Submitted To AECOM Canada Ltd.
189 Wyld Street Suite 103, North Bay, Ontario P1B 1Z2
On Behalf of the Ontario Ministry of Transportation

Highway 535 Rehabilitation
Retaining Wall
Twp of Hagar
Intersection of Highway 17 & 535
GWP 5563-04-00

Highway 535
From 8.1 km North of Highway 64 (Noelville) Northerly 12.1 km;
And, 0.6 km North of Highway 64 Northerly 1.4 km
District of Sudbury

FINAL FOUNDATION INVESTIGATION REPORT

Date: May 7, 2012
Ref. Nº: 11/04/11046-F10

Geocres No. 41I-284

LVM | MERLEX
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1.0 INTRODUCTION

LVM | MERLEX has been retained by AECOM Canada Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation for a proposed retaining wall and light pole base. This retaining wall and light pole base are located in the west quadrant of the intersection of Highway 17 and Highway 535, in the Township of Hagar.

The foundation investigation location was specified by AECOM Canada Ltd. in their correspondence dated August 8, 2012, and covered under MTO Agreement No. 5010-E-0015. The terms of reference for the scope of work are outlined in LVM | MERLEX's proposal for additional investigation 11/04/11046, dated August 11, 2011, and in accordance with LVM | MERLEX's original proposal P-10-169, dated December 2010. The purpose of this investigation was to determine the subsurface conditions in the areas of the retaining wall in order to provide design recommendations. LVM | MERLEX investigated the foundation areas by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2.0 SITE DESCRIPTION

The field work for this retaining wall foundation investigation was carried out at the intersection of Highways 17 and 535, Township of Hagar. The retaining wall is located some 11.9 to 18 m right of the centerline of Highway 17, between Stations 10+139 and 10+210. The topography at the site slopes from south to north down to the grade of the existing highway (see Photos, Appendix D). The retaining wall will be constructed along an existing slope with an anticipated wall height of some 2 and 3 m. The slope to be retained was recorded at an angle of 2:1 (H:V), at the center of the proposed wall, decreasing (flattening) to 10:1 and 5:1 behind the wall, at the east and west ends of the proposed wall, respectively (see Cross Sections, Figure No. 2, Appendix C).

Infrastructure at this location consists of overhead power and communication wires to the south of the proposed wall.

2.1 Site Physiography and Surficial Geology

This project is located in the Geomorphic Sub-province known as the North Shore - Sudbury Ridges and Pockets. The topography on this section of Highway 535 is generally rolling. There are a few exposed bedrock ridges. At many locations, significant layers of earth overlay the bedrock. Organic terrain was also observed. Within the project area, overburden consists primarily of sands.

Bedrock in the area, as indicated on OGS Map 2506, is of the Late to Middle Precambrian Era. At the location of this retaining wall foundation investigation, the bedrock comprises of Metasediments including conglomerate, sandstone, siltstone, chert, and iron formations.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out between the dates of November 8th and 11th, 2011, during which five (5) sampled boreholes were advanced. For the purposes of foundation design for the retaining wall, one borehole was advanced at either end of the proposed wall, and one borehole was advanced at the center of the proposed wall. One borehole was also advanced at a proposed light pole location. Shallow refusal was encountered in the borehole at the light pole, as such, a second borehole was advanced at this location. On May 1, 2012, a series of eight (8) auger probes (Auger Probe (AP) Nos. 1 to 8, inclusive) were advanced between the borehole locations along the proposed retaining wall alignment to confirm the absence/presence of bedrock along the alignment of the retaining wall foundation.

The field investigation was carried out using a Bombardier mounted CME drilling rig equipped with hollow stem augers, standard augers, and routine geotechnical sampling equipment. Soil samples were obtained at the borehole locations 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 (ASTM D-1586). The SPT method involves advancing a 50 mm O.D. split spoon sampler with the force of a 63.5 kg hammer freely dropping 760 mm mounted in a trip (automatic) hammer. The number of blows per 300 mm penetration was recorded as the "N" value. At the boreholes, a Dynamic Cone Penetration Test (DCPT) was carried out to give a continuous plot of the soil resistance with depth. All samples taken during this investigation were stored in labeled airtight containers for transport to our North Bay laboratory for visual examination and select laboratory testing.

Groundwater conditions in the open boreholes were observed during the advancement of, and immediately following, completion of the individual boreholes. All open boreholes were backfilled upon completion with compacted auger cuttings in the general order they were removed and, where necessary, bentonite pellet backfill was added to the boreholes to bring them up to 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 routine testing for natural moisture content determination and particle size analysis, as well as specific gravity. The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix B), with a summary of results presented on the laboratory sheets in Appendix C (Figures Nos. L-1 to L-3).

The location of the individual boreholes were determined in the field using highway chainage (established by others) and offset relative to highway centerline. The MTO co-ordinates, northing and easting, were then established for the boring locations. Elevations contained in this report are referenced to a geodetic datum.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Record of Borehole Logs (Appendix B) and on Figure No. 2 (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, the results of SPT and Dynamic Cone Penetration Test (DCPT) plus field observations. Typically such boundaries represent transitions from one zone to another and are not an exact demarcation of specific geological units. Additional consideration should be given to the fact that subsurface conditions may vary markedly between adjacent boreholes and beyond any specific boring location, and are shown on the drawings for illustration purposes only.

4.1 Retaining Wall

A plan and profile illustrating the borehole and auger probe locations and stratigraphic sequences is shown on Figure No. 2, Appendix C. Borehole Nos. 1 to 3 were advanced along the orientation of the proposed retaining wall, where as the auger probes were advanced along the wall alignment between the boreholes. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 3 were recorded at 213.4, 214.3, and 213.5 m, respectively.

4.1.1 Surficial Layers

At surface, at Borehole No. 2, a surficial deposit of black silty sand some 150 mm thick was penetrated. Vegetative cover, including grass and light brush, was encountered at the surface of all boreholes.

4.1.2 Fill

Underlying the surficial silty sand at Borehole No. 2, and at surface at Borehole Nos. 1 and 3, a deposit of fill consisting of brown fine sand some to with silt some to with gravel was penetrated. The natural moisture content measured on samples of this deposit was in the order of 5 to 18%. A gradation analysis was carried out on one (1) sample of this deposit, the results of which indicated 14% gravel size particles, 57% sand size particles, and 29% silt and clay size particles (Figure No. L-1, Appendix C). Based on SPT 'N' values of 8 blows per 300 mm penetration, the compactness of this deposit was described as loose. This deposit was encountered to depths of 0.9, 1.4, and 0.7 m below grade at Borehole Nos. 1 to 3, respectively (elevations 212.5, 212.9, and 212.8 m, respectively).

