June 2009

REPORT ON

FOUNDATION INVESTIGATION REPORT CARLING AVENUE WESTBOUND, KIRKWOOD AVENUE AND CARLING AVENUE EASTBOUND STRUCTURE REPLACEMENTS HIGHWAY 417 CONSTRUCTION STAGING AREAS W.P. 4058-01-00

Submitted to:
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REPORT

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Golder Associates

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by McCormick Rankin Corporation (MRC) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out foundation investigations associated with the Carling Westbound (WB), Kirkwood and Carling Eastbound (EB) overpass bridges in the City of Ottawa. The section of Highway 417 included in this assignment (W.P. 4058-01-00) extends from approximately the Carling Avenue Eastbound bridge overpass to Merivale Road.

Foundation investigation services are required for the following components under W.P. 4058-01-00:

- Construction staging area for Carling Avenue WB bridge (between Carling Avenue WB and Carling Avenue EB, south of Highway 417).
- Construction staging area for Kirkwood Avenue bridge (between Kirkwood Avenue, Carling Avenue WB and Highway 417). The staging area for the Carling WB bridge will also be used during the construction of the Kirkwood Avenue bridge overpass.
- Construction staging area for Carling Avenue EB bridge (between Carling Avenue EB and Carling Avenue WB, north of Highway 417).

This report addresses the above staging areas.

2.0 SITE DESCRIPTION

The proposed construction staging area for the Carling Avenue WB bridge overpass (which will also be used for the Kirkwood Avenue bridge overpass) is a roughly triangular field located between Carling Avenue WB and Carling Avenue EB, south of Highway 417 (Drawing 1). The site is presently unused and in general is covered in short grasses. Trees line the perimeter of the site with a few trees in the interior of the site.

The proposed construction staging area for the Kirkwood Avenue bridge overpass is a roughly triangular field bounded by Kirkwood Avenue, Carling Avenue WB and Highway 417 (Drawing 2). The site is presently unused and in general the site is covered in short grasses with a few specimen trees.

The proposed construction staging area for the Carling Avenue EB bridge overpass is a roughly triangular field bounded by Carling Avenue EB, Carling Avenue WB and Highway 417 (Drawing 3). Saigon Crescent crosses roughly north-south through the wider south-east portion of this staging area. The site is presently unused and in general is covered in short grasses and lined with trees on the perimeter.

3.0 INVESTIGATION PROCEDURES

The field work for this subsurface investigation was carried out between November 7 and 30, 2006. During this period, nine boreholes (Boreholes 06-204 to 06-212, inclusive) were put down at the locations shown on Drawings 1 to 3 in Appendix A. The boreholes were advanced using a track mounted drill rig supplied and operated by Marathon Drilling Company Ltd. of Ottawa, Ontario.

Three boreholes were advanced at the Carling Avenue WB staging area (Boreholes 06-204 to 06-206, inclusive) as shown on Drawing 1 in Appendix A. The boreholes were advanced to auger refusal at depths which vary from 10.4 to 11.8 m below present ground surface. Borehole 06-205 was then cored an additional 3.2 m into the bedrock after practical refusal to augering had been reached.

At the Kirkwood Avenue staging area three boreholes (Boreholes 06-207 to 06-209, inclusive) were put down as shown on Drawing 2 in Appendix A. The boreholes were advanced to auger refusal at depths which vary from 9.8 to 11.5 m below present ground surface. Borehole 06-208 was then cored an additional 4.9 m, through cobbles and boulders and into the bedrock, after practical refusal to augering had been reached.

Three boreholes were advanced at the Carling Avenue EB staging area (Boreholes 06-210 to 06-212, inclusive) as shown on Drawing 3 in Appendix A. The boreholes were advanced to auger refusal at depths which vary from 2.1 to 2.7 m below present ground surface. Borehole 06-211 was then cored an additional 3.7 m into the bedrock after practical refusal to augering had been reached.

The boreholes were drilled at the approximate locations of the proposed construction pads. Samples of the overburden were obtained at 0.6 m to 1.2 m intervals of depth using 50 mm outside diameter split-spoon samplers in accordance with the Standard Penetration Test (SPT) procedure. Three relatively undisturbed, 75 mm diameter thin-walled Shelby tube samples of the clay at the Carling WB (Boreholes 06-204 and 06-205) Kirkwood (Borehole 06-208) sites were obtained using a fixed piston sampler. A piezometer was installed in one borehole at each staging area (Boreholes 06-205, 06-208 and 06-211) to monitor the groundwater level at each site.

The field work was supervised by members of Golder's staff who located the boreholes in the field, directed the drilling, sampling, and in situ testing operations, and logged the boreholes. The soil and bedrock samples were **identified in the field, placed in labelled containers and transported to Golder Associates' laboratory in** Ottawa for **further examination, and to Golder Associates' laboratory in Mississauga for testing. Index and classification** tests consisting of water content determinations, Atterberg Limits testing and grain size distribution analyses were carried out on selected soil samples. Laboratory oedometer consolidation testing was carried out on two samples of the clay deposit.

The borehole locations were selected by McCormick Rankin Corporation (MRC) in consultation with Golder Associates and located in the field by Golder staff relative to existing site features. The borehole elevations were obtained by MRC from a digital terrain model, based on the locations provided by Golder. The borehole locations, including MTM NAD83 northing and easting coordinates and ground surface elevations referenced to geodetic datum, are summarized in the following table and are shown on Drawings 1 through 3.

Borehole Number	Borehole Location	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)
06-204	Carling WB Staging Area	5027517.3	364548.9	75.1
06-205	Carling WB Staging Area	5027515.9	364501.3	75.4
06-206	Carling WB Staging Area	5027491.3	364478.1	75.5
06-207	Kirkwood Staging Area	5027504.7	364354.9	77.1
06-208	Kirkwood Staging Area	5027482.9	364336.4	77.1
06-209	Kirkwood Staging Area	5027461.8	364320.4	76.7
06-210	Carling EB Staging Area	5027154.5	364084.5	76.0
06-211	Carling EB Staging Area	5027149.6	364054.3	75.8
06-212	Carling EB Staging Area	5027141.7	364023.7	76.1

4.0 SITE GEOLOGY AND STRATIGRAPHY

4.1 Regional Geological Conditions

The study area for this assignment lies within the Ottawa Valley Clay Plain, as delineated in *The Physiography of Southern Ontario*[1], that lies within the major physiographic region of the Ottawa-St. Lawrence Lowland.

The Ottawa Valley Clay Plain region is characterized by relatively thick deposits of sensitive marine clay, silt and silty clay that were deposited within the Champlain Sea basin. These deposits, known as the Champlain Sea clay or Leda clay, overlie relatively thin, commonly reworked glacial till and glaciofluvial deposits, that in turn overlie bedrock.[2] This region is underlain by a series of sedimentary rocks, consisting of sandstones, dolostones, limestones and shales that are, in turn, underlain by igneous and metamorphic bedrock of the Precambrian Shield.

4.2 Site Stratigraphy

The detailed subsurface soil and groundwater conditions encountered in the boreholes and the results of the in-situ and laboratory testing are given on the Record of Borehole sheets in Appendix B and on Figures 1 to 15 in Appendix C. The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. Subsoil conditions will vary between and beyond the borehole locations.

4.2.1 Carling Avenue Westbound Staging Area

As part of the subsurface investigation at this site, three boreholes were advanced at the approximate locations of the construction pads for the proposed new Carling Avenue WB bridge deck. The borehole locations and ground surface elevations are shown on Drawing 1 in Appendix A.

In summary, the soils encountered during the current investigation within the Carling Avenue WB staging area consist of topsoil, fill materials and thin layers of sandy silt to silty sand overlying clay to silty clay extending to depths of about 5.6 to 6.3 m and by glacial till and sand extending to depths of about 10.4 to 11.8 m. These overburden materials are underlain by limestone bedrock.

A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

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

[2] **Belanger, J.R. "Urban Geology of Canada's National Capital Area"**, in *Urban Geology of Canadian Cities*, Geological Association of Canada Special Paper 42, Ed. P.F. Karrow and O.L. White, 1998.

4.2.1.1 Topsoil and Fill Materials

Topsoil was encountered extending from the ground surface to depths ranging 0.1 to 0.2 m at all the boreholes.

The surficial topsoil is underlain by fill materials extending to depths ranging from 0.8 to 1.3 m. The fill materials vary in composition from sandy silt to sand containing varying amounts of gravel and cobbles. The fill materials at Borehole 06-206 contains traces of clay and asphalt.

The fill materials are in turn underlain by a buried layer of topsoil extending to depths ranging from 1.0 to 1.7 m.

4.2.1.2 Silty Sand to Sandy Silt

A very thin layer of sandy silt to silty sand, about 0.1 m in thickness, underlies the buried topsoil at Boreholes 06-204 and 06-205.

4.2.1.3 Clay to Silty Clay

The buried topsoil and sandy silt to silty sand are underlain by a deposit of clay to silty clay that is between 4.5 and 5.1 m thick. The lower portion of this deposit, less than one metre in thickness, is inter-layered with clayey silt and contains gravel.

Weathered Clay Crust

The upper 1.9 to 2.8 m of the clay deposit has been weathered to a grey-brown crust. The measured SPT "N" values in this portion of the deposit ranged from 9 blows per 0.3 m of penetration to 'weight of hammer' at depth. The results of in situ vane testing in this material gave undrained shear strengths ranging from 46 to greater than 96 kilopascals indicating a firm to very stiff consistency.

The results of Atterberg limit testing on one selected sample of the weathered crust from Borehole 06-205 indicate a plasticity index of 57 percent and a liquid limit of 83 per cent. These results, summarized on the plasticity chart on Figure 1, confirm that this material is a clay of high plasticity. The measured natural water contents of the weathered crust ranged from 55 to 71 percent.

Unweathered Clay to Silty Clay

The clay to silty clay below the depth of weathering is grey in colour.

In the unweathered clay to silty clay, one standard penetration test N value of 'weight of hammer' was obtained. The results of in situ vane testing in this material gave undrained shear strengths ranging from 31 to 54 kilopascals indicating a firm to stiff consistency. In situ vane testing carried out on remoulded silty clay gave undrained shear strengths ranging from 4 to 11 kilopascals, with corresponding sensitivities ranging from 4 to 11. A summary of the results of the in situ vane testing is provided on Figure 2.

The results of Atterberg limit testing on selected samples of this portion of the deposit indicate plasticity indices ranging from 32 to 40 percent, and liquid limits ranging from 53 to 62 per cent. These results, which are summarized

on the plasticity chart on Figure 1, indicate that this unweathered material is a clay of high plasticity. The measured natural water content of the unweathered grey clay ranged from 50 to 58 percent.

Oedometer consolidation testing was carried out on one thin-walled Shelby tube sample of the clay below the depth of weathering. The results of that testing are provided on Figure 3 and are summarized in the table below.

Borehole/ Sample Number	Sample Depth/Elev. (m)	Unit Weight (kN/m^3)	σ_P' (kPa)	σ_{VO}' (kPa)	σ_P'-σ_{VO}' (kPa)	Cc	Cr	e_o	OCR	Cv (cm^2/s)
06-204/SA 5	4.8/70.3	16.9	175	50	125	0.81	0.011	1.44	3.5	0.03

NOTES:

σ_P' - Apparent preconsolidation pressure
σ_{VO}' - Computed existing vertical effective stress
Cc - Compression index
Cr - Recompression index
e_o - Initial void ratio
OCR - Overconsolidation ratio
Cv - Coefficient of consolidation

4.2.1.4 Silty Sand to Sandy Silt Till

A 0.5 m to 1.6 m thick layer of glacial till was encountered below the silty clay and clayey silt deposit. The surface of this till deposit was encountered at elevations ranging from 69.2 to 69.5 m (at depths below ground surface ranging from 5.6 to 6.3 m).

Based on local experience and observations of the drilling resistance, the glacial till consists of a heterogeneous mixture of gravel, cobbles, and boulders in a matrix of silty sand to sandy silt, and contains a trace of clay. Due to the limited thickness of this deposit, only limited standard penetration testing could be carried out. Measured **SPT "N" values of 5 and 22 blows per 0.3 m of penetration indicates the deposit to have a loose to compact** relative density. Grain size distribution test results obtained from one sample of the glacial till are shown on Figure 4. Since these results were obtained for samples retrieved using a 50 mm diameter sampler, they do not reflect the cobble and boulder content of the deposit.

4.2.1.5 Sand and Gravel

A 3.9 m to 4.3 m thick layer of sand and gravel containing varying amounts of silt, clay, cobbles and boulders **was encountered below the glacial till deposit. Measured SPT "N" values ranging from 9 to greater than 100** blows per 0.3 m of penetration indicates the deposit to have a loose to very dense relative density. The higher **"N" values may reflect the cobble and boulder content, rather than the actual state of packing. At Borehole 06-**205 diamond drilling techniques were used to penetrate the cobbles and boulders in the lower portion of the sand and gravel deposit.

Grain size distribution test results obtained from three samples of the sand and gravel are shown on Figure 5. Since these results were obtained for samples retrieved using a 50 mm diameter sampler, they do not reflect the cobble and boulder content of the deposit.

4.2.1.6 Auger Refusal

Practical refusal to augering was encountered at depths between about 10.4 and 11.8 m, below the existing ground surface at Boreholes 06-204 and 06-206, respectively. Auger refusal may indicate the bedrock surface; however, it could also represent cobbles and/or boulders within the sand and gravel.

4.2.1.7 Limestone Bedrock

Limestone bedrock underlies the sand and gravel deposit at Borehole 06-205. The surface of the bedrock was encountered at Elevation 64.7 m (10.7 m depth).

The limestone bedrock at the site is a member of the Gull River Formation; it is medium-strong and thinly- to medium-bedded and is slightly weathered to fresh. Rock Quality Designation (RQD) values measured on recovered bedrock core samples ranged from 40 to 100 percent, generally increasing with depth and indicating poor to excellent quality rock. The discontinuities observed in the rock core are typically horizontal to sub-horizontal, associated with the bedding planes, although some vertical fracturing was noted in the upper bedrock. A description of some of the terms used in the description of the bedrock samples from this site is provided on the *Lithological and Geotechnical Rock Description Terminology* sheet which precedes the Record of Borehole sheets included with this report.

4.2.1.8 Groundwater Conditions

A piezometer was installed in Borehole 06-205 within the grey silty clay overburden, and the water level measured in that piezometer on December 10, 2006, one month after installation, is given in the following table:

Borehole No.	Depth (m)	Elevation (m)
06-205	1.2	74.2

It should be expected that the groundwater levels will fluctuate seasonally.

4.2.2 Kirkwood Avenue Staging Area

As part of the subsurface investigation at this site, three boreholes were advanced at the approximate locations of the construction pads for the proposed new Kirkwood Avenue bridge deck. The borehole locations and ground surface elevations are shown on Drawing 2 in Appendix A.

In summary, the soils encountered during the current investigation within the Kirkwood Avenue staging area consist of topsoil, fill materials and sandy silt to sand at some locations overlying clay to silty clay extending to depths of about 5.2 to 6.7 m and underlain in turn by glacial till and sand and gravel extending to depths of about 9.8 to 11.5 m. These overburden materials are underlain by limestone bedrock.

4.2.2.1 Topsoil and Fill Materials

Topsoil was encountered extending from the ground surface to depths ranging 0.1 to 0.5 m at all the boreholes.

The surficial topsoil is underlain by fill materials extending to depths ranging from 0.2 to 2.3 m. The fill materials generally consist of silty sand containing varying amounts of gravel. The fill materials at Borehole 06-209 contain brick and wood fragments. The results of grain size distribution testing carried out on one selected sample of the silty sand fill materials from Borehole 06-209 are provided on Figure 6.

