

**FOUNDATION INVESTIGATION AND DESIGN
FINAL REPORT**

**NOISE BARRIER UPGRADES ALONG HIGHWAY 417
SITE # 417-11 MELROSE TO LORETTA AVENUES
SITE # 417-10 NEAR REID AVENUE
SITE # 417-24 N/S – W RAMP AT MAITLAND
OTTAWA, ONTARIO**

MTO – WP 4010-05-00

Submitted to:

**Ministry of Transportation
Geotechnical Section
Eastern Region
1355 John Counter Boulevard
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Submitted by:

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29 November 2007

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29 November 2007

TZ71046

The Greer Galloway Group Inc.
973 Crawford Drive
Peterborough, ON K9J 3X1

Attention: Mr. Ravie Erathasari

Dear Mr. Erathasari:

**RE: Final Report
Foundation Investigation and Design - Noise Barrier Upgrades Along Highway 417
Site # 417-11 Melrose To Loretta Avenues
Site # 417-10 Near Reid Avenue
Site # 417-24 N/S – W Ramp At Maitland
Ottawa, Ontario**

We take pleasure in enclosing seven hard copies and two digital copies of our Final Foundation Investigation and Design Report carried out for the above-mentioned project and we will be glad to discuss any questions arising from this work.

Soil samples will be retained for a period of twelve months, and will thereafter be disposed of unless we are otherwise instructed.

We thank you for giving us this opportunity to be of service to you.
Sincerely,

**AMEC Earth & Environmental
a division of AMEC Americas Limited**

Wissam Farah, MSc., MEng., P.Eng., PMP
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1.0 INTRODUCTION

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC), Consulting Geotechnical, Construction Quality Control and Environmental Engineers, was retained by the Ministry of Transportation (Eastern Region) c/o Greer Galloway Group Inc., to conduct a foundation investigation for existing Noise Barrier Upgrades at three different sites along Highway 417 in Ottawa, Ontario. A key plan showing the locations of the three sites is presented on Figure No. 1 in Appendix A of this report. The three different sites are defined as follows:

- Site 417-11 - Replacement of Wooden Noise Barrier (Northside) from Melrose Avenue easterly approximately 700 m to Loretta Avenue. The site is shown on Figure Nos. 2A and 2B;
- Site 417-10 - In-filling/Extension of the Noise Barrier (Southside) adjacent to Reid Avenue (64 m Noise Barrier +/-). The site is shown on Figure No. 3; and
- Site 417-24 - Extension of the existing Noise Barrier (Northside) adjacent to the N/S-W Ramp at Maitland (172 m Noise Barrier +/-). The site is shown on Figure No. 4.

The purpose of this investigation is to determine the subsurface conditions at the three sites for the proposed noise barrier wall upgrades. Authorization to proceed with this investigation was provided by MTO, c/o Greer Galloway Group Inc. The work was carried out by AMEC according to the MTO Terms of Reference dated April 2007 and AMEC's Proposal No. OP8519 dated April 2007 and revised on 11 May 2007.

The investigation was carried out by means of a limited number of boreholes, in-situ tests and laboratory tests on selected samples. Based on AMEC's interpretation of the data obtained, recommendations for the foundation design are provided.

2.0 SITE AND PROJECT DESCRIPTIONS

2.1 Site 417-11 - Melrose Avenue to Loretta Avenue

This section of the site is approximately 700 m long and it extends along the north side of the pavement for the West Bound Lane of Highway 417 from Melrose Avenue easterly to Loretta Avenue. The existing noise barrier consists of a wooden wall except for the most easterly 200 m section which consists of a steel barrier. It is proposed to replace this barrier with a 4 m to 5 m high Jersey Face Concrete Barrier integral with noise wall. The site location is shown on Figure Nos. 2A and 2B in Appendix A of this Report.

2.2 Site 417-10 - Adjacent to Reid Avenue

This section of the site extends approximately over a 64 m long distance. It is located on the south side of the East Bound Lane of Highway 417 just east of Parkdale and near Reid Avenue cul-de-sac. The site is located on top of a very steep cliff overlooking the highway. The site is presently bordered by an MTO chain link fence. It is proposed to construct a 4 m to 5 m high ground mounted concrete noise barrier. The site location is shown on Figure No. 3 in Appendix A of this Report.

2.3 Site 417-24 - N/S-W Ramp at Maitland

It is proposed to erect a 4 m to 5 m ground mounted concrete noise wall along an approximately 172 m long distance located on the north side of the N/S-W ramp at Maitland. Presently, an MTO chain link fence can be seen at the proposed location of the noise barrier behind a landscaped area. The proposed noise barrier location is at a few metres (3 m to 6 m) to the north of the existing shoulder to the ramp. The site location is shown on Figure No. 4 in Appendix A of this Report.

3.0 SCOPE OF WORK

The scope of work for this geotechnical investigation was conducted in accordance with the requirements detailed in the Terms of Reference published by MTO for this project and it included the following:

Site 417-11 Noise Barrier:

Fourteen 6 m deep foundation boreholes are to be advanced along the alignment of the new noise barrier. The boreholes are to be spaced at approximately 50 m apart. Should bedrock be encountered, rock cores will be acquired in each hole to a maximum of 3 m depth.

Site 417-10 Noise Barrier:

Three 6 m deep foundation boreholes will be advanced along the alignment of the new noise barrier. The boreholes will be spaced at approximately 25 m to 30 m apart. Should bedrock be encountered, rock cores will be acquired in each hole to a maximum of 3 m depth.

Site 417-24 Noise Barrier:

Four 6 m deep foundation boreholes will be advanced along the alignment of the new noise barrier. The boreholes will be spaced at approximately 50 m apart. Should bedrock be encountered, rock cores will be acquired in each hole to a maximum of 3 m depth.

Perform laboratory tests, including moisture content and soil grain size distribution test analyses on selected samples.

Document the results of the field and laboratory programmes in a Foundation Investigation Report and a Foundation Investigation and Design Report complete with geotechnical recommendations concerning the following:

- Subgrade preparations;
- Foundation design and construction;
- Soils Parameters;
- Pavement structure design;
- Permanent and temporary excavation side slopes; and
- Excavation conditions.

4.0 INVESTIGATION PROCEDURES

4.1 Field Investigation

In accordance with the Terms of Reference and AMEC's proposal for this investigation the following drilling programme was completed:

- **Site 417-11 Noise Barrier:** Fourteen 6 m deep foundation boreholes numbered BH07-1 through BH07-14 were advanced along the proposed alignment of the new noise barrier. The boreholes were drilled between 8 June and 14 June, 2007. The borehole locations are indicated on the Site and Borehole Location Plan Figure Nos. 2A and 2B in Appendix A of this report. The boreholes were spaced at approximately 50 m apart. Some of the borehole locations had to be moved slightly in order to avoid existing underground service lines. It should be noted that a major Hydro line is present adjacent to the north side of the existing wall at this site. The Hydro line runs parallel to the wall up to split to Parkdale ramp where it crosses to the south side of the wall going westerly. Dynamic cone penetration tests (DCPT) were conducted below 6 m depth in three of the fourteen boreholes in order to determine the depth to bedrock. The bedrock was cored by approximately 2 m in one borehole (BH07-11). Rock core samples were retrieved using NQ core barrel size.
- **Site 417-10 Noise Barrier:** Three 6 m deep foundation boreholes numbered BH07-15 to BH07-17 were advanced along the proposed alignment of the new noise barrier. The boreholes were drilled on 13 June and 14 June, 2007. The borehole locations are indicated on the Site and Borehole Location Plan Figure No. 3 in Appendix A of this report. The boreholes were spaced at approximately 25 m to 30 m apart. Some of the borehole locations had to be moved slightly in order to avoid existing underground service lines. The bedrock was cored by approximately 3.0 m to 3.9 m in each of the three boreholes using NQ core barrel size.
- **Site 417-24 Noise Barrier:** Four 6 m deep foundation boreholes numbered BH07-18 through BH07-21 were advanced along the proposed alignment of the new noise barrier. The boreholes were drilled on 5, 6 and 18 June, 2007. The borehole locations are indicated on the Site and Borehole Location Plan Figure No. 4 in Appendix A of this report. The boreholes were spaced at approximately 50 m apart. Some of the borehole locations had to be moved slightly in order to avoid existing underground service lines. It should be noted that a major service line is present adjacent to the north side of the existing fence at this site where the wall is proposed. The line runs parallel to the proposed wall. The bedrock was cored by approximately 3 m in each borehole. Rock core samples were retrieved using NQ core barrel size.

Most of the boreholes were advanced to beyond the indicated depths shown in the Terms of Reference due to the presence of fill. Soil samples were normally taken at 1.5 m intervals to a depth of 6 m during the performance of Standard Penetration Test (SPT) in hollow stem augers and in accordance with ASTM D1586. This consisted of freely dropping a 63.5 kg (140 lbs.) hammer for a vertical distance of 0.76 m (30 inches) to drive a 51 mm (2 inches) diameter O.D.

split-barrel (split spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m (12 inches) was recorded as SPT 'N' value of the soil which indicated the consistency of cohesive soils or the relative density of non-cohesive soils. The majority of the boreholes were terminated due to auger refusal on possible bedrock, or SPT 'N' value in excess of 100 blows per 0.30 m.

The dynamic cone penetration test (DCPT) was carried out by advancing a steel cone into the ground with a 63.5 kg (140 lbs.) hammer. The number of blows per 0.3 m required to advance the cone was recorded and presented in the Borehole Records in Appendix B.

The borehole locations and ground surface elevations at these locations were surveyed in the field by a survey crew from McIntosh Perry of Ottawa. The borehole locations established in the field by the survey crew are presented in tables shown on the Borehole Location Plan Figure Nos. 2A, 2B, 3 and 4 and included in Appendix A of this report. The coordinates and the geodetic ground surface elevations at the specified borehole locations were surveyed by the surveyor and confirmed by a hand-held GPS unit (NAD 83 system) after the completion of drilling. Existing geodetic benchmarks located within or close to the sites were used for reference in surveying the borehole locations and elevations. The coordinates and elevations of the boreholes are within 2 cm of accuracy.

Upon completion of drilling, the test holes were backfilled with bentonite then patched with cold asphalt mix where applicable. The soil samples were transported to AMEC's Advanced Soil Laboratory for further examination and laboratory soil testing. The programme of laboratory testing included, where applicable, grain size analysis and in-situ water content determination on more than 25% of the retrieved samples.

4.2 Laboratory Tests

Representative soil samples were subject to geotechnical laboratory testing in AMEC's Advanced Soil Laboratory for soil classification. Twelve selected samples were sent to Caduceon Environmental Laboratories for chemical testing. The following tests were conducted:

- Natural water content determination (82).
- Grain size distribution analysis (14).
- Chemical tests for pH, Sulphate, Chloride and resistivity (12).

The encountered soil strata and the results of the field and laboratory tests are presented on the Borehole Records in Appendix B. The grain size distribution curves and the chemical test results are presented in Appendix C.

5.0 INVESTIGATION RESULTS

This section of the report summarizes the encountered surface and subsurface conditions at the three sites for the proposed noise barrier upgrades. The field and laboratory test results along with the encountered soil strata are detailed below.

5.1 Surface Conditions

5.1.1 Site 417-11 Noise Barrier

This site is located along the north side of the shoulder for the West Bound Lane of Highway 417. It stretches, westerly, over a 700 m long distance between Loretta Avenue and Melrose Avenue. The ground surface at the borehole locations placed along this stretch is covered with asphaltic concrete. The boreholes were placed either along the edge of pavement (White line that separates the most right hand lane from the right hand shoulder) or along the paved shoulder. The boreholes were advanced at approximately 3 m to the south of the existing noise barrier. The existing wall consists of approximately 500 m long wooden barrier and 200 m long steel barrier.

The ground surface along this stretch of the site rises from Melrose Avenue and easterly up to approximately 50 m to the east of the Bayswater Avenue overpass (BH07-1 to BH07-11). The ground surface, then, drops downward gently toward the east to Loretta Avenue overpass (BH07-11 to BH07-14). A maximum ground surface elevation difference of 6.2 m was recorded at the borehole locations between Melrose Avenue and Bayswater Avenue overpass. A maximum ground surface elevation difference of 1.4 m was recorded at the borehole locations between Bayswater Avenue overpass and Loretta Avenue.

5.1.2 Site 417-10 Noise Barrier

The site for 417-10 noise barrier is located to the west of Reid Avenue cul-de-sac and east of Parkdale Avenue. The site is located on top of a very steep cliff overlooking the East Bound Lane of Highway 417. The site is presently bordered by an MTO chain link fence. The ground surface is covered with some asphaltic concrete, gravel and/or silty sand with roots and organics under some bush cover. Bedrock outcrop and boulders can be seen along the northern face of the cliff. The ground surface at this site is generally flat with a gentle downward slope toward the west. A maximum ground surface elevation difference of 1.65 m was recorded at the borehole locations.

5.1.3 Site 417-24 Noise Barrier

The site for 417-24 noise barrier is located to the north of the N/S-W ramp at Maitland. It stretches over an approximate distance of 172 m. Presently, an MTO chain link fence can be seen at the proposed location of the noise barrier behind a landscaped area. The proposed noise barrier location is at approximately 3 m to 6 m to the north of the existing shoulder to the ramp. The ground surface is covered with tall grass, bush and a few trees. The ground surface at this site is generally flat. A maximum ground surface elevation difference of 0.66 m was recorded at the borehole locations.

5.2 Subsurface Conditions

5.2.1 Site 417-11 Noise Barrier

The following Soil strata were encountered at this site:

Asphaltic Concrete

A surficial 130 mm to 330 mm thick layer of asphaltic concrete was encountered at all of the borehole locations at this site, with an average thickness of about 250 mm.

Concrete

A 250 mm thick layer of concrete was encountered and cored underlying the asphaltic concrete in BH07-1 and BH07-11 through BH07-13. No concrete was encountered in any of the other boreholes. It should be noted that the concrete layer was encountered under the right hand lane of the travelled highway. Concrete was not present under the right hand shoulder.

Fill

Mixed fill material was encountered underlying the asphaltic concrete and concrete in all of the boreholes. The fill extended to variable depths ranging between 1.7 m (Elev. 69.7 m) and 8.0 m (Elev. 64.4 m) below ground surface, with an average depth of around 4.5 m to 5.0 m below existing grades. In BH07-5, the fill extended to a depth of 11 m (Elev. 62.2 m) below ground surface. It should be noted that the thickness of fill may vary from one borehole to another borehole.

The upper 100 mm to 400 mm of the fill consisted of crushed gravelly sand fill. The lower fill consisted mainly of sand, silty sand and clayey silt materials mixed with some to trace gravel, asphalt, roots, organics, cobbles and brick. The compactness of the fill was variable and generally loose to very dense, as indicated by the recorded SPT 'N'-values, which varied between 3 and 74 blows per 300 mm of penetration.

Laboratory testing on several fill samples indicated moisture contents between 3% and 40% for the tested samples. Grain size distribution analyses were conducted on five selected fill samples. The results of the gradation tests are recorded below and presented on Figures 7, 9, 12, 13 and 14 in Appendix C of this report. The fill included the following gradation percentages:

Gravel:	5% to 45%
Sand:	50% to 90%
Silt and Clay:	0% to 15%

Silty Sand

A brown silty sand deposit was encountered underlying the fill layers at the location of BH07-8 at 4.1 m (Elev. 72.3 m) depth below ground surface. The silty sand was not encountered anywhere else. The silty sand extended to a maximum depth of 5.3 m below ground surface. The silty sand was found to be generally compact as indicated by the SPT 'N'- values which ranged between 15 and 16 blows per 300 mm of penetration.

Laboratory tests on two selected samples indicated moisture contents of 15% and 18% denoting moist conditions. A grain size distribution analysis was conducted on one selected sample revealed that this deposit consisted of 73% sand and 27% silt and clay size particles. The results of the gradation test are presented on Figure 10 in Appendix C of this report.

Glacial Till

A glacial till deposit was encountered underlying the fill or the silty sand materials in all of the boreholes except for BH07-4 and BH07-11. The till was encountered at depths ranging between 1.7 m (Elev. 69.7 m) and 6.4 m (Elev. 70.9 m) below ground surface. The till was encountered at a depth of 11 m (Elev. 62.2 m) below ground surface at the location of BH07-5. The till extended to the maximum depth of exploration, where refusal on bedrock was encountered. The till consisted mainly of sand, some silt, some gravel to sand and gravel, trace silt with cobbles and boulders. The till was found to be generally loose to very dense as indicated by the recorded SPT 'N' values which ranged between 4 and 120 blows per 300 mm of penetration.

Laboratory testing on several till samples indicated moisture contents between 3% and 17% for the tested samples. Grain size distribution analyses were conducted on five selected till samples. The results of the gradation tests are recorded below and presented on Figures 5, 6, 8, 11 and 15 in Appendix C of this report. The till included the following components:

Gravel:	7% to 60%
Sand:	35% to 80%
Silt and Clay:	5% to 17%

Bedrock

Bedrock was contacted at refusal by auger or probably by the dynamic cone in all of the boreholes at depths ranging between 5.2 m (Elev. 72.3 m) and 10.3 m (Elev. 61.4 m) below existing grades. The bedrock was not encountered in BH07-5 within 15 m depth. The bedrock was cored by 2.0 m in BH07-11. The bedrock consisted, mainly, of limestone with shale partings. The upper 0.6 m of the bedrock was severely weathered with Rock Quality Designation (RQD) of zero. The lower bedrock was slightly weathered with an RQD of 100% for the cored sample.

5.2.2 Site 417-10 Noise Barrier

The following Soil strata were encountered at this site:

Asphaltic Concrete

A surficial 40 mm to 50 mm thick layer of asphaltic concrete was encountered at all of the borehole locations at this site except for BH07-15.

Fill

Mixed fill material was encountered at the surface or underlying the asphaltic concrete in all of the boreholes. The fill extended to variable depths ranging between 0.2 m (Elev. 76.1 m) and 2.7 m (Elev. 71.9 m) below ground surface. It should be noted that the thickness of fill may vary from one borehole to another borehole. The fill consisted of silty sand material mixed with some to trace gravel, roots, organics, cobbles and concrete with cobbles and boulders.

Bedrock

Bedrock was contacted at refusal by auger in all of the boreholes at depths ranging between 0.2 m (Elev. 76.1 m) and 2.7 m (Elev. 71.9 m) below existing grades. The bedrock was cored by 3.0 m in each borehole. The bedrock consisted mainly of limestone with shale partings. The bedrock was severely to moderately weathered with RQD values of zero to 92% for the cored samples.

5.2.3 Site 417-24 Noise Barrier

The following Soil strata were encountered at this site:

Sandy Silt/Silty Sand

A surficial 100 mm (Elev. 83.8 m) to 600 mm (Elev. 82.9 m) thick layer of sandy silt to silty sand with roots and organics was encountered at all of the borehole locations at this site, except for BH07-21, with an average thickness of about 400 mm. Laboratory testing on two samples indicated moisture contents between 12% and 18% for the tested samples.

Fill

Mixed fill material was encountered at the surface or underlying the silty sand with roots in BH07-20 and BH07-21. In BH07-20, the fill consisted of clayey silt with sand and gravel, trace roots, brick and asphalt. The fill extended in BH07-20 to a maximum depth of 1.8 m (Elev. 81.8 m) below ground surface. In BH07-21, the fill consisted of a 1.4 m thick upper layer of crushed sand and gravel over clayey silt fill material extending to 3.7 m (Elev. 79.3 m) below existing grades. It should be noted that the thickness of fill may vary from one borehole to another borehole. The crushed sand and gravel fill was generally compact as indicated by the recorded SPT “N”- values which ranged between 22 and 28 blows per 300 mm of penetration. The clayey silt fill was stiff to hard, as indicated by the recorded SPT ‘N’-values ranging between 5 and 75 blows per 300 mm of penetration.

Laboratory testing on several fill samples indicated moisture contents between 3% and 43% for the tested samples. Grain size distribution analyses were conducted on one selected fill sample from the upper fill layer at BH07-21 (crushed sand and gravel). The results of the gradation test are recorded below and presented on Figure 17 in Appendix C of this report. The fill included the following gradation percentages:

Gravel:	50%
Sand:	45%
Silt and Clay:	5%

Clayey Silt

A grey clayey silt deposit was encountered underlying the sandy silt or the clayey silt fill in BH07-18 and BH07-21, respectively. The clayey silt deposit extended to a maximum depth of 1.2 m (Elev. 82.3 m) and 3.1 m (Elev. 80.6 m) below ground surface. The clayey silt was generally stiff to very stiff as indicated by the SPT ‘N’- values which ranged between 9 and 22 blows per 300 mm of penetration.

Laboratory test on one selected sample indicated a moisture content of 32% denoting wet conditions.

Glacial Till

A glacial till deposit was encountered underlying the silty sand with roots, fill or the clayey silt materials in BH07-19, BH07-20 and BH07-21, respectively. The till was encountered at depths ranging between 0.3 m (Elev. 83.1 m) and 3.7 m (Elev. 79.3 m) below ground surface. The till extended to the maximum depth of exploration, where refusal on bedrock was encountered. The till consisted mainly of sand, some silt, some gravel to sand and gravel, trace silt with cobbles and boulders. The till was generally compact as indicated by the recorded SPT ‘N’ values which ranged between 18 and 28 blows per 300 mm of penetration.