4.1.3 Silty Sand

Underlying the fill at Borehole Nos. 1 to 3, a deposit of brown to grey silty sand to sand and silt, trace to with gravel was penetrated. Based on drill response during advance of the boreholes and auger probes, this deposit contains cobble and probably small boulder size rock. The natural moisture content measured on samples of this deposit was in the order of 5 to 21%. Gradation analyses were carried out on twelve (12) samples of this deposit, the results of which indicated 6 to 27% gravel size particles, 32 to 55% sand size particles, and 26 to 47% silt and clay size particles (Figure No. L-2, Appendix C). Based on SPT 'N' values of 2 to greater than 100 blows per 300 mm penetration, the compactness of this deposit was described as very loose to very dense, generally very dense. Auger refusal was encountered at depths of 5.3, 5.0,

and 4.8 m below ground surface at Borehole Nos. 1 to 3, respectively (elevations 208.1, 209.3, and 208.7 m, respectively).

Auger probes were advanced along the proposed retaining wall alignment. Auger refusal on cobbles/boulders in the very dense silty sand deposit was encountered at AP Nos. 1, 3, and 7 at depths of 3.1, 2.0, and 2.2 m below grade, respectively. These auger probes were relocated some 0.5 m offset, where they were advanced past the refusal depth to a depth of 4.7 m. At each auger probe location auger advance was achieved to a depth of 4.7 m below grade. The table below provides a summary of the auger probe refusal depths, if encountered.

Auger Probe No.	Auger Probe Depth (m)	Refusal Encountered (Y/N)
1	3.1	Y
1A	4.7	N
2	4.7	N
3	2.0	Y
3A	4.7	N
4	4.7	N
5	4.7	N
6	4.7	N
7	2.2	Y
7A	4.7	N
8	4.7	N

4.2 Light Pole Base

A plan and profile illustrating the borehole locations and stratigraphic sequences is shown on Figure No. 2, Appendix C. Borehole Nos. 4 and 4A were advanced in the area of the proposed light pole base. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 4 and 4A were recorded at 211.4 and 211.8 m, respectively.

4.2.1 Surficial Layers

At surface at Borehole No. 4A, a surficial deposit of sand fill some 150 mm thick was penetrated. Vegetative cover consisting of grass was encountered at both boreholes.

4.2.2 Fill

Underlying the surficial sand fill at Borehole No. 4A, and at surface at Borehole No. 4, a deposit of fill consisting of grey silty sand with gravel was penetrated. The natural moisture content measured on samples of this deposit was in the order of 14 to 15%. This deposit was encountered to depths of 0.6 and 0.7 m below grade at Borehole Nos. 4 and 4A, respectively (elevations 210.8 and 211.1 m, respectively).

4.2.3 Silty Sand

Underlying the fill at Borehole Nos. 4 and 4A, a deposit of grey sand with silt, with gravel was penetrated. Based on drill response during advance of the boreholes and auger probes, this deposit contains cobble and boulder size rock. The natural moisture content measured on samples of this deposit was in the order of 7 to 8%. Gradation analyses were carried out on two (2) samples of this deposit, the results of which indicated 22 to 25% gravel size particles, 47 to 48% sand size particles, and 23 to 28% silt size particles, and 3 to 4% clay size particles (Figure No. L-3, Appendix C). Based on SPT ‘N’ values greater than 100 blows per 300 mm penetration, the compactness of this deposit was described as very dense. Auger refusal was encountered at depths of 2.1 and 2.6 m below ground surface at Borehole Nos. 4 and 4A, respectively (elevations 209.2 and 209.2 m, respectively).

An unsampled auger probe was advanced some 1 m east of Borehole No. 4A. Auger refusal on the probe was encountered at a depth of 2.6 below grade (elevation 209.2 m).

4.3 Groundwater Conditions

Measurements of the groundwater table and cave-in levels were undertaken, where possible, in the open boreholes during the advance of the individual borings and upon completion. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix B). Borehole Nos. 1 to 4 were dry at the time of sampling and the boreholes remained dry 1 to 2 days after completion. Surface runoff flooded Borehole No. 4A which was situated in the existing ditch (elevation 211.8 m).

The groundwater levels will fluctuate seasonally.

LVM | MERLEX

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MTO Designate

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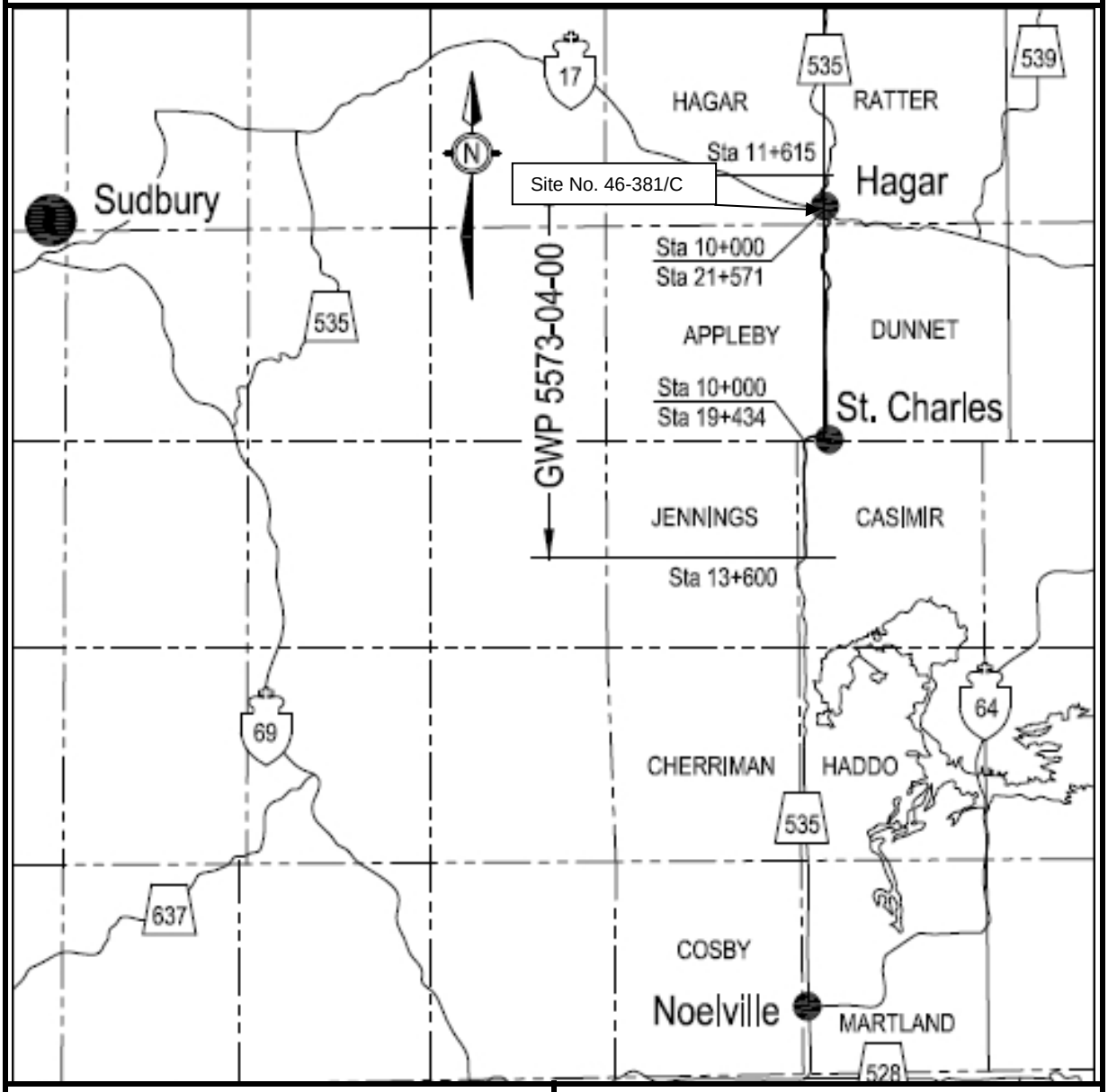
Appendix A Key Plan

