



MERLEX ENGINEERING LTD.

CONSULTING GEOTECHNICAL ENGINEERS

FINAL FOUNDATION INVESTIGATION AND DESIGN REPORT

GWP 175-98-00 WP 5161-01-00

FOUNDATION AREA C

Highway 17, Township of Calvin

Culvert at Station 11+715

MEL Ref. No.: 05/07/05090-FC February 2006

Submitted to:

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MTO GEOCREs No. 31L-100



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1.0 INTRODUCTION

Merlex Engineering Ltd. (MEL) has been retained by Earth Tech (Canada) Inc., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation for WP 5161-01-00. The general work project (GWP 175-98-00) is located on Highway 17 from 0.2 km west of Highway 531 to 8.5 km east of Highway 630 for 26.4 km, within the Townships of Bonfield, Calvin and Papineau. Highway 17 is an undivided two lane Rural Arterial King's Highway (RAU110). Highway 17 intersects with Highway 417, approximately 24 km west of Kanata, and runs westerly a distance of 2,129 km to the Ontario/Manitoba Provincial Boundary, approximately 55 km west of Kenora. This east/west route forms part of the Trans Canada Highway system.

This foundation investigation location was not specified in the RFP/TPM documentation Agreement No. 5004-E-0053. However, a field review of the culverts located within the work project was carried out by Earth Tech and the MTO shortly after the commencement of this project and the culvert at this location was designated for replacement. Subsequently, a foundation investigation was requested for this culvert location. Although this culvert was not specified in the work, the terms of reference for the scope of work are similar to those outlined in MEL's proposal P-05-038 dated May 27, 2005. Originally, it was proposed to replace the culvert with a new culvert at the same location however, this was later changed to replacing the existing culvert, which is on a skew to the existing highway embankment, with a new culvert placed perpendicular to the highway. The new culvert will be rotated such that the south end remains relatively close to the south end of the existing culvert and, with the rotation, the culvert will cross the highway at approximately Station $\pm 11+700$. The purpose of the investigation was to determine the subsurface conditions at the location of a centerline culvert within a high fill embankment along the existing highway in order to provide detail design recommendations for replacement. This report addresses Foundation Area C, a centerline culvert located on



Highway 17, ± 11 km east of the junction of Highway 17 and Highway 531, in the Township of Calvin at Station $\pm 11+715$ (see Enclosure No. 2: Key Plan). MEL investigated the foundation area by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on selected samples. Based on the information recovered from this program and our interpretation of the conditions that were encountered at the subject site, we have provided recommendations on the geotechnical aspects of the culvert replacement, along with discussions on excavations, fills and embankment design.

The ETR plans and centerline profiles for Highway 17, in the area of the foundation investigation, were provided by Earth Tech (Canada) Inc. Prior to commencing the fieldwork, stations and offsets in the area of the foundation investigations were surveyed by others and this field data was incorporated in preparation of the plans and profiles presented in this report. The locations of the boreholes are referenced to chainage painted in the field and the borehole elevations were established relative to centerline grade. The plan and profile information for Foundation Area C is presented on Figure No. 1. Stratigraphic information contained on the noted figure is based on our evaluation of conditions encountered in the field.

2.0 SITE DESCRIPTION

The specific location of the centerline culvert on Highway 17 is Station $11+715$, Twp. of Calvin, east of the Town of Rutherglen, ± 11 km east of the junction of Highway 17 and Highway 531. At the time of this investigation, the culvert at this site consisted of a 1520 mm diameter x 55.4 m CSP. The inlet and outlet of the existing culvert are almost submerged (see Photos 1 and 2 in Appendix D).



2.1 Physiography and Surficial Geology

This Highway 17 project borders on the south limits of the geomorphic sub-provinces known as the Muskoka Ridges and Pockets, and the Algonquin Uplands and the north limit of the Eastern Sandy Uplands. The topography at the site is generally rolling. There are exposed bedrock ridges; at some locations significant layers of earth overburden overlay the bedrock. Within the project area overburden conditions consist primarily of sand containing varying amounts of silt, occasionally overlain by organic (peat) deposits.

The highway embankment is elevated above the surrounding topography in the investigation area by several meters. The land to the north and south of the highway is lowland grass and scrub brush with swampy areas and little or no trees. At the edges of the swamp area, the vegetation consists of predominantly mature deciduous and coniferous species.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out during the period of November 8 and 10, 2005, and December 13 and 19, 2005, and consisted of a total of eight (8) sampled boreholes.

The field investigation was carried out using a Bombardier mounted CME 45B drilling rig operated by Merlex Engineering Ltd. and under the supervision of Mr. E. Sullivan, of MEL. The drill rig is equipped with hollow stem augers and routine geotechnical sampling equipment. The boreholes were advanced using 165 mm O.D. continuous flight hollow stem augers or 110 mm O.D. continuous flight standard augers. Soil samples were obtained at regular intervals of depth using the standard 50 mm O.D. split spoon sampler advanced in accordance with the Standard Penetration Test (SPT) procedures and/or auger samples where applicable. In-situ vane testing, using an MTO "N" size vane, was carried out where appropriate and possible. Maximum exploration depth was 12.6 m by auger (Borehole No. C7).



Groundwater conditions in the open boreholes were observed during and immediately following completion of the individual boreholes and temporary standpipes were installed for the duration of the drilling operation. A set of water level observations were taken prior to removal of the temporary standpipes. All open boreholes were backfilled upon completion with the auger cuttings in the order they were removed, using reverse augering techniques. Where necessary, imported bentonite was used to seal the hole at grade.

The field work for this investigation was under the full time direction of a Senior member of our engineering staff, who was responsible for locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations, logging of the boreholes, labeling and preparation of samples for transport to our North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in our laboratory. Laboratory testing of select samples included natural water content determination, Atterberg Limits determination, grain size analysis (sieve and/or hydrometer), and specific gravity testing. The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix B) with a summary of select results presented on the laboratory sheets in Appendix C (Figures L-1 to L-4).

The location of the individual boreholes were established in the field using highway chainage and offset from centerline.

4.0 SUBSURFACE CONDITIONS

Details of subsurface conditions revealed by the investigation program are presented on the enclosed Record of Borehole Logs (Appendix B) and on Figure No. 1 (Appendix C). Please note that stratigraphic delineation presented on the borehole logs and soil strata plot are the results of non-continuous sampling, response to drilling progress, and the results of SPT, plus



field observations. Typically such boundaries represent transitions from one zone to another and are not an exact demarcation of specific geological unit. Additional consideration should be given to the fact that subsurface conditions may vary markedly between adjacent boreholes and beyond any specific boring location.

4.1 Foundation Area C: Culvert at 11+715, Calvin Twp.

A plan and profile showing the borehole locations and stratigraphic sequences is shown on Figure No. 1. During the course of our exploration program, eight (8) sampled boreholes were put down at this site (Borehole Nos. C1 to C8). BH Nos. C1 and C2, and BH Nos. C3, C4, and C7, were put down through the highway embankment on the south and north sides respectively. BH Nos. C5 and C6 were put down at the ends of the existing culvert on the south and north ends respectively. BH No. C8 was put down in the area of the outlet of the proposed new culvert.

4.1.1 Embankment

At the surface of BH Nos. C1 to C4, inclusive and BH No. C7, a layer of crushed gravel some 200 mm thick was penetrated. Underlying this surficial deposit, a fine to medium sand fill containing trace/some silt, trace/some gravel, and occasional cobbles and boulders was encountered. Standard Penetration "N" values recorded in conjunction with the split spoon sampling within this stratum returned values of 8 to 73 blows/0.3 m indicating a compactness of loose to very dense. It should be noted however that the higher "N" values were likely a result of the presence of occasional cobbles and/or boulders in the stratum and in general the compactness of the deposit is compact. Natural moisture content determinations carried out on samples obtained from this stratum indicated values of 4 to 25%. Gradation analyses was carried out on six samples of this deposit which indicated 4 to 28% gravel size particles, 53 to 87% sand size particles, and 7 to 13% silt and clay size particles. The specific distribution



curves can be found on the Summary of Laboratory Testing sheets (Appendix C, Figure No. L-1). The granular fill deposit was penetrated to depths below existing grade of 4.8, 4.5, 5.0, 5.2, and 6.7 m (elevations 214.7, 215.1, 214.7, 214.5, and 212.6 m) at BH Nos. C1, C2, C3, C4, and C7 respectively. A thin layer (i.e. 50 to 100 mm) of black fine fibrous peat was observed underlying the fill at BH Nos. C3 and C4.