The fill materials at Boreholes 06-207 and 06-208 are underlain by a buried layer of topsoil 0.2 and 0.3 m in thickness, respectively.

4.2.2.2 Sandy Silt to Silty Sand

Sandy silt to silty sand, about 1.4 m and 1.8m in thickness, underlies the buried topsoil at Boreholes 06-207 and 06-208, respectively. Measured SPT "N" values ranging from 7 to 9 blows per 0.3 m of penetration indicates the deposit to have a loose relative density. The results of grain size distribution testing carried out on two samples of this material are provided on Figure 7.

4.2.2.3 Clay to Silty Clay

The fill materials and sandy silt to silty sand are underlain by a deposit of clay to silty clay that is between 2.9 and 4.5 m thick. The lower portion of this deposit at Borehole 06-207, less than 0.5 m in thickness, contains gravel.

Weathered Clay Crust

The upper 0.6 to 1.4 m of the clay deposit has been weathered to a grey-brown crust. The measured SPT "N" values in this portion of the deposit ranged from 2 to 7 blows per 0.3 m of penetration indicating a stiff to very stiff consistency.

The results of Atterberg limit testing on three samples of the weathered crust indicate plasticity indices ranging from 47 to 58 percent, and liquid limits ranging from 74 to 87 per cent. These results, which are summarized on the plasticity chart on Figure 8, confirm that this material is a clay of high plasticity. The measured natural water contents of three samples of the weathered crust ranged from 65 to 78 percent.

Unweathered Clay to Silty Clay

The clay to silty clay below the depth of weathering is grey in colour.

In the unweathered clay to silty clay, one standard penetration test N value of 'weight of hammer' per 0.3 metres of penetration was obtained. The results of in situ vane testing in this material gave undrained shear strengths ranging from 33 to 52 kilopascals indicating a firm to stiff consistency. In situ vane testing carried out on remoulded silty clay gave undrained shear strengths ranging from 5 to 9 kilopascals, with corresponding sensitivities ranging from 5 to 10. A summary of the results of the in situ vane testing is provided on Figure 9.

The results of Atterberg limit testing on two samples of this portion of the deposit indicate plasticity indices of 52 and 60 percent, and liquid limits of 80 and 91 percent. These results, which are summarized on the plasticity chart on Figure 8, indicate that this unweathered material is a clay of high plasticity. The measured natural water contents of two samples of the unweathered grey clay were 76 and 81 percent.

Oedometer consolidation testing was carried out on one thin-walled Shelby tube sample of the silty clay to clay below the depth of weathering. The results of that testing are provided on Figure 10 and are summarized in the table below.

Borehole/ Sample Number	Sample Depth/Elev. (m)	Unit Weight (kN/m^3)	σ_P' (kPa)	σ_{VO}' (kPa)	$\sigma_P'-\sigma_{VO}'$ (kPa)	Cc	Cr	e_o	OCR	Cv (cm^2/s)
06-208/SA 5	4.8/ 72.3	15.1	165	56	109	1.66	0.012	2.17	2.9	0.02

NOTES:

- σ_P' - Apparent preconsolidation pressure
- σ_{VO}' - Computed existing vertical effective stress
- Cc - Compression index
- Cr - Recompression index
- e_o - Initial void ratio
- OCR - Overconsolidation ratio
- Cv - Coefficient of consolidation

4.2.2.4 Silty Sand to Sandy Silt Till

A 2.3 m to 3.2 m thick layer of glacial till was encountered below the clay to silty clay deposit at all the boreholes. The surface of this till deposit was encountered at elevations 70.4 to 71.6 m (at depths below ground surface ranging from 5.2 m to 6.7 m).

Based on local experience and observations of the drilling resistance, the glacial till consists of a heterogeneous mixture of gravel, cobbles, and boulders in a matrix of silty sand to sandy silt, and contains a trace of clay. **Measured SPT "N" values from 1 to 18 blows per 0.3 m of penetration indicates the deposit to have a very loose** to compact relative density. One higher value of 50 blows per 0.3 metres of penetration may reflect the cobble and boulder content, rather than the actual state of packing of the soil matrix. Grain size distribution test results obtained from one sample of the glacial till at Borehole 06-207 are shown on Figure 11. Since these results were obtained for a sample retrieved using a 50 mm diameter sampler, they do not reflect the cobble and boulder content of the deposit.

4.2.2.5 Sand and Gravel

A 0.8 m to 3.0 m thick layer of sand and sand and gravel containing varying amounts of silt, clay, cobbles and **boulders was encountered below the silty clay and clayey silt deposit. Measured SPT "N" values ranging from** 9 to greater than 100 blows per 0.3 m of penetration indicates the deposit to have a loose to very dense **relative density. The higher "N" values may reflect the cobble and boulder content, rather than the actual** state of packing.

Grain size distribution test results obtained from one sample of the sand and gravel are shown on Figure 12 and grain size distribution test results obtained from one sample of the fine sand from Borehole 209 are shown on Figure 13. Since these results were obtained for samples retrieved using a 50 mm diameter sampler, they do not reflect the cobble and boulder content of the deposit.

4.2.2.6 Cobbles and Boulders

Cobbles and boulders were encountered underlying the sand and gravel deposit at Borehole 06-208 extending to about elevation 63.3 m (i.e., about 13.9 m depth).

4.2.2.7 Auger Refusal

Practical refusal to augering was encountered at depths between about 9.8 and 11.5 m below the existing ground surface. Auger refusal may indicate the bedrock surface; however, it could also represent cobbles and/or boulders within or underlying the sand deposits.

4.2.2.8 Limestone Bedrock

Limestone bedrock with shale interbeds underlies the cobbles and boulders at Borehole 06-208. The surface of the bedrock was encountered at Elevation 63.3 m (13.9 m depth).

The limestone bedrock at the site is a member of the Gull River Formation; it is medium-strong and thinly- to medium-bedded and is fresh. Rock Quality Designation (RQD) values measured on recovered bedrock core samples ranged from 85 to 100 percent indicating good to excellent quality rock. The discontinuities observed in the rock core are typically horizontal to sub-horizontal, associated with the bedding planes. A description of some of the terms used in the description of the bedrock samples from this site is provided on the *Lithological and Geotechnical Rock Description Terminology* sheet which precedes the Record of Borehole sheets included with this report.

4.2.2.9 Groundwater Conditions

A piezometer was installed in Borehole 06-208 within the overburden, and the water level measured in that piezometer on December 10, 2006, about one month after installation, is given in the following table:

Borehole No.	Depth (m)	Elevation (m)
06-208	1.9	75.2

It should be expected that the groundwater levels will fluctuate seasonally.

4.2.3 Carling Avenue Eastbound Staging Area

As part of the subsurface investigation at this site, three boreholes were advanced at the approximate locations of the construction pads for the proposed new Carling Avenue EB bridge deck. The borehole locations and ground surface elevations are shown on Drawing 3 in Appendix A.

In summary, the soils encountered during the current investigation within the staging area consist of topsoil, fill material and peat overlying thin deposits of silty clay, sand and glacial till extending to depths of about 2.1 to 2.7 m. These overburden materials are underlain by limestone bedrock.

A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2.3.1 Topsoil, Fill Materials and Peat

Topsoil, about 0.1 m in thickness, was encountered extending from the ground surface at all the boreholes.

The topsoil is underlain by fill materials extending to depths ranging from 1.3 m to 1.7 m. The fill materials generally range in composition from sandy silt to silty sand containing varying amounts of gravel, cobbles, and at some locations crushed stone, ash and brick fragments. The results of grain size distribution testing carried out on one selected sample of the sand fill materials from Borehole 06-211 are provided on Figure 14.

The fill materials at all the boreholes are underlain by peat ranging in thickness from about 0.1m to 0.4 m in thickness.

4.2.3.2 Silty Sand to Sand and Gravel

A very thin layer of silty sand to sandy gravel, about 0.3 m in thickness, underlies the peat at Borehole 06-211.

4.2.3.3 Weathered Silty Clay

The peat at Borehole 06-210 is underlain by a deposit of silty clay that is about 0.1 m in thickness.

4.2.3.4 Silty Sand to Sandy Silt Till

A 0.2 m to 0.6 m thick layer of glacial till was encountered below the silty clay, sand and gravel and peat. The surface of this till deposit was encountered at elevations 74.0 and 74.4 m (at depths below ground surface ranging from 1.7 m to 2.0 m).

Based on local experience and observations of the drilling resistance, the glacial till consists of a heterogeneous mixture of gravel, cobbles, and boulders in a matrix of silty sand to sandy silt, and contains a trace of clay. Due to the limited thickness of this deposit, only limited standard penetration testing could be carried out before sampler refusal was encountered. However, one measured SPT "N" value of 30 blows per 0.3 m of penetration indicates the deposit to have a compact relative density. Grain size distribution test results obtained from one sample of the glacial till at Borehole 06-210 are shown on Figure 15. Since these

results were obtained for a sample retrieved using a 50 mm diameter sampler, they do not reflect the cobble and boulder content of the deposit.

4.2.3.5 Auger Refusal

Practical refusal to augering was encountered at depths of 2.7 and 2.4 m below the existing ground surface at Boreholes 06-210 and 06-212, respectively. At Borehole 06-212 auger refusal was obtained within the weathered limestone bedrock at a depth of about 0.1 m below the bedrock surface. Auger refusal at Borehole 06-210 may indicate the bedrock surface; however, it could also represent cobbles and/or boulders within or underlying the sand deposits.

4.2.3.6 Limestone Bedrock

Limestone bedrock underlies the till deposit at Borehole 06-211. The surface of the bedrock was encountered at Elevation 73.7 m (2.1 m depth).

The limestone bedrock at the site is a member of the Gull River Formation; it is medium-strong, thinly- to medium-bedded and weathered to fresh.

The upper portion of the bedrock, to depths of about 3 m below the bedrock surface, contains fractured and weathered zones with mud seams. Rock Quality Designation (RQD) values measured on recovered bedrock core samples ranged from 0 to 80 percent indicating very poor to good quality rock.

The remainder of the bedrock contains shale interbeds and is of excellent quality based on an RQD value of 96 percent.

A description of some of the terms used in the description of the bedrock samples from this site is provided on the *Lithological and Geotechnical Rock Description Terminology* sheet which precedes the Record of Borehole sheets included with this report.

4.2.3.7 Groundwater Conditions

A piezometer was installed in Borehole 06-211 within the overburden, and the piezometer was dry on December 10, 2007, eleven days after installation.

It should be expected that the groundwater levels will fluctuate seasonally.

5.0 CLOSURE

The investigation was carried out using equipment supplied and operated by Marathon Drilling. The field portions were supervised by Mr. Jim Samotowka and Mr. Doug Grylls under the direction of Mr. William Cavers, P.Eng. The testing was carried out in the Mississauga laboratory of Golder Associates. The report was prepared by Mr. William Cavers, P.Eng, under the direction of Mr. Michael Snow, P.Eng. This report was reviewed by Mr. Fintan J. Heffernan P.Eng, the designated MTO contact for this project.

Yours truly,

GOLDER ASSOCIATES LTD.

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WC/MSS/FJH/cm/cg

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APPENDIX A

Drawing 1 – Carling Westbound Staging Area, Borehole Locations
Drawing 2 – Kirkwood Avenue Staging Area, Borehole Locations
Drawing 3 – Carling Eastbound Staging Area, Borehole Locations

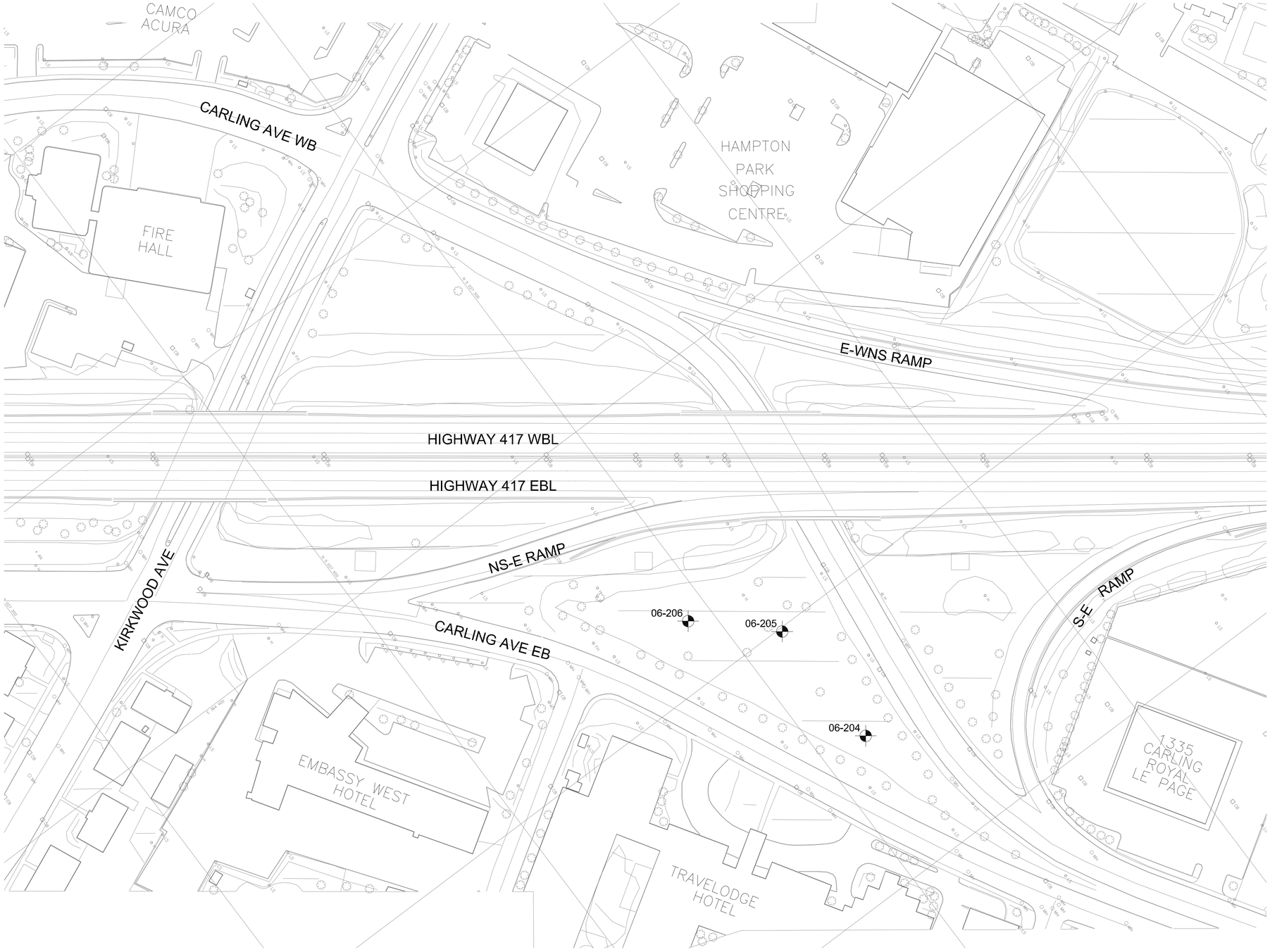
HWY. 417

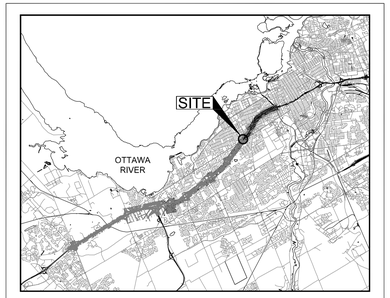
WP No. WP 4058-01-00

SHEET

CARLING WESTBOUND
STAGING AREA
BOREHOLE LOCATIONS

Golder Associates Ltd.
OTTAWA, ONTARIO, CANADA





KEY PLAN

LEGEND

Borehole – Current Golder Associates Ltd. Investigation

No.	ELEVATION	LOCATION	
		NORTHING	EASTING
06-204	75.1	5027517.3	364548.9
06-205	75.4	5027515.9	364501.3
06-206	75.5	5027491.3	364478.1