Figure No. 1: Key Plan

KEY PLAN

Figure No. 1

NOT TO SCALE



FINAL
FOUNDATON INVESTIGATION REPORT
GWP 5563-04-00
Highway 535
From 8.1 km North of Highway 64
(Noelville) Northerly 12.1 km;
And, 0.6 km North of Highway 64
Northerly 1.4 km
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Ref. No.: 11/04/11046-F10

May, 2012

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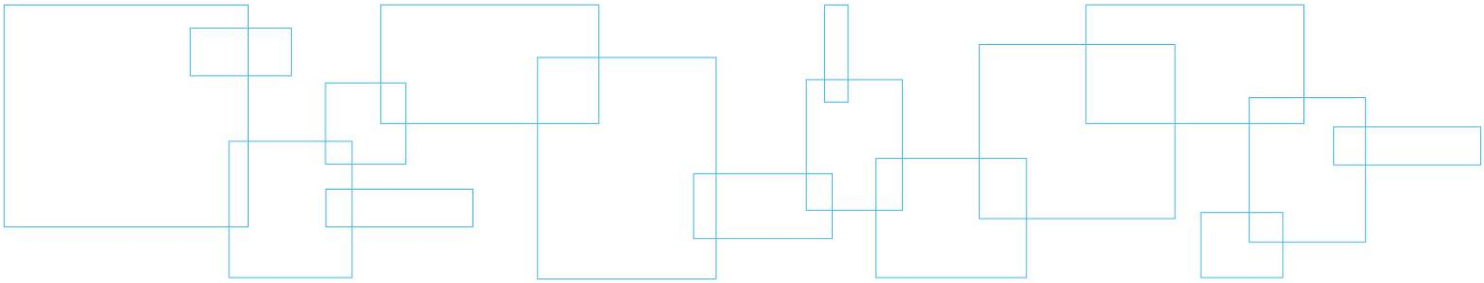
Appendix B Abbreviations
Record of Borehole Sheets

Enclosure No. 1: List of Abbreviations and Symbols
Enclosure Nos. 2 to 6: Record of Borehole Sheets
Enclosure No. 7: Record of Auger Probe Logs



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LIST OF ABBREVIATIONS AND 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
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
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 60° cone attached to AW rod 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

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

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.

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

Accep	Acceptable	**Hi**	Highly	**RSS**	Remoulded Shear Strength
Agg	Aggregate	**HP**	High Plasticity	**RF**	Rock Fill
Amor	Amorphous	**HM**	Hot Mix	**Sa**	Sand
Asph	Asphalt	**Ip**	Plasticity Index	**Sat**	Saturated
AP	Auger Probe	**L**	Loose	**SH**	Shale
BR	Bedrock	**Lt**	Light or Left	**Sh Rk**	Shot Rock
Blk	Black	**Liq**	Liquid	**Si (y)**	Silt (y)
Bl	Blue	**Lo**	Loam	**Sl (y)**	Slight (ly)
BH	Borehole	**Matl**	Material	**(L,M,H)SFH**	Susceptibility to Frost Heave (L – Low, M – Med, H – High)
Bld (y)	Boulder (y)	**Max**	Maximum		
Blds	Boulders	**Med**	Medium		
Br	Brown	**Mod**	Moderate	**SP**	Slight Plasticity
CF	Channel Face	**Mott**	Mottled	**SSM**	Select Subgrade Material
Cl	Clay	**Mrl**	Marl	**St**	Sensitivity
Co	Coarse	**Mul**	Mulch	**Stn (y)**	Stoney
Cob	Cobbles	**Num**	Numerous	**Stks**	Streaks
Comp	Compact	**MDD**	Maximum Dry Density	**Surf**	Surface
Conc	Concrete	**MWD**	Maximum Wet Density	**Temp**	Temperature
Contam	Contaminated	**MP**	Medium Plasticity	**TH**	Test Hole
Cr	Crushed	**NFP**	No Further Progress	**TP**	Test Pit
Dk	Dark	**NFP (Blds)**	No Further Progress (Boulders)	**Tps**	Topsoil
Decomp	Decomposed	**NMC**	Natural Moisture Content	**Tr**	Trace
D	Dense	**OCC**	Occasional	**USS**	Undisturbed Shear Strength
D_R	Relative Density	**Ora**	Orange	**Unreinf**	Unreinforced
E	Earth	**Org**	Organic	**Varv**	Varved
Fib	Fibrous	**Org M**	Organic Matter	**VF**	Very Fine
F	Fine	**Ob**	Overburden	**WT**	Water Table
Fr Wat	Free Water	**Pavt**	Pavement	**Weath**	Weathered
FB	Frost Boil	**Pedo**	Pedological	**W**	With
FH	Frost Heave	**Pen Mac**	Penetration Macadam	**w**	Field Moisture Content
Gran	Granular	**Psty**	Polystyrene	**Wd (y)**	Wood (y)
Gr	Gravel (ly)	**Poss**	Possible	**Wopt**	Optimum Moisture Content
Grn	Green	**PST**	Prime & Surface Treated	**Wp**	Plastic Limit
Gry	Grey	**Quant**	Quantity	**W_L**	Liquid Limit
H	Heavy	**Reinf**	Reinforced	**Yel**	Yellow