Underlying the fill, a deposit of grey fine to medium sand trace/some silt trace gravel was penetrated. At BH Nos. C1, C3, and C7, seams of grey silty clay and/or grey silty fine sand were observed embedded in this deposit. Standard Penetration "N" values recorded in conjunction with the split spoon sampling within this stratum returned values of 1 to 9 blows/0.3 m indicating a compactness of very loose to loose. Natural moisture content determinations carried out on samples obtained from this stratum indicated values of 22 to 54%. The higher moisture contents were obtained from the seams of silty clay. Gradation analyses was carried out on four samples of this sand deposit which indicated 0 to 8% gravel size particles, 79 to 95% sand size particles, and 4 to 13% silt and clay size particles. Gradation analyses was carried out on one sample of this silty fine sand seam which indicated 1% gravel size particles, 70% sand size particles, and 29% silt and clay size particles. The specific distribution curves can be found on the Summary of Laboratory Testing sheets (Appendix C, Figure No. L-2). BH Nos. C3, C4, and C7 were terminated in this deposit at depths below existing grade of ± 9.7 , 9.8, and 12.6 m respectively (elevations ± 210.0 , 209.9, 206.7 m).

Underlying this sand stratum at BH Nos. C1 and C2, at depths of 9.1 and 8.6 m respectively (elevations ± 210.4 and 211.0 m), a deposit of grey silt with fine sand with clay was encountered. Standard Penetration "N" values recorded in conjunction with one split spoon sample within this stratum returned a value of 4 blows/0.3 m indicating a compactness of loose. Natural moisture content determinations carried out on samples obtained from this stratum indicated values of 27



to 38%. Gradation analysis was carried out on one sample of this silt deposit which indicated 0% gravel size particles, 25% sand size particles, 47% silt size particles, and 28% clay size particles. The specific distribution curve can be found on the Summary of Laboratory Testing sheets (Appendix C, Figure No. L-3). Atterberg Limits determinations carried out on one sample from this stratum indicates a CL (Inorganic Silty Clay of Low Plasticity) designation with a Plastic Limit of 17.5% and a Liquid Limit of 25.0% (Appendix C, Figure No. L-4). BH Nos. C1 and C2 were terminated in this deposit at depths below existing grade of ± 9.6 and 9.1 m respectively (elevations ± 209.9 and 210.5 m).

4.1.2 North and South of Embankment

As noted previously, BH No. C5 was advanced near the end of the existing culvert to the south of the embankment and BH No. C6 was advanced near the end of the existing culvert to the north of the embankment. BH No. C8 was put down in the area of the outlet of the proposed new culvert.

At BH No. 6, underlying approximately 200 mm of water, a deposit of peat was penetrated that extended to a depth of some 700 mm (elevation 215.2 m). This, in turn, was underlain by approximately 500 mm of organic silt and clay. Natural moisture content determinations carried out on samples of the peat and organic silt were in the order of 62% and 146 % respectively.

At BH No. 5, underlying some 50 mm of surficial organics, and underlying the organic silt at BH No. C6, a deposit of grey fine to medium sand trace/some silt, trace gravel was penetrated. Standard Penetration "N" values recorded in conjunction with split spoon samples within this stratum returned values ranging from 1 to 8 blows/0.3 m indicating a compactness of very loose to loose. Natural moisture content determinations carried out on samples obtained from this stratum indicated values of 26 to 33%.



Underlying the sand at BH No. C6, at a depth of some 3.2 m (elevation 212.7 m), a stratum of grey silty clay was penetrated. Natural moisture content determination carried out on one sample obtained from this stratum indicated a value of 45%. An in-situ vane shear test carried out in this layer returned a value of 44 kPa.

Underlying the silty clay stratum at BH No. C 6 and the sand at BH No. C5, a deposit of grey silty fine sand was penetrated. The sand content in this deposit was found to decrease with depth and, as such, a gradual change to grey silt some fine sand occurred with depth. Standard Penetration “N” values recorded in conjunction with split spoon samples within this stratum returned values ranging from 0 (weight of hammer) to 12 blows/0.3 m indicating a compactness of very loose to compact. Natural moisture content determinations carried out on samples obtained from this stratum indicated values of 21 to 31%. BH Nos. C5 and C6 were both terminated in this deposit at a depth of 11.1 m below existing grade (elevation 203.8 and 204.8 m respectively).

At BH No. 8, underlying approximately 100 mm of water, a thin layer of silty organics some 200 mm thick was observed. The organics were underlain by 200 mm of fine to medium sand. At a depth of 500 mm a deposit of grey silty clay with fine sand was encountered. Natural moisture content determinations carried out on a sample obtained from this stratum indicated a value of 52%. Atterberg Limits determinations carried out on one sample from this stratum indicated a CI (Inorganic Silty Clay of Medium Plasticity) designation with a Plastic Limit of 25.5% and a Liquid Limit of 43.0% (Appendix C, Figure No. L-4). BH C8 was terminated in this deposit at a depth of 3.0 m below existing grade (elevation 212.3 m).



4.2 Groundwater Conditions

Groundwater levels in the open boreholes were taken during the advance of the individual borings and upon completion. Temporary standpipes were installed in BH Nos. C1 and C3. Groundwater levels and cave-in depths are summarized on the individual Record of Borehole Log Sheets (Appendix B).

The groundwater level was measured in the temporary standpipes at elevations ranging between ± 215.5 to 215.7 m (i.e. ± 4 m below the existing embankment). The groundwater level was measured in BH No. C5 at elevation ± 214.5 m some 3.5 hours post completion of the boring. There was water at the surface of BH Nos. C6 and C8 (elevations ± 215.9 and 215.3 m respectively).

Groundwater levels will fluctuate seasonally. In general, the groundwater levels are higher in the spring during the spring melt and runoff and during the fall rainy season. Typically, the groundwater levels in this area will be at their lowest in mid to late summer.

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5.0 DESIGN COMMENTS AND RECOMMENDATIONS

5.1 General

This foundation investigation location was not specified in the RFP/TPM documentation Agreement No. 5004-E-0053. However, a field review of the culverts located within the work project was carried out by Earth Tech and the MTO shortly after the commencement of this project and the culvert at this location was designated for replacement. Subsequently, a foundation investigation was requested for this culvert location. Originally, it was proposed to replace the existing culvert with a new culvert at the same location. This proposal was later changed to replacing the existing culvert, which is on a skew to the existing highway embankment, with a new culvert placed perpendicular to the highway. This would result in a shorter culvert as well as allowing the use of the existing culvert during construction to help control the flow of water. The new culvert will be rotated such that the south end remains relatively close to the south end of the existing culvert and, with the rotation, the new culvert will cross the highway at approximately Station $\pm 11+700$.

This section of the report provides our recommendations on the foundation aspects of design for the culvert. A foundation investigation was carried out at this location to obtain sufficient subsurface information to verify design assumptions and provide adequate subsurface descriptions to provide recommendations for culvert replacement. It must be noted that the interpretations and recommendations are intended only for use by the design engineer. Where comments are made on construction they are provided only in order to highlight those aspects that could affect the design of the project. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction method and scheduling.



5.2 Existing Conditions

At the culvert location, the embankment is approximately ± 4.5 m higher than the natural ground surface to the south of the embankment (i.e. BH No. C5) and ± 4 m higher than the land to the north of the culvert (i.e. area of BH No. C8). Based on the embankment cross section through the culvert location provided by ET, the north side of the embankment has a slope of 2.7H:1V. The south side of the embankment has a slope of 2.1H:1V. Visual observations indicate these embankment slopes are stable. Based on our soils exploration program in the vicinity of this culvert, the embankment consists of granular fill generally overlying a deposit of sand. The sand was found to have a varying silt content and occasional seams of silty clay and silty fine sand. The silt content was found to increase with depth and the deposit gradually changed to silt with sand. To the north of the embankment, in the area of BH No. C8, a deposit of silty clay with sand was penetrated.

This culvert location was labeled as Foundation Area C. The existing culvert section is a corrugated steel pipe 1520 mm in diameter by 55.4 m long. No significant structural problems, other than aging, have been reported at this culvert system. The new culvert will be the same diameter as the existing culvert however, will be shorter due to the proposed change in alignment. The culvert is located in an area with a passing lane. It is proposed to use the wider embankment at this location to allow continual flow of traffic during the replacement operations. The culvert replacement will be carried out as a continuous operation and, if necessary, traffic will be controlled by traffic control personnel. At times, traffic flow may be reduced to one lane. It is anticipated the operation will be completed in one day. No embankment construction for a detour will be required. The wider embankment in this area will allow the slopes of open excavations to be cut back to the geometry required by the OHSA. As such, a roadway protection system (i.e. shoring, etc.) is not anticipated. Although not anticipated, sliver widening may be required to maintain the minimum required lane width during culvert replacement. A



typical detail will be provided in the contract. The vertical alignment at the culvert and along the embankment will essentially remain constant, or increase slightly (order of ± 100 mm or less), to allow for proposed highway improvements.

The invert of the existing culvert is at approximately elevation ± 213.9 m. As such, it appears that the new culvert, which will have the invert at a similar elevation, will be bedded in the granular embankment fill.

Based on visual observations, the existing embankment is stable and does not exhibit any signs of distress that would indicate problems with settlement or embankment slippage. Frost heaving has not been reported at this location.