NOTES

This drawing is for subsurface information only. Any surface details are for conceptual illustration.
The boundaries between soil strata have been established only at borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

Base plan provided in electronic format by McCormick Rankin Corporation

NO.	DATE	BY	REVISION

15 0 15 30
SCALE METRES

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

Geocres No. 31G5-215

HWY. 417		PROJECT NO. 05-1120-210-2700	DIST.
SUBM'D. W.C.	CHKD. M.I.C.	DATE: DECEMBER 2006	SITE:
DRAWN: J.M.	CHKD. W.C.	APPD.	DWG. 1

05-1120-210-2700-01-2.dwg

1:1

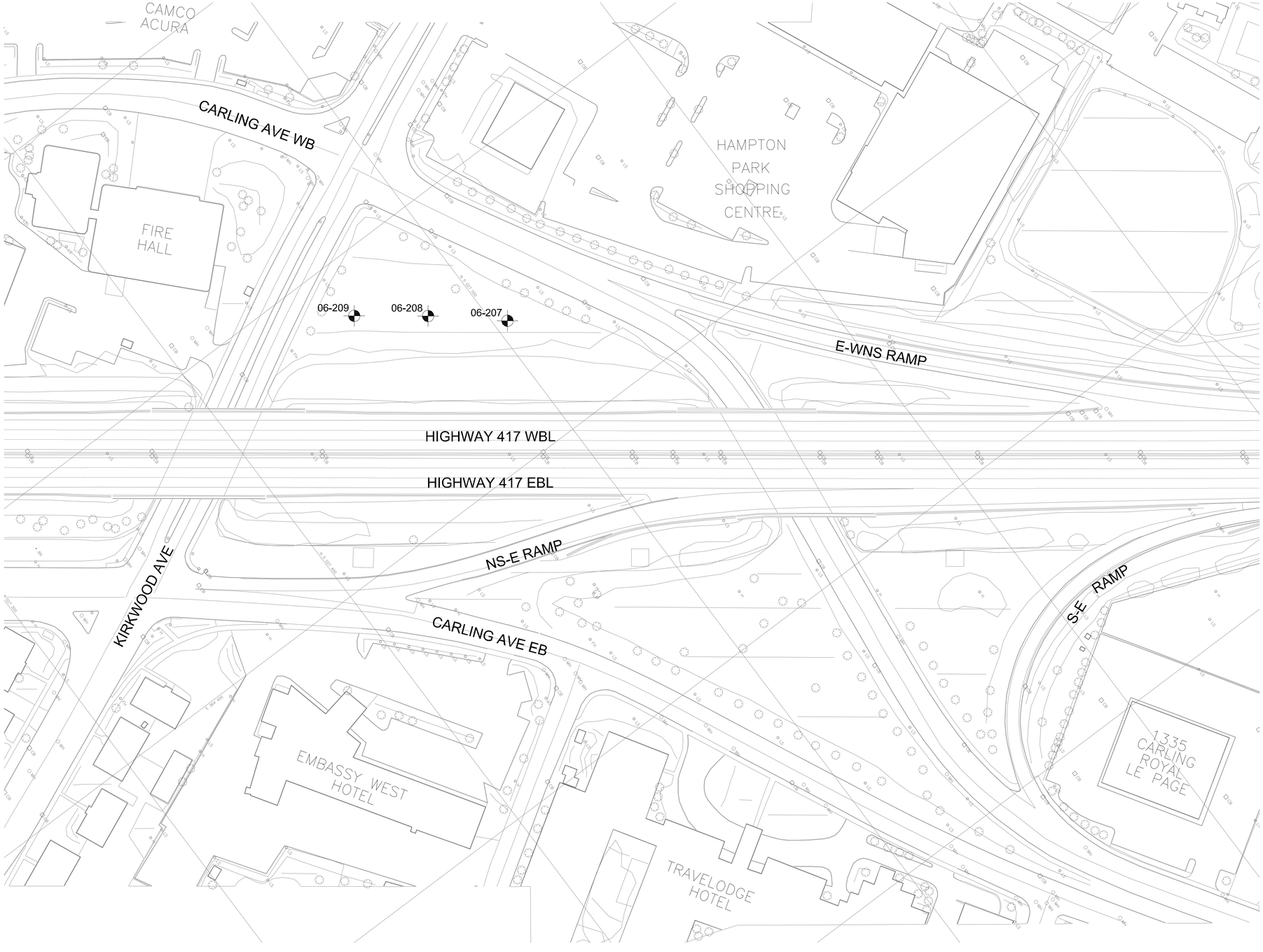
HWY. 417

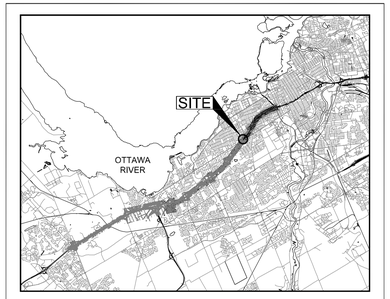
WP No. WP 4058-01-00

KIRKWOOD AVE.
STAGING AREA
BOREHOLE LOCATIONS

SHEET

Golder Associates Ltd.
OTTAWA, ONTARIO, CANADA





KEY PLAN

LEGEND

Borehole – Current Golder Associates Ltd. Investigation

No.	ELEVATION	LOCATION	
		NORTHING	EASTING
06-207	77.1	5027504.7	364354.9
06-208	77.1	5027482.9	364336.4
06-209	76.7	5027461.8	364320.4

NOTES

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Base plan provided in electronic format by McCormick Rankin Corporation

15 0 15 30
SCALE METRES

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

NO.	DATE	BY	REVISION

Geocres No. 31G5-215

HWY. 417		PROJECT NO. 05-1120-210-2700	DIST.
SUBM'D. W.C.	CHKD. M.I.C.	DATE: DECEMBER 2006	SITE:
DRAWN: J.M.	CHKD. W.C.	APPD.	DWG. 2

1:1

05-1120-210-2700-01-2.dwg

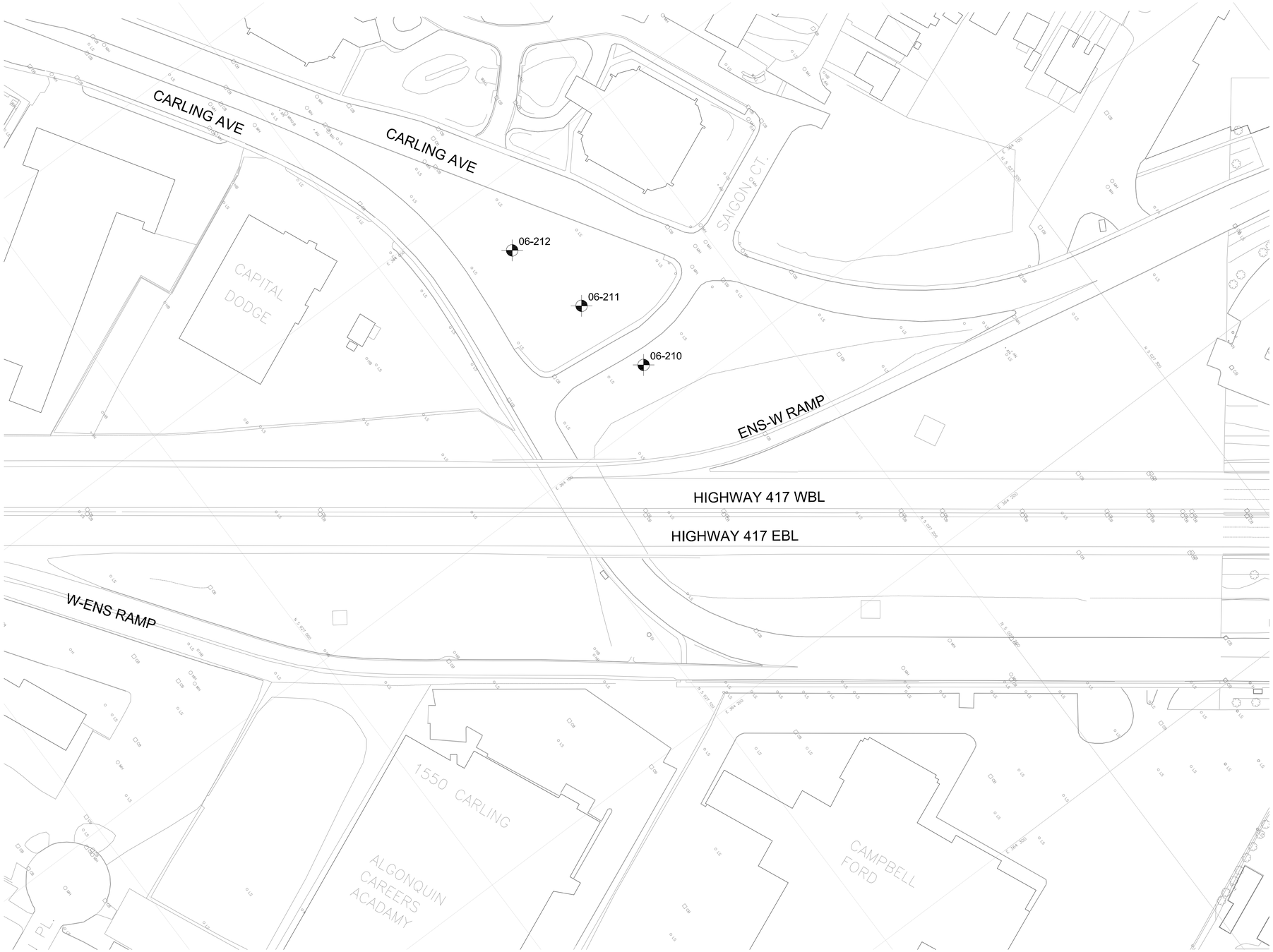
HWY. 417

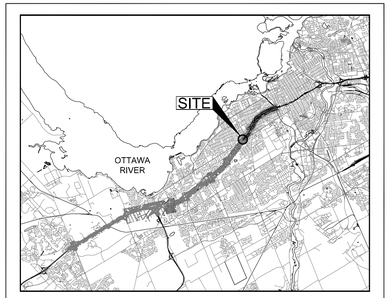
WP No. WP 4058-01-00

CARLING EASTBOUND
STAGING AREA
BOREHOLE LOCATIONS

SHEET

Golder Associates Ltd.
OTTAWA, ONTARIO, CANADA





KEY PLAN

LEGEND

Borehole – Current Golder Associates Ltd. Investigation

No.	ELEVATION	LOCATION	
		NORTHING	EASTING
06-210	76.0	5027154.5	364084.5
06-211	75.8	5027149.6	364054.3
06-212	76.1	5027141.7	364023.7

NOTES

This drawing is for subsurface information only. Any surface details are for conceptual illustration.
The boundaries between soil strata have been established only at borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

Base plan provided in electronic format by McCormick Rankin Corporation

SCALE 15 0 15 30 METRES

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

NO.	DATE	BY	REVISION

Geocres No. 31G5-215

HWY. 417		PROJECT NO. 05-1120-210-2700	DIST.
SUBM'D. W.C.	CHKD. M.I.C.	DATE: DECEMBER 2006	SITE:
DRAWN: J.M.	CHKD. W.C.	APPD.	DWG. 3

05-1120-210-2700-01-2.dwg

1:1

APPENDIX B

Lists of Abbreviations and Symbols
Lithological and Geotechnical Rock Description Terminology
Records of Boreholes 06-204 to 06-212

June 2009
Report No. 05-1120-210-2700-2

Golder Associates

LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample
DT	Dual Tube sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open Sampler for a distance of 300 mm (12 in.)
DD- Diamond Drilling

Dynamic Penetration Resistance; N_d:
The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive Uncased a 50 mm (2 in.) diameter, 60^0 cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

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

Peizo-Cone Penetration Test (CPT):
An electronic cone penetrometer with a 60^0 conical tip and a projected end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded Electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

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

(b) Cohesive Soils

Consistency	C_u or S_u Kpa	Psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	Over 200	Over 4,000

IV. SOIL TESTS

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

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

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

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

III. SOIL PROPERTIES

(a) Index Properties

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

* Density symbol is p. Unit weight symbol is γ where γ=pg(i.e. mass density x acceleration due to gravity)

(a) Index Properties (cont'd.)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

Notes: 1. $\tau=c'\sigma'$ tan |'
2. Shear strength=(Compressive strength)/2

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING STATE

Fresh: no visible sign of weathering

Faintly Weathered: weathering limited to the surface of major discontinuities.

Slightly weathered: penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

Moderately weathered: weathering extends throughout the rock mass but the rock material is not friable

Highly weathered: weathering extends throughout rock mass and the rock material is partly friable.

Completely weathered: rock is wholly decomposed and in a friable condition but the rock texture and structure are preserved.

BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	>2 m
Thickly bedded	0.6 m to 2m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	<6 mm

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	>3 m
Wide	1 – 3 m
Moderately close	0.3 – 1 m
Close	50 – 300 mm
Very close	<50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	>60 mm
Coarse Grained	2 – 60 mm
Medium Grained	60 microns - 2mm
Fine Grained	2 – 60 microns
Very Fine Grained	<2 microns

Note: *Grains >60 microns diameter are visible to the naked eye.

O:\ Templates\Rock Description Terminology

CORE CONDITION

Total Core Recovery

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varies from 0% for completely broken core 100% for core in solid sticks.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to (W.R.T.) Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90^0 angle is horizontal.

