sandy silt
6 55 12
SAND, brown very fine sandy silt
7 88 31
DENSE
8 55 16

CLAY, brown silty clay
9 55 16
V. STIFF
10 88 46
HOLE TERMINATED AT 31 1/2'

WATER CONTENT
10 15 20

EDM Peto Associates Ltd.
Consulting Soil Engineers
### Log of Borehole No. 1

**Location:** Main Street West, Hamilton

**Project Manager:** Ian Shew, B. Eng., EIT

**Client:** Sutton & Associates

#### Subsurface Profile

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Description</th>
<th>Type</th>
<th>Blown/300mm</th>
<th>PP (Kn/400mm)</th>
<th>LIM (%)</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Ground Surface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.24</td>
<td>Asphalastic Concrete</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-1.00</td>
<td>Granular Base</td>
<td>SS</td>
<td>1</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-1.00</td>
<td>Sand and Gravel Fill</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2.30</td>
<td>Silty Sand/Sandy Silt</td>
<td>SS</td>
<td>3</td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**End of Borehole**

**Notes:**
1. Borehole advanced using solid stem continuous flight auger equipment on February 11, 2004 to a depth of 2.3 metres.
2. No free groundwater present at the completion of drilling. Borehole backfilled with auger cuttings.
3. Soil samples will be discarded after three months unless otherwise directed by the client.

---

### Log of Borehole No. 4

**Location:** Main Street West, Hamilton

**Project Manager:** Ian Shew, B. Eng., EIT

**Client:** Sutton & Associates

#### Subsurface Profile

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Description</th>
<th>Type</th>
<th>Blown/300mm</th>
<th>PP (Kn/400mm)</th>
<th>LIM (%)</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Ground Surface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.30</td>
<td>Topsoil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2.30</td>
<td>Silty Sand and Gravel Fill</td>
<td>A3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**End of Borehole**

**Notes:**
1. Borehole advanced using solid stem continuous flight auger equipment on February 11, 2004 to a depth of 2.3 metres.
2. No free groundwater present at the completion of drilling. Borehole backfilled with auger cuttings.
3. Soil samples will be discarded after three months unless otherwise directed by the client.
### Log of Borehole No. 5

**Borehole Location:** See Drawing No. 1

**Client:** Sutton & Associates

**Project Manager:** Ian Shew, B. Eng., EIT

#### SUBSURFACE PROFILE

<table>
<thead>
<tr>
<th>Depth</th>
<th>Symbol</th>
<th>Description</th>
<th>Elevation</th>
<th>Number</th>
<th>Blow/300mm</th>
<th>DP (mm)</th>
<th>UM (M/Nm²)</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td></td>
<td>Topsoil</td>
<td></td>
<td></td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.10</td>
<td></td>
<td>Silty Sand Fill</td>
<td></td>
<td></td>
<td>17</td>
<td></td>
<td>10%</td>
<td>60%</td>
</tr>
<tr>
<td>1.10</td>
<td></td>
<td>Silty Sand/Sandy Silt</td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td>10%</td>
<td>60%</td>
</tr>
<tr>
<td>-2.30</td>
<td></td>
<td>End of Borehole</td>
<td></td>
<td></td>
<td>6</td>
<td></td>
<td>10%</td>
<td>60%</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Borehole advanced using solid stem continuous flight auger equipment on February 11, 2004 to a depth of 2.3 metres.
2. No free groundwater present at the completion of drilling. Borehole backfilled with auger cuttings.
3. Soil samples will be discarded after three months unless otherwise directed by the client.

**Drill Method:** Solid Stem Auger

**Datum:** Ground Surface

**Hole Size:** 100mm

**Drill Date:** Feb 11, 2004

**Phone:** (905) 318-7440, Fax: (905) 318-7455

**e-mail:** info@soil-mat.on.ca

**Sheet:** 1 of 1

---

### Log of Borehole No. 7

**Borehole Location:** See Drawing No. 1

**Client:** Sutton & Associates

**Project Manager:** Ian Shew, B. Eng., EIT

#### SUBSURFACE PROFILE

<table>
<thead>
<tr>
<th>Depth</th>
<th>Symbol</th>
<th>Description</th>
<th>Elevation</th>
<th>Number</th>
<th>Blow/300mm</th>
<th>DP (mm)</th>
<th>UM (M/Nm²)</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td></td>
<td>Asphaltic Concrete</td>
<td></td>
<td></td>
<td>-0.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.10</td>
<td></td>
<td>Silty Sand and Gravel Fill</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>10%</td>
<td>60%</td>
</tr>
<tr>
<td>1.10</td>
<td></td>
<td>Silty Sand/Sandy Silt</td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td>10%</td>
<td>60%</td>
</tr>
<tr>
<td>-2.30</td>
<td></td>
<td>End of Borehole</td>
<td></td>
<td></td>
<td>11</td>
<td></td>
<td>10%</td>
<td>60%</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Borehole advanced using solid stem continuous flight auger equipment on February 11, 2004 to a depth of 2.3 metres.
2. No free groundwater present at the completion of drilling. Borehole backfilled with auger cuttings.
3. Soil samples will be discarded after three months unless otherwise directed by the client.

