

**FOUNDATION INVESTIGATION REPORT
PROPOSED HIGHWAY 17 TRUNK ACCESS ROAD BRIDGES
OVER THE BLACK CREEK
SAULT STE. MARIE, ONTARIO
G.W.P. 406-01-00**

GEOCRES NO. 41K00-060

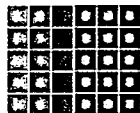
Prepared For:

MARSHALL MACKLIN MONAGHAN LTD.

Prepared by:

SHAHEEN & PEAKER LIMITED

**Project: SPT1074
September 3, 2003**



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DRAWINGS

DRAWING NO.

BOREHOLE LOCATION PLAN & SOIL STRATA

1 & 2

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1. INTRODUCTION

The realignment of the existing Highway 17 between Black Road in Sault Ste. Marie and Bar River Road to the south-east of the City involves the construction of a Link Road (Trunk Road Access) which will connect the existing Highway 17 (Trunk Road) and Highway 17 (new). The new Link Road will cross Black Creek at about mid-point between Trunk Road and Highway 17 (new). Shaheen & Peaker Limited (S&P) was retained by Marshall Macklin Monaghan Limited (MMM) to conduct a foundation investigation for proposed twin bridges at the Black Creek crossing.

The site is located near the eastern limits of the City of Sault Ste. Marie and is immediately beyond the Garden River First Nation Reserve, about 0.5 km north of Trunk Road.

The purpose of the investigation was to obtain subsurface information at the site by means of boreholes.

This report presents the findings of the investigation.

2. SITE DESCRIPTION AND GEOLOGY

The site is located near the eastern limits of the City of Sault Ste. Marie. The City of Sault Ste. Marie is located on the north shore of the St. Marys River which drains Lake Superior into Lake Huron, at St. Marys Rapids. The presence of these rapids is due to a ridge of Cambrian sandstone extending across the river. The area of the City itself and the lands immediately to the north, east, and west consist predominantly of a terraced clay lowland, which is bordered by a prominent belt of beach sand abutting on the Pre-Cambrian shield to the north and by the St. Marys River to the south. The prevalent hills of the topography of the City is typical of clay or till plains, leveled by the wave action of ancient lakes consisting of flats, beach scraps, and sharply-cut erosion channels. The sand belt increases in width towards the east, being more than 2.5 km wide at Peoples Road. The northern part of the City is underlain by Archean intrusive-gneissic granitoid rocks, forming a rolling upland with thin drift.

The Physiography of the City is determined by the structure and topography of the bedrock and by variations in the character and thickness of the overlying Quaternary sediments.

The ground slopes generally from north to south, but there is also a west to east gradient following the St. Marys River between Lake Superior and Lake Huron.

The soils of the Sault Ste. Marie region can be considered in three categories. The first two are of Pleistocene origin, i.e. well-compacted glacial tills; and lacustrine clays and poorly-compacted sands, silts and gravels. The third includes recent deposits such as peat, alluvium or river flood plains, and man-made fill.

The natural groundwater table varies considerably depending on location, but is often relatively shallow, particularly downtown and in other locations close to the St. Marys River.

Available information indicates that the surficial overburden at the site can be expected to consist of lacustrine sand deposits. The thickness of the overburden to the surface of the bedrock can be expected to be in excess of 60 metres. The bedrock probably consists of Cambrian Jacobsville Formation which is known to be mainly sandstone while the site is believed to be located close to the interface of this formation with Precambrian rocks which consist of mainly gneiss formations.

Black Creek meanders through site, flowing from west to east. The south bank of the creek at the proposed bridge location site is about 4 to 5 m above the creek level elevation of 181.5 \pm m and stands at slopes of about 1.5H:1V. From thereon, the grade slowly rises to about El. 189 m to the table and towards the CPR tracks and Trunk Road, some ½ km away. On the other side, the north bank stands at steeper slopes (i.e. generally 1:1 or steeper) but only about 0.5 to 1 m high above the creek level (i.e. bank top elevation of about 182-182.5 \pm m). Further to the north, grade rises very gradually to about El. 184 m within a distance of some 30 m.

About 50 m to the east of the proposed centerline of the bridges, a dirt logging road provides access to the creek along with a portable wooden bridge (which is removed during the winter) across the creek.

3. INVESTIGATION PROCEDURES

The fieldwork for the proposed twin bridges was performed during the period of April 22 through May 11, 2003 and consisted of drilling and sampling four deep boreholes (Boreholes A, B, C and D) and three relatively shallow boreholes (Boreholes E, F and G), as well as performing Dynamic Cone Penetration Tests (DCPT). The plan location of the boreholes are shown on Drawing Nos. 1 and 2.

Colbar Resources of Sudbury, Ontario, drilling contractor, carried out the drilling, testing and sampling work under the direction and supervision of a Geotechnical Engineer from S&P. The boreholes were advanced using a track-mounted drilling rig, outfitted with tools and equipment for soil sampling and testing. Drilling started using continuous-flight, hollow-stem

augers. But in the deeper boreholes excessive sand back-up was noted, in spite of the fact that heavy drilling mud was utilized as a counter-balancing measure against hydrostatic uplift. For this reason, the drilling had to be modified and switched to extending steel casing and advancing the boreholes by wash-boring methods. Even though drilling mud was utilized to counter balance the hydrostatic uplift due to water table, and withdrawing the sampler slowly, some inevitable disturbance may have occurred and may have effected the recorded N-values in the cohesionless soils below a depth of about 6 m.

Samples in the boreholes were taken at frequent intervals of depth by the Standard Penetration Test method (SPT), in general accordance with ASTM D1586. The test consists of freely dropping a 63.5 kg hammer a vertical distance of 0.76 m to drive a 51 mm O.D. split barrel (SS – split-spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m is recorded as the Standard Penetration Resistance or the N-value of the soil which is indicative of the compactness condition of granular (or cohesionless) soils (gravels, sands and silts) or the consistency of cohesive soils (clays and clayey soils).

Boreholes A, B, C and D were extended to depths ranging between 46.2 and 51.0 m, while the depth of Boreholes E, F and G ranged from 6.6 to 16.8 m.

At the deep borehole locations, Dynamic Cone Penetration Tests (DCPT) was carried out. In these tests a 51 mm diameter, 60 deg. apex cone point, screw-attached to the tip of A-size rods, is driven into the ground using the same driving energy as in the SPT method. By recording the number of blows to drive the cone/rod assembly into the soil every 0.3 m, a qualitative record of relative density/consistency is obtained. Although the interpretation of the test results is difficult because no samples are obtained by the DCPT method and the penetration resistances are not necessarily equal to the N-values, useful information is gained by the continuity of the results and by the elimination of unbalanced hydrostatic effects which in many cases affect the SPT values, especially in the fine-grained granular soils. The DCPT commenced at the ground level prior to drilling the sampled boreholes and/or at greater depths between the sampling, as well as from the bottom of some of the boreholes. The DCPT was generally terminated when the number of blows to drive the cone/rod assembly 0.3 m exceeded 100. When the test was performed between samples, the DCPT began and ended at predetermined depths. The depths penetrated below the ground surface by the DCPT below the bottom of the deep boreholes ranged from 53.2 to 53.3 m.

In cohesive (clayey) deposits, where the consistency of the soil permitted, relatively undisturbed samples (TW) were taken with 51 mm and 70 mm diameter thin-walled (Shelby) tubes which were pushed into the bottom of the borehole by the application of static weight by hydraulic pressure. The undrained shear strength of the soil was also measured in-situ by Field Vane tests.

Groundwater conditions in the boreholes were observed during drilling in the open boreholes, prior to introducing drilling mud. A piezometer was installed in each of Boreholes A, B, C and D, upon their completion to enable us to monitor the groundwater levels in the boreholes over a prolonged period of time, without interference from surface water. Upon their completion, the boreholes were backfilled to about 6 to 8 m below the ground surface with auger cuttings and the upper 6 to 8 m of the open boreholes was then grouted using bentonite seal.

The soil profile and groundwater levels encountered in the boreholes, type of samples and sampling depths, N-values and Field Vane test results are presented on the Record of Borehole Sheets, in Appendix A of this report. Record of Borehole of Borehole 95-1, drilled by others at the site in 1995, is also included in Appendix A.

The borehole locations were established in the field using surveying stakes (showing centerline and stations at EBL and WBL) put down by surveyors from MMM, who also provided us with Geodetic ground surface elevations at the borehole locations.

A laboratory testing programme, consisting of natural moisture content measurements, Atterberg (liquid and plastic) Limits, grain-size analyses, one-dimensional consolidation (oedometer) and quick triaxial compression (undrained triaxial) and bulk unit weight tests, was performed on selected soil samples. The results of laboratory tests are presented on the appropriate Record of Borehole Sheets and also in Appendix B.

4. SUBSURFACE CONDITIONS

In general, underlying a 0.1 m to 0.35 m thick layer of topsoil, the boreholes contacted a silty fine sand deposit which extends to depths ranging between 6.7 m and 11.3 m below the ground surface or to elevations ranging between 175.8 m and 174.1 m. The silty fine sand is underlain by an extensive clay deposit. In some of the boreholes, layers of sand were encountered in the clay. At deep borehole locations the clay deposit extends to depths ranging between 41 and 45 m or to elevations between 141.3 and 139.7 m. The clay is in turn underlain by a basal silty fine sand deposit. The boreholes were terminated in this lower silty fine sand deposit after penetrating it for a vertical distance of 1.2 to 10.0 m.

The groundwater table at the time of our investigation was recorded in the upper silty fine sand deposit at between 0.6 and 4.5 m below the ground surface or between El. 182.8 m and 180.6 m. The groundwater table can be expected to be subject to seasonal fluctuations as well as fluctuations in the water level in the creek, along with major weather events.

The details of the subsurface conditions encountered in the boreholes are presented on the Record of Borehole Sheets in Appendix A, while inferred stratigraphic profiles are given in Drawing Nos. 1 and 2. The various soil strata encountered in the boreholes and their geotechnical properties are briefly described in the following subsections of this report.

4.1 TOPSOIL

The boreholes contacted a layer of topsoil layer which ranges in thickness from 0.1 to 0.35 m. It should be pointed out that the thickness of organic rich soils could be variable in between and beyond borehole locations and could be thicker in depressed areas and immediately adjacent to water courses.

4.2 SILTY FINE SAND

Underlying the topsoil, all the boreholes contacted a sand deposit which extends to depths/elevations 6.7 m/175.8 m (Borehole G) to 11.3 m (Borehole A) or El. 174.1 m (Borehole D). In general, the upper zones of the deposit within about 0.8 m of the ground surface contains frequent silt and clayey silt seams. Some sandy silt seams/zones were also found below this depth. In Borehole C, a relatively thicker (approximately 2 m thick) sandy silt layer/lense was contacted below a depth of 10.0 or El. 174.7 m. The presence of occasional very thin clay seams was also noted within this deposit, but generally below a depth of 5 m.

This upper sand deposit is underlain by an extensive deposit of clay. However, layers/lenses of sand were contacted in the upper zones of this clay deposit in most of the boreholes. In particular, a 9.5 m thick sand layer was contacted in Borehole A below El. 168.7 m. In Borehole B, a 3.0 m thick sand layer was contacted from 10.0 to 13.0 m or between El. 172.9 and 169.9 m and once again a 2.2 m thick layer/lenses from 17.3 to 19.5 m or El. 165.6-163.4 m. In Boreholes C and F, 4.1 and 3.1 m thick layers/lense were contacted at depths 13.4 m/El. 171.3 m and 10.4 m/El. 172.8 m, respectively.

The grain-size distribution of selected samples from the deposit is presented in Appendix B. Figures B-1 represents the grain-size distribution of seventeen selected samples from the deposit in envelope form. The results indicate a predominantly fine-grained granular soil primarily in the fine to very fine sand range with a variable silt content and traces of clay-size particles. The following grain-size distribution is indicated:

Gravel:	0%
Sand:	60-91%
Silt & Clay:	9-40%

The clay content is generally less than 9%.

The presence of zones or layers of sandy silt and very thin clay interbeds was also noted within the silty fine sand deposit. The grain-size distribution of samples from such zones/layers is given in Figures B-2 and B-3 in Appendix B. The presence of organic traces was noted in several of the samples. The colour of the soil is brown/reddish brown to depths ranging between 1.5 and 5.0 m, changing to reddish grey/grey, below. The deposit

was found to be wet and water bearing below a depth of 0.6 to 4.5 m or below elevations ranging from 181.2 and 182.7 m.

Standard Penetration tests yielded N-values ranging from 1 to 34 blows/0.3 m, but the results are generally between 2 and 10 blows/0.3 m. The variation of N-values recorded within this sand deposit (to about 174 m) with elevation is given in Figure C-1. When analyzing these results, it should be kept in mind the relatively high values (N=16-22) were generally recorded in Borehole E only. These results indicate that the relative density of the deposit is generally loose with some compact and occasional dense zones (mostly near the bottom of the deposit, near the interface with the underlying clay).

4.3 CLAY

At depths ranging from 6.7 m (Borehole G) to 11.9 m (Borehole C) or below El. 175.8-172.8 m, all boreholes contacted an extensive clay deposit, except Borehole E (shallow borehole). In the deep boreholes (i.e. Boreholes A, B, C and D) the clay deposit was found to extend to depths of between 41.0 m/El. 141.3 m at Borehole D to 45.0 m in Boreholes A and C or to El. 141.2 and 139.7 m, respectively. As was detailed in the preceding section of this report, the upper zones of this extensive clay deposit contains frequent sand layers/lenses (2.2 to 9.5 m thick) in the majority of the boreholes.

The clay consists of an irregularly layered material. In some cases, it was noted to consist of clay (CH & CI) with some silty clay (CL) and thin clayey silt (CL-ML), silt and occasional very thin silty very fine sand seams or partings, but in most cases, it consists of irregular layers of clay of differing plasticity (i.e. CH to CI), occasional silty clay/clayey silt (CL or CL-ML) zones. The colour of this cohesive deposit is generally reddish grey, with grey zones. Below about El. 148-146 m, the presence of greenish grey layers was also noted.

The grain-size distribution of samples from the deposit is given in Figures B-4, B-5 and B-6 in Appendix B. Figure B-4 presents grain-size distribution of samples with higher plasticity while B-5 represents samples from relatively less plastic zones. Figure B-6 is from a Shelby tube sample which showed the presence of silty clay and relatively thin clayey silt and silt interbeds.

The following index values were obtained from 18 samples tested in the laboratory, as shown in Figure B-7 and B-8 in Appendix B.

Liquid Limit:	24 – 72%
Plastic Limit:	16 – 33%
Plasticity Index:	7 – 43%

As shown on the Plasticity Chart (Figure B-7) most values are representative of clays of high plasticity (CH) while some are in the low plasticity range (i.e. clayey silt to silty clay) as

shown in Figure B-8. The measured natural moisture contents are generally closer to the measured Liquid Limits rather than Plastic Limit values with Liquidity Index values of generally between 0.5 and 1.5.

Standard Penetration tests conducted in the deposit gave N-values which vary from 1 to 27 blows/0.3 m, but are generally in the 2 to 11 blows/0.3 m range. Undrained shear strengths as measured by Field Vane tests, range from 24 to in excess of 150 kPa. Two unconsolidated undrained triaxial compression tests performed in the laboratory on relatively undisturbed (Shelby tube) samples yielded undrained shear strength values of 68 and 85 kPa. As shown in Figure C-2 of Appendix C, the lower results are generally in the upper zones of the clay, immediately below the upper silty fine sand deposit. Figure C-2 indicates the following:

Elevation	General Range of Measured Undrained Shear Strengths
175 – 163 m	36 – 80 kPa
163 – 140 m	70-150 kPa

Figure C-3 (Appendix C) shows the variation of measured shear strength (c_u) with elevation in Boreholes B and D only. On this figure, the effective overburden stresses (P_o') for these two boreholes are superimposed. For normally-consolidated clays in Northern Ontario, our experience shows that undrained shear strengths can be represented by a factor of 0.23 (i.e. $c_u \cong 0.23 P_o'$) which is also shown in the same figure. Since the measured shear strength values are in excess of $0.23 P_o'$, the deposit can be expected to be somewhat overconsolidated. This probably is primarily due to a phenomenon known as 'aging' rather than removal of existing overburden, although some soil removal has probably also occurred because of the erosion of the upper sand deposits along the north bank area by the meandering Black Creek.

Based on the field and laboratory values, the consistency of this cohesive deposit in the upper zones is described as generally firm to stiff, becoming stiff to very stiff in the middle and lower zones.

The measured bulk unit weights of the clay range from 15.4 to 18.9 kN/m³ (due to layered structure), with an average value of about 16.7 kN/m³.

The consolidation characteristics of the deposit were investigated by means of four one-dimensional consolidation (oedometer) tests performed on Shelby tube samples from Boreholes B, C and D. The results are presented in Figures B-9, 10, 11 and 12 in Appendix B. These tests indicate probable pre-consolidation pressures of between about 25 and 120 kPa in excess of the existing overburden pressures (P_o'). The test results also

indicate that the soil has a very compressible structure beyond the pre-consolidation pressure range with C_c values in the range of 0.3 to 1.3, but generally about 0.9.

4.4 LOWER SILTY FINE SAND

In the deep boreholes, the clay is underlain by a deposit of silty fine sand below depths ranging from 41.0 m or El. 141.3 m in Borehole D to 45.0 m in Boreholes A and C (El. 141.2 and 139.7 m, respectively). In Boreholes B and D, this unit was penetrated for a vertical distance of 7.6 and 10.0 m, respectively, while Boreholes A and C were terminated after penetrating deposit by 1.2 m to El. 140.0 and 138.5 m, respectively. However, Dynamic Cone Penetration tests were performed from the termination depth of the boreholes. The tests were extended to refusal (i.e. blow counts in excess of 100 blows/0.3 m) to 53.2 m (El. 133.0 m) and 53.3 m (El. 131.4 m) in Boreholes A and C, respectively, probably in the silty fine sand deposit.

The grain-size distribution of a typical sample from the deposit is given in Figure B-13. The figure indicates about 72% fine to very fine sand and 28% soil fines (i.e. silt and clay-size particles). Based on these results, together with a visual examination of the samples, the grain-size distribution characteristic of this basal (lower) silty fine sand is considered to be very similar to the upper silty fine sand deposit. Similar to the upper sand, the lower sand also contains some sandy silt zones/seams and the presence of occasional thin clay seams was also noted. Figure B-14 shows the grain-size distribution of a sample from within these zones.

4.5 GROUNDWATER CONDITIONS

Groundwater conditions in the open boreholes were observed during the drilling and upon completion of each borehole. In addition, piezometers were installed in each of the four deep boreholes to enable us to monitor groundwater levels over a prolonged period of time without interference from surface water. The recorded water levels are shown on the individual Record of Borehole Sheets. These show groundwater levels ranging from 0.6 to 4.5 m or between El. 182.8 and 180.6 m. We also took a water level reading in the piezometer which was installed at the site in 1995 by Golder Associates Ltd. During this previous investigation (i.e. October 1995) the water level in this piezometer was recorded at El. 181.2 m, while at the time of our investigation (April 2003), it was recorded at El. 181.9 m.

Based on these records, observations made during the drilling, together with moisture contents of the samples recovered, the groundwater level at the time of our investigation ranged from about 183 m to 181 \pm m. The groundwater table is likely to be also controlled by the water level in the creek. On November 1, 2002, the water level in the creek was measured at El. 181.5 m. It should be pointed out that the groundwater level is also subject to seasonal fluctuations and in response to major weather events.

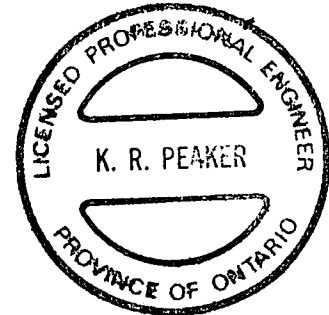
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Z.S. Ozden, P.Eng.

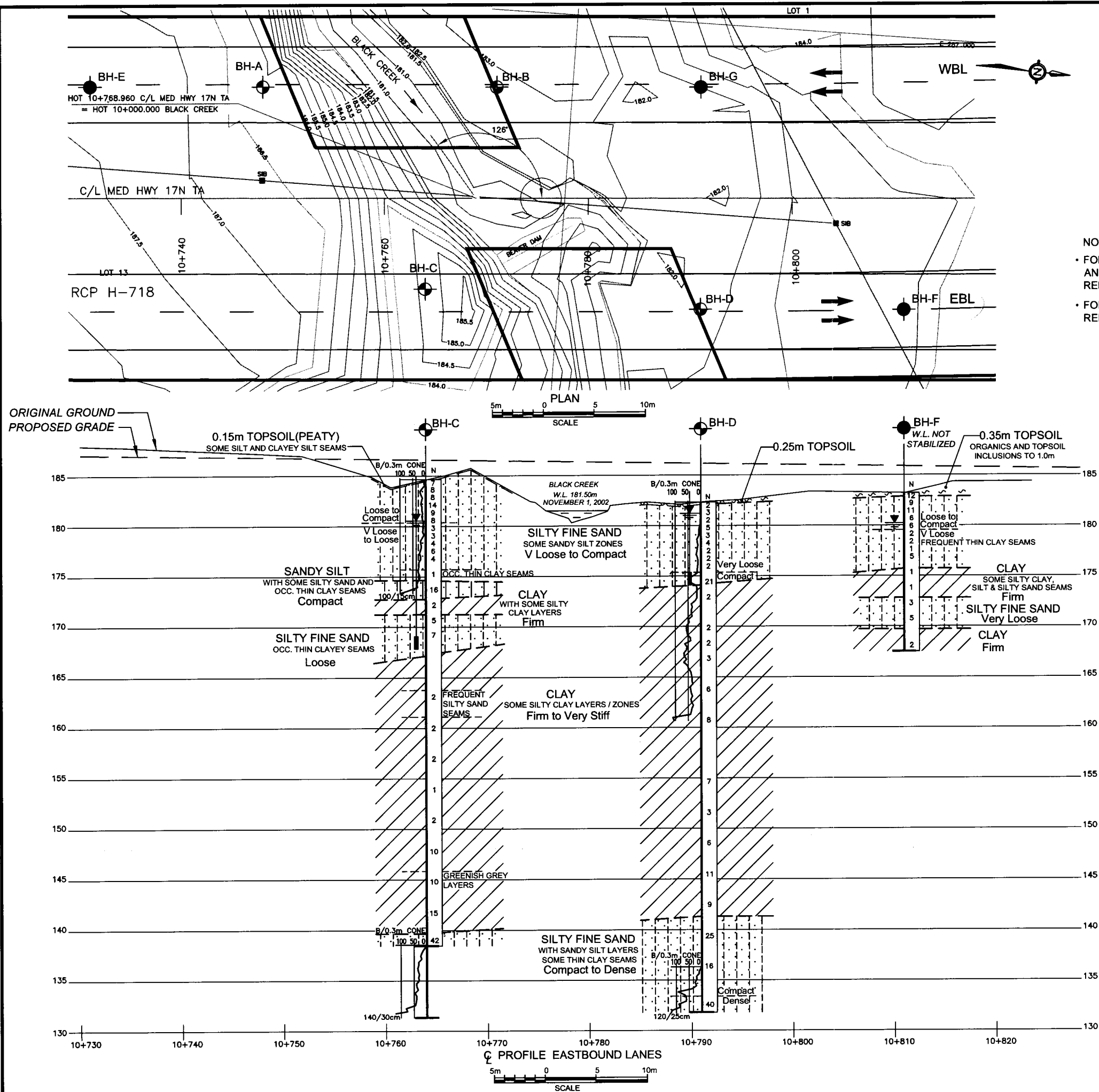


K. R. Peaker, Ph.D., P.Eng.



ZO:tr/hd

Drawings



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
ARE IN KILOMETRES + METRES.

- NOTES:
- FOR DETAILED SUBSURFACE CONDITIONS AND DYNAMIC CONE PENETRATION TESTS REFER TO RECORD OF BOREHOLE SHEETS.
 - FOR WESTBOUND LANES PROFILE REFER TO DRAWING 2.



CONT No.
GWP: 406-01-00

HIGHWAY 17 (NEW)
BLACK CREEK
BORE HOLE LOCATIONS & SOIL STRATA

SHAHEEN & PEAKER LIMITED

KEY PLAN
N.T.S

LEGEND

Bore Hole

Bore Hole & Cone

Blows/0.3m (Std. Pen. Test, 475 J/blow)

Water Level at Time of Investigation
Apr. , May. and Jun. , 2003

Water Level in Piezometer

Piezometer

No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
BH-C	184.7	5 156 486.9	287 028.1
BH-D	182.3	5 156 514.0	287 028.3
BH-F	183.2	5 156 534.0	287 026.9

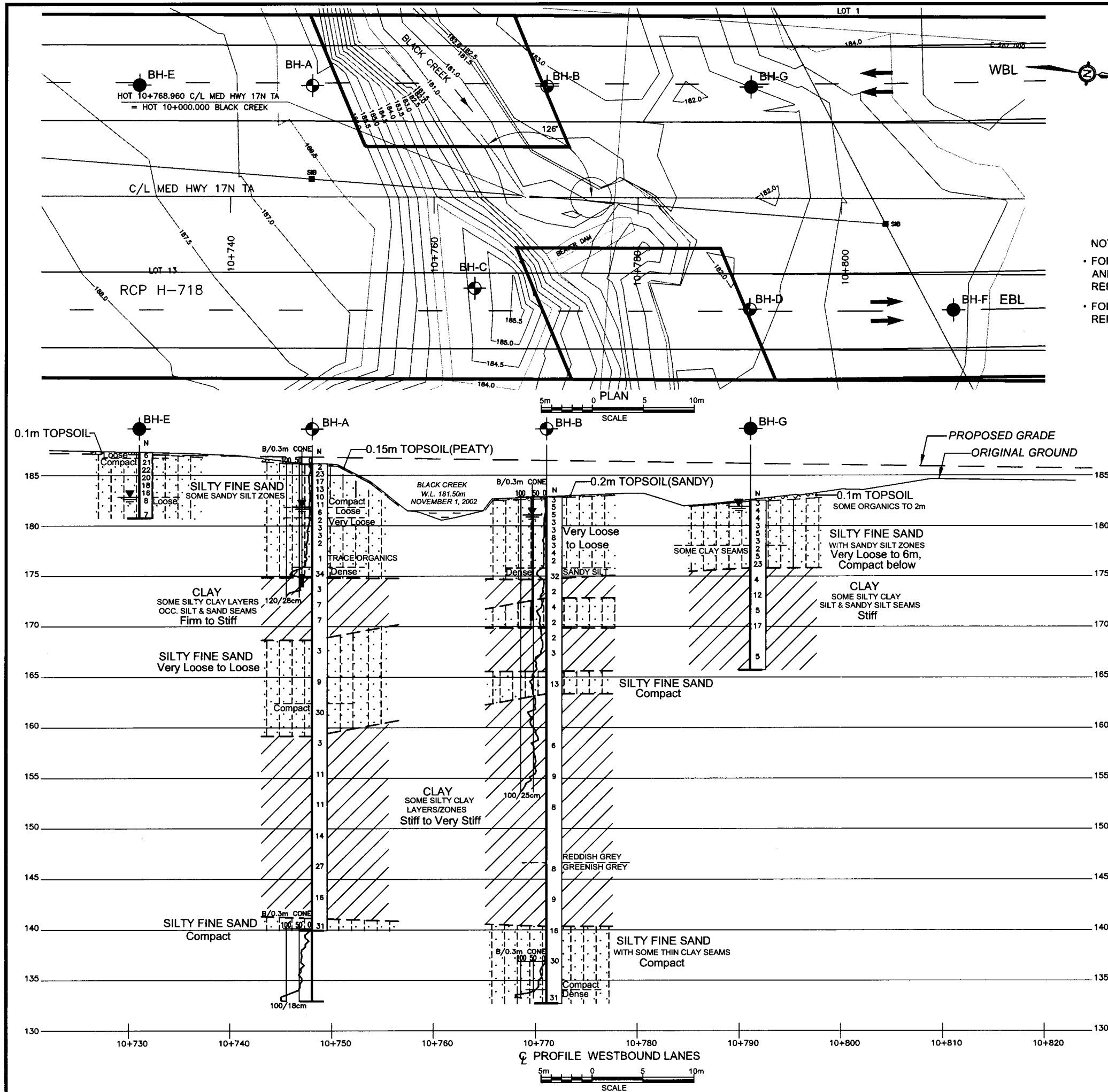
NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents are specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

REV.	DATE	BY	DESCRIPTION

Geocres No. 41K00-060

HWY No. 17 (New)			DIST 62
SUBM'D ZO	CHECKED JP	DATE Jul, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 1



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
ARE IN KILOMETRES + METRES.

- NOTES:
- FOR DETAILED SUBSURFACE CONDITIONS AND DYNAMIC CONE PENETRATION TESTS REFER TO RECORD OF BOREHOLE SHEETS.
 - FOR EASTBOUND LANES PROFILE REFER TO DRAWING 1.



CONT No.
GWP: 406-01-00

HIGHWAY 17 (NEW)
BLACK CREEK
BORE HOLE LOCATIONS & SOIL STRATA

SHAHEEN & PEAKER LIMITED

KEY PLAN
N.T.S.

LEGEND

- Bore Hole
- ⊙ Bore Hole & Cone
- N Blows/0.3m (Std. Pen. Test, 475 J/blow)
- ≡ Water Level at Time of Investigation
Apr. , May. and Jun. , 2003
- ≡ Water Level in Piezometer
- ▬ Piezometer

No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
BH-A	186.2	5 156 469.6	287 009.3
BH-B	182.9	5 156 492.6	287 007.7
BH-E	187.3	5 156 452.7	287 010.5
BH-G	182.5	5 156 512.5	287 006.3

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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REV.	DATE	BY	DESCRIPTION

Geocres No. 41K00-060

HWY No. 17 (New)			DIST 62
SUBM'D ZO	CHECKED JP	DATE Jul, 2003	SITE
DRAWN JZ	CHECKED	APPROVED	DWG 2

Appendix A

Record of Borehole Sheets

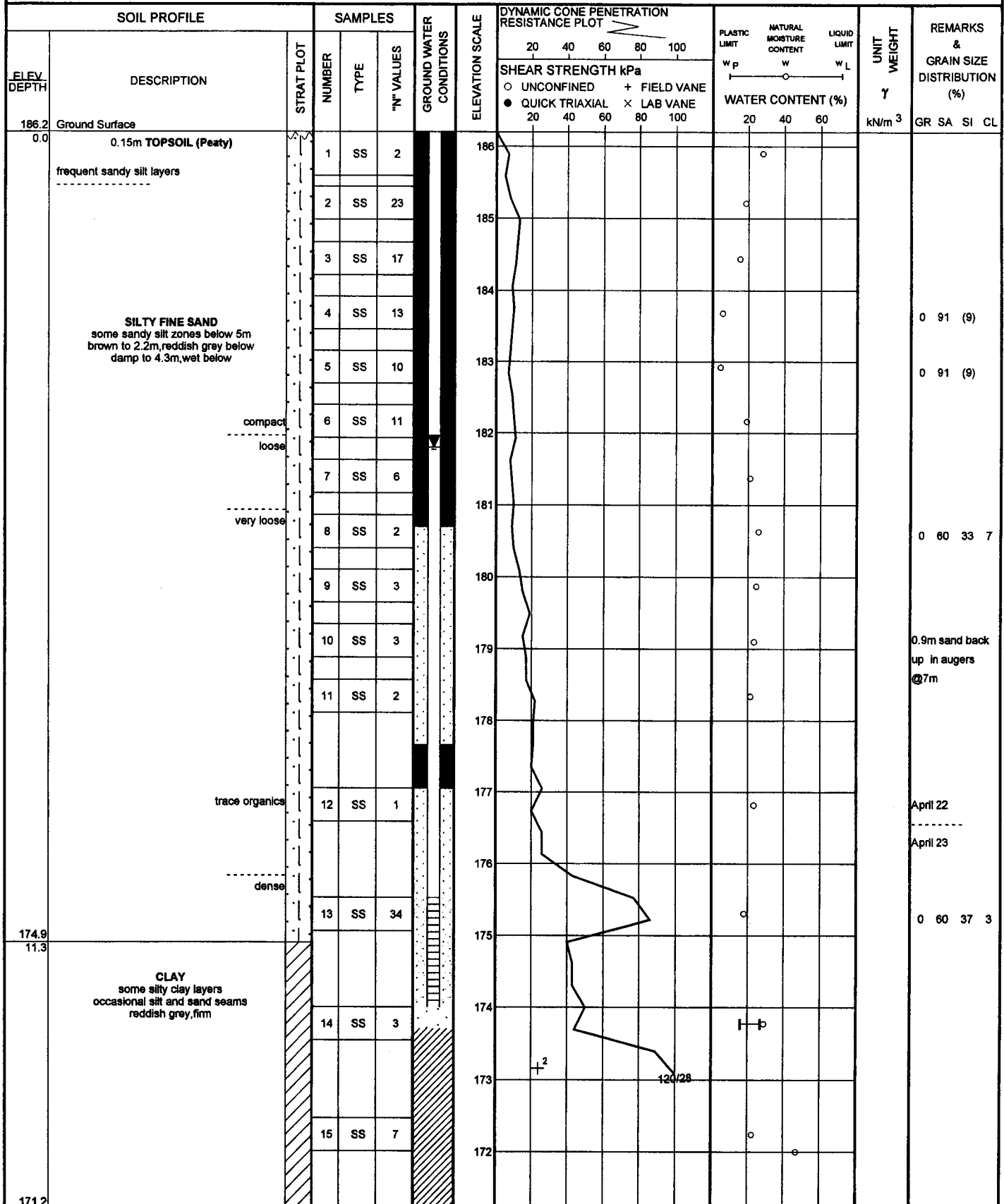
SPT 1074

RECORD OF BOREHOLE No A

1 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 469.6 ; E 287 009.3 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 4/22/2003 to 4/25/2003 CHECKED BY R.M.



Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity
20
15
10 (%) STRAIN AT FAILURE

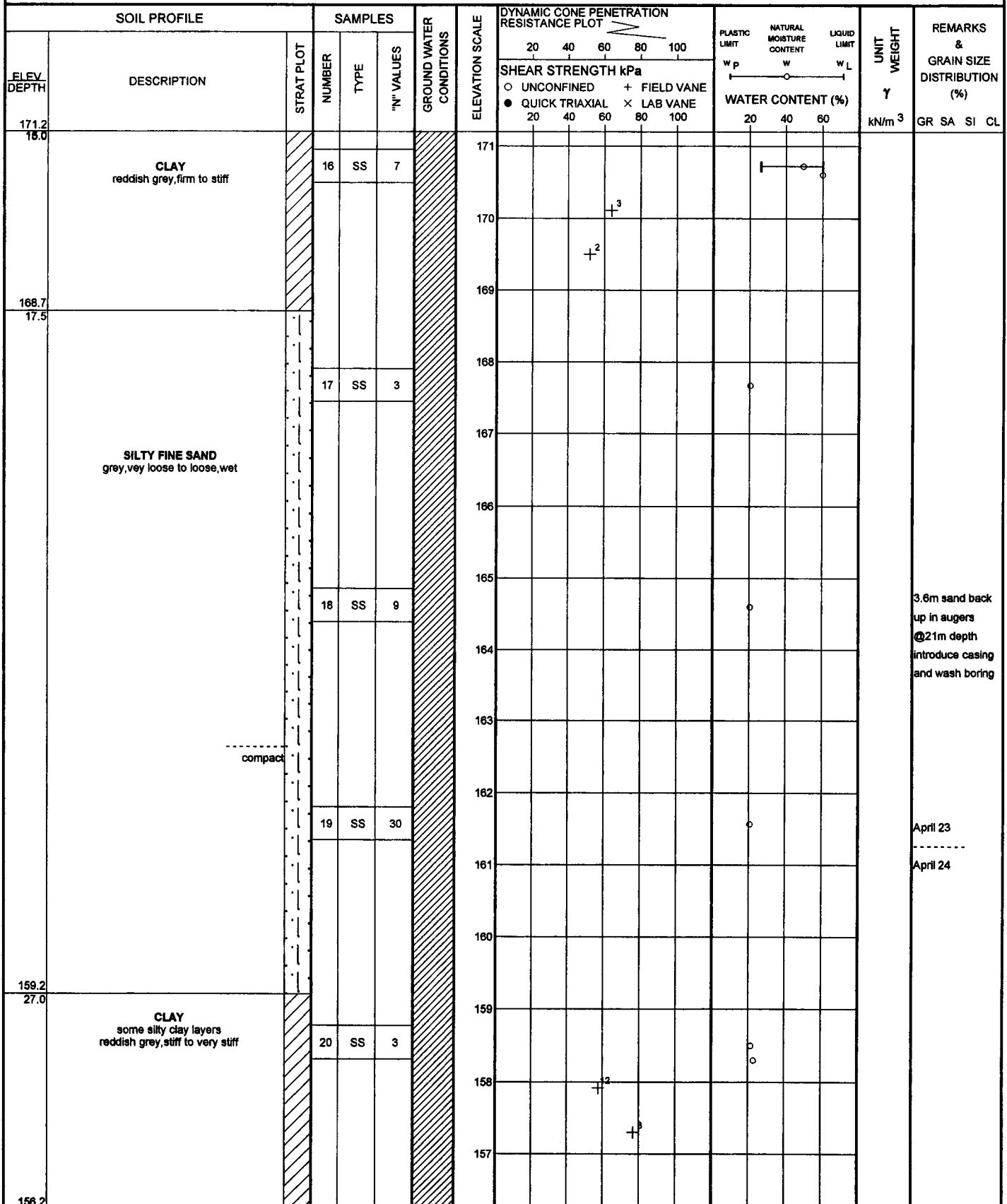
SPT 1074

RECORD OF BOREHOLE No A

2 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 469.6 ; E 287 009.3 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 4/22/2003 to 4/25/2003 CHECKED BY R.M.



Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity
20
15
10
(%) STRAIN AT FAILURE

SPT 1074

RECORD OF BOREHOLE No A

3 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 469.6 ; E 287 009.3 ORIGINATED BY Y.L.
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
 DATUM Geodetic DATE 4/22/2003 to 4/25/2003 CHECKED BY R.M.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
156.2 30.0	CLAY some silty clay zones reddish grey, stiff to very stiff		21	SS	11		156							
							155							
							154							
							153							
					22	SS	11	152						
								151						
								150						
					23	SS	14	149						
								148						
								147						
			24	SS	27		146							
							145							
							144							
			25	SS	16		143							
							142							

141.2

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

SPT 1074

RECORD OF BOREHOLE No A

4 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 469.6 ; E 287 009.3 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 4/22/2003 to 4/25/2003 CHECKED BY R.M.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	WATER CONTENT (%)	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES							
141.2 45.0	SILTY FINE SAND grey, compact, wet					[Hatched Box]	141					April 24
140.0 46.2			26	SS	31		140					April 25 0 72 (28)
133.0 53.2	End of Borehole. Dynamic Cone Penetration Test (D.C.P.T.) performed from 0 to 13.2m and 46.0m to 53.2m						139					
							138					
							137					
							136					
							135					
							134					
							133					
	End of D.C.P.T. Piezometer installed to 12.2 m. Water level on: April, 25, 2003 - 4.3 m (El. 181.9 m) June, 3, 2003 - 4.4 m (El. 181.8 m)											

+ 3, x 3: Numbers refer to
Sensitivity

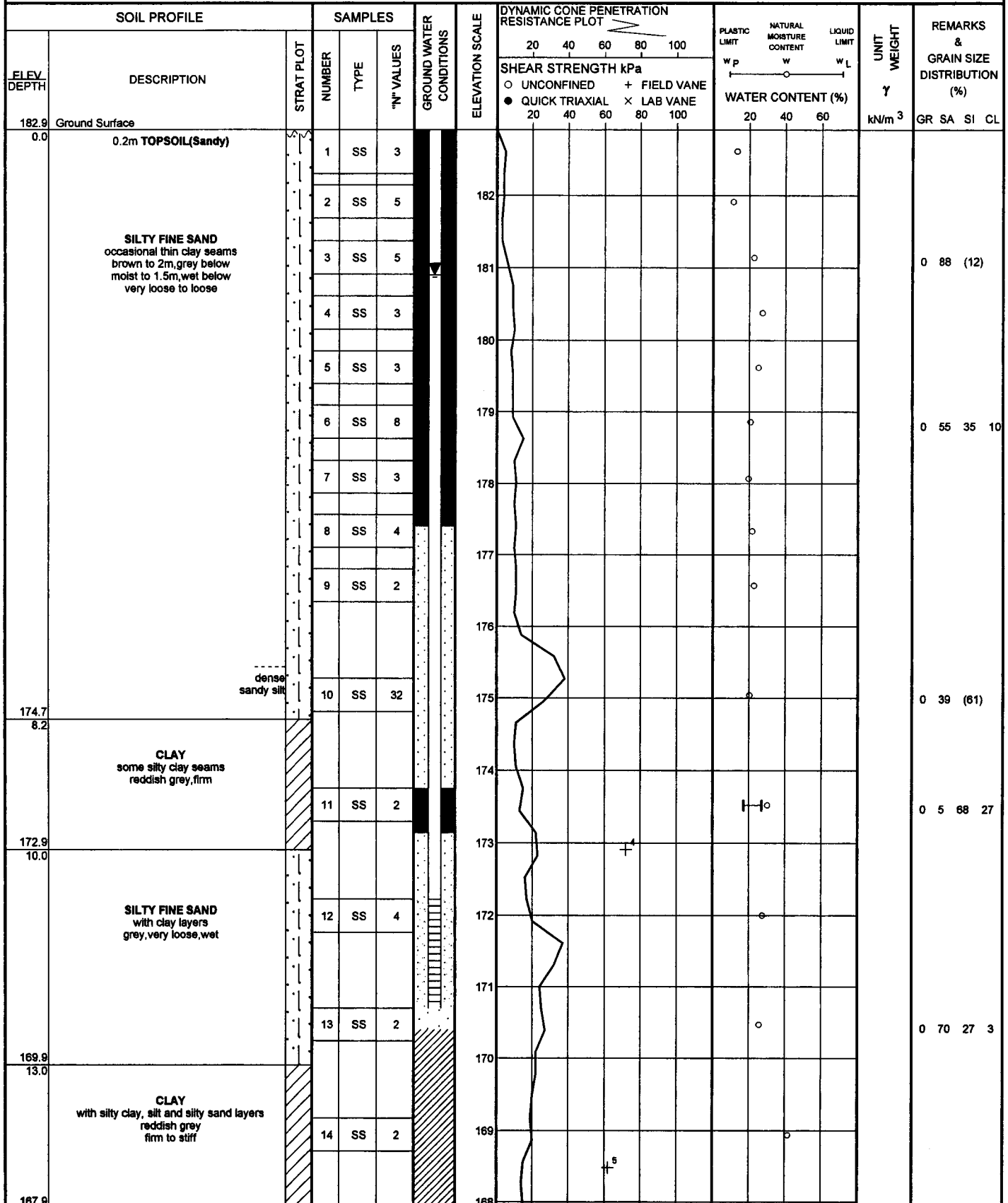
20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No B

1 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 492.6; E 287 007.7 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 5/9/2003 to 5/11/2003 CHECKED BY R.M.



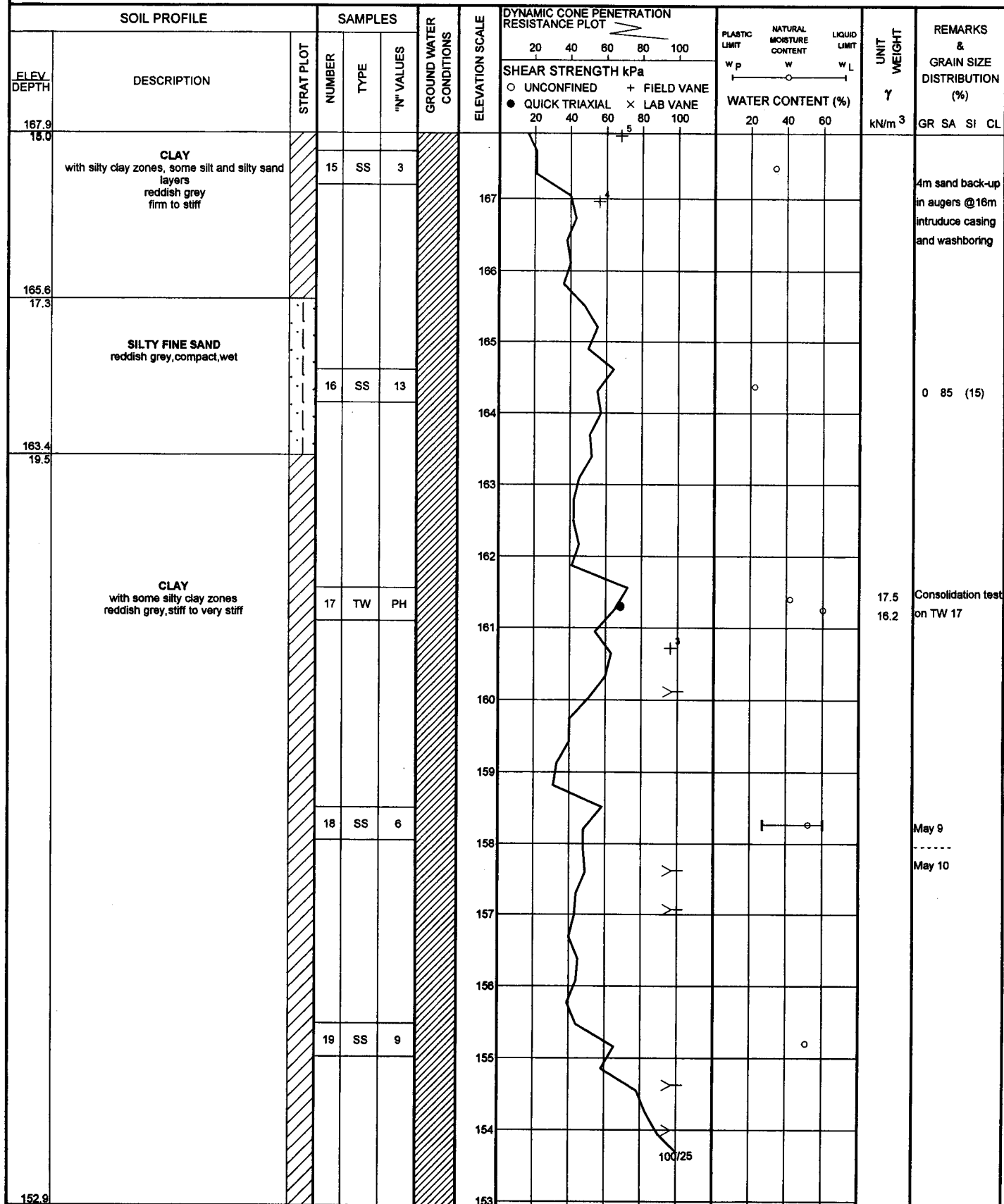
SPT 1074

RECORD OF BOREHOLE No B

2 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 492.6; E 287 007.7 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 5/9/2003 to 5/11/2003 CHECKED BY R.M.



Continued Next Page

+ 3, x 3: Numbers refer to Sensitivity 15-5 10 (%) STRAIN AT FAILURE

SPT 1074

RECORD OF BOREHOLE No B

3 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 492.6; E 287 007.7 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 5/9/2003 to 5/11/2003 CHECKED BY R.M.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
152.9 30.0	CLAY stiff to very stiff		20	SS	8		152					15.4
							151					
							150					
			21	TW	PH		149					
							148					
							147					
			22	SS	8		146					
							145					
							144					
			23	SS	9		143					
	SILTY FINE SAND with some thin clay seams greenish and reddish grey compact, wet						142					
							141					
							140					
							139					
							138					
140.4 42.5			24	SS	16							
137.9												

Continued Next Page

+³, x³: Numbers refer to Sensitivity
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No B

4 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 492.6; E 287 007.7 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 5/9/2003 to 5/11/2003 CHECKED BY R.M.

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
137.9 45.0	SILTY FINE SAND with some sandy silt and thin clay seams grey, wet	compact dense	25	SS	30	137	136	135	134	133				0 44 52 4 May 10 ----- May 11
132.8 50.1			26	SS	31									
<p>End of Borehole.</p> <p>Dynamic Cone Penetration Test (D.C.P.T.) performed from 0 to 29.2m and 45.0m to 49.6m</p> <p>Piezometer installed to 12.2 m. Water level on: May, 11, 2003 - 1.7 m (El. 181.2 m) May, 12, 2003 - 1.8 m (El. 181.1 m) Jun, 3, 2003 - 2.0 m (El. 180.9 m)</p>														

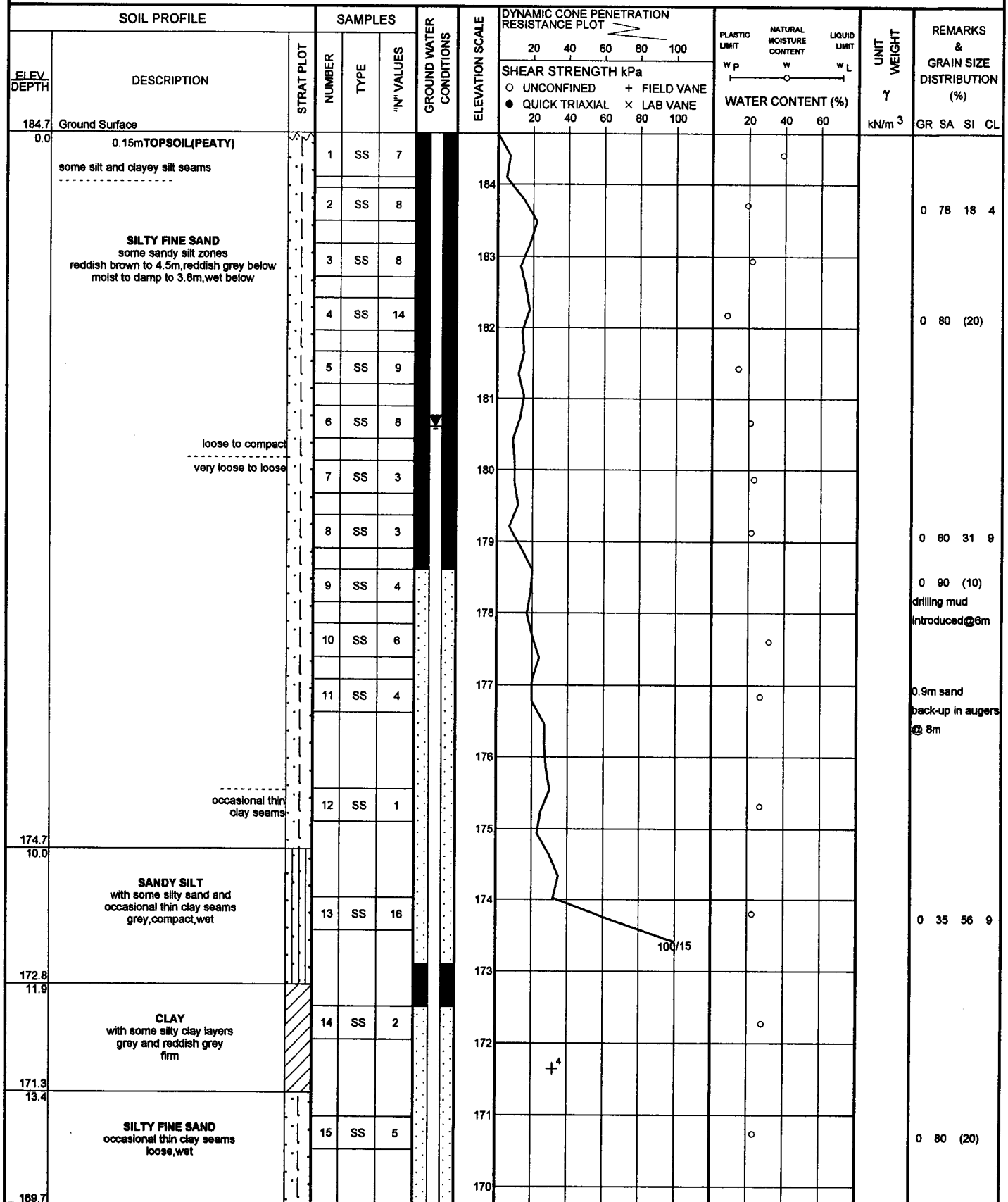
SPT 1074

RECORD OF BOREHOLE No C

1 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 486.9; E 287 028.1 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 4/26/2003 to 4/28/2003 CHECKED BY R.M.



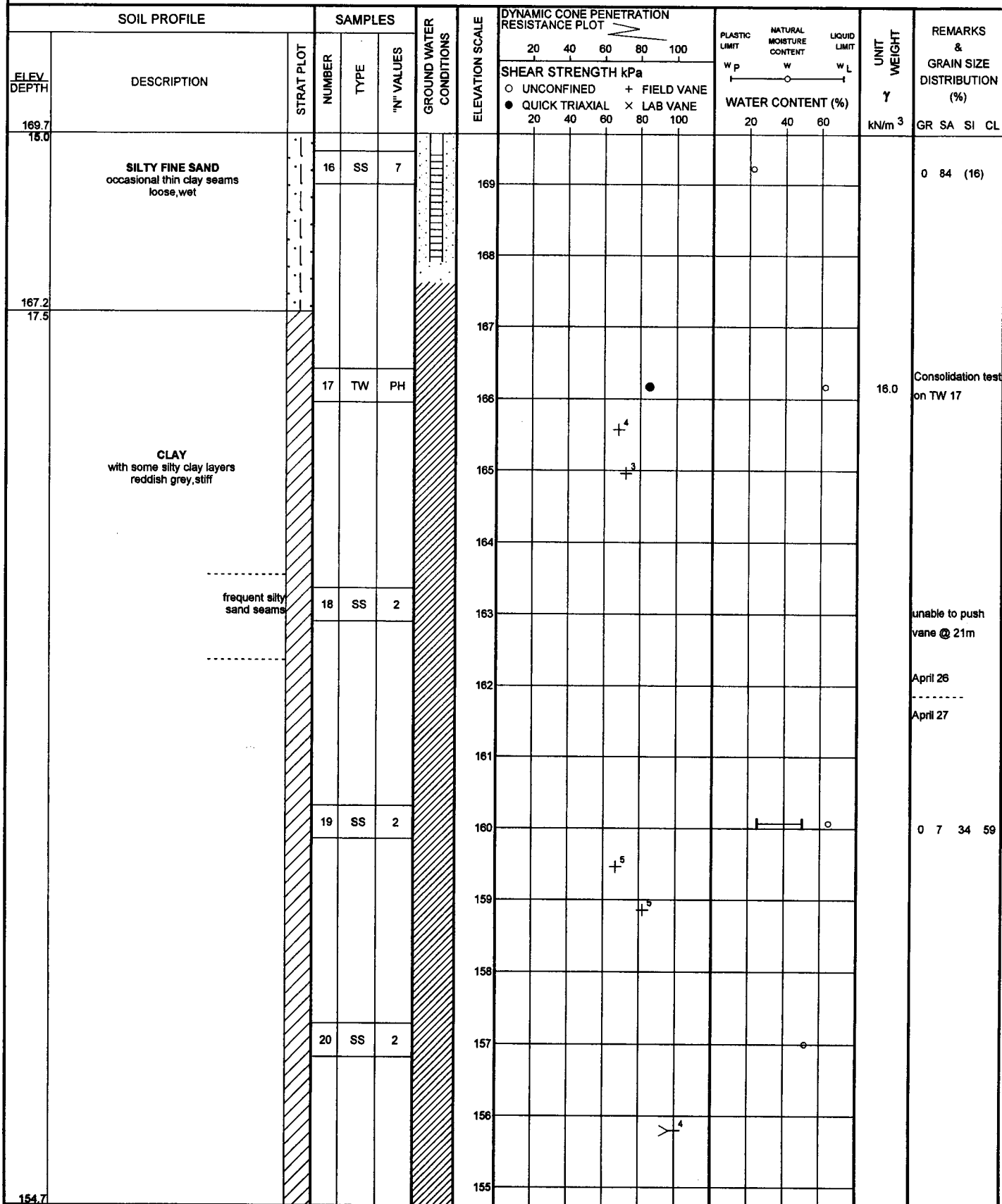
SPT 1074

RECORD OF BOREHOLE No C

2 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 486.9; E 287 028.1 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 4/26/2003 to 4/28/2003 CHECKED BY R.M.



Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

SPT 1074

3 OF 4

METRIC

GWP 406-01-00

LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 486.9; E 287 028.1

ORIGINATED BY Y.L.

DIST 62 HWY 17 (New)

BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T.

COMPILED BY J.Z.

DATUM Geodetic

DATE 4/26/2003 to 4/28/2003

CHECKED BY R.M.

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

SPT 1074

RECORD OF BOREHOLE No C

4 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 486.9; E 287 028.1 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 4/26/2003 to 4/28/2003 CHECKED BY R.M.

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	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
139.7 45.0	SILTY FINE SAND some thin clay seams compact to dense	[Strat Plot]				[Ground Water Conditions]	[Elevation Scale]	[D.C.P. Plot]	[Moisture Content]	[Unit Weight]	[Remarks]
138.5 46.2			26	SS	42						
131.4 53.3	End of Borehole. Dynamic Cone Penetration Test (D.C.P.T.) performed from 0 to 11.3m and 46.1m to 53.3m										
	End of D.C.P.T. Piezometer installed to 16.8 m. Water level on: April, 29, 2003 - 4.0 m (El. 180.7 m) June, 3, 2003 - 4.1 m (El. 180.6 m)										

+ 3 . x 3 : Numbers refer to
Sensitivity

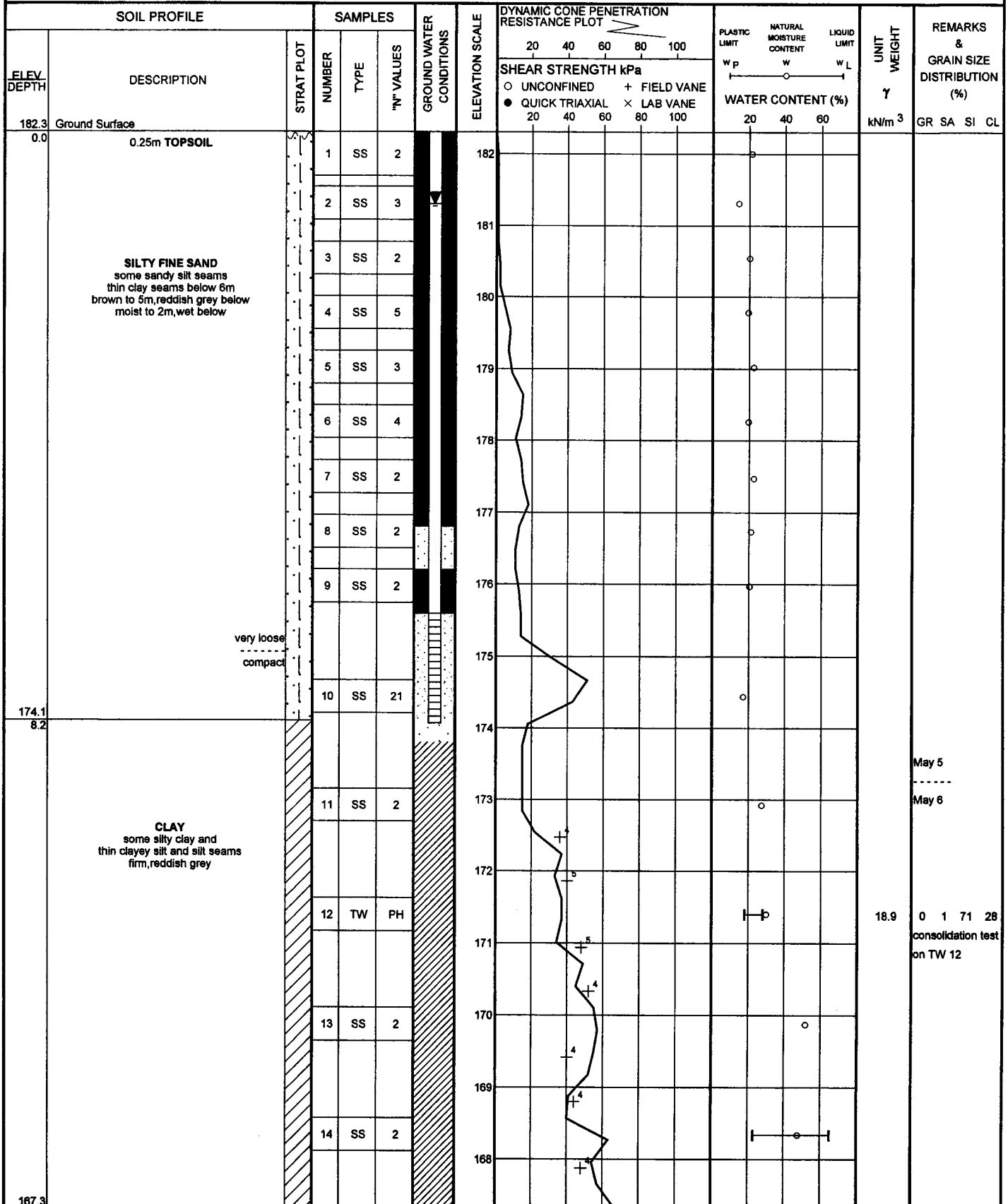
20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No D

1 OF 4

METRIC

GWP 408-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 514.0; E 287 028.3 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 5/5/2003 to 5/8/2003 CHECKED BY R.M.



Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity 15 20 10
(%) STRAIN AT FAILURE

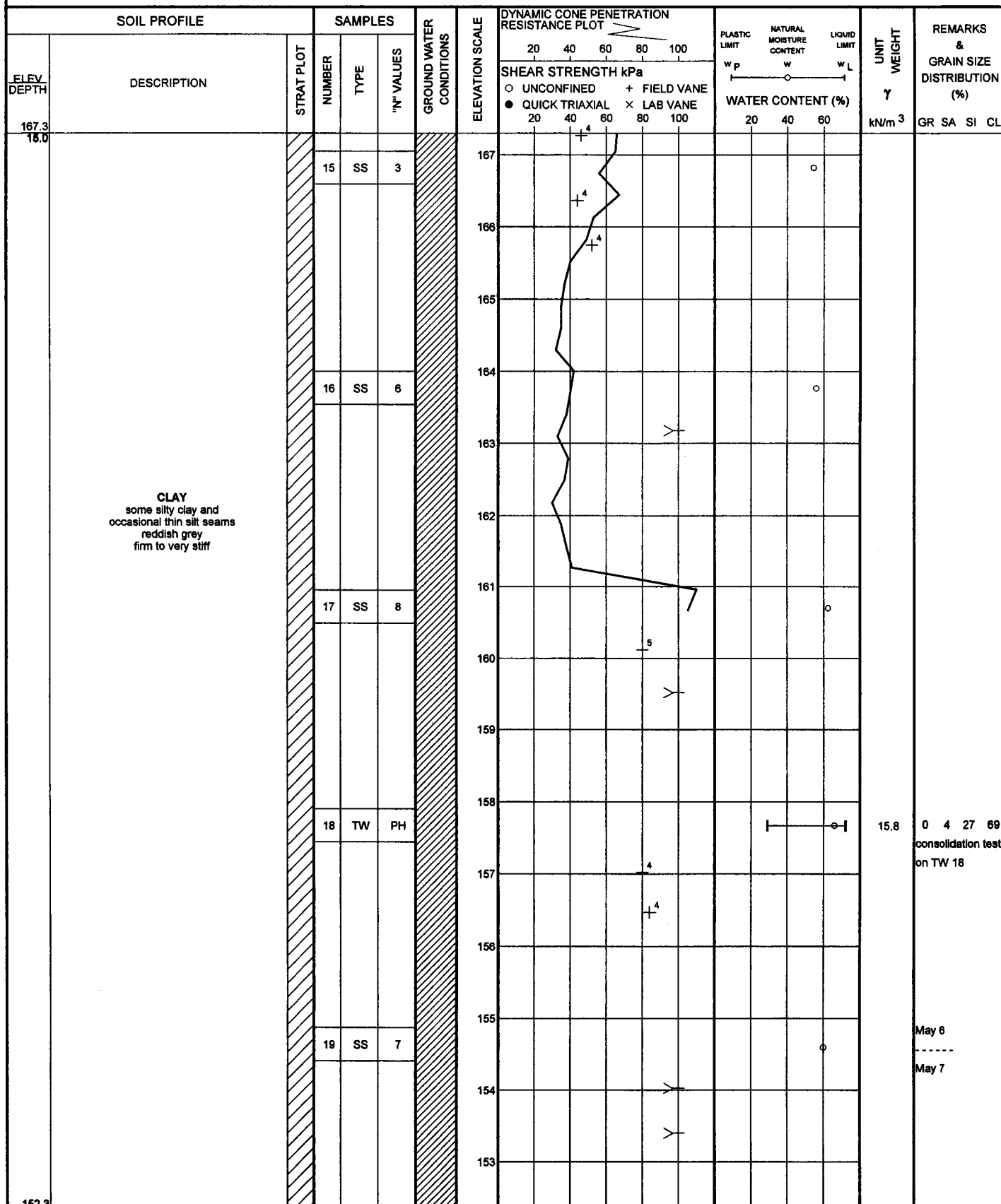
SPT 1074

RECORD OF BOREHOLE No D

2 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 514.0; E 287 028.3 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 5/5/2003 to 5/8/2003 CHECKED BY R.M.



Continued Next Page

+ 3, x 3; Numbers refer to
Sensitivity
20
15 10 5 (%) STRAIN AT FAILURE

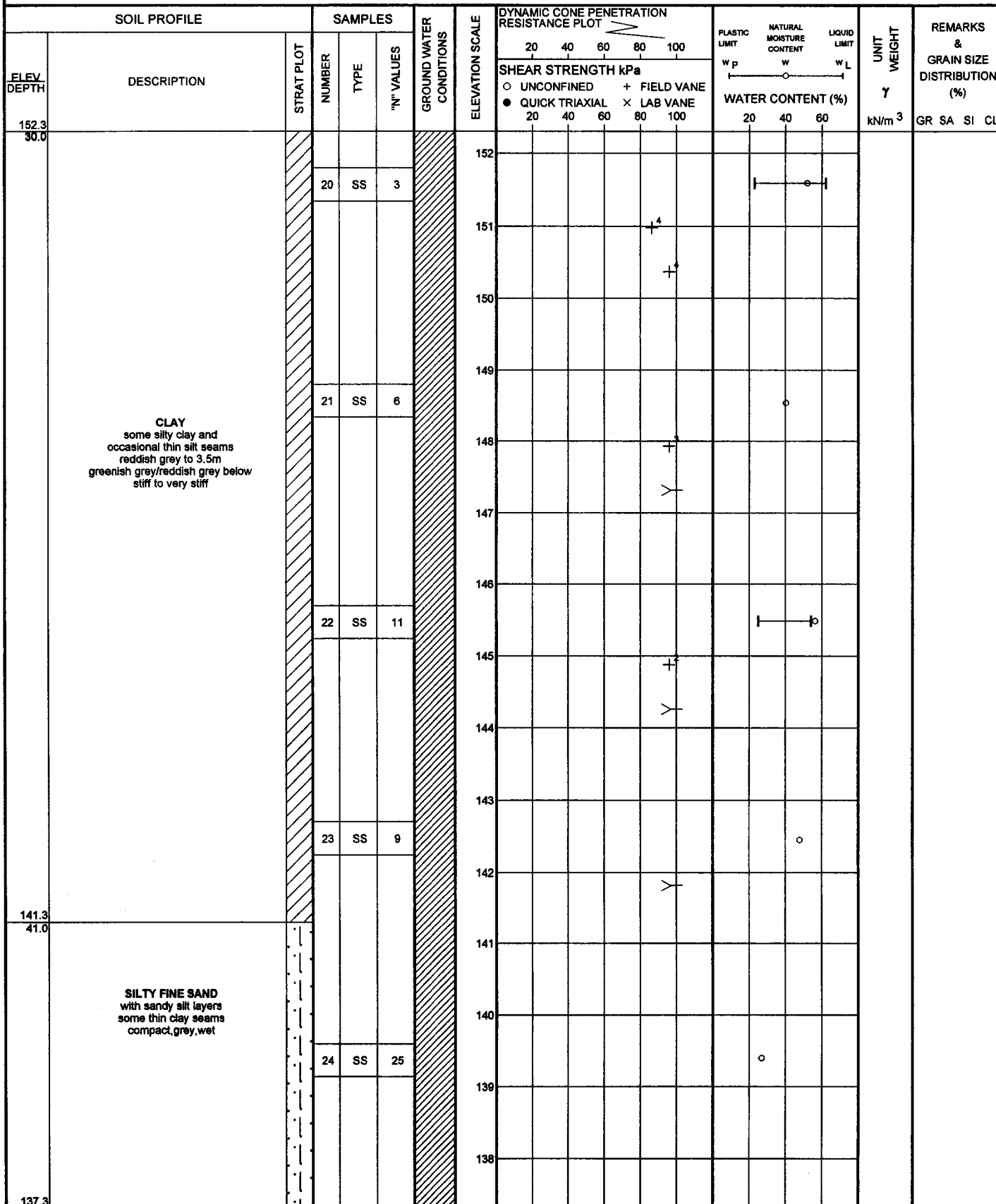
SPT 1074

RECORD OF BOREHOLE No D

3 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 514.0; E 287 028.3 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 5/5/2003 to 5/8/2003 CHECKED BY R.M.



Continued Next Page

+ 3, × 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

SPT 1074

RECORD OF BOREHOLE No D

4 OF 4

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 514.0; E 287 028.3 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers, Casing & Washboring, D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 5/5/2003 to 5/8/2003 CHECKED BY R.M.

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
137.3 46.0	SILTY FINE SAND with sandy silt layers some thin clay seams wet <													

SPT 1074

RECORD OF BOREHOLE No E

1 OF 1

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 452.7; E 287 010.5 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
DATUM Geodetic DATE 4/29/2003 CHECKED BY R.M.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
187.3 0.0	Ground Surface 0.1m TOPSOIL some clayey silt seams to 0.7m		1	SS	6		187							
		loose	2	SS	21		186							
		compact	3	SS	22		185							0 65 28 7
	SILTY FINE SAND some sandy silt zones brown to 4.5m, reddish grey below moist to 4.5m, wet below		4	SS	20		184							
			5	SS	18		183							
			6	SS	16		182							
		loose	7	SS	8		181							sampler wet @ 4.5m
180.7 6.6	End of Borehole. * Water level on: April, 29, 2003 - 4.5 m (El. 182.8 m)		8	SS	7									

RECORD OF BOREHOLE No F

1 OF 2

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 534.0; E 287 026.9 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
DATUM Geodetic DATE 5/5/2003 CHECKED BY R.M.

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	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
183.2 0.0	Ground Surface						183								
	0.35m TOPSOIL organics and topsoil inclusions to 1.0 m		1	SS	12										
	SILTY FINE SAND with sand silt zones brown to 1.5m reddish grey 1.5 to 3m, grey below moist to 1.5m, wet below		2	SS	9		182								0 72 (28)
			3	SS	11										
			4	SS	6		181								0 65 27 8
			5	SS	6		180								sampler wet @ 3m
	loose to compact														
	very loose		6	SS	2		179								
	frequent thin clay seams		7	SS	2		178								
			8	SS	1										
			9	SS	5		177								
175.7 7.5	CLAY some silty clay silt and silty sand seams grey, firm		10	SS	1		176								
							175								
			11	SS	1		174								
172.8 10.4	SILTY FINE SAND reddish grey, very loose wet		12	SS	3		173								
							172								
			13	SS	5		171								0 75 22 3
169.7 13.5	CLAY reddish grey, firm						170								
168.2							169								

Continued Next Page

+ 3 . x 3 : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

SPT 1074

RECORD OF BOREHOLE No F

2 OF 2

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 534.0; E 287 026.9 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
DATUM Geodetic DATE 5/5/2003 CHECKED BY R.M.

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
168.2 18.0	CLAY reddish grey, firm		14	SS	2		168										
167.5 15.7																	
	End of Borehole. * Water level on completion: May, 5, 2003 - 3 m (not stabilized)																

SPT 1074

RECORD OF BOREHOLE No G

1 OF 2

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 512.5; E 267 006.3 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
DATUM Geodetic DATE 5/8/2003 CHECKED BY R.M.