5.3 Culvert Design Comments

This culvert can be replaced using trench reinstatement and standard bedding. As noted, it appears that the existing culvert is bedded in the granular embankment fill. Based on the OHSA Construction Regulations, this soil is classified as Type 3. Temporary open excavations in this type of soil will be stable at an angle of 1H:1V with proper groundwater control. All excavations must be sloped or shored in accordance with the OHSA.

Based on the results of gradation analysis of the existing embankment materials, frost tapers will not be necessary.

The purpose of this culvert is equalization between the swamps located to the north and south of the highway embankment. Flow rates through the culvert are low. The culvert will be embedded at a minimum depth below stream bottom of 10% of culvert diameter. The ends of the culvert (inlet and outlet) should be provided with rip rap (OPSS 511) to protect the slope



face from erosion at the intersection with the culvert and to reduce/eliminate the development of flow paths along the outside face of the culvert and the resultant risk of internal erosion within the embankment. A Class II Geotextile with an F.O.S. of between 50 to 100 μm should be used below the rock protection layer as this material will be used elsewhere on the project.

The culvert replacement must be carried out "in the dry". As noted, the new culvert will be installed perpendicular to the highway alignment and the existing culvert will be used during the replacement operation to control the flow of water. At the time of this investigation, the groundwater below the embankment was measured at elevation ± 215.5 m. Ultimately, groundwater control during construction is the responsibility of the contractor and may vary depending upon their method of operation, equipment, scheduling, etc. It is anticipated that a cofferdam of sand bags may be constructed around the ends of the culvert, to separate the culvert replacement operation from the swamps. It should then be possible to dewater and control any groundwater seepage through pumping from a number of strategically placed filtered sump holes, located in the base of the excavation outside the area of influence of the replacement operation. Dewatering should be carried out with reference to OPSS 517.

Embedment material for flexible culverts shall be Granular 'B' Type I. Bedding for rigid pipe culverts shall be Granular 'A'; cover material shall be Granular 'B' Type I. Generally the embedment, or cover and bedding thicknesses, shown in the OPSD 800 series will be sufficient.

Culvert backfill material may be either granular materials or native materials, depending on the site conditions. If native backfill is used, it must be replaced in the same order in which it was removed. If at the time of construction it is found that the native earth backfill material cannot be properly placed and compacted, granular backfill may be used. If the native material is not used, culvert backfill material should be Granular 'B' Type I.



The embankment fill materials are generally sandy in nature. The upper portion of the embankment fill consisted of sands acceptable as OPSS Granular B Type I or SSM and, as such, have a low susceptibility to surficial erosion. No special erosion protection measures are required. Newly exposed earth cut slopes should be covered with top soil and seeded as soon as practical.

Once the new culvert is installed and is operational, the old culvert must be properly decommissioned. If the old culvert is left in place it should be filled with non-shrink fill (i.e. grout) to prevent the culvert from collapsing in the future resulting in potential settlement in the highway embankment. Alternatively, the old culvert can be removed. Backfill to the trench post removal of the culvert can either be native materials, provided they are at an appropriate moisture content to allow for compaction, or alternatively, Granular B Type I can be used.

Based on the MTO Manual, Aspects of Prolonged Exposure of Pavements to Sub-Zero Temperatures, the depth of frost penetration used for design on this project shall be 2.0 m. The actual frost depth may vary.

The reconstruction of the pavement structure is detailed in the Pavement Design Report produced for this work project by Merlex Engineering Ltd. under separate cover.



6.0 CLOSURE

Information provided in this report is valid only at the locations described above. Any assumptions of continuity of soil stratigraphy between boreholes, as shown on the enclosed cross-sections, is intended as an aid for design purposes only and does not constitute a statement of existing conditions for contractual or construction purposes.

Details of the investigation, the material analysis and recommendation in this report are considered to be complete. However, should any questions arise, please do not hesitate to contact the undersigned.

MERLEX ENGINEERING LTD.

M. A. Merleau, P. Eng.
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APPENDIX A

Enclosure No. 1: List of Abbreviations and Symbols

Enclosure No. 2: Key Plan



LIST OF ABBREVIATIONS & DESCRIPTION OF TERMS

The abbreviations and terms, used to describe retrieved samples and commonly employed on the borehole logs, on the figures and in the report are as follows:

1. ABBREVIATIONS

AS	Auger Sample
CS	Chunk Sample
DS	Denison type sample
FS	Foil Sample
HB	Hammer Bouncing
NFP	No Further Progress
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
RC	Rock core with size & percentage of recovery
SS	Split Spoon
ST	Slotted Tube
TO	Thin-walled, open
TP	Thin-walled, piston
WH	Sampler Advanced by static weight (weight of hammer and/or rods)
WS	Wash Sample

2. PENETRATION RESISTANCE/"N"

Dynamic Cone Penetration Test (DCPT):

A continuous profile showing the number of blows for each 300 mm of penetration of a 50 mm diameter 90° point cone driven by a 63 kg hammer falling 760 mm.

Plotted as 

Standard Penetration Test (SPT) or "N" Values

The number of blows of a 63 kg hammer falling 760 mm required to advance a 50 mm O.D. drive open sampler 300 mm.

3. SOIL DESCRIPTION

a) *Cohesionless Soils:*

"N" (blows/0.3 m)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

3. SOIL DESCRIPTION (Cont'd)

b) *Cohesive Soils:*

Undrained Shear Strength (kPa)	Consistency
Less than 12	very soft
12 to 25	soft
25 to 50	firm
50 to 100	stiff
100 to 200	very stiff
over 200	hard

c) *Method of Determination of Undrained Shear Strength of Cohesive Soils:*

+ 3.2 - Field Vane test in borehole.
The number denotes the sensitivity to remoulding.

D - Laboratory Vane Test

.. - Compression test in laboratory

For a saturated cohesive soil the undrained shear strength is taken as one-half of the undrained compressive strength.

4. TERMINOLOGY

Terminology used for describing soil strata is based on the proportion of individual particle sizes present in the samples (please note that, with the exception of those samples subject to a grain-size analysis, all samples were classified visually and the accuracy of visual examination is not sufficient to determine exact grain sizing):

Trace, or occasional	Less than 10%
Some	10 to 20%
With	20 to 30%
Adjective (i.e. silty or sandy)	30 to 40%
And (i.e. sand and gravel)	40 to 60%

5. LABORATORY TESTS

P	Standard Proctor Test
A	Atterberg Limit Test
GS	Grain Size Analysis
H	Hydrometer Analysis
C	Consolidation