**Drill Method:** Solid Stem Auger

**Datum:** Ground Surface

**Hole Size:** 100mm

**Drill Date:** Feb 11, 2004

**Phone:** (905) 318-7440, Fax: (905) 318-7455

**e-mail:** info@soil-mat.on.ca

**Sheet:** 1 of 1
### Log of Borehole No. 8

**Project No.:** SM 041546-G  
**Project:** Watermain Replacement  
**Location:** Main Street West, Hamilton  
**Client:** Sutton & Associates  
**Project Manager:** Ian Shaw, B. Eng., EIT

---

### SUBSURFACE PROFILE

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Soil Description</th>
<th>Soil Type</th>
<th>Penetration Number (SS)</th>
<th>Moisture Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Ground Surface</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.10</td>
<td>Silty Sand/Sandy Silt</td>
<td>SS 1 17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.00</td>
<td>Sand and Gravel Fill</td>
<td>SS 2 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.30</td>
<td>Silty Sand/Sandy Silt</td>
<td>SS 3 9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**End of Borehole**  
NOTES:  
1. Borehole advanced using solid stem continuous flight auger equipment on February 11, 2004 to a depth of 2.3 metres.  
2. No free groundwater present at the completion of drilling. Borehole backfilled with auger cuttings.  
3. Soil samples will be discarded after three months unless otherwise directed by the client.

---

### SAMPLE

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Soil Type</th>
<th>Penetration Number (SS)</th>
<th>Moisture Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.10</td>
<td>Silt</td>
<td>SS 1 35</td>
<td></td>
</tr>
<tr>
<td>4.00</td>
<td>Silt</td>
<td>SS 2 35</td>
<td></td>
</tr>
<tr>
<td>6.30</td>
<td>Silt</td>
<td>SS 3 35</td>
<td></td>
</tr>
</tbody>
</table>

**BOREHOLE TERMINATED**  
2.6 ft

---

### Material Description

- **Ground Surface:** 0.00 ft
- **100 mm Asphalt:** 0.00 ft
- **150 mm Concrete:** 1.10 ft
- **75 mm Gravel:** 4.00 ft
- **SILT:** 6.30 ft

### Soil Sample

- **SPT N Value:** 35

---

**Drill Method:** Solid Stem Auger  
**Drill Date:** Feb 11, 2004  
**Hole Size:** 100mm  
**Datum:** Ground Surface  
**Checked by:** IS  
**Sheet:** 1 of 1

---

**Notes:**  
1. On completion, borehole open to 2.8 m and dry.
### Log of Borehole

#### Project: Proposed Store Severs

**Location:** Region of Hamilton - Wentworth, Main St. at Bond St., Hamilton, Ontario

**Project No.:** 101780-6

#### Soil Description

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Type of Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 - 0.5</td>
<td>Open sand and silt, moist</td>
</tr>
<tr>
<td>0.5 - 1.0</td>
<td>Open gravel and silt, moist, dense</td>
</tr>
<tr>
<td>1.0 - 1.5</td>
<td>Silty clay, gray, fine to medium grained, moist, firm to soft</td>
</tr>
<tr>
<td>1.5 - 2.0</td>
<td>Silty clay, gray, fine to medium grained, moist, firm to soft</td>
</tr>
</tbody>
</table>

#### Notes:

- (1) Borehole advanced uncontrolled by soil conditions at 1.4 m depth, on January 16, 1986, by Trow 114.

---

#### Notes:

- (1) Borehole advanced uncontrolled by soil conditions at 1.4 m depth, on January 16, 1986, by Trow 114.
LOG OF BOREHOLE NO. 2

SOIL DESCRIPTION

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample</th>
<th>Type</th>
<th>Blows per 300 mm (N Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>79.7</td>
<td>SS</td>
<td>11</td>
<td>0 20 40 60 80 100 120</td>
</tr>
<tr>
<td>8.2</td>
<td>SS</td>
<td>14</td>
<td>0 20 40 60 80 100 120</td>
</tr>
</tbody>
</table>

SILTY CLAY
layered with silt and sand seams, vertical fissures, red shale fragments, trace of gravel, oxidized brown to unoxidized grey below 10.9 m, moist to very moist,
(VERY STIFF TO STIFF)
— desiccated and oxidized grey—brown becoming unoxidized grey below 10.9 m

SHALE (Queenston Formation)
layered with grey siltstone seams, weathered, red
moist,

BOREHOLE TERMINATED

NOTES:
1. BOREHOLE OPEN TO 163 m ON COMPLETION.
2. WATER LEVEL AT 12 m ON COMPLETION.