Laboratory testing on several till samples indicated moisture contents between 4% and 13% for the tested samples. Grain size distribution analyses were conducted on two selected till samples. The results of the gradation tests are recorded below and presented on Figures 16 and 18 in Appendix C of this report. The till included the following components:

Gravel:	15% to 57%
Sand:	40% to 70%
Silt and Clay:	5% to 17%

Bedrock

Bedrock was contacted at refusal by auger in all of the boreholes at depths ranging between 1.2 m (Elev. 82.3 m) and 4.2 m (Elev. 78.8 m) below existing grades. The bedrock was cored by 3.0 m to 4.5 m in each borehole. The bedrock consisted, mainly, of limestone with shale partings. The bedrock was severely to slightly weathered with RQD values ranging between 20% to 100% for the cored samples.

5.3 Groundwater

The three sites were generally dry. The groundwater was encountered in four out of the twenty one boreholes as shown in the table below:

Borehole No.	Groundwater Depth, m
BH07-1	4.6 (Elev. 66.8 m)
BH07-2	7.9 (Elev. 63.8 m)
BH07-7	6.1 (Elev. 69.3 m)
BH07-18	1.9 (Elev. 81.6 m)

Fluctuations in the groundwater level due to seasonal variations or in response to a particular precipitation event should be anticipated.

5.4 Chemical Test Results

Twelve selected soil samples from the three sites were sent to Caduceon Environmental Laboratories in Ottawa to test for pH, sulphate, chloride concentrations and resistivity. The results are summarized in a table in Appendix C of this report.

6.0 DISCUSSIONS AND RECOMMENDATIONS

It is understood that the Ministry of Transportation is proposing upgrades for the existing noise barriers and/or construction of new noise barriers at three different sites along Highway 417 in Ottawa, Ontario. Contractors are advised to refer to MTO Specification No. SP#599F01 for the requirements for the design and construction of the noise barriers. The following information was available for the development of this report:

Site 417-11 - Melrose Avenue to Loretta Avenue

This section of the site stretches over a 700 m long distance along the north side of the pavement for the West Bound Lane of Highway 417 from Melrose Avenue easterly to Loretta Avenue. The existing noise barrier consists of a wooden wall except for the most easterly 200 m section which consists of a steel barrier. This wall will be replaced with a 4 m to 5 m high Jersey Face Concrete Barrier integral with noise wall.

The encountered subsurface conditions consisted of thick and variable layers of fill materials extending to depths ranging between 1.7 m and 11.0 m below ground surface, with an average depth of around 4.5 m to 5.0 m below existing grades. The fill also contained traces of brick, asphalt and organic materials. The fill was underlain by glacial till or bedrock.

Site 417-10 - Adjacent to Reid Avenue

This section of the site extends approximately over a 64 m long distance. It is located on the south side of the East Bound Lane of Highway 417 just east of Parkdale and near Reid Avenue cul-de-sac. The site is located on top of a very steep rock cliff overlooking the highway. The site is presently bordered by an MTO chain link fence. It is proposed to construct a 4 m to 5 m high ground mounted concrete noise barrier.

The encountered subsurface conditions consisted of upper fill layers over bedrock. The upper zone of the bedrock was weathered. More intact rock was encountered at shallow depths.

Site 417-24 - N/S-W Ramp at Maitland

It is proposed to connect the existing noise barrier at the southwest corner of the N/S-W ramp at Maitland with a 4 m to 5 m high ground mounted concrete noise wall extending easterly over a distance of 172 m long on the north side of the ramp at Maitland. The proposed noise barrier location is at a few metres (3m to 6m) to the north of the existing shoulder to the ramp.

The subsurface conditions at this site consisted of thick and variable layers of fill material extending to a maximum depth of 3.7 m over stiff to very stiff clayey silt over glacial till and bedrock. A layer of silty sand with roots was encountered at the surface.

General

It is understood that the foundations for the noise barriers will typically consist of concrete caissons supporting steel posts. The noise barrier will consist of pre-cast concrete walls inserted between the steel posts. The steel posts will be spaced at 3.65 m apart. The height of the concrete panels will be between 4 m to 5 m.

Based on the results of the investigation, concrete caissons may be used to support the proposed posts of the walls. All caissons should be founded in the competent native and undisturbed deposits or bedrock below the frost depth.

Due to the presence of mixed materials in the encountered fill which included organics, roots and other debris and due to the lack of placement/compaction information of the encountered fill material, AMEC does not recommend placing the footings in the fill. Should the concrete caissons be founded in the existing fill, much larger (greater diameter) caissons will be anticipated to provide sufficient lateral resistance. The use of wider caissons may cause more extensive damage to the existing pavement structure and may interfere with the existing utility lines. Alternatively, the concrete caissons may have to be deeper and the steel posts may have to be extended into the concrete caissons or re-bars may have to be installed in the concrete caissons. Such decisions should be made by the design engineers during the detail design phase.

The presence of major underground service lines along the proposed alignment for the walls at Site No. 417-11 and 417-24 should be considered at construction time as it will interfere in the installation of the new post foundations. The caissons for the noise barriers should be located sufficiently far away from the present underground service lines in order to avoid inducing lateral stresses on the service lines and mobilize high lateral resistance for the caissons. A minimum distance of 2.0 m should be allowed between the outer edge of the caisson that is closest to the service line and the outer edge of the service line facing the caisson.

In addition, the edge of the stretch of pavement along Highway 417 between Melrose and Loretta Avenues may need to be re-instated after the removal of the existing wall and the installation of the proposed walls.

Foundations recommendations, for the proposed noise barriers, provided in this report are based on concrete caissons founded on native and undisturbed soils or sound bedrock. This section of the report provides the needed soils parameters including the bearing capacity of the encountered soil conditions, new pavement thickness, construction procedures and recommendation.

6.1 Foundations

Concrete caissons founded on clean, sound and unweathered bedrock surface or on the encountered undisturbed native soils (glacial till, silty sand or clayey silt) could be considered for the foundation of the noise barrier posts at the three sites.

The proposed noise barrier may be supported on spread/strip footings placed directly on the native glacial till, sand or unweathered bedrock surface and connected into the bedrock using rock dowels, if necessary. Due to the relatively large depths of the encountered native soils or sound bedrock, the size of the open excavation will be enormous should the sides of the excavation be sloped at 1H:1V from the base of the excavation as per OHSA (refer to Section 6.2.2 of this report). Alternatively, the excavation may be supported or shored. In either case, an excavation along the alignment of the new wall may cause major damages along the highway and traffic disruption. It is, therefore, advisable to found the proposed noise barriers using concrete caissons.

The caissons will mainly resist lateral load due to wind load acting on the noise barrier walls. The lateral load will be transferred to the area surrounding the caissons. The resistance to the lateral load may be reduced if there are large service pipes close to the caissons. Furthermore, the lateral load may impose lateral stress and/or cause lateral soil movement which may affect the structural integrity of the utilities. The soil-structure interaction should therefore be considered during the detail design. A minimum distance of 2.0 m should be allowed between the outer edge of the caisson that is closest to the service line and the outer edge of the service line facing the caisson. The following sections of the report are based on concrete caissons as the selected type of foundation for this project.

A minimum soil cover of 1.8 m will be required above the underside of the caisson to protect against any frost action. Footings placed on sound unweathered bedrock require 0.9 m of soil cover for frost protection. If this soil cover cannot be provided, it should be compensated for using synthetic insulation. The table below shows the expected depth of the bottom of the caisson foundation at the specific borehole locations.

Borehole Location	Expected Depth of Bottom of Caisson **, m		Founding Stratum
	Depth below existing grade (minimum)	Geodetic Elevation	
BH07-1	2.0	69.4	Till
BH07-2	4.7	67.0	Till
BH07-3	4.7	67.3	Till
BH07-4	8.3	64.1	Bedrock
BH07-5	11.3	61.9	Till
BH07-6	5.9	68.3	Till
BH07-7	4.9	70.5	Till
BH07-8	4.4	72.0	Silty Sand
BH07-9	5.6	71.3	Till
BH07-10	6.7	70.6	Till
BH07-11	5.8	71.7	Sound Bedrock
BH07-12	6.5	70.8	Till
BH07-13	6.1	69.7	Till
BH07-14	5.2	70.9	Till
BH07-15	3.0	71.6	Bedrock
BH07-16	0.9	74.3	Bedrock*
BH07-17	0.9	75.4	Bedrock*
BH07-18	1.2	82.3	Bedrock
BH07-19	1.8	81.6	Till
BH07-20	2.1	81.5	Clayey Silt
BH07-21	4.0	79.0	Till

*The concrete caissons at these two locations may need to be socketed into the bedrock in order to meet the soil cover requirement for protection against frost action and the minimum embedment requirement. Spread footings may be used, provided they are designed to resist the applied moment and lateral loads.

**The concrete caissons should be embedded by at least 300 mm into competent soil or bedrock and subject to the structural design using the soil parameters recommended in this report.

It should be noted that the existing noise barriers and fences should be removed first. New foundations should not be placed at the same location of the existing footings. It is recommended to place the proposed caisson foundations in between the existing footings.

The typical procedure for the installation of concrete caissons is described as follows. The area of the planned caisson foundations is augured to the planned founding elevation, and the exposed subgrade is inspected and approved. Quality Verification Engineering should be implemented to approve the exposed subgrade prior to placement of concrete. A Certificate of Conformance should be issued at the end of the subgrade inspection as per MTO SP599F01 requirements. Sonotubes are normally installed in the augured holes. The concrete caissons are placed on the prepared surface and filled with reinforcing steel, if required by the structural design. After

sufficient time for curing of the concrete, any voids created due to auguring around the concrete caissons should be filled using concrete or sand to the design subgrade elevation.

On auguring to the founding level, the exposed surface of the subgrade should be inspected and approved immediately prior to placing the concrete to confirm that the surface is uniform and suitable to support the foundations. Subgrades should be dry of any groundwater and free of any loose materials before placing concrete.

For concrete caissons installed in a competent soil/rock stratum, the following axial resistances should be used for design:

- Factored Geotechnical Axial Resistance (Compression) at Ultimate Limit States = 250 kN in competent native soil / weathered rock stratum and 750 kN on sound unweathered bedrock, with an applied resistance factor of 0.5.
- Geotechnical Reaction at Serviceability Limit States = 150 kN in competent soil/weathered rock stratum and 500 kN on sound unweathered bedrock.

Based on the conditions of the native soil encountered in the boreholes, the recommended 150 kN at SLS should be used for design. Similarly, the recommended 150 kN at SLS should be used for completely-weathered rock which would behave like soils.

It is recommended that the concrete caissons for the walls be structurally designed in consideration of the anticipated loading conditions, including lateral forces associated with wind loads on the face of the wall. In assessing the overturning stability and lateral earth pressures, the following geotechnical parameters may be used:

	Station to Station (Approx.)	Nearest Borehole N°	Soil Strata	Depth of Bottom of Strata Below Existing Grade (m) (Approx.)	Geotechnical Design Parameters					
					Cu (kPa)	Φ (deg.)	γ (kN/m ³)	γ' (kN/m ³)	K p	Groundwater Depth (m)
Site 417-11: Melrose to Loretta Av.	26+025 to 26+075	BH07-1	Fill	1.7	--	30	19	9	1.0	4.6
			Till	7.8	--	32	20	10	1.1	
	26+075 to 26+225	BH07-2 to BH07-4	Fill	4.4 to 8.0	--	30	19	9	1.0	7.9
			Till	6.2 to 10.3	--	32	20	10	1.1	
	26+225 to 26+275	BH07-5	Fill	11.0	--	30	19	9	1.0	Not Encountered
			Till	14.9	--	32	20	10	1.1	
	26+275 to 26+325	BH07-6	Fill	5.6	--	30	19	9	1.0	Not Encountered
			Till	6.1	--	32	20	10	1.1	
	26+325 to 26+425	BH07-7 to BH07-8	Fill	4.1 to 4.6	--	30	19	9	1.0	6.1
			Silty Sand	5.3	--	30	19	9	1.0	
			Till	6.2 to 6.7	--	32	20	10	1.1	Not Encountered
	26+425 to 26+700	BH07-9 to BH07-14	Fill	4.9 to 6.4	--	30	19	9	1.0	
			Till	6.1 to 7.4	--	32	20	10	1.1	
Site 417-10: Near Reid Av.	25+925 to 25+975	BH07-15	Fill	2.7	--	30	19	9	1.0	Not Encountered

	Station to Station (Approx.)	Nearest Borehole N°	Soil Strata	Depth of Bottom of Strata Below Existing Grade (m) (Approx.)	Geotechnical Design Parameters					
					Cu (kPa)	Φ (deg.)	γ (kN/m ³)	γ' (kN/m ³)	K p	Groundwater Depth (m)
Site 417-24: N/S-W Maitland Ramp	21+800 to 22+000	BH07-18	Clayey Silt	1.2	--	25	18	8	1.0	1.8
		BH07-19	Till	3.5	--	32	20	10	1.1	Not Encountered
		BH07-20	Fill	1.8	--	30	19	9	1.0	Not Encountered
			Clayey Silt	3.0	--	25	18	8	1.0	
		BH07-21	Fill	3.7	--	30	19	9	1.0	Not Encountered
			Till	4.2	--	32	20	10	1.1	

Note: Kp values are reduced to limit lateral movements

For lateral soil-concrete pier interaction analysis, the horizontal subgrade reaction to the concrete pier in cohesionless soils may be calculated from the following expression:

$$k_s = n_h \times z/d$$

where,

n_h = Coefficient related to soil density as given below,

d = Concrete pier width

z = Depth

The following estimated n_h values can be used for the purpose of this project:

Soil Type	n_h values, MN/m ³ Soil above Groundwater
Existing Fill	2.2 (recommend not to include in calculation)
Clayey Silt	3.0*
Sandy Silt/Silty Sand	6.6
Glacial Till	18

*For cohesive soils, $k_s = 67C_u/d = n_h \times z/d$ which leads to $n_h = 67C_u/z$. For $z = 1.0$ m (approx. depth of the clayey silt zone) and $C_u = 50$ kPa or 0.05 MPa (as estimated from field investigation), $n_h = 3.0$.

6.2 Construction Considerations

6.2.1 General

It is recommended that a programme of geotechnical/material inspection and testing be carried out during the construction phase of the project to confirm that the conditions exposed in the excavations are consistent with those encountered in the boreholes and the design assumptions, and to confirm that the various project specifications and materials requirements are being met. Quality Verification Engineering should be implemented regarding the footing inspections and a Certificate of Conformance should be issued as per MTO SP599F01 requirements.

Earth removals, should be inspected by a geotechnical engineer to confirm that all unsuitable materials are removed prior to placement of concrete. Inspection and testing services will be critical to confirm that all backfill used is suitable and is placed and compacted to the required degrees.

Subgrade surfaces will be prone to disturbance by weather. Surface run-off from precipitation should be controlled during construction. Furthermore, the groundwater levels at this site may be encountered in the open excavations and dewatered by sump and pumping methods. Where construction is undertaken during winter conditions, footing subgrades should be protected from freezing.

6.2.2 Excavation and Dewatering

It is recommended that the excavation for the wall foundations be performed by means of auguring to install the concrete caissons. Personnel should not be allowed inside the augured hole at anytime unless steel casing is installed. For any other excavations, they should be carried out in accordance with the Ontario Health and Safety Regulations. The soils to be excavated at this site can be classified as Type 3. Accordingly, for unsupported excavation, a bank slope of 1H:1V is required from the bottom of the excavation in accordance with the Ontario Health and Safety Regulations. Flatter side slopes may be required if groundwater is encountered. If the required side slopes cannot be provided due to space limitations, the sides of the open excavation should be supported or shored.

No major excavation difficulties are foreseen but allowance should be made for boulders and cobbles that should always be expected in glacial till deposits. In addition, auguring through weathered bedrock may be time consuming and require significant effort. **Contractors should refer to the Non-Standard Special Provisions (NSSP) included in Appendix D of this report.**

It should also be noted that loose fill and sand materials were encountered during the investigation programme. Therefore, casing or sonotubes may be required at certain locations during the auguring process for the caisson installation in order to protect sides of the augured hole from collapsing or caving in. **Contractors should refer to the Non-Standard Special Provisions (NSSP) included in Appendix D of this report.**

Most of the boreholes were dry. Where encountered, the groundwater level was fairly low. Groundwater and surface water runoff could be controlled by filtered sumps and pumps. However, if groundwater is encountered in sandy layers, additional efforts may be required in dewatering, preventing cave – in/sloughing, etc.

6.3 Earthquake Consideration

In conformance with Section 4 of the Canadian Highway Bridge Design Code (CHBDC), the encountered soil types at these three sites with the recommended Site Coefficient, S, are as follows:

Site	Soil Type	S
417-11	II	1.2
417-10	I	1.0
417-24	I	1.0

Liquefaction is not an anticipated event at any of the above sites.

6.4 Cement Type and Corrosion Potential

Twelve selected soil samples from the three sites were sent to Caduceon Environmental Laboratories in Ottawa to test for pH, sulphate, chloride concentrations and resistivity. The results are summarized in a table in Appendix C of this report. The presented results should be considered while selecting the type of concrete and the requirement for coating of any buried steel.

Generally, the soluble sulphate results from the three sites indicated that a low degree of sulphate attack is expected for concrete in contact with soil and groundwater. Type 10 Portland Cement should therefore be suitable for use in concrete at all of the three sites.

The results for the samples tested for this project indicate a resistivity between 397 and 2260 Ohm-cm for the tested samples. The indicated resistivity results reflect that severe corrosion activity may occur for steel placed within this soil. Therefore, protective coatings will be required for steel protection against corrosion.

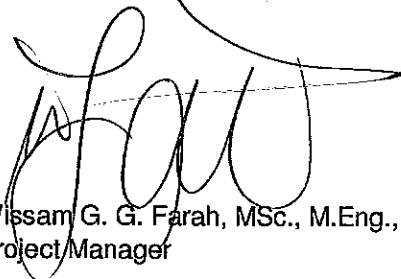


7.0 CLOSURE

The sub-soil information and recommendations contained in this report should be used solely for the purpose of foundation assessment of this site. AMEC should be retained to review the recommendations provided in this report, once the details of the development are finalized and prior to the final design stage of the project. The attached Report Limitations, in Appendix E, are an integral part of this report. Should you have any questions, please contact the undersigned.

Sincerely,

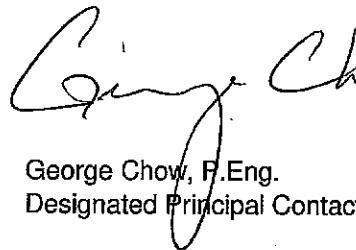
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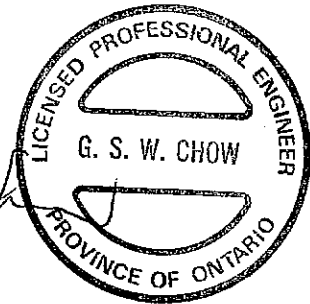
Wissam G. G. Farah, MSc., M.Eng., P.Eng., PMP
Project Manager



Prapote Boonsinsuk, Ph.D., P.Eng.
Project Reviewer

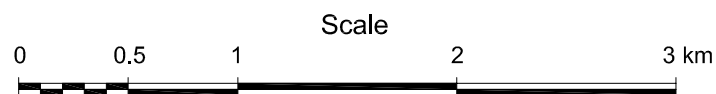
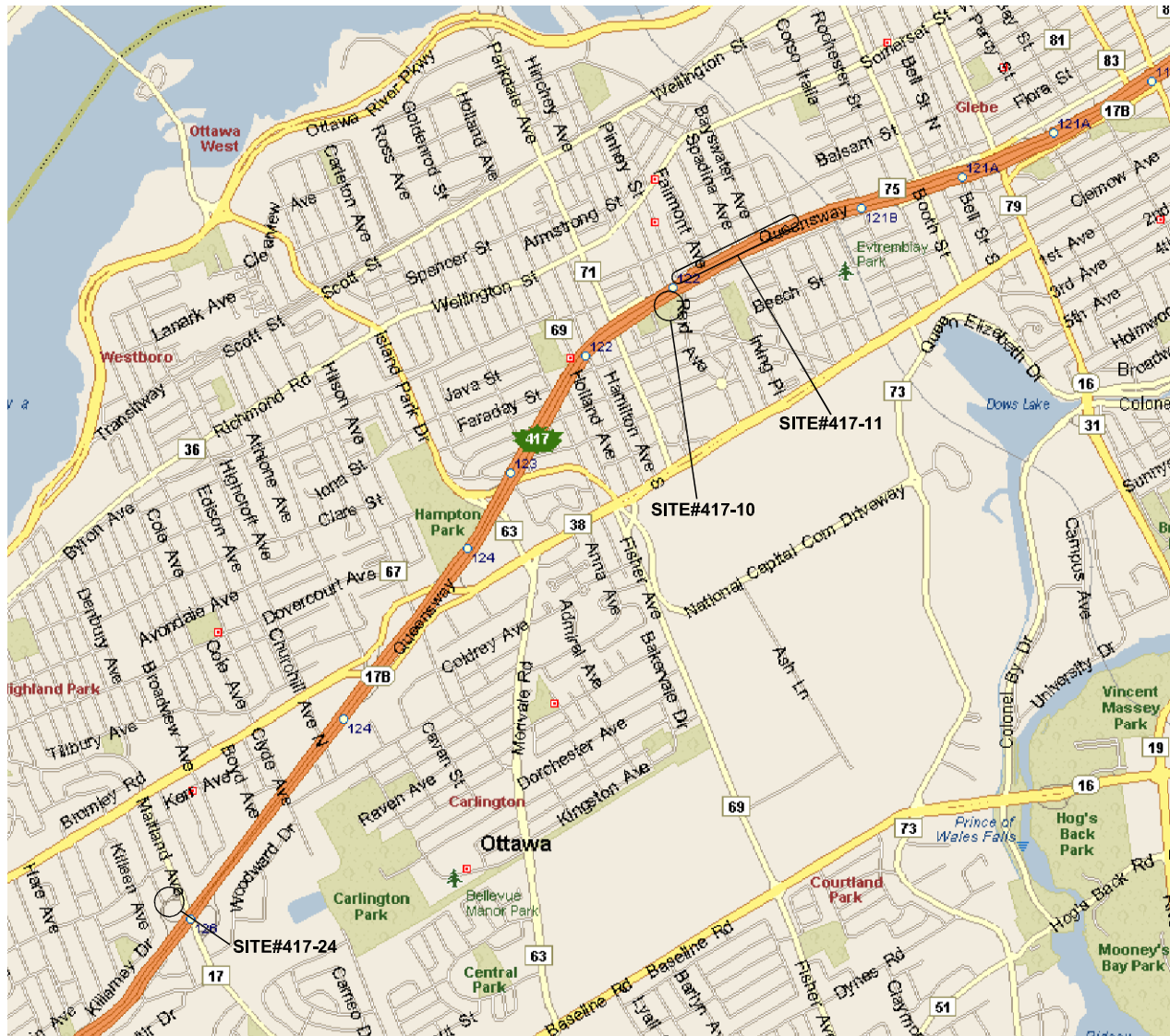