Description and Notes

An abbreviated description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

B –	Bedding	Ca-	Calcite
FO-	Foliation/Schistosity	P-	Polished
CL -	Cleavage	S-	Slickensided
SH -	Shear Plane/Zone	SM-	Smooth
VN-	Vein	R-	Ridged/Rough
F -	Fault	ST-	Stepped
CO-	Contact	PL-	Planar
J -	Joint	FL-	Flexured
FR-	Fracture	UE-	Uneven
MF -	Mechanical	W-	Wavy
A-	Angular	C-	Curved
BP-	Bedding Plane	H-	Hackly
BL-	Blast Induced	SL-	Sludge Coated
||	Parallel To	TCA-	To Core Axis
	Perpendicular To	STR-	Stress Induced

Golder Associates

RECORD OF BOREHOLE No 06-204

1 OF 1

METRIC

PROJECT 05-1120-210-2700 | W.P. 4058-01-00 | DIST ____ HWY 417 | DATUM Geodetic

LOCATION N 5027517.3; E 364548.9 | BOREHOLE TYPE Power Auger 108mm I.D. Hollow Stem Auger | DATE November 9, 2006

ORIGINATED BY D.J.S. | COMPILED BY J.M. | CHECKED BY M.I.C.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
75.1	GROUND SURFACE						75				
0.0 / 0.1	Topsoil (FILL)										
74.4	Fine to medium sand, some gravel (FILL) Brown										
74.1	Fine sand (FILL) Loose Brown Moist TOPSOIL		1	SS	7		74				
1.1	Sandy SILT Grey Moist		2	SS	9				○		
	CLAY (Weathered Crust) Firm to very stiff Grey brown Moist to wet		3	SS	4		73				
71.4			4	SS	WH		72		○		
3.7	CLAY Firm Grey						71	× + / × +			
70.1			5	TP	PH				⊢○⊣		
5.0	Layered silty CLAY and clayey SILT, trace gravel Stiff Grey Wet						70				
69.5 / 5.6			6	SS	7						
69.0	Sandy SILT, some gravel and clay (TILL) Compact Grey Wet		7	SS	>100		69				
6.1	SAND and GRAVEL, some silt with cobbles Dense to very dense Grey Wet		8	SS	51		68				
			9	SS	43		67		○		43 40 14 3
			10	SS	>100						
			11	SS	91		66				
			12	SS	>100		65				
64.7											
10.4	End of Borehole Auger Refusal										

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

Golder Associates

RECORD OF BOREHOLE No 06-205

1 OF 1

METRIC

PROJECT 05-1120-210-2700 | W.P. 4058-01-00 | DIST | HWY 417 | DATUM Geodetic

LOCATION N 5027515.9; E 364501.3 | BOREHOLE TYPE Power Auger 108mm I.D. Hollow Stem Auger | DATE November 7, 2006

ORIGINATED BY D.J.S. | COMPILED BY J.M. | CHECKED BY M.I.C.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
75.4	GROUND SURFACE						
0.0	Topsoil (FILL)						
0.2	Sandy silt, some gravel with cobbles (FILL) Dark brown						
74.6	TOPSOIL Moist		1	SS	6		
1.2	Silty SAND Brown Moist						
	CLAY (Weathered Crust) Stiff to very stiff Grey brown Moist to wet		2	SS	8		
			3	SS	2		
			4	SS	WH		
71.4							
4.0	CLAY Firm Grey Wet		5	TP	PH		
69.8							
5.6	Silty CLAY and clayey SILT, trace gravel Stiff Grey Wet						
69.2			6	SS	22		
6.3	Sandy SILT, some gravel and clay (TILL) Compact Grey Wet						
68.6			7	SS	31		
6.8	SAND and GRAVEL, some silt with cobbles and boulders Dense to very dense Grey Wet		8	SS	39		
			9	SS	36		
			10	SS	>100		
			11	NQ RC	DD		
64.7			12	NQ RC	DD		
10.7	Limestone (BEDROCK) Slightly weathered Grey		13	NQ RC	DD		
			14	NQ RC	DD		
			15	NQ RC	DD		
62.5			16	NQ RC	DD		
13.0	Limestone (BEDROCK) Fresh Grey						
61.5	Bedrock cored between 10.7m 13.9m depth. For bedrock coring details refer to Record of Drillhole 06-205.		17	NQ RC	DD		
13.9	End of Borehole						

Note:
Water level in standpipe at 1.20m depth below ground surface on Dec. 10, 2006

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (25 50 75)

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
	39	39	18	4

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

PROJECT: 05-1120-210-2700

RECORD OF DRILLHOLE: 06-205

SHEET 1 OF 1

LOCATION: N 5027515.9; E 364501.3

DRILLING DATE: Nov. 7, 2006

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

FR/FX-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR & RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
		ROCK SURFACE		64.70													
11	Rotary Drill NQ Core	Limestone (BEDROCK) Slightly weathered Grey		10.70	1												
12					2												
					3												
13				62.40													
		Limestone (BEDROCK) Fresh Grey		13.00	4												
					5												
14		End of Drillhole		61.50 13.90													
15																	
16																	
17																	
18																	
19																	
20																	
21																	
22																	
23																	
24																	
25																	

DEPTH SCALE
1 : 75

Golder Associates

LOGGED: D.J.S.
CHECKED: W.C.

MIS-RCK 001 051120210-2700-2-ROCK.GPJ GAL-MISS.GDT 6/1/09 J.M

Golder Associates

RECORD OF BOREHOLE No 06-206

1 OF 1

METRIC

PROJECT 05-1120-210-2700 | LOCATION N 5027491.3; E 364478.1 | ORIGINATED BY D.J.S.

W.P. 4058-01-00 | BOREHOLE TYPE Power Auger 108mm I.D. Hollow Stem Auger | COMPILED BY J.M.

DIST HWY 417 | DATE November 10, 2006 | CHECKED BY M.I.C.

DATUM Geodetic

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
75.5	GROUND SURFACE										
0.0	Topsoil (FILL)										
0.3	Fine to medium sand (FILL) Brown										
	Sandy silt, some gravel with cobbles, clay and asphalt (FILL) Compact Brown Moist		1	SS	23						
74.2	TOPSOIL Moist										
73.8			2	SS	6						
1.7	CLAY (Weathered Crust) Firm to very stiff Grey brown Moist										
71.9											
3.6	CLAY Firm Grey Wet		3	SS	WH						
70.0											
5.5	Silty CLAY and clayey SILT, trace gravel Stiff Grey Wet										
69.2			4	SS	1						
6.3	Silty SAND, some gravel and clay with cobbles (TILL) Loose Grey Wet		5	SS	5				o		12 48 29 11
67.6			6	SS	8						
7.9	SAND and GRAVEL, trace silt and clay with cobbles Loose to dense Grey Wet		7	SS	9						
			8	SS	23						
			9	SS	23				o		34 55 9 2
			10	SS	46						
63.7											
11.8	End of Borehole Auger Refusal										

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

MISS_MTO 051120210-2700-2 (EDIT).GPJ ON_MOT.GDT 6/1/09

Golder Associates

RECORD OF BOREHOLE No 06-207

1 OF 1

METRIC

PROJECT 05-1120-210-2700
W.P. 4058-01-00
DIST HWY 417
DATUM Geodetic
LOCATION N 5027504.7; E 364354.9
BOREHOLE TYPE Power Auger 108mm I.D. Hollow Stem Auger
DATE November 13, 2006
ORIGINATED BY D.J.S.
COMPILED BY J.M.
CHECKED BY M.I.C.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.1	GROUND SURFACE						77				
0.0	Topsoil (FILL)										
	Silty sand, some gravel (FILL)										
76.5	Dark brown										
	Fine sand (FILL)										
0.8	Brown										
	TOPSOIL		1	SS	7		76				
	Silty fine SAND										
75.6	Loose										
1.5	Brown										
	Moist										
	Fine SAND with thin sandy silt seams		2	SS	9		75		o		0 50 46 4
74.9	Loose										
2.2	Brown										
	Moist										
	CLAY (Weathered Crust)		3	SS	7						
	Stiff to very stiff										
	Grey brown						74				
	Moist to wet		4	SS	2				⊢o⊣		
73.5											
3.6	CLAY							× +			
	Firm to stiff						73	× +			
	Grey										
	Wet		5	SS	WH				⊢o⊣		
							72				
								× +			
								× +			
70.9							71				
6.3	Silty CLAY, trace gravel		6	SS	2						
	Very stiff										
70.4	Grey										
6.7	Wet						70				
	Silty SAND, some gravel, trace clay (TILL)		7	SS	1						
	Very loose to loose										
	Grey										
	Wet		8	SS	2		69		o		16 46 28 10
			9	SS	8						
68.1											
9.0	Fine to coarse SAND						68				
	Loose		10	SS	9						
67.5	Grey										
	Wet										
9.8	SAND and GRAVEL										
	Grey										
	Wet										
	End of Borehole										
	Auger Refusal										

○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED

$+^3$, $\times^3$: Numbers refer to Sensitivity

$O^{3\%}$ STRAIN AT FAILURE

MISS_MTO 05112021O-2700-2 (EDIT) GPJ ON_MOT GDT 6/1/09

Golder Associates

RECORD OF BOREHOLE No 06-208

1 OF 2

METRIC

PROJECT 05-1120-210-2700
W.P. 4058-01-00
DIST HWY 417
DATUM Geodetic
LOCATION N 5027482.9; E 364336.4
BOREHOLE TYPE Power Auger 108mm I.D. Hollow Stem Auger
DATE November 13, 2006
ORIGINATED BY D.J.S.
COMPILED BY J.M.
CHECKED BY M.I.C.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.1	GROUND SURFACE						77				
0.0	Topsoil (FILL)										
	Silty sand, some gravel (FILL) Brown										
0.6	TOPSOIL										
	Silty fine SAND Brown		1	SS	7		76				
75.9	Moist										
1.2	Sandy SILT with fine sand layers Loose Brown Moist to wet		2	SS	7		75		○		0 43 50 7
74.7											
2.4	CLAY (Weathered Crust) Stiff to very stiff Grey brown Moist to wet		3	SS	3						
			4	SS	2		74				
73.5											
3.6	CLAY Firm Grey Wet						73	× + × +			
			5	TP	PH						
71.6							72	× +			
5.5	Sandy SILT, some gravel and clay (TILL) Very loose to loose Grey Wet		6	SS	7						
			7	SS	3		71				
			8	SS	6		70				
			9	SS	7		69				
68.6											
8.5	SAND and GRAVEL, some silt, trace clay with cobbles Very dense Grey Wet		10	SS	59						
			11	SS	57		68				
			12	SS	51		67		○		39 44 14 3
			13	SS	>100						
65.6							66				
11.5	Cobbles and boulders		14	NQ RC	DD						
			15	NQ RC	DD		65				
			16	NQ RC	DD		64				
63.3											
13.9			17	NQ RC	DD		63				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\bigcirc^{3\%}$ STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No 06-208

2 OF 2

METRIC

PROJECT 05-1120-210-2700
W.P. 4058-01-00
DIST HWY 417
DATUM Geodetic
LOCATION N 5027482.9; E 364336.4
BOREHOLE TYPE Power Auger 108mm I.D. Hollow Stem Auger
DATE November 13, 2006
ORIGINATED BY D.J.S.
COMPILED BY J.M.
CHECKED BY M.I.C.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---							20 40 60 80 100	25 50 75		
	Limestone with black shale interbeds (BEDROCK) Fresh Grey Bedrock cored between 11.5m 16.4m depth. For bedrock coring details refer to Record of Drillhole 06-208.		18	NQ RC	DD		62 61				
60.7 16.4	End of Borehole Note: Water level in standpipe at 1.90m depth below ground surface on Dec. 10, 2006										

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

PROJECT: 05-1120-210-2700

RECORD OF DRILLHOLE: 06-208

SHEET 1 OF 1

LOCATION: N 5027482.9; E 364336.4

DRILLING DATE: Nov. 10, 2006

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: --

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

FR/FX-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	PLUSH	COLOUR & % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
		ROCK SURFACE		65.60													
12	Rotary Drill / NQ Core	Cobbles and boulders		11.50	1												
13					2												
				63.20	3												
14		Limestone with black shale interbeds (BEDROCK) Fresh Grey		13.90	4												
15					5												
16				60.70													
		End of Drillhole		16.40													
17																	
18																	
19																	
20																	
21																	
22																	
23																	
24																	
25																	
26																	

DEPTH SCALE
1 : 75

Golder Associates

LOGGED: D.J.S.
CHECKED: W.C.

MIS-RCK 001 05112021O-2700-2-ROCK.GPJ GAL-MISS.GDT 6/1/09 J.M

Golder Associates

RECORD OF BOREHOLE No 06-209

1 OF 1

METRIC

PROJECT 05-1120-210-2700
W.P. 4058-01-00
DIST HWY 417
DATUM Geodetic
LOCATION N 5027461.8; E 364320.4
BOREHOLE TYPE Power Auger 108mm I.D. Hollow Stem Auger
DATE November 22, 2006
ORIGINATED BY D.G.
COMPILED BY J.M.
CHECKED BY M.I.C.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.7	GROUND SURFACE										
0.0 / 76.2	TOPSOIL										
0.5	Silty fine sand with brick and wood fragments (FILL) Loose Brown Moist to wet		1	SS	8						
			2	SS	5				○		0 52 43 5
74.4											
2.3 / 73.8	CLAY (Weathered Crust) Very stiff Grey brown Moist		3	SS	3				○		
2.9 / 71.5	CLAY Firm to stiff Grey Moist to wet							× + × + × + × + × +			
5.2	Sandy SILT, some gravel, trace clay with cobbles and boulders (TILL) Loose to compact Grey Wet		4	SS	6						
			5	SS	7						
			6	SS	50						
			7	SS	18						
68.3											
8.4 / 67.6	Fine to medium SAND, trace silt and gravel with cobbles Compact Grey Wet		8	SS	25						
9.1	Fine SAND, trace silt with cobbles Very dense Grey Wet		9	SS	81				○		0 88 11 1
			10	SS	>100						
65.7			11	SS	>100						
11.0	End of Borehole Auger Refusal										

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

Golder Associates

RECORD OF BOREHOLE No 06-210

1 OF 1 **METRIC**

PROJECT 05-1120-210-2700
W.P. 4058-01-00
DIST HWY 417
DATUM Geodetic

LOCATION N 5027154.5; E 364084.5
BOREHOLE TYPE Power Auger 108mm I.D. Hollow Stem Auger
DATE November 29, 2006

ORIGINATED BY D.J.S.
COMPILED BY J.M.
CHECKED BY M.I.C.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.0	GROUND SURFACE										
0.0	Topsoil (FILL)										
0.1	Sandy silt, some gravel and crushed stone (FILL) Brown										
75.2	Fine to medium sand, trace gravel (FILL) Brown Moist		1	SS	17		75				
1.0	Sandy silt, some gravel with cobbles (FILL) Compact Brown Moist		2	SS	16		74				
74.3	PEAT Moist		3	SS	30				○		66 27 (7)
2.0	Silty CLAY, trace sand Grey brown Moist										
73.3	GRAVEL, some sand, trace silt with cobbles (TILL) Compact to dense Brown Wet										
2.7	End of Borehole Auger Refusal										

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No 06-211

1 OF 1 **METRIC**

PROJECT 05-1120-210-2700 | W.P. 4058-01-00 | DIST ____ HWY 417 | DATUM Geodetic

LOCATION N 5027149.6; E 364054.3 | BOREHOLE TYPE Power Auger 108mm I.D. Hollow Stem Auger | DATE November 29, 2006

ORIGINATED BY D.J.S. | COMPILED BY J.M. | CHECKED BY M.I.C.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
75.8	GROUND SURFACE										
0.0	Topsoil (FILL)										
0.1	SAND, some silt, with ash (FILL) Brown Moist										
			1	SS	11		75				0 72 20 8
74.5											
74.2	PEAT Dark brown Moist to wet		2	SS	9		74		○		
	Silty SAND Brown Moist to wet		3	NQ RC	DD						
2.1	SAND and GRAVEL Brown Moist to wet										
	Sandy SILT (TILL) Compact Brown Moist to wet		4	NQ RC	DD		73				
	Limestone with mud seams (BEDROCK) Weathered Grey brown		5	NQ RC	DD		72				
			6	NQ RC	DD						
			7	NQ RC	DD		71				
70.6											
5.2	Limestone with black shale interbeds (BEDROCK) Fresh Grey		8	NQ RC	DD						
70.0							70				
5.8	Bedrock cored between 2.1m 5.8m depth. For bedrock coring details refer to Record of Drillhole 06-211. End of Borehole										
	Note: Standpipe dry on Dec. 10, 2006										

+ 3, × 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 05-1120-210-2700

RECORD OF DRILLHOLE: 06-211

SHEET 1 OF 1

LOCATION: N 5027149.6; E 364054.3

DRILLING DATE: Nov. 29, 2006

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

FR/FX-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH % RETURN	COLOUR	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.3	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
		ROCK SURFACE		73.70													
	Rotary Drill NQ Core	Limestone with mud seams (BEDROCK) Weathered Grey brown		2.10	1 2 3 4 5				80 60 40 20	80 60 40 20	80 60 40 20	5 10 15 20	0 30 60 90		10^{-6} 10^{-5} 10^{-4} 10^{-3}	2 4 6	
		Limestone, with black shale interbeds (BEDROCK) Fresh Grey		70.60 5.20 70.00	6												
		End of Drillhole		5.80													

DEPTH SCALE
1 : 75

Golder Associates

LOGGED: D.J.S.
CHECKED: W.C.