LOG OF BOREHOLE NO. 3

SOIL DESCRIPTION

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample</th>
<th>Type</th>
<th>Blows per 300 mm (N Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>97.3</td>
<td>SS</td>
<td>11</td>
<td>0 20 40 60 80 100 120</td>
</tr>
<tr>
<td>86.4</td>
<td>SS</td>
<td>14</td>
<td>0 20 40 60 80 100 120</td>
</tr>
</tbody>
</table>

FILL
silty clay with silt and sand, dark brown to brown, rockinls and organics, moist

FILL: 5 SS 1.1 1.5
ash, cinders, sand, organics, decayed plant fibers and wood, pieces of porcelain and glass, generally grey to black
(LOOSE TO VERY LOOSE)

SAND AND SILT
fine sand grains, slightly clayey, oxidized brown, clay seams @ 4.0 m
(COMPAKT)

SILTY CLAY
layered with silt and sand seams, vertical fissures, red shale fragments, trace of gravel, oxidized brown to unoxidized grey below 6.1 m, moist to very moist
(FIRM TO STIFF)

BOREHOLE CONTINUED ON NEXT PAGE
<table>
<thead>
<tr>
<th>ELEV.</th>
<th>SOIL DESCRIPTION</th>
<th>N</th>
<th>SAMPLE IDENT.</th>
<th>STD PENETRATION TEST</th>
<th>MOIST (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>77.3</td>
<td>Continued from previous page</td>
<td>10.0</td>
<td>20 40 60 80 100 120</td>
<td>0</td>
<td>14.9 %</td>
</tr>
<tr>
<td></td>
<td>Silt and sand seams, vertical fissures, red shale fragments, trace of gravel, oxidized brown to unoxidized grey below 6.1 m, moist to very moist (FIRM TO STIFF)</td>
<td></td>
<td></td>
<td>12</td>
<td>21.7 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>21.3 %</td>
</tr>
<tr>
<td></td>
<td>SHALE (Queenston Formation) layered with grey silstone seams, weathered, red, moist (HARD)</td>
<td>15</td>
<td>20.4</td>
<td>18</td>
<td>20.9 %</td>
</tr>
<tr>
<td>86.2</td>
<td>FILL</td>
<td>3</td>
<td>1.1</td>
<td>0.7</td>
<td>33.0 %</td>
</tr>
<tr>
<td>87.5</td>
<td>silty clay with silt and sand, dark brown to brown, rootless and organic, moist</td>
<td>7</td>
<td>1.8</td>
<td>7</td>
<td>31.2 %</td>
</tr>
<tr>
<td></td>
<td>FILL</td>
<td>4</td>
<td>6.6</td>
<td>11</td>
<td>20.9 %</td>
</tr>
<tr>
<td></td>
<td>ash, cinders, sand, organic, decayed plant fibres and wood, pieces of porcelain and glass, generally grey to black, possible asphalt shingles @ 5m, black cemented foundry sand @ 6 m, wet below 7m</td>
<td>8</td>
<td>4.1</td>
<td>8</td>
<td>37.6 %</td>
</tr>
<tr>
<td></td>
<td>(LOSE TO VERY LOOSE)</td>
<td>15</td>
<td>6.4</td>
<td>15</td>
<td>33.7 %</td>
</tr>
<tr>
<td>78.1</td>
<td>SILT CLAY</td>
<td>5</td>
<td>7.9</td>
<td>5</td>
<td>19.5 %</td>
</tr>
<tr>
<td></td>
<td>layered with silt and sand seams, vertical fissures, red shale fragments, trace of gravel, oxidized brown, moist to very moist (HARD)</td>
<td>10.1</td>
<td>10.4</td>
<td>10.1</td>
<td>61.2 %</td>
</tr>
</tbody>
</table>

**Notes:**
1. BOREHOLE OPEN TO 20.5 m ON COMPLETION.
2. BOREHOLE WAS DRY UPON COMPLETION.
### Log of Borehole No. 4

- **MOL PROJECT NO.**: S0520
- **Drilling Date**: May 10, 1994
- **Client**: Regional Municipality of Hamilton-Wentworth
- **Project Name**: Proposed Cog Tank
- **Location**: Cathedra Park, Main St. @ HWY 403, Hamilton
- **Elev. Datum**: Geodetic
- **Driller**: K & S Drilling

**SOIL DESCRIPTION**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth</th>
<th>Type</th>
<th>N Value</th>
<th>Penetration Test</th>
<th>QL (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>79.3</td>
<td>10.0</td>
<td>SS</td>
<td>0 20 40 60 80 100 120</td>
<td>0 20 40 60 80 100 120</td>
<td>19.5%</td>
</tr>
</tbody>
</table>

- **Silty Clay**
  - Layered with silt and sand seams, vertical fissures, red stony fragments, trace gravel, oxidized browns, oxidized grey below 11.6 m, moist to very moist
  - **HARD**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth</th>
<th>Type</th>
<th>N Value</th>
<th>Penetration Test</th>
<th>QL (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>65.6</td>
<td>23.2</td>
<td>SS</td>
<td>0 20 40 60 80 100 120</td>
<td>0 20 40 60 80 100 120</td>
<td>23.1%</td>
</tr>
</tbody>
</table>

- **Shale** (Queenston Formation)
  - Layered with grey silstone seams, weathered, red, moist
  - **HARD**

**Borehole continued on next page**

### Log of Borehole No. 5

- **MOL PROJECT NO.**: S0520
- **Drilling Date**: May 16, 1994
- **Client**: Regional Municipality of Hamilton-Wentworth
- **Project Name**: Proposed Cog Tank
- **Location**: Cathedra Park, Main St. @ HWY 403, Hamilton
- **Elev. Datum**: Geodetic
- **Driller**: K & S Drilling