George Chow, P.Eng.
Designated Principal Contact

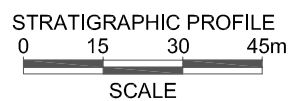
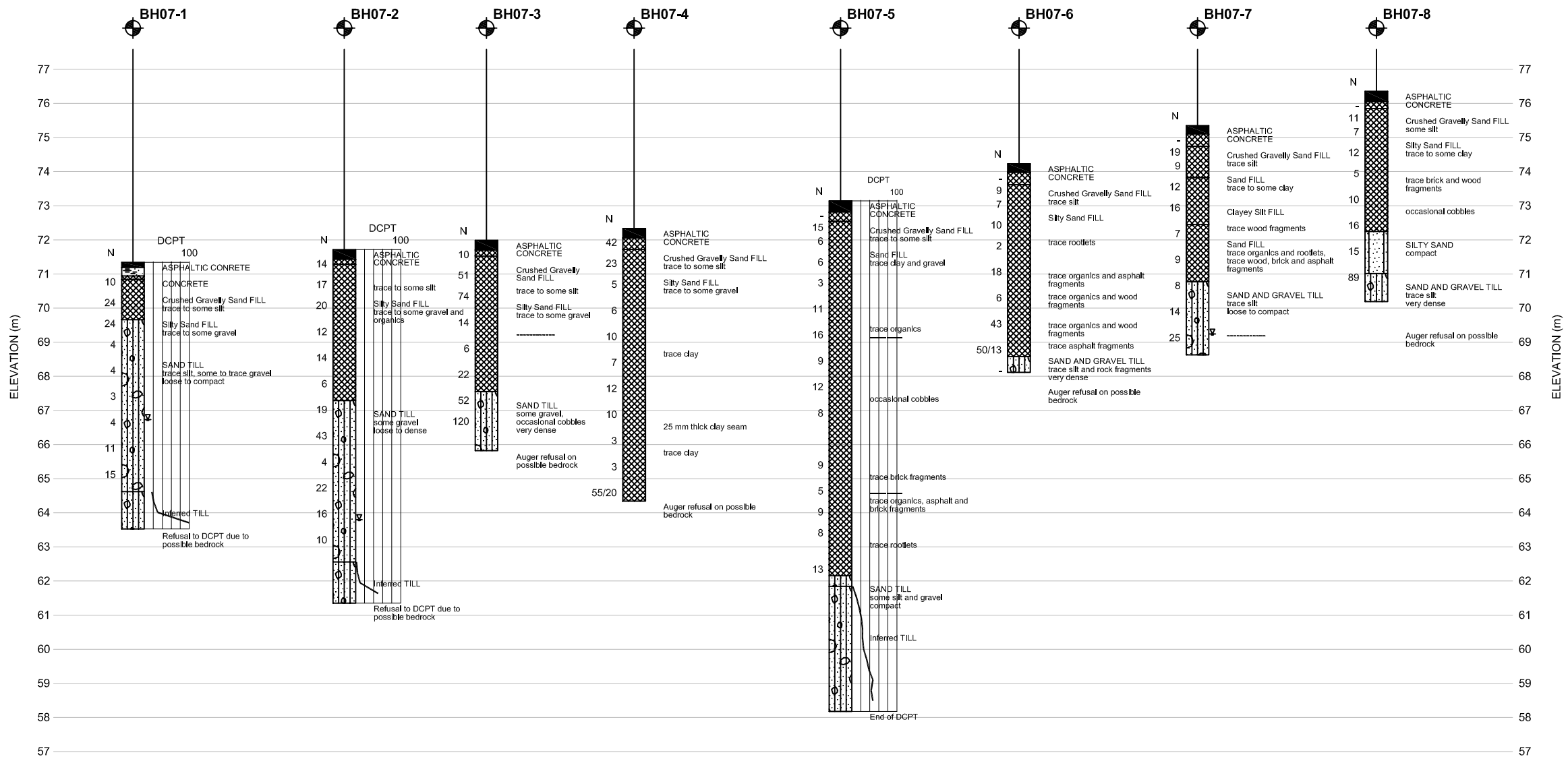
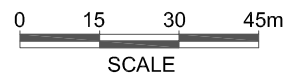
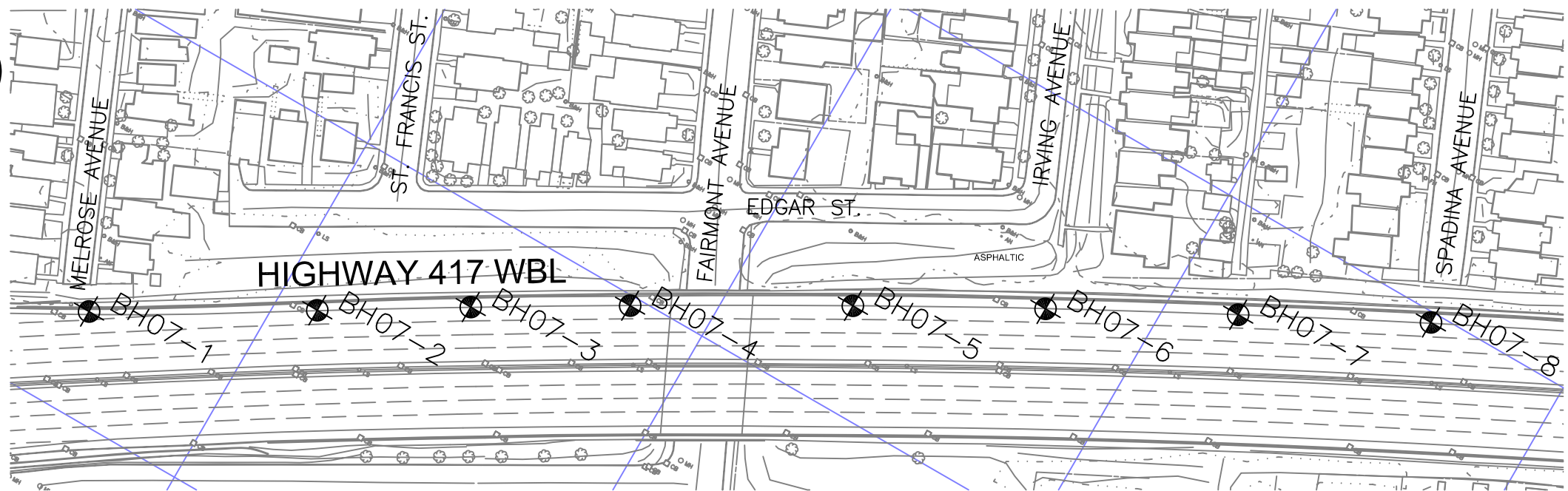


APPENDIX A

KEY AND BOREHOLE LOCATION PLANS (FIGURES 1, 2A, 2B, 3 AND 4)



AMEC Earth & Environmental a Division of AMEC Americas Limited				CLIENT LOGO 		CLIENT MINISTRY OF TRANSPORTATION ONTARIO			
TITLE SITE MAP				DWN BY: KW		DATUM: -		DATE: July 2007	
PROJECT FOUNDATION INVESTIGATION FOR NOISE BARRIER UPGRADE ALONG HIGHWAY 417 Site# 417-11 Melrose to Loretta Ave, Site# 417-10 Near Reid & Site# 417-24 N/S - W Ramp at Mailland Ottawa, Ontario				CHK'D BY: PB		REV. NO.: A		PROJECT NO: TZ71046	
				PROJECTION: -		SCALE: AS SHOWN		FIGURE No. 1	



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AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

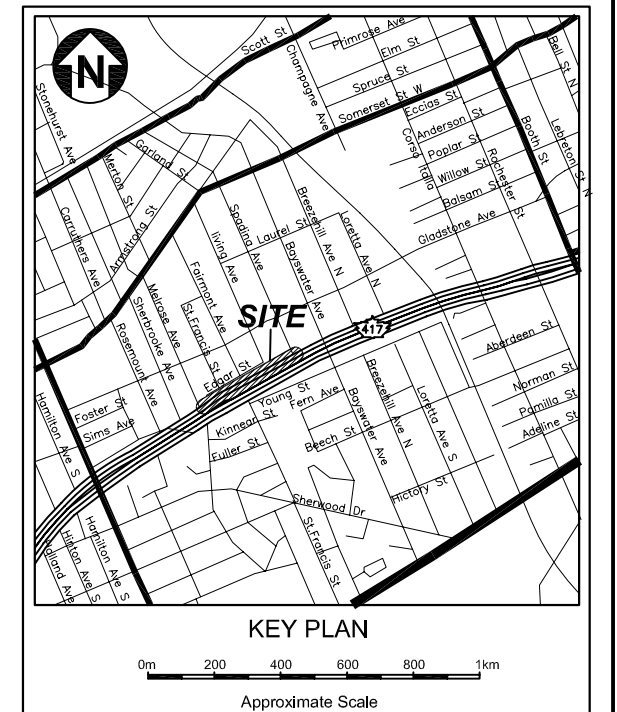
AGREEMENT No.
4006-E-0042

G.W.P. No.
4010-05-00

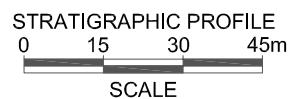
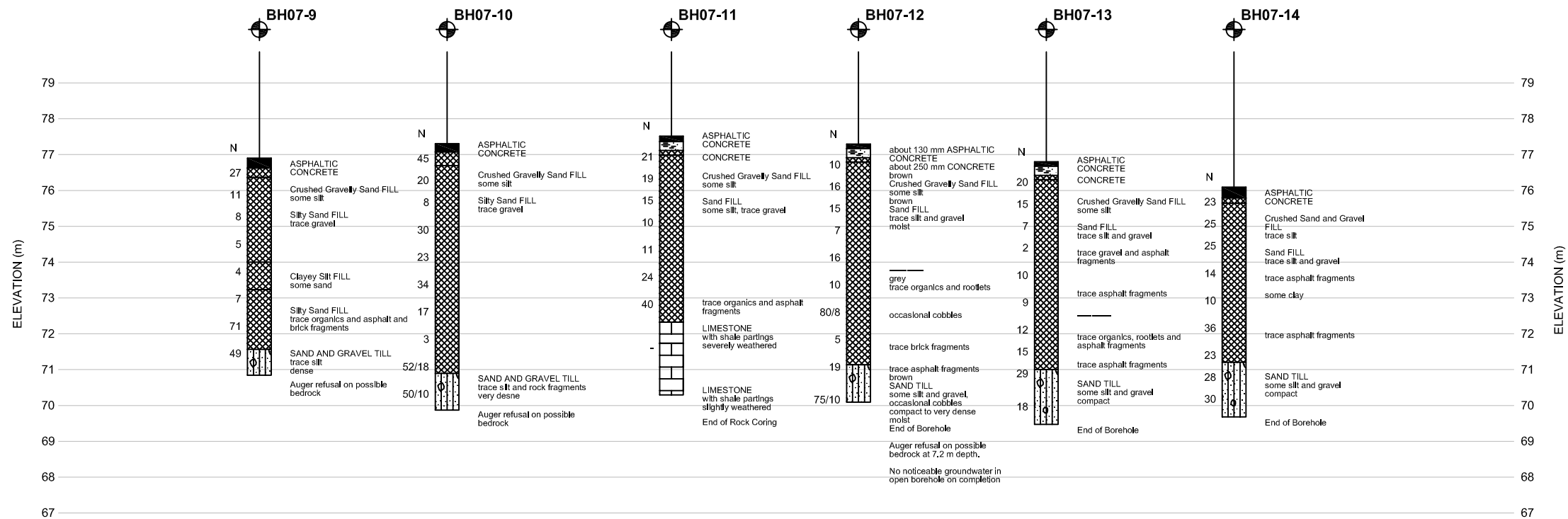
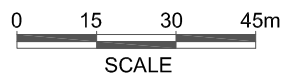
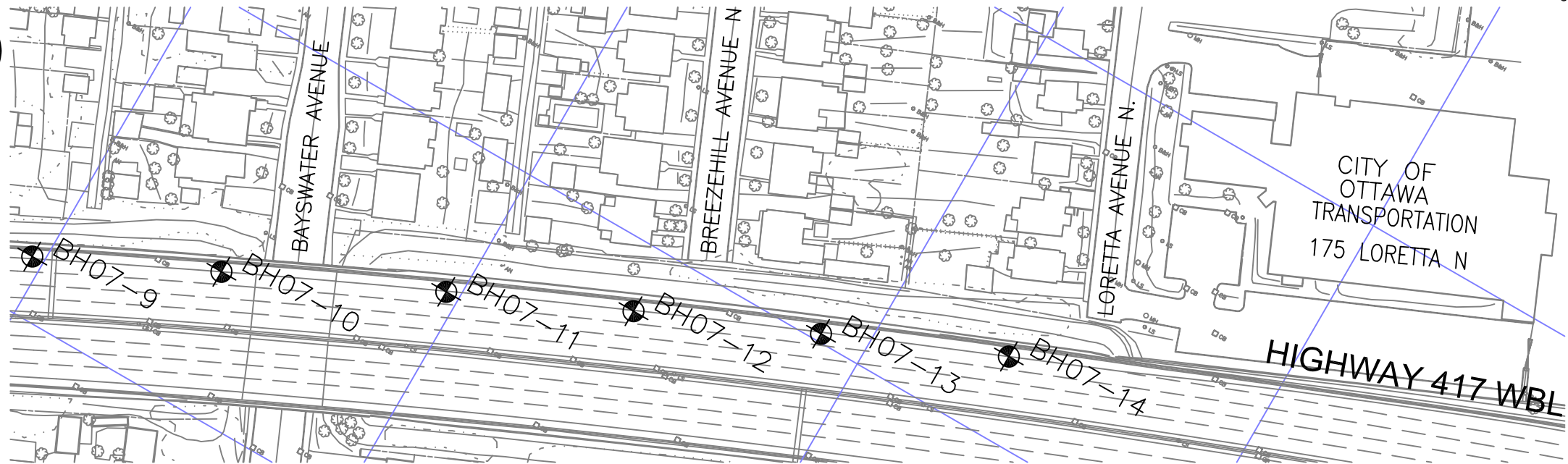
FOUNDATION INVESTIGATION FOR
NOISE BARRIER UPGRADE ALONG HIGHWAY 417
HIGHWAY 417 WBL - MELROSE AVE TO LORETTA AVE
SITE No.: 417-11

AMEC Earth & Environmental,
a Division of AMEC Americas Limited

SHEET
2A



LEGEND			
BOREHOLE IN STRUCTURAL AREA			
BOREHOLE	MTM COORDINATES		ELEVATION (m)
	NORTHING	EASTING	
BH07-1	5029126	365659	71.34
BH07-2	5029156	365710	71.71
BH07-3	5029177	365744	71.98
BH07-4	5029198	365780	72.33
BH07-5	5029226	365830	73.14
BH07-6	5029251	365874	74.23
BH07-7	5029274	365918	75.35
BH07-8	5029297	365962	76.35



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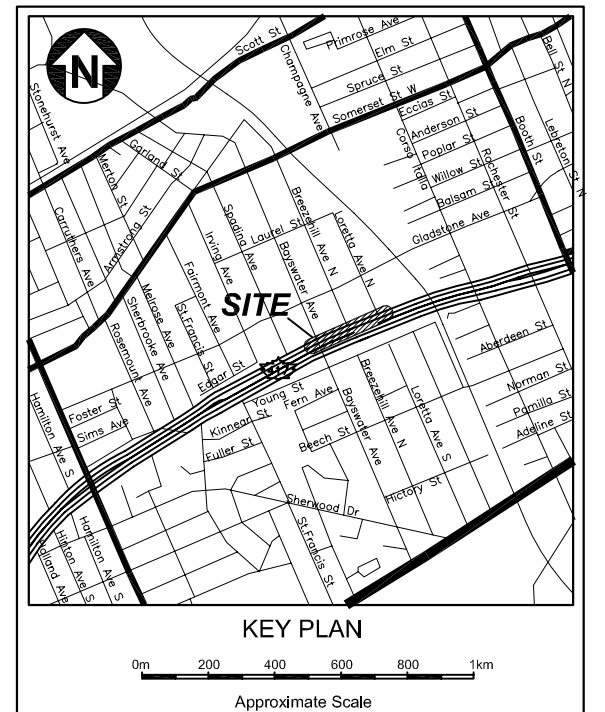
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G.W.P. No.
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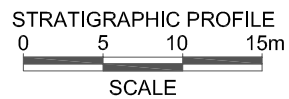
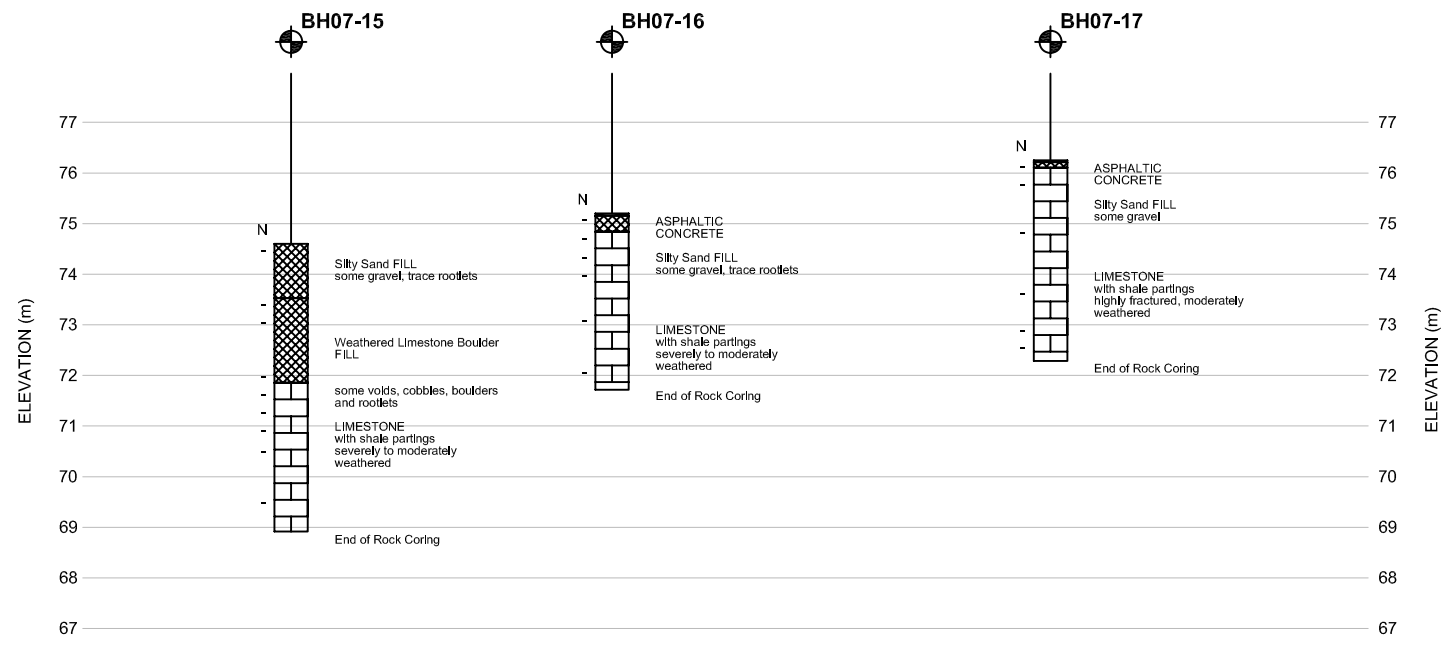
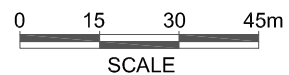
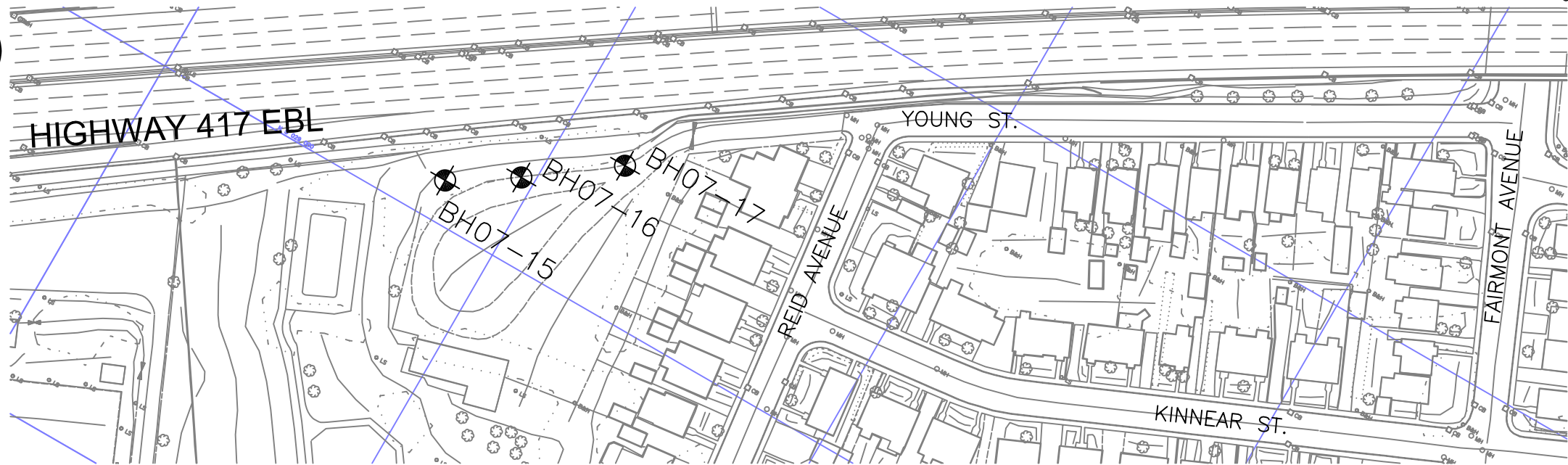
FOUNDATION INVESTIGATION FOR
NOISE BARRIER UPGRADE ALONG HIGHWAY 417
HIGHWAY 417 WBL - MELROSE AVE TO LORETTA AVE
SITE No.: 417-11