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	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
182.5 0.0	Ground Surface														
	0.1m TOPSOIL some organics to 2m		1	SS	3		182								
			2	SS	4										
			3	SS	4		181								
	SILTY FINE SAND with sandy silt zones brown to 1.5m, grey below very loose to 6m, compact below		4	SS	3		180								
			5	SS	5		179								
			6	SS	3										
			7	SS	2		178								
		some clay seams	8	SS	5		177								
			9	SS	23		176								
175.8 6.7			10	SS	4		175								
							174								
	CLAY some silty clay silt and sandy silt seams reddish grey, stiff		11	SS	12		173								
			12	SS	5		172								
							171								
			13	SS	17		170								
167.5							169								
							168								

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

SPT 1074

RECORD OF BOREHOLE No G

2 OF 2

METRIC

GWP 406-01-00 LOCATION Black Creek, Sault Ste. Marie, ON - Coords: N 5 156 512.5; E 287 006.3 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
DATUM Geodetic DATE 5/8/2003 CHECKED BY R.M.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
167.5 16.0	CLAY reddish grey, stiff		14	SS	5		167							
165.7 16.8							166							
165.7 16.8														
165.7 16.8	End of Borehole. * Water level on: May, 8, 2003 - 0.6 m (El. 181.9 m)													

Appendix B

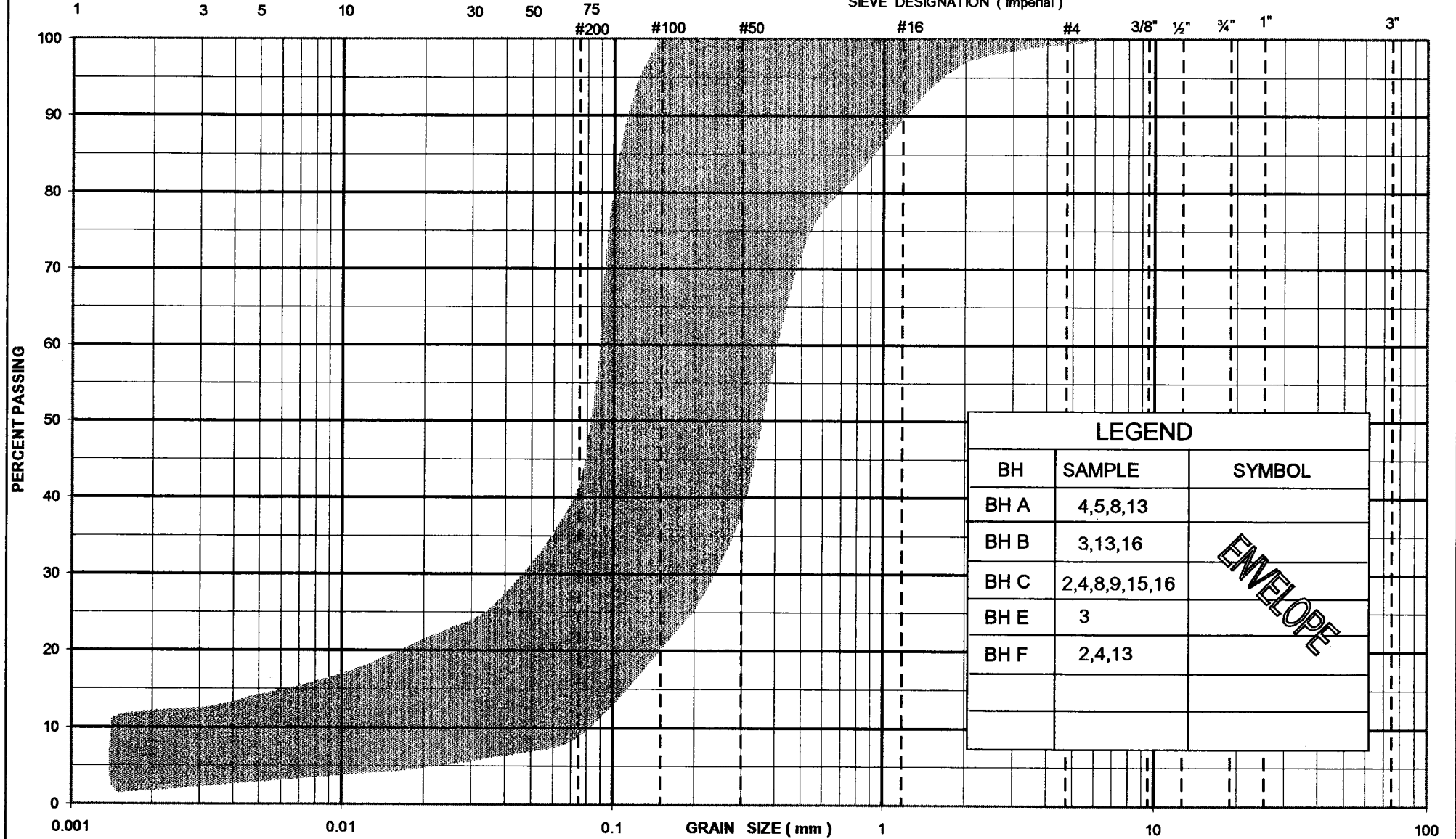
Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse

GRAIN SIZE IN MICROMETERS

SIEVE DESIGNATION (Imperial)



SHAHEEN & PEAKER LIMITED

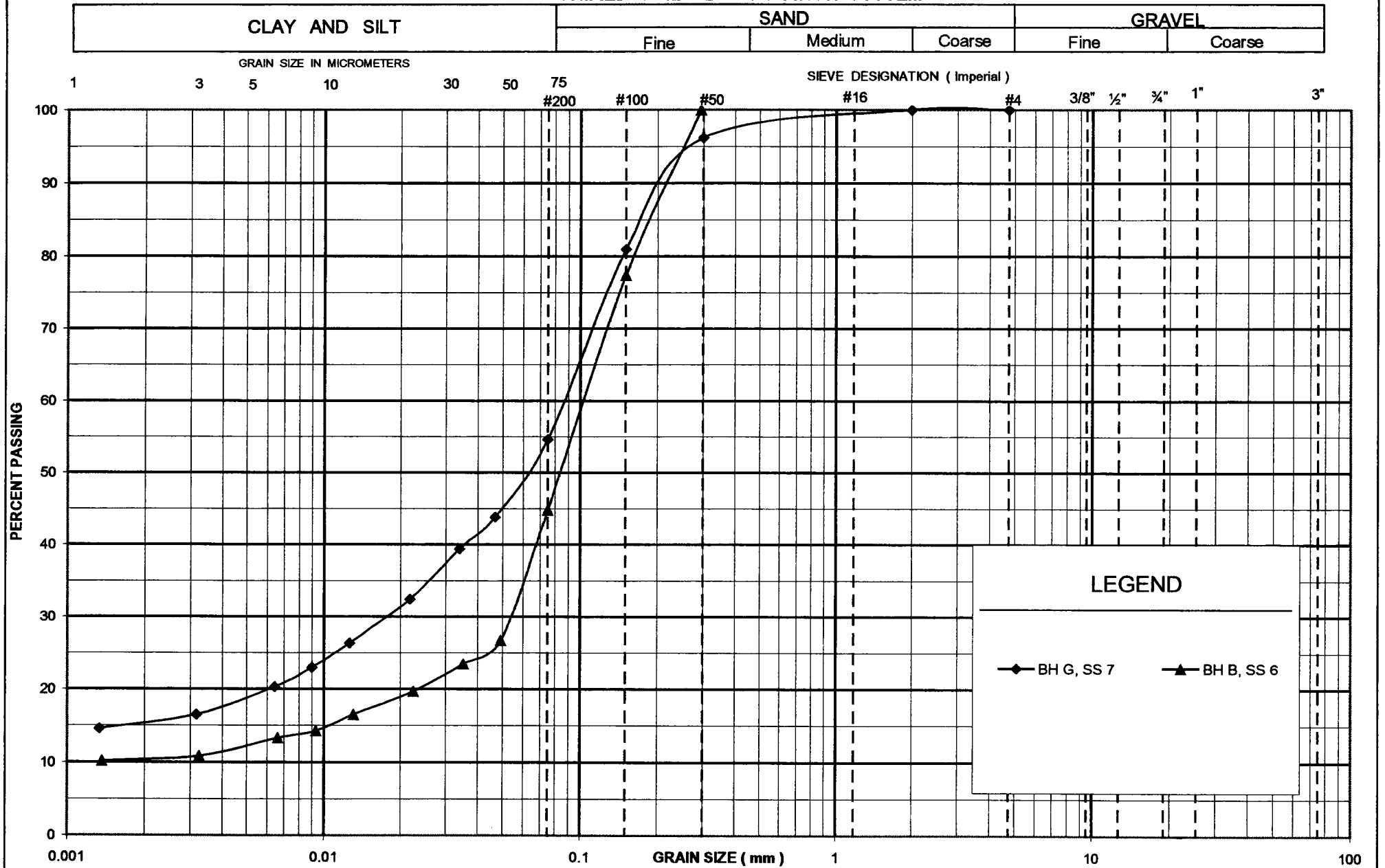
GRAIN SIZE DISTRIBUTION
SILTY FINE SAND

FIGURE No. B - 1

REF. No. SPT1074

GWP: 406-01-00

UNIFIED SOIL CLASSIFICATION SYSTEM

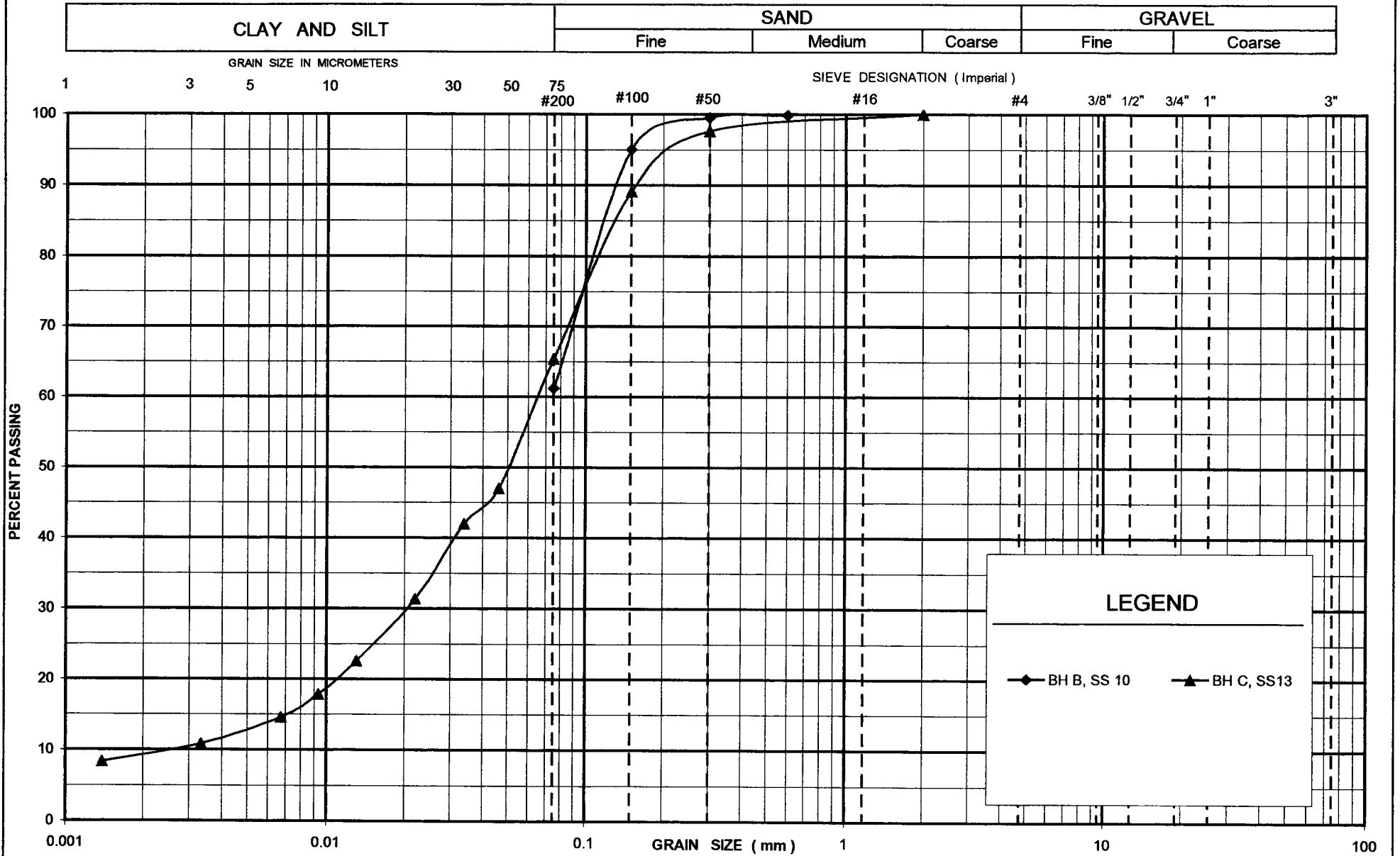


SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION
SILTY FINE SAND, with some sandy silt and thin clay seams

FIGURE No. B - 2
 REF. No. SPT1074
 GWP: 406-01-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND

◆ BH B, SS 10 ▲ BH C, SS 13

SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION
SANDY SILT

FIGURE No. B - 3

REF. No. SPT 1074

GWP: 406-01-00

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT

SAND

GRAVEL

Fine

Medium

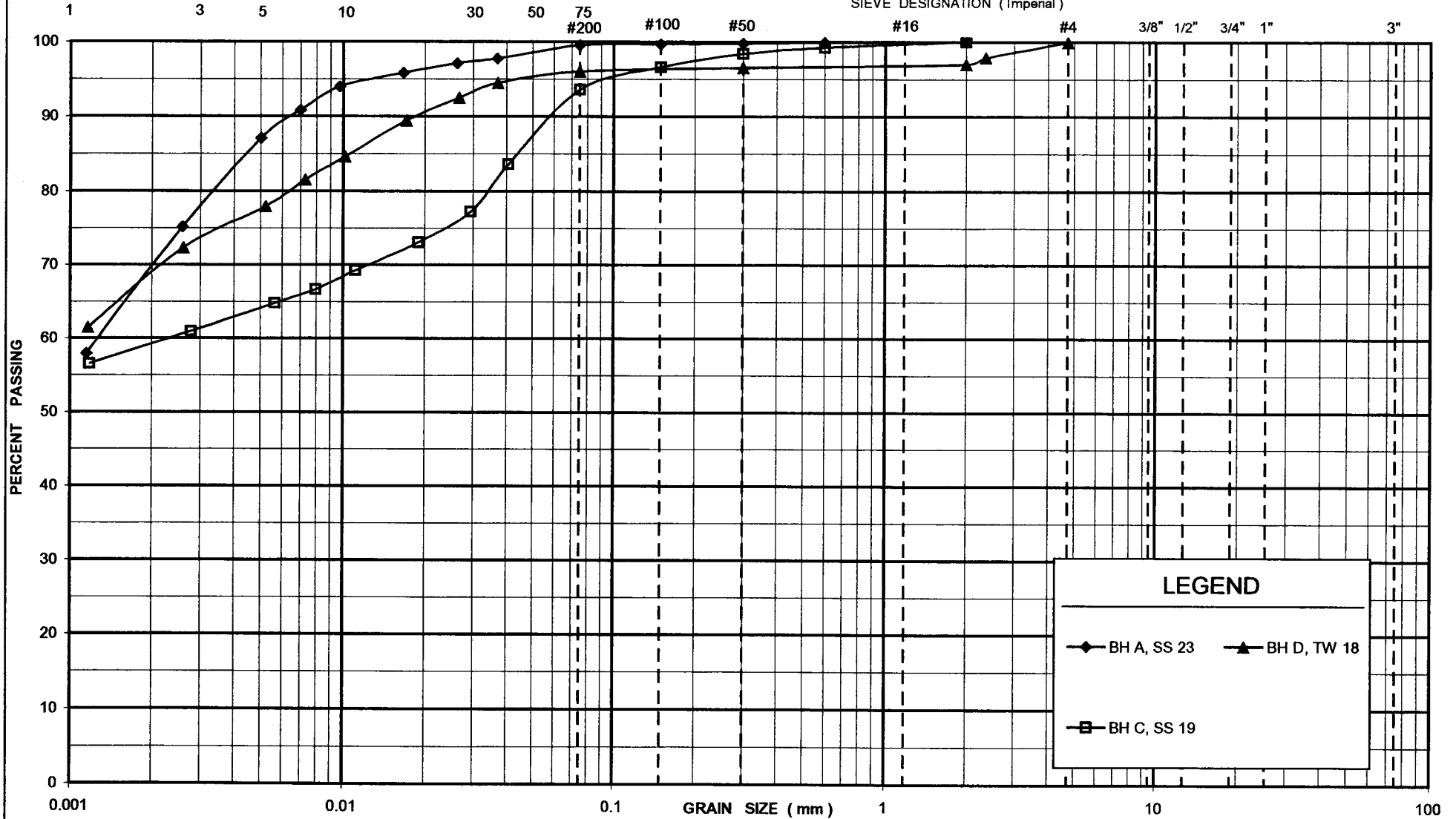
Coarse

Fine

Coarse

GRAIN SIZE IN MICROMETERS

SIEVE DESIGNATION (Imperial)



LEGEND

- ◆ BH A, SS 23
- ▲ BH D, TW 18
- BH C, SS 19

SHAHEEN & PEAKER LIMITED

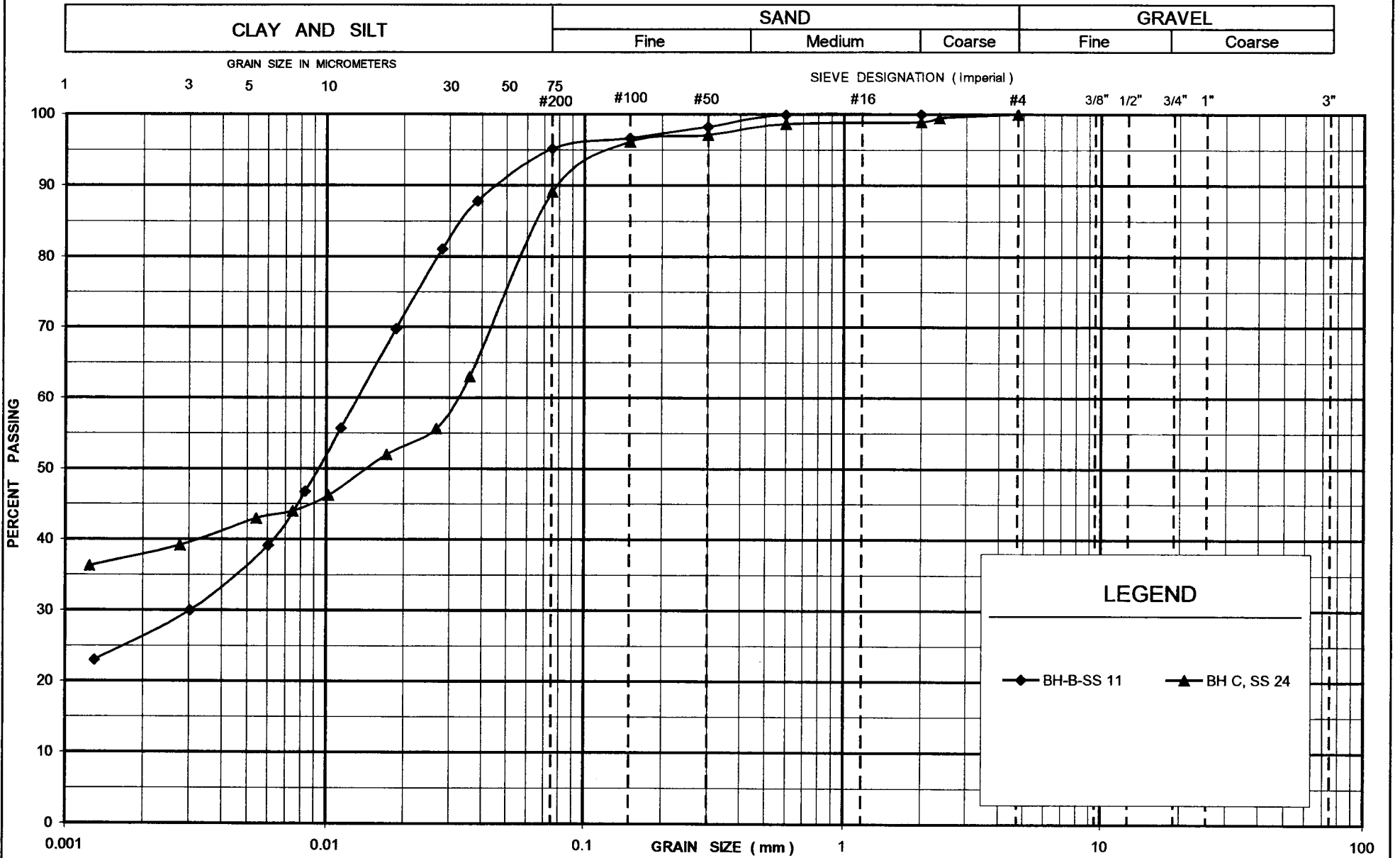
GRAIN SIZE DISTRIBUTION
CLAY

FIGURE No. B - 4

REF. No. SPT 1074

GWP: 406-01-00

UNIFIED SOIL CLASSIFICATION SYSTEM



SHAHEEN & PEAKER LIMITED

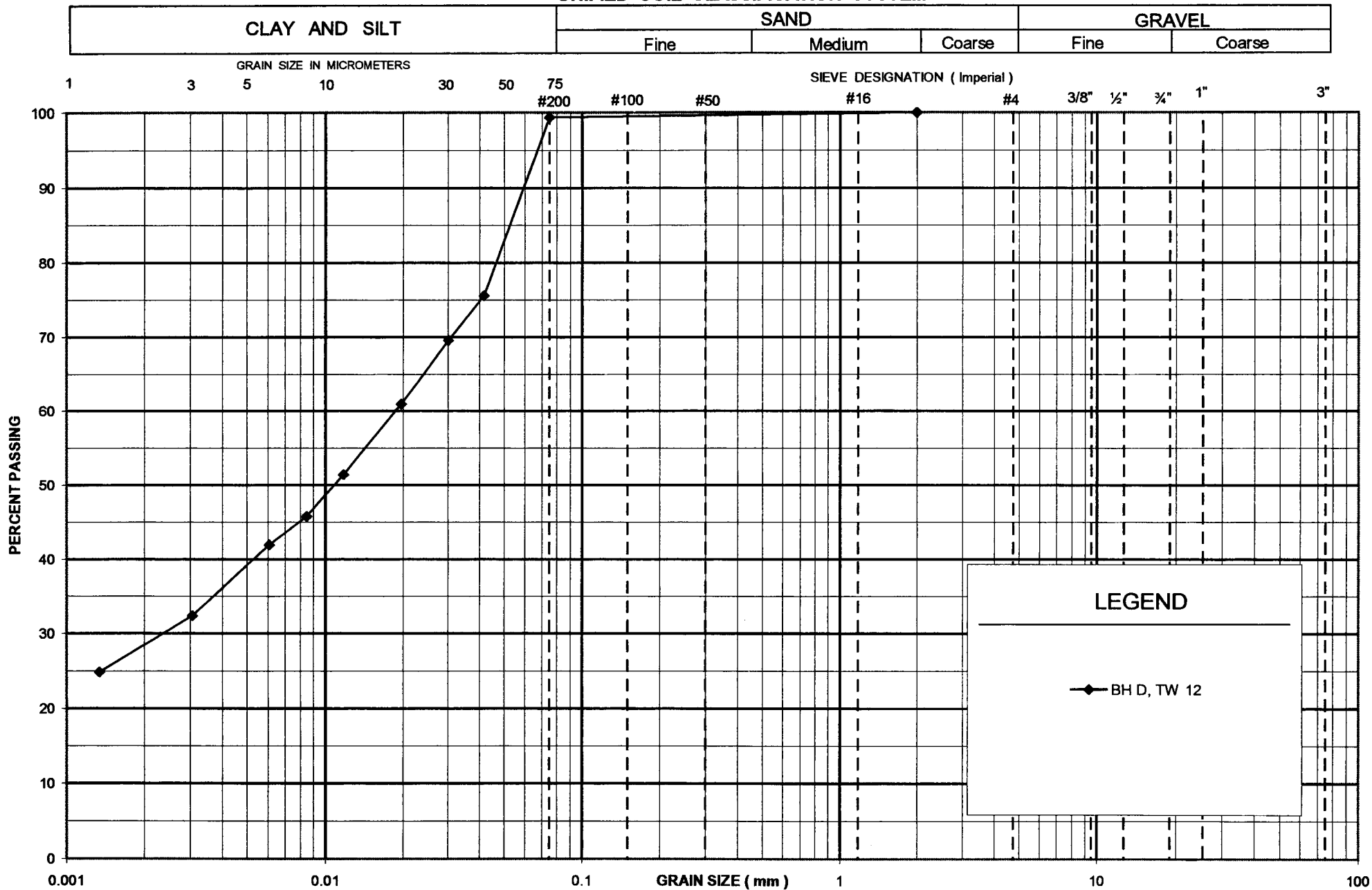
GRAIN SIZE DISTRIBUTION
CLAY

FIGURE No. B - 5

REF. No. SPT 1074

GWP: 406-01-00

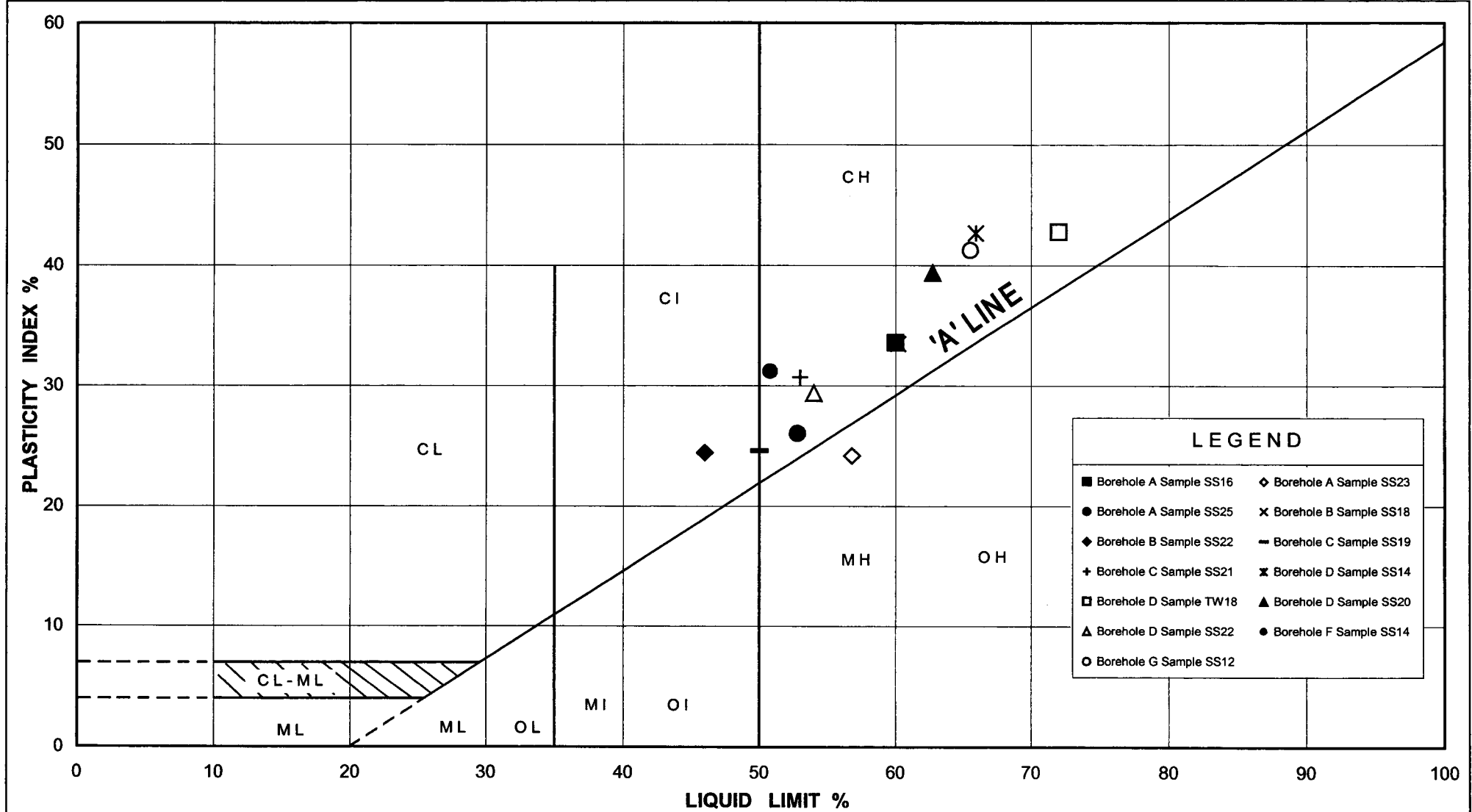
UNIFIED SOIL CLASSIFICATION SYSTEM



SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION
CLAY, with silty clay, clayey silt and silt seams

FIGURE No.	B - 6
REF. No.	SPT 1074
GWP:	406-01-00



SHAHEEN & PEAKER LIMITED

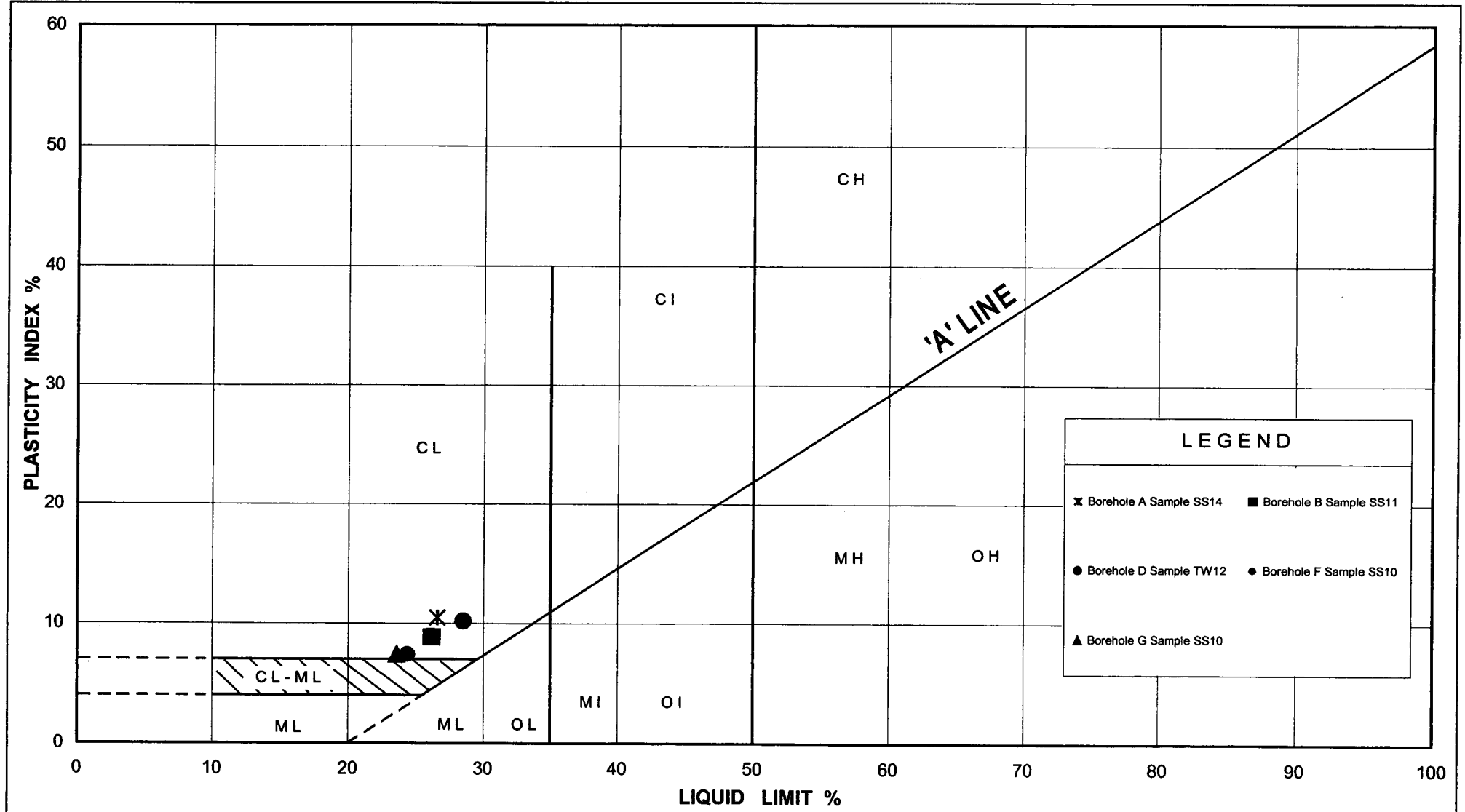
PLASTICITY CHART

CLAY

FIG No B-7

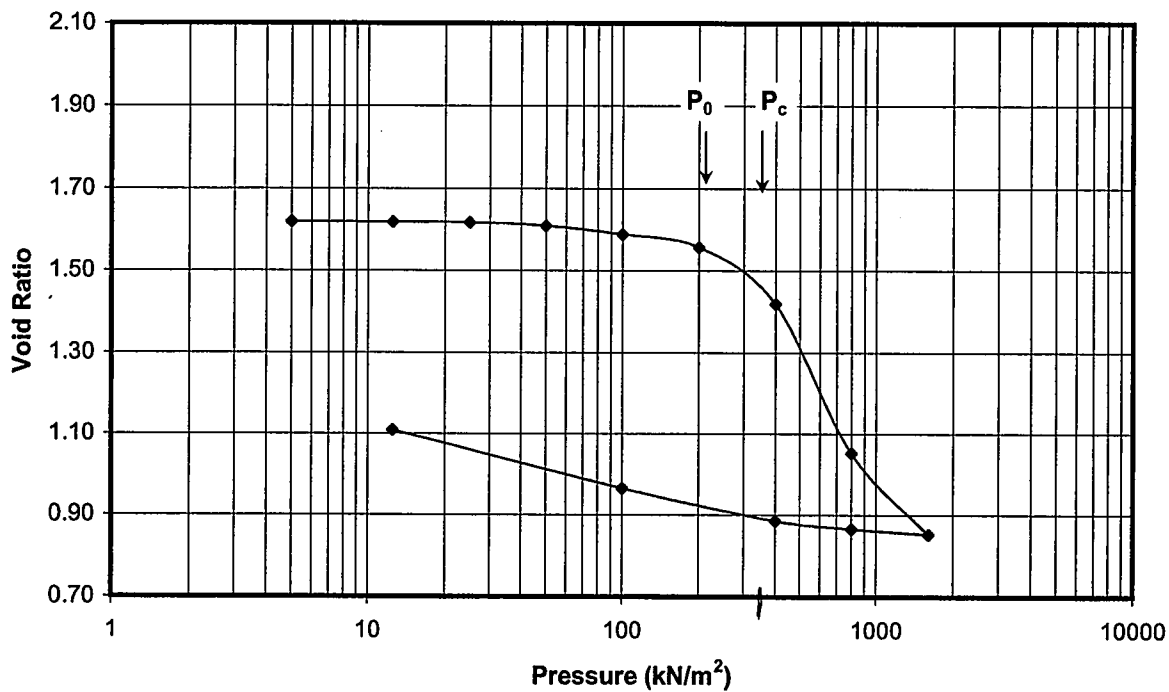
G.W.P. 406-01-00

SPT 1074

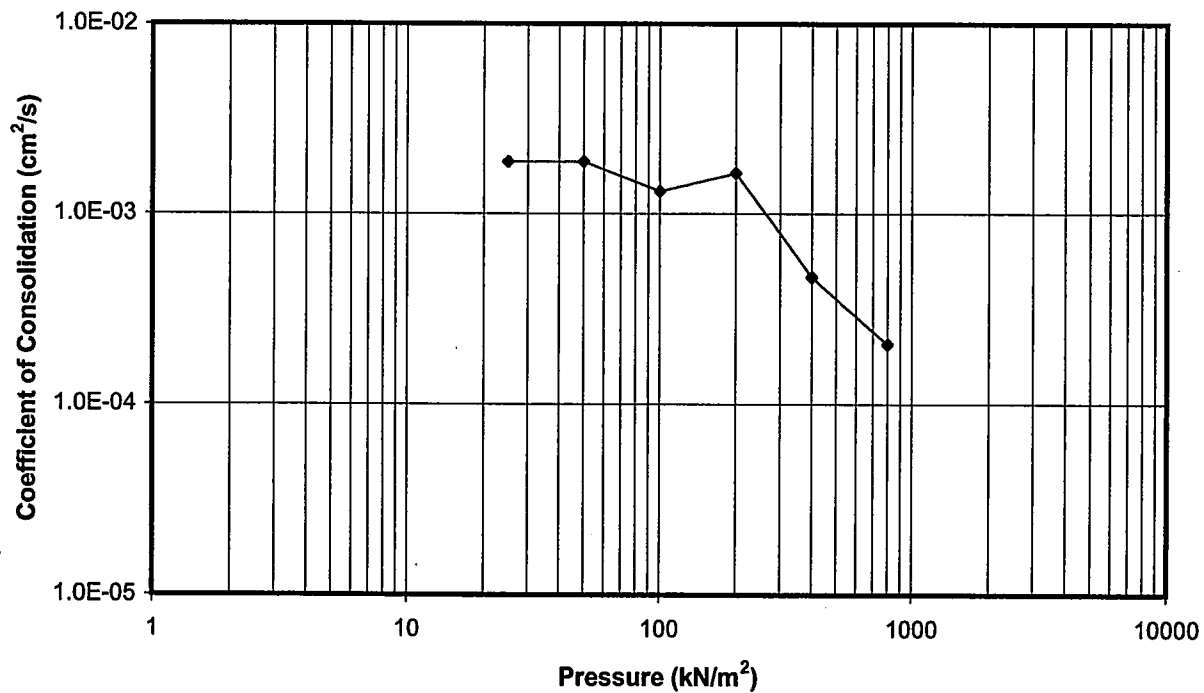


SHAHEEN & PEAKER LIMITED	PLASTICITY CHART CLAYEY SILT TO SILTY CLAY LAYERS in the Clay Deposit	FIG No B-8
		G.W.P. 406-01-00
		SPT 1074

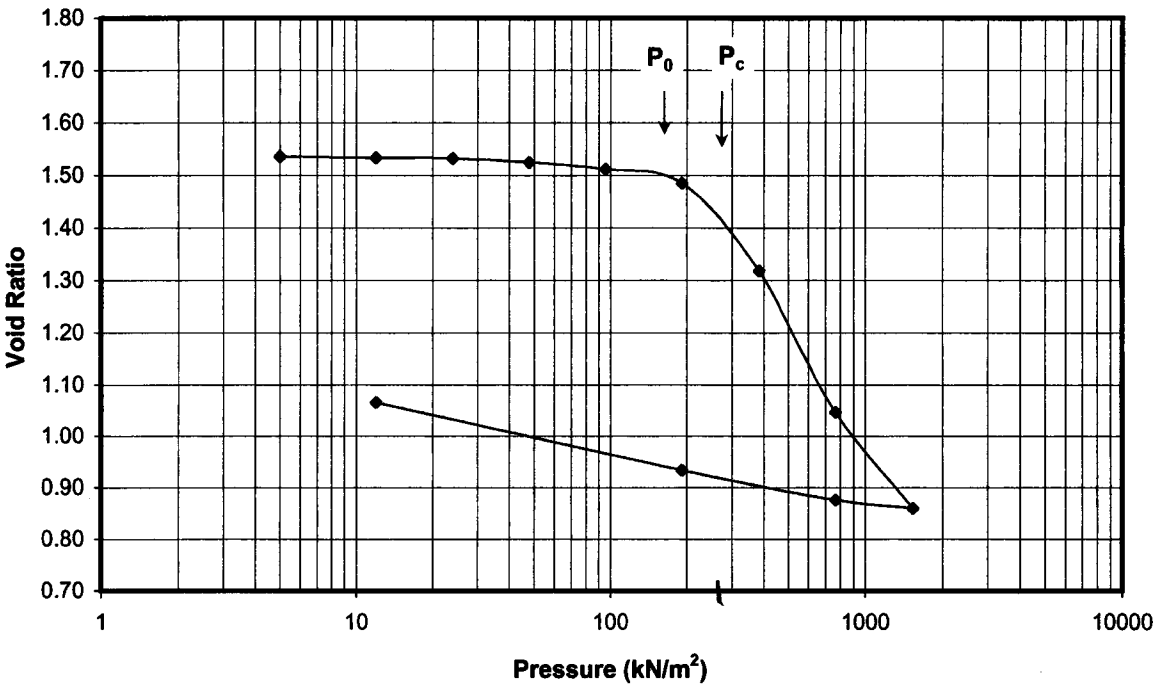
Void Ratio versus Pressure



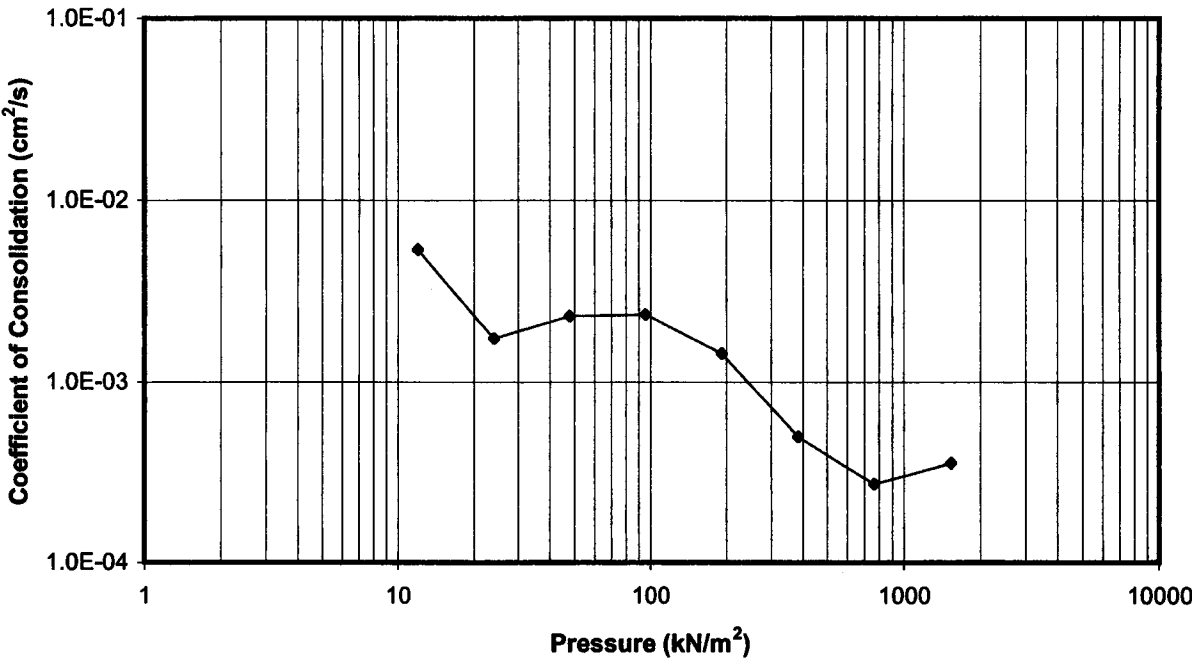
Coefficient of Consolidation vs. Pressure