**SOIL DESCRIPTION**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth</th>
<th>Type</th>
<th>N Value</th>
<th>Penetration Test</th>
<th>QL (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>89.8</td>
<td>0.0</td>
<td>SS</td>
<td>0 20 40 60 80 100 120</td>
<td>0 20 40 60 80 100 120</td>
<td>39.5%</td>
</tr>
</tbody>
</table>

- **Fill**
  - Silty clay with silt and sand, dark brown to brown, rootless and organics, moist

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth</th>
<th>Type</th>
<th>N Value</th>
<th>Penetration Test</th>
<th>QL (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>89.2</td>
<td>4</td>
<td>SS</td>
<td>1.1</td>
<td>1.1</td>
<td>45.5%</td>
</tr>
<tr>
<td>2</td>
<td>SS</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>36.5%</td>
</tr>
<tr>
<td>6</td>
<td>SS</td>
<td>2.6</td>
<td>2.6</td>
<td>2.6</td>
<td>34.6%</td>
</tr>
<tr>
<td>7</td>
<td>SS</td>
<td>3.4</td>
<td>3.4</td>
<td>3.4</td>
<td>21.2%</td>
</tr>
<tr>
<td>17</td>
<td>SS</td>
<td>6.4</td>
<td>6.4</td>
<td>6.4</td>
<td>45.5%</td>
</tr>
</tbody>
</table>

- **Fill**
  - Ash, clays, sand, organics, decayed plant fibres and wood, pieces of porcelain and glass, generally grey to black, wet below 9.4 m

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth</th>
<th>Type</th>
<th>N Value</th>
<th>Penetration Test</th>
<th>QL (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>SS</td>
<td>4.9</td>
<td>4.9</td>
<td>4.9</td>
<td>21.2%</td>
</tr>
</tbody>
</table>

**Borehole continued on next page**
### LOG OF BOREHOLE NO. 5

**MOUNTAINVIEW GEOTECHNICAL LTD.**

**CONSULTING ENGINEERS**

**DFW NO. 1**

**LOG OF BOREHOLE NO. 5**

(Cont'd)

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Soil Description</th>
<th>Sample</th>
<th>Borehole Test</th>
<th>Moisture Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>79.8</td>
<td>FILL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79.2</td>
<td>SILT CLAY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>84.1</td>
<td>FILL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>83.2</td>
<td>SILT CLAY</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### LOG OF BOREHOLE NO. 20

**MOUNTAINVIEW GEOTECHNICAL LTD.**

**CONSULTING ENGINEERS**

**DFW NO. 40**

**LOG OF BOREHOLE NO. 20**

(Cont'd)

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Soil Description</th>
<th>Sample</th>
<th>Borehole Test</th>
<th>Moisture Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>84.1</td>
<td>FILL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>83.2</td>
<td>SILT CLAY</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**BOREHOLE CONTINUES ON NEXT PAGE**

**NOTES:**

1. WET CAVE TO 82 m. WATER LEVEL AT 6.7 m.
KING STREET WEST
### LOG OF BOREHOLE No. 3 & 4

**PETO MAcCALLUM LTD.**
**CONSULTING GEOTECHNICAL ENGINEERS**

**FOR:** PROPOSED EDER CONSTRUCTION  
**LOCATION:** King Street, Hamilton  
**BORING DATE:** Feb. 17, 1977  
**REPORT:** 2/25

#### DEPTH (FT)  |  DESCRIPTION  |  SAMPLE  |  DENSITY  (MG/L)  |  PLASTIC LIMIT  |  WATER CONTENT  |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 10</td>
<td>SAND: Compact brown silty fine sand. Becoming loose.</td>
<td>1.65 28</td>
<td>1.85 8</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>10 - 20</td>
<td>SAND: Brown silty fine to medium sand. Becoming medium silty.</td>
<td>1.65 37</td>
<td>1.85 66</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>20 - 30</td>
<td>SAND: Loose light brown fine sand.</td>
<td>1.65 31</td>
<td>1.85 65</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>30 - 40</td>
<td>SAND AND GRAVEL: Dense to very dense brown coarse sand with gravel.</td>
<td>1.65 43</td>
<td>1.85 65</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>40 - 50</td>
<td>SAND: Silty fine to coarse sand with gravel.</td>
<td>1.65 43</td>
<td>1.85 65</td>
<td>7.5</td>
<td></td>
</tr>
</tbody>
</table>

**Borehole No. 4**  
**Ground Elevation:** 341.4

**SAND:** Compact brown silty fine to coarse sand and gravel. Becoming very loose dark brown silty fine to coarse sand.  
**Borehole terminated at 18' 5".**