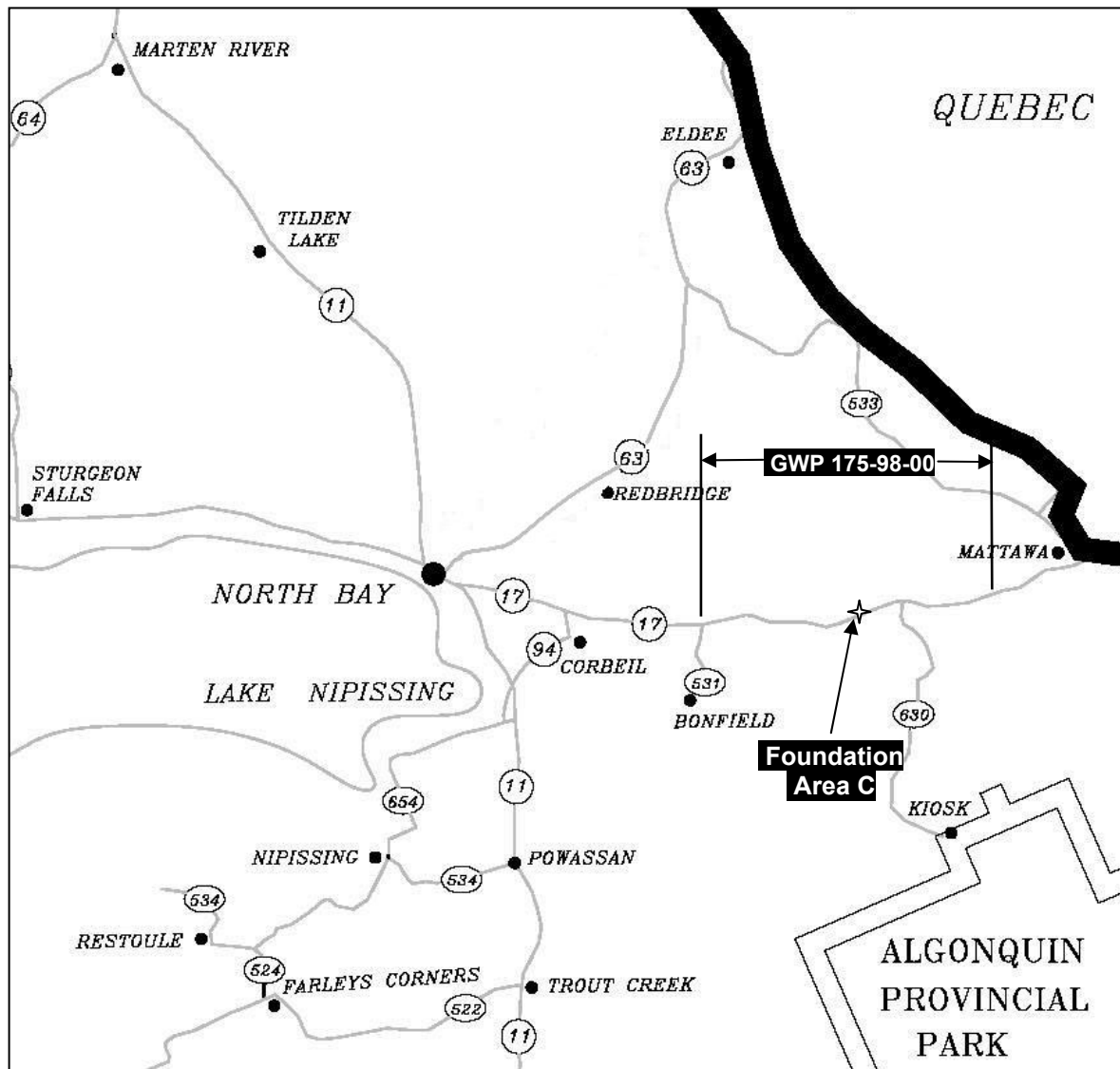


SAMPLE DESCRIPTION NOTES:

1. **FILL:** The term fill is used to designate all man-made deposits of natural soil and/or waste materials. The reader is cautioned that fill materials can be very heterogeneous in nature and variable in depth, density and degree of compaction. Fill materials can be expected to contain organics, waste materials, construction materials, shot rock, rip-rap, and/or larger obstructions such as boulders, concrete foundations, slabs, abandoned tanks, etc.; none of which may have been encountered in the borehole. The description of the material penetrated in the borehole therefore may not be applicable as a general description of the fill material on the site as boreholes cannot accurately define the nature of fill material. During the boring and sampling process, retrieved samples may have certain characteristics that identify them as 'fill'. Fill materials (or possible fill materials) will be designated on the Borehole Logs. If fill material is identified on the site, it is highly recommended that testpits be put down to delineate the nature of the fill material. However, even through the use of testpits defining the true nature and composition of the fill material cannot be guaranteed. Fill deposits often contain pockets or seams of organics, organically contaminated soils or other deleterious material that can cause settlement or result in the production of methane gas. It should be noted that the origins and history of fill material is frequently very vague or non-existent. Often fill material may be contaminated beyond environmental guidelines and the material will have to be disposed of at a designated site (i.e. registered landfill). Unless requested or stated otherwise in this report, fill material on this site has not been tested for contaminants however, environmental testing of the fill material can be carried out at your request. Detection of underground storage tanks cannot be determined with conventional geotechnical procedures.
2. **TILL:** The term till indicates a material that is an unstratified, glacial deposit, heterogeneous in nature and, as such, may consist of mixtures and pockets of clay, silt, sand, gravel, cobbles and/or boulders. These heterogeneous deposits originate from a geological process associated with glaciation. It must be noted that due to the highly heterogeneous nature of till deposits, the description of the deposit on the borehole log may only be applicable to a very limited area and therefore, caution must be exercised when dealing with a till deposit. When excavating in till, contractors may encounter cobbles/boulders or possibly bedrock even if they are not indicated on the borehole logs. It must be appreciated that conventional geotechnical sampling equipment does not identify the nature or size of any obstruction.
3. **BEDROCK:** Auger refusal may be due to the presence of bedrock, but possibly could also be due to the presence of very dense underlying deposits, boulders or other large obstructions. Auger refusal is defined as the point at which an auger can no longer be practically advanced. It must be appreciated that conventional geotechnical sampling equipment does not differentiate between nature and size of obstructions that prevent further penetration of the boring below grade. Bedrock indicated on the borehole logs will be labeled 'possibly' or 'probable' etc. based on the response of the boring and sampling equipment, surrounding topography, etc. Bedrock can be proven at individual borehole locations, at your request, by diamond core drilling operations or, possibly, by testpits. It must also be appreciated that bedrock surfaces can be, and most times are, very erratic in nature (i.e. sheer drops, isolated rock knobs, etc.) and caution must be used when interpreting subsurface conditions between boreholes. A bedrock profile can be more accurately estimated, at the clients' request, through a series of closely positioned unsampled auger probes combined with core drilling.
4. **GROUNDWATER:** Although the groundwater table may have been encountered during this investigation and the elevation noted in the report and/or on the record of boreholes, it must be appreciated that the elevation of the groundwater table will fluctuate based upon seasonal conditions, localized changes, erratic changes in the underlying soil profile between boreholes, underlying soil layers with highly variable permeabilities, etc. These conditions may affect the design and type and nature of dewatering procedures. Cave-in levels recorded in borings give a general indication of the groundwater level in cohesionless soils however, it must be noted that cave-in levels may also be due to the relative density of the deposit, drilling operations etc.

KEY PLAN

Enclosure No. 2



↑
Not to Scale

DRAFT FOUNDATION INVESTIGATION AND DESIGN REPORT

GWP 175-98-00 WP 5161-01-00 - FOUNDATION AREA C
Highway 17, Township of Calvin
Culvert at Station 11+715

MEL Reference No. 05/07/05090-FC

January 2006



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CONSULTING GEOTECHNICAL ENGINEERS

APPENDIX B

Enclosure Nos. 3 to 10: Record of Borehole Sheets

METRIC**RECORD OF BOREHOLE No. C1**

REFERENCE 05/07/05090-FC DATUM Geodetic LOCATION 11+709.2 4.8 m Rt - Calvin Twp. ORIGINATED BY ELS
 PROJECT Hwy 17 - GWP-175-98-00 / WP-5161-01-00 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DVL
 CLIENT Earth Tech (Canada) DATE (Started/Completed) 8/11/05 - 8/11/05 TIME 3:40:00 PM CHECKED BY JRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)											
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES									WATER CONTENT (%) 20 40 60										
219.5	Ground Surface																							
0.0	200 mm Crushed Gravel																							
	SAND FILL																							
	Brown Fine to Medium Sand trace Gravel Trace/Some Silt Occasional Cobbles/Boulders		1	AS																				
	Asphalt and Crushed Gravel Layer at ±1.8																							
	(Compact)		2	SS	23																			
			3	SS	31																			
			4	SS	73																			
	150 mm Black Silty Organics																							
214.7			5	SS	3																			
4.8	SAND																							
	Grey Fine to Medium Sand Trace/Some Silt trace Gravel with Seams of Grey Silty Clay and Grey Silty Sand																							
	(Very Loose/Loose)		6	SS	3																			
			7	SS	4																			
210.4																								
9.1	SILT																							
	Grey Silt with Fine Sand with Clay		8	SS	4																			
209.9																								
9.6	End of Borehole																							
COMMENTS Temporary standpipe installed to 9.71m. Standpipes removed on completion of the field drilling program.(Nov 16,2005) The stratification lines represent approximate boundaries. The transition may be gradual.								+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE		WATER LEVEL RECORDS <table border="1"> <thead> <tr> <th>Date (yy/mm/dd)/Time</th> <th>Water Depth (m)</th> <th>Cave In (m)</th> </tr> </thead> <tbody> <tr> <td>1) 8/11/05 4:50:00 PM</td> <td>4.1</td> <td>-</td> </tr> <tr> <td>2) 16/11/05 2:00:00 PM</td> <td>4</td> <td>-</td> </tr> <tr> <td>3)</td> <td>-</td> <td>-</td> </tr> </tbody> </table>			Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)	1) 8/11/05 4:50:00 PM	4.1	-	2) 16/11/05 2:00:00 PM	4	-	3)	-	-
Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)																						
1) 8/11/05 4:50:00 PM	4.1	-																						
2) 16/11/05 2:00:00 PM	4	-																						
3)	-	-																						

MEL-GEO 05090-FC.GPJ MEL-GEO.GDT 5/5/06

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METRIC**RECORD OF BOREHOLE No. C2**

REFERENCE 05/07/05090-FC DATUM Geodetic LOCATION 11+713.4 4.8 m Rt - Calvin Twp. ORIGINATED BY ELS
 PROJECT Hwy 17 - GWP-175-98-00 / WP-5161-01-00 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DVL
 CLIENT Earth Tech (Canada) DATE (Started/Completed) 8/11/05 - 8/11/05 TIME 4:55:00 PM CHECKED BY JRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)												
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES																				
219.6 0.0	Ground Surface 200 mm Crushed Gravel SAND FILL Brown Fine to Medium Sand trace Gravel Trace/Some Silt Occasional Cobbles/Boulders (Compact)		1	AS									10 82 (8)												
			2	SS	15																				
			3	SS	8																				
215.1 4.5	SAND Brown to Grey(at ±6.0m) Fine Medium Sand trace Gravel Trace/Some Silt (Very Loose/Loose)		4	SS	1																				
			5	SS	5																				
			6	SS	7																				
211.0 8.6	SILT Grey Silt with Fine Sand with Clay		7	AS									0 25 47 28												
210.5 9.1	End of Borehole																								
COMMENTS								+ ³ , × ³ : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE																	
								WATER LEVEL RECORDS <table border="1"> <thead> <tr> <th>Date (yy/mm/dd)/Time</th> <th>Water Depth (m)</th> <th>Cave In (m)</th> </tr> </thead> <tbody> <tr> <td>1)</td> <td>-</td> <td>-</td> </tr> <tr> <td>2)</td> <td>-</td> <td>-</td> </tr> <tr> <td>3)</td> <td>-</td> <td>-</td> </tr> </tbody> </table>						Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)	1)	-	-	2)	-	-	3)	-	-
Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)																							
1)	-	-																							
2)	-	-																							
3)	-	-																							

The stratification lines represent approximate boundaries. The transition may be gradual.