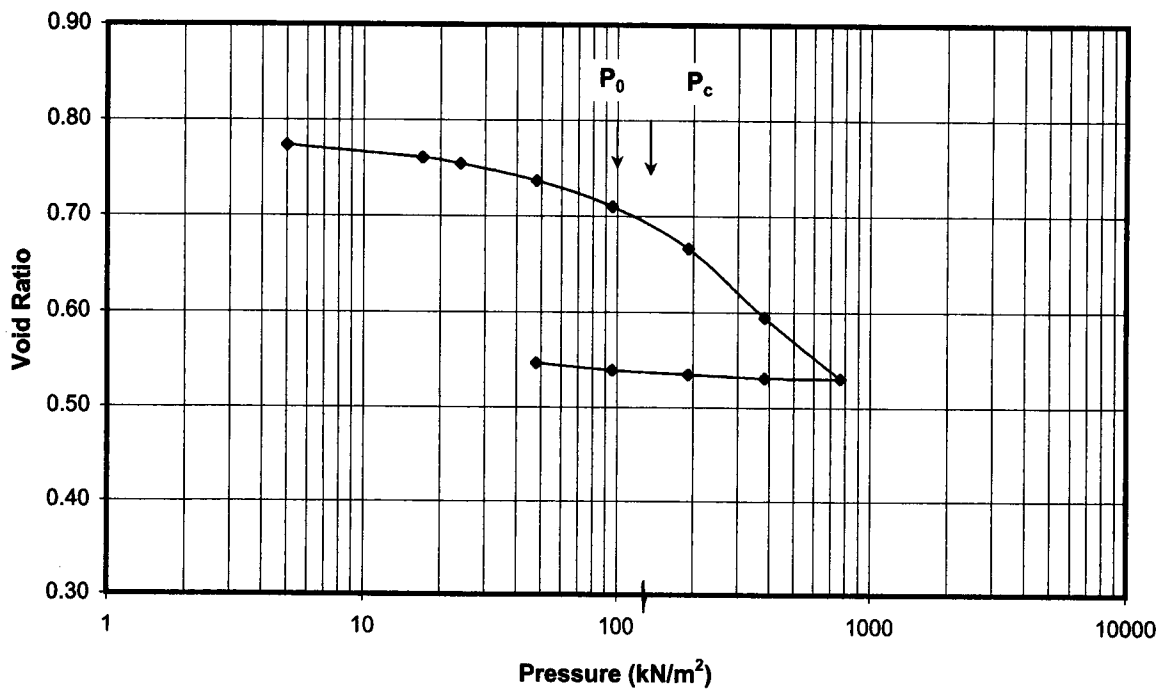
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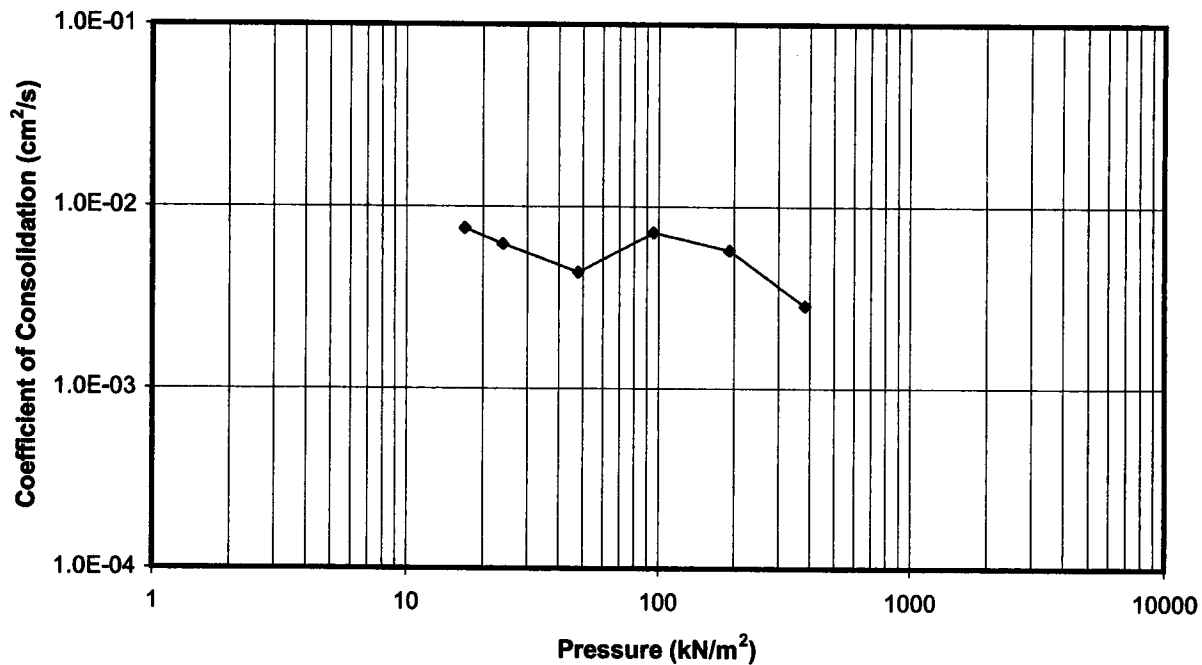
Coefficient of Consolidation vs. Pressure



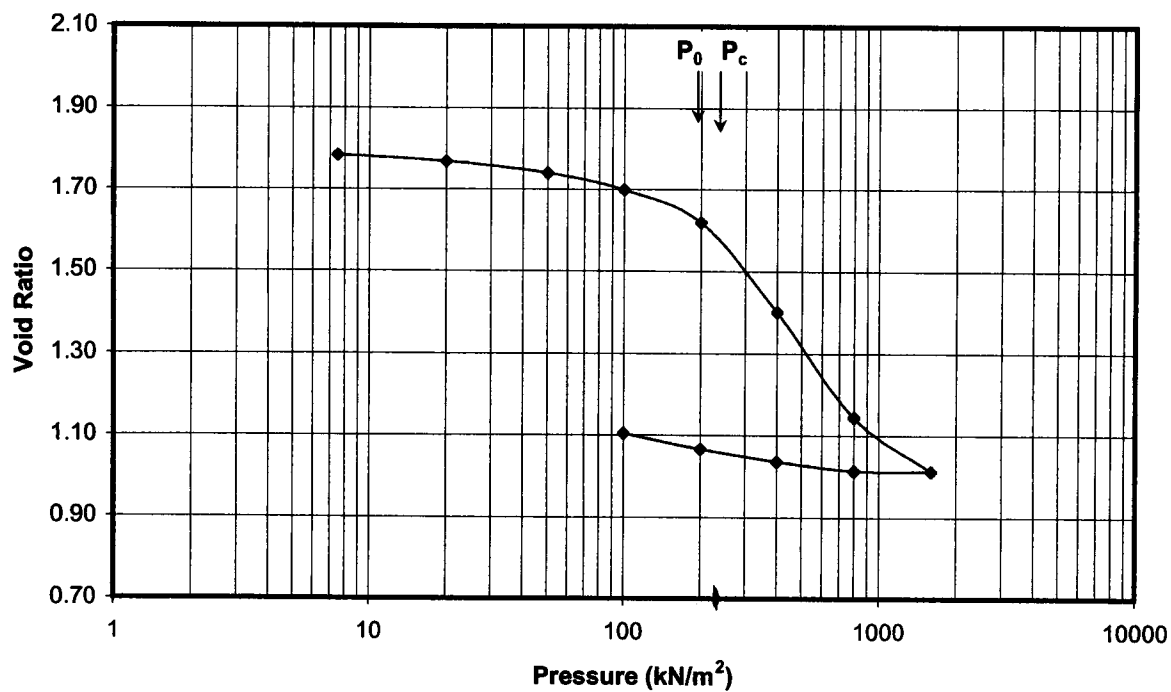
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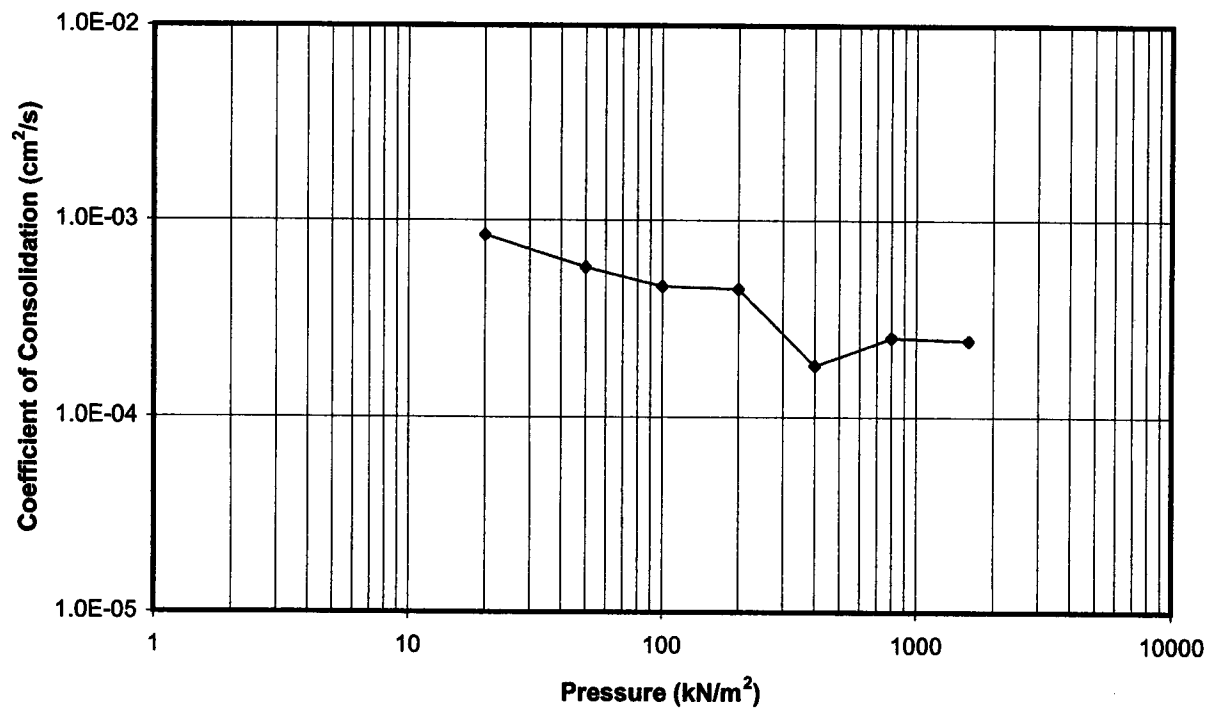
Coefficient of Consolidation vs. Pressure



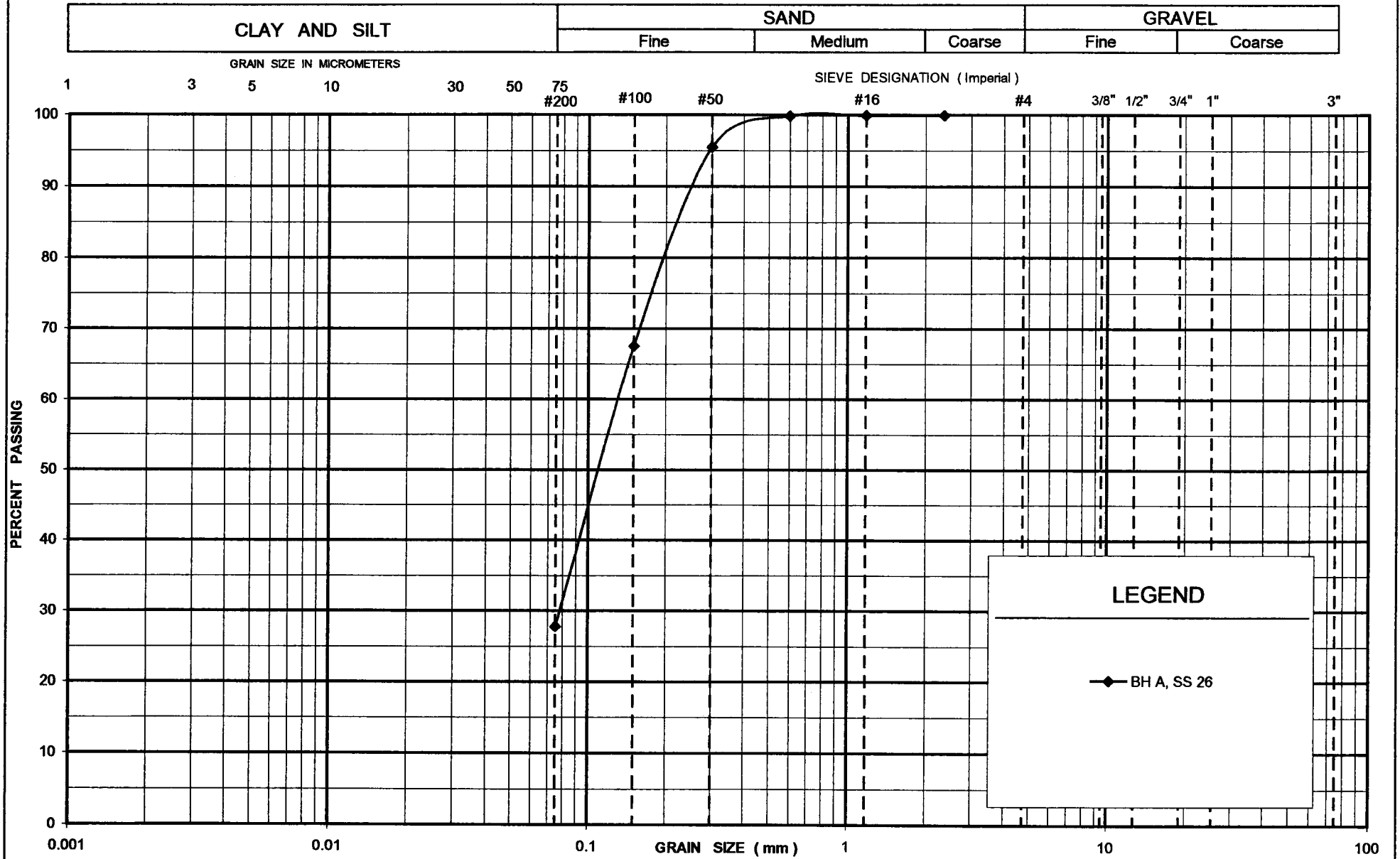
Void Ratio versus Pressure



Coefficient of Consolidation vs. Pressure



UNIFIED SOIL CLASSIFICATION SYSTEM



SHAHEEN & PEAKER LIMITED

**GRAIN SIZE DISTRIBUTION
SILTY FINE SAND**

FIGURE No. B - 13

REF. No. SPT 1074

GWP: 406-01-00

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT

SAND

GRAVEL

Fine

Medium

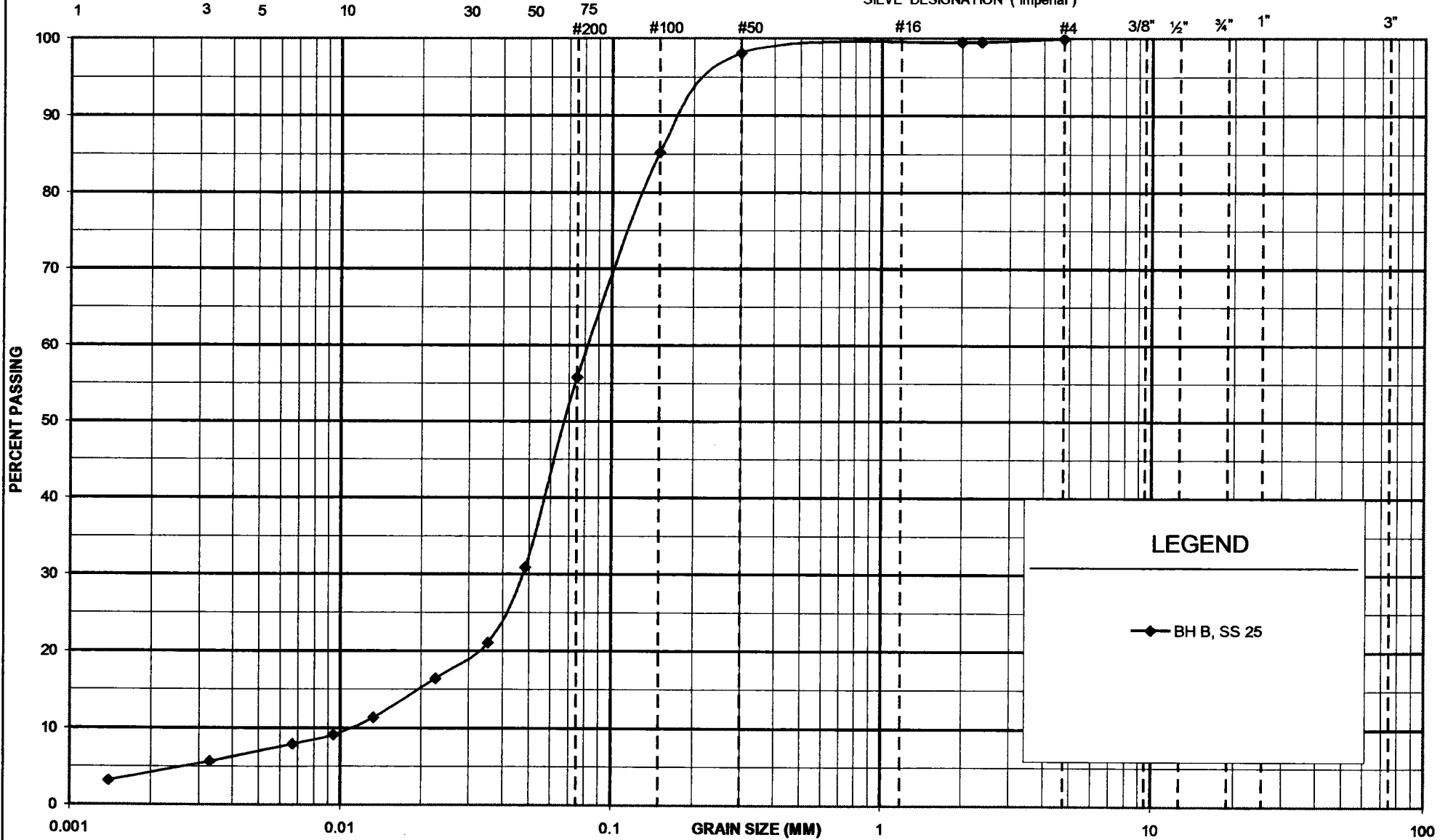
Coarse

Fine

Coarse

GRAIN SIZE IN MICROMETERS

SIEVE DESIGNATION (Imperial)



LEGEND

—◆— BH B, SS 25

SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION

SILTY FINE SAND, with some sandy silt and thin clay seams

FIGURE No. B - 14

REF. No. SPT1074

GWP: 406-01-00

Appendix C

Standard Penetration Test Results and Measured Undrained Shear Strength Results

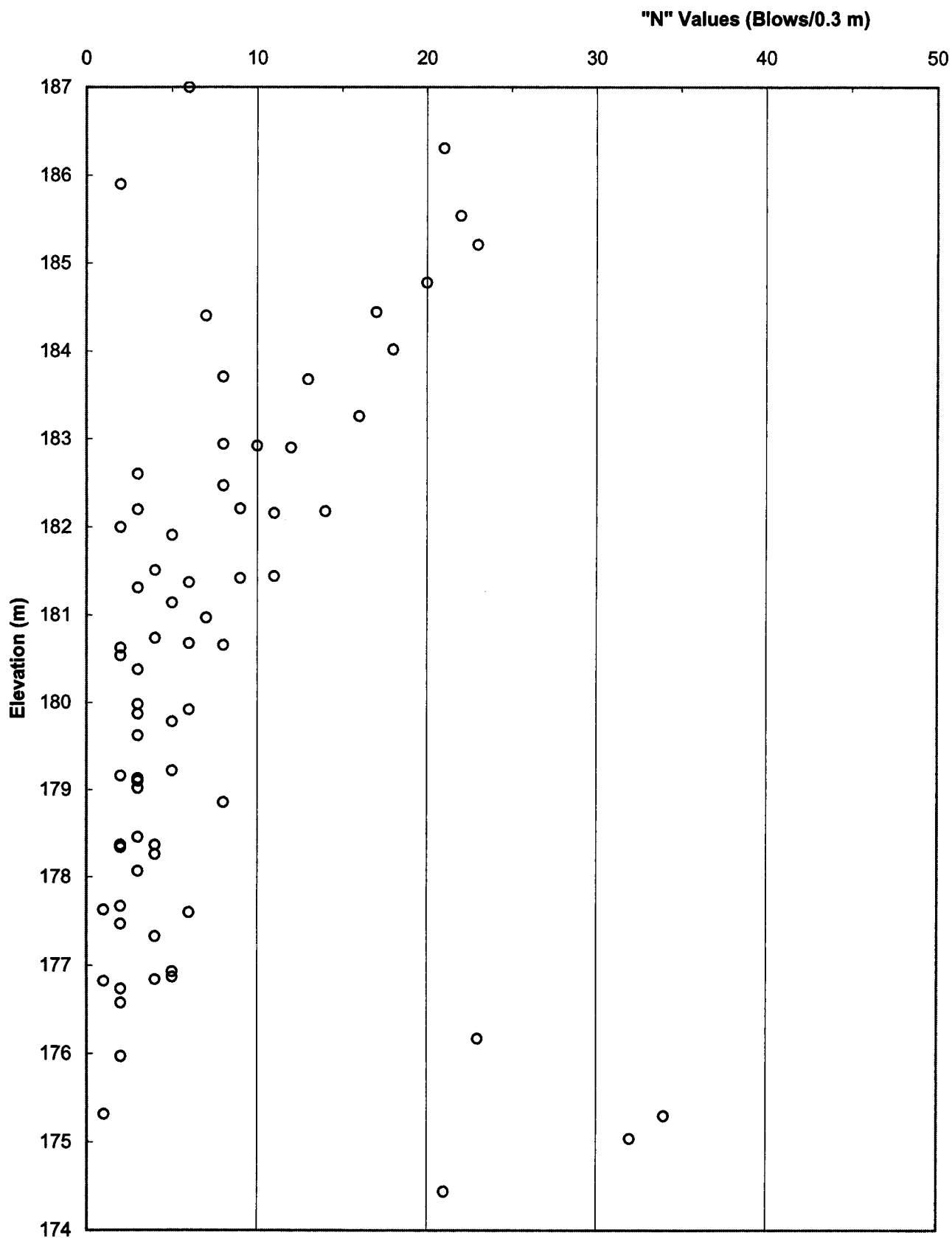


Fig. C-1: Variation of "N" Values in the Upper Silty Fine Sand Deposit (as measured by Standard Penetration Tests) with Elevation

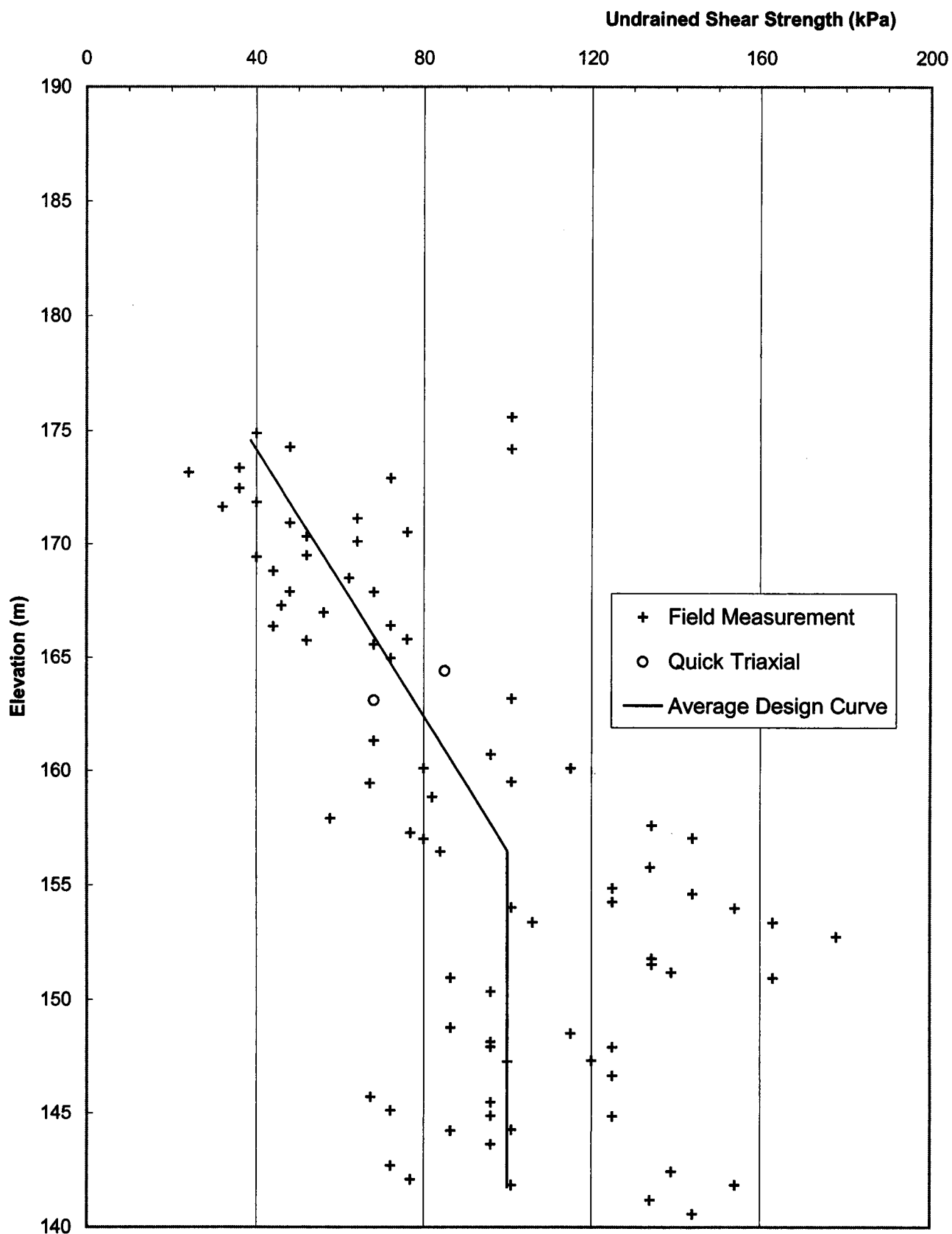


Fig. C-2: Variation of Undrained Shear Strength (as measured by field vane tests, and quick triaxial tests) with Elevation (Boreholes A, B, C, D, F and G)

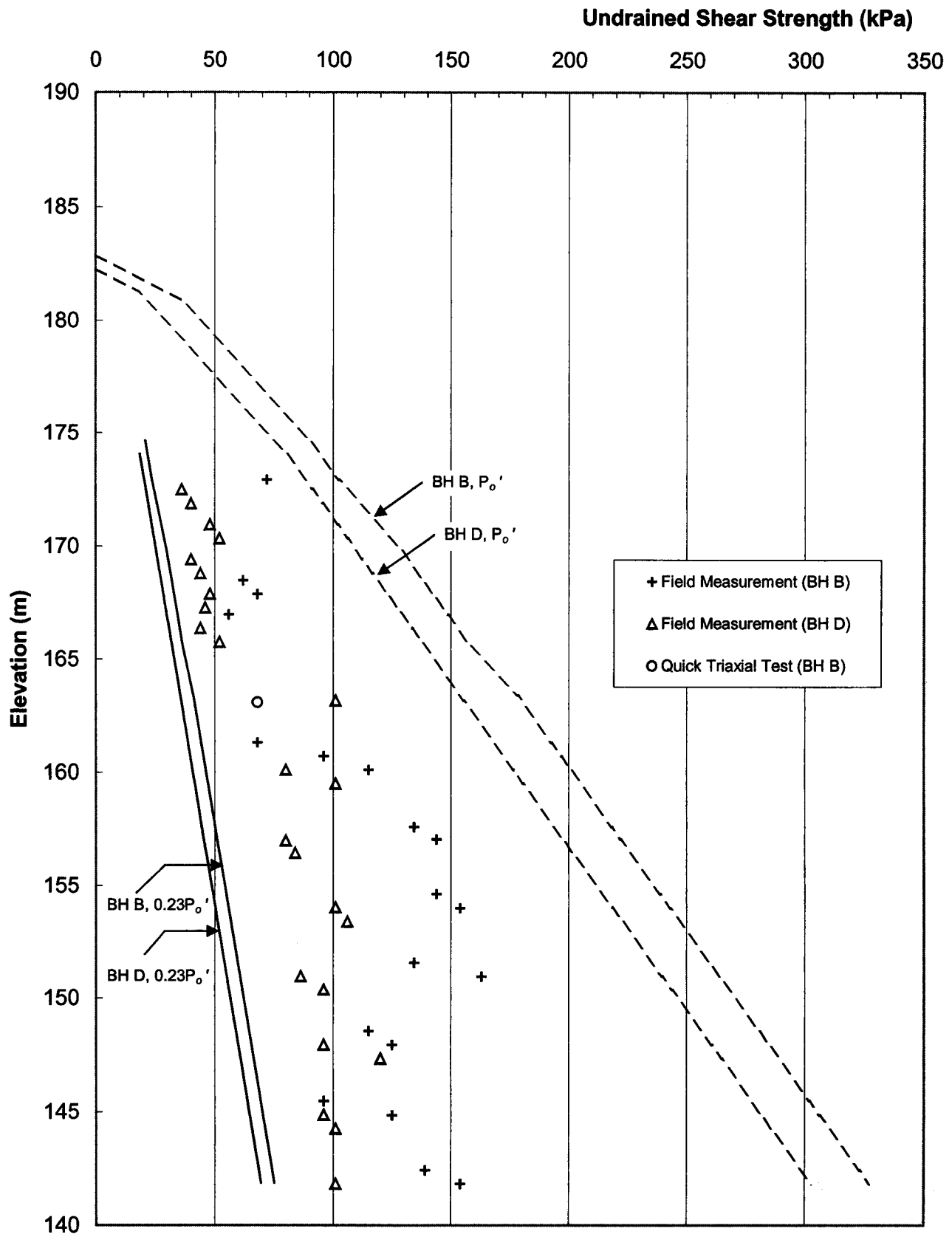


Fig. C-3: Variation of Undrained Shear Strength (as measured by field vane tests, and quick triaxial test) with Elevation (Boreholes B and D)

Appendix D

Explanation of Terms Used In Report

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg. FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
C_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = c_u / τ_r

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kN/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $(w_L - w_p)$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $(w - w_p) / I_p$	l	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m ³	UNIT WEIGHT OF SATURATED SOIL	I_c	1	CONSISTENCY INDEX = $(w_L - w) / I_p$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m ²	SEEPAGE FORCE
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

**FOUNDATION DESIGN REPORT
PROPOSED HIGHWAY 17 TRUNK ACCESS ROAD BRIDGES
OVER THE BLACK CREEK
SAULT STE. MARIE, ONTARIO
G.W.P. 406-01-00**

GEOCRES NO. 41K00-060

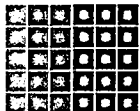
Prepared For:

MARSHALL MACKLIN MONAGHAN LTD.

Prepared by:

SHAHEEN & PEAKER LIMITED

**Project: SPT1074
September 3, 2003**



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APPENDICES

APPENDIX E: SLOPE STABILITY ANALYSIS RESULTS

APPENDIX F: LIMITATIONS OF REPORT

**FOUNDATION DESIGN REPORT
PROPOSED HIGHWAY 17 TRUNK ACCESS ROAD BRIDGES
OVER THE BLACK CREEK
SAULT STE. MARIE, ONTARIO
G.W.P. 406-01-00**

5. DISCUSSION AND RECOMMENDATIONS

The proposed Trunk Access Road (Link Road) from Trunk Road north easterly for 1.6 km to Highway 17 (new) crosses Black Creek about midway along the proposed alignment. At this crossing, the north bank of the creek is only about 0.5 to 1 m above the creek level of 181.5 ±m and then rises gradually to about El. 184 m within a horizontal distance of about 30 m, while on the south side, the bank of the creek first rises sharply to about El. 186 ±m and then more gently to about El. 189 m. The ground surface elevations at the borehole locations range from 187.3 m (Borehole E) on the south side to 182.3 m (Borehole D) on the north side of the creek. The boreholes showed below a veneer of topsoil, the presence of silty fine sand with sandy silt zones to about El. 175 m, which is underlain by an extensive clay deposit to about El. 140 ±m. Interbeds/lenses of silty clay, clayey silt and silt as well as occasional layers/lenses of silty fine sand to sandy silt were also found within the clay deposit in the upper zones (between about El. 170-159 m). The silty fine sand deposit is generally very loose to loose. The clay deposit is generally of firm to stiff consistency in the upper zones becoming stiff to very stiff with increasing depth. The clay extends to about El. 140 ±m (i.e. more than 40 m below the prevailing ground surface) and is underlain by a lower silty fine sand with some sandy silt zones. This lower sand deposit is considered to be compact to dense.

Groundwater table at the time of our investigation was found at depths ranging between 0.6 and 4.5 m below the ground surface or at El. 182.8 to 180.6 m, but would be subject to seasonal changes and in response to water level in the creek.

We understand that the new twin bridges, which will carry the EBL and WBL of the connecting link, will be single span structures and integral type abutments are preferred. At the time of the preparation of this report, the conceptual design incorporated 20 m long span and approximately 13 m wide structures, subject to possible changes as the project evolves. The presently proposed finished grades are about Elevation 186.3 m and 186.5 m for the EBL and WBL bridges, respectively and as such very minor regrading (i.e. fills and cuts less than 1 m) is required on the south side. On the north side, where the existing grade is lower (i.e. flood plain of the creek), about 3.6 m of fill will be required at the abutment locations gradually decreasing to about 3.0 m some 10 to 25 m to the north, as shown in Drawing Nos. 1 and 2.

5.1 FOUNDATION CONDITIONS

5.1.1 GENERAL

The upper silty fine sand which is generally loose to very loose is considered unsuitable for the support of normal shallow spread footing foundations, including the use of footings on engineered fill (i.e. on compacted Granular 'A' pad). The density (i.e. compactness condition) of the soil can be improved by surcharging and/or by means of various in-situ densification methods but such operations are considered to be impractical immediately adjacent to the creek, particularly in view of environmental aspects and duration of the operations. The bridges will, therefore, need to be supported on deep foundations.

The use of drilled and cast-in-place concrete (caisson) foundations to support the structures is considered impractical due to the presence of water bearing fine sand deposits and the lack of a well-defined bearing stratum to support the caissons within the clay. Auger press piles can be extended in the cohesionless (sand) soils even below the groundwater table, but these offer little resistance to lateral loads and will not be economical. They are, therefore, not recommended based on reliability and cost.

Expanded base (Franki type) concrete piles and driven concrete piles are not considered to represent a practical and cost-effective solution for this project and as such they are not recommended.

It is our opinion that for this project the use of driven steel piles represents the best choice. Low displacement steel H-piles are better suited with the prevailing subsurface conditions, in comparison with steel tube piles, because H-piles will more easily penetrate through the thick clay deposits in excess of 40 m depth, as well since integral abutments are preferred.

The following table presents the merits and disadvantages of various foundation solutions.

Table 5.1.1.1
Summary of Foundation Alternatives

Foundation Type	Comments	Recommendations
<ul style="list-style-type: none">o Normal spread footingso Spread footings on compacted Granular 'A' pad	Excessive settlements due to loose to very loose sands to depths of about 7 to 11 m and the underlying firm to stiff clay	Not recommended based on reliability.
<ul style="list-style-type: none">o Normal spread footings or spread footings on compacted Granular 'A' after surcharging	Surcharging impractical due to close proximity to the creek	Impractical due to environmental and time restraints.