**Borehole No. 5**  
**Ground Elevation:** 352.6

**SAND:** Loose light brown silty fine sand.  
**Borehole terminated at 18' 5".**

---

**MEMBER OF THE ASSOCIATION OF CONSULTING ENGINEERS OF CANADA**

---

---
# Engineering Data Sheet for Borehole

**Location:** King St. W., Hamilton, Ont.

**Hole Location:** See Drawing No. 1

**Hole Elevation and Datum:** 325.4 ft.

**Start Date:** March 15/71

**End Date:** 15/71

**Prep:** E.H.

**Checked:** O.B.

**Casing:**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>APM</td>
<td>Asphalts &amp; Conc. Base (unb)</td>
</tr>
<tr>
<td>325.4</td>
<td>324</td>
</tr>
<tr>
<td></td>
<td>Sand-loose; fine to medium; reddish brown; moist (probably fill).</td>
</tr>
<tr>
<td>317</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sand-dense; fine to medium; reddish brown; moist</td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Layer of conglomerate; white sand and gravel; approx. 9&quot; thick at 17 ft. depth; underlain by sand &amp; gravel.</td>
</tr>
<tr>
<td>302</td>
<td></td>
</tr>
<tr>
<td></td>
<td>End of Borehole</td>
</tr>
</tbody>
</table>

**Depth and Penetration Resistance**

<table>
<thead>
<tr>
<th>ELEV. FEET</th>
<th>DEPTH FEET</th>
<th>STRENGTH AND PENETRATION RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>325.4</td>
<td>0</td>
<td>F, 20, 40, 60, 80</td>
</tr>
<tr>
<td>317</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>302</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

1. Borehole advanced to 17 ft. depth using flight auger equipment together with conventional wash boring technique for breaking through the conglomerate layer.

2. On completion, hole dry and open to 21 ft. depth.
Log of Borehole 1

Project No.: HAGE-0001496-A  Drawing No.: 4
Project: Geotechnical Investigation - Proposed Sewer and Watermain Construction  Sheet No.: 1 of 1
Location: James Street (King Street to Wilson Street), Hamilton, Ontario

Date Drilled: May 12, 2001
Dell Type: Truck Mount
Date:  

Soil Description

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
<th>Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Asphalt</td>
<td>0.00-0.40</td>
</tr>
<tr>
<td>0.40</td>
<td>Fill (sand and gravel)</td>
<td>0.40-0.70</td>
</tr>
<tr>
<td>0.70</td>
<td>Sand &amp; gravel, brown, milty, 100 mm brick</td>
<td>0.70-3.70</td>
</tr>
<tr>
<td>3.70</td>
<td>Sand, fine grained, some clay, very loose to loose</td>
<td>3.70-8.04</td>
</tr>
<tr>
<td>8.04</td>
<td>Sand &amp; gravel, very loose, silty sand, some gravel, compact to dense</td>
<td>8.04-12.04</td>
</tr>
</tbody>
</table>

Borehole Terminated

Notes:
1. Borehole was advanced by solid stem auger equipment to a termination depth of 12.0 m on May 12, 2001.
2. Upon completion of drilling, no core, no water.
3. In hole moisture reading using MSA equipment: 9% moisture.
4. Upon completion of drilling, 19 mm (3/4") diameter P.V.C. standoff injected to 5.4 m depth, screened portion 2.6 to 3.3 m in depth

Trow Consulting Engineers Ltd.
425 Milton Road
Stoney Creek, Ontario, L8E 3N9
Telephone: 905-664-3300
Fax: 905-662-4144
E-Mail: hamilton@trow.com
<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>DESCRIPTION</th>
<th>ELEV.</th>
<th>DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GROUND SURFACE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brown gravel, fine sand, gravel and cobbles</td>
<td>90.46</td>
<td>4.11</td>
</tr>
<tr>
<td></td>
<td>Dense, brown, silty sand, gravel and cobbles</td>
<td>89.57</td>
<td>5.20</td>
</tr>
<tr>
<td></td>
<td>Raw gravel, some silt, gravel</td>
<td>88.63</td>
<td>5.94</td>
</tr>
<tr>
<td></td>
<td>BOREHOLE TERMINATED</td>
<td>80.02</td>
<td>6.55</td>
</tr>
</tbody>
</table>

**NOTES:**
- gw: Groundwater encountered at 6.6 metres, level observed at 5.0 metres on completion.
- Borehole was backfilled on completion of fieldwork.
## LOG OF BOREHOLE 2

**Auger Sample**
- SPT(N) Value: 0
- Dynamic Cone Test: 0
- Shelby Tube: +
- Natural Moisture: X
- Plastic and Liquid Limit: X

**Penetrometer**
- Borehole location and datum see Drawing No. 2

<table>
<thead>
<tr>
<th>Soil Description</th>
<th>Depth (m)</th>
<th>N Value</th>
<th>Natural Moisture % Dry Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphallic Concrete - 150 mm thick</td>
<td>91.7</td>
<td>0.5</td>
<td>18</td>
</tr>
<tr>
<td>FILL: Sand and gravel, same slag, grey, moist</td>
<td>91.7</td>
<td>0.5</td>
<td>18</td>
</tr>
<tr>
<td>SILTY SAND: Reddish brown, trace of clay and gravel, moist, compact to dense</td>
<td>91.7</td>
<td>0.5</td>
<td>18</td>
</tr>
<tr>
<td>- becoming brown from 3.2 to 3.5m depth</td>
<td>91.7</td>
<td>0.5</td>
<td>18</td>
</tr>
</tbody>
</table>