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METRIC**RECORD OF BOREHOLE No. C4**

REFERENCE 05/07/05090-FC DATUM Geodetic LOCATION 11+722 8.0 m Lt - Calvin Twp. ORIGINATED BY ELS
 PROJECT Hwy 17 - GWP-175-98-00 / WP-5161-01-00 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DVL
 CLIENT Earth Tech (Canada) DATE (Started/Completed) 10/11/05 - 10/11/05 TIME 1:20:00 PM CHECKED BY JRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES								
219.7	Ground Surface												
0.0	200 mm Crushed Gravel												
	SAND FILL												
	Brown Fine to Medium Sand some Gravel trace Silt Occasional Cobbles/Boulders (Compact/Loose)		1	AS									
			2	SS	26								
			3	SS	14								
			4	SS	6								
			5	SS	4								
214.5	50 mm Black Fine Fibrous Peat SAND												
5.2	Grey Fine to Medium Sand Trace Silt (Very Loose/Loose)		6	SS	2								
			7	SS	7								
			8	SS	4								
209.9	End of Borehole												
9.8													
COMMENTS								WATER LEVEL RECORDS					
								Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)			
+ ³ , × ³ : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE								1)	-	-	-		
								2)	-	-	-		
								3)	-	-	-		

The stratification lines represent approximate boundaries. The transition may be gradual.

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METRIC**RECORD OF BOREHOLE No. C5**

REFERENCE 05/07/05090-FC DATUM Geodetic LOCATION 11+705 18.5 Rt - Calvin Twp. ORIGINATED BY ELS
 PROJECT Hwy 17 - GWP-175-98-00 / WP-5161-01-00 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DVL
 CLIENT Earth Tech (Canada) DATE (Started/Completed) 12/12/05 - 12/12/05 TIME 11:50:00 AM CHECKED BY JRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p — W — W _L WATER CONTENT (%)	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
214.9	Ground Surface										
0.0	50 mm Black Silty Organic SAND		1	AS							
	Grey Fine to Medium Sand trace/some Silt trace Gravel (Loose)		2	SS	6						
			3	SS	8						
			4	SS	7						
			5	SS	8						
			6	SS	7						
209.7	SILTY SAND		7	SS	6						
5.2	Grey Silty Fine Sand (Loose)		8	SS	3						
207.0	Gradual Change to SILT		9	SS	3						
7.9	Grey Silt some Fine Sand trace Clay										
Continued Next Page							205				
COMMENTS The stratification lines represent approximate boundaries. The transition may be gradual.							+ ³ , × ³ : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE				
							WATER LEVEL RECORDS				
							Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)		
							1) 13/12/05 3:15:00 PM	0.4	4.2		
2)	-	-									
3)	-	-									

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METRIC**RECORD OF BOREHOLE No. C5**

REFERENCE 05/07/05090-FC DATUM Geodetic LOCATION 11+705 18.5 Rt - Calvin Twp. ORIGINATED BY ELS
 PROJECT Hwy 17 - GWP-175-98-00 / WP-5161-01-00 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DVL
 CLIENT Earth Tech (Canada) DATE (Started/Completed) 12/12/05 - 12/12/05 TIME 11:50:00 AM CHECKED BY JRB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p W W _L 20 40 60					
203.8	Continued from Previous Page		10	SS	4											
204																
11.1	End of Borehole															

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METRIC

RECORD OF BOREHOLE No. C6



REFERENCE	05/07/05090-FC	DATUM	Geodetic	LOCATION	11+740 22.6 Lt - Calvin Twp.	ORIGINATED BY	ELS
PROJECT	Hwy 17 - GWP-175-98-00 / WP-5161-01-00	BOREHOLE TYPE	Hollow Stem Augers	COMPILED BY	DVL		
CLIENT	Earth Tech (Canada)	DATE (Started/Completed)	13/12/05 - 13/12/05	TIME	2:40:00 PM	CHECKED BY	JRB

[illegible]

MEL-GEO 05090-FC.GPJ MEL-GEO.GDT 5/5/06

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METRIC**RECORD OF BOREHOLE No. C6**

REFERENCE 05/07/05090-FC DATUM Geodetic LOCATION 11+740 22.6 Lt - Calvin Twp. ORIGINATED BY ELS
 PROJECT Hwy 17 - GWP-175-98-00 / WP-5161-01-00 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DVL
 CLIENT Earth Tech (Canada) DATE (Started/Completed) 13/12/05 - 13/12/05 TIME 2:40:00 PM CHECKED BY JRB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					20 40 60 W _p W W _L					
	Continued from Previous Page															
204.8			10	SS	8											
11.1	End of Borehole															

MEL-GEO 05090-FC.GPJ MEL-GEO.GDT 5/5/06

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METRIC**RECORD OF BOREHOLE No. C7**

REFERENCE 05/07/05090-FC DATUM Geodetic LOCATION 11+699 8.0 m Lt - Calvin Twp. ORIGINATED BY MCH
 PROJECT Hwy 17 - GWP-175-98-00 / WP-5161-01-00 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DVL
 CLIENT Earth Tech (Canada) DATE (Started/Completed) 19/12/05 - 19/12/05 TIME 12:15:00 PM CHECKED BY JRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES								
219.3	Ground Surface												
0.0	200 mm Crushed Gravel		1	AS			219		○				
	SAND FILL												
	Brown Fine to Medium Sand trace Gravel Trace/Some Silt Occasional Cobbles/Boulders		2	AS			218		○				24 53 (13)
	(Compact/Loose)												
			3	SS	19				○				
			4	SS	12		217		○				
			5	SS	9		216		○				20 72 (8)
			6	SS	8		215		○				
			7	SS	13		214						
212.6	SAND		8	SS	4		213			○			
6.7	Grey Fine to Medium Sand Trace/Some Silt trace Gravel with Seams of Grey Silty Clay and Grey Silty Sand		9	SS	6		212		○				
	(Compact/Loose)												
			10	SS	9		211						
							210		○				1 70 (29) 8 79 (13)
Continued Next Page													
COMMENTS The stratification lines represent approximate boundaries. The transition may be gradual.								WATER LEVEL RECORDS					
								Date (yy/mm/dd)/Time		Water Depth (m)		Cave In (m)	
								1) 19/12/05		DRY		3	
								2)		-		-	
								3)		-		-	

MEL-GEO 05090-FC.GPJ MEL-GEO.GDT 5/5/06

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METRIC**RECORD OF BOREHOLE No. C7**

REFERENCE 05/07/05090-FC DATUM Geodetic LOCATION 11+699 8.0 m Lt - Calvin Twp. ORIGINATED BY MCH
 PROJECT Hwy 17 - GWP-175-98-00 / WP-5161-01-00 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DVL
 CLIENT Earth Tech (Canada) DATE (Started/Completed) 19/12/05 - 19/12/05 TIME 12:15:00 PM CHECKED BY JRB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	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	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
	Continued from Previous Page												
			11	SS	5								
			12	SS	4								
206.7													
12.6	End of Borehole												

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METRIC**RECORD OF HAND AUGER BOREHOLE No. C8**

REFERENCE 05/07/05090-FC DATUM Geodetic LOCATION 11+699 22.0 m Lt - Calvin Twp. ORIGINATED BY MCH
 PROJECT Hwy 17 - GWP-175-98-00 / WP-5161-01-00 BOREHOLE TYPE Hand Auger COMPILED BY DVL
 CLIENT Earth Tech (Canada) DATE (Started/Completed) 19/12/05 - 19/12/05 TIME _____ CHECKED BY JRB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	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	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
215.3	Water Surface												
0.0	100 mm Water												
215.0	SILTY ORGANICS												
214.8	SAND												
0.3	Fine to Medium Sand some Silt												
0.5	SILTY CLAY												
	Grey Silty Clay with Sands		1	AS									
			2	AS									
			3	AS									
212.3	End of Borehole												
3.0	AP C8A Elev 215.3 11+699 25.0 m Lt 0 - 300 Water 300 - 1.5 Silty Clay trace Fine Sand some Organics												