Foundation Type	Comments	Recommendations
o Normal spread footings or footings on compacted Granular 'A' pad after in-situ densification of foundation soils and expanded base (Franki type) concrete piles	Impractical due to the close proximity of the abutments to the creek, including adverse environmental effects during construction.	Not recommended based on practicability of construction and economics.
o Drilled caissons	Impractical due to water bearing sands and a lack of well-defined bearing zone in the clay	Not recommended based on cost and reliability.
o Auger press concrete piles	Do not provide lateral support and are costly.	Not recommended based on cost and reliability.
o Driven concrete piles	Considered uneconomical	Not recommended based on cost.
o Timber piles	Short piles will not provide adequate axial resistance	Not recommended based on reliability.
o <u>Steel H-piles</u>	Being <u>low displacement piles</u> , represent the best option to reach a suitable end bearing at about <u>50 m depths</u> , as well as being necessary for <u>integral abutments</u> .	Considered <u>best choice</u> based on reliability and suitability.
o Steel tube piles	Less reliable than steel H-piles; are not suitable for integral abutment but represent a more economical solution.	Can be considered an alternative to steel H-piles.

From the foregoing discussion and table presented, it is evident that driven steel piles represent the best alternative for the support of the proposed twin bridges.

It should, however, be pointed out that both the very loose to loose silty fine sands and the firm to very stiff clay deposits encountered can be expected to undergo considerable settlements due to the stresses imposed by the approach and abutment fills to be placed on the north side where the existing grades are relatively low (i.e. flood plain of the creek). These aspects and their influence on the staging of the construction of the foundations (e.g. piles will need to be driven after the surcharging period is completed) will be discussed in further sections of the report.

5.1.2 STEEL H-PILES

The boreholes show that with the prevailing subsurface conditions the use of a low displacement pile, such as a steel H-pile with a heavy section (e.g. HP 310 x 110), would be better suited than other pile types (e.g. steel tube piles, steel H-piles with lighter sections or precast concrete piles).

The following table summarizes the approximate average tip elevations that may be utilized for design purposes.

Table 5.1.2.1
Estimated Pile Tip Elevations for Steel H-Piles

Support Location	Reference Borehole	Estimated Pile Tip Elevation	Estimated Approximate Pile Length Below Existing Ground Surface	Soil Deposit
WBL Bridge South Abutment	A	133.5 m	53 m	Silty fine sand
WBL Bridge North Abutment	B	133.5 m	49 m	Silty fine sand
EBL Bridge South Abutment	C	132.0 m	53 m	Silty fine sand
EBL Bridge North Abutment	D	132.0 m	50 m	Silty fine sand

The following axial resistances are estimated for HP 310 x 110 steel piles driven to tip elevations documented in Table 5.1.2.1.

$$\begin{aligned} \text{Factored Axial Resistance at U.L.S.} &= 1550 \text{ kN/pile} \\ \text{Axial Resistance at S.L.S.} &= 1050 \text{ kN/pile} \end{aligned} \quad \times 2 = 3100$$

The piles should be driven using a suitably heavy hammer capable of delivering a rated energy of at least 60 kilojoules/blow, but not more than 70 kilojoules/blow. The driving of the piles in the field should be controlled by a recognized pile driving formula, such as the Hiley Formula. The estimated ultimate resistance of the piles by the Hiley Formula can be calculated by multiplying the recommended axial resistance at S.L.S. by a factor of 3 (i.e., 1050×3), giving an ultimate resistance of 3150 kN.

In accordance with the above criterion, we recommend that the piles be driven to about 2.5 m above the quoted design elevation and driving should then be monitored and controlled by employing the Hiley Dynamic Pile Driving Formula in accordance with MTO Standards SS103-10 and SS103-11.

It is possible that the piles may drive some distance below the estimated pile tip elevations.

All pile driving should be carried out in accordance with SP903S01. The use of light-weight (e.g. HP 310 x 79) piles is not recommended due to the energy required to extend the piles to relatively deep tip elevations (i.e. piles may be damaged). We recommend in contract documents the possibility of pile load test(s) be allowed for.

For frost protection, all pile caps should have a permanent earth cover of at least 1.8 m.

In cohesionless soils the coefficient of horizontal subgrade reaction can be estimated from:

$$k_s = n_h z / d$$

Where k_s = coefficient of horizontal subgrade reaction
 z = depth
 d = pile width
 n_h = coefficient related to soil density as given in Table 5.1.2.2.

Also as presented in the same table are estimated values for angle of internal friction and bulk unit weights.

Where the soil is primarily cohesive, the undrained shear strength of the soil is given.

Table 5.1.2.2
Recommended Soil Parameters

Area Reference/ Borehole No.	Applicable Elevation (m)	Soil Type	Bulk Unit Weight (kN/m ³)	Angle of Internal Friction (φ) Degrees	Recommended n_h Value (MN/m ³)	Recommended Undrained Shear Strength (kPa)
South Abutment WBL Bridge Borehole A	186.0-185.5	Sandy silt	18.0	27	1.0	50
	185.5-174.9	Silty fine sand	18.5	29	1.3	
	174.9-168.7	Clay	17.0			
	168.7-163.0	Silty fine sand	18.5	29	1.3	80
	163.0-159.2	Silty fine sand	19.0	30	4.4	
	159.2-141.2	Clay	17.0			
	141.2-140.0	Silty fine sand	19.0	30	4.4	
North Abutment WBL Bridge Borehole B	182.7-175.5	Silty fine sand	18.5	29	1.3	40
	175.5-174.7	Silty fine sand	19.0	30	4.4	
	174.7-172.9	Clay	17.0			
	172.9-169.9	Silty fine sand	18.5	29	1.3	50
	169.9-165.6	Clay	17.0			
	165.6-163.4	Silty fine sand	19.0	30	2.0	70
	163.4-161.0	Clay	17.0			
	161.0-140.4	Clay	17.0			
	140.4-132.8	Silty fine sand	19.0	30	4.4	100
South Abutment EBL Bridge Borehole C	184.5-174.7	Silty fine sand	18.5	29	1.3	30
	174.7-172.8	Sandy silt	19.5	29	2.0	
	172.8-171.3	Clay	16.5			
	171.3-167.2	Silty fine sand	18.5	29	1.3	70
	167.2-156.0	Clay	16.5			
	156.0-139.7	Clay	17.0			
	139.7-138.5	Silty fine sand	19.5	30	4.4	100
North Abutment EBL Bridge Borehole D	182.0-175.0	Silty fine sand	18.5	29	1.3	40
	175.0-174.1	Silty fine sand	19.0	30	4.4	
	174.1-164.0	Clay	16.5			
	164.0-141.3	Clay	17.0			90
	141.3-131.3	Silty fine sand	19.5	30	4.4	

For preliminary estimating purposes, the recommended horizontal resistances for HP310x110 steel H-piles are as follows:

Factored Horizontal Resistance at U.L.S. = 120 kN/pile
Horizontal Resistance at S.L.S. = 50 kN/pile

If integral abutments are not constructed then the lateral resistance of the piles can be supplemented, if desired, by the horizontal components of battered piles. In this instance, we recommend that the batter be limited to no more than 5:1, as in practice greater batter is difficult to install, especially considering the length of the piles. The minimum spacing between piles should be in accordance with Clause 6.8.9.2 of the CAN/CSA-S6-00, Canadian Highway Bridge Design Code (CHBDC). When selecting the minimum pile spacing, due consideration should be given to more than usual pile lengths required for this project.

Oversize materials (e.g. greater than 75 mm nominal diameter) should not be used in the embankment fills through which piles would be driven.

In accordance with MTO requirements (MTO Structural Office Standard), piles for integral abutments require a 3 m long flex zone. In essence where a false RSS type abutment is to be constructed, the current MTO standard for the flex zone consists of an annular space in between two concentric corrugated steel pipes (CSP's). One of the CSP's surrounds the H-pile (i.e. has a diameter of about 600 mm surrounding the pile, while the second CSP has a somewhat larger diameter; typically 800 mm for a 310 mm H-pile). The annular space in between the CSP's is the 3 m long flex zone. In accordance with current MTO practice, this space between the CSP's can be left void. After the pile is driven, the space between the H-pile and the inner CSP is filled with sand.

If a retained soil system is not used, then in accordance with MTO structural office requirements (Report SO-96-01), the flex zone is provided by augering a 600 mm diameter hole 3000 mm deep and filling with uniform sand. An NSSP should be included in the contract drawings specifying the gradation of the sand as follows:

Sieve Size	Percentage Passing
2 mm	100 %
600 µm	80-100 %
425 µm	40-80 %
250 µm	4-25 %
150 µm	0-6 %

5.1.3 STEEL TUBE PILES

Tube piles will provide lower resistances in comparison with H-piles as they will not drive as deep, but it is possible that the lower resistances may be compensated by the relatively shorter pile lengths. These piles may not drive into a well-defined competent layer across the site and, therefore, geotechnical resistances will be based on both friction and end-bearing. Steel tube piles have the advantage that they can be inspected after driving and prior to pouring the concrete for possible damage that may have incurred while driving. They should have sufficient wall thickness and base plate thickness to minimize potential damage caused by the expected hard driving conditions. The end plates should not be wider than the base area of the piles (i.e. should not project beyond the circumference of the pile) so that adhesion/friction is not adversely affected. Tube piles will need to be filled with concrete after their installation and inspection for possible damage.

Steel tube piles of 300 mm nominal diameter (e.g. 324 mm x 12.5 mm) driven at least 1 m into the sand deposit underlying the clay can be expected to provide a Factored Axial Resistance at U.L.S. of 1050 kN and an Axial Resistance at S.L.S. equal to 700 kN at about El. 139.0 m.

U.L.S. = 1050 kN

S.L.S. = 700 kN

40 m long

The piles will need to be driven using a suitably heavy hammer capable of delivering a rated energy of at least 60 kilojoules/blow, but not more than 70 kilojoules/blow. The driving of the piles in the field should be controlled by a recognized pile driving formula, such as the Hiley Formula. The estimated ultimate resistance of the piles based on the Hiley Formula can be calculated by multiplying the recommended axial resistance at S.L.S. by a factor of 3. With this criterion, the estimated ultimate resistance required would be $700 \times 3 = 2100$ kN.

The piles should be driven to about 1 m above the design elevation and driving should then be monitored and controlled by employing Hiley Dynamic Pile Driving Formula in accordance with MTO Standards SS103-10 and SS103-11.

The driving of the piles should be conducted in accordance with SP903S01.

Pile lengths may be different than the estimated values and, therefore, this aspect will need to be considered in the contract documents and when ordering piles. As mentioned before, piles may not reach the required pile tip elevations and pile load test(s) may need to be conducted.

The minimum pile spacing should be in accordance with CHBDC and with due consideration of the pile lengths.

Suggested soil parameters for the calculation of the lateral resistance/deflection of the piles were given in the previous section of this report. If battered piles are required to sustain horizontal loads, then the batter should be limited to 5:1 in view of the lengths of the piles as was discussed before.

The piles will need to be driven after the surcharging period, as discussed in Section 5.3.

5.2 LATERAL EARTH PRESSURES

Backfill behind abutments and retaining walls should consist of non-frost susceptible, free-draining granular materials in accordance with the Ontario Ministry of Transportation Standards and the requirements of OPSP 3501.00.

Free-draining backfill materials (i.e. Granular 'A' or Granular 'B') and the provision of drain pipes and weep holes, etc., should prevent hydrostatic pressure build-up. Computation of earth pressures should be in accordance with C.H.B.D.C.. For design purposes, the following parameters (unfactored) can be used.

Compacted Granular 'A'

$\phi = ?$

Unit Weight = 22 kN/m³

Coefficient of Lateral Earth Pressure:

$K_a = 0.27$

$K_b = 0.35$

$K_o = 0.43$

$K^* = 0.45$

Compacted Granular 'B' Type 1

$\phi = ?$

Unit Weight = 21 kN/m³

Coefficient of Lateral Earth Pressure:

$K_a = 0.31$

$K_b = 0.41$

$K_o = 0.47$

$K^* = 0.57$

Rock Fill

$\phi = ?$

Unit Weight = 18 kN/m³

Coefficient of Lateral Earth Pressure:

$K_a = 0.27$

$K_b = 0.35$

$K_o = 0.43$

$K^* = 0.45$

Where K_b is the 'intermediate' earth pressure coefficient for a partially restrained structure.

K^* is the earth pressure coefficient for a soil loading a fully-restrained structure, including compaction surcharge effects.

These values are based on the assumption that the backfill behind the retaining structure is free-draining and adequate drainage is provided. As well, it is assumed that the ground behind the retaining structure is level.

The earth pressure coefficient adopted will depend on whether the retaining structure is restrained or movements can be allowed such that the active state of earth pressure can develop. If the abutment is restrained and does not allow lateral yielding, then at rest pressures should be used C.H.B.D.C.. The effect of compaction should also be taken into account in the selection of the appropriate earth pressure coefficients in accordance with Section 6.9 of C.H.B.D.C..

For unrestrained wing walls (if any), the intermediate earth pressure coefficient K_b may be adopted. In the determination of degree of wall displacement or rotation to mobilize the fully active earth pressure state, Section C6.9 of the C.H.B.D.C. Commentary can be consulted.

Vibratory equipment for use behind abutments and retaining walls should be restricted in size as per current MTO practice.

If rock fill is used for backfill, special care is required to prevent damage to the retaining structures. In such a case, a cushion of Granular 'A' material or finely-graded rock fill (e.g. less than 200 mm normal diameter) should be placed between the structure and the rock fill. This cushion should be at least 0.45 m wide and if Granular 'A' is used, proper filtering should be provided to prevent the loss of finer particles from the Granular 'A' cushion into the coarse rock fill. As was mentioned, however, coarse materials (e.g. rock fill) should not be used in areas through which piles will be driven.

As an alternative to conventional retaining walls, MTO's Retained Soil System may be used. The following should be included in the Contract Documents:

- identify longitudinal extent in plan of the Retained Soil System
- identify in plan transverse space constraints (top of wall and bottom of wall)
- identify elevation of top of wall and bottom of wall
- include NSSP for Retained Soil Systems in Contract Documents

The Retained Soil System should be of high performance and moderate to high appearance.

5.3 APPROACH EMBANKMENTS

At present, it is expected that the grades at the proposed north embankment locations will be raised by about 3.6 m while minor fill and cut (e.g. generally less than 1 m) is involved on the south side.

Based on the borehole results, no foundation failures are anticipated for up to 4 m high embankments with normal (2H:1V) side slopes, assuming that all organic, weak or otherwise unsuitable materials will be removed as per MTO standards prior to placing the embankment fills.

All organic and other unsuitable soils should be removed with an envelope area given by an imaginary slope not steeper than 1:1 from the toe of the proposed embankment. Based on the available borehole data, for preliminary estimating purposes, the average thickness of unsuitable soils to be stripped can be assumed to be 0.2 m. At many sites, however, the thickness of organic or otherwise organic soils can be variable, especially near watercourses. After stripping, the exposed subgrade should be inspected, approved and properly compacted from the surface, using a suitably heavy compactor. The existing site conditions (i.e. high watertable and fine-grained granular soils) could influence the choice of compaction equipment.

Assuming—properly compacted, acceptable inorganic earth fill materials are utilized, 2 horizontal in 1 vertical side slopes can be used for the construction of the approach fills. Proper erosion control measures should be implemented by seed and cover (OPSS 572) or sodding (OPSS 571).

The materials used for the construction of the embankment fills should consist of approved, acceptable earth fill. Oversize materials (having a nominal diameter in excess of 75 mm) should not be used in embankment fills through which piles would be driven. Fill used for construction of the embankments should be in accordance with OPSS 212 and fill placement should meet or exceed the requirements of OPSS 501 and OPSS 206. In general, the fills should be placed in lifts not exceeding 300 mm before compaction and each lift should be uniformly compacted to at least 95% of the material's Standard Proctor Maximum Dry Density.

The settlement of embankment fills under this own weight, prepared as described above, should not exceed 25 mm for embankment heights of up to 4 m. The time-rate of settlement will depend on the materials used. For example, granular soils will settle more rapidly than finer soils.

In addition to settlement under self-weight, considerable foundation settlements can be expected under the weight of the approach fills to be placed on the north side. With the present design, on the north side the approach embankments will be approximately 3.6 m high. Somewhat less favourable conditions were encountered in Borehole D because the clay deposit is relatively thicker. In this borehole, the surficial silty fine sand, which is about 8 m deep, is generally loose to very loose and can be expected to settle about 75 mm under the stresses imposed by the 3.6 m high embankment. This settlement should be fully completed within a period of about six weeks after the construction of the embankment to its full height, while the consolidation settlement of the underlying approximately 33 m thick clay deposit can be expected to be in the order of 250 mm and will take a very long time to complete (i.e. more than 30 years). If the site is preloaded for a period of about 2 years, residual settlements can be expected to be in the order of 120 mm, after the preloading period. This is because the clay is more than 30 m thick and hence, the drainage path to effect the consolidation of the clay is also long (i.e. drainage is very slow). Surcharging can be

considered to accelerate the consolidation settlements but in this case since the height of the fill during the surcharging period is higher than embankment heights for the highway, instability is expected due to a foundation failure of the fill into the creek. This is because with the present configuration the abutments are very close to the creek banks. Furthermore, even if about 2 m of surcharge is placed for a period of two years, the residual settlements after this surcharging period can be expected to be of the order of 80 mm, which is still excessive.

In view of these concerns, the following or a combination thereof can be considered.

- Culverts may be considered to replace the bridge structures;
- Increasing the lengths of the bridge spans and/or number of spans;
- Preloading for extended periods of time with due consideration to stability issues (the presently predicted instability can be rectified by placing the embankments at a sufficient distance beyond the creek banks by increasing the bridges' lengths, i.e. by moving the north abutment location further away from the north bank of the creek).

We have looked into various combinations of the above criteria and for a single span structure, the following option appear, to represent the optimum solution.

- Relocate the north embankments by about 7 m towards the north which will require increasing the bridges' span from 20 to 27 m. While this is a longer span, it is still considered economical in terms of foundation design, as well as being more attractive from an environmental point of view.
- Use light-weight fill (e.g. pellitized slag) and surcharge for about two years in order to reduce settlements to within acceptable levels.

14.1 kN/m³

The light-weight fill (blast furnace slag) will extend from the existing ground surface level to the proposed road subgrade level (i.e about 1 m below the final road grade). On top of the light-weight fill, granular subbase materials or ordinary earth fill would be placed. On top of this, surcharge material (lightly compacted) would be placed to at least 2.3 m above the final road (top of asphalt) level. A suitable separator should be placed between the light-weight fill (or the granular subbase soils) and the surcharge material, since the surcharge would be removed after the surcharging period.

Surcharging should be carried out for a period of not less than two years.

We considered speeding up the rate of consolidation by means of wick drains rather than using light-weight fill but due to the presence of about 8 ±m of sand near the surface and the relatively layered nature of the clay within the upper 5 ±m, the wick drains will have to extend

to considerable depths to be effective. A further assessment of the use of light-weight fill vs. wick drains can, however, be made after the details of the structure are known.

Based on the contour plans provided to us, the light-weight material should be extended from the existing ground level to its full height (i.e. to subgrade level) for a horizontal distance of about 7 m beyond the face of the abutment. From thereon, it should be tapered-off at 6H:1V slopes to zero thickness. We recommend, however, the surcharging should be continued further beyond this point until the height of the embankment is not more than 2.0 m, beyond which it can be tapered-off to no surcharge at 5H:1V (i.e. within the next 10 m or so). Beyond this point preloading should be applied (i.e. without surcharge) until the height of the embankment is not more than 0.6 m.

The piles should be driven after the preloading period.

All these details, including the possible use of wick drains, should be reviewed when the details of the bridges and vertical elevations are finalized.

The light-weight fill generally consists of pellitized blast furnace slag. It is of two types, namely light-weight and ultra light-weight. According to the manufacturers, when compacted the light-weight type has a bulk unit weight of 14.0 kN/m³ while the ultra light-weight is 11.5 kN/m³. For this project either type can be used. It should, however, be pointed out that the availability and cost of the material varies from time to time and should be discussed with the manufacturers. The angle of shear resistance (friction angle, ϕ) can be taken as 35 degrees for both types of materials. For earth pressure calculations on retaining structures, the earth pressure coefficients quoted for Granular 'A' materials can be used, except of course, for the unit weight values. The compaction of the light-weight fill should be carried out in a manner to avoid crushing of the particles.

5.4 CONSTRUCTION

The high watertable in the floor of the valley will likely necessitate some drainage and/or surficial dewatering during stripping, subsequent proofrolling and fill placement. For this reason, it is our opinion that a granular fill will likely be necessary in the low-lying areas, until the fill reaches the existing ground surface level or even slightly higher, depending on the construction season and site conditions. The dewatering will likely consist of gravity drainage and pumping from strategically placed filtered sumps.

It should be pointed out the surficial fine-grained granular soils (i.e. silty fine sand to sandy silt) are highly erodible and frost susceptible materials. These aspects should be considered in the design.

The side slopes should be protected against erosion during construction and permanently, including rip-rap placed to the high water level, as per hydrological considerations. The rip-

rap should be separated from the native soils or embankment material with a geotextile filter fabric or a filter zone of granular material. The filter fabric should have a filtering opening size (F.O.S.) not larger than 120 microns.

5.5 FROST PROTECTION

Design frost protection for the general area is 1.8 m. Therefore, a permanent soil cover of 1.8 m thermal equivalent is required for frost protection of foundations, including pile caps. In case of rip-rap (rock fill) only one-half of the rock fill thickness should be assumed to be effective in providing frost protection.

6. CLOSURE

We recommend that during finalizing of the details of the twin bridges, close liaison be maintained with the foundation (geotechnical) consultant to select optimum solutions regarding settlement, fill stability, surcharging, etc. issues, as well as reviewing recommendations contained in this report for their specific applicability.

The Limitations of Report, as quoted in Appendix F, are an integral part of this report.

SHAHEEN & PEAKER LIMITED



Z.S. Ozden, P.Eng.



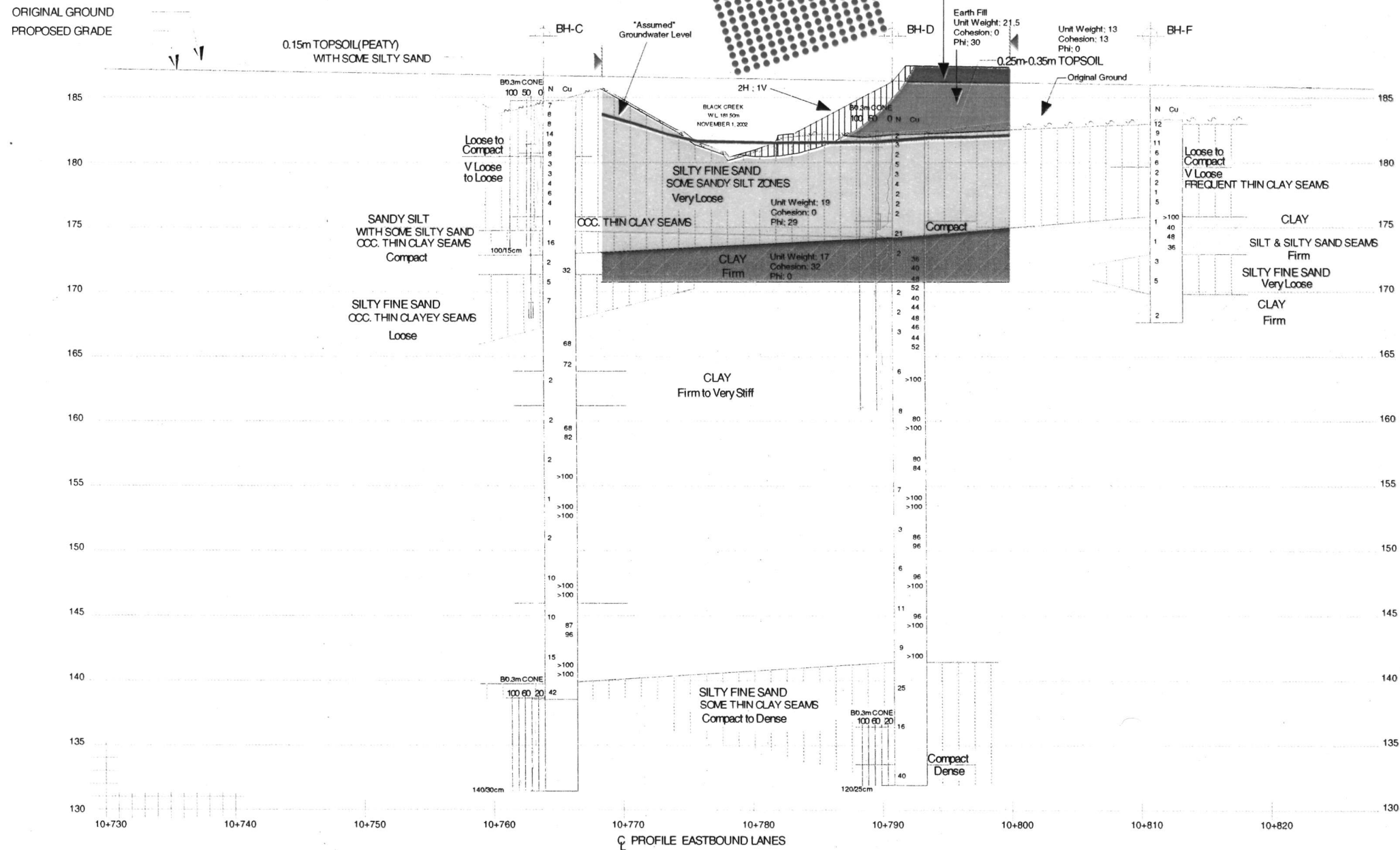
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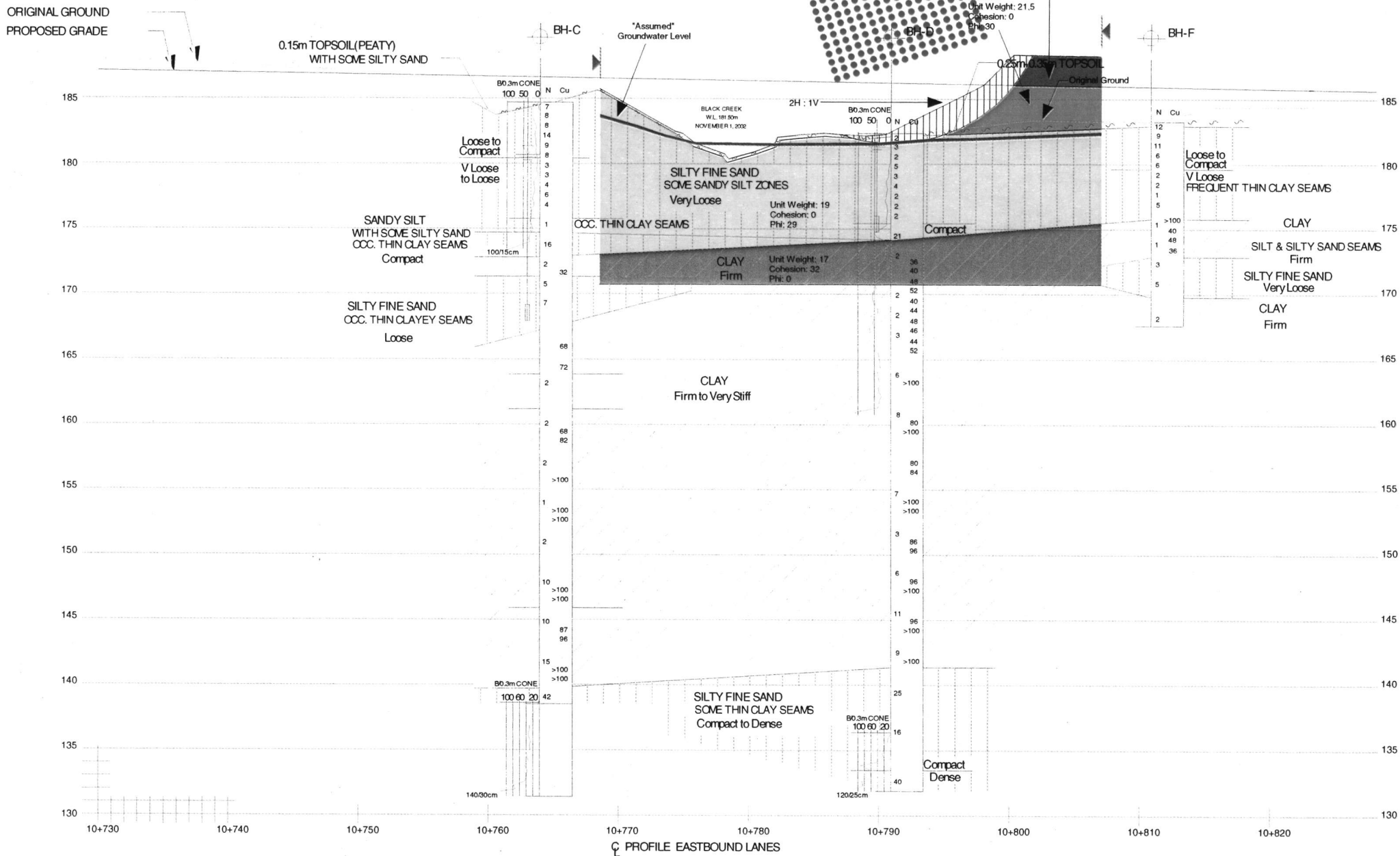


Appendix E

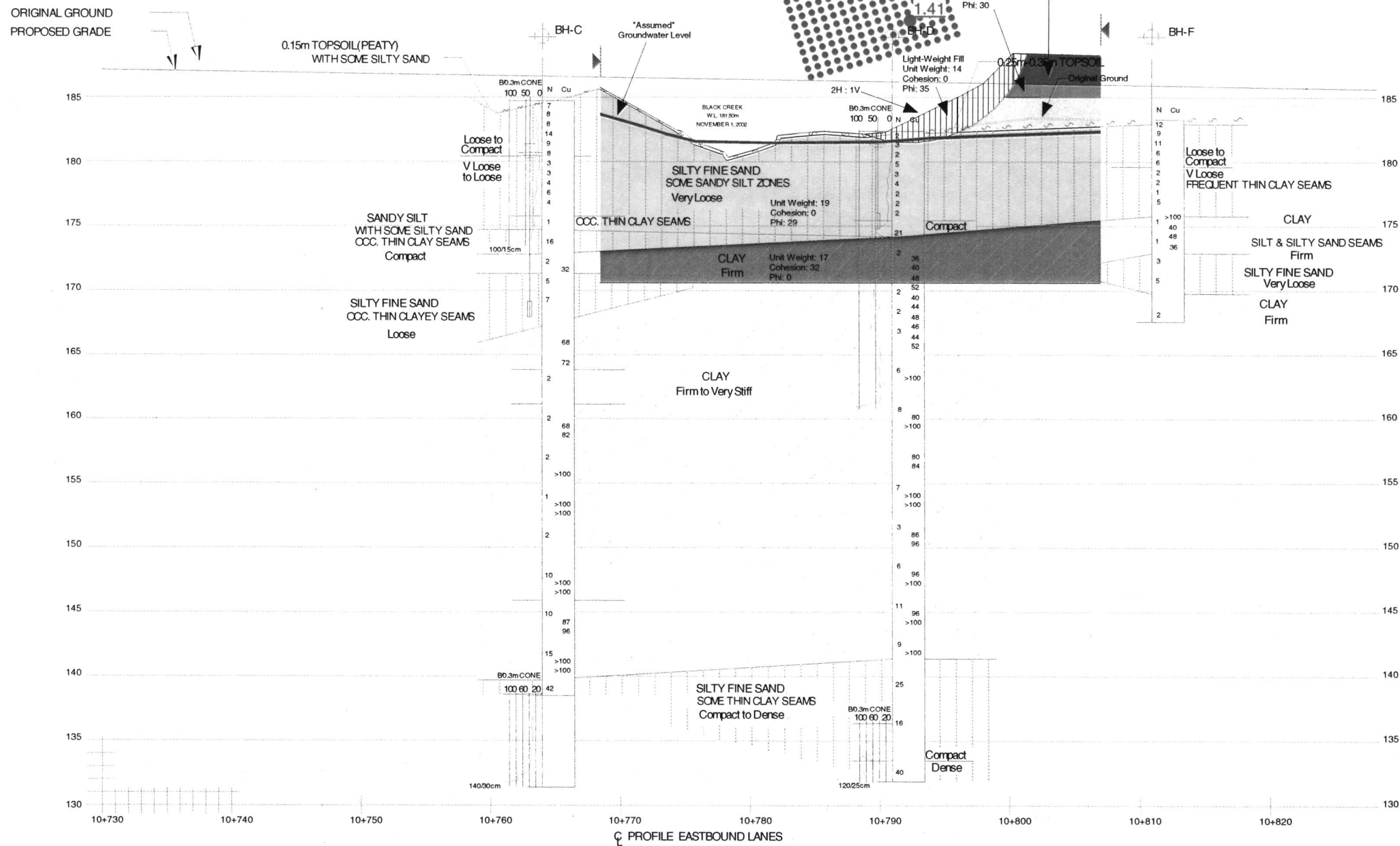
Slope Stability Analysis Results



SPT 1074
 Highway 17 Trunk Access Road Bridges
 Over the Black Creek
 (Earth Fill Embankment, 7m Setback)



SPT 1074
Highway 17 Trunk Access Road Bridges
Over the Black Creek
(Light-Weight Fill Embankment, 7m Setback)



Appendix F

Limitations of Report

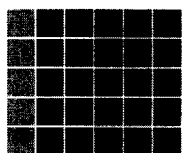
LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

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



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Project: SPT1169

June 15, 2006

**McCormick Rankin Corporation
2655 North Sheridan Way
Mississauga, Ontario
L5K 2P8**

Attention: Mr. Gord Firth, P. Eng.

Dear Sirs:

**Re: Proposed Highway 17 (New)
Trunk Road Access Road Over the Black Creek
Sault Ste Marie, Ontario
G.W.P. 406-01-00**

Further to our letter dated February 24, 2006, here is an update report, as requested, regarding the captioned project.

We understand that the contract for this project has now been awarded and the advance fills may be removed anytime from now. Since our report of February 24, 2006, further monitoring was carried out (by others) on March 7, March 24, April 6, April 20 and May 29, 2006 (See Appendix A). The following settlements were recorded during the period of February 14 (the last readings before our report of February 24) and May 29 (i.e. during a time span of 104 days).

**Table 1
Cumulative Settlement Readings**

Monitor Location	Total Recorded Settlement As of February 14/06 (mm)*	Total Recorded Settlement as of May 29/06 (mm)*	Difference (Recorded Settlement Between Feb 14 and May 29 (mm))	Approximate Height of Surcharge Fill
SR1 Sta.10+761	275	296	21	8.5 m
SR2 Sta.10+778	301	333	32	8.5 m
SR3 Sta.10+797	340	376	36	7.9 m
SR4 Sta.10+808	325	363	38	5.3 m

*adjusted reading values for apparent discrepancy.

These readings indicate that the settlements are continuing at a rate similar to those reported in our letter of February 24, 2006. It is, therefore, our opinion that there is no need to make any changes regarding the EPS thicknesses recommended in our original design report.

It is of interest to note that the height of fill at Monitor Stations 10+797 (SR3) and 10+808 (SR4) are less than those of Stations 10+778 (SR2) and 10+761 (SR1) yet the settlements are greater (both total and incremental), particularly at Station 10+808 (SR4). This could be because the clay deposit is becoming weaker (i.e. more compressible) in the northerly direction, towards the proposed bridge location and/or possibly some organic soil may have been left in place at Station 10+808 area when stripping of the site was carried out last year. You may wish to look into the latter aspect when the advance fill is removed to place the EPS.

As well, an excess pore pressure of 25 kPa is reported in the vibrating wire piezometer (VWP6) at SR3 location.

We recommend that settlement readings be continued on a monthly basis until the removal of the advance fill and if possible beyond this period. Needless to say, it is advantageous to leave the advance fill in place as long as possible, but not necessary.

We hope that this information is what you required. If you have any questions, however, please contact us.