MIS-RCK 001 05112021 0-2700-2-ROCK GPJ GAL-MISS GDT 6/1/09 J.M.

Golder Associates

RECORD OF BOREHOLE No 06-212 1 OF 1 METRIC

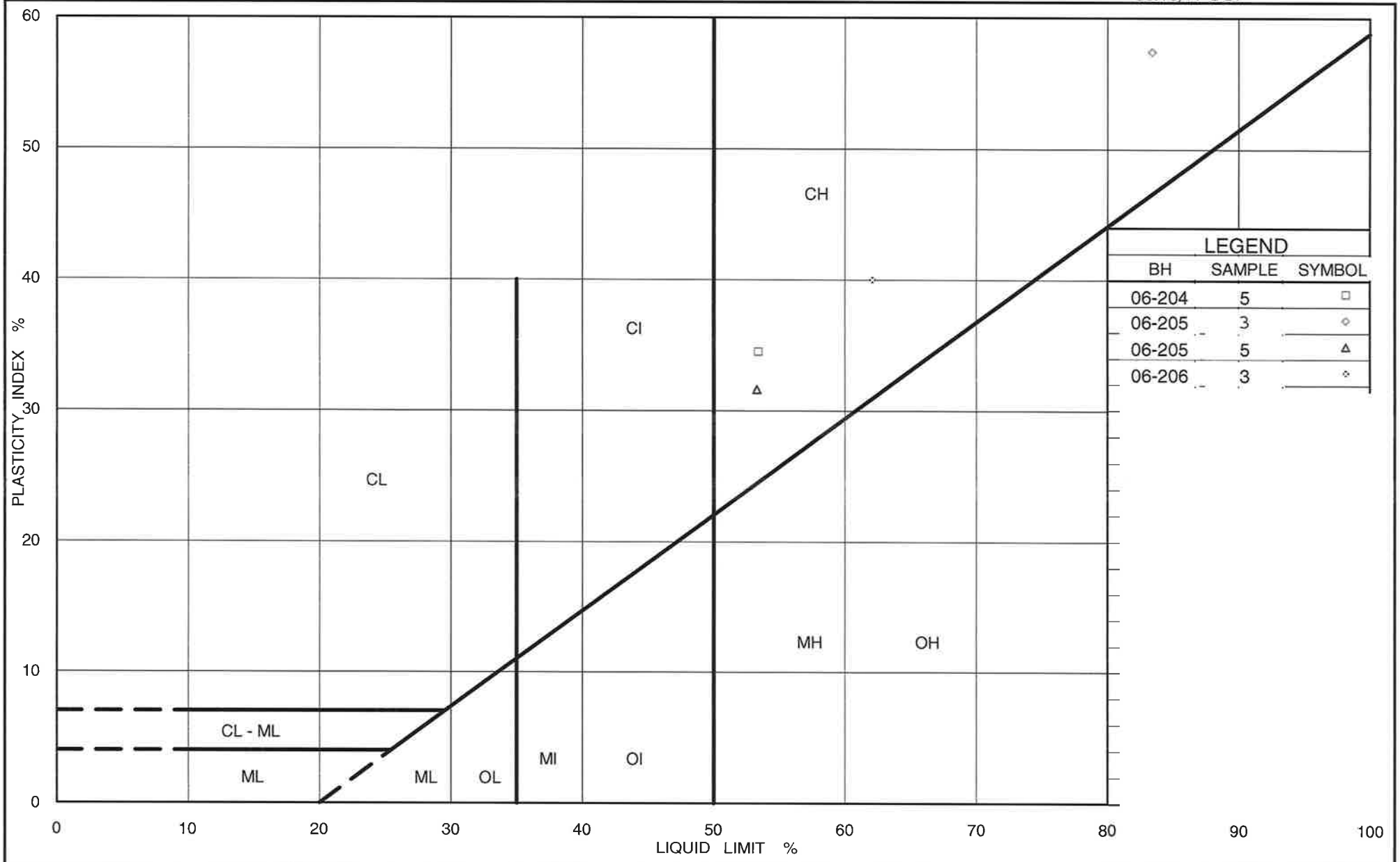
PROJECT 05-1120-210-2700
W.P. 4058-01-00
DIST HWY 417
DATUM Geodetic
LOCATION N 5027141.7; E 364023.7
BOREHOLE TYPE Power Auger 108mm I.D. Hollow Stem Auger
DATE November 29, 2006
ORIGINATED BY D.J.S.
COMPILED BY J.M.
CHECKED BY M.I.C.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 25 50 75	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.1	GROUND SURFACE						76				
0.0	Topsoil (FILL)										
	Silty sand and gravel (FILL) Brown										
0.4	Sandy silt, some gravel with cobbles (FILL) Loose Brown Moist		1	SS	4						
74.9	Fine to medium sand, with brick fragments (FILL)						75				
74.4	Brown Moist		2	SS	9				o		
1.7	PEAT										
73.8	Sandy SILT, some gravel and clay (TILL) Compact Brown Moist						74				
2.4	Limestone (BEDROCK) Weathered										
	End of Borehole Auger Refusal										

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

APPENDIX C

Oct 75, FF-S-21

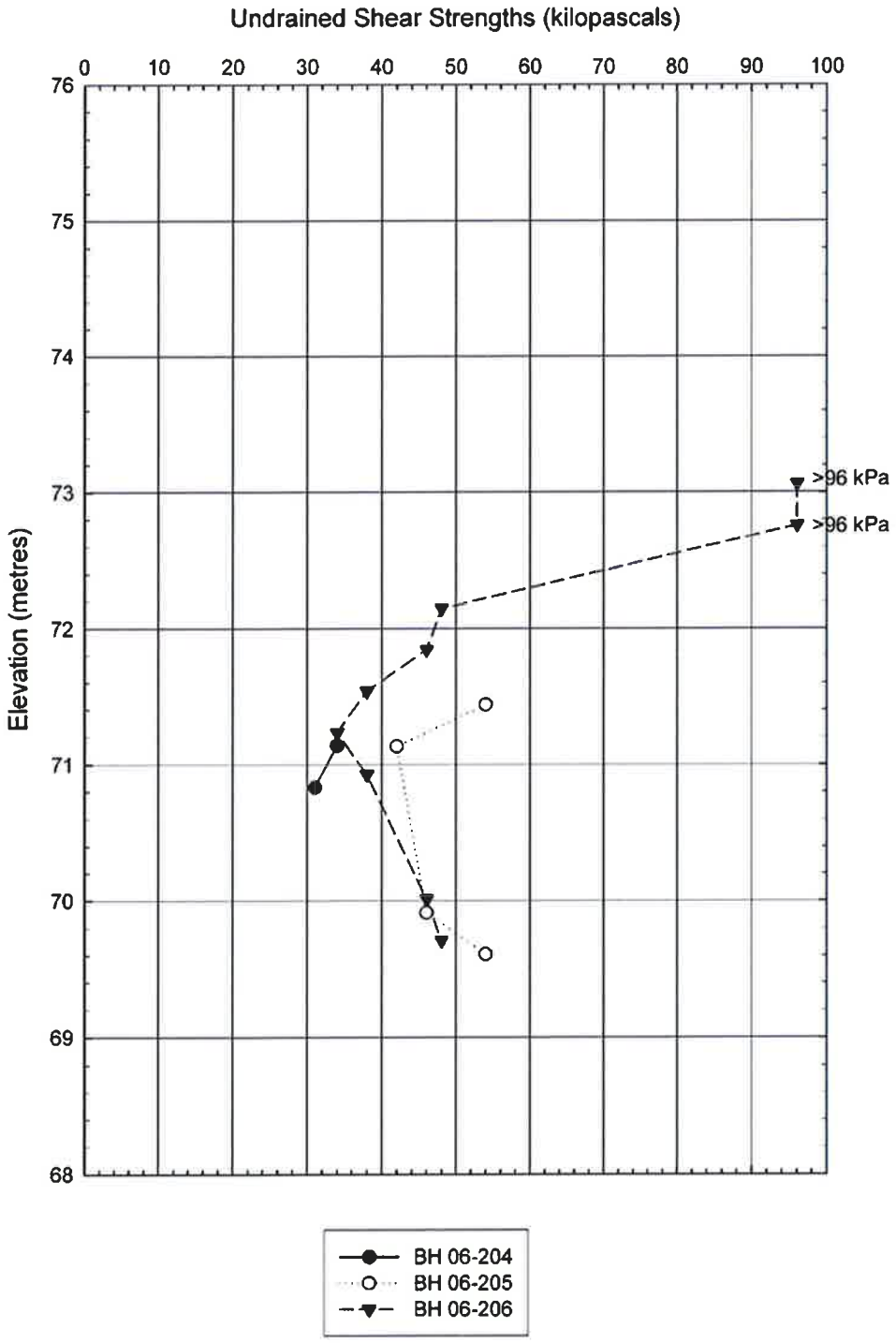


Ministry of Transportation
Ontario

PLASTICITY CHART
Clay

Carling Avenue Westbound Staging Area
Project No. 05-1120-210-2700-2
Figure 1

Summary of Undrained Shear Strengths



Golder Associates
Ottawa, Ontario

FILE No.	051120210-2700-02-1.dwg
PROJECT No.	05-1120-210
REV.	0
SCALE	AS SHOWN
DATE	28 JUNE 07
DESIGN	W.C.
CADD	J.M.
CHECK	W.C.
REVIEW	F.J.H.

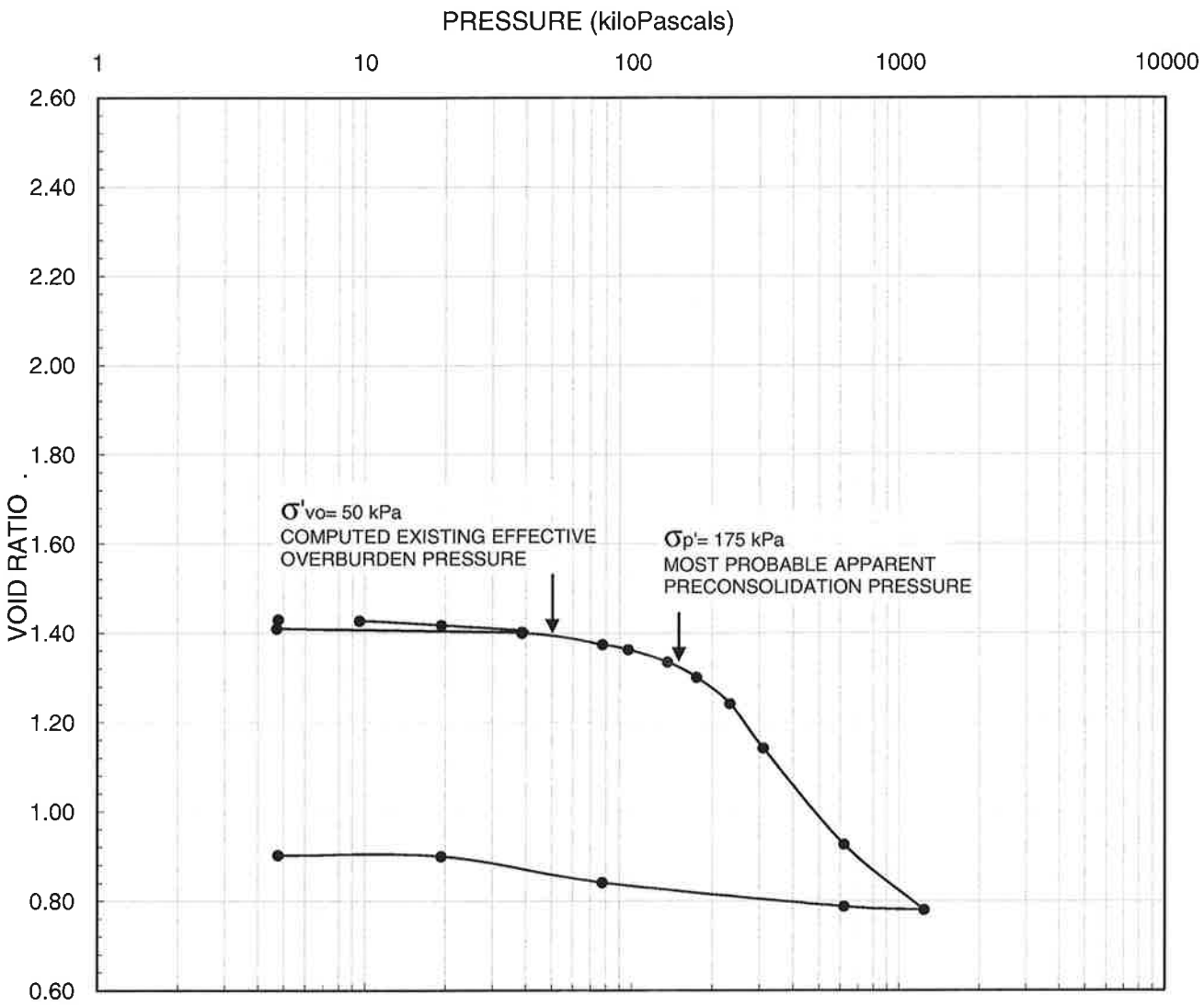
TITLE

CARLING WESTBOUND STAGING AREA
SUMMARY OF UNDRAINED SHEAR STRENGTHS

-

FIGURE 2

Drawing file: 051120210-2700-02-1.dwg Jun 01, 2009 - 4:40pm



LEGEND

Borehole:	06-204	w_i = 49.0%	S_o = 97%
Sample:	5	w_f = 33.0%	C_c = 0.81
Depth (m):	4.80	w_l = 53.4%	C_r = 0.011
		w_p = 18.9%	