Example of an Abbreviated Borehole

10+000		On C/L	
0	- 300	Rooty Peat Fr Wat @ 200	
300	- 800	Br F Sa Tr Gr Tr Si NOT Accep Granular 'B' Type I 21% PASSING 75 µm Accep SSM	**20ELS107**
800	- 4.0	Gry Si F Sa Tr Gr w @ 3.6 = 20.0 % % Passing 2.00 mm = 91 425 µm = 80 75 µm = 34	**20ELS108** LSFH
4.0		NFP Bld or BR	

Station	Offset from Centerline (C/L) (Rt – Right; Lt – Left)
Depth below Grade*	Abbreviated Soil Description Groundwater Data (where encountered) Abbreviated Lab Data (where applicable) - Sample No., Type of Test(s) and Test Results - Relation to Ontario Provincial Standards and Specifications (OPSS) included (i.e. pass or fail; reason) where applicable

* Depths are measured in millimeters from 0 up to 1 meter and in meters for depths equal to greater than 1 meter

ENCLOSURE NO.:2 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 01

LVM | MERLEX

REFERENCE 11/04/11046-F10 DATUM Geodetic LOCATION N5146299.5 E349545.6 - Township of Hagar ORIGINATED BY JL

PROJECT GWP 5573-04-00, Highway 17/535 Intersection Retaining Wall BOREHOLE TYPE Track Mounted CME 45 B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started) November 8, 2011 TIME (Completed) 12:50:00 PM CHECKED BY MAM

DATE (Completed) November 8, 2011

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
213.4	Ground Surface										
0.0 / 212.5	FILL - brown fine sand some silt trace gravel		1	AS	N/A		213				
0.9	SILTY SAND - grey fine sand with silt to sand and silt trace to with gravel		2	SS	42						6 47 (47)
211.9	occasional cobbles and boulders						212				
1.5	DCPT Refusal		3	SS	104/ 225mm						
	(dense/very dense)		4	SS	80		211				27 32 (41)
			5	SS	>100		210				
			6	SS	58						18 54 (28)
			7	SS	78/ 175mm		209				15 55 (30)
208.1											
5.3	Auger Refusal End of Borehole										

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 (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 11/9/11 8:15:00 AM	DRY	2.98
2) 11/11/11 8:15:00 AM	DRY	-
3)	-	-

MEL-GEO 11046 - BOREHOLE LOGS - RETAINING WALL.GPJ MEL-GEO.GDT 5/8/12

LVM | MERLEX
120 Progress Court, North Bay, On P1A 0C2 Phone: (705)476-2550 Fax: (705)476-8882 Email: northbay@lvm.ca

ENCLOSURE NO.:3 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 02

LVM | MERLEX

REFERENCE 11/04/11046-F10 DATUM Geodetic LOCATION N5146294.2 E349581.0 - Township of Hagar ORIGINATED BY JL/RG

PROJECT GWP 5573-04-00, Highway 17/535 Intersection Retaining Wall BOREHOLE TYPE Track Mounted CME 45 B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started) November 9, 2011 TIME (Completed) CHECKED BY MAM

DATE (Completed) November 11, 2011

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
214.3	Ground Surface										
0.0	150 mm black silty sand FILL - brown sand with silt trace gravel (loose)		1	AS	N/A		214				
			2	SS	8						14 57 (29)
212.9							213				
1.4	SILTY SAND - brown sand with silt trace gravel (loose)		3	SS	9						18 54 (28)
211.9			4	SS	50/75mm		212				24 46 (30)
2.4	Auger Refusal - Probably Boulder(s) -moved 3.5 m S and 1.2 m E of BH, sampling continued. SILTY SAND - grey fine sand with silt to silty fine sand occasional cobbles and boulders		5	SS	73/150mm						25 48 (27)
	(very dense)		6	SS	60/150mm		211				13 54 (33)
			7	SS	50/125mm		210				16 52 (32)
209.3											
5.0	Auger Refusal End of Borehole										

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 (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 11/11/11 1:10:00 PM	DRY	4.8
2)	-	-
3)	-	-

MEL-GEO 11046 - BOREHOLE LOGS - RETAINING WALL.GPJ MEL-GEO.GDT 5/8/12

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ENCLOSURE NO.:4 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 03

LVM | MERLEX

REFERENCE 11/04/11046-F10 DATUM Geodetic LOCATION N5146292.9 E349619.2 - Township of Hagar ORIGINATED BY JL/RG

PROJECT GWP 5573-04-00, Highway 17/535 Intersection Retaining Wall BOREHOLE TYPE Track Mounted CME 45 B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started) November 8, 2011 TIME (Completed) 10:00:00 AM CHECKED BY MAM

DATE (Completed) November 9, 2011

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
213.5	Ground Surface										
0.0 / 212.8	FILL - brown fine to medium sand with gravel trace silt		1	AS	N/A		213		○		
0.7 / 211.4	SILTY SAND - grey/brown silty sand some gravel trace clay ocassional cobbles and boulders (loose)		2	SS	44				○		20 43 (37)
			3	SS	2		212		○		
2.1 / 211.1	SILTY SAND - grey fine sand with silt some to with gravel trace clay		4	SS	55/170mm				○		25 49 23 3
2.4	DCPT Refusal						211				
	Occasional cobbles and boulders (very dense)		5	SS	>100				○		
			6	SS	>100		210		○		17 52 27 4
208.7			7	SS	118/175mm		209		○		
4.8	Auger Refusal End of Borehole										

COMMENTS

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

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 11/9/11 10:00:00 AM	DRY	-
2)	-	-
3)	-	-

MEL-GEO 11046 - BOREHOLE LOGS - RETAINING WALL.GPJ MEL-GEO.GDT 5/8/12

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ENCLOSURE NO.:5 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 04

LVM | MERLEX

REFERENCE 11/04/11046-F10 DATUM Geodetic LOCATION N5146303.1 E349581.6 - Township of Hagar ORIGINATED BY RG

PROJECT GWP 5573-04-00, Highway 17/535 Intersection Retaining Wall BOREHOLE TYPE Track Mounted CME 45 B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started) November 9, 2011 TIME (Completed) CHECKED BY MAM