Yours very truly,

SHAHEEN & PEAKER LIMITED

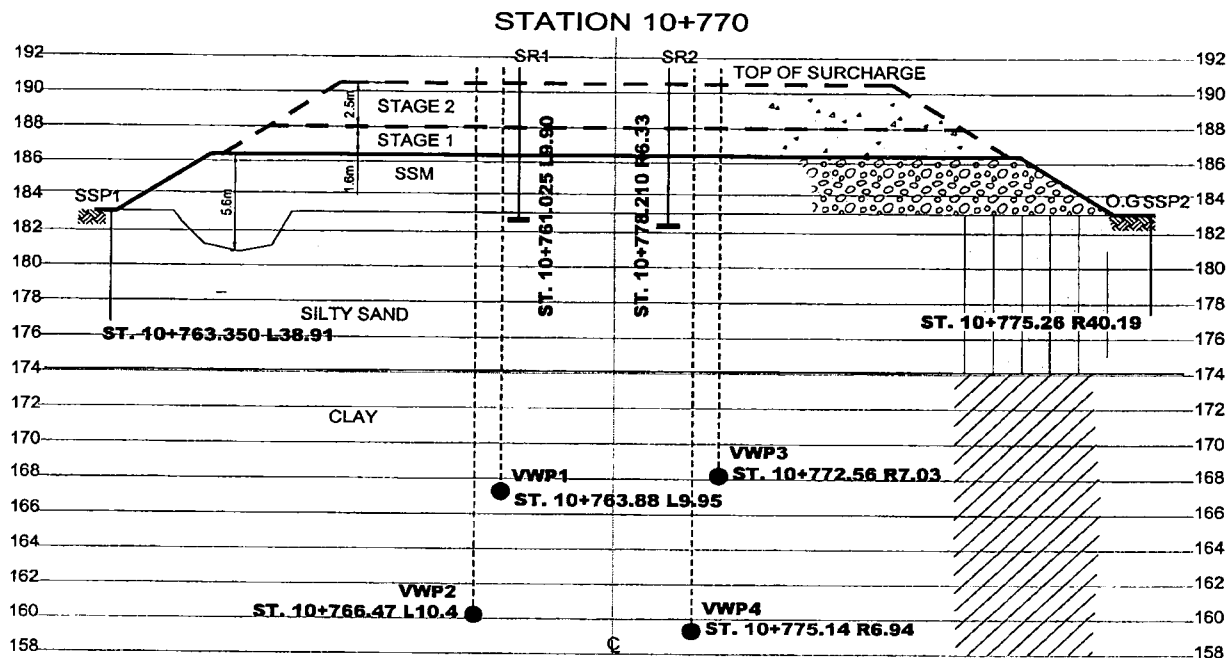
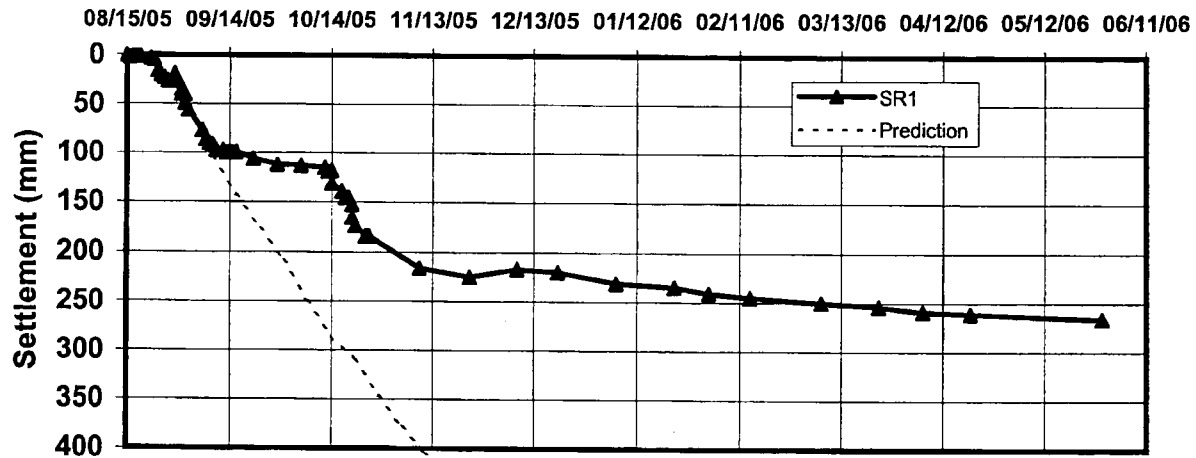
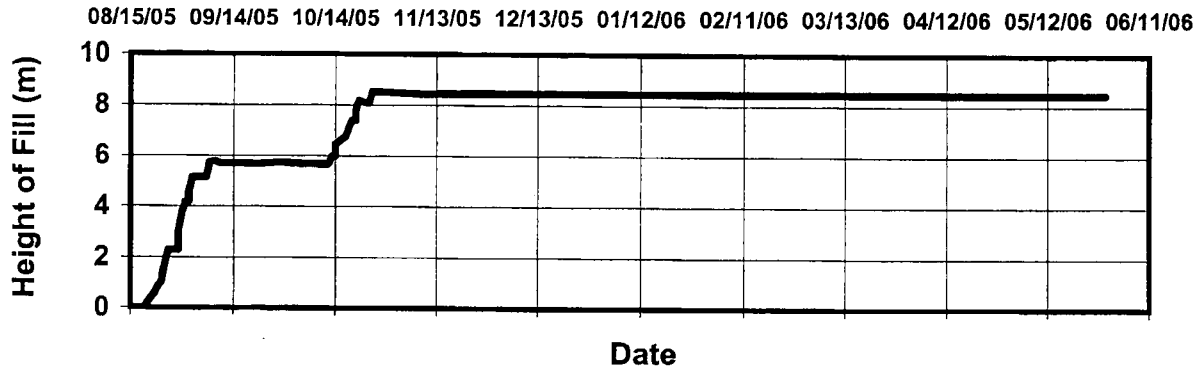
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K. R. Peaker, Ph.D., P.Eng.

Figure May 29, 2006 Height of Fill

Highway 17 Black Creek Realignment
(Station 10+761.025 O/S 9.9Lt)
Settlement Rod SR 1



Contract 2005-5147 Settlement Rod Readings

SR #1 @10+761.025 O/S 9.90Lt

Original Ground Surface Elevation (m)
Original Top of Rod Elevation (m)

182.514
184.304

Date	Time	Top of Rod Elevation (m)	Settlement (mm)	Extension (mm)	Top of Fill Elevation (m)	Height of Fill (m)	Comments
08/15/05	12:20 PM	184.305			182.514	0.000	Baseline Reading
08/16/05	12:00 PM	184.303	2		182.514	0.000	Baseline Reading
08/17/05	11:30 AM	184.305	0		182.514	0.000	Baseline Reading
08/18/05	11:30 AM	184.304	1		182.514	0.000	Baseline Reading
08/19/05	11:45 AM	184.304	1		182.514	0.000	Baseline Reading
08/22/05	11:30 AM	184.302	3		183.080	0.566	Lift 1
08/23/05	9:00 AM	184.301	4		183.346	0.832	Lift 2 Stage 1
08/24/05	7:45 AM	184.289	16		183.541	1.027	Lift 2 Stage 2
08/25/05	11:00 AM	185.813		-1524	183.541	1.027	After Extension of SR
08/25/05	7:45 PM	185.809	20		184.249	1.735	Lift 3
08/26/05	5:00 PM	185.806	23		184.787	2.273	Lift 4
08/27/05	11:40 AM	185.803	26		184.787	2.273	Lift 4
08/29/05	8:15 AM	185.810	19		184.787	2.273	Prior to Extension of SR
08/29/05	9:00 AM	187.348		-1538	184.787	2.273	After Extension of SR
08/29/05	6:00PM	187.344	23		185.513	2.999	Lift 5
08/30/05	6:45PM	187.341	26		186.261	3.747	Lift 6
08/31/05	6:38PM	187.332	35		186.672	4.158	Lift 7
08/31/05	9:30AM	187.327	40		186.672	4.158	Prior to Extension of SR
09/01/05	9:30AM	188.881		-1554	186.672	4.158	After Extension of SR
09/01/05	6:30PM	188.872	49		187.069	4.555	Lift 8
09/02/05	4:10PM	188.865	56		187.646	5.132	Lift 9
09/06/05	7:45AM	188.844	77		187.669	5.155	Lift 9
09/07/05	6:10PM	188.835	86		188.256	5.742	Lift 10
09/08/05	03:10PM	188.831	90		188.272	5.758	Lift 10
09/09/05	03:00PM	188.829	92		188.283	5.769	Lift 10
09/10/05	1:18PM	188.824	97		188.217	5.703	Lift 10
09/12/05	3:00PM	188.824	97		188.218	5.704	Lift 10
09/13/05	3:35PM	188.821	100		188.221	5.707	Lift 10
09/14/05	4:00PM	188.822	99		188.222	5.708	Lift 10
09/15/05	3:50PM	188.821	100		188.215	5.701	Lift 10
09/16/05	3:20PM	188.822	99		188.216	5.702	Lift 10
09/21/05	11:00AM	188.815	106		188.197	5.683	Lift 10
09/28/05	9:00AM	188.809	112		188.253	5.739	Lift 10
10/05/05	9:25AM	188.808	113		188.203	5.689	Lift 10
10/12/05	9:30AM	188.806	115		188.190	5.676	Lift 10
10/13/05	4:50PM	188.802	119		188.491	5.977	Lift 11
10/14/05	9:00AM	188.803	118		188.491	5.977	Prior to Extension of SR
10/14/05	9:00AM	190.359		-1438	188.491	5.977	After Extension of SR
10/14/05	4:15PM	190.346	131		188.952	6.438	Lift 12
10/17/05	4:05PM	190.338	139		189.262	6.748	Lift 13
10/18/05	4:40PM	190.332	145		189.616	7.102	Lift 14
10/19/05	4:10PM	190.332	145		189.910	7.396	Lift 15
10/20/05	10:00AM	190.325	152		189.910	7.396	Prior to Extension of SR
10/20/05	10:00AM	191.884		-1407	189.910	7.396	After Extension of SR
10/20/05	4:35PM	191.871	165		190.329	7.815	Lift 16
10/21/05	03:20PM	191.863	173		190.687	8.173	Lift 17
10/24/05	9:10AM	191.852	184		190.587	8.073	Lift 17
10/25/05	3:30PM	191.852	184		191.051	8.537	Final Lift
11/09/05	11:45AM	191.820	216		190.962	8.448	Final Lift
11/24/05	11:55AM	191.811	225		190.989	8.475	Final Lift
12/08/05	3:00 PM	191.819	217		190.989	8.475	Final Lift
12/20/05	1:45 PM	191.816	220		190.989	8.475	Final Lift
01/06/06	2:00 PM	191.805	231		190.989	8.475	Final Lift
01/23/06	1:30 PM	191.801	235		190.989	8.475	Final Lift
02/02/06	2:05 PM	191.795	241		190.989	8.475	Final Lift
02/14/06	2:00 PM	191.791	245		190.989	8.475	Final Lift
03/07/06	2:15 PM	191.786	250		190.989	8.475	Final Lift
03/24/06	9:30 AM	191.782	254		190.989	8.475	Final Lift
04/06/06	1:30 PM	191.777	259		190.981	8.467	Final Lift
04/20/06	1:20 PM	191.775	261		190.981	8.467	Final Lift
05/29/06	2:15 PM	191.770	266		190.981	8.467	Final Lift

Figure May 29, 2006 Monitoring Plots

Highway 17 Black Creek Realignment (10+764 O/S 10Lt)
Vibrating Wire Piezometer VWP1

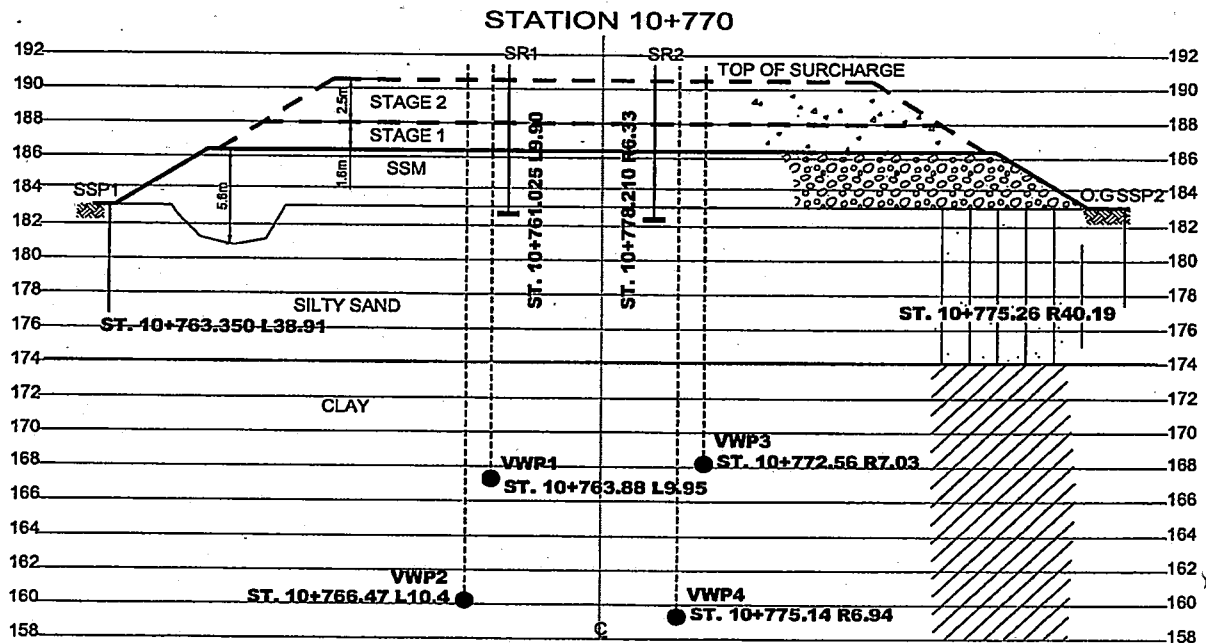
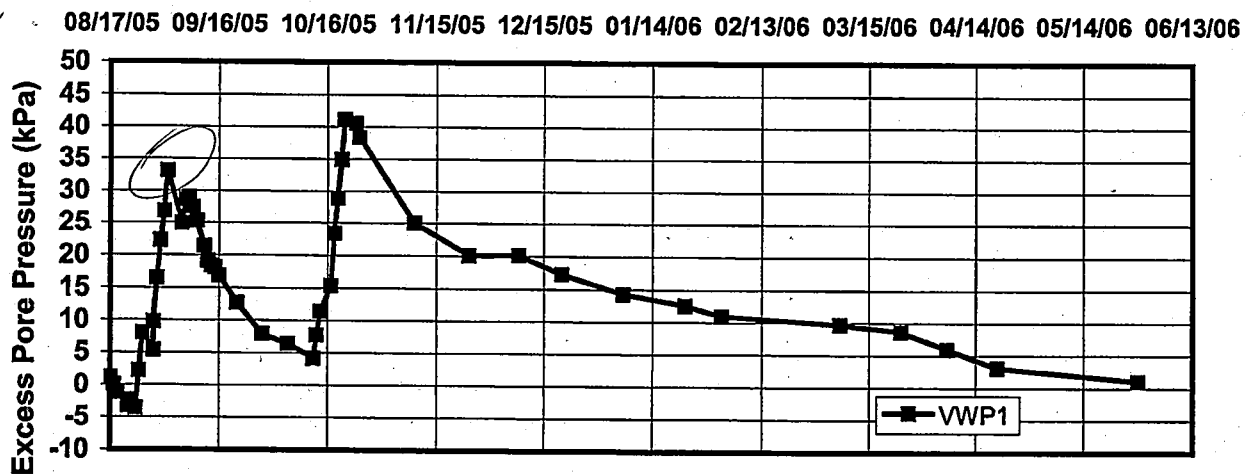
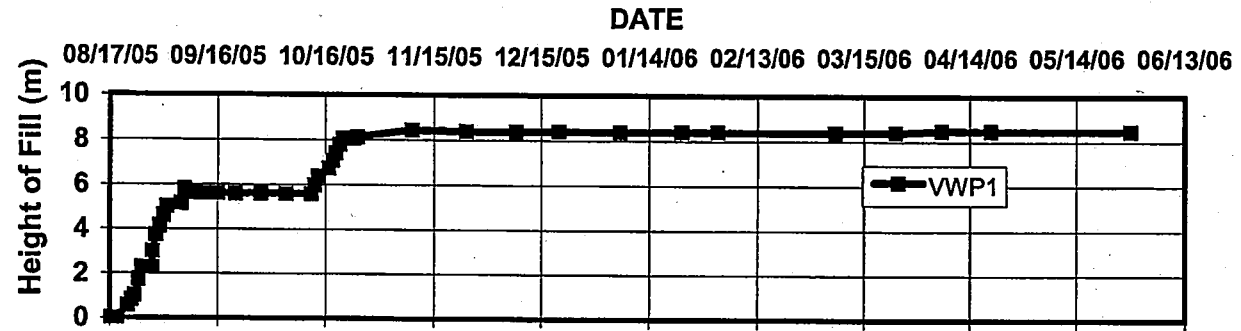
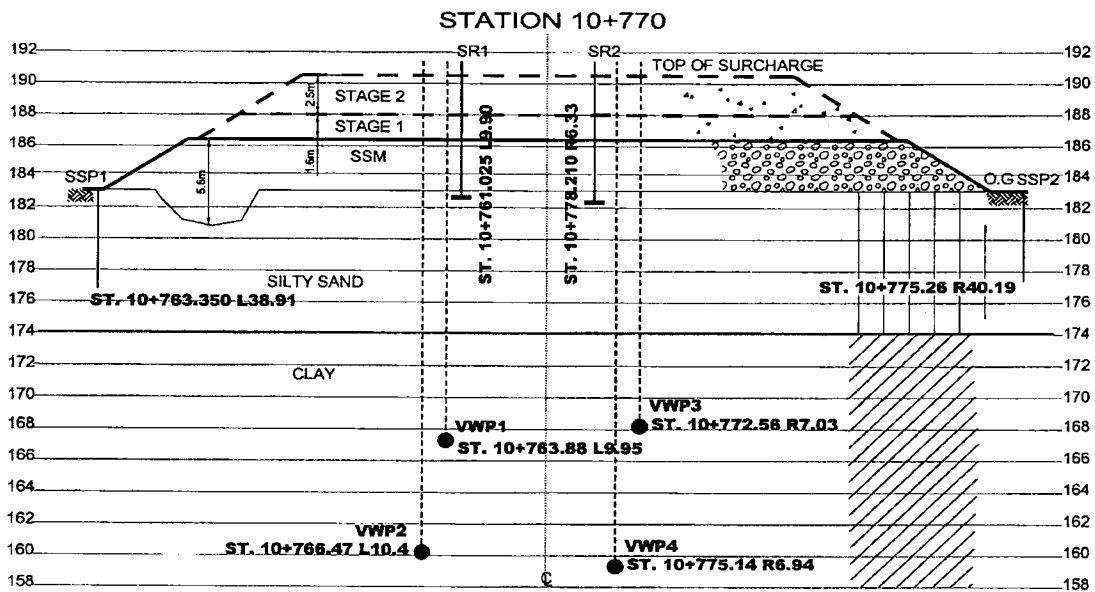
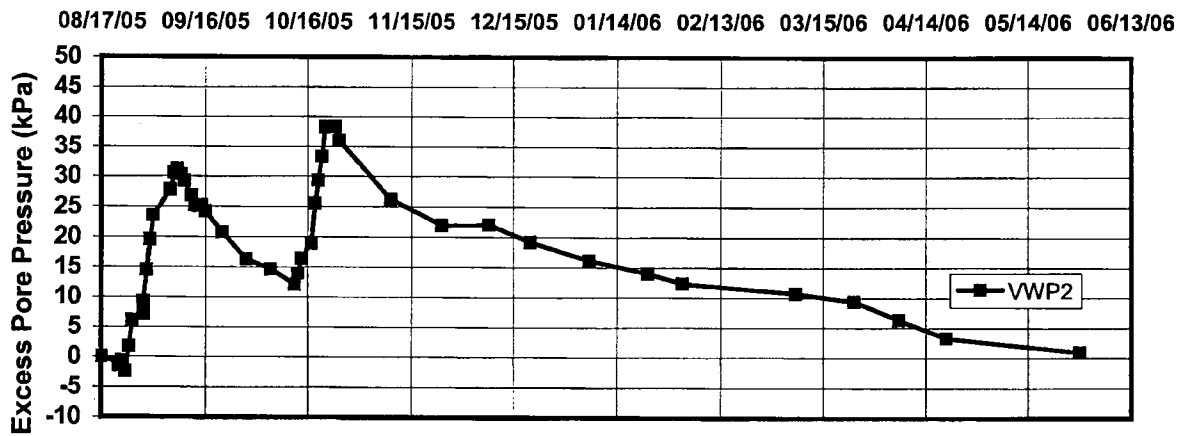
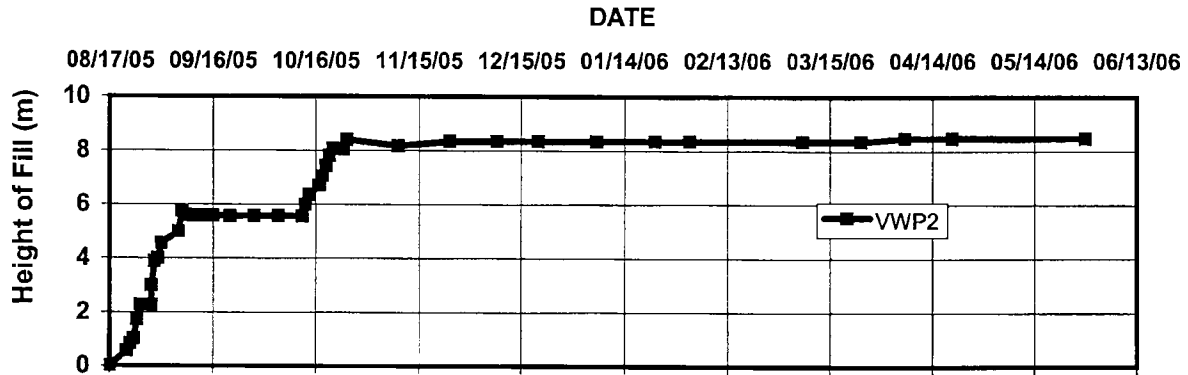


Figure May 29, 2006 Monitoring Plots

Highway 17 Black Creek Realignment (10+767 O/S 10Lt)
Vibrating Wire Piezometer VWP2

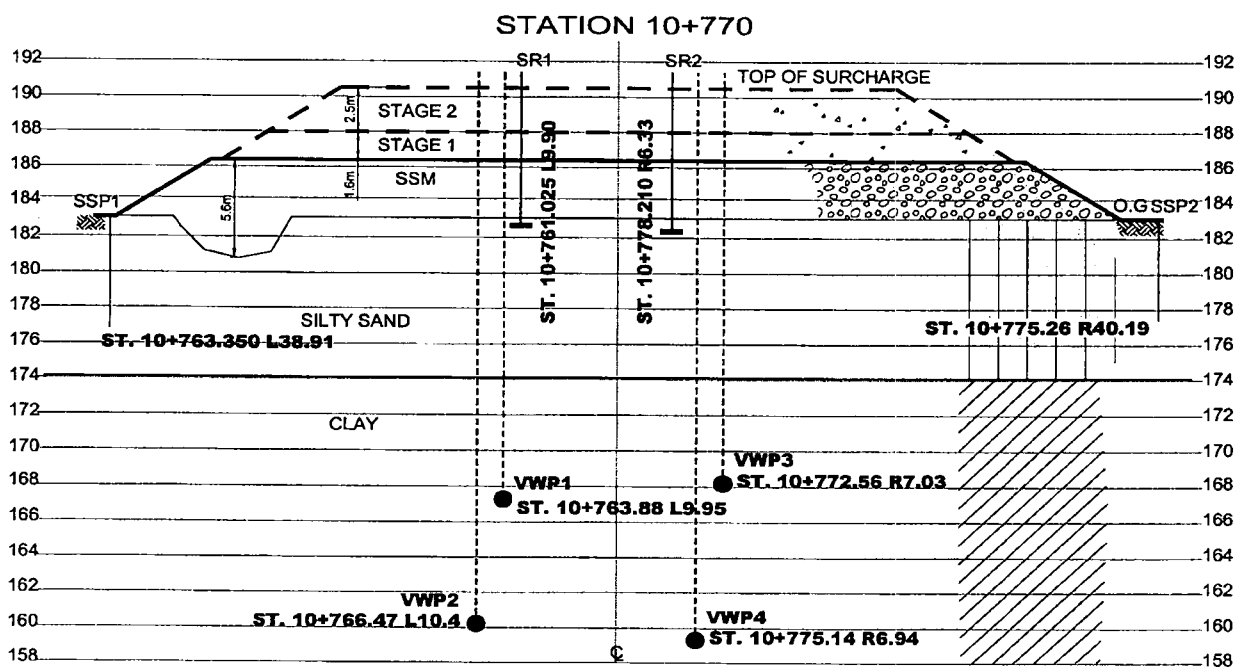
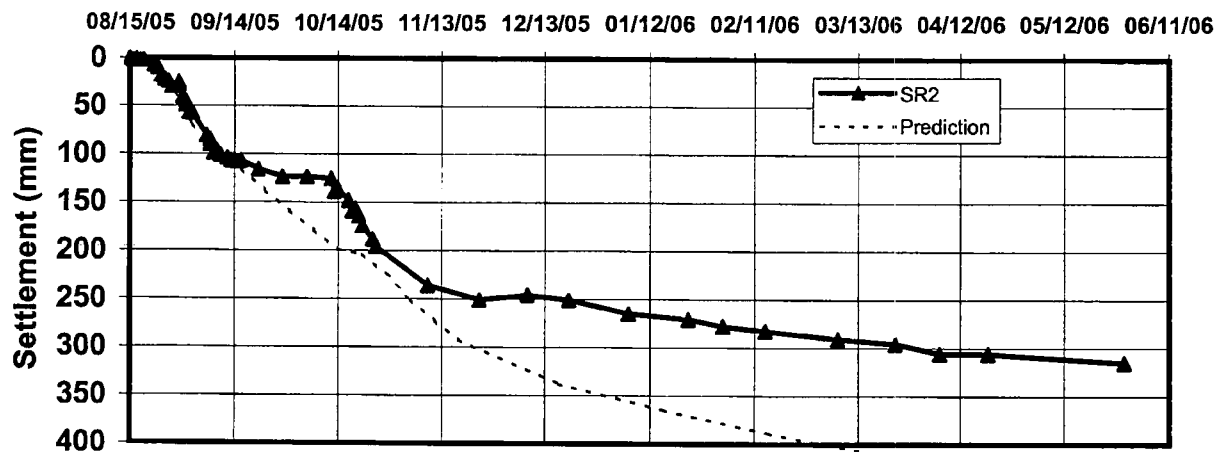
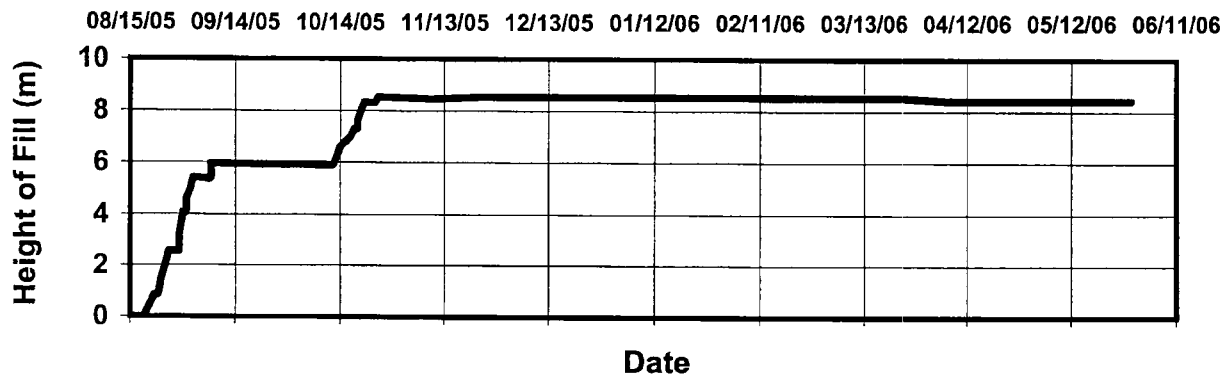


Figure

May 29, 2006

Height of Fill

Highway 17 Black Creek Realignment
(Station 10+778.210 O/S 6.33 Rt)
Settlement Rod SR 2



Contract 2005-5147 Settlement Rod Readings

SR #2 @ 10+778.210 O/S 6.33Rt

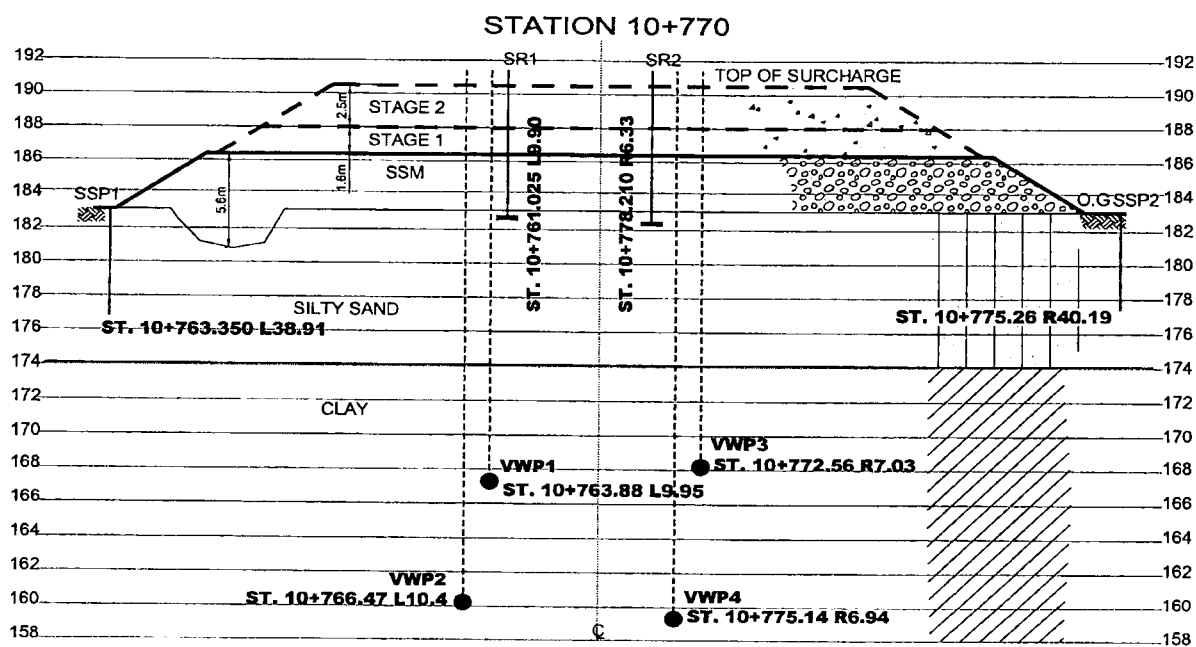
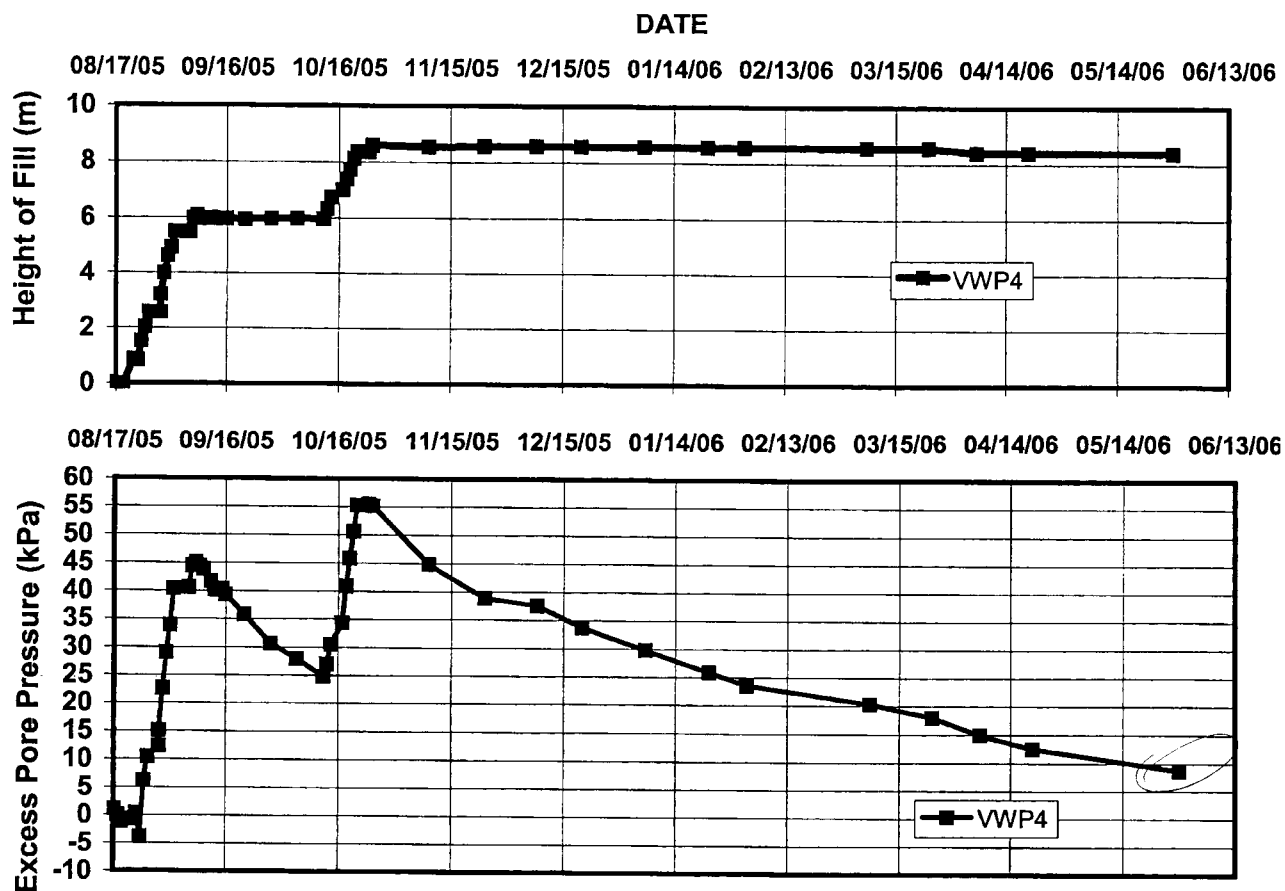
Original Ground Surface Elevation (m)
Original Top of Rod Elevation (m)

182.124
183.944

Date	Time	Top of Rod Elevation (m)	Settlement (mm)	Extension (mm)	Top of Fill Elevation (m)	Height of Fill (m)	Comments
08/15/05	12:20 PM	183.946			182.124	0.000	Baseline Reading
08/16/05	12:00 PM	183.944	2		182.124	0.000	Baseline Reading
08/17/05	11:30 AM	183.945	1		182.124	0.000	Baseline Reading
08/18/05	11:30 AM	183.944	2		182.124	0.000	Baseline Reading
08/19/05	11:45 AM	183.944	2		182.124	0.000	Baseline Reading
08/22/05	11:30 AM	183.939	7		182.979	0.855	Lift 1
08/23/05	9:00 AM	183.936	10		182.976	0.852	Lift 2 Stage 1
08/24/05	7:45 AM	183.928	18		183.641	1.517	Lift 2 Stage 2
08/25/05	11:00 AM	185.461		-1533	183.641	1.517	After Extension of SR
08/25/05	7:45 PM	185.457	22		184.153	2.029	Lift 3
08/26/05	5:00 PM	185.455	24		184.671	2.547	Lift 4
08/27/05	11:40 AM	185.449	30		184.671	2.547	Lift 4
08/29/05	8:15 AM	185.454	25		184.671	2.547	Prior to Extension of SR
08/29/05	9:00 AM	185.991		-1537	184.671	2.547	After Extension of SR
08/29/05	6:00 PM	186.988	28		185.332	3.208	Lift 5
08/30/05	6:45 PM	186.975	41		186.191	4.067	Lift 6
08/31/05	10:30 AM	186.971	45		186.191	4.067	Prior to Extension of SR
08/31/05	10:30 AM	188.501		-1530	186.191	4.067	After Extension of SR
08/31/05	6:38 PM	188.497	49		186.711	4.587	Lift 7
09/01/05	6:30 PM	188.489	57		187.074	4.950	Lift 8
09/02/05	4:10 PM	188.488	58		187.536	5.412	Lift 9
09/06/05	7:45 AM	188.465	81		187.502	5.378	Lift 9
09/07/05	8:30 AM	188.461	85		187.502	5.378	Prior to Extension of SR
09/07/05	8:30 AM	190.006		-1545	187.502	5.378	After Extension of SR
09/07/05	6:10 PM	190.001	90		188.094	5.970	Lift 10
09/08/05	03:10 PM	189.992	99		188.066	5.942	Lift 10
09/09/05	03:00 PM	189.994	97		188.095	5.971	Lift 10
09/10/05	1:18 PM	189.990	101		188.076	5.952	Lift 10
09/12/05	3:00 PM	189.987	104		188.074	5.950	Lift 10
09/13/05	3:35 PM	189.984	107		188.067	5.943	Lift 10
09/14/05	4:00 PM	189.985	106		188.068	5.944	Lift 10
09/15/05	3:50 PM	189.983	108		188.069	5.945	Lift 10
09/16/05	3:20 PM	189.984	107		188.068	5.944	Lift 10
09/21/05	11:00 AM	189.975	116		188.049	5.925	Lift 10
09/28/05	9:00 AM	189.967	124		188.058	5.934	Lift 10
10/05/05	9:25 AM	189.967	124		188.056	5.932	Lift 10
10/12/05	9:30 AM	189.965	126		188.027	5.903	Lift 10
10/13/05	4:50 PM	189.952	139		188.342	6.218	Lift 11
10/14/05	4:15 PM	189.954	137		188.727	6.603	Lift 12
10/17/05	4:05 PM	189.943	148		189.107	6.983	Lift 13
10/18/05	4:40 PM	189.932	159		189.413	7.289	Lift 14
10/19/05	9:30 AM	189.935	156		189.413	7.289	Prior to Extension of SR
10/19/05	9:30 AM	191.474		-1383	189.413	7.289	After Extension of SR
10/19/05	4:10 PM	191.471	159		189.754	7.630	Lift 15
10/20/05	4:35 PM	191.466	164		190.133	8.009	Lift 16
10/21/05	03:20 PM	191.456	174		190.458	8.334	Lift 17
10/24/05	9:10 AM	191.442	188		190.435	8.311	Lift 17
10/25/05	3:30 PM	191.434	196		190.650	8.526	Final Lift
11/09/05	11:45 AM	191.394	236		190.581	8.457	Final Lift
11/24/05	11:55 AM	191.379	251		190.656	8.532	Final Lift
12/08/05	3:00 PM	191.384	246		190.656	8.532	Final Lift
12/20/05	1:45 PM	191.379	251		190.656	8.532	Final Lift
01/06/06	2:00 PM	191.365	265		190.656	8.532	Final Lift
01/23/06	1:30 PM	191.359	271		190.656	8.532	Final Lift
02/02/06	2:05 PM	191.352	278		190.656	8.532	Final Lift
02/14/06	2:00 PM	191.347	283		190.656	8.532	Final Lift
03/07/06	2:15 PM	191.339	291		190.656	8.532	Final Lift
03/24/06	9:30 AM	191.334	298		190.656	8.532	Final Lift
04/08/06	1:30 PM	191.324	308		190.541	8.417	Final Lift
04/20/06	1:20 PM	191.324	306		190.541	8.417	Final Lift
05/29/06	2:20 PM	191.315	315		190.541	8.417	Final Lift

Figure May 29, 2006 Monitoring Plots

Highway 17 Black Creek Realignment (10+775 O/S 7Lt)
Vibrating Wire Piezometer VWP4