Golder Associates

SCALE	AS SHOWN
DATE	06/01/09
DESIGN	NA
CADD	NA
CHECK	
REVIEW	

FILE No. Consolidation summary

PROJECT No. 05-1120-210-2700-2 REV. 0

TITLE

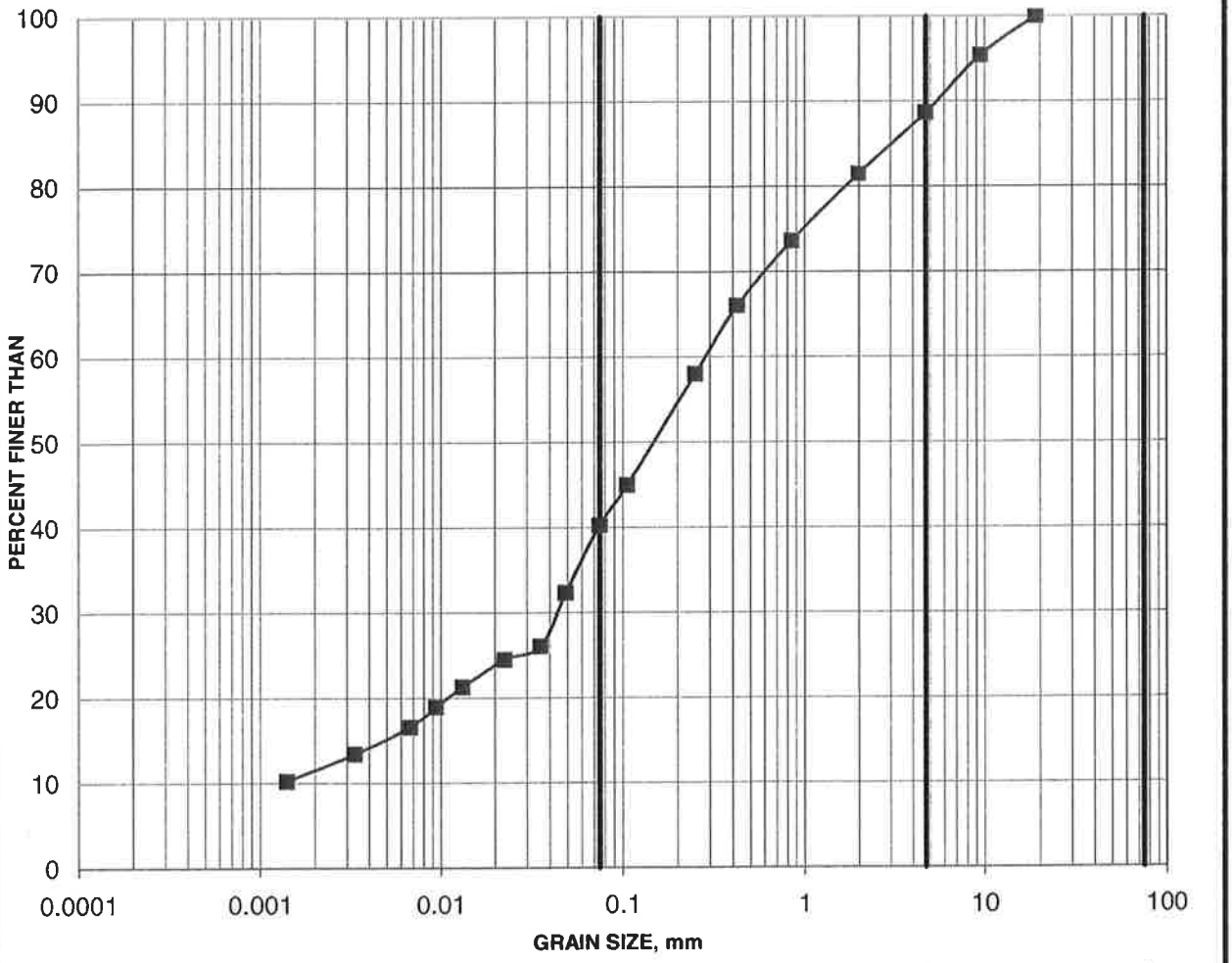
CONSOLIDATION TEST RESULTS

FIGURE 3

GRAIN SIZE DISTRIBUTION

Figure 4

Till



Borehole	Sample	Depth (m)
06-206	5	6.9-7.5

Received: Dec 7th, 2006

Project: 05-1120-210-2700-2

Golder Associates

26-Jun-07

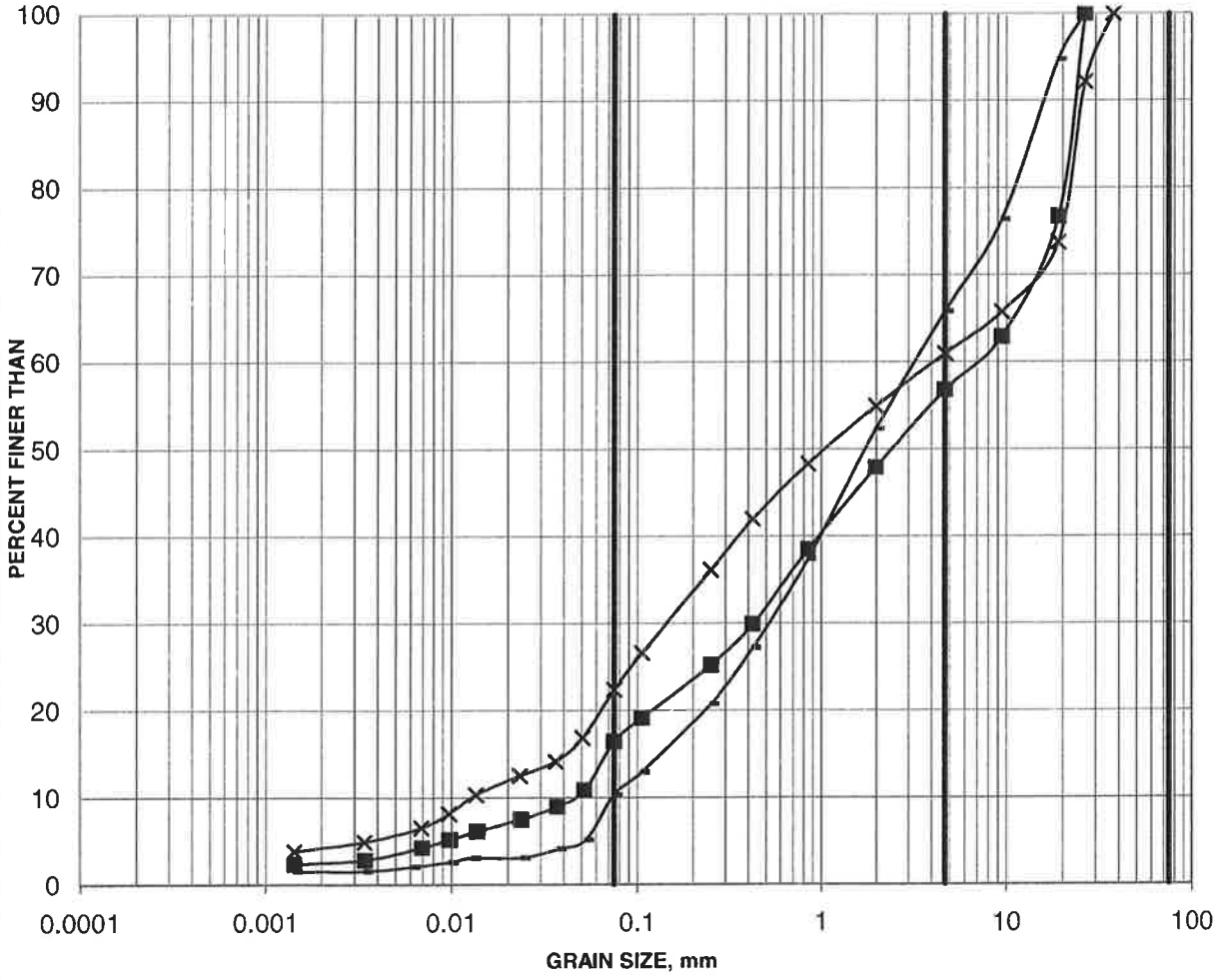
Created by: MaD

Checked by: BaJ

GRAIN SIZE DISTRIBUTION

Figure 5

Sand and Gravel



Borehole	Sample	Depth (m)
06-204	9	7.6-8.2
06-205	7	6.9-7.5
06-206	9	9.9-10.5

Received: Dec 7th, 2006

Project: 05-1120-210-2700-2

Golder Associates

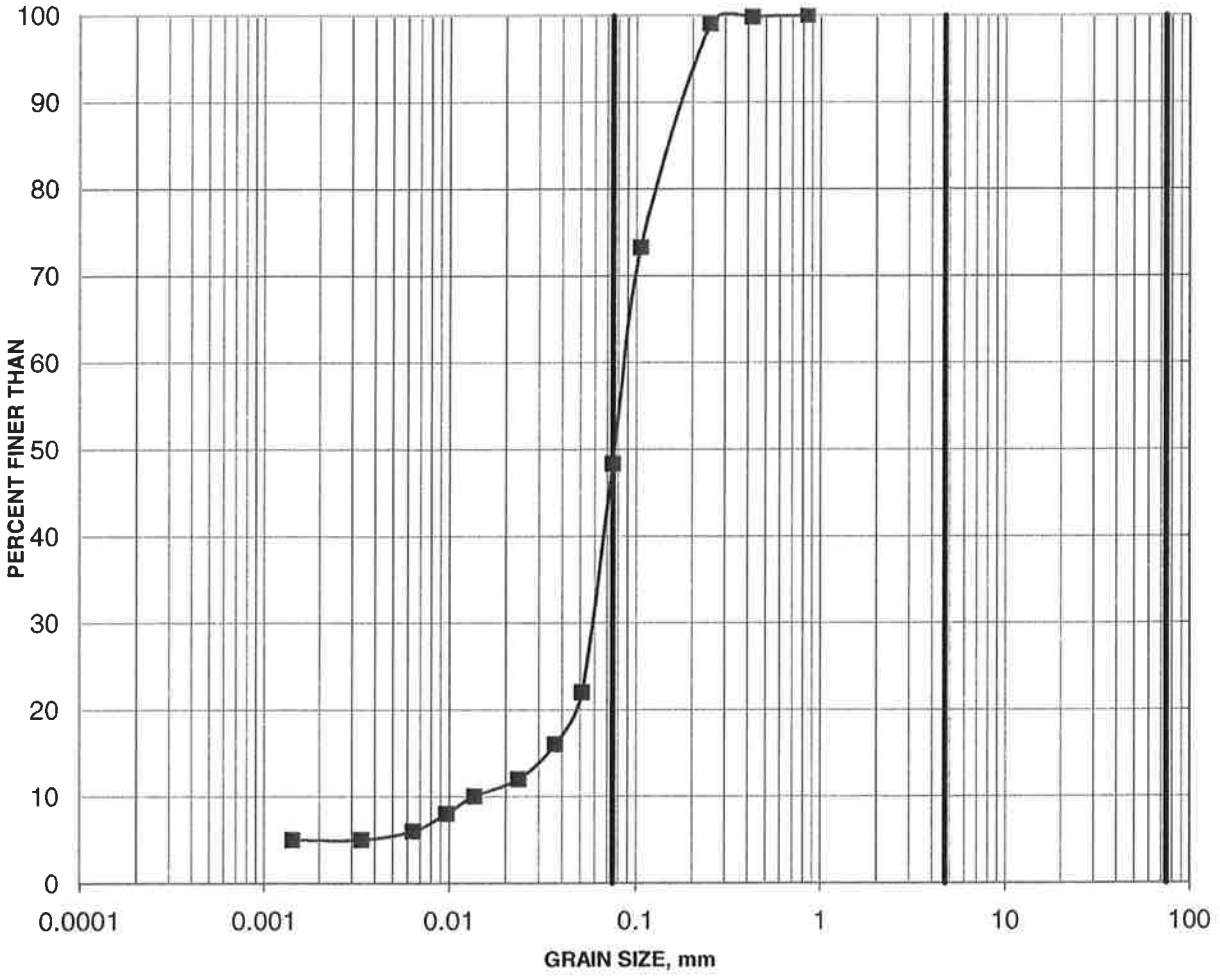
26-Jun-07

Created by: MaD

Checked by: BaJ

GRAIN SIZE DISTRIBUTION	Figure 6

Silty Sand Fill



Borehole	Sample	Depth (m)
06-209	2	1.5-2.1

Received: Dec 7th, 2006
Project: 05-1120-210-2700-2

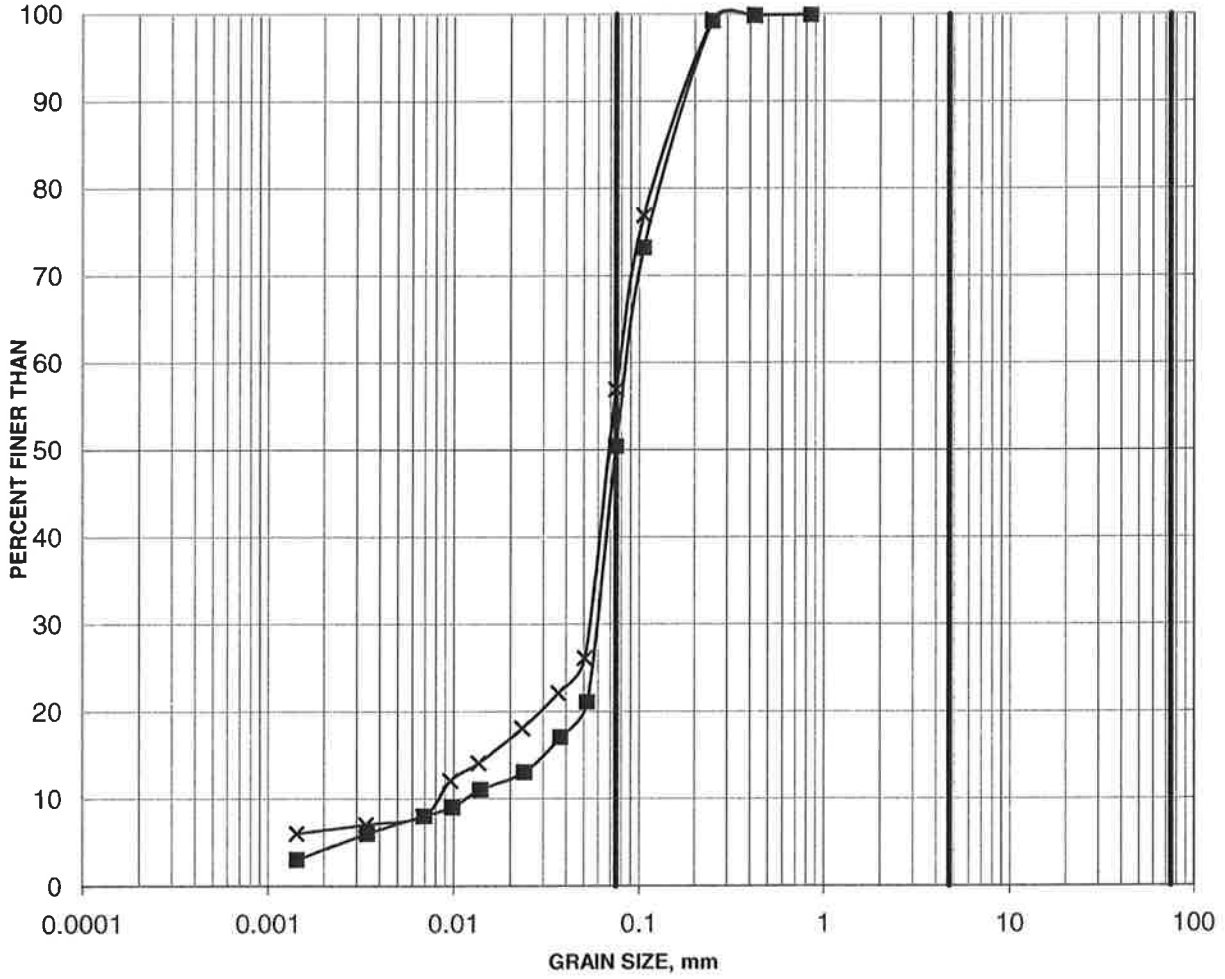
Golder Associates

26-Jun-07

Created by: MaD
Checked by: BaJ

GRAIN SIZE DISTRIBUTION	Figure 7

Sandy Silt



Borehole	Sample	Depth (m)