**BOREHOLE TERMINATED**

---

## LOG OF BOREHOLE 3

**Auger Sample**
- SPT(N) Value: 0
- Dynamic Cone Test: 0
- Shelby Tube: +
- Natural Moisture: X
- Plastic and Liquid Limit: X

**Penetrometer**
- Borehole location and datum see Drawing No. 2

<table>
<thead>
<tr>
<th>Soil Description</th>
<th>Depth (m)</th>
<th>N Value</th>
<th>Natural Moisture % Dry Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphallic Concrete - 200mm thick</td>
<td>91.7</td>
<td>0.5</td>
<td>18</td>
</tr>
<tr>
<td>FILL: Sand and gravel, same slag, brown, damp</td>
<td>91.7</td>
<td>0.5</td>
<td>18</td>
</tr>
<tr>
<td>SILTY SAND: Reddish Brown, trace of clay and gravel, moist, compact to dense</td>
<td>91.7</td>
<td>0.5</td>
<td>18</td>
</tr>
<tr>
<td>- with trace of red from 1.5 to 2.0m depth</td>
<td>91.7</td>
<td>0.5</td>
<td>18</td>
</tr>
<tr>
<td>- brown cemented sand seams from 3.4 to 3.5m depth</td>
<td>91.7</td>
<td>0.5</td>
<td>18</td>
</tr>
</tbody>
</table>

**BOREHOLE TERMINATED**

---

**NOTE:** BOREHOLE DATA REQUIRES INTERPRETATION ASSISTANCE FROM TROW BEFORE USE BY OTHERS.
1. Borehole advanced by solid stem auger to a termination depth of 3.5 m on March 16, 1968 by Landada Drilling Ltd.
2. Upon completion of drilling, no core, no free water.
3. Borehole backfilled and packed upon completion of drilling.
### Log of Borehole No. 6-1

**Project:** Proposed Road Reconstruction - Phase II  
**Location:** Hamilton, Ontario  
**Borehole Location:** Wellington St. N, N of King St. E  
14m N, 2m W of road hydro pole #8390  

**Client:** Sutton & Associates  
**Project Manager:** Ian Shaw, B.Eng., E.I.T.

---

#### Subsurface Profile

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td></td>
<td>Ground Surface 91.29</td>
</tr>
<tr>
<td>0.02</td>
<td></td>
<td>Asphaltic Concrete 91.02</td>
</tr>
<tr>
<td>0.05</td>
<td></td>
<td>Portland Cement Concrete Approximately 200mm 09.85</td>
</tr>
<tr>
<td>0.09</td>
<td></td>
<td>Granular Base Approximately 100mm 09.85</td>
</tr>
<tr>
<td>0.11</td>
<td></td>
<td>Silty Sand Fill Brown, trace of fine gravel, moist, compact.</td>
</tr>
<tr>
<td>0.12</td>
<td></td>
<td>Sand Brown, medium to fine grained, trace of to some silt, occasional thin layering, moist, compact.</td>
</tr>
<tr>
<td>0.19</td>
<td></td>
<td>Silty Clay Grey, trace fine gravel, moist, very stiff. 87.29</td>
</tr>
</tbody>
</table>

---

**NOTES:**

1. Borehole advanced using solid stem continuous flight auger equipment on October 23, 2003 to a depth of 5.2 metres.
3. Soil samples will be discarded after three months unless otherwise directed by the client.

**Drill Method:** Solid Stem Auger

**SOIL-MAT ENGINEERS & CONSULTANTS LTD.**  
130 Lancing Drive, Hamilton, ON L8W 3A1  
Phone: (905) 318-7440 Fax: (905) 318-7455  
e-mail: info@soil-mat.on.ca

**Datum:** Geodetic  
**Drill Date:** October 23, 2003  
**Hole Size:** 150mm  
**Checked by:** IS  
**Sheet:** 1 of 1
### Soil Profile

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
<th>Samples</th>
<th>Liquid Limit W&lt;sub&gt;L&lt;/sub&gt;</th>
<th>Plastic Limit W&lt;sub&gt;P&lt;/sub&gt;</th>
<th>Water Content W&lt;sub&gt;W&lt;/sub&gt;</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.75</td>
<td>Fill, Dark brown sandy till, moist</td>
<td>2 S2 4</td>
<td>20 20 30 40 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.25</td>
<td>Loose</td>
<td>2 S2 8</td>
<td>20 20 30 40 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.5</td>
<td>Red/Brown, brown interbedded sandy and silty sand, moist, compact</td>
<td>4 S2 12</td>
<td>20 20 30 40 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.0</td>
<td>Gray clayey to medium sand, wet</td>
<td>6 S2 21</td>
<td>20 20 30 40 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.0</td>
<td>Viscous, clayey till, moist, Silt till</td>
<td>2 S2 11</td>
<td>20 20 30 40 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>Wet, Viscous, clayey till, moist, Silt till</td>
<td>2 S2 11</td>
<td>20 20 30 40 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33.85</td>
<td>Viscous, clayey till, moist, Silt till</td>
<td>6 S2 11</td>
<td>20 20 30 40 50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Site Test Engineering Data Sheet for Borehole