COMMENTS		WATER LEVEL RECORDS	
The stratification lines represent approximate boundaries. The transition may be gradual.	+ 3, X 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE	Date (yy/mm/dd)/Time	Water Depth (m)
		1) 19/12/05	0
		2)	-
		3)	-

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APPENDIX C

Figure 1: Plan and Profile
Figures L-1 to L-3: Summary Grain Size Analysis Graph
Figure L-4: Plasticity Chart



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STRATIGRAPHY LEGEND

- TOPSOIL
- SAND
- SILTY SAND/
SANDY SILT
- PEAT
- SAND & GRAVEL
- SILT
- VARVED/
INTERLAYERED
CLAYS & SILTS
- CLAY
- SILTY CLAY
- FILL
- TILL
- CRUSHED
GRAVEL
- ASPHALT COATED
- ORGANIC SILTS

LEGEND

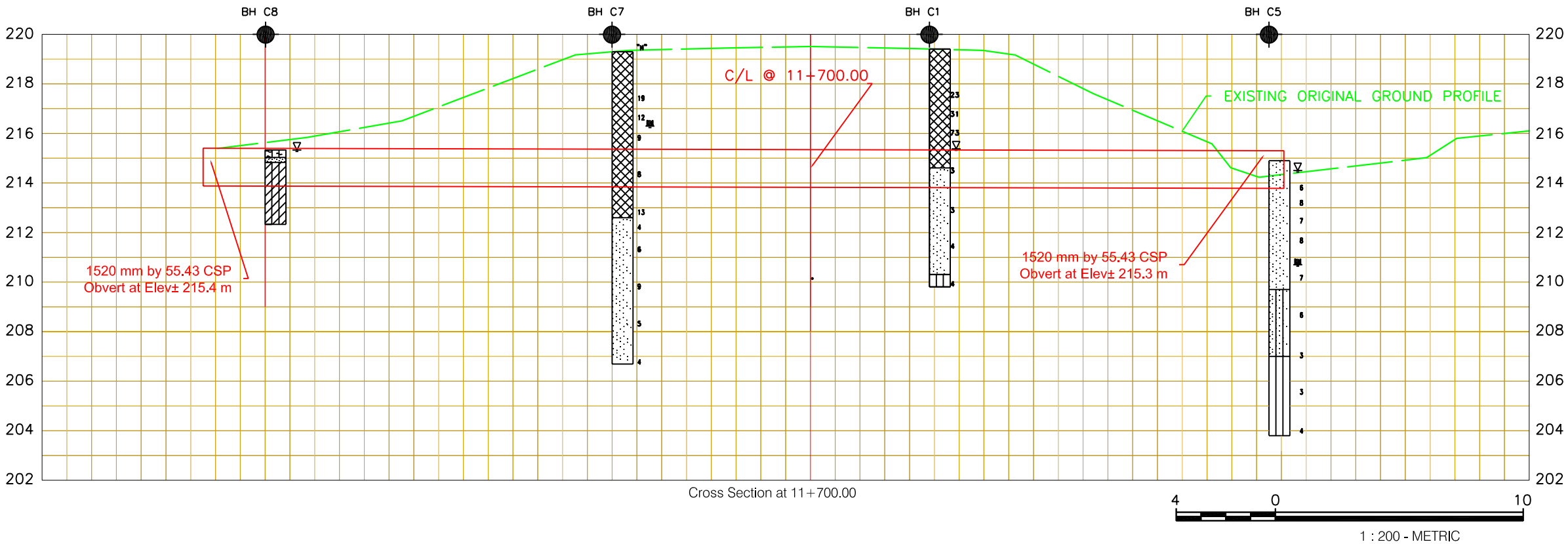
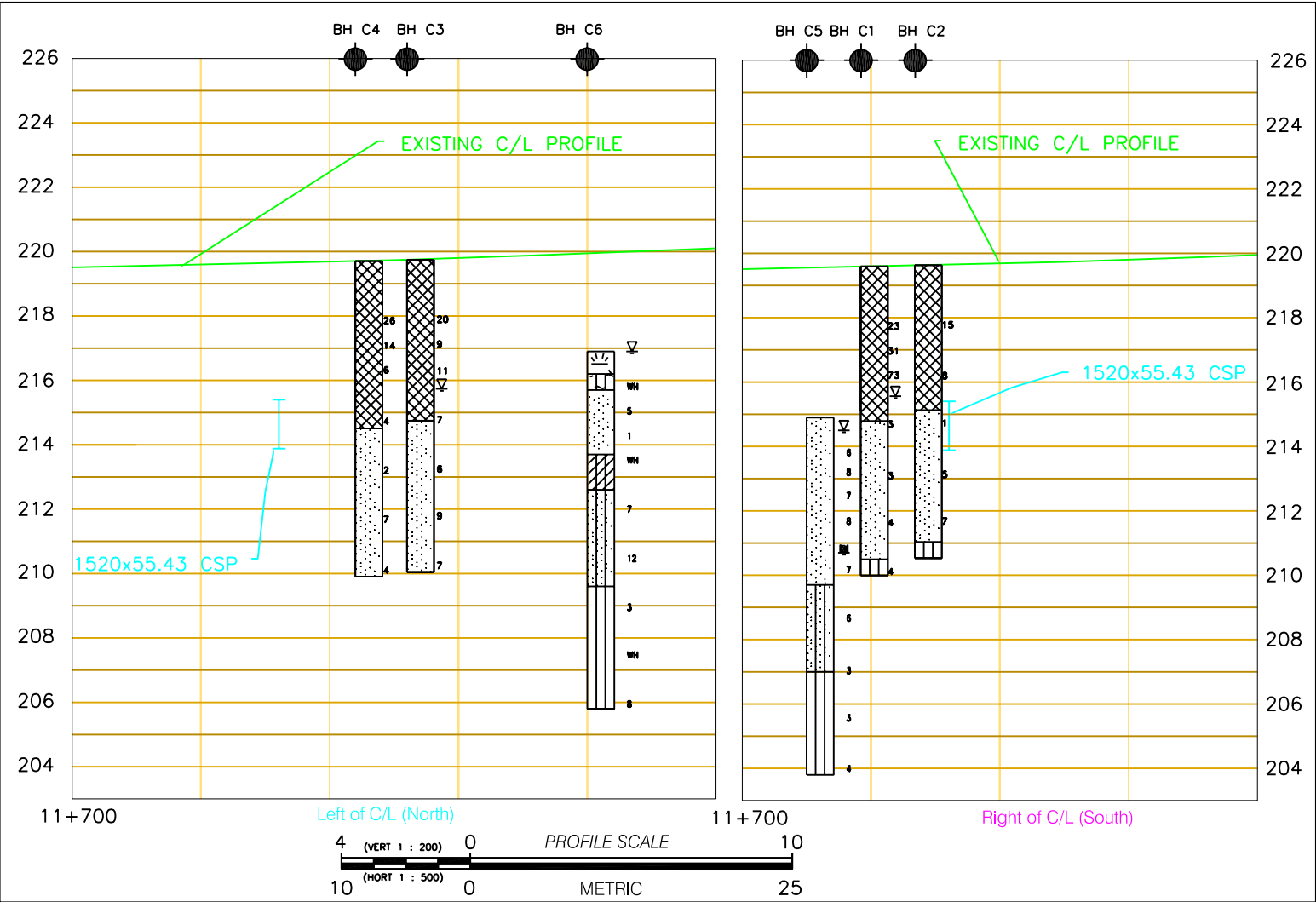
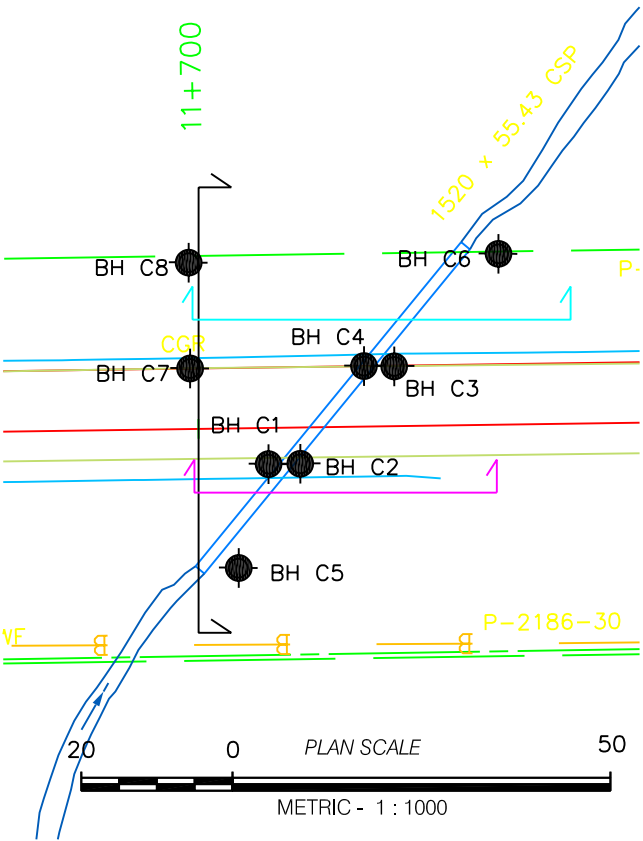
- Borehole and Dynamic Cone Penetration Test
- Borehole
- Dynamic Cone Penetration Test
N Blows/0.3 m (Std Pen Test, 475 J/blow)
CONE Blows/0.3 m (60° Cone, 475 J/blow)
- Water Level at Time of Investigation
- A/R Auger Refusal at Elevation