DATE (Completed) November 9, 2011

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
211.4	Ground Surface							20 40 60 80 100	20 40 60		
0.0 / 210.8	FILL - grey silty sand with gravel		1	AS	N/A		211		○		
0.6	SILTY SAND - grey sand with gravel some silt trace clay occasional cobbles and boulders		2	SS	>100				○		25 48 23 4
	(very dense)		3	SS	30/150mm 20/0mm		210		○		
209.3											
2.1	Auger Refusal End of Borehole										

COMMENTS

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

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 11/9/11	DRY	-
2)	-	-
3)	-	-

MEL-GEO 11046 - BOREHOLE LOGS - RETAINING WALL.GPJ MEL-GEO.GDT 5/8/12

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ENCLOSURE NO.:6 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 04A

LVM | MERLEX

REFERENCE 11/04/11046-F10 DATUM Geodetic LOCATION N5146303.3 E349577.6 - Township of Hagar ORIGINATED BY JL

PROJECT GWP 5573-04-00, Highway 17/535 Intersection Retaining Wall BOREHOLE TYPE Track Mounted CME 45 B - Hollow Stem Augers COMPILED BY RG

CLIENT AECOM Inc. DATE (Started) November 11, 2011 TIME (Completed) 11:00:00 AM CHECKED BY MAM

DATE (Completed) November 11, 2011

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
211.8	Ground Surface										
0.0	150 mm brown sand fill										
	FILL - grey fine silty sand with gravel		1	AS	N/A				○		
211.1											
0.7	SILTY SAND - grey fine sand with silt with gravel trace clay		2	SS	53/175mm	▽	211		○		
210.7											
1.1	Auger Refusal - Probably Boulder(s) -moved 0.5 m W of BH, sampling continued.										
	SILTY SAND - grey fine sand with silt with gravel trace clay occasional cobbles and boulders		3	SS	103/275mm		210		○		22 47 28 3
	(very dense)		4	SS	103/275mm				○		
209.2											
2.6	Auger Refusal End of Borehole										
	Advanced Auger Probe 1 m E of Borehole 04A. Auger refusal @ 2.6 m depth.										

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 (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 11/11/11 10:55:00 AM	0 ▽	0.9 ▨
2)	- ▽	-
3)	- ▼	-

MEL-GEO 11046 - BOREHOLE LOGS - RETAINING WALL.GPJ MEL-GEO.GDT 5/8/12

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AP 1. 10+145.3 17.7 Rt C/L

0 - 3.1
3.1 NFP BLD

AP 1A. 10+145.3 18.2 Rt C/L

0 - 4.7
4.7 E/S

AP 2. 10+152.5 17.5 Rt C/L

0 - 2.7
2.7 - 4.7 very dense material
4.7 - E/S

AP 3. 10+159 17.0 Rt C/L

0 - 2.0
2.0 NFP BLD

AP 3A. 10+159.7 17.5 Rt C/L

0 - 4.7
4.7 E/S

AP 4. 10+166.9 16.6 Rt C/L

0 - 2.7
2.7 - 4.7 very dense material
4.7 - E/S

AP 5. 10+181.3 15.4 Lt C/L

0 - 2.7
2.7 - 4.7 very dense material
4.7 - E/S

AP 6. 10+188.5 14.7 Lt C/L

0 - 3.0
3.0 - 4.7 very dense material
4.7 - E/S

AP 7. 10+195.6 13.8 Lt C/L

0 - 2.2
2.2 - NFP BLD

AP 7A. 10+195.6 14.3 Lt C/L

0 - 4.7
4.7 - E/S

AP 8. 10+203 12.9 Lt C/L

0 - 3.0
3.0 - 4.7 very dense material
4.7 - E/S

Appendix C Borehole Location Plan Labwork

Figure No. 2: Borehole Location and Soil Strata
Figure No. L-1 to L-3: Grain Size Analysis Graph

METRIC

Dimensions are in metres and/or millimetres unless otherwise shown. Stations are in kilometers + meters.

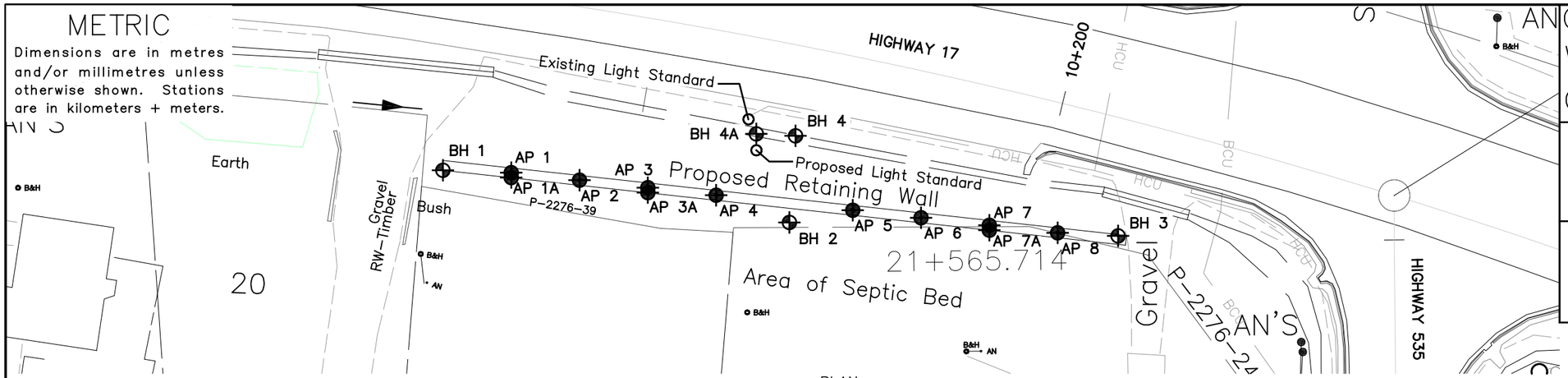
GWP No 5563-04-01
WP No 6257-11-01
GEOCRES No 41I-284

N

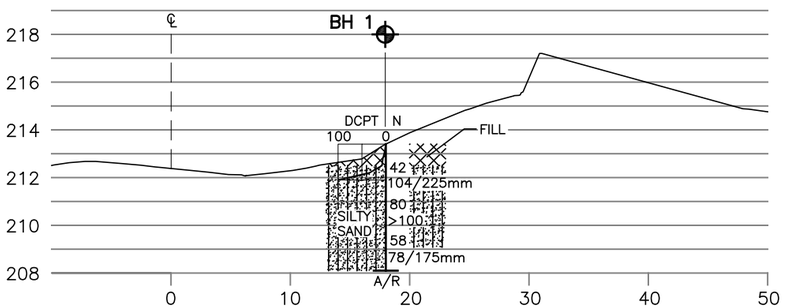
HWY NO. 535 – Township of Hagar
Retaining Wall
Intersection of Highway 17 & 535
BOREHOLE LOCATIONS & SOIL STRATA