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Depth (ft) ELEV.</td>
</tr>
<tr>
<td></td>
<td>10  20  30  40  50</td>
</tr>
<tr>
<td></td>
<td>Water Content W&lt;sub&gt;W&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>Sample REC No.</td>
</tr>
</tbody>
</table>

- **Field Tests**
  - Soil: 5D O.D. Split Trench
  - Natural Moisture Content
  - Plastic Limit

- **Laboratory Tests**
  - Core Sample
  - Cone Test
  - Penetrometer
  - Unconfined Compressibility

**NOTES:**
1. Borehole was mixed and open to 4.1 meters on completion.
2. Borehole was backfilled on completion of the fieldwork.
Log of Borehole 1

Project No.: HAGE-0000494-4
Project: Geotechnical Investigation - Proposed Sewer and Watermain Construction
Location: Wentworth Street (King Street to Barton Street), Hamilton, Ontario
Sheet No.: 1 of 1

Date Dated: April 29, 2001
Dill Type: Truck Mount
Drill: None

Soil Description

ASPHALT - 22 mm thick
CONCRETE (javeline slabs) - 100 mm thick
PSL: stiff sand, brown, fine grained, moist, compact
- wet/dried brown from 0.6 to 1.2 m

SILTY SAND: light brown to dark brown, well graded sand, moist, dense

SILTY CLAY TILL: grey, moist

Borehole Terminated

Notes:
1. Borehole advanced by solid stem auger equipment to a termination depth of 3.3 m on April 28, 2001.
2. Upon completion of drilling, core at 3.4 m depth, no water.
4. Upon completion of drilling, 10 mm (3/8") diameter P.V.C. standpipe installed to 3.4 m depth, intended position 2.5 to 2.4 m depth, transmitted 0.3 to 0.1 m depth and asphalt patch from 0 to 0.2 m depth.

Trow Consulting Engineers Ltd.
229 Millen Road
Stoney Creek, Ontario, L8E 3N9
Telephone: 905-666-3300
Fax: 905-652-4144
E-Mail: hamilton@trow.com
<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
<th>Sample</th>
<th>Density</th>
<th>Specific Gravity</th>
<th>Water Cont.</th>
<th>Color</th>
<th>Texture</th>
<th>Soils in Core</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Drift clay (silt)</td>
<td>1</td>
<td>2.55</td>
<td>2.55</td>
<td>0.00</td>
<td>Brown</td>
<td>Gritty</td>
<td></td>
</tr>
<tr>
<td>1.50</td>
<td>Drift sand (silt)</td>
<td>2</td>
<td>2.55</td>
<td>2.55</td>
<td>0.00</td>
<td>Brown</td>
<td>Gritty</td>
<td></td>
</tr>
<tr>
<td>3.50</td>
<td>Drift sand (silt)</td>
<td>3</td>
<td>2.55</td>
<td>2.55</td>
<td>0.00</td>
<td>Brown</td>
<td>Gritty</td>
<td></td>
</tr>
<tr>
<td>5.50</td>
<td>Drift sand (silt)</td>
<td>4</td>
<td>2.55</td>
<td>2.55</td>
<td>0.00</td>
<td>Brown</td>
<td>Gritty</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- Borehole located 30° south of anticipated location due to previous wires.
- The borehole was terminated at 15'.
### Project No. R903
**Location:** PROPOSED SEWER - KING STREET & GAGE
***Ontario***

- **Date:** APR 07, 1992
- **Method:** SOIL STEM AUGER (160 MM O.D.)
- **Date:** GEOEDIC - 87.564 METRES

### Data Sheet for Borehole

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
<th>Elevation</th>
<th>Depth</th>
<th>Percentage</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Fill, Silt</strong></td>
<td>87.38</td>
<td>0.18</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>87.13</td>
<td>0.43</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>Silty Clay</strong></td>
<td>85.89</td>
<td>1.67</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>Sandy Clay</strong></td>
<td>82.23</td>
<td>5.33</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><strong>Silty Clay Till</strong></td>
<td>82.00</td>
<td>5.50</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><strong>Sandy Clay</strong></td>
<td>81.16</td>
<td>6.40</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td><strong>Borehole Terminated</strong></td>
<td>79.48</td>
<td>8.08</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. Water level observed at 5.5 metres 1/2 hour after completion of borehole.
2. Borehole was backfilled on completion.
3. Borehole was relocated to the southeast corner of King/Gage.
4. Actual elevations are slightly lower than shown.