AMEC Earth & Environmental,
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SHEET
2B



LEGEND			
BOREHOLE IN STRUCTURAL AREA			
BOREHOLE	MTM COORDINATES		ELEVATION (m)
	NORTHING	EASTING	
BH07-9	5029316	365997	76.90
BH07-10	5029337	366042	77.30
BH07-11	5029362	366096	77.51
BH07-12	5029383	366142	77.29
BH07-13	5029402	366188	76.80
BH07-14	5029422	366234	76.09



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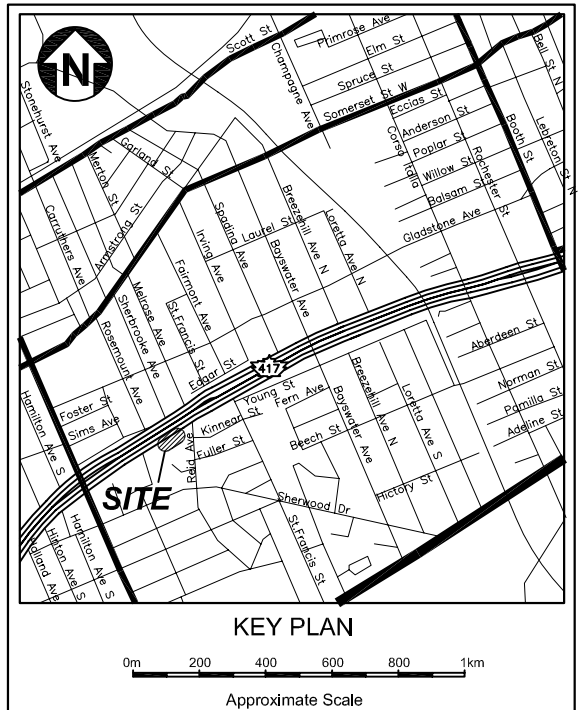
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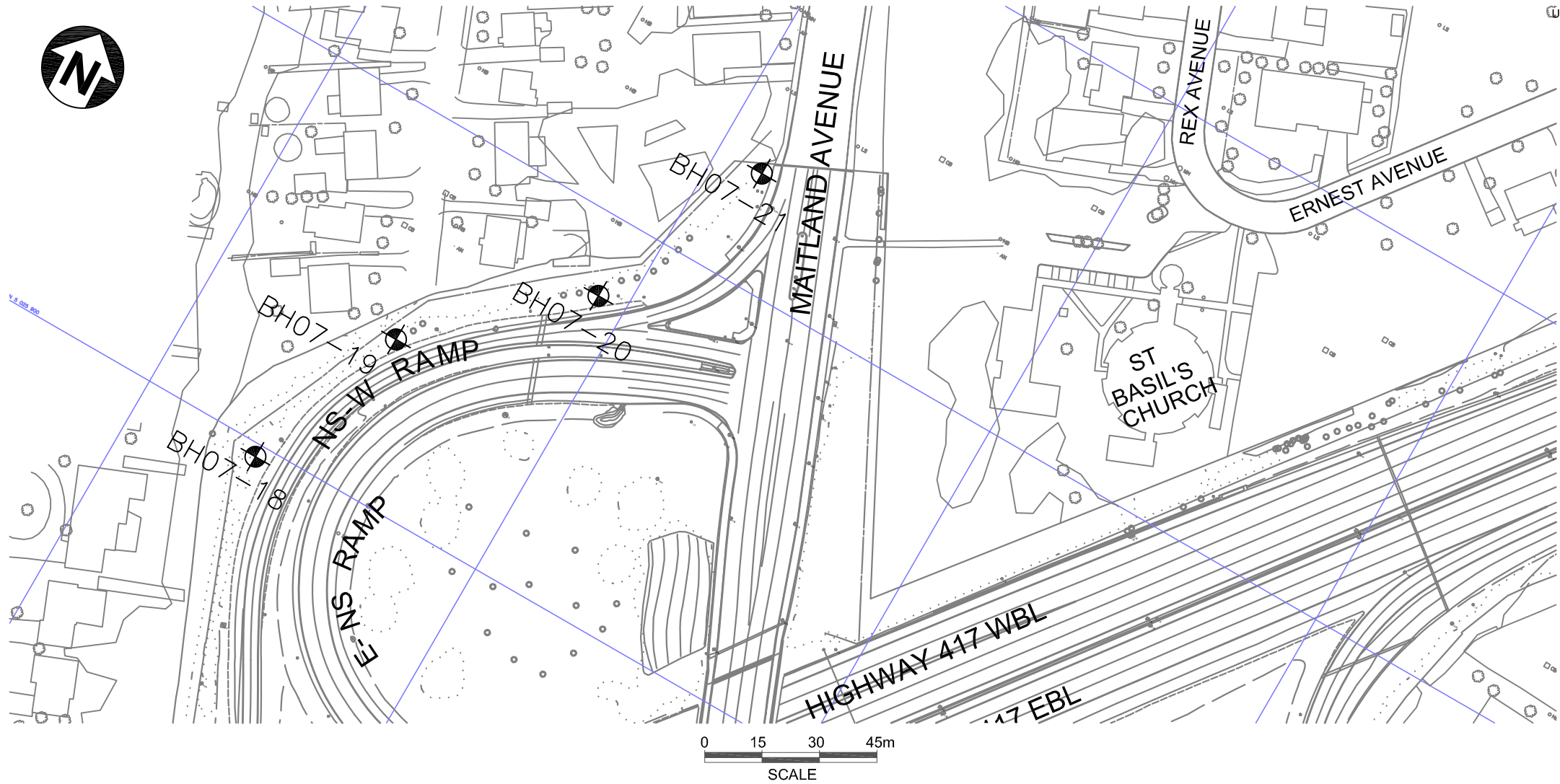
FOUNDATION INVESTIGATION FOR
NOISE BARRIER UPGRADE ALONG HIGHWAY 417
HIGHWAY 417 - NEAR REID AVE
SITE No.: 417-10

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SHEET
3

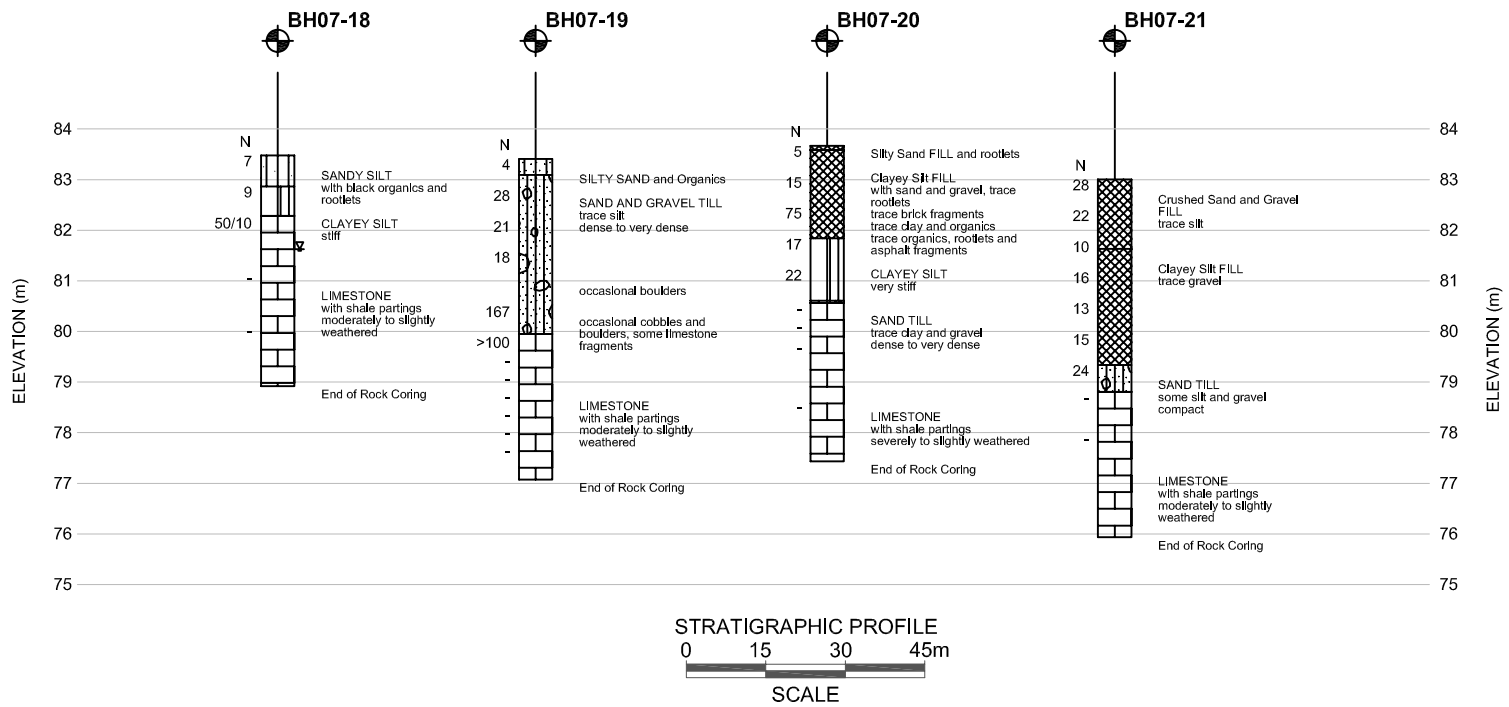
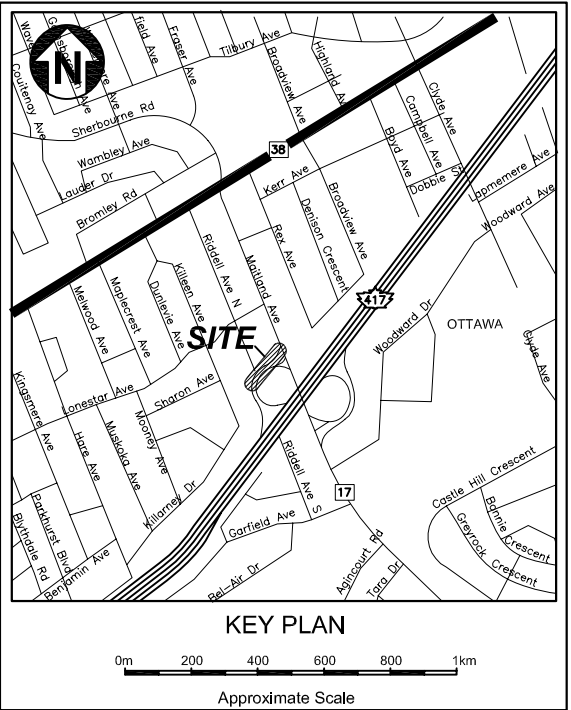



LEGEND			
BOREHOLE IN STRUCTURAL AREA			
BOREHOLE	MTM COORDINATES		ELEVATION (m)
	NORTHING	EASTING	
BH07-15	5029011	365579	74.60
BH07-16	5029022	365596	75.20
BH07-17	5029038	365619	76.25



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

AGREEMENT No.	4006-E-0042	
G.W.P. No.	4010-05-00	
FOUNDATION INVESTIGATION FOR NOISE BARRIER UPGRADE ALONG HIGHWAY 417 HIGHWAY 417 - N/S - W RAMP AT MAITLAND		SHEET 4
SITE No.: 417-24		
		
AMEC Earth & Environmental, a Division of AMEC Americas Limited		



LEGEND			
 BOREHOLE IN STRUCTURAL AREA			
BOREHOLE	MTM COORDINATES		ELEVATION (m)
	NORTHING	EASTING	
BH07-18	5025897	363034	83.47
BH07-19	5025942	363051	83.40
BH07-20	5025979	363092	83.66
BH07-21	5026029	363113	83.00

APPENDIX B

BOREHOLE RECORDS (BH07-1 THROUGH BH07-21)

EXPLANATION OF BOREHOLE LOG

This form describes some of the information provided on the borehole logs, which is based primarily on examination of the recovered samples, and the results of the field and laboratory tests. Additional description of the soil/rock encountered is given in the accompanying geotechnical report.

GENERAL INFORMATION

Project details, borehole number, location coordinates and type of drilling equipment used are given at the top of the borehole log.

SOIL LITHOLOGY

Elevation and Depth

This column gives the elevation and depth of inferred geologic layers. The elevation is referred to the datum shown in the Description column.

Lithology Plot

This column presents a graphic depiction of the soil and rock stratigraphy encountered within the borehole.

Description

This column gives a description of the soil strata, based on visual and tactile examination of the samples augmented with field and laboratory test results. Each stratum is described according to the *Modified Unified Soil Classification System*.

The compactness condition of cohesionless soils (SPT) and the consistency of cohesive soils (undrained shear strength) are defined as follows (*Ref. Canadian Foundation Engineering Manual*):

Compactness of		Consistency of		Undrained Shear Strength	
Cohesionless	SPT N-Value	Cohesive Soils	kPa	psf	
Soils					
Very loose	0 to 4	Very soft	0 to 12	0 to 250	
Loose	4 to 10	Soft	12 to 25	250 to 500	
Compact	10 to 30	Firm	25 to 50	500 to 1000	
Dense	30 to 50	Stiff	50 to 100	1000 to 2000	
Very Dense	> 50	Very stiff	100 to 200	2000 to 4000	
		Hard	Over 200	Over 4000	

Soil Sampling

Sample types are abbreviated as follows:

SS	Split Spoon	TW	Thin Wall Open (Pushed)	RC	Rock Core
AS	Auger Sample	TP	Thin Wall Piston (Pushed)	WS	Washed Sample

Additional information provided in this section includes sample numbering, sample recovery and numerical testing results.

Field and Laboratory Testing

Results of field testing (e.g., SPT, pocket penetrometer, and vane testing) and laboratory testing (e.g., natural moisture content, and limits) executed on the recovered samples are plotted in this section.

Instrumentation Installation

Instrumentation installations (monitoring wells, piezometers, inclinometers, etc.) are plotted in this section. Water levels, if measured during fieldwork, are also plotted. These water levels may or may not be representative of the static groundwater level depending on the nature of soil stratum where the piezometer tips are located, the time elapsed from installation to reading and other applicable factors.

Comments

This column is used to describe non-standard situations or notes of interest.

MODIFIED "UNIFIED" CLASSIFICATION SYSTEM FOR SOILS					
The soil of each stratum is described using the Unified Soil Classification System (Technical Memorandum 38-357 prepared by Waterways Experiment Station, Vicksburg, Mississippi, Corps of Engineers, U.S. Army, Vol. 1 March 1953), modified slightly so that an inorganic clay of "medium plasticity" is recognized.					
MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (TRACE OR NO FINES)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} \geq 4; C_c = \frac{(D_{30})^2}{D_{10} D_{60}} = 1 \text{ to } 3$
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME OR MORE FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I. MORE THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I. MORE THAN 7
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (TRACE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} \geq 6; C_c = \frac{(D_{30})^2}{D_{10} D_{60}} = 1 \text{ to } 3$
			SP	POORLY GRADED SANDS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME OR MORE FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I. MORE THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I. MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	SILTS BELOW "A" LINE (NEGLECTIBLE ORGANIC CONTENT)	$W_L < 50\%$	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)
		$W_L < 50\%$	MH	INORGANIC SILTS, MUCKEY OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	
	CLAYS ABOVE "A" LINE (NEGLECTIBLE ORGANIC CONTENT)	$W_L < 30\%$	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	
		$30\% < W_L < 50\%$	CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		$W_L < 50\%$	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS & CLAYS BELOW "A" LINE	$W_L < 50\%$	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "P", E.G. GP IS A MIXTURE OF SAND WITH SILT OR CLAY
		$W_L < 50\%$	OH	ORGANIC CLAYS OF HIGH PLASTICITY	
	HIGH ORGANIC SOILS			PI	PEAT AND OTHER HIGHLY ORGANIC SOILS

SOIL COMPONENTS					
FRACTION	U.S. STANDARD SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS		
		PASSING	RETAINED	PERCENT	DESCRIPTOR
GRAVEL	COARSE				
		75 mm	19 mm	35-50	AND
SAND	FINE				
		19 mm	4.75 mm	20-35	VERY
	COARSE				
		4.75 mm	2.00 mm	10-20	SOME
SAND	MEDIUM	2.00 mm	425 µm		
	FINE	425 µm	75 µm		
FINES (SILT OR CLAY BASED ON PLASTICITY)		75 µm			
OVERSIZED MATERIAL					
ROUNDED OR SUBROUNDED: COBBLES 75 mm TO 200 mm BOULDERS > 200 mm			NOT ROUNDED: ROCK FRAGMENTS > 75 mm ROCKS > 0.76 CUBIC METRE IN VOLUME		

Plasticity Chart for Soil Passing 425 Micron Sieve

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Note 1: Soils are classified and described according to their engineering properties and behaviour.
Note 2: The modifying adjectives used to define the actual or estimated percentage range by weight of minor components are consistent with the Canadian Foundation Engineering Manual (3rd Edition, Canadian Geotechnical Society, 1992.)
Rev 5 Nov. '06

RECORD OF BOREHOLE No BH 07-1

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029126.14 E:365659.36) 1 OF 1 ORIGINATED BY SM
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering COMPILED BY SN
 DATUM Geodetic DATE 14 June 2007 CHECKED BY WF
 PROJECT Noise Barrier Upgrade - Site No. 417-11 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa					
71.3									20 40 60 80 100					
70.9	about 150 mm ASPHALTIC CONCRETE								20 40 60 80 100					
70.8	about 250 mm CONCRETE								20 40 60 80 100					
70.8	Crushed Gravelly Sand FILL trace to some silt		1	SS	10		1		20 40 60 80 100					
70.3	Silty Sand FILL trace to some gravel moist trace brick fragments		2	SS	24		1		20 40 60 80 100					
69.7	grey SAND TILL trace silt, some to trace gravel loose to compact moist to wet		3	SS	24		2		20 40 60 80 100					
69.7			4	SS	4		3		20 40 60 80 100					
			5	SS	4		4		20 40 60 80 100					
			6	SS	3		5		20 40 60 80 100					
			7	SS	4		6		20 40 60 80 100					
			8	SS	11		7		20 40 60 80 100					
			9	SS	15		8		20 40 60 80 100					
64.6	End of Borehole						9		20 40 60 80 100					
63.5	Inferred TILL						10		20 40 60 80 100					
63.5	Dynamic Cone Penetration Test (DCPT) was conducted below 6.7 m depth.						11		20 40 60 80 100					
63.5	End of DCPT						12		20 40 60 80 100					
	Refusal to Dynamic Cone Penetration Test at 7.8 m depth due to possible bedrock.						13		20 40 60 80 100					
	Groundwater in open borehole on completion: 4.6 m						14		20 40 60 80 100					
	Depth of cave-in on completion: 5.5 m						15		20 40 60 80 100					

RECORD OF BOREHOLE No BH 07-2

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029155.97 E:365710.39) 1 OF 2
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering ORIGINATED BY SM
 DATUM Geodetic DATE 13 June 2007 COMPILED BY SN
 PROJECT Noise Barrier Upgrade - Site No. 417-11 CHECKED BY WF
 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
71.7									20 40 60 80 100						
0.0	about 280 mm ASPHALTIC CONCRETE								○ UNCONFINED + FIELD VANE						
71.4									● QUICK TRIAXIAL × LAB VANE						
70.3	Crushed Gravelly Sand FILL / brown trace to some silt		1	SS	14		71		20 40 60 80 100		10	20	30		
0.4	dark grey to brown Silty Sand FILL trace to some gravel and organics moist		2	SS	17		1								
			3	SS	20		70								
	trace asphalt fragments						2								
			4	SS	12		69								
	trace brick fragments						3								
			5	SS	14		68								
	trace wood fragments						4								
			6	SS	6		67								
	trace clay						5								
67.3			7	SS	19		66								17 71 (12)
4.4	brown/grey SAND TILL some gravel loose to dense moist to wet		8	SS	43		6								
			9	SS	4		65								
			10	SS	22		7								
			11	SS	16		64								
			12	SS	10		63								8 84 (8)
62.6							9								
9.1	End of Borehole														