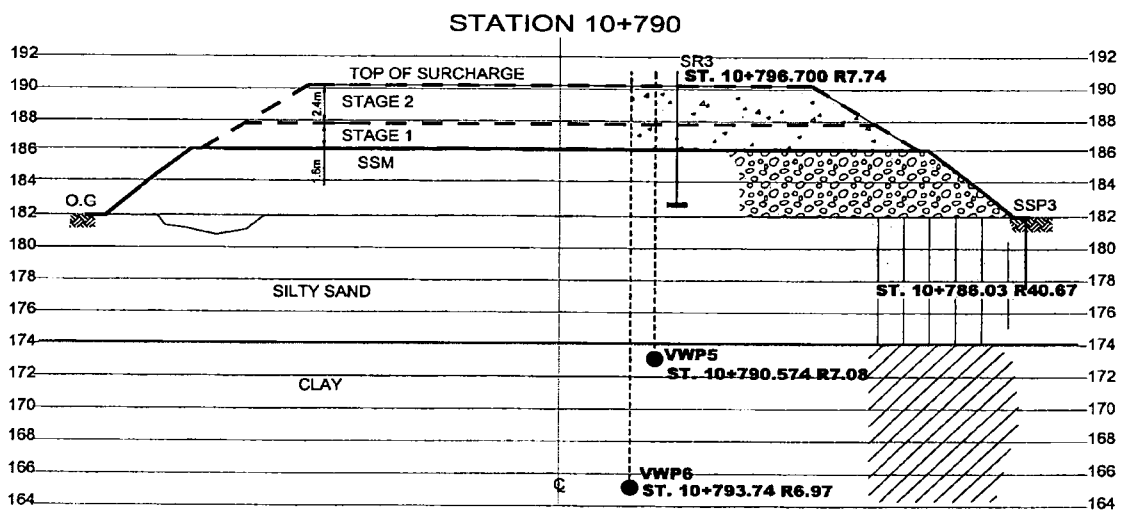
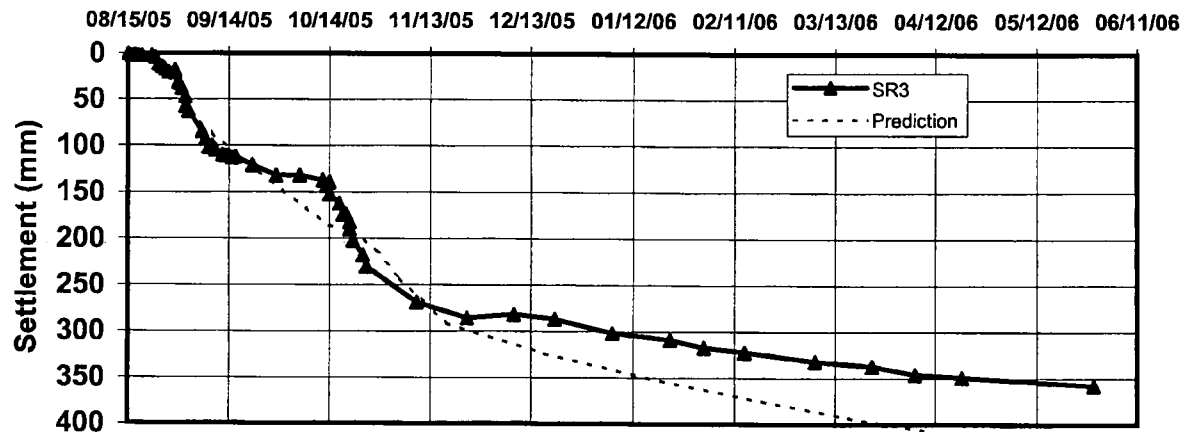
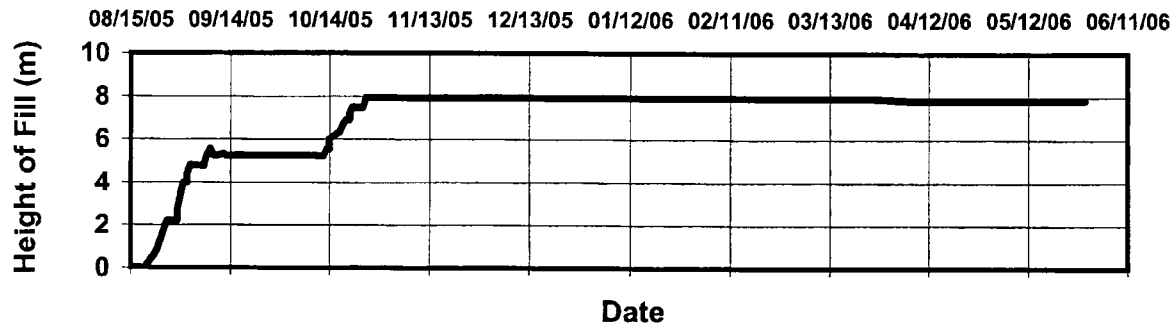


Figure

May 29, 2006

Height of Fill

Highway 17 Black Creek Realignment
(Station 10+796.700 O/S 7.74 Rt.)
Settlement Rod SR 3



Contract 2005-5147 Settlement Rod Readings

SR #3 @10+796.700 O/S 7.74 Rt

Original Ground Surface Elevation (m)
Original Top of Rod Elevation (m)

182.510
184.299

Date	Time	Top of Rod Elevation (m)	Settlement (mm)	Extension (mm)	Top of Fill Elevation (m)	Height of Fill (m)	Comments
08/15/05	12:20 PM	184.305			182.510	0	Baseline Reading
08/16/05	12:00 PM	184.303	2		182.510	0	Baseline Reading
08/17/05	11:30 AM	184.304	1		182.510	0	Baseline Reading
08/18/05	11:30 AM	184.303	2		182.510	0	Baseline Reading
08/19/05	11:45 AM	184.303	2		182.510	0	Baseline Reading
08/22/05	11:30 AM	184.303	2		183.113	0.603	Lift 1
08/23/05	9:00 AM	184.301	4		183.425	0.915	Lift 2 Stage 1
08/24/05	7:45 AM	184.294	11		183.853	1.343	Lift 2 Stage 2
08/25/05	11:00 AM	185.827		-1533	183.853	1.343	After Extension of SR
08/25/05	7:45 PM	185.824	14		184.363	1.853	Lift 3
08/26/05	5:00 PM	185.821	17		184.709	2.199	Lift 4
08/27/05	11:40 AM	185.818	20		184.709	2.199	Lift 4
08/29/05	8:15 AM	185.820	18		184.709	2.199	Prior to Extension of SR
08/29/05	9:00 AM	187.361		-1541	184.709	2.199	After Extension of SR
08/29/05	6:00 PM	187.358	21		185.229	2.719	Lift 5
08/30/05	6:45 PM	187.348	31		185.898	3.388	Lift 6
08/31/05	6:38 PM	187.341	38		186.494	3.984	Lift 7
09/01/05	9:30 AM	187.332	47		186.494	3.984	Prior to Extension of SR
09/01/05	9:30 AM	188.880		-1548	186.494	3.984	After Extension of SR
09/01/05	6:30 PM	188.869	58		186.903	4.393	Lift 8
09/02/05	4:10 PM	188.864	63		187.306	4.796	Lift 9
09/06/05	7:45 AM	188.842	85		187.263	4.753	Lift 9
09/07/05	6:10 PM	188.834	93		187.753	5.243	Lift 10
09/08/05	03:10 PM	188.825	102		188.066	5.556	Lift 10
09/09/05	03:00 PM	188.827	100		187.751	5.241	Lift 10
09/10/05	1:18 PM	188.822	105		187.751	5.241	Lift 10
09/12/05	3:00 PM	188.817	110		187.825	5.315	Lift 10
09/13/05	3:35 PM	188.816	111		187.749	5.239	Lift 10
09/14/05	4:00 PM	188.816	111		187.749	5.239	Lift 10
09/15/05	3:50 PM	188.814	113		187.746	5.236	Lift 10
09/16/05	3:20 PM	188.815	112		187.751	5.241	Lift 10
09/21/05	11:00 AM	188.806	121		187.739	5.229	Lift 10
09/28/05	9:00 AM	188.795	132		187.753	5.243	Lift 10
10/05/05	9:25 AM	188.795	132		187.751	5.241	Lift 10
10/12/05	9:30 AM	188.790	137		187.727	5.217	Lift 10
10/13/05	4:50 PM	188.784	143		188.041	5.531	Lift 11
10/14/05	9:00 AM	188.788	139		188.041	5.531	Prior to Extension of SR
10/14/05	9:00 AM	190.341		-1414	188.041	5.531	After Extension of SR
10/14/05	4:15 PM	190.328	152		188.533	6.023	Lift 12
10/17/05	4:05 PM	190.318	162		188.840	6.33	Lift 13
10/18/05	4:40 PM	190.306	174		189.171	6.661	Lift 14
10/19/05	4:10 PM	190.306	174		189.420	6.91	Lift 15
10/20/05	10:00 AM	190.298	182		189.420	6.91	Prior to Extension of SR
10/20/05	10:00 AM	191.853		-1373	189.420	6.91	After Extension of SR
10/20/05	4:35 PM	191.845	190		189.709	7.199	Lift 16
10/21/05	03:20 PM	191.833	202		190.011	7.501	Lift 17
10/24/05	9:10 AM	191.817	218		189.980	7.47	Lift 17
10/25/05	3:30 PM	191.805	230		190.454	7.944	Final Lift
11/09/05	11:45 AM	191.766	269		190.439	7.929	Final Lift
11/24/05	11:55 AM	191.749	286		190.449	7.939	Final Lift
12/08/05	3:00 PM	191.753	282		190.449	7.939	Final Lift
12/20/05	1:45 PM	191.748	287		190.449	7.939	Final Lift
01/06/06	2:00 PM	191.733	302		190.449	7.939	Final Lift
01/23/06	1:30 PM	191.726	309		190.449	7.939	Final Lift
02/02/06	2:05 PM	191.718	317		190.449	7.939	Final Lift
02/14/06	2:00 PM	191.713	322		190.449	7.939	Final Lift
03/07/06	2:15 PM	191.703	332		190.449	7.939	Final Lift
03/24/06	9:30 AM	191.698	337		190.449	7.939	Final Lift
04/06/06	1:30 PM	191.689	346		190.343	7.833	Final Lift
04/20/06	1:20 PM	191.686	349		190.343	7.833	Final Lift
05/29/06	2:20 PM	191.677	358		190.343	7.833	Final Lift

Figure May 29, 2006 Monitoring Plots

Highway 17 Black Creek Realignment (10+791 O/S 7Lt)
Vibrating Wire Piezometer VWP5

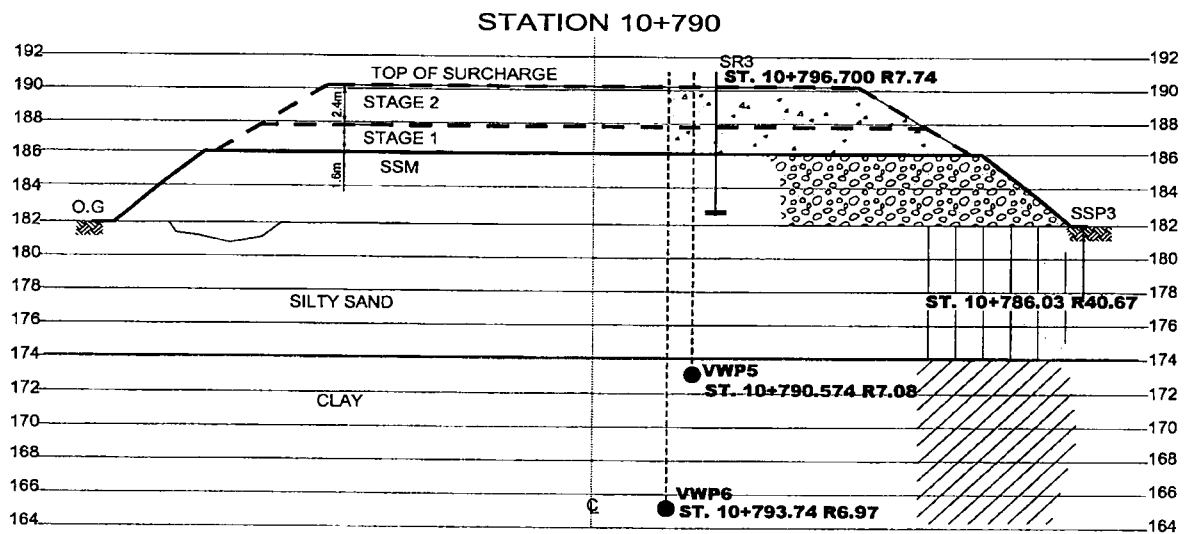
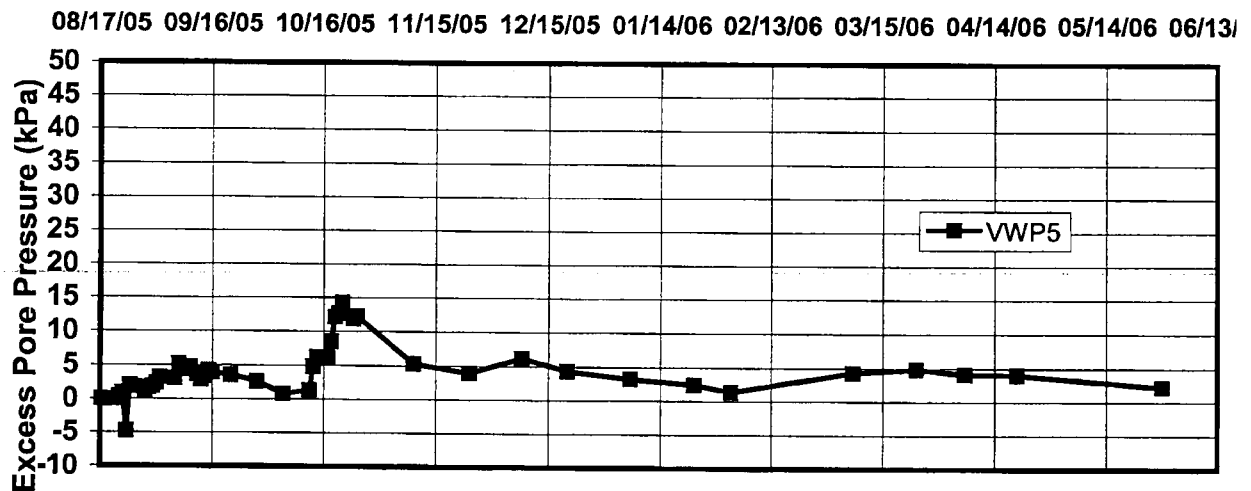
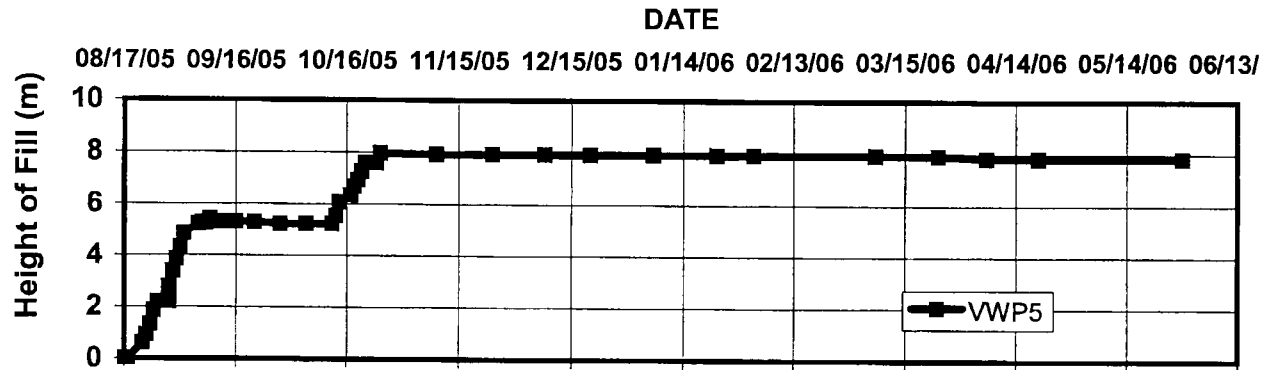
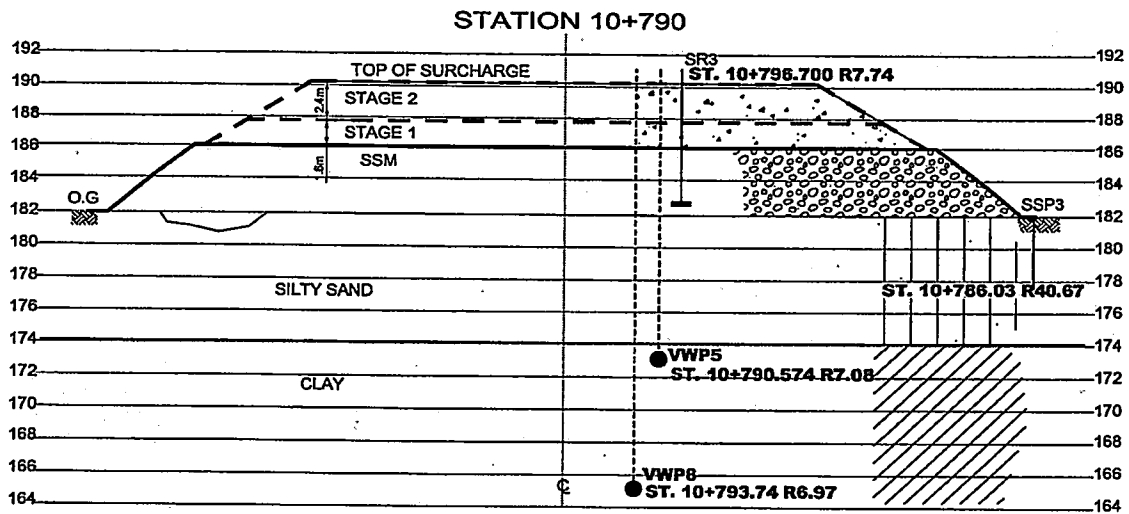
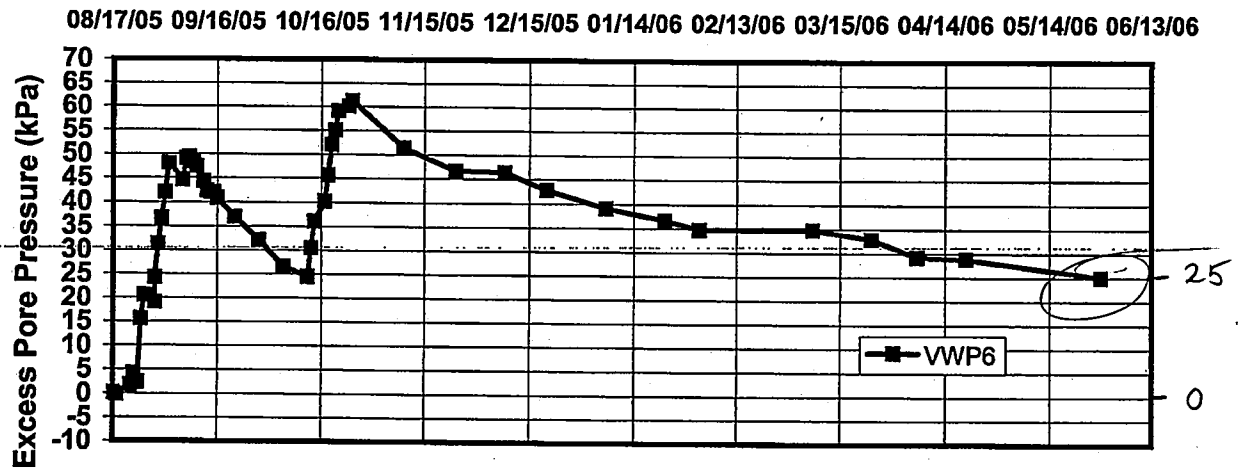
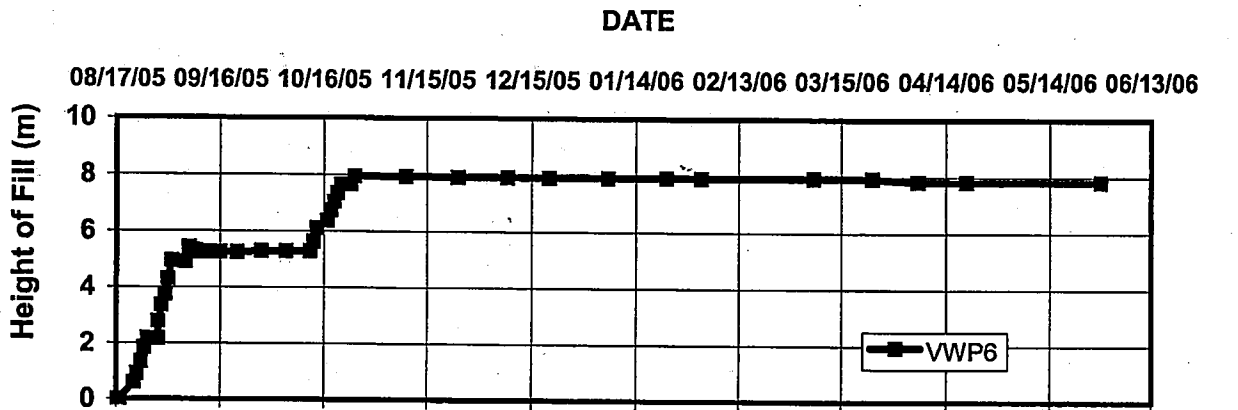


Figure May 29, 2006 Monitoring Plots

Highway 17 Black Creek Realignment (10+794 O/S 7Lt)
Vibrating Wire Piezometer VWP6

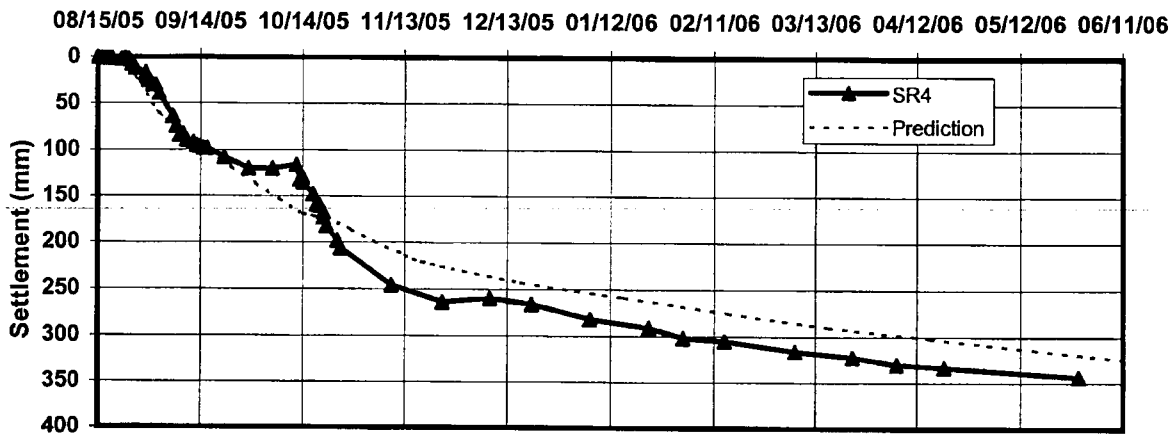
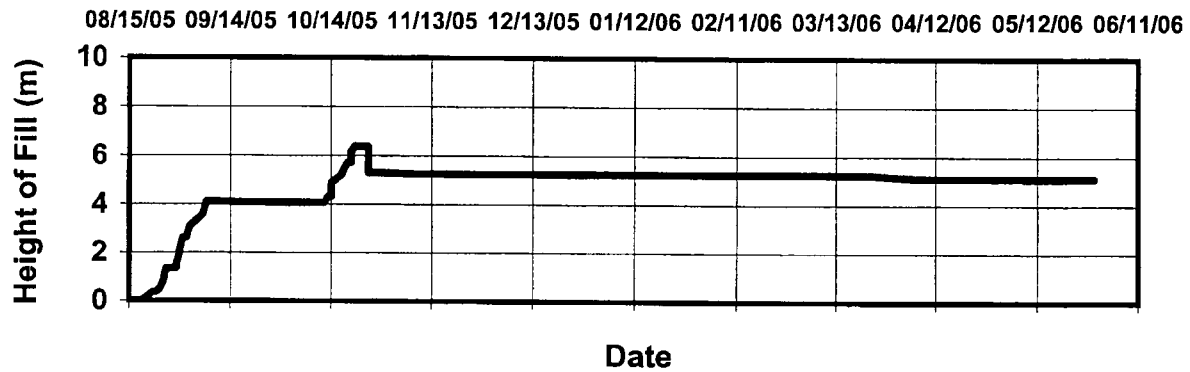


Figure

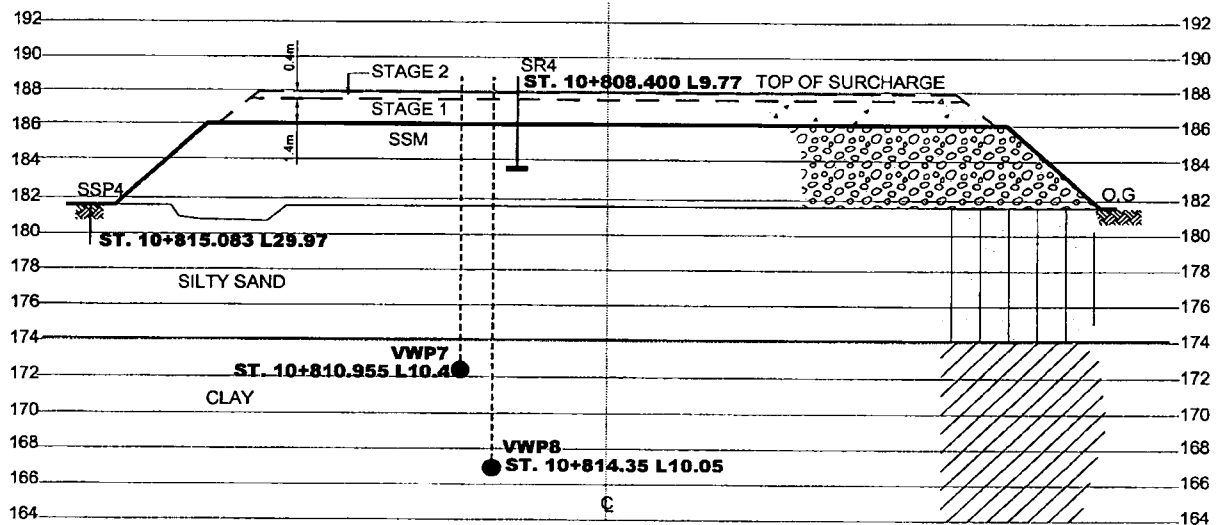
May 29, 2006

Height of Fill

Highway Black Creek Realignment
(Station 10+808.400 O/S 9.77 Lt.)
Settlement Rod SR 4



STATION 10+810



Contract 2005-5147 Settlement Rod Readings

SR #4 @10+808.400 O/S 9.77Lt

Original Ground Surface Elevation (m)

183.471

Original Top of Rod Elevation (m)

185.280

Date	Time	Top of Rod Elevation (m)	Settlement (mm)	Extension (mm)	Top of Fill Elevation (m)	Height of Fill (m)	Comments
08/15/05	12:20 PM	185.281			183.471	0	Baseline Reading
08/16/05	12:00 PM	185.280			183.471	0	Baseline Reading
08/17/05	11:30 AM	185.281	0		183.471	0	Baseline Reading
08/18/05	11:30 AM	185.280	1		183.471	0	Baseline Reading
08/19/05	11:45 AM	185.281	0		183.471	0	Baseline Reading
08/22/05	11:30 AM	185.279	2		183.819	0.348	Lift 1
08/23/05	9:00 AM	185.280	1		183.829	0.358	Lift 2 Stage 1
08/24/05	7:45 AM	185.279	2		183.930	0.459	Lift 2 Stage 2
08/25/05	11:00 AM	185.279	2		183.930	0.459	No Extension of SR
08/25/05	7:45 PM	185.274	7		184.242	0.771	Lift 3
08/26/05	11:00 AM	186.820		-1546	184.242	0.771	After Extension of SR
08/26/05	5:00 PM	186.815	12		184.809	1.338	Lift 4
08/29/05	9:00 AM	186.810	17		184.809	1.338	Lift 4
08/29/05	6:00PM	186.807	20		184.948	1.477	Lift 5
08/30/05	6:45PM	186.802	25		185.493	2.022	Lift 6
08/31/05	6:38PM	186.797	30		186.072	2.601	Lift 7
09/01/05	9:30AM	186.816	30 *		186.072	2.601	Prior to Extension of SR
09/01/05	9:30AM	188.338		-1522	186.072	2.601	After Extension of SR
09/02/05	4:10PM	188.329	39		186.528	3.057	Lift 8
09/06/05	7:45:AM	188.304	64		187.048	3.577	Lift 9
09/07/05	6:10PM	188.294	74		187.581	4.11	Lift 10
09/08/05	03:10PM	188.284	84		187.578	4.107	Lift 10
09/09/05	03:00PM	188.285	83		187.586	4.115	Lift 10
09/10/05	1:18pm	188.279	89		187.576	4.105	Lift 10
09/12/05	3:00PM	188.276	92		187.568	4.097	Lift 10
09/13/05	3:35PM	188.273	95		187.565	4.094	Lift 10
09/14/05	4:00PM	188.272	96		187.564	4.093	Lift 10
09/15/05	3:50PM	188.270	98		187.561	4.09	Lift 10
09/16/05	3:20PM	188.270	98		187.561	4.09	Lift 10
09/21/05	11:00AM	188.260	108		187.555	4.084	Lift 10
09/28/05	9:00AM	188.248	120		187.543	4.072	Lift 10
10/05/05	9:25AM	188.248	120		187.542	4.071	Lift 10
10/12/05	9:30AM	188.252	116		187.540	4.069	Lift 10
10/13/05	4:50PM	188.236	132		187.768	4.297	Lift 11
10/14/05	9:00AM	188.238	130		187.769	4.298	Prior to Extension of SR
10/14/05	9:00AM	189.785		-1417	187.769	4.298	After Extension of SR
10/14/05	4:15PM	189.780	135		188.334	4.863	Lift 12
10/17/05	4:05PM	189.767	148		188.683	5.212	Lift 13
10/18/05	4:40PM	189.756	159		188.966	5.495	Lift 14
10/19/05	4:10PM	189.755	160		189.213	5.742	Lift 15
10/20/05	10:00AM	189.748	167		189.213	5.742	Prior to Extension of SR
10/20/05	10:00AM	191.298		-1383	189.213	5.742	After Extension of SR
10/20/05	4:35PM	191.292	173		189.648	6.177	Lift 16
10/21/05	03:20PM	191.283	182		189.871	6.4	Lift 17
10/24/05	9:10AM	191.267	198		189.856	6.385	Lift 17
10/25/05	3:30PM	191.259	206		189.856	6.385	With Extension of SR
10/25/05	3:30PM	189.716		-1749	189.856	6.385	Removing Extension of SR
10/25/05	3:30PM	189.716	206		188.789	5.318	Final Lift
11/09/05	11:45AM	189.676	246		188.734	5.263	Final Lift
11/24/05	11:55AM	189.658	264		188.717	5.246	Final Lift
12/08/05	3:00 PM	189.662	260		188.717	5.246	Final Lift
12/20/05	1:45 PM	189.656	266		188.717	5.246	Final Lift
01/06/06	2:00 PM	189.640	282		188.717	5.246	Final Lift
01/23/06	1:30 PM	189.631	291		188.717	5.246	Final Lift
02/02/06	2:05 PM	189.620	302		188.717	5.246	Final Lift
02/14/06	2:00 PM	189.617	305		188.717	5.246	Final Lift
03/07/06	2:15 PM	189.606	316		188.717	5.246	Final Lift
03/24/06	9:30 AM	189.600	322		188.717	5.246	Final Lift
04/06/06	1:30 PM	189.592	330		188.599	5.128	Final Lift
04/20/06	1:20 PM	189.589	333		188.599	5.128	Final Lift
05/29/06	2:20 PM	189.579	343		188.599	5.128	Final Lift

Figure May 29, 2006 Monitoring Plots

Highway 17 Black Creek Realignment (10+815 O/S 10Lt)
Vibrating Wire Piezometer VWP7

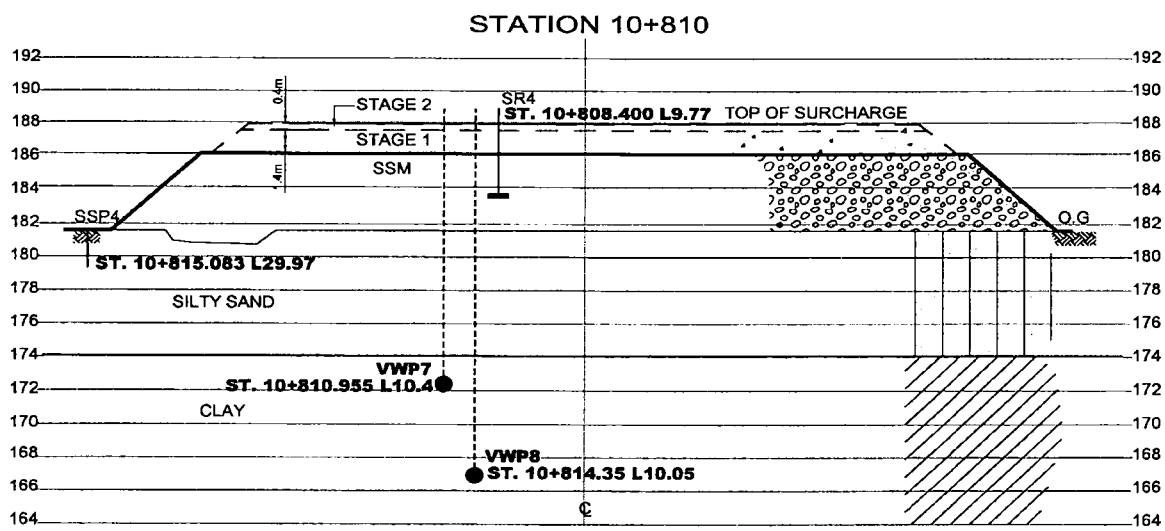
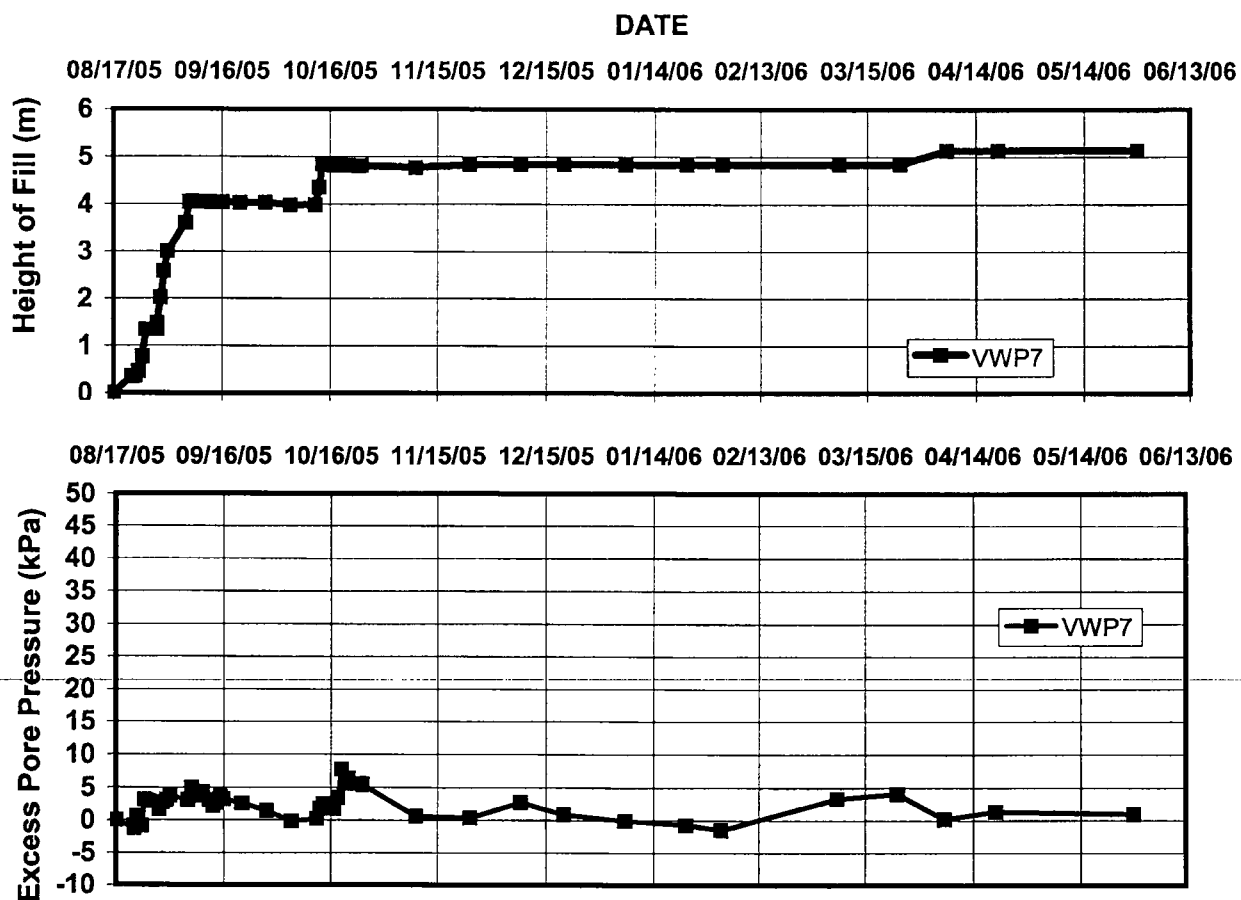
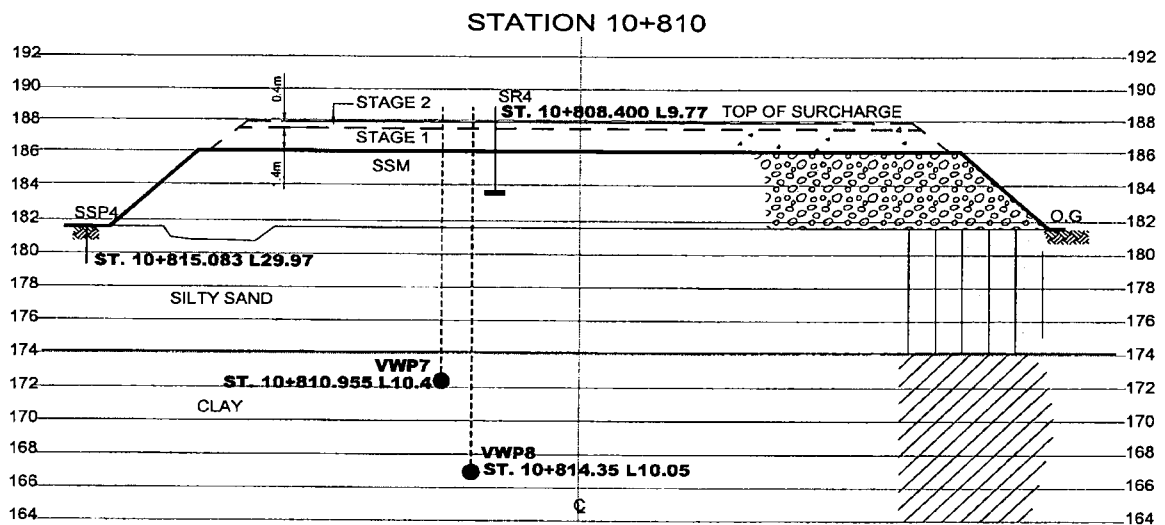
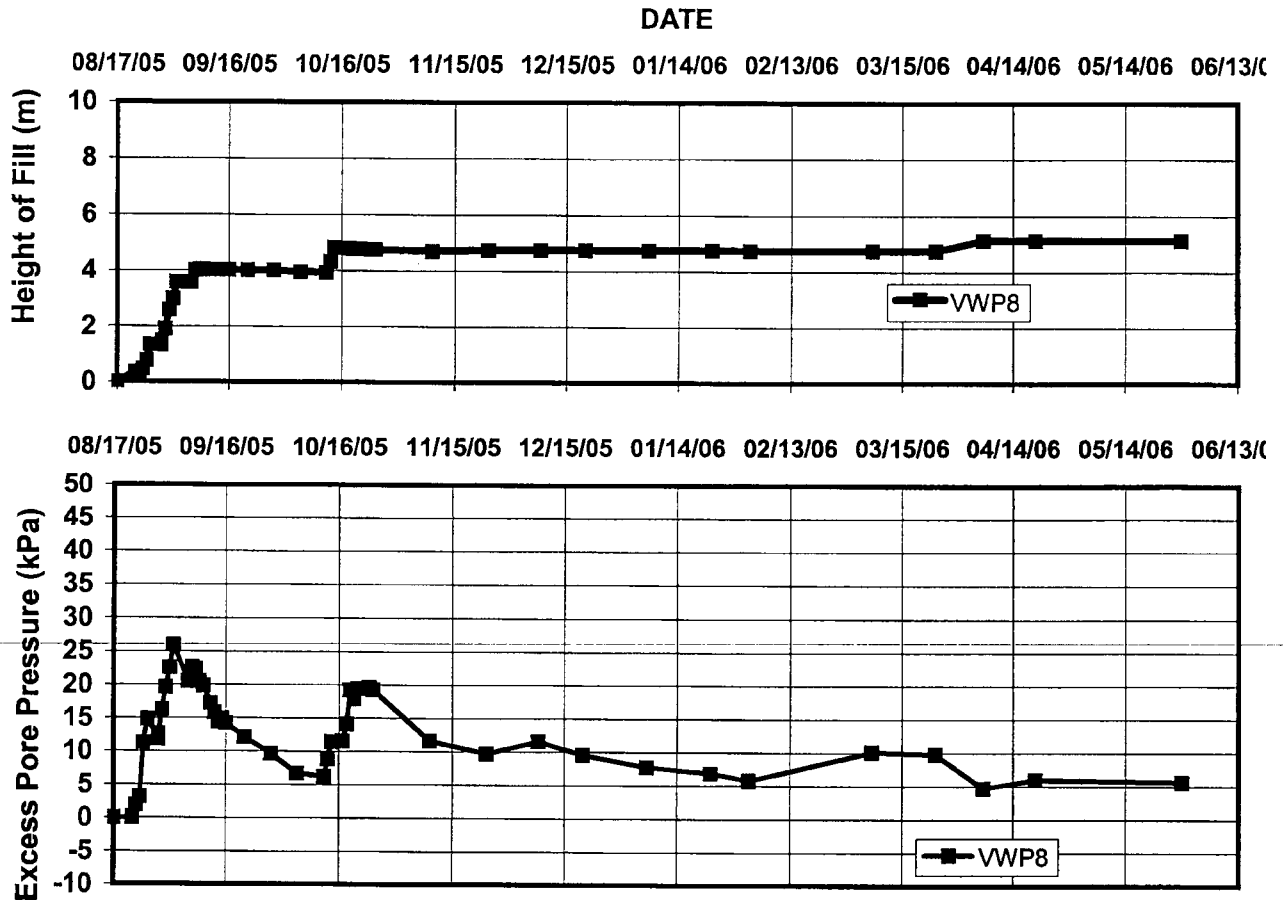


Figure May 29, 2006 Monitoring Plots

Highway 17 Black Creek Realignment (10+8184 O/S 10Lt)
Vibrating Wire Piezometer VWP8



Contract 2005-5147 Standpipe Readings
SSP1 Station: 10+763.350 O/S 38.91 Lt.