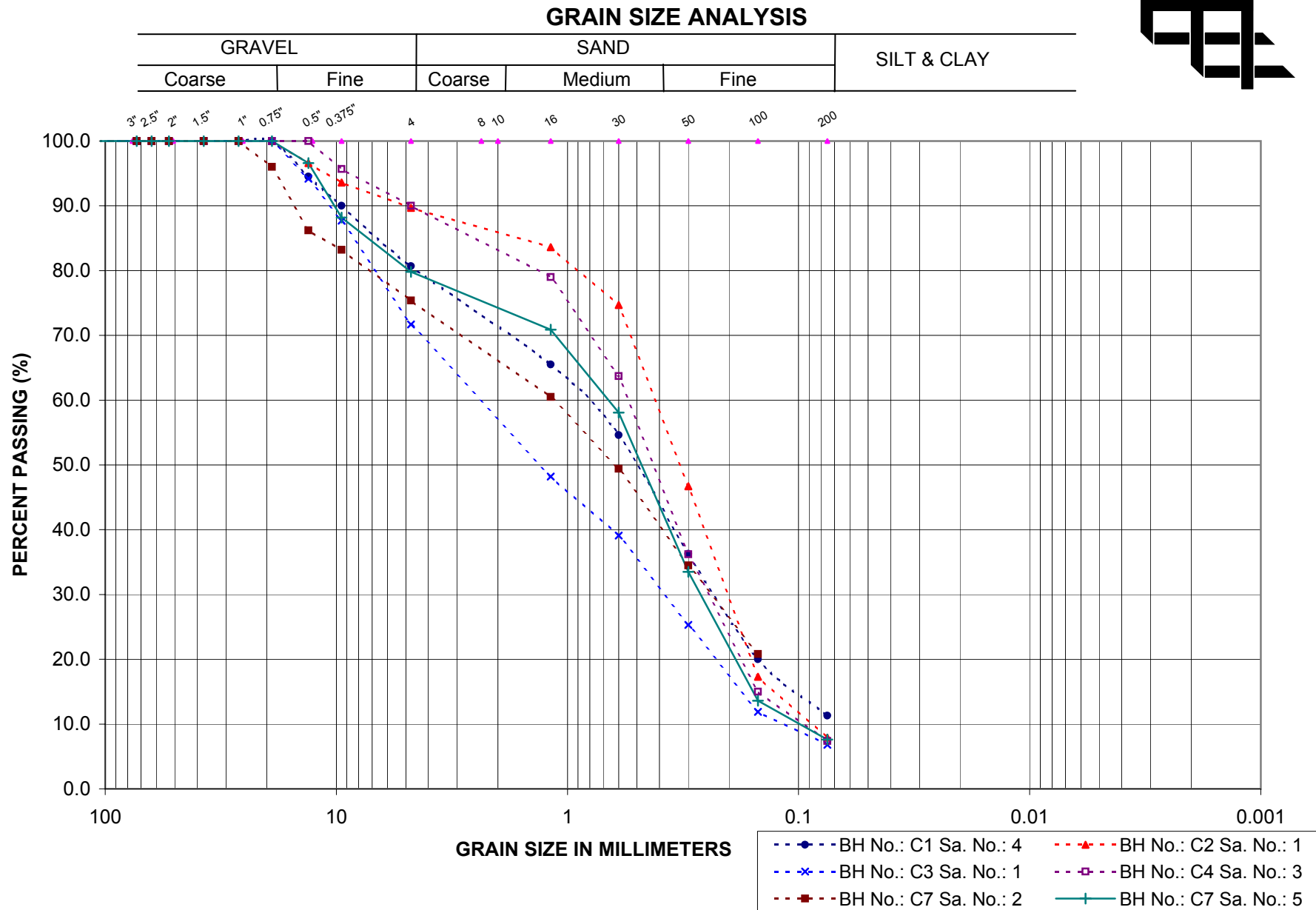
Borehole No.	Stations		Elevation
	Station	Offset	
Borehole No.C1	11+709.2	4.8m Rt	219.5
Borehole No.C2	11+713.4	4.8m Rt	219.6
Borehole No.C3	11+726	7.9m Rt	219.7
Borehole No.C4	11+722	8.0m Lt	219.7
Borehole No.C5	11+705	18.5m Rt	214.9
Borehole No.C6	11+740	22.6m Lt	215.9
Borehole No.C7	11+699	8.0m Lt	219.3
Borehole No.C8	11+699	22.0m Lt	215.3

NOTE 1:
The boundaries between soil strata have been established at the borehole locations only. The boundaries between boreholes are assumed based on borehole data.

REVISIONS	DATE	BY	DESCRIPTION
	16/12/05	DVL	REV 0 - Borehole Stations & Plots
	04/01/06	DVL	REV 1 - Cross Sections
	23/02/06	DVL	REV 2 - MTO Comments and Revisions

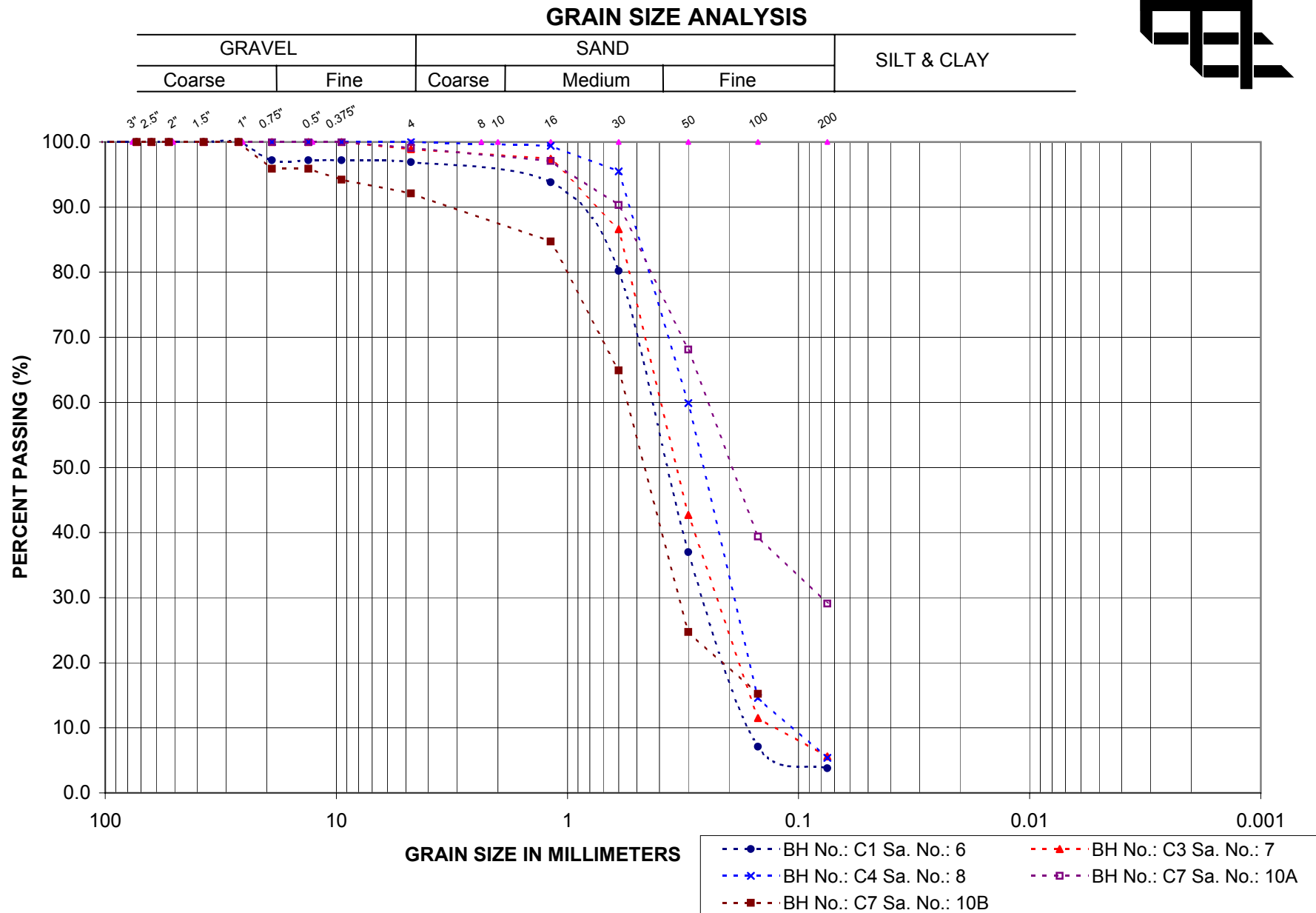
HWY No. 17	11+700 to 11+750	DIST
DWG File: 05090-FC - Plan and Profile - MEL		SITE
DRAWN DVL	CHK JRB	DATE 05/01/06
		FIG C2