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

RECORD OF BOREHOLE No BH 07-2

2 OF 2

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029155.97 E:365710.39) ORIGINATED BY SM
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering COMPILED BY SN
 DATUM Geodetic DATE 13 June 2007 CHECKED BY WF
 PROJECT Noise Barrier Upgrade - Site No. 417-11 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
	Inferred TILL													
61.4	Dynamic Cone Penetration Test (DCPT) was conducted below 9.1 m depth.						62							
10.3	End of DCPT													
	Refusal to Dynamic Cone Penetration Test at 10.34 m depth due to possible bedrock.													
	Groundwater in open borehole on completion: 7.9 m													
	Depth of cave-in on completion: 7.2 m													

RECORD OF BOREHOLE No BH 07-3

1 OF 1

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029176.56 E:365744.4) ORIGINATED BY SM
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering COMPILED BY SN
 DATUM Geodetic DATE 13 June 2007 CHECKED BY WF
 PROJECT Noise Barrier Upgrade - Site No. 417-11 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
72.0									20 40 60 80 100	20 40 60 80 100	10 20 30				
0.0	about 280 mm ASPHALTIC CONCRETE														
71.7	brown														
71.3	Crushed Gravelly Sand FILL / trace to some silt		1	SS	10		1	71							
0.5	brown Silty Sand FILL trace to some gravel moist trace wood fragments		2	SS	51										
	trace brick fragments		3	SS	74		2	70							
	grey														
	trace brick fragments		4	SS	14										
							3	69							
	trace organics		5	SS	6										
	brown trace organics		6	SS	22		4	68							
67.6	brown/grey SAND TILL														
4.4	some gravel, occasional cobbles very dense		7	SS	52		5	67							
			8	SS	120										
65.8							6	66							
6.2	End of Borehole														
	Auger refusal on possible bedrock at 6.2 m depth.														
	No noticeable groundwater in open borehole on completion														
	Depth of cave-in on completion: 5.7 m														

RECORD OF BOREHOLE No BH 07-4

G.W.P. 4010-05-00	LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029197.54 E:365779.98)	1 OF 1	ORIGINATED BY SM
DIST HWY 417, Ottawa	BOREHOLE TYPE Hollow Stem Augering	COMPILED BY SN	
DATUM Geodetic	DATE 13 June 2007	CHECKED BY WF	
PROJECT Noise Barrier Upgrade - Site No. 417-11	JOB NO. TZ71046		

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa								WATER CONTENT (%)	
									○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL							x LAB VANE
72.3 0.0	about 280 mm ASPHALTIC CONCRETE							20 40 60 80 100	20 40 60 80 100	10 20 30								
72.1 0.3	Crushed Gravelly Sand FILL trace to some silt		1	SS	42													
71.7 0.6	Silty Sand FILL trace to some gravel		2	SS	23													
			3	SS	5													
			4	SS	6													
			5	SS	10													
	trace clay		6	SS	7													
			7	SS	12													
			8	SS	10													
	25 mm thick clay seam		9	SS	3													
	trace clay		10	SS	3													
			11	SS	55/20													
64.4 8.0	some limestone fragments																	
	End of Borehole																	
	Auger refusal on possible bedrock at 8.0 m depth.																	
	No noticeable groundwater in open borehole on completion																	

RECORD OF BOREHOLE No BH 07-5

G.W.P. 4010-05-00	LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029226.39 E:365829.97)	1 OF 2	ORIGINATED BY SM
DIST HWY 417, Ottawa	BOREHOLE TYPE Hollow Stem Augering	COMPILED BY SN	
DATUM Geodetic	DATE 12 June 2007	CHECKED BY WF	
PROJECT Noise Barrier Upgrade - Site No. 417-11	JOB NO. TZ71046		

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa		W _p	W	W _L		
73.1									20 40 60 80 100						
0.0	about 330 mm ASPHALTIC CONCRETE							73							
72.8															
0.3	Crushed Gravelly Sand FILL		1	AS	-										
72.5	trace to some silt														
0.6	trace clay and gravel		2	SS	15		1								
	trace clay and gravel														
	trace clay and gravel		3	SS	6			72							
	trace clay and gravel														
	trace clay and gravel		4	SS	6		2								
	trace clay and gravel														
	trace clay and gravel		5	SS	3			71							
	trace clay and gravel														
	trace clay and gravel		6	SS	11		3	70							
	trace clay and gravel														
	trace clay and gravel		7	SS	16		4	69							
	trace clay and gravel														
	trace clay and gravel		8	SS	9		5	68							
	trace clay and gravel														
	trace clay and gravel		9	SS	12		6								
	trace clay and gravel														
	trace clay and gravel		10	SS	8		7	67							
	trace clay and gravel														
	trace clay and gravel														
	trace clay and gravel		11	SS	9		8	66							
	trace clay and gravel														
	trace clay and gravel														
	trace clay and gravel		12	SS	5		9	65							
	trace clay and gravel														
	trace clay and gravel		13	SS	9			64							

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

RECORD OF BOREHOLE No BH 07-5

2 OF 2

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029226.39 E:365829.97) ORIGINATED BY SM
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering COMPILED BY SN
 DATUM Geodetic DATE 12 June 2007 CHECKED BY WF
 PROJECT Noise Barrier Upgrade - Site No. 417-11 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa		W _p	W	W _L		
									○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
	trace rootlets		14	SS	8		-10	63							
62.2															
11.0	grey														
61.9	SAND TILL		15	SS	13		-11	62							15 75 (10)
11.3	some silt and gravel compact moist														
	End of Borehole														
	Inferred TILL						-12	61							
	Dynamic Cone Penetration Test (DCPT) was conducted below 11.3 m depth.						-13	60							
							-14	59							
58.2															
14.9	End of DCPT														
	No noticeable groundwater in open borehole on completion														

RECORD OF BOREHOLE No BH 07-6

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029250.66 E:365873.58) 1 OF 1
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering ORIGINATED BY SM
 DATUM Geodetic DATE 12 June 2007 COMPILED BY SN
 PROJECT Noise Barrier Upgrade - Site No. 417-11 CHECKED BY WF
 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa		WATER CONTENT (%)				
74.2									20 40 60 80 100						
0.0	about 250 mm ASPHALTIC CONCRETE								○ UNCONFINED + FIELD VANE						
74.0									● QUICK TRIAXIAL x LAB VANE						
0.3	Crushed Gravelly Sand FILL		1	AS	-										
73.6	trace silt														
0.6	Silty Sand FILL		2	SS	9		1								
	trace to some clay and gravel moist to damp														
	trace rootlets		3	SS	7										
			4	SS	10		2								
			5	SS	2										
							3								
	trace organics and asphalt fragments		6	SS	18										
	trace organics and wood fragments		7	SS	6		4								
	trace organics and wood fragments		8	SS	43		5								
	trace asphalt fragments		9	SS	50/13										
68.6															
5.6	SAND AND GRAVEL TILL														
68.1	trace silt and rock fragments		10	AS	-		6								
6.1	very dense damp														
	End of Borehole														
	Auger refusal on possible bedrock at 6.1 m depth.														
	No noticeable groundwater in open borehole on completion.														
	Additional 1 borehole was drilled to confirm the bedrock depths.														
	Borehole (BH07-6A) was drilled 3.0 m west of BH07-6 and auger refusal on possible bedrock was at 6.1 m depth.														

RECORD OF BOREHOLE No BH 07-7

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029274.44 E:365917.56) 1 OF 1
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering ORIGINATED BY SM
 DATUM Geodetic DATE 12 June 2007 COMPILED BY SN
 PROJECT Noise Barrier Upgrade - Site No. 417-11 CHECKED BY WF
 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							
75.4									20 40 60 80 100							
0.0	about 250 mm ASPHALTIC CONCRETE								○ UNCONFINED + FIELD VANE							
75.1									● QUICK TRIAXIAL × LAB VANE							
0.3	Crushed Gravelly Sand FILL		1	AS	-		75		20 40 60 80 100							
74.7	trace silt															
0.6	Sand FILL		2	SS	19		1									
	trace to some clay moist															
73.8			3	SS	9		74									
1.5	grey Clayey Silt FILL															
	moist		4	SS	12		2									
	trace wood fragments		5	SS	16		73									
72.5																
2.9	brown Sand FILL						3									
	trace organics and rootlets, trace wood, brick and asphalt fragments moist		6	SS	7		72									
			7	SS	9		4									
70.8																
4.6	brown SAND AND GRAVEL TILL		8	SS	8		5									
	trace silt loose to compact wet															
			9	SS	14		70									
	grey		10	SS	25		69									
68.6																
6.7	End of Borehole															
	Groundwater in open borehole on completion: 6.1 m															
	Depth of cave-in on completion: 5.9 m															

RECORD OF BOREHOLE No BH 07-8

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029297.48 E:365961.82) 1 OF 1
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering ORIGINATED BY SM
 DATUM Geodetic DATE 12 June 2007 COMPILED BY SN
 PROJECT Noise Barrier Upgrade - Site No. 417-11 CHECKED BY WF
 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa		WATER CONTENT (%)				
76.4 0.0	about 300 mm ASPHALTIC CONCRETE														
76.1 0.3	Crushed Gravelly Sand FILL		1	AS	-										25 61 (14)
75.9 0.5	Crushed Gravelly Sand FILL some silt		2	SS	11										
	brown and grey Silty Sand FILL		3	SS	7										
	trace to some clay moist		4	SS	12										
	trace brick and wood fragments		5	SS	5										
	occasional cobbles		6	SS	10										
72.3 4.1	brown SILTY SAND		7	SS	16										0 73 (27)
	compact moist		8	SS	15										
71.0 5.3	grey SAND AND GRAVEL TILL		9	SS	89										63 32 (5)
	trace silt very dense moist														
70.2 6.2	End of Borehole														
	Auger refusal on possible bedrock at 6.2 m depth.														
	No noticeable groundwater in open borehole on completion														
	Depth of cave-in on completion: 5.7 m														

RECORD OF BOREHOLE No BH 07-9

G.W.P. 4010-05-00	LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029315.46 E:365996.68)	1 OF 1	ORIGINATED BY SM
DIST HWY 417, Ottawa	BOREHOLE TYPE Hollow Stem Augering	COMPILED BY SN	
DATUM Geodetic	DATE 9 June 2007 - 11 June 2007	CHECKED BY WF	
PROJECT Noise Barrier Upgrade - Site No. 417-11	JOB NO. TZ71046		

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa				
76.9 0.0	about 280 mm ASPHALTIC CONCRETE								20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
76.6 0.3	Crushed Gravelly Sand FILL some silt		1	SS	27				20 40 60 80 100	WATER CONTENT (%)			
76.4 0.5	brown and grey Silty Sand FILL trace gravel moist		2	SS	11		1						
			3	SS	8		2						
			4	SS	5								
74.0 2.9	grey and brown Clayey Silt FILL some sand moist		5	SS	4		3						
73.2 3.7	brown Silty Sand FILL trace organics and asphalt and brick fragments moist		6	SS	7		4						
			7	SS	71		5						
71.6 5.3	brown SAND AND GRAVEL TILL trace silt dense moist		8	SS	49		6						
70.9 6.1	End of Borehole Auger refusal on possible bedrock at 6.1 m depth. No noticeable groundwater in open borehole on completion Depth of cave-in on completion: 5.4 m												

RECORD OF BOREHOLE No BH 07-10

1 OF 1

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029336.99 E:366042.14) ORIGINATED BY SM
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering COMPILED BY SN
 DATUM Geodetic DATE 9 June 2007 CHECKED BY WF
 PROJECT Noise Barrier Upgrade - Site No. 417-11 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
77.3 0.0 77.1 0.2	about 230 mm ASPHALTIC CONCRETE														
76.7 0.6	Crushed Gravelly Sand FILL some silt brown		1	SS	45										
	Silty Sand FILL trace gravel damp to moist		2	SS	20										
			3	SS	8										
			4	SS	30										
			5	SS	23										
			6	SS	34										
			7	SS	17										
			8	SS	3										
70.9 6.4	grey SAND AND GRAVEL TILL trace silt and rock fragments very dense moist		9	SS	52/18										
69.9 7.4	End of Borehole		10	SS	50/10										
	Auger refusal on possible bedrock at 7.4 m depth.														
	No noticeable groundwater in open borehole on completion														

RECORD OF BOREHOLE No BH 07-11

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029362.14 E:366096.25) 1 OF 1
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering ORIGINATED BY SM
 DATUM Geodetic DATE 8 June 2007 COMPILED BY SN
 PROJECT Noise Barrier Upgrade - Site No. 417-11 CHECKED BY WF
 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa								WATER CONTENT (%)
									○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
77.5									20 40 60 80 100		10 20 30					GR SA SI CL	
77.4	about 140 mm ASPHALTIC CONCRETE																
77.1	about 250 mm CONCRETE																
77.0	Crushed Gravelly Sand FILL some silt		1	SS	21		1	77									
76.9	Crushed Gravelly Sand FILL some silt, trace gravel moist		2	SS	19			76									
			3	SS	15		2	75								5 80 (15)	
			4	SS	10			74									
			5	SS	11		3	73									
			6	SS	24		4	72									
	trace organics and asphalt fragments		7	SS	40		5	71									
72.3	LIMESTONE with shale partings severely weathered		8	SS	70/3			70									
71.7	End of Hollow Stem Augering						6										
5.8	Run coring from a depth of 5.8 m																
	LIMESTONE with shale partings slightly weathered		9	RC	-		7									RC 9: TCR = 100% RQD = 100%	
70.3	End of Rock Coring																
7.2																	

RECORD OF BOREHOLE No BH 07-12

G.W.P. 4010-05-00	LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029382.49 E:366141.73)	1 OF 1	ORIGINATED BY SM
DIST HWY 417, Ottawa	BOREHOLE TYPE Hollow Stem Augering	COMPILED BY SN	
DATUM Geodetic	DATE 8 June 2007	CHECKED BY WF	
PROJECT Noise Barrier Upgrade - Site No. 417-11	JOB NO. TZ71046		

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa					
77.3									20 40 60 80 100					
77.2	about 130 mm ASPHALTIC CONCRETE								○ UNCONFINED + FIELD VANE					
77.1	about 250 mm CONCRETE								● QUICK TRIAXIAL x LAB VANE					
76.9	Crushed Gravelly Sand FILL								WATER CONTENT (%)					
76.8	some silt								w _p w w _L					
76.7	Crushed Gravelly Sand FILL								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT					
76.6	some silt								w _p w w _L					
76.5	Crushed Gravelly Sand FILL								w _p w w _L					
	some silt								w _p w w _L					
	Crushed Gravelly Sand FILL								w _p w w _L					
	some silt								w _p w w _L					
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	Crushed Gravelly Sand FILL								w _p w w _L					
	some silt		</											

RECORD OF BOREHOLE No BH 07-13

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029402.14 E:366187.7) 1 OF 1
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering ORIGINATED BY SM
 DATUM Geodetic DATE 7 June 2007 - 8 June 2007 COMPILED BY SN
 PROJECT Noise Barrier Upgrade - Site No. 417-11 CHECKED BY WF
 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa				
76.8									20 40 60 80 100				
76.9	about 130 mm ASPHALTIC CONCRETE								○ UNCONFINED + FIELD VANE				
76.4	about 250 mm CONCRETE								● QUICK TRIAXIAL × LAB VANE				
76.3	Crushed Gravelly Sand FILL some silt		1	SS	20		76		20 40 60 80 100				
0.1	Crushed Gravelly Sand FILL some silt		2	SS	15								
0.5	Crushed Gravelly Sand FILL some silt		3	SS	7		75						
	Crushed Gravelly Sand FILL some silt		4	SS	2								
	Crushed Gravelly Sand FILL some silt		5	SS	10		74						
	Crushed Gravelly Sand FILL some silt		6	SS	9		73						
	Crushed Gravelly Sand FILL some silt		7	SS	12		72						
	Crushed Gravelly Sand FILL some silt		8	SS	15								
71.0	Crushed Gravelly Sand FILL some silt		9	SS	29		71						
5.8	Crushed Gravelly Sand FILL some silt		10	SS	18		70						
69.5	End of Borehole												
7.3	No noticeable groundwater in open borehole on completion												

RECORD OF BOREHOLE No BH 07-14

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - Loretta Ave. to Melrose Ave. (N:5029421.82 E:366233.77) 1 OF 1 ORIGINATED BY SM
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering COMPILED BY SN
 DATUM Geodetic DATE 6 June 2007 - 7 June 2007 CHECKED BY WF
 PROJECT Noise Barrier Upgrade - Site No. 417-11 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT W _p W W _L			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa		WATER CONTENT (%)				
76.1															
0.0	about 300 mm ASPHALTIC CONCRETE							76							
75.8	brown														
75.8	Crushed Sand and Gravel FILL		1	SS	23									45 50	(5)
0.5	trace silt														
	brown														
	Sand FILL		2	SS	25		1	75						7 89	(4)
	trace silt and gravel														
	damp to moist														
			3	SS	25		2	74							
	trace asphalt fragments														
			4	SS	14										
	grey						3	73							
	some clay														
			5	SS	10										
							4	72							
	trace asphalt fragments		6	SS	36										
71.2	brown		7	SS	23		5	71							
4.9	SAND TILL														
	some silt and gravel		8	SS	28									14 71	(15)
	compact														
	moist						6	70							
			9	SS	30										
69.7															
6.4	End of Borehole														
	No noticeable groundwater in open borehole on completion														

RECORD OF BOREHOLE No BH 07-15































1 OF 1

G.W.P. 4010-05-00 LOCATION HWY 417 - Near Reid Ave. (N:5029010.85 E:365579.34) ORIGINATED BY CM
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering COMPILED BY SN
 DATUM Geodetic DATE 14 June 2007 - 15 June 2007 CHECKED BY WF
 PROJECT Noise Barrier Upgrade - Site No. 417-10 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa		WATER CONTENT (%)				
74.6								20 40 60 80 100	20 40 60 80 100	10 20 30	10 20 30	10 20 30	kN/m ³	GR SA SI CL	
0.0	brown Silty Sand FILL some gravel, trace rootlets		1	GS	-										
73.5	Run coring from a depth of 1.1 m		2	RC	-		1							RC 2: TCR = 100% RQD = 0%	
1.1	Weathered Limestone Boulder FILL		3	RC	-									RC 3: TCR = 24% RQD = 0%	
	concrete fill at 2.2 m depth						2								
71.9	some voids, cobbles, boulders and rootlets		4	RC	-									RC 4: TCR = 100% RQD = 0%	
2.7	grey LIMESTONE with shale partings severely to moderately weathered		5	RC	-									RC 5: TCR = 33% RQD = 0%	
			6	RC	-		3							RC 6: TCR = 78% RQD = 31%	
			7	RC	-									RC 7: TCR = 87% RQD = 27%	
			8	RC	-		4							RC 8: TCR = 88% RQD = 76%	
	mud seam at 4.8 m depth						5								
	mud seam at 5.2 m depth		9	RC	-									RC 9: TCR = 87% RQD = 85%	
68.9															
5.7	End of Rock Coring														

RECORD OF BOREHOLE No BH 07-16

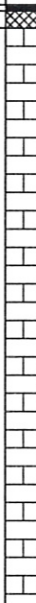
G.W.P. 4010-05-00 LOCATION HWY 417 - Near Reid Ave. (N:5029021.6 E:365596.4) 1 OF 1 ORIGINATED BY CM
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering COMPILED BY SN
 DATUM Geodetic DATE 13 June 2007 CHECKED BY WF
 PROJECT Noise Barrier Upgrade - Site No. 417-10 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa		WATER CONTENT (%)				
75.2															
75.2	about 50 mm ASPHALTIC CONCRETE		1	GS	-										
74.8	dark brown Silty Sand FILL		2	RC	-										RC 2: TCR = 87% RQD = 0%
74.8	some gravel, trace rootlets Run coring from a depth of 0.4 m		3	RC	-										RC 3: TCR = 100% RQD = 0%
0.4	grey LIMESTONE with shale partings severely to moderately weathered		4	RC	-										RC 4: TCR = 91% RQD = 62%
															
															
															
															
	vertical fractures at 2.8-2.9 m depth		5	RC	-										RC 5: TCR = 95% RQD = 44%
															
															
															
															
															
															
															
															
															
															
															
															
															
															
															
															
															
															
															
															
															

RECORD OF BOREHOLE No BH 07-17

1 OF 1

G.W.P. 4010-05-00 LOCATION HWY 417 - Near Reid Ave. (N:5029037.98 E:365618.58) ORIGINATED BY CM
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering COMPILED BY SN
 DATUM Geodetic DATE 13 June 2007 CHECKED BY WF
 PROJECT Noise Barrier Upgrade - Site No. 417-10 JOB NO. TZ71046

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE				"N" VALUES	SHEAR STRENGTH kPa		WATER CONTENT (%)					
76.3	<div>about 40 mm ASPHALTIC CONCRETE</div> <div>brown Silty Sand FILL some gravel</div> <div>Run coring from a depth of 0.2 m</div> <div>grey LIMESTONE with shale partings highly fractured, moderately weathered</div>		1	GS	-									RC 2: TCR = 96% RQD = 44%		
76.2			2	RC	-											
			3	RC	-											RC 3: TCR = 90% RQD = 34%
			4	RC	-											RC 4: TCR = 100% RQD = 43%
			5	RC	-											RC 5: TCR = 100% RQD = 0%
			6	RC	-											RC 6: TCR = 100% RQD = 72%
72.3 4.0	mud seam with rootlets at 3.9-4.0 m depth															
	End of Rock Coring															