Figure 2

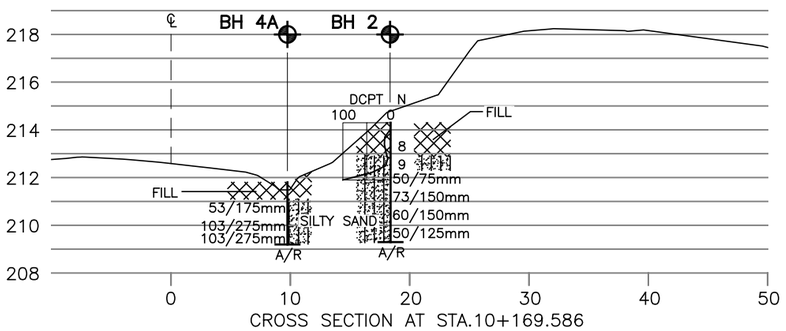
L|V|M | MERLEX



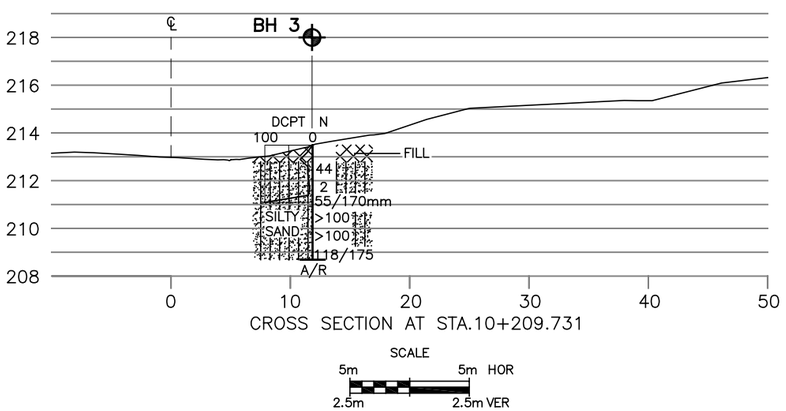
PLAN
SCALE
5m 5m



CROSS SECTION AT STA.10+139.039

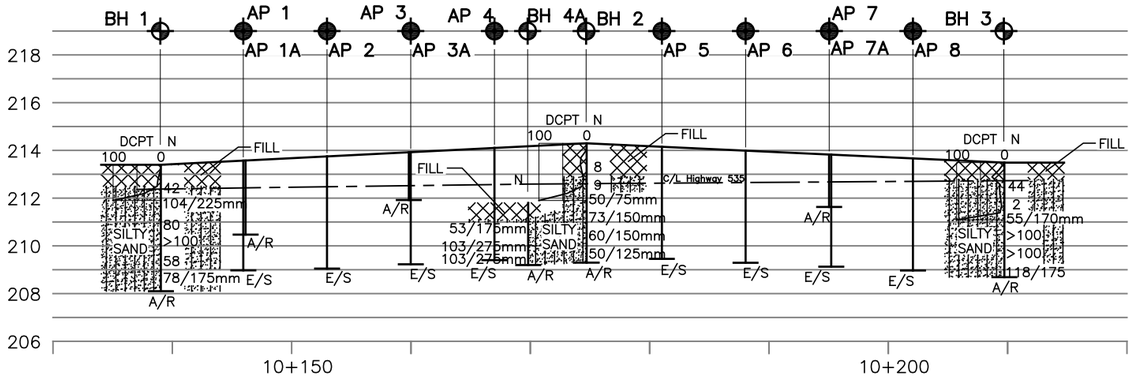


CROSS SECTION AT STA.10+169.586

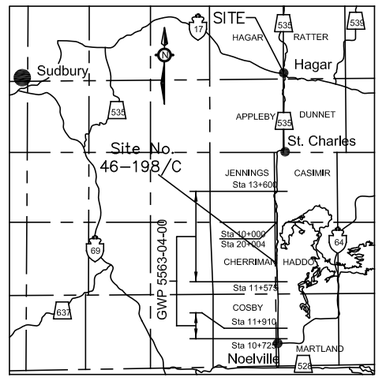


CROSS SECTION AT STA.10+209.731

SCALE
5m 5m HOR
2.5m 2.5m VER



RETAINING WALL PROFILE
SCALE
5m 5m HOR
2.5m 2.5m VER



KEY PLAN – NOT TO SCALE

LEGEND

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

Borehole No.	Elev.	O/S	Station	Co-ordinates Northerly	Co-ordinates Easterly
Borehole No. 1	213.4	17.9m Rt	10+139	5146299.5	349545.6
Borehole No. 2	213.3	18.3m Rt	10+175	5146294.2	349581.0
Borehole No. 3	213.5	11.8m Lt	10+210	5146292.9	349619.2
Borehole No. 4	211.3	9.1m Lt	10+170	5146303.1	349581.6
Borehole No. 4b	211.8	9.8m Lt	10+166	5146303.3	349577.6

NOTE 2:
The boundaries between soil strata have been established at the borehole locations only. The boundaries illustrated and stratigraphy between boreholes on this drawing are assumed based on borehole data and may vary. They are intended for design purposes only.

REVISIONS	DATE	BY	DESCRIPTION
	May 2012	MCM	Revisions

HWY No. 17/535 – Appleby Twp – Retaining Wall			REF: 11046
SUBM'D			SITE
DRAWN RG	CHK MAM	DATE Jan 2012	FIG 2