06-207	2	1.5-2.1
06-208	2	1.5-2.1

Received: Dec 7th, 2006

Project: 05-1120-210-2700-2

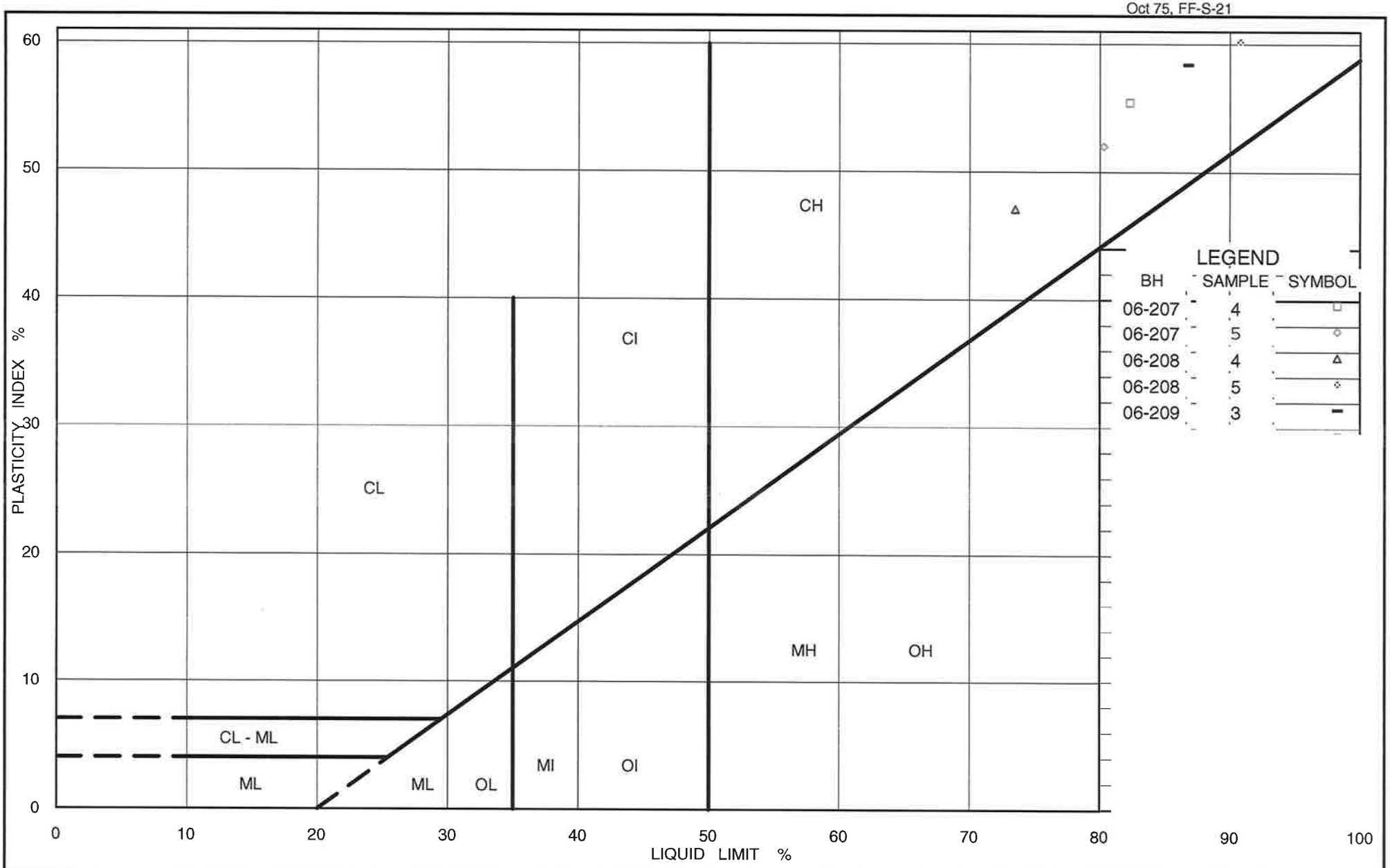
Golder Associates

26-Jun-07

Created by: MaD

Checked by: BaJ

Oct 75, FF-S-21



Ministry of Transportation

Ontario

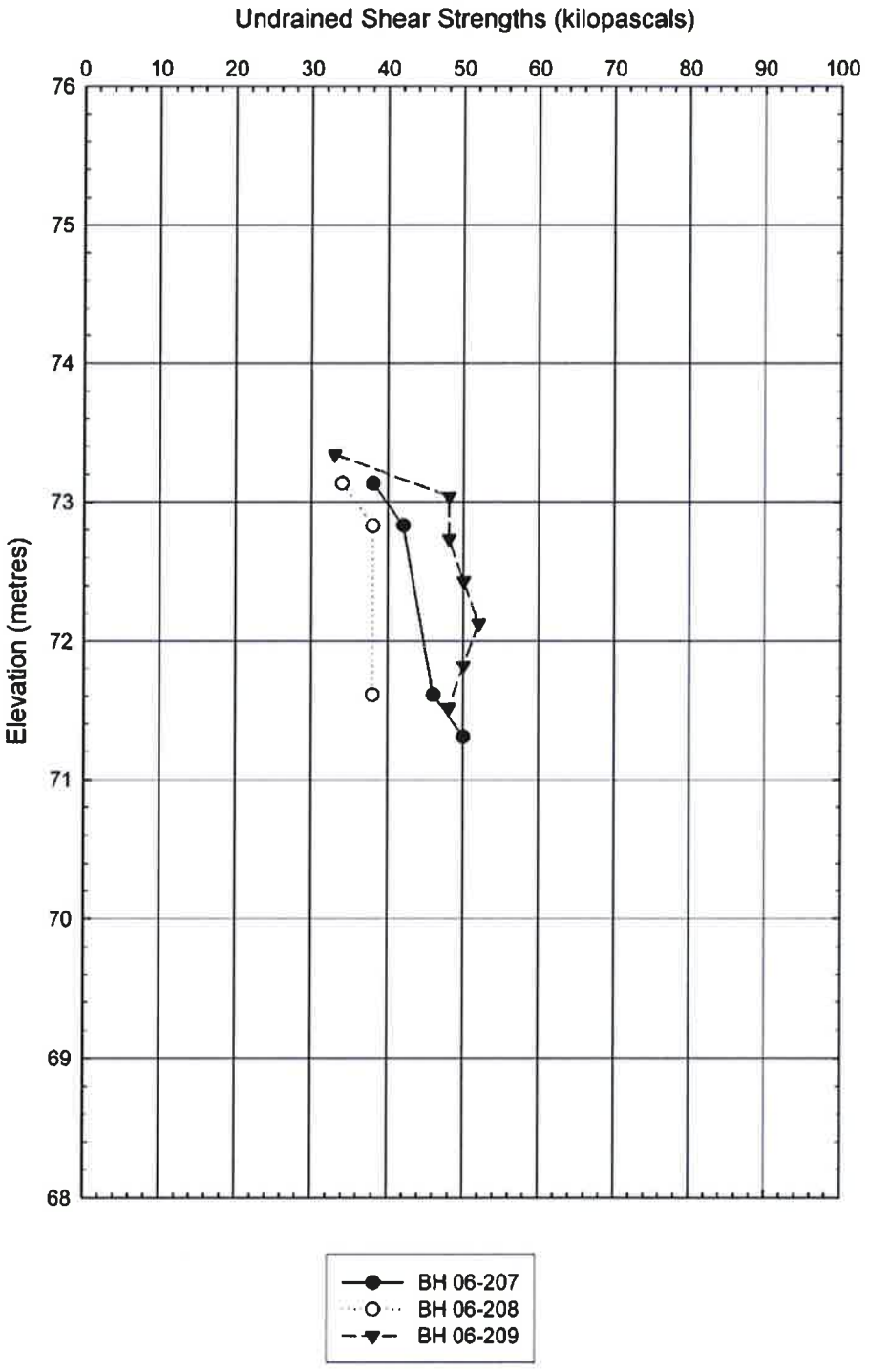
PLASTICITY CHART
Clay

Kirkwood Avenue Staging Area

Project No. 05-1120-210-2700-2

Figure 8

Summary of Undrained Shear Strengths



Golder Associates
Ottawa, Ontario

FILE No.	051120210-2700-09-1.dwg
PROJECT No.	05-1120-210
REV.	0
SCALE	AS SHOWN
DATE	28 JUNE 07
DESIGN	W.C.
CADD	J.M.
CHECK	W.C.
REVIEW	F.J.H.

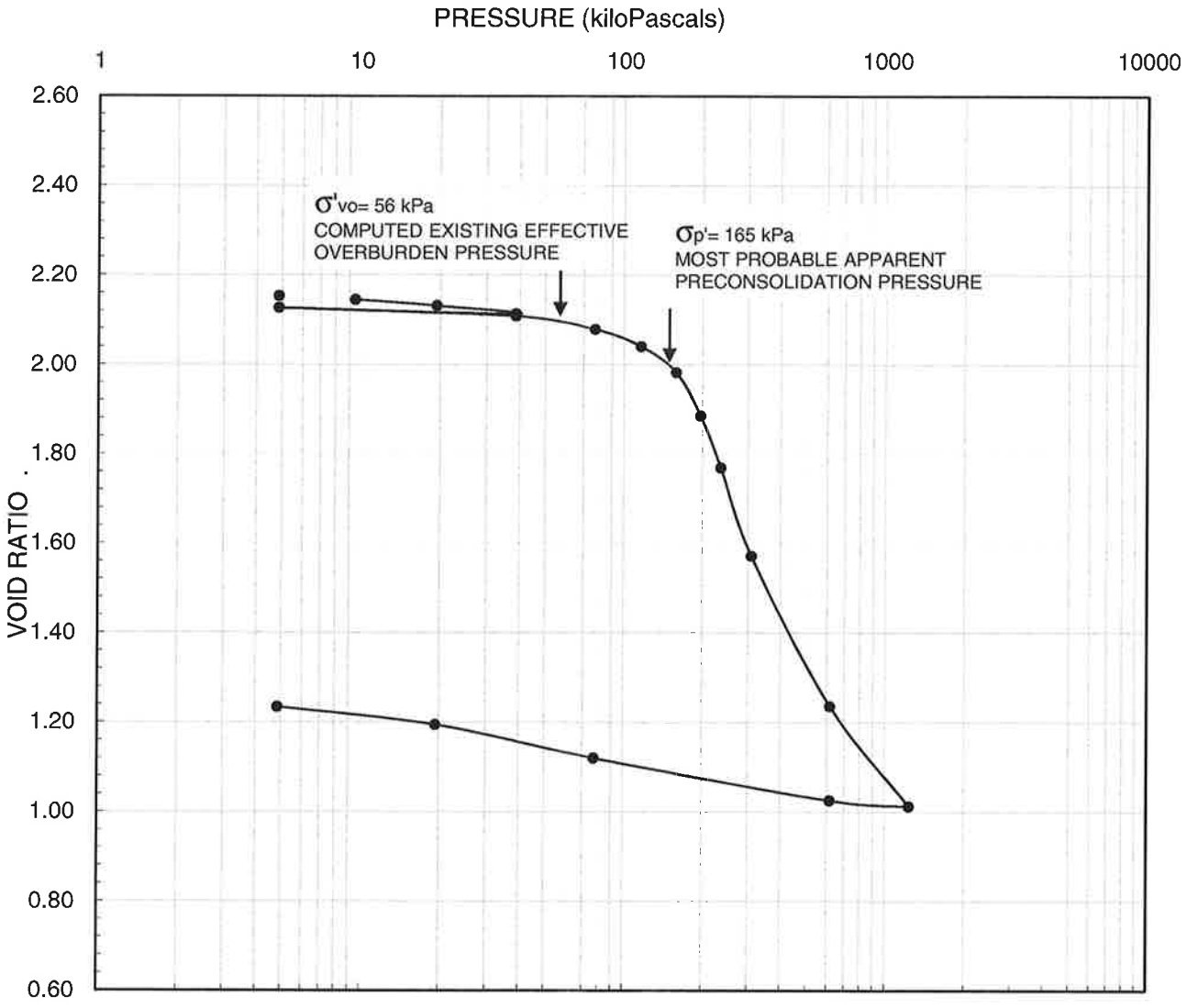
TITLE

KIRKWOOD AVENUE STAGING AREA
SUMMARY OF UNDRAINED SHEAR STRENGTHS

-

FIGURE 9

Drawing file: 051120210-2700-09-1.dwg Jun 01, 2009 - 4:42pm



LEGEND

Borehole:	06-208	w_i = 76.0%	S_o = 97%
Sample:	5	w_f = 47.0%	C_c = 1.66
Depth (m):	4.8m	w_l = 90.8%	C_r = 0.012
		w_p = 30.6%	

Golder Associates

FILE No.	Consolidation summary
PROJECT No.	05-1120-210-2700-2 REV. 0
SCALE	AS SHOWN
DATE	06/01/09
DESIGN	NA
CADD	NA
CHECK	
REVIEW	