RECORD OF BOREHOLE No BH 07-18

1 OF 1

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - N/S-W Ramp at Maitland Ave. (N:5025896.68 E:363034.45) ORIGINATED BY CM
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering COMPILED BY SN
 DATUM Geodetic DATE 5 June 2007 CHECKED BY WF
 PROJECT Noise Barrier Upgrade - Site No. 417-24 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
83.5 0.0	brown SANDY SILT with black organics and rootlets		1	SS	7										
82.9 0.6	grey CLAYEY SILT stiff		2	SS	9		1								
82.3 1.2	Run coring from a depth of 1.2 m		3	SS	50/10										
	grey LIMESTONE with shale partings moderately to slightly weathered		4	RC			2								RC 4: TCR = 100% RQD = 84%
			5	RC	-		3								RC 5: TCR = 96% RQD = 85%
			6	RC	-		4								RC 6: TCR = 100% RQD = 94%
78.9 4.6	End of Rock Coring														

RECORD OF BOREHOLE No BH 07-19

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - N/S-W Ramp at Maitland Ave. (N:5025942.36 E:363051.2) 1 OF 1 ORIGINATED BY CM
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering COMPILED BY SN
 DATUM Geodetic DATE 5 June 2007 CHECKED BY WF
 PROJECT Noise Barrier Upgrade - Site No. 417-24 JOB NO. TZ71046

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa								
83.4									20 40 60 80 100								
0.0	brown																
83.1	SILTY SAND and Organics		1	SS	4												
0.3	grey																
	SAND AND GRAVEL TILL		2	SS	28		1										
	trace silt																
	dense to very dense		3	SS	21												
	moist		4	SS	18		2										
	occasional boulders																
	occasional cobbles and boulders, some limestone fragments		5	SS	167		3										
80.0	Run coring from a depth of 3.5 m																
3.5			6	SS	>100												
	grey		7	RC	-												
	LIMESTONE		8	RC	-		4										
	with shale partings																
	moderately to slightly weathered		9	RC	-												
			10	RC	-		5										
			11	RC	-												
			12	RC	-		6										
77.1																	
6.3	End of Rock Coring																

RECORD OF BOREHOLE No BH 07-20

G.W.P. 4010-05-00	LOCATION HWY 417 WBL - N/S-W Ramp at Maitland Ave. (N:5025979.27 E:363091.97)	1 OF 1	ORIGINATED BY CM
DIST HWY 417, Ottawa	BOREHOLE TYPE Hollow Stem Augering	COMPILED BY SN	
DATUM Geodetic	DATE 6 June 2007 - 18 June 2007	CHECKED BY WF	
PROJECT Noise Barrier Upgrade - Site No. 417-24	JOB NO. TZ71046		

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							
83.7									20 40 60 80 100							
83.7 0.1	Silty Sand FILL and rootlets brown		1	SS	5											
	Clayey Silt FILL with sand and gravel, trace rootlets		2	SS	15											
	trace brick fragments trace clay and organics		3	SS	75											
	trace organics, rootlets and asphalt fragments															
81.8 1.8	grey CLAYEY SILT very stiff		4	SS	17											
			5	SS	22											
80.6 3.1	grey SAND TILL trace clay and gravel dense to very dense moist		6	SS	-											
	Run coring from a depth of 3.1 m		7	RC	-											
			8	RC	-											
	grey LIMESTONE with shale partings severely to slightly weathered		9	RC	-											
			10	RC	-											
77.4 6.2	End of Rock Coring															

RC 7:
TCR = 100%
RQD = 100%

RC 8:
TCR = 86%
RQD = 20%

RC 9:
TCR = 100%
RQD = 94%

RC 10:
TCR = 100%
RQD = 95%

RECORD OF BOREHOLE No BH 07-21

G.W.P. 4010-05-00 LOCATION HWY 417 WBL - N/S-W Ramp at Maitland Ave. (N:5026029.11 E:363113.32) 1 OF 1
 DIST HWY 417, Ottawa BOREHOLE TYPE Hollow Stem Augering COMPILED BY SN
 DATUM Geodetic DATE 18 June 2007 CHECKED BY WF
 PROJECT Noise Barrier Upgrade - Site No. 417-24 JOB NO. TZ71046

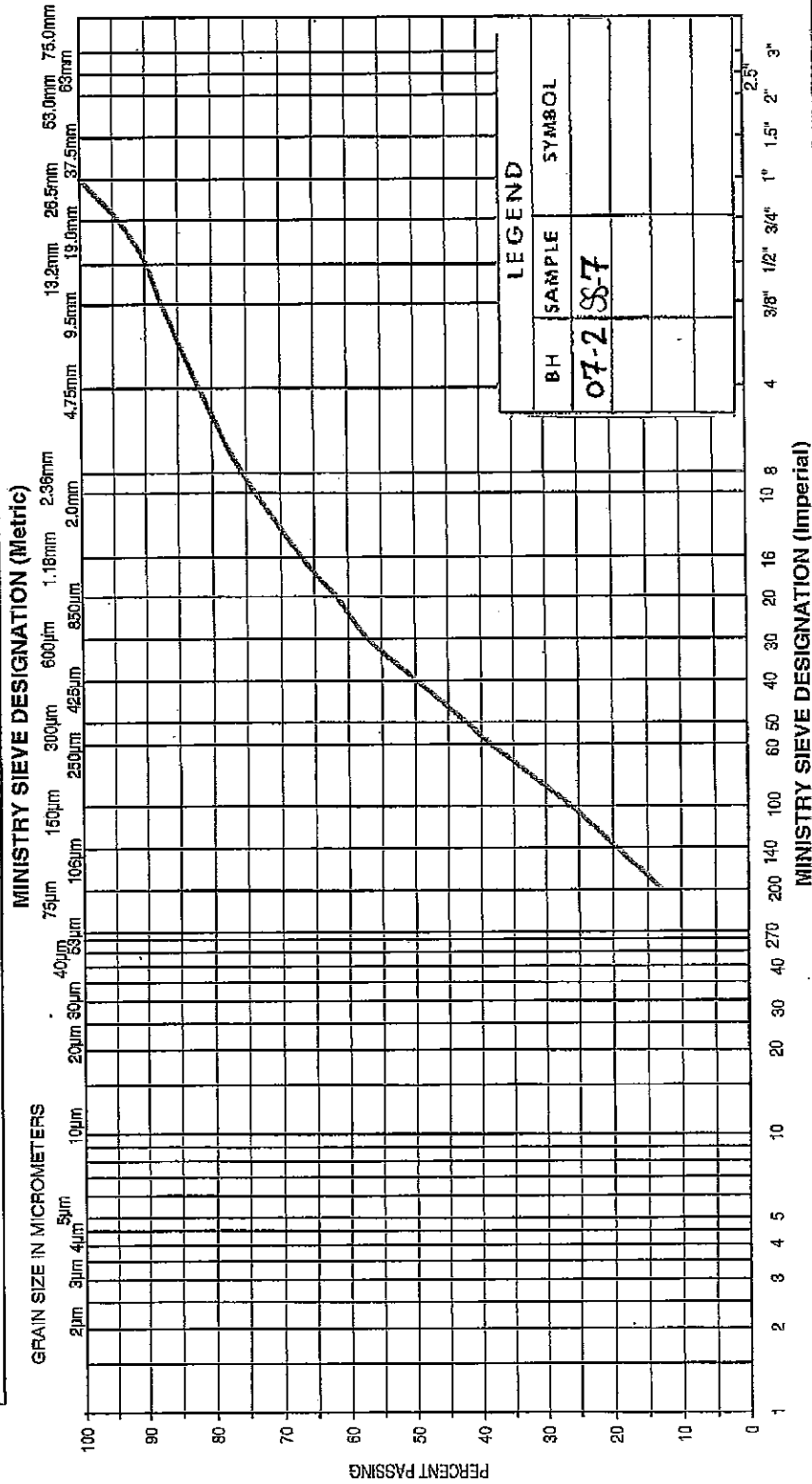
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa						
83.0									20 40 60 80 100	20 40 60 80 100					
0.0	brown Crushed Sand and Gravel FILL trace silt		1	SS	28										
			2	SS	22		1	82							50 45 (5)
81.6	brown Clayey Silt FILL trace gravel		3	SS	10										
1.4			4	SS	16		2	81							
			5	SS	13										
			6	SS	15		3	80							
79.3	grey SAND TILL some silt and gravel compact moist		7	SS	24		4	79						15 68 (17)	
3.7	Run coring from a depth of 4.2 m		8	RC	-									RC 8: TCR = 100% RQD = 67%	
78.8	grey LIMESTONE with shale partings moderately to slightly weathered						5	78							
4.2			9	RC	-		6	77						RC 9: TCR = 100% RQD = 100%	
75.9	End of Rock Coring						7	76							
7.1															

APPENDIX C

LABORATORY TEST RESULTS

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	



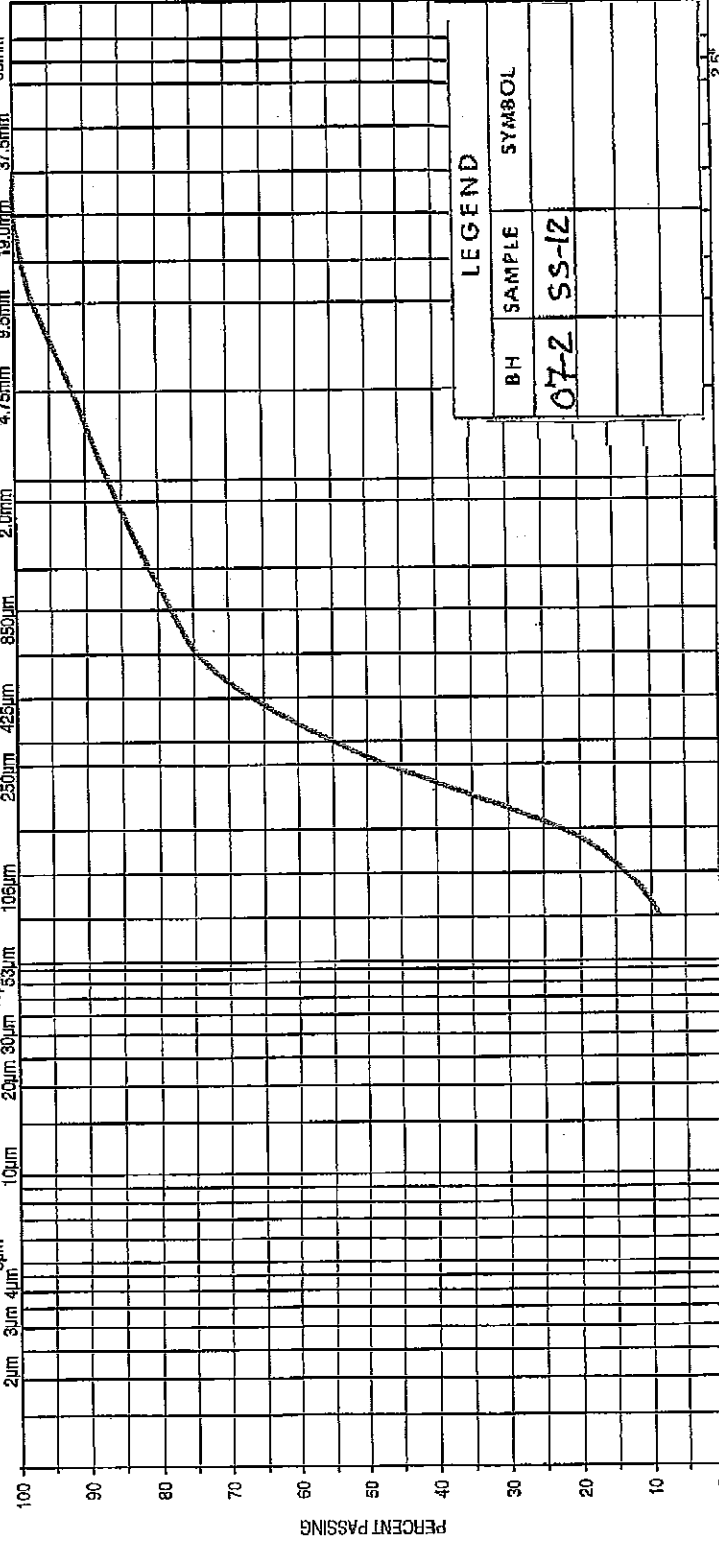
UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	

MINISTRY SIEVE DESIGNATION (Metric)

GRAIN SIZE IN MICROMETERS

2µm 3µm 4µm 5µm 10µm 20µm 30µm 40µm 50µm 60µm 75µm 100µm 150µm 200µm 250µm 300µm 425µm 600µm 850µm 1.18mm 1.8mm 2.36mm 4.75mm 9.5mm 19.0mm 26.5mm 37.5mm 53.0mm 75.0mm 85µm



LEGEND

BH	SAMPLE	SYMBOL
07-2	SS-12	

MINISTRY SIEVE DESIGNATION (Imperial)

1 2 3 4 5 10 20 30 40 50 60 70 80 100 150 200 250 300 400 500 600 750 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500 7000 7500 8000 8500 9000 9500 10000

GRAIN SIZE DISTRIBUTION

SAND TILL, some gravel

FIG No 6

W P 4010-05-00

Ministry of Transportation



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL		
	Fine	Medium	Coarse	Fine	Coarse	

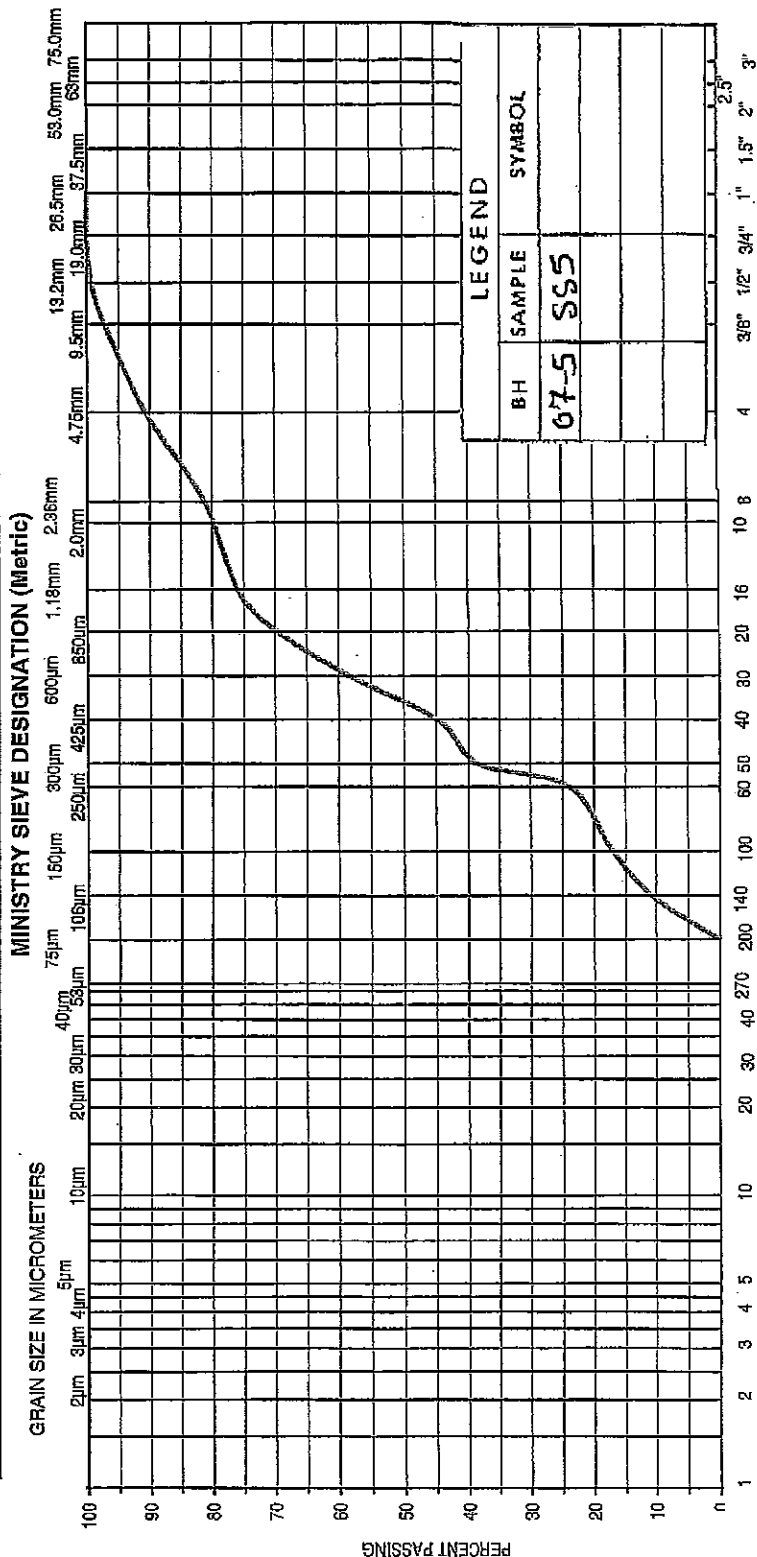


FIG No 7
W P 4010-05-00

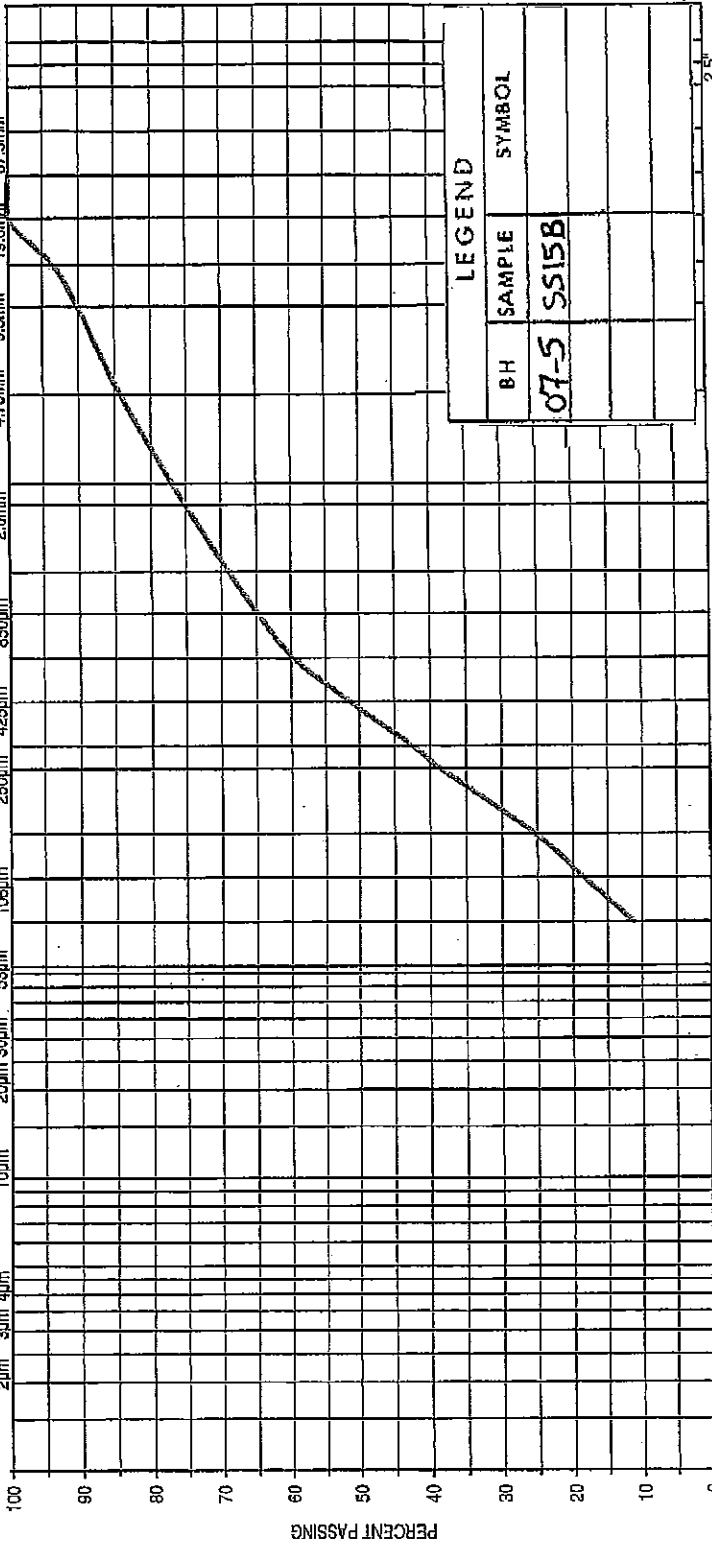
GRAIN SIZE DISTRIBUTION
SAND FILL, trace gravel & clay



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

GRAIN SIZE IN MICROMETERS
2µm 3µm 4µm 5µm 10µm 20µm 30µm 40µm 50µm 75µm 150µm 250µm 300µm 425µm 600µm 850µm 1.18mm 2.0mm 2.36mm 4.75mm 9.5mm 13.2mm 19.0mm 26.5mm 37.5mm 53.0mm 63.0mm 75.0mm