Reference No.: 11/04/11046-F10
Date: May 2012

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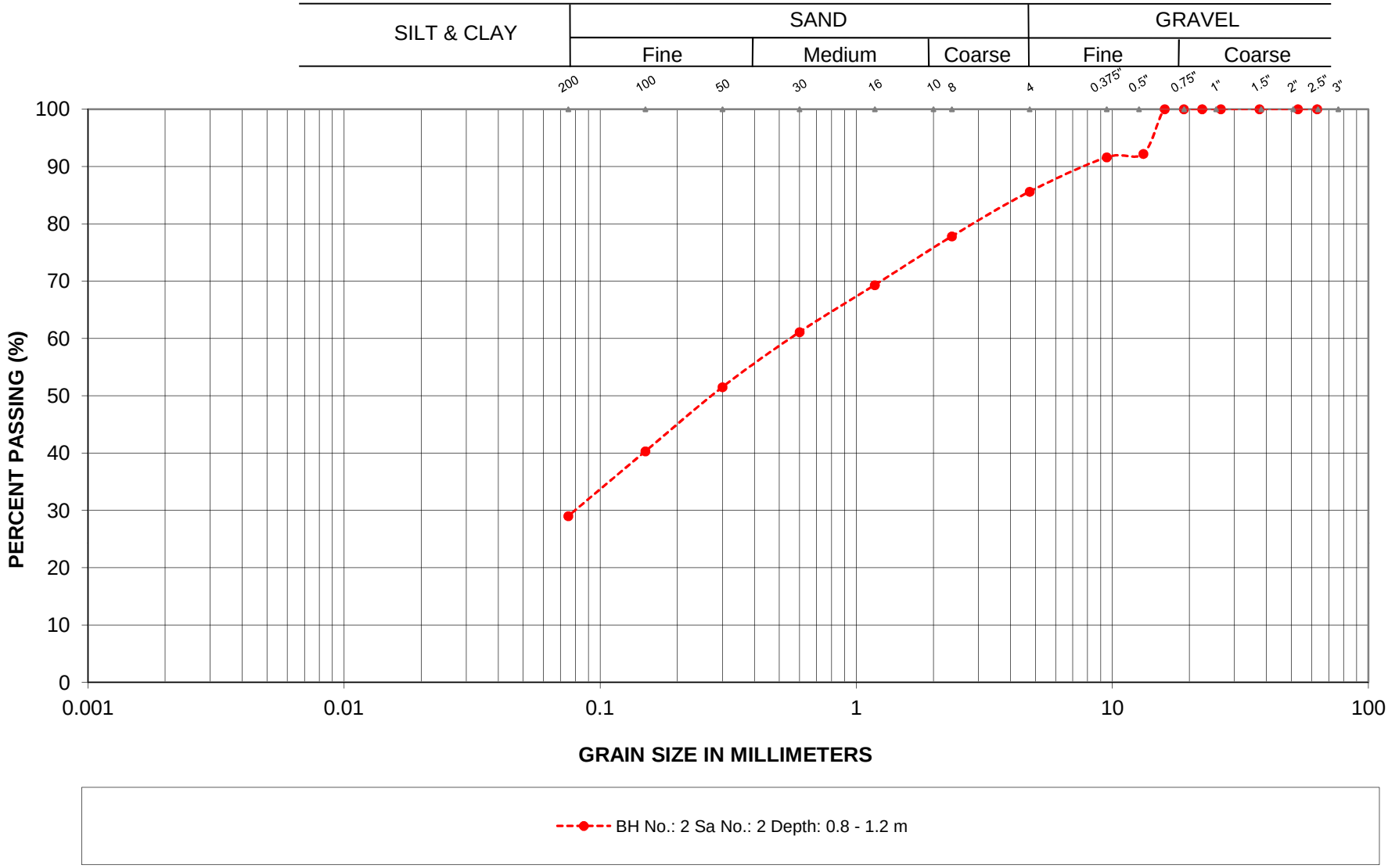
GRAIN SIZE ANALYSIS



G.W.P.: 5563-04-00
LOCATION: Hwy 535

FILL

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FIGURE L-1

Reference No.: 11/04/11046-F10
Date: May 2012

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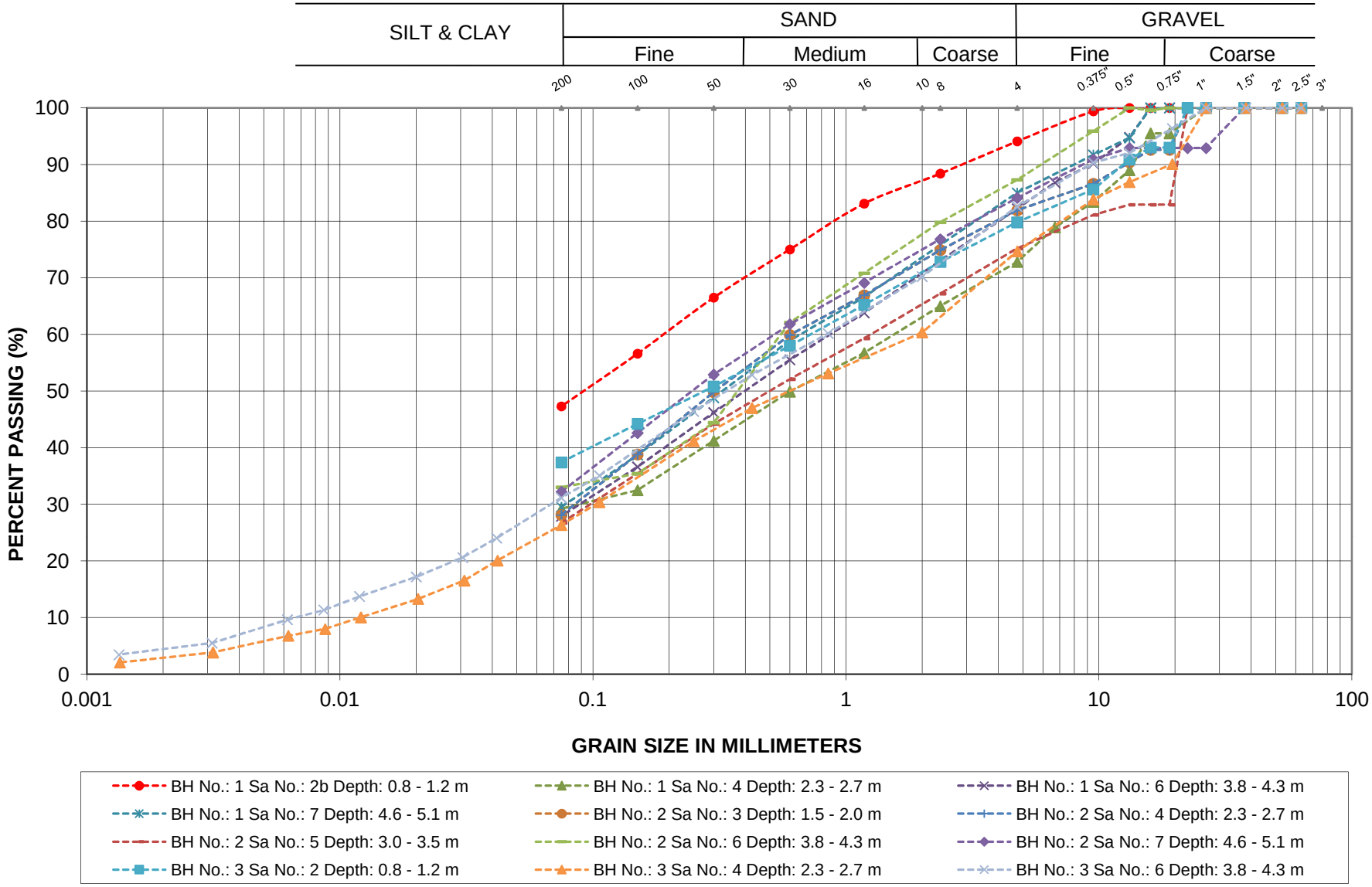
GRAIN SIZE ANALYSIS