---

### Project No. R903
**Location:** PROPOSED SEWER - KING STREET & EASTEND
***Ontario***

- **Date:** APR 07, 1992
- **Method:** SOIL STEM AUGER (160 MM O.D.)
- **Date:** GEOEDIC - 89.432 METRES

### Data Sheet for Borehole

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
<th>Elevation</th>
<th>Depth</th>
<th>Percentage</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Silt</strong></td>
<td>89.28</td>
<td>0.15</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>89.09</td>
<td>0.35</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>Silty Clay</strong></td>
<td>81.23</td>
<td>3.20</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>Borehole Terminated</strong></td>
<td>82.88</td>
<td>6.55</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. Borehole was moist and open to 6.0 metres on completion of borehole.
2. Borehole was backfilled on completion.
3. Borehole was relocated to the southwest corner of King/Eastend.
4. Actual elevations are slightly lower than shown.
1. BOREHOLE WAS MOIST AND OPEN TO 4.5 METRES ON COMPLETION OF BOREHOLE.
2. BOREHOLE WAS BACKFILLED ON COMPLETION.
3. BOREHOLE WAS RELOCATED TO THE SOUTHWEST CORNER OF KING/GLENDALE.
4. ACTUAL ELEVATIONS ARE SLIGHTLY LOWER THAN SHOWN.
MAIN STREET EAST
APPENDIX C

BOREHOLE LOCATION PLANS
AND INFERRED STRATIGRAPHIC PROFILE
For preliminary configuration west of this point please see Figure 2.1 in main body of Report
APPENDIX D

STATEMENT OF GENERAL CONDITIONS
STATEMENT OF GENERAL CONDITIONS

1. STANDARD OF CARE
This study and Report have been prepared in accordance with generally accepted engineering or environmental consulting practices in this area. No other warranty, expressed or implied, is made.

2. COMPLETE REPORT
All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT
The Report has been prepared for the specific site, development, design objectives and purposes that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this Report expressly addresses proposed development, design objectives and purposes, and then only to the extent there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation or to consider such representations, information and instructions.

4. USE OF THE REPORT
The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS WE MAY EXPRESSLY APPROVE. The contents of the Report remain our copyright property. The Client may not give, lend, or sell the Report, or otherwise make the Report, or any portion thereof, available to any person without our prior written permission. Any use which a third party makes of the Report, are the sole responsibility of such third parties. Unless expressly permitted by us, no person other than the Client is entitled to rely on this Report. We accept no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without our express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description. Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel, may fail to locate some contaminants. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our expressed written consent should be aware of this risk and this report is delivered on the express condition that such risk is accepted by the Client and such other parties. Some conditions are subject to change over time and those making use of the Report should be aware of the possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should discuss them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of the site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

[see over . . . .]
INTERPRETATION OF THE REPORT (continued . . . )

c) Design Services: The Report may form part of the design and construction documents for information purposes even if it may have been issued prior to the final design being completed. You would be retained to review the final design, project plans and documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the report recommendations and the final design detailed in the contract documents should be reported to us immediately so that we can address potential conflicts.

d) Construction Services: During construction we must be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thuerber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RISK LIMITATION

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to result in accidental release of those substances. In consideration of the provision of the services by us, which are for the Clients benefit, the Client agrees to hold harmless and to indemnify and defend us and our directors, officers, servants, agents, employees, workmen and contractors (hereinafter referred to as the “Company”) from and against any and all claims, losses, damages, demands, disputes, liability and legal investigative costs of defence, whether for personal injury including death, or any other loss whatsoever, regardless of any action or omission on the part of the Company, that result from an accidental release of pollutants or hazardous substances occurring as a result of carrying out the Project. This indemnification shall extend to all Claims brought or threatened against the Company under any federal or provincial statute as a result of constructing work on this Project. In addition to the above indemnification, the Client further agrees not to bring any claims against the Company in connection with any of the aforementioned causes.

7. SERVICES OF SUBCONSULTANTS AND CONTRACTORS

The conduct of engineering and environmental studies frequently requires hiring the services of individuals and companies with special expertise and/or services which we do not provide. We may arrange the hiring of those services as a convenience to our Clients. As those services are for the Client’s benefit, the Client agrees to hold the Company harmless and to indemnify and defend us from and against all claims arising through such hirings to the extent that the Client would incur had he hired those services directly. This includes responsibility for payment for services rendered and pursuit of damages for errors, omissions or negligence by those parties in carrying out their work. In particular, these conditions apply to the use of drilling, excavation and laboratory testing services.

8. CONTROL OF WORK AND JOBSITE SAFETY

We are responsible only for the activities of our employees on the job site. The presence of our personnel on the site shall not be construed in any way to relieve the Client of any contractors on site from their responsibilities for site safety. The Client acknowledges that he, his representatives, contractors or others retain control of the site and that we never occupy a position of control at the site. The Client undertakes to inform us of all hazardous conditions, or other relevant conditions of which he is aware. The Client also recognizes that our activities may uncover previously unknown hazardous conditions or materials and that such a discovery may result in the necessity to undertake emergency procedures to protect our employees as well as the public at large and the environment in general. These procedures may well involve additional costs outside of any budgets previously agreed to. The Client agrees to pay us for any expenses incurred as the result of such discovery and to compensate us through payment of additional fees and expenses for time spent by us to deal with the consequences of such discoveries. The Client also acknowledges that in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed and the Client agrees that notification to such bodies by us will not be a cause of action or dispute.

9. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on our interpretation of conditions revealed through limited investigation conducted within a defined scope of services. We cannot accept responsibility for independent conclusions, interpretations, negotiations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.