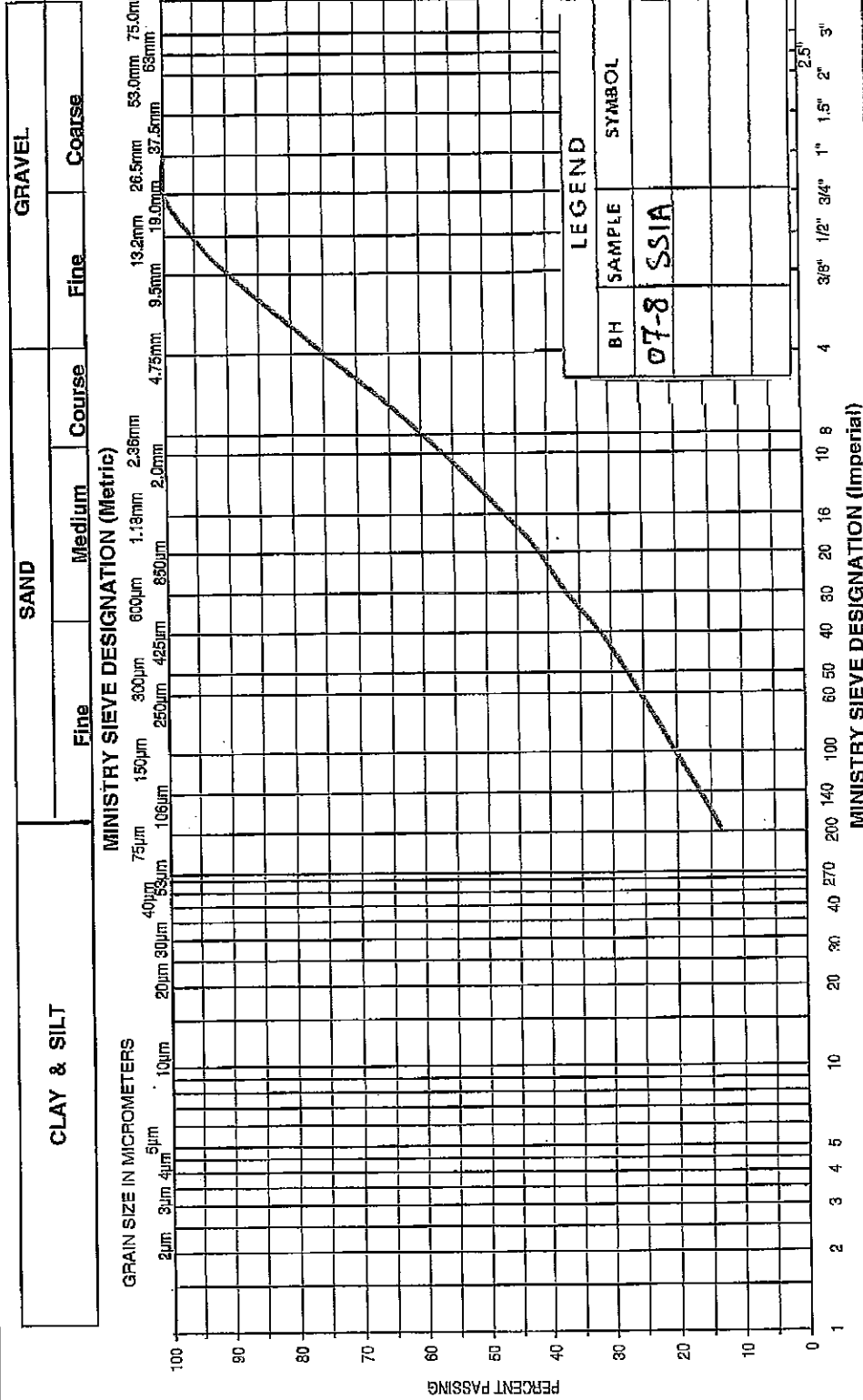
LEGEND	
BH	SYMBOL
07-5	SS15B


MINISTRY SIEVE DESIGNATION (Imperial)

FIG No 8
W P. 4010-05-00

GRAIN SIZE DISTRIBUTION
SAND TILL, some silt and gravel

UNIFIED SOIL CLASSIFICATION SYSTEM





Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

GRAVELLY SAND FILL

FIG No 9

W.P. 4010-05-00



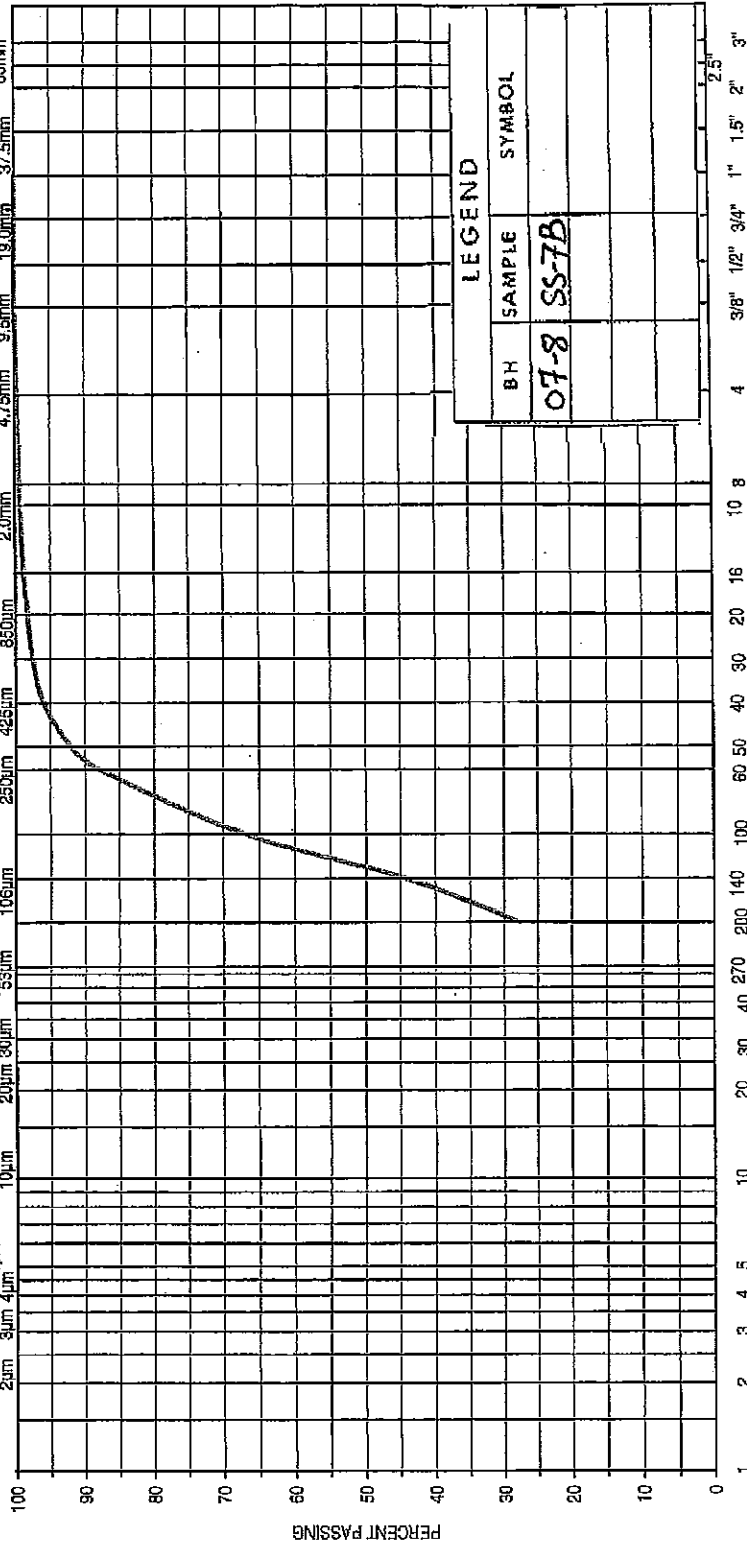
UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION (Metric)

GRAIN SIZE IN MICROMETERS

2µm	3µm	4µm	5µm	10µm	20µm	30µm	40µm	50µm	60µm	75µm	106µm	150µm	200µm	250µm	300µm	425µm	600µm	850µm	2.0mm	2.36mm	1.18mm	600µm	850µm	1.18mm	2.36mm	4.75mm	9.5mm	19.0mm	37.5mm	53.0mm	75.0mm
-----	-----	-----	-----	------	------	------	------	------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--------	--------	-------	-------	--------	--------	--------	-------	--------	--------	--------	--------



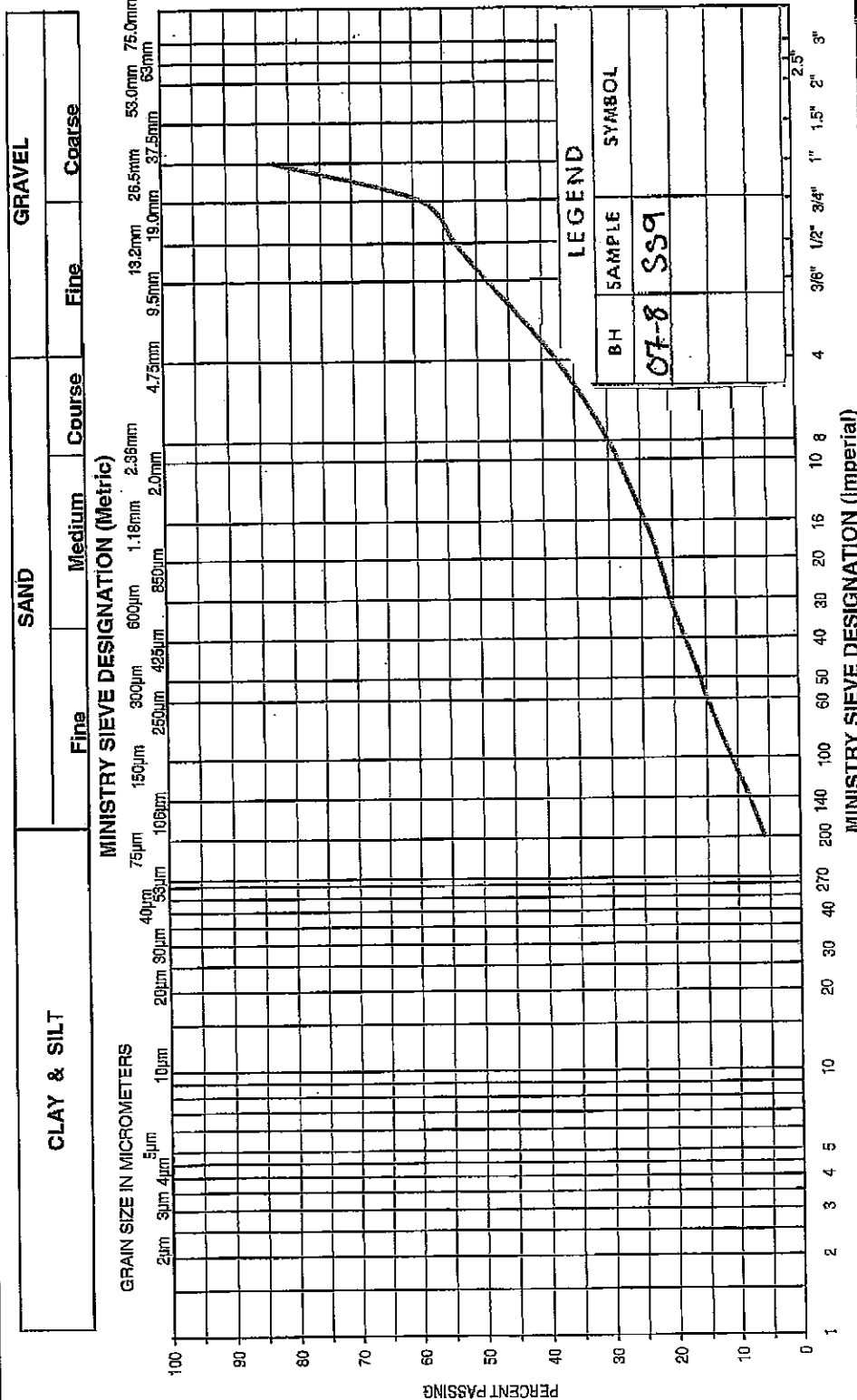
LEGEND	
BH	SYMBOL
07-8	SS-7B

MINISTRY SIEVE DESIGNATION (Imperial)

	GRAIN SIZE DISTRIBUTION	FIG No 10
		W P. 44010-05-00

SILTY SAND

UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM

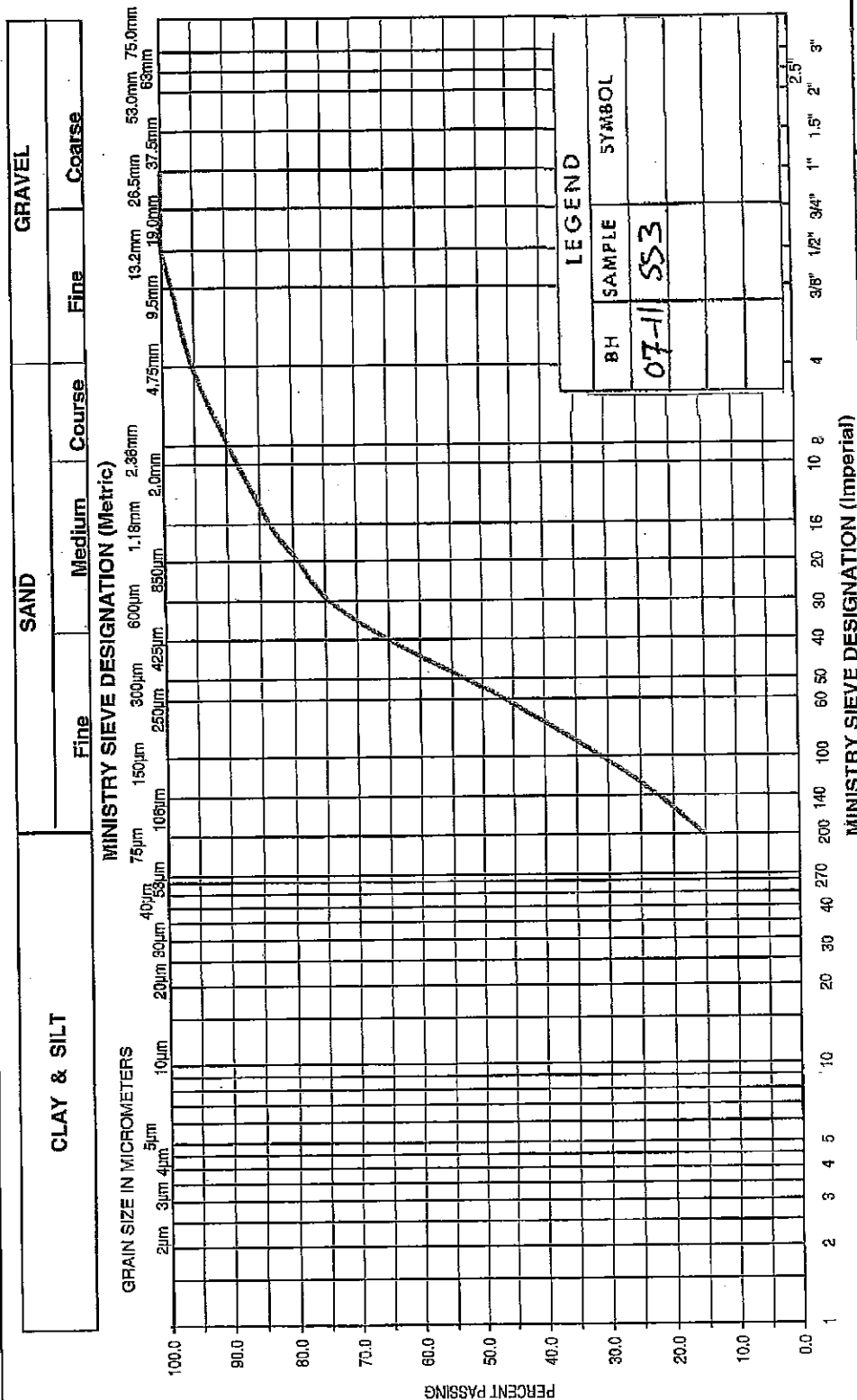


FIG No 12
W P 4010-05-00

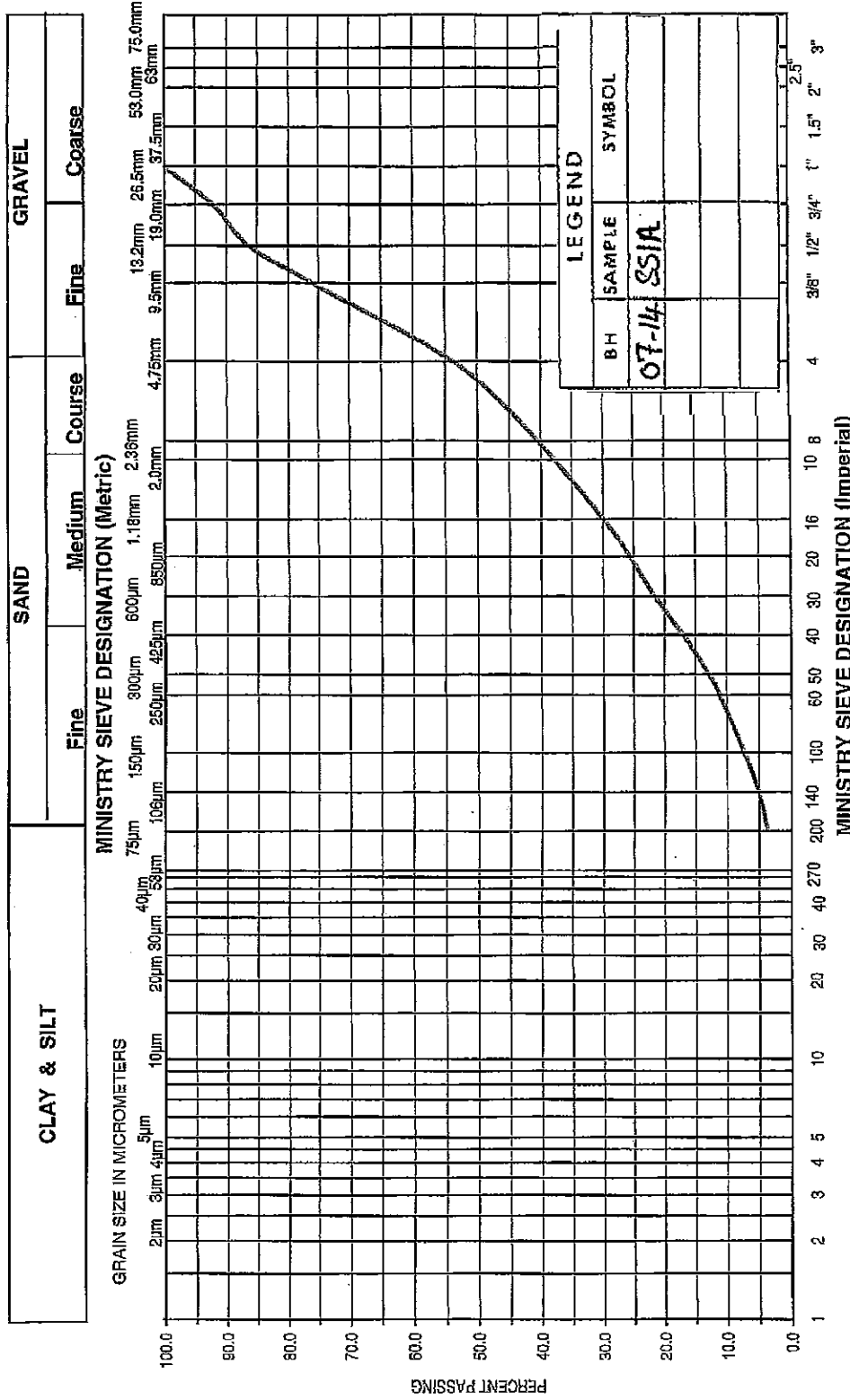
GRAIN SIZE DISTRIBUTION


SAND FILL, some silt trace gravel

Ministry of
Transportation



UNIFIED SOIL CLASSIFICATION SYSTEM



 Ministry of Transportation Ontario	GRAIN SIZE DISTRIBUTION SAND & GRAVEL FILL	FIG No 13 W.P. 40/0-05-00
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UNIFIED SOIL CLASSIFICATION SYSTEM