G.W.P.: 5563-04-00
LOCATION: Hwy 535

SILTY SAND

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FIGURE L-2

Reference No.: 11/04/11046-F10
Date: May 2012

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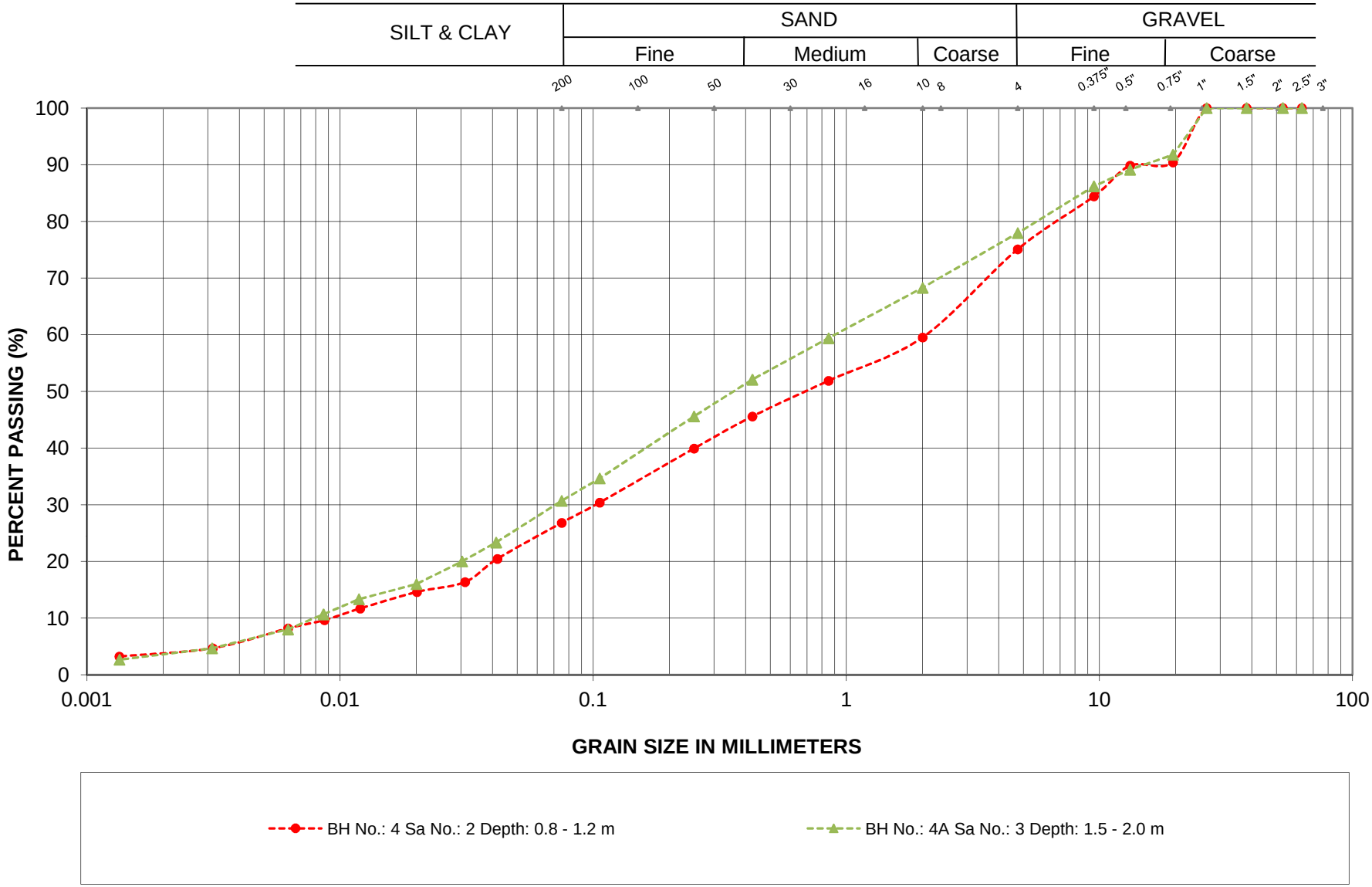
GRAIN SIZE ANALYSIS



G.W.P.: 5563-04-00
LOCATION: Hwy 535

SILTY SAND

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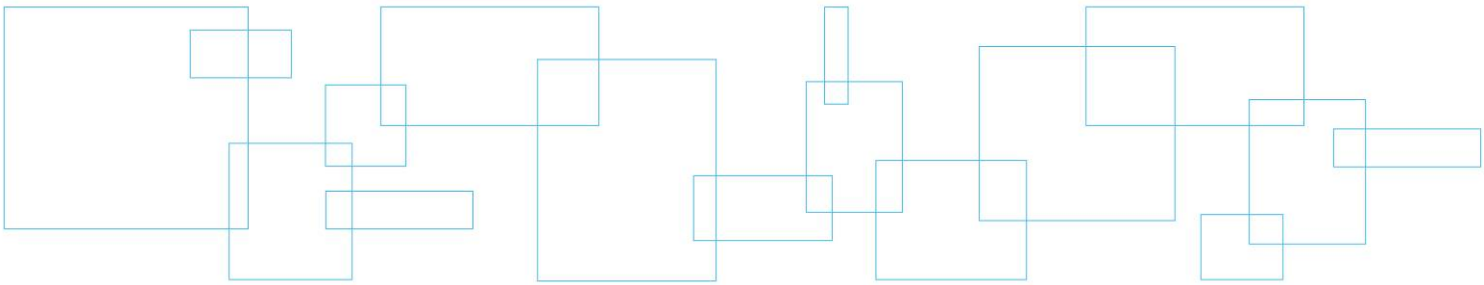
FIGURE L-3

Appendix D Photo Essay

Enclosure No. 8: Photo Essay



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Top: Existing slope, and light pole location, looking west Bottom: Existing slope, looking east	Photo: 1 - 2

Reference Number: 11/04/11046-F10 Project: Hwy 535 – Retaining Wall	Provided By: LVM | MERLEX Date: November 2011