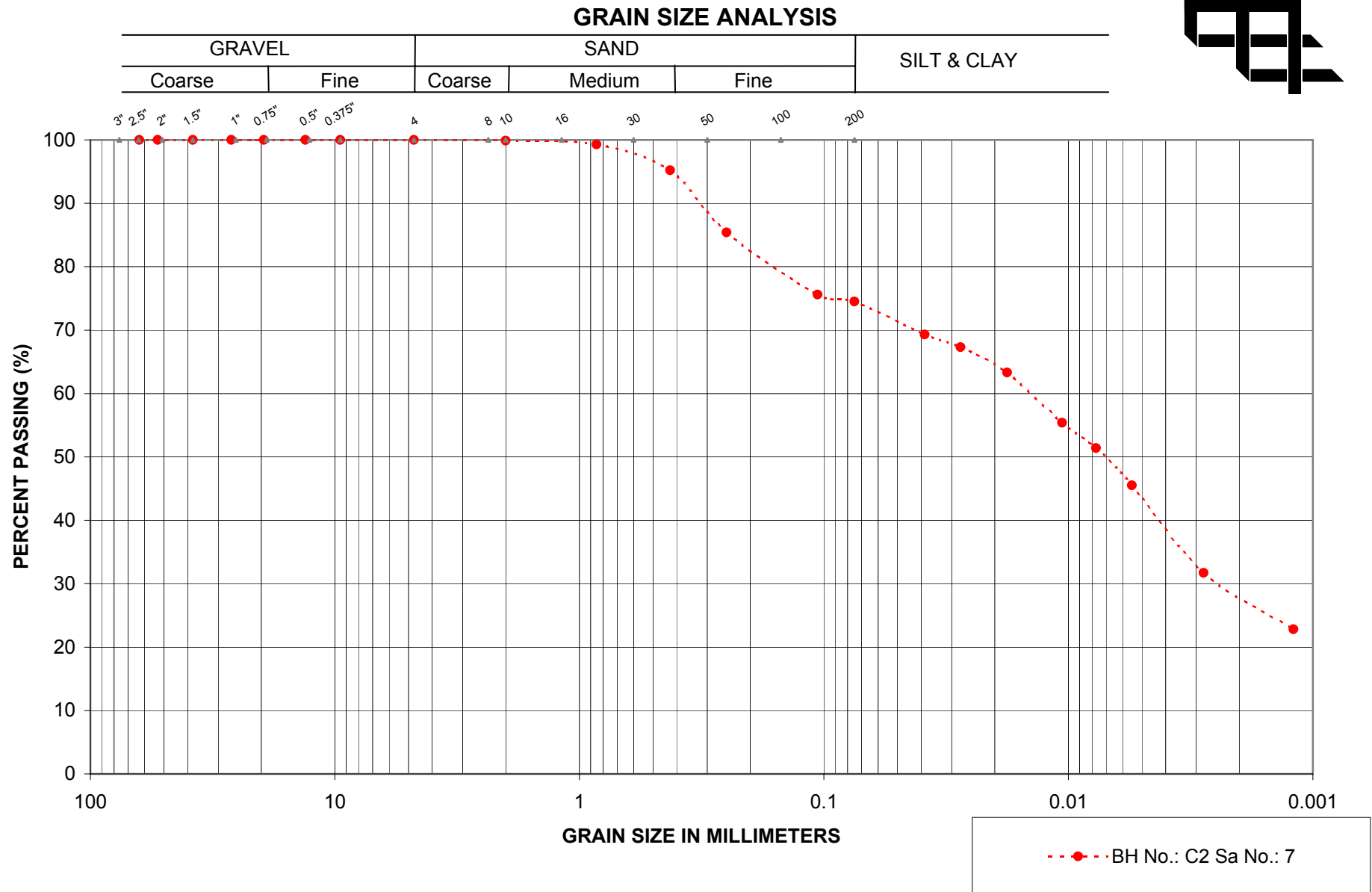




GWP 175-98-00 WP 5161-01-00
Foundation Area C
Highway 17, Township of Calvin
Culvert at Station 11+715

FILL





GWP 175-98-00 WP 5161-01-00
 Foundation Area C
 Highway 17, Township of Calvin
 Culvert at Station 11+715

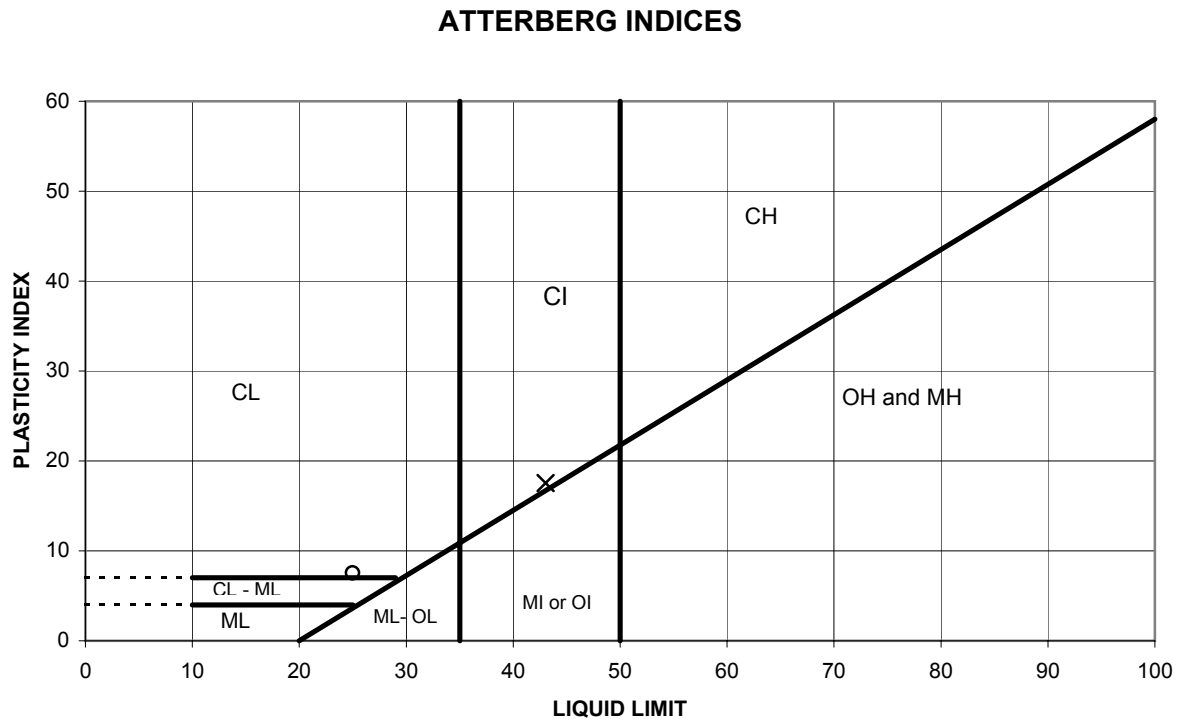
SILT

MERLEX ENGINEERING LTD.

FIGURE L-3

ATTERBERG LIMITS TEST RESULTS

FIGURE L-4



SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Liquid Limit	Plasticity Index
o	C2	7	8.85	210.8	24.99	7.53
x	C8	1	1	214.3	43.03	17.53

Date: 23-Feb-06
 Project: GWP 175-98-00 WP 5161-01-00
 Foundation Area B, Highway 17, Township of Calvin
 Culvert at Station 11+700

Prep'd: DVL
 Chkd: JRB

MERLEX ENGINEERING LTD.

APPENDIX D

Enclosure No. 11: Photo Essay



Photo: 1



Township of Calvin, Foundation Area C, Station 11+675.
 Looking easterly at the right slope.

Taken By: E. Sullivan
 MEL Ref. No.: 05/07/05090-FC
 Date: 01/11/2005

Photo: 2



Township of Calvin, Foundation Area C, Station 11+675.
 Looking easterly at the left slope.

Taken By: E. Sullivan
 MEL Ref. No.: 05/07/05090-FC
 Date: 01/11/2005



Photo: 3



Township of Calvin, Foundation Area C, Station 11+675.
 Looking easterly at the left slope from toe of slope.

Taken By: E. Sullivan
 MEL Ref. No.: 05/07/05090-FC
 Date: 01/11/2005

Photo: 4



Township of Calvin, Foundation Area C, Station 11+700.
 Looking at right end of the culvert.

Taken By: E. Sullivan
 MEL Ref. No.: 05/07/05090-FC
 Date: 01/11/2005