TITLE

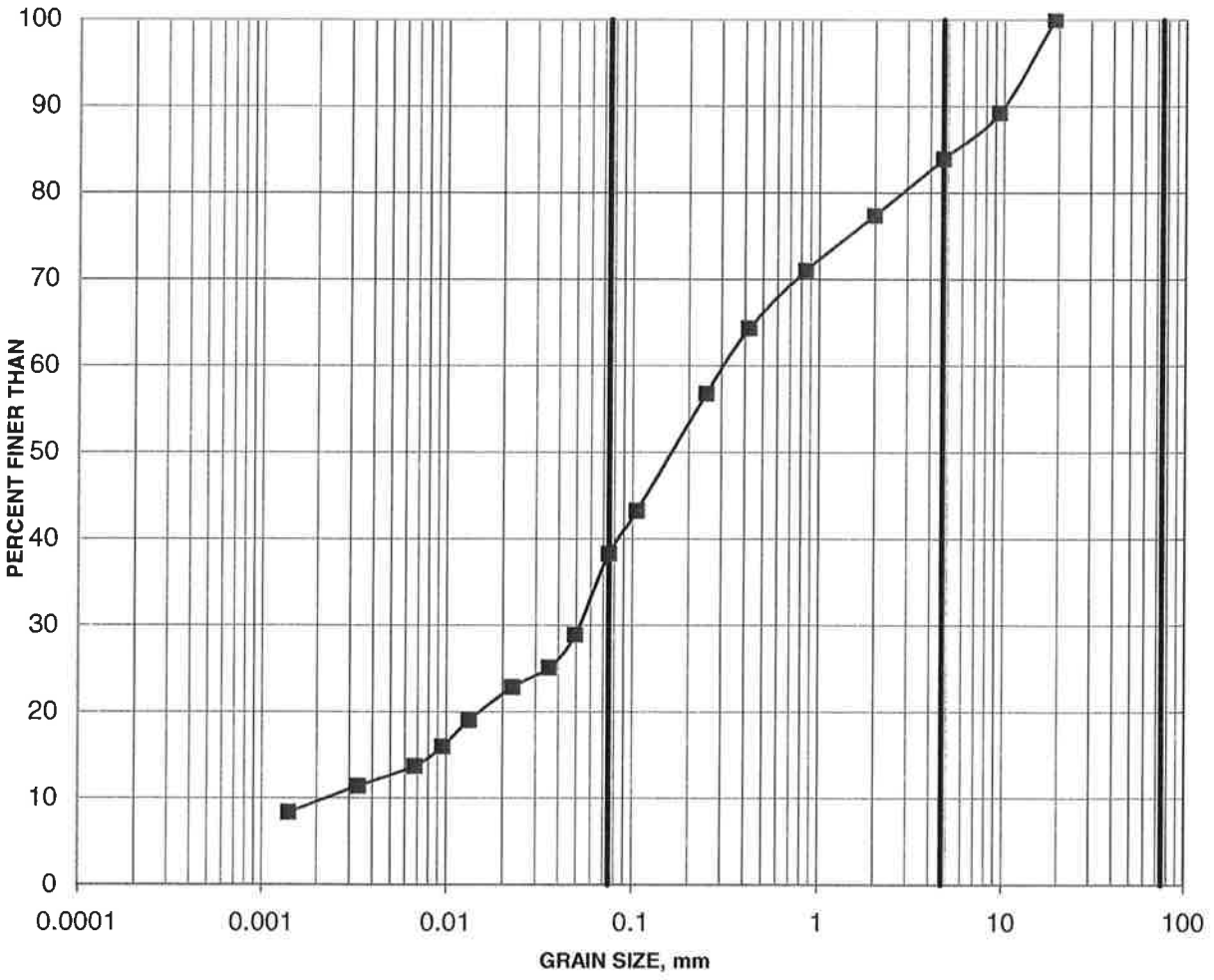
CONSOLIDATION TEST RESULTS

FIGURE 10

GRAIN SIZE DISTRIBUTION

FIGURE 11

TILL



Borehole	Sample	Depth (m)
06-207	8	7.6-8.2

Received: Dec 7th, 2006

Project: 05-1120-210-2700-2

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9-Jul-07

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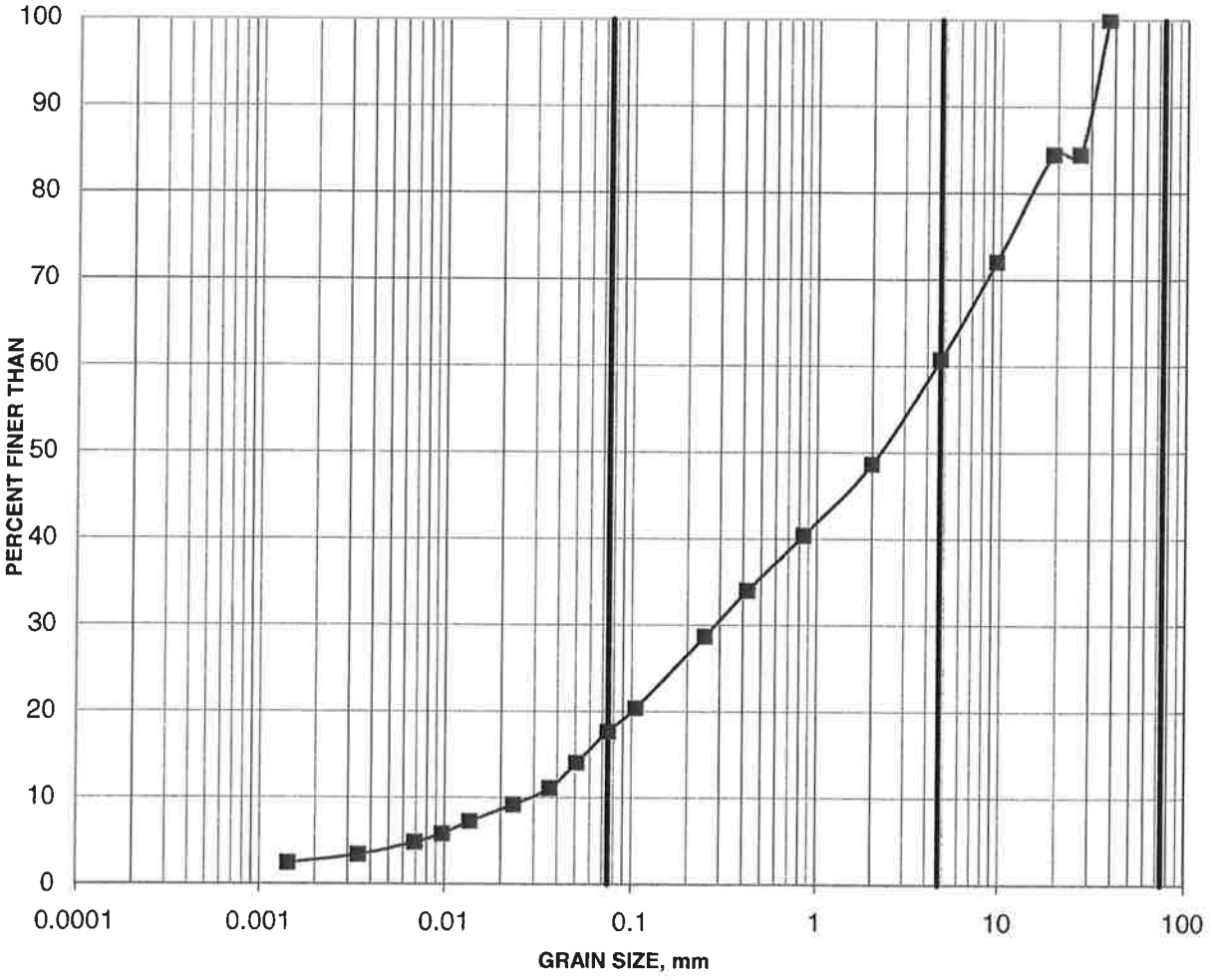
Checked by: BaJ

GRAIN SIZE DISTRIBUTION

Figure 12

Sand and Gravel



Borehole	Sample	Depth (m)
06-208	12	9.9-10.5

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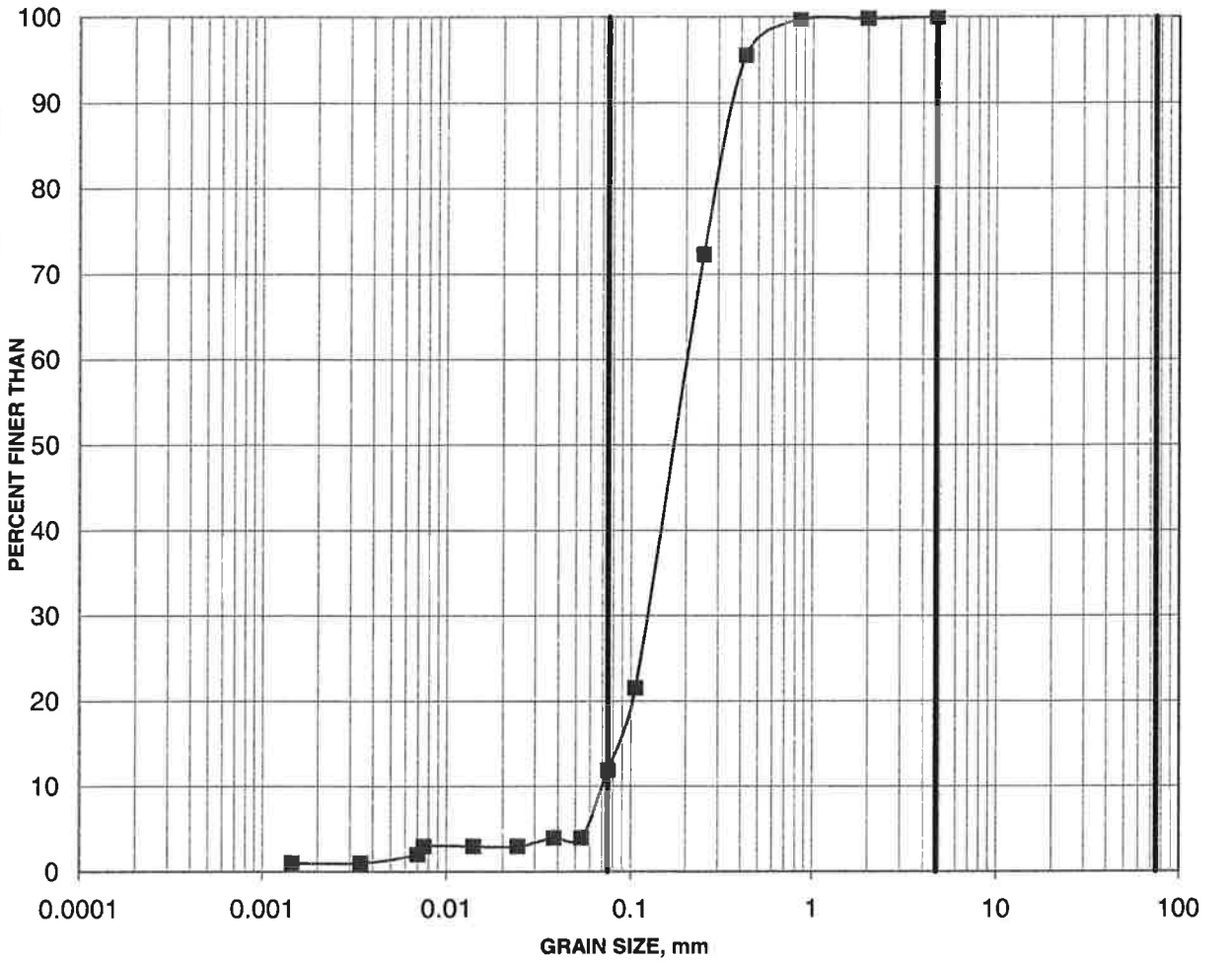
Figure 13

Fine Sand



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

Borehole	Sample	Depth (m)
06-209	9	9.1-9.8

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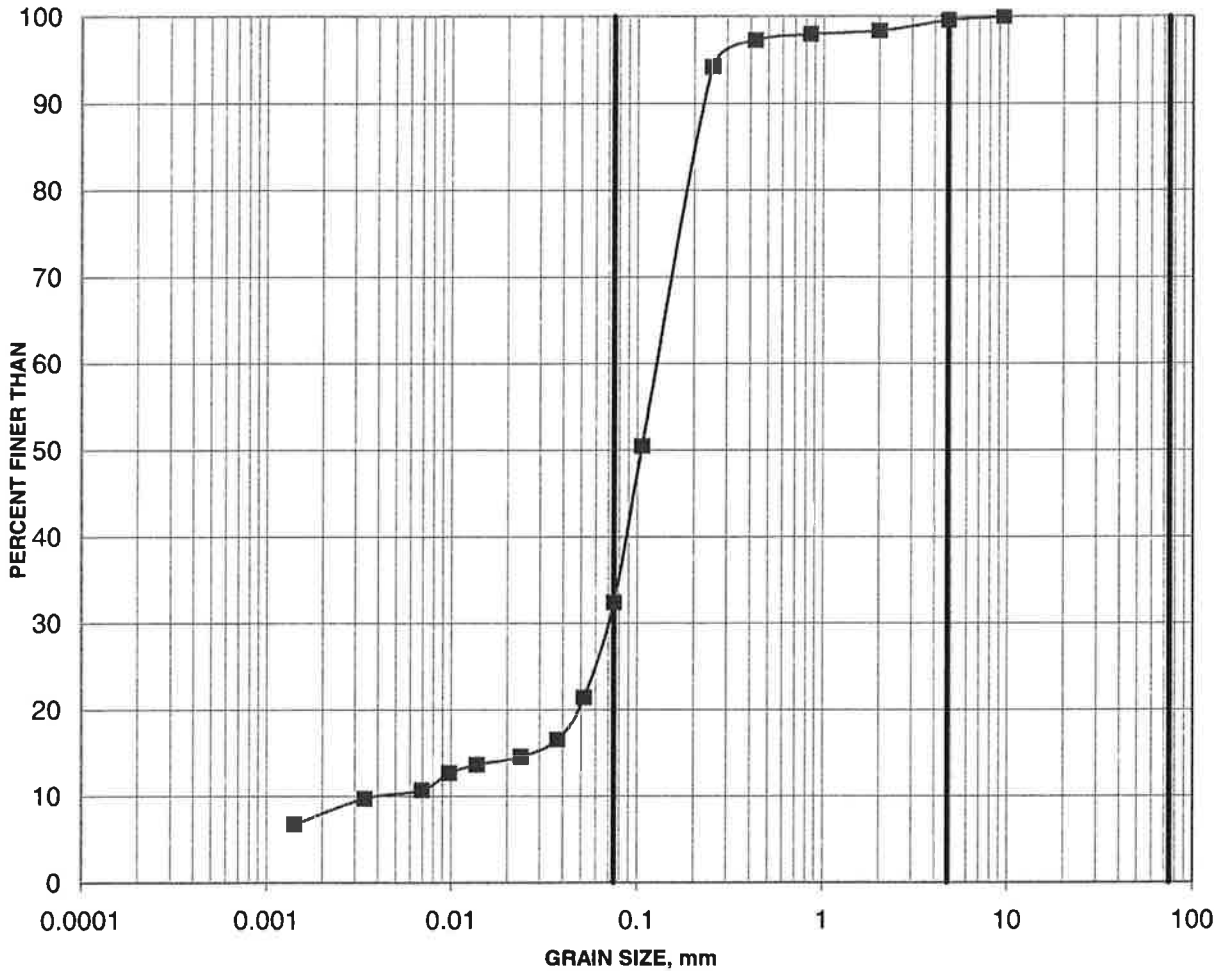
GRAIN SIZE DISTRIBUTION	Figure 14

Sand Fill



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

Borehole	Sample	Depth (m)
06-211	1	0.8-1.4

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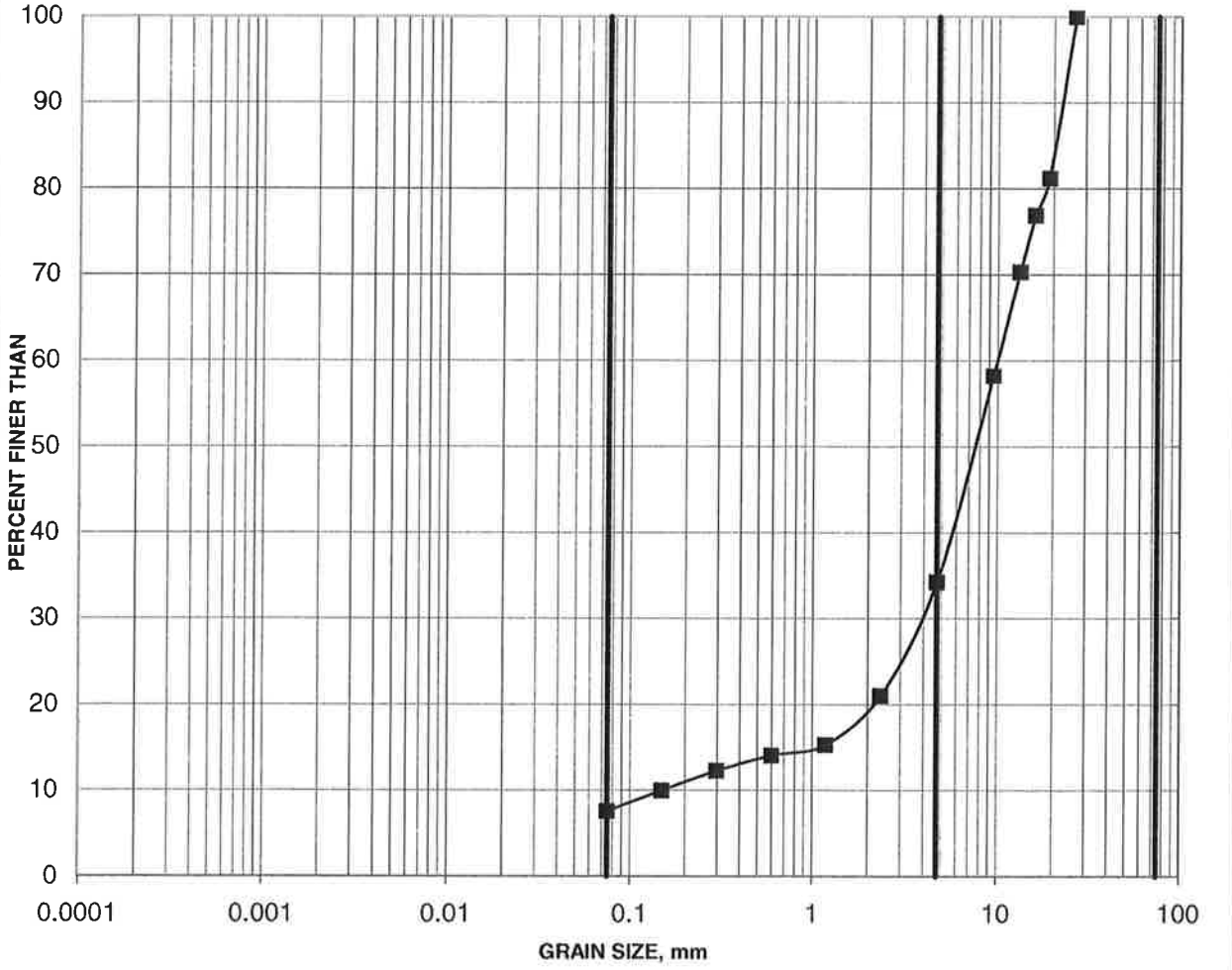
GRAIN SIZE DISTRIBUTION	Figure 15

Till



Borehole	Sample	Depth (m)
06-210	3	2.3-2.6

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