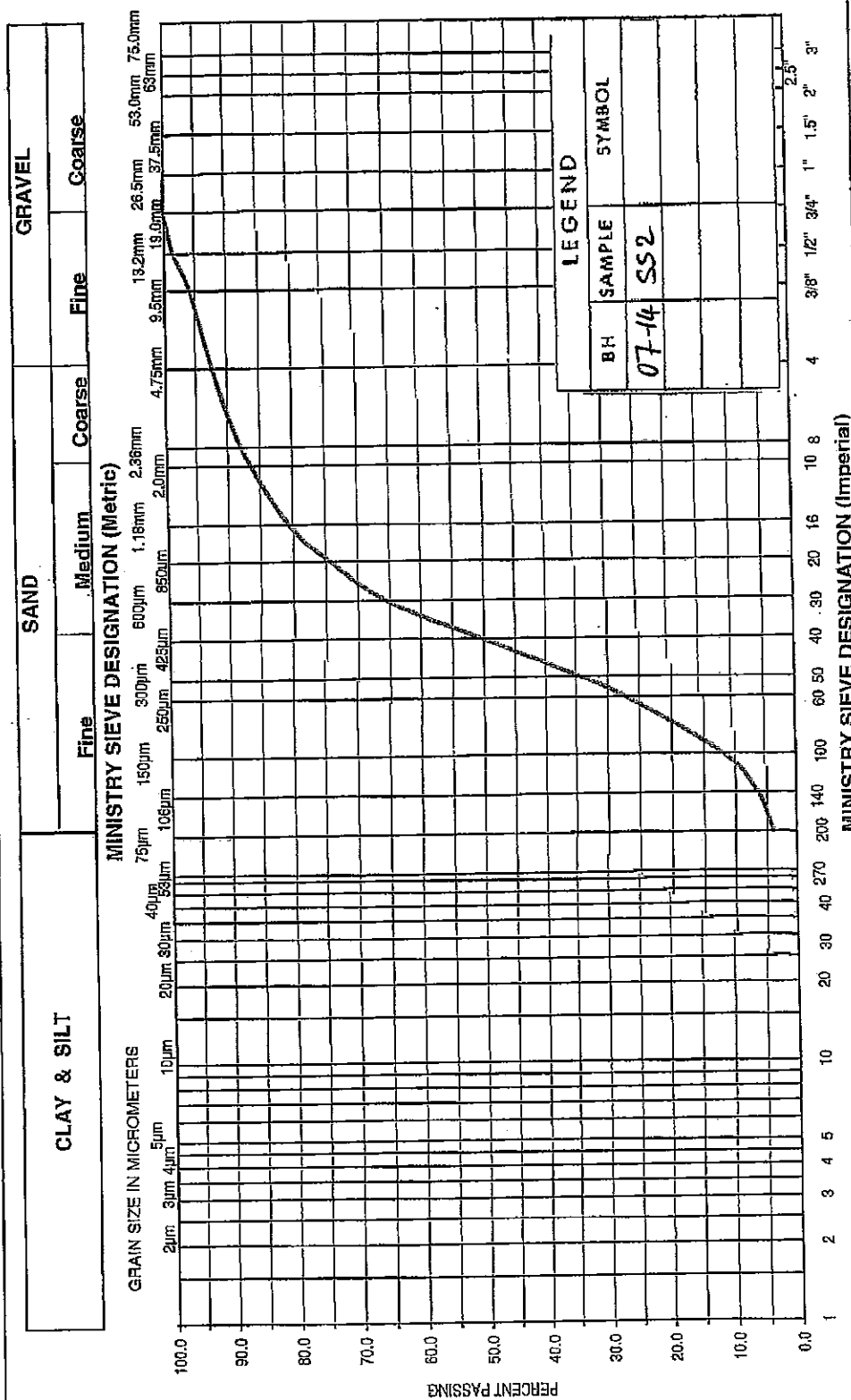


FIG No 14

W P 4016-05-00

GRAIN SIZE DISTRIBUTION

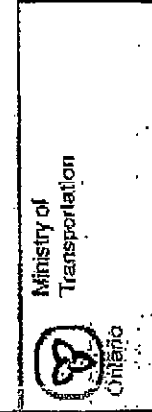
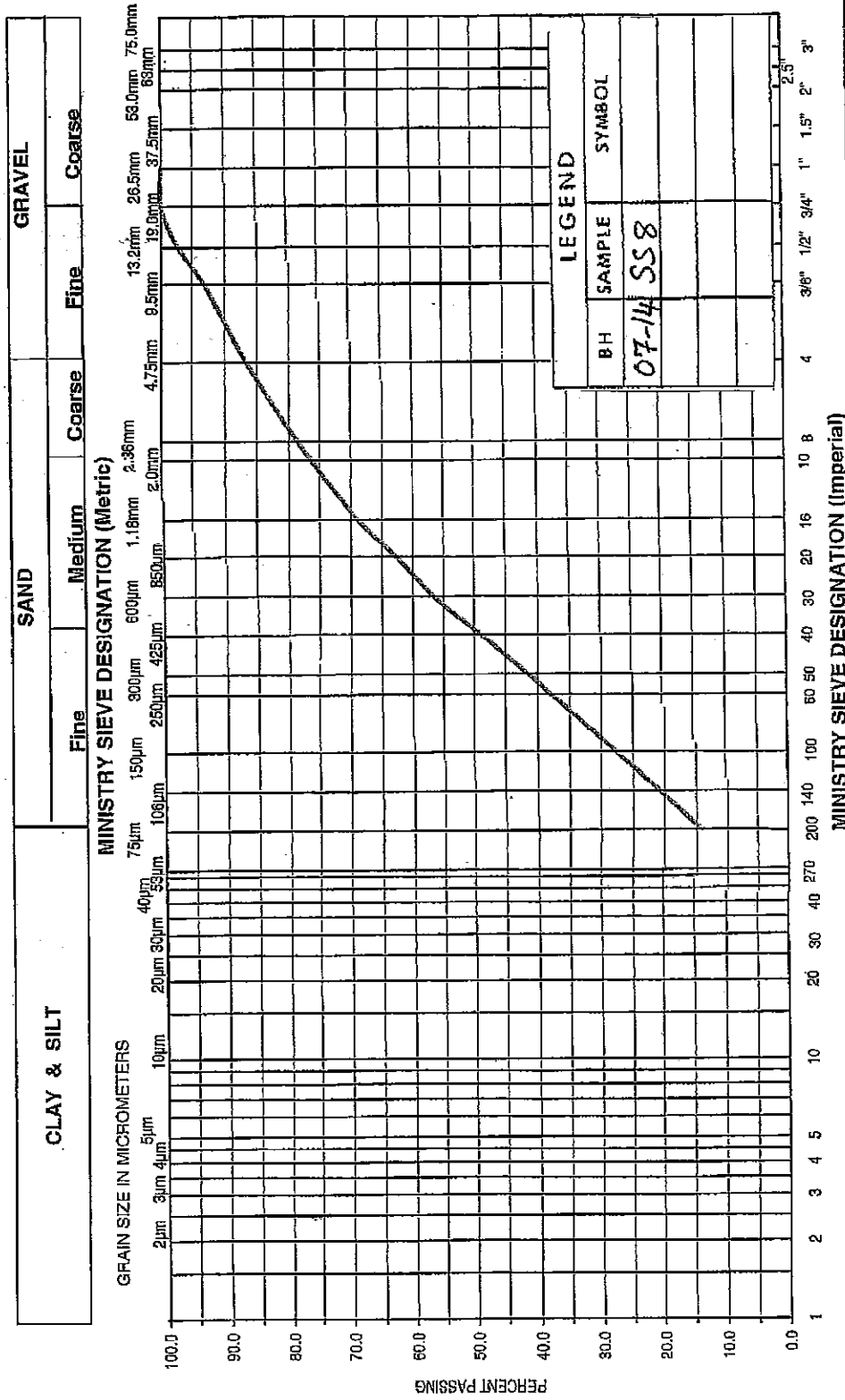
SAND FILL, trace silt & gravel

Ministry of
Transportation





UNIFIED SOIL CLASSIFICATION SYSTEM

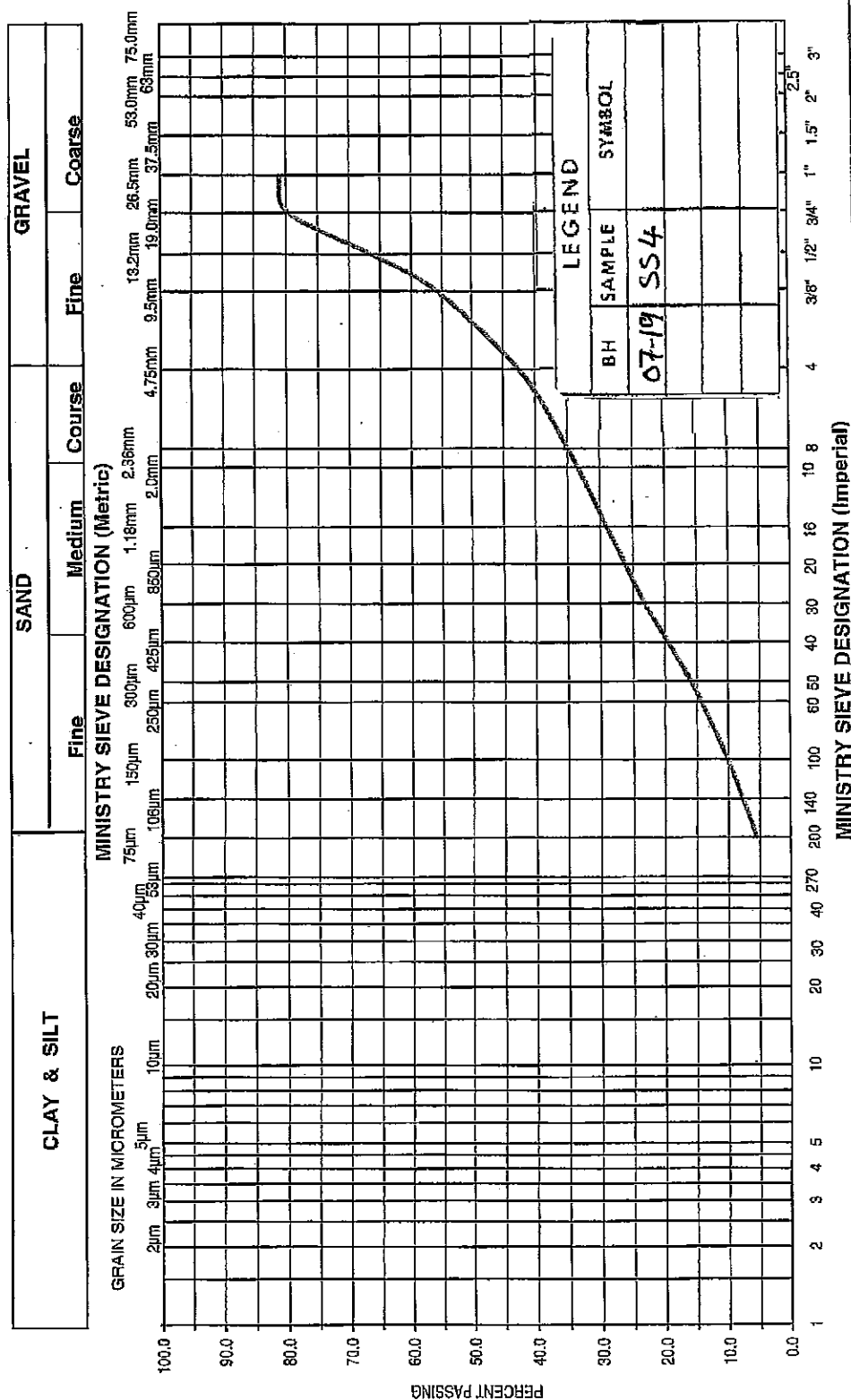


GRAIN SIZE DISTRIBUTION

SAND TILL, some silt & gravel

FIG No 15

W.P. 40/0-05-00

Ministry of
Transportation

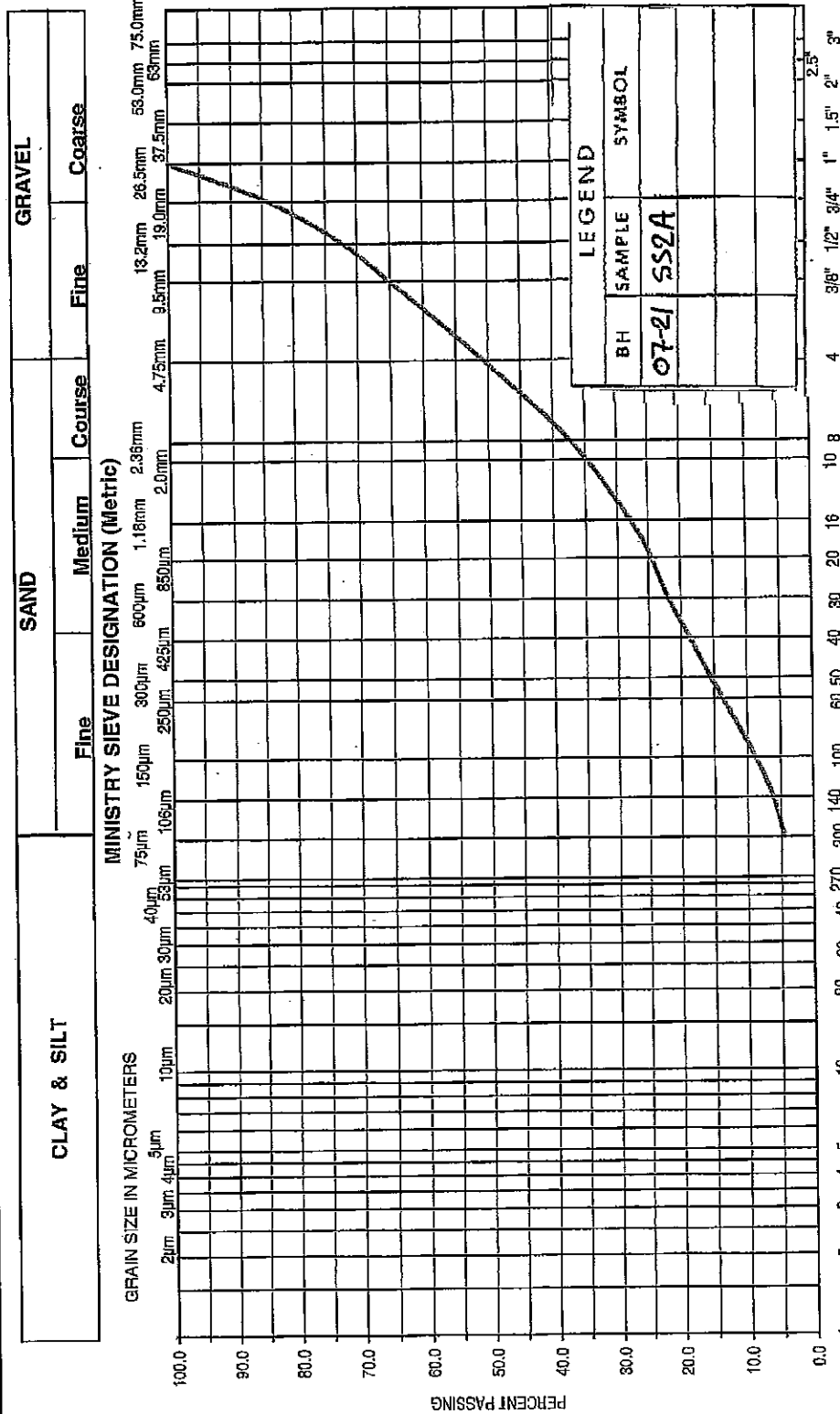
GRAIN SIZE DISTRIBUTION

SAND & GRAVEL TILL

FIG No 16

W.P. 4010-05-00

UNIFIED SOIL CLASSIFICATION SYSTEM



MINISTRY SIEVE DESIGNATION (Imperial)

**GRAIN SIZE DISTRIBUTION
SAND & GRAVEL FILL**

Ministry of
Transportation



FIG No 17

W P 401005-00

UNIFIED SOIL CLASSIFICATION SYSTEM

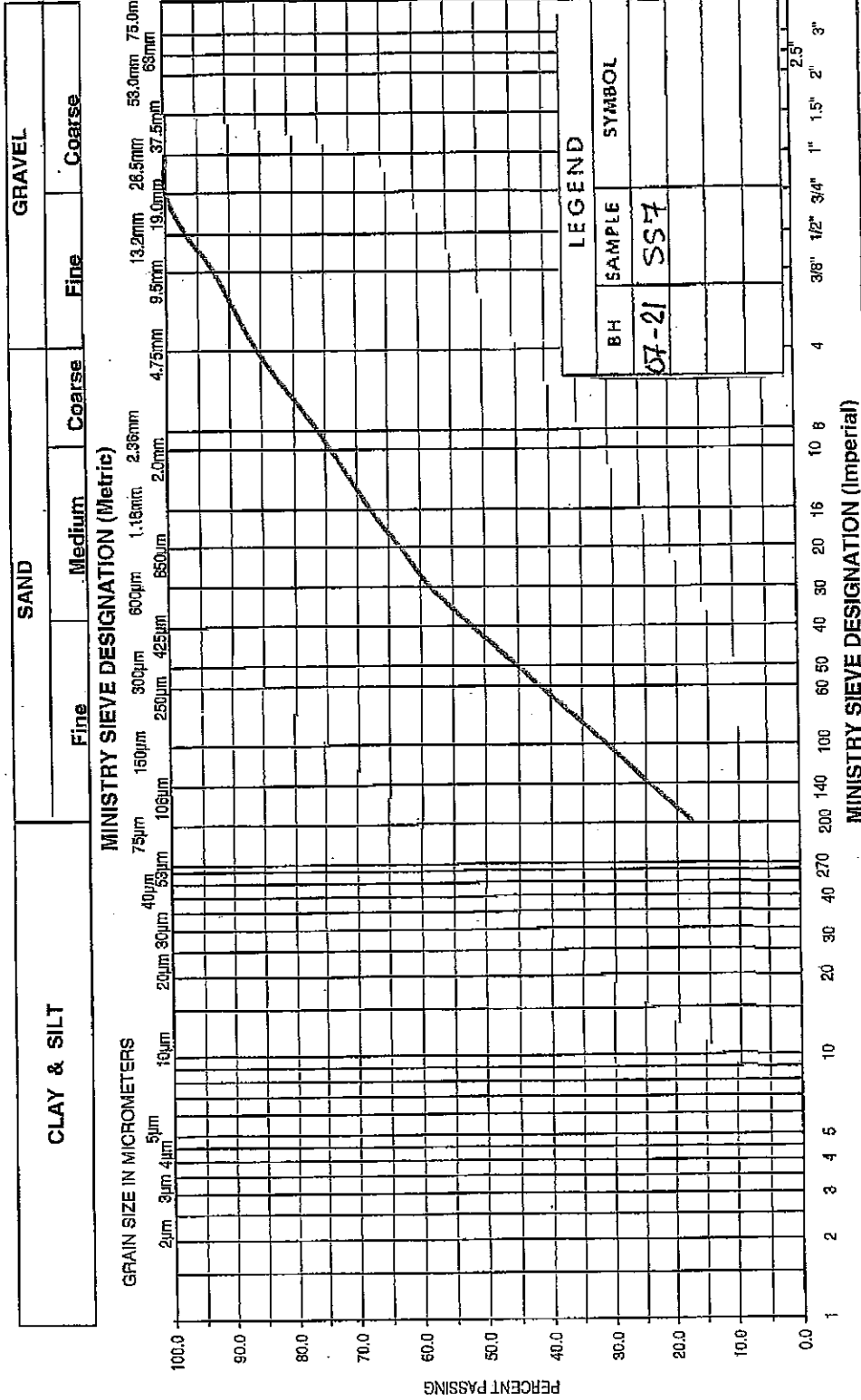


FIG No 18
W.P. 4010-05-00

GRAIN SIZE DISTRIBUTION
SAND TILL, some silt & gravel

Ministry of
Transportation



C.O.C.: 115166

REPORT No. B07-18124

Report To:

AMEC

300 - 210 Colonnade Road South

Nepean, Ontario, K2E 7L5

Attention: Wissam Farah

Caduceon Environmental Laboratories

2378 Holly Lane

Ottawa, Ontario, K1V 7P1

Tel: 613-526-0123

Fax: 613-526-1244

DATE RECEIVED: 25-Jun-07

DATE REPORTED: 29-Jun-07

SAMPLE MATRIX: Soil

JOB/PROJECT NO.: TZ71046-MTO

P.O. NUMBER:

WATERWORKS NO.

Parameter:	Chloride	Sulphate	pH	Resistivity	
Units:	µg/g	µg/g	pH Units	ohms-cm	
M.D.L.:	5	10			
Reference Method:	EPA 300.0	EPA 300.0	EPA 150.1	SM 2510	
Date Analyzed:	28-Jun-07	28-Jun-07	27-Jun-07	28-Jun-07	
Client I.D.	Sample I.D.	Date Collected			
BH07-20 SS4	B07-18124-1	22-Jun-07	646	230	8.17
BH07-21 SS4	B07-18124-2	22-Jun-07	104	230	8.52
BH07-19 SS2	B07-18124-3	22-Jun-07	306	350	8.61
BH07-1 SS4	B07-18124-4	22-Jun-07	876	250	8.80
BH07-3 SS6B	B07-18124-5	22-Jun-07	724	90	8.96
BH07-5 SS6B	B07-18124-6	22-Jun-07	821	250	8.55
BH07-5 SS3	B07-18124-7	22-Jun-07	177	60	9.45
BH07-7 SS8	B07-18124-8	22-Jun-07	171	70	8.89
BH07-10 SS4	B07-18124-9	22-Jun-07	224	150	9.27
BH07-12 SS6	B07-18124-10	22-Jun-07	1350	220	8.34
BH07-14 SS5	B07-18124-11	22-Jun-07	1730	140	8.13
BH07-14 SS8	B07-18124-12	22-Jun-07	356	120	9.00

K. Pipin

Krystyna Pipin, M. Sc.

Lab Supervisor

M.D.L. = Method Detection Limit

Accredited by the Standards Council of Canada and CAEL for specific tests.

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior written consent from Caduceon Environmental Laboratories.

APPENDIX D

NON-STANDARD SPECIAL PROVISIONS (NSSP)

NON STANDARD SPECIAL PROVISION (NSSP)

The following NSSP should be considered in the construction:

1. The soil conditions at the site contain cobbles / boulders which will have to be removed from the excavation for foundation and / or the augured holes for the post foundations.
2. It should also be noted that loose fill and sand materials were encountered during the investigation programme. Therefore, casing installation prior to auguring is recommended during the auguring process for the concrete caisson installation in order to protect sides of the augured hole from collapsing or caving in.

APPENDIX E

REPORT LIMITATIONS

REPORT LIMITATIONS

The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Geotechnical Engineer be retained during the construction to confirm that the subsurface conditions across the site do not deviate materially from those encountered in the testholes.

The design recommendations given in this report are applicable only to the project described in the text, and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

The comments made in this report relating to potential construction problems and possible methods of construction are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

The benchmark and elevations mentioned in this report were obtained strictly for use by this office in the geotechnical design of the project. They should not be used by any other party for any other purpose.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. AMEC Earth & Environmental accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