Tip Elevation (m)

176.8

Date	Time	Water Depth Below Top of Pipe (m)	Top of Pipe Elevation (m)	Water Level Elevation (m)	Comments
08/17/05	1:00:00 PM	1.284	182.852	181.568	Baseline Reading
08/18/05	11:20:00 AM	1.302	182.852	181.550	Baseline Reading
08/19/05	9:50:00 AM	1.290	182.852	181.562	Baseline Reading
08/22/05	11:30:00 AM	1.285	182.852	181.567	Lift 1
08/23/05	9:00:00 AM	1.256	182.850	181.594	Lift 2 Stage 1
08/24/05	7:49:00 AM	1.230	182.849	181.619	Lift 2 Stage 2
08/25/05	7:07:00 PM	0.800	182.849	182.049	Lift 3
08/26/05	4:57:00 PM	1.050	182.849	181.799	Lift 4
08/29/05	9:00:00 AM	1.220	182.848	181.628	Lift 4
08/29/05-#2	6:15PM	1.140	182.848	181.708	Lift 5
08/30/05	6:30:00PM	1.140	182.848	181.708	Lift 6
08/31/05	6:30:00PM	1.150	182.848	181.698	Lift 7
09/01/05	6:10:00PM	1.040	182.848	181.808	Lift 8
09/02/05	3:55:00PM	1.050	182.848	181.798	Lift 9
09/06/05	7:55:00AM	1.230	182.848	181.618	Lift 9
09/07/05	6:00:00PM	1.226	182.846	181.620	Lift 10
09/08/05	03:20PM	1.200	182.846	181.646	Lift 10
09/09/05	03:15PM	1.205	182.846	181.641	Lift 10
09/10/05	12:50PM	1.153	182.846	181.693	Lift 10
09/12/05	2:55PM	1.252	182.846	181.594	Lift 10
09/13/05	3:10PM	1.270	182.846	181.576	Lift 10
09/14/05	3:46PM	1.298	182.846	181.548	Lift 10
09/15/05	3:40PM	1.311	182.846	181.535	Lift 10
09/16/05	3:20PM	1.315	182.846	181.531	Lift 10
09/21/05	11:15AM	1.327	182.846	181.519	Lift 10
09/28/05	9:20AM	1.296	182.846	181.550	Lift 10
10/05/05	9:45AM	1.300	182.846	181.546	Lift 10
10/12/05	9:20AM	1.175	182.846	181.671	Lift 10
10/13/05	05:05PM	1.166	182.846	181.680	Lift 11
10/14/05	04:10PM	1.128	182.846	181.718	Lift 12
10/17/05	04:00PM	1.063	182.846	181.783	Lift 13
10/18/05	04:40PM	1.390	182.846	181.456	Lift 14
10/19/05	4:30PM	1.368	182.846	181.478	Lift 15
10/20/05	5:00PM	1.393	182.846	181.453	Lift 16
10/21/05	03:30PM	1.720	182.846	181.126	Lift 17
10/24/05	09:20AM	1.720	182.846	181.126	Lift 17
10/25/05	04:00PM	1.390	182.846	181.456	Final Lift
11/09/05	12:10PM	1.400	182.846	181.446	Final Lift
11/24/05	11:55AM				
12/20/05	2:20 PM	1.409	182.841	181.432	Final Lift
01/06/06	2:15 PM	1.411	182.841	181.430	Final Lift
02/02/06	2:30 PM	1.413	182.841	181.428	Final Lift
03/07/06	2:20 PM		182.841	181.428	Frozen - Unable to measure
03/24/06	9:10 AM		182.841	181.428	Frozen - Unable to measure
04/06/06	1:50 PM	1.249	182.841	181.592	Final Lift
04/21/06	10:30 AM	0.853	182.841	181.988	Final Lift
05/29/06	2:20 PM	0.853	182.841	181.988	Final Lift

Contract 2005-5147 Standpipe Readings
 SSP2 Station: 10+775.260 O/S 40.19 Rt.

Tip Elevation (m)

177.4

Date	Time	Water Depth Below Top of Pipe (m)	Top of Pipe Elevation (m)	Water Level Elevation (m)	Comments
08/17/05	1:00:00 PM	4.642	183.469	178.827	Baseline Reading
08/18/05	11:20:00 AM	4.643	183.469	178.826	Baseline Reading
08/19/05	9:50:00 AM	4.644	183.469	178.825	Baseline Reading
08/22/05	11:30:00 AM	4.650	183.469	178.819	Lift 1
08/23/05	9:00:00 AM	4.650	183.469	178.819	Lift 2 Stage 1
08/24/05	7:51:00 AM	3.630	183.465	179.835	Lift 2 Stage 2
08/25/05	7:31:00 PM	4.660	183.465	178.805	Lift 3
08/26/05	4:50:00 PM	4.650	183.465	178.815	Lift 4
08/29/05	9:00:00 AM	4.644	183.466	178.822	Lift 4
08/29/05 #2	6:15PM	4.650	183.466	178.816	Lift 5
08/30/05	6:30:00PM	4.640	183.466	178.826	Lift 6
08/31/05	6:30:00PM	4.640	183.466	178.826	Lift 7
09/01/05	6:10:00PM	4.639	183.466	178.827	Lift 8
09/02/05	3:55:00PM	4.600	183.466	178.866	Lift 9
09/06/05	7:55:00AM	4.640	183.466	178.826	Lift 9
09/07/05	6:00:00PM	4.645	183.498	178.853	Lift 10
09/08/05	03:20PM	4.643	183.498	178.855	Lift 10
09/09/05	03:15PM	4.640	183.498	178.858	Lift 10
09/10/05	12:50PM	4.644	183.498	178.854	Lift 10
09/12/05	2:55PM	4.640	183.498	178.858	Lift 10
09/13/05	3:10PM	4.645	183.498	178.853	Lift 10
09/14/05	3:46PM	4.640	183.498	178.858	Lift 10
09/15/05	3:40PM	4.640	183.498	178.858	Lift 10
09/16/05	3:20PM	4.638	183.498	178.860	Lift 10
09/21/05	11:15AM	4.644	183.498	178.854	Lift 10
09/28/05	9:20AM	4.646	183.498	178.852	Lift 10
10/05/05	9:45AM	4.650	183.498	178.848	Lift 10
10/12/05	9:20AM	4.650	183.498	178.848	Lift 10
10/13/05	05:05PM	4.644	183.498	178.854	Lift 11
10/14/05	04:10PM	4.644	183.498	178.854	Lift 12
10/17/05	04:00PM	4.650	183.498	178.848	Lift 13
10/18/05	04:40PM	4.645	183.498	178.853	Lift 14
10/19/05	4:30PM	4.645	183.498	178.853	Lift 15
10/20/05	5:00PM	4.644	183.498	178.854	Lift 16
10/21/05	03:30PM	4.644	183.498	178.854	Lift 17
10/24/05	09:20AM	4.646	183.498	178.852	Lift 17
10/25/05	04:00PM	4.647	183.498	178.851	Final Lift
11/09/05	12:10PM	4.650	183.498	178.848	Final Lift
11/24/05	11:55AM	4.660	183.498	178.838	Final Lift
12/20/05	2:00 PM	4.663	183.447	178.784	Final Lift
01/06/06	2:10 PM	4.667	183.447	178.780	Final Lift
02/02/06	2:25 PM	4.665	183.447	178.782	Final Lift
03/07/06	2:20 PM	4.665	183.447	178.782	Final Lift
03/24/06	9:10 AM	4.662	183.447	178.785	Final Lift
04/06/06	1:50 PM	4.661	183.447	178.786	Final Lift
04/20/06	1:35 PM	4.657	183.447	178.790	Final Lift
05/29/06	2:20 PM	4.657	183.447	178.790	Final Lift

Contract 2005-5147 Standpipe Readings
SSP3 Station: 10+786.030 O/S 40.67 Rt.

Tip Elevation (m)

177.5

Date	Time	Water Depth Below Top of Pipe (m)	Top of Pipe Elevation (m)	Water Level Elevation (m)	Comments
08/17/05	1:00:00 PM	2.330	183.616	181.286	Baseline Reading
08/18/05	11:20:00 AM	4.392	183.616	179.224	Baseline Reading
08/19/05	9:50:00 AM	4.396	183.616	179.220	Baseline Reading
08/22/05	11:30:00 AM	4.400	183.616	179.216	Lift 1
08/23/05	9:00:00 AM	4.396	183.616	179.220	Lift 2 Stage 1
08/24/05	7:52:00 AM	3.395	183.61	180.215	Lift 2 Stage 2
08/25/05	7:29:00 PM	4.410	183.61	179.200	Lift 3
08/26/05	4:53:00 PM	4.450	183.61	179.160	Lift 4
08/29/05	9:00:00 AM	4.402	183.613	179.211	Lift 4
08/29/05-#2	6:15PM	4.420	183.613	179.193	Lift 5
08/30/05	6:30:00PM	4.400	183.603	179.203	Lift 6
08/31/05	6:30:00PM	4.400	183.603	179.203	Lift 7
09/01/05	6:10:00PM	4.400	183.603	179.203	Lift 8
09/02/05	3:55:00PM	4.400	183.603	179.203	Lift 9
09/06/05	7:55:00AM	4.396	183.603	179.207	Lift 9
09/07/05	6:00:00PM	4.397	183.595	179.198	Lift 10
09/08/05	03:20PM	4.398	183.595	179.197	Lift 10
09/09/05	03:15PM	4.395	183.595	179.200	Lift 10
09/10/05	12:50PM	4.398	183.595	179.197	Lift 10
09/12/05	2:55PM	4.397	183.595	179.198	Lift 10
09/13/05	3:10PM	4.397	183.595	179.198	Lift 10
09/14/05	3:46PM	4.395	183.595	179.200	Lift 10
09/15/05	3:40PM	4.399	183.595	179.196	Lift 10
09/16/05	3:20PM	4.395	183.595	179.200	Lift 10
09/21/05	11:15AM	4.398	183.595	179.197	Lift 10
09/28/05	9:20AM	4.400	183.595	179.195	Lift 10
10/05/05	9:45AM	4.000	183.595	179.595	Lift 10
10/12/05	9:20AM	4.000	183.595	179.595	Lift 10
10/13/05	05:05PM	4.400	183.595	179.195	Lift 11
10/14/05	04:10PM	4.400	183.595	179.195	Lift 12
10/17/05	04:00PM	4.400	183.595	179.195	Lift 13
10/18/05	04:40PM	4.400	183.595	179.195	Lift 14
10/19/05	4:30PM	4.400	183.595	179.195	Lift 15
10/20/05	5:00PM	4.400	183.595	179.195	Lift 16
10/21/05	03:30PM	4.4	183.595	179.195	Lift 17
10/24/05	09:20AM	4.400	183.595	179.195	Lift 17
10/25/05	04:00PM	4.400	183.595	179.195	Final Lift
11/09/05	12:10PM	4.402	183.595	179.193	Final Lift
11/24/05	11:55AM	4.410	183.595	179.185	Final Lift
12/20/05	2:15 PM	4.411	183.598	179.187	Final Lift
01/06/06	2:10 PM	4.415	183.598	179.183	Final Lift
02/02/06	2:25 PM	4.414	183.598	179.184	Final Lift
03/07/06	2:20 PM	4.442	183.598	179.156	Final Lift
03/24/06	9:10 AM	4.411	183.598	179.187	Final Lift
04/06/06	1:50 PM	4.507	183.598	179.091	Final Lift
04/20/06	1:35 PM	4.414	183.598	179.184	Final Lift
05/29/06	2:20 PM	4.212	183.598	179.386	Final Lift

Contract 2005-5147 Standpipe Readings
 SSP4 Station: 10+815.083 O/S 29.97 Lt.

Tip Elevation (m)

179.3

Date	Time	Water Depth Below Top of Pipe (m)	Top of Pipe Elevation (m)	Water Level Elevation (m)	Comments
08/17/05	1:00:00 PM	4.000	185.409	181.409	Baseline Reading
08/18/05	11:20:00 AM	4.000	185.409	181.409	Baseline Reading
08/19/05	9:50:00 AM	3.994	185.409	181.415	Baseline Reading
08/22/05	11:30:00 AM	3.800	185.409	181.609	Lift 1
08/23/05	9:00:00 AM	3.762	185.41	181.648	Lift 2 Stage 1
08/24/05	7:53:00 AM	3.830	185.406	181.576	Lift 2 Stage 2
08/25/05	7:28:00 PM	3.780	185.406	181.626	Lift 3
08/26/05	4:55:00 PM	3.760	185.406	181.646	Lift 4
08/29/05	9:00:00 AM	3.875	185.410	181.535	Lift 4
08/29/05-#2	6:15PM	3.850	185.41	181.560	Lift 5
08/30/05	6:30:00PM	3.752	185.41	181.658	Lift 6
08/31/05	6:30:00PM	3.701	185.41	181.709	Lift 7
09/01/05	6:10:00PM	3.676	185.41	181.734	Lift 8
09/02/05	3:55:00PM	3.600	185.41	181.810	Lift 9
09/06/05	7:55:00AM	3.855	185.41	181.555	Lift 9
09/07/05	6:00:00PM	3.757	185.408	181.651	Lift 10
09/08/05	03:20PM	3.776	185.408	181.632	Lift 10
09/09/05	03:15PM	3.773	185.408	181.635	Lift 10
09/10/05	12:50PM	3.862	185.408	181.546	Lift 10
09/12/05	2:55PM	3.912	185.408	181.496	Lift 10
09/13/05	3:10PM	3.920	185.408	181.488	Lift 10
09/14/05	3:46PM	3.934	185.408	181.474	Lift 10
09/15/05	3:40PM	3.955	185.408	181.453	Lift 10
09/16/05	3:20PM	3.965	185.408	181.443	Lift 10
09/21/05	11:15AM	3.969	185.408	181.439	Lift 10
09/28/05	9:20AM	3.950	185.408	181.458	Lift 10
10/05/05	9:45AM	3.705	185.408	181.703	Lift 10
10/12/05	9:20AM	3.685	185.408	181.723	Lift 10
10/13/05	05:05PM	3.650	185.408	181.758	Lift 11
10/14/05	04:10PM	3.573	185.408	181.835	Lift 12
10/17/05	04:00PM	3.510	185.408	181.898	Lift 13
10/18/05	04:40PM	3.484	185.408	181.924	Lift 14
10/19/05	4:30PM	3.880	185.408	181.528	Lift 15
10/20/05	5:00PM	3.344	185.408	182.064	Lift 16
10/21/05	03:30PM	3.340	185.408	182.068	Lift 17
10/24/05	09:20AM	3.460	185.408	181.948	Lift 17
10/25/05	04:00PM	3.474	185.408	181.934	Final Lift
11/09/05	12:10PM	3.396	185.408	182.012	Final Lift
11/24/05	11:55AM				
12/20/05	2:20 PM	3.404	185.407	182.003	Final Lift
01/06/06	2:15 PM	3.405	185.407	182.002	Final Lift
02/02/06	2:30 PM	3.424	185.407	181.983	Final Lift
03/07/06	2:20 PM	4.055	185.407	181.352	Final Lift
03/24/06	9:10 AM	4.055	185.407	181.352	Pipe Blocked
04/06/06	1:50 PM	3.364	185.407	182.043	Final Lift
04/20/06	1:35 PM	3.622	185.394	181.772	Final Lift
05/29/06	2:20 PM	3.845	185.394	181.549	Final Lift

Manual ABC Factors	A= (kPa)	-0.00912365	
	B= (kPa)	0.017868	
	C= (kPa)	1040.5	
Temp. Coefficients	m=(PSI/°C)	-0.0133	-0.091637 (kPa/°C)
	b= (PSI)	0.323	2.22547 (kPa)
Temp. Offset	(°C)	-0.2	

Notes (*): Standalone Piezometer readings not taken necessarily on the same day of VW readings

Run ID	Run Date	Run Time	Run Type	Run Status	Run Duration	Run Length	Run Width	Run Depth	Run Volume	Run Weight	Run Density	Run Temperature	Run Humidity	Run Pressure	Run Wind Speed	Run Wind Direction	Run Rainfall	Run Cloud Cover	Run Visibility	Run Air Quality	Run Water Quality	Run Soil Quality	Run Plant Health	Run Animal Health	Run Human Health	Run Environmental Health	Run Overall Health
08/17/05	9:32 AM	2764.516	6.903987	144.895	1.594	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	144.895	Baseline Reading	
08/18/05	8:57 AM	2766.458	6.906292	143.802	1.594	145.196	142.991	140.643	139.993	0.812	1.188	-1.013	-1.172	162.614	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Baseline Reading	
08/19/05	8:45 AM	2768.174	6.901446	143.458	1.594	144.093	151.874	160.690	131.058	-0.123	-1.203	-1.219	162.514	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Baseline Reading	
08/22/05	8:06 AM	2770.055	6.899250	140.963	1.594	142.487	151.816	160.691	131.071	-2.282	-2.771	-1.568	163.090	0.566	11.9	6.9										LM 1	
08/22/05	10:25 AM	2770.521	6.899092	140.963	1.594	142.486	151.815	160.700	131.652	-0.333	-3.263	-4.482	163.090	0.566	11.9	6.9										LM 1	
08/23/05	8:36 AM	2769.623	6.897906	141.492	1.594	143.088	161.878	160.699	131.248	-0.240	-2.359	0.904	163.346	0.832	11.9	6.6										LM 2 Stage 1	
08/24/05	7:45 AM	2766.196	6.903160	143.778	1.594	146.369	162.106	161.024	134.734	-0.363	-3.562	-1.203	163.541	1.027	21.5	4.1										LM 2 Stage 2	
08/25/05	8:10 PM	2758.423	6.891787	148.847	1.585	150.542	162.636	160.968	134.178	0.221	2.167	5.729	164.249	1.735	36.4	14.9										LM 3	
08/26/05	6:08 PM	2751.871	6.879940	153.228	1.585	154.823	163.072	160.804	132.576	0.821	8.891	5.863	164.788	2.274	47.8	11.3										LM 4	
08/29/05	9:00 AM	2757.840	6.876432	149.467	1.589	151.863	162.680	160.693	131.480	0.549	6.396	-2.865	164.788	2.274	47.8	0.0										LM 4	
08/29/05	6:27 PM	2750.245	6.872136	154.372	1.586	155.967	163.189	166.744	131.964	0.980	8.787	4.401	165.613	2.999	63.0	16.2										LM 5	
08/30/05	6:48 PM	2740.101	6.872136	156.877	1.596	162.873	163.872	168.747	132.016	1.678	16.499	6.673	166.261	3.747	78.7	19.7										LM 5	
08/31/05	7:12PM	2731.367	6.870340	166.819	1.586	168.405	164.875	160.741	131.951	2.269	22.267	8.798	166.859	4.145	87.8	15.4										LM 6	
09/01/05	6:12PM	2723.364	6.876622	172.985	1.594	173.689	164.994	160.814	132.674	2.733	26.809	4.952	167.127	4.813	96.9	9.8										LM 7	
09/02/05	05:08PM	2713.618	6.877982	178.454	1.595	180.891	165.945	160.851	132.736	3.999	33.178	6.157	167.858	5.924	105.5	8.8										LM 8	
09/06/05	09:05AM	2729.407	6.877515	184.999	1.595	186.984	166.994	160.851	131.428	3.544	24.869	-6.157	167.853	5.149	105.5	2.8										LM 9	
09/07/05	03:49PM	2722.400	6.879227	172.717	1.599	174.312	165.029	160.999	131.529	2.914	28.585	3.916	168.290	5.782	121.4	13.3										LM 10	
09/08/05	03:12PM	2721.362	6.879547	173.297	1.595	174.952	165.128	160.718	131.769	2.965	29.088	6.500	168.180	5.668	119.9	-2.4										LM 10	
09/09/05	03:00PM	2723.067	6.878125	171.696	1.595	173.291	164.955	160.713	131.689	2.796	27.414	-1.671	168.137	5.623	116.1	-0.9										LM 10	
09/10/05	01:13PM	2728.098	6.878852	169.887	1.595	171.483	164.771	160.747	132.016	2.578	25.286	-2.129	168.126	6.614	117.9	-0.2										LM 10	
09/12/05	03:02PM	2733.992	6.881315	165.307	1.586	166.962	164.303	160.682	131.276	2.174	21.329	-3.996	168.120	6.606	117.7	-0.2										LM 10	
09/13/05	03:29PM	2737.199	6.879093	162.991	1.595	164.588	164.067	160.668	131.241	1.952	19.147	-2.182	168.120	6.608	117.7	0.0										LM 10	
09/14/05	3:48PM	2738.556	6.881558	162.096	1.585	163.691	163.978	160.651	131.075	1.878	18.419	-4.728	168.120	6.606	117.7	0.0										LM 10	
09/15/05	3:40PM	2739.081	6.880812	161.750	1.595	163.345	163.941	160.643	130.999	1.851	18.158	-4.261	168.118	6.604	117.7	0.0										LM 10	
09/16/05	3:23PM	2741.025	6.881927	160.467	1.595	162.062	163.810	160.641	130.873	1.722	16.892	-1.266	168.118	6.604	117.7	0.0										LM 10	
09/21/05	11:45AM	2747.547	6.882147	156.158	1.595	167.752	163.371	166.331	130.872	1.293	12.883	-4.208	168.107	5.593	117.5	-0.2										LM 10	
09/28/05	9:28AM	2754.455	6.876052	151.575	1.595	153.170	162.904	160.651	131.068	0.906	7.906	-4.687	168.115	5.601	117.9	0.0										LM 10	
10/05/05	6:28AM	2766.780	6.874488	160.938	1.596	151.634	162.747	160.947	131.029	0.853	8.408	-4.687	168.112	5.598	117.9	-0.1										LM 10	
10/12/05	6:48AM	2768.895	6.871550	148.634	1.596	150.590	162.904	160.739	131.645	0.788	7.728	-3.222	168.105	5.594	117.5	-0.1										LM 10	
10/13/05	4:31PM	2763.440	6.873005	152.254	1.595	152.890	162.973	160.730	131.825	0.788	7.728	3.542	168.095	5.982	123.8	8.1										LM 11	
10/14/05	4:19PM	2763.440	6.873005	152.254	1.595	152.890	162.973	160.730	131.825	0.788	7.728	3.542	168.095	5.982	123.8	8.1										LM 11	
10/17/05	4:06PM	2747.878	6.870092	160.596	1.596	162.182	163.820	160.695	132.579	1.568	15.398	4.900	169.245	6.731	141.4	7.8										LM 13	
10/17/05	04:10PM	2731.897	6.869927	166.591	1.596	168.097	164.425	160.588	130.687	2.390	23.443	8.057	169.587	7.073	148.8	7.2										LM 14	
10/19/05	03:38PM	2732.556	6.868953	172.090	1.596	173.696	164.999	160.603	130.691	2.945	28.888	5.445	169.910	7.396	166.3	6.8										LM 15	
10/20/05	04:11PM	2714.411	6.870306	177.945	1.596	176.540	165.582	160.587	130.440	3.558	34.903	6.915	169.323	7.809	164.0	8.7										LM 16	
10/21/05	04:24PM	2708.046	6.869643	182.098	1.596	183.694	166.015	160.369	128.305	4.189	41.192	8.289	169.581	8.087	168.4	5.4										LM 17	
10/24/05	09:28AM	2709.043	6.864715	181.448	1.596	183.445	165.949	160.368	128.295	4.134	40.553	-0.440	169.687	8.073	199.5	0.1										LM 17	
10/25/05	03:45PM	2706.132	6.867615	181.399	1.598	182.987	166.943	160.588	136.459	3.968	38.339	-2.213	169.654	8.140	179.9	1.4										Final Lift	
11/06/05	12:18PM	2726.533	6.869633	168.035	1.597	168.035	164.582	160.589	136.375	2.555	25.060	-13.279	169.952	8.448	177.9	8.5										Final Lift	
11/24/05	12:01PM	2737.199	6.849066	183.090	1.598	184.692	164.074	160.577	136.342	2.060	20.106	-4.932	169.905	8.391	176.2	-1.2										Final Lift	
12/08/05	4:26 PM	2737.042	6.846510	183.094	1.598	184.692	164.074	160.577	136.342	2.064	20.163	0.645	169.905	8.391	176.2	0.0										Final Lift	
12/20/05	3:37 PM	2741.800	6.846152	158.595	1.598	161.554	183.758	160.549	130.074	1.762	17.293	-2.870	169.905	8.391	176.2	0.0										Final Lift	
01/06/06	3:16 PM	2748.406	6.841391	166.911	1.599	166.909	183.448	160.547	130.048	1.454	14.265	-3.018	169.905	8.391	176.2	0.0										Final Lift	
01/23/06	1:53 PM	2748.945	6.843615	155.232	1.599	166.931	183.277	160.547	130.048	1.454	14.265	-3.018	169.905	8.391	176.2	0.0										Final Lift	
02/02/06	2:26 PM	2751.456	6.841385	153.699	1.599	166.168	183.277	160.547	130.048	1.454	14.265	-3.018	169.905	8.391	176.2	0.0										Final Lift	
03/07/06	2:37 PM	2753.219	6.855967	152.335	1.597	163.902	183.281	160.546	130.041	1.114	10.930	-1.856	169.905	8.391	176.2	0.0										Final Lift	
03/24/06	9:01 AM	2754.656	6.857520	151.263	1.598	152.891	183.277	160.547	130.051	0.878	8.812	-1.891	169.905	8.391	176.2	0.0										Final Lift	
04/08/06	1:36 PM	2757.290	6.867639	148.720	1.599	161.315	182.715	160.557	131.139	0.510	5.888	-2.624	169.981	8.467	177.8	1.8										Final Lift	
04/20/06	1:49 PM	2757.855	6.867159	148.457	1.599	161.252	182.688	160.922	133.730	0.319	3.125	-2.863	169.981	8.467	177.8	0.0										Final Lift	
05/29/06	2:30 PM	2760.619	6.849499	147.499	1.584	148.978	182.476	160.922	133.730	0.107	1.851	-2.674	169.981	8.467	177.8	0.0										Final Lift	

Manual ABC Factors	A= (kPa)	-0.00014093	
	B= (kPa)	0.042285	
	C= (kPa)	1123.7	
Temp. Coefficients	m=(PSI/°C)	-0.0079	-0.054431 (kPa/°C)
	b= (PSI)	0.193	1.32977 (kPa)
Temp. Offset	(°C)	-0.1	

Original Ground Surface	182.514	182.5		
Tip Elevation (m)	180.220			
Assumed Initial Standpipe GWL reading:	200.461 kPa	} Excess Pore Pressure Offset:	28.818 kPa	
Assumed Initial VWP reading:	229.279 kPa		Excess Piezometer Head Offset:	2.938 m
Assumed Embankment Unit Weight:	21.000 kN/m ³			

Notes (*): Standpipe Piezometer readings not taken necessarily on the same day of VW readings

Date/Time	Lat	Long	Low Baseline		Mid Baseline		High Baseline		Baseline 7		Baseline 8		Baseline 9		Baseline 10		Baseline 11		Baseline 12		Baseline 13		Baseline 14		Baseline 15		Baseline 16		Baseline 17		Baseline 18		Baseline 19		Baseline 20		Baseline 21		Baseline 22		Baseline 23		Baseline 24		Baseline 25		Baseline 26		Baseline 27		Baseline 28		Baseline 29		Baseline 30		Baseline 31		Baseline 32		Baseline 33		Baseline 34		Baseline 35		Baseline 36		Baseline 37		Baseline 38		Baseline 39		Baseline 40		Baseline 41		Baseline 42		Baseline 43		Baseline 44		Baseline 45		Baseline 46		Baseline 47		Baseline 48		Baseline 49		Baseline 50		Baseline 51		Baseline 52		Baseline 53		Baseline 54		Baseline 55		Baseline 56		Baseline 57		Baseline 58		Baseline 59		Baseline 60		Baseline 61		Baseline 62		Baseline 63		Baseline 64		Baseline 65		Baseline 66		Baseline 67		Baseline 68		Baseline 69		Baseline 70		Baseline 71		Baseline 72		Baseline 73		Baseline 74		Baseline 75		Baseline 76		Baseline 77		Baseline 78		Baseline 79		Baseline 80		Baseline 81		Baseline 82		Baseline 83		Baseline 84		Baseline 85		Baseline 86		Baseline 87		Baseline 88		Baseline 89		Baseline 90		Baseline 91		Baseline 92		Baseline 93		Baseline 94		Baseline 95		Baseline 96		Baseline 97		Baseline 98		Baseline 99		Baseline 100		Baseline 101		Baseline 102		Baseline 103		Baseline 104		Baseline 105		Baseline 106		Baseline 107		Baseline 108		Baseline 109		Baseline 110		Baseline 111		Baseline 112		Baseline 113		Baseline 114		Baseline 115		Baseline 116		Baseline 117		Baseline 118		Baseline 119		Baseline 120		Baseline 121		Baseline 122		Baseline 123		Baseline 124		Baseline 125		Baseline 126		Baseline 127		Baseline 128		Baseline 129		Baseline 130		Baseline 131		Baseline 132		Baseline 133		Baseline 134		Baseline 135		Baseline 136		Baseline 137		Baseline 138		Baseline 139		Baseline 140		Baseline 141		Baseline 142		Baseline 143		Baseline 144		Baseline 145		Baseline 146		Baseline 147		Baseline 148		Baseline 149		Baseline 150		Baseline 151	
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[illegible]

Manual ABC Factors	A= (kPa)	-0.0001369	
	B= (kPa)	0.036487	
	C= (kPa)	1111.4	
Temp. Coefficients	m=(PSI/°C)	-0.0145	-0.000005 (kPa/°C)
	b= (PSI)	0.286	1.97054 (kPa)
Temp. Offset	(°C)	-0.2	

Original Ground Surface	182.124		
Tip Elevation (m)	159.320		
Assumed Initial Standpipe GWL reading:	200.294 kPa	}	Excess Pore Pressure Offset: 47.383 kPa
Assumed Initial VWP reading:	247.677 kPa		Excess Piezometric Head Offset: 4.830 m
Assumed Embankment Unit Weight:	21.800 kN/m ³		

Notes (*): Standpipe Piezometer readings not taken necessarily on the same day of VW readings

Date	Time	Altitude (m)	Horizontal Position (m)			Vertical Position (m)			Horizontal Position (m)			Vertical Position (m)			Remarks	
			North	East	Down	North	East	Down	North	East	Down	North	East	Down		
09/17/05	9:36 AM	2546.701	6.629422	247.594	1.298	248.852	184.887	178.741	200.327	8.117	1.143		182.124	8.900	6.0	Baseline Reading
09/18/05	9:01 AM	2550.502	6.077402	246.384	1.283	247.648	184.564	178.734	200.281	8.090	0.094	-1.130	182.124	8.900	6.0	Baseline Reading
09/19/05	8:49 AM	2552.119	6.708989	245.250	1.280	246.737	184.650	178.732	200.294	-8.117	-1.147	-1.811	182.124	8.900	6.0	Baseline Reading
08/22/05	6:47 AM	2551.529	6.614518	245.858	1.290	246.848	184.493	178.733	200.271	-0.072	-0.708	0.439	182.979	8.858	18.9	LHR 1
08/22/05	8:19 AM	2551.465	6.612797	245.708	1.290	246.890	184.497	178.735	200.271	-0.068	-0.683	0.044	182.979	8.858	18.9	LHR 1
08/22/05	10:32 AM	2551.500	6.629431	245.876	1.268	246.985	184.495	178.735	200.271	-0.070	-0.689	-0.026	182.979	8.858	18.9	LHR 1
09/23/05	9:04 AM	2549.863	6.599068	246.805	1.292	246.097	184.619	178.744	200.339	0.038	0.355	1.044	182.976	8.852	17.9	-0.1 LHR 2 Stage 1
09/24/05	7:45 AM	2545.199	6.575810	249.334	1.284	250.628	184.865	180.430	207.096	-0.351	-3.840	-4.186	183.641	1.517	31.9	LHR 2 Stage 2
08/26/05	8:13 PM	2539.305	6.624538	254.068	1.289	255.354	188.350	178.886	201.786	0.634	6.216	10.057	184.183	2.029	42.6	LHR 3
08/28/05	6:11 PM	2534.213	6.605671	287.895	1.301	259.845	188.706	178.910	201.084	1.068	10.459	14.243	184.601	2.507	53.9	LHR 4
08/29/05	9:00 AM	2532.293	6.450593	288.889	1.291	256.174	188.841	178.757	200.490	1.354	12.901	14.601	184.601	2.507	53.9	LHR 4
08/29/05	6:22 PM	2527.872	6.607332	281.881	1.291	253.183	196.142	178.780	200.713	1.872	15.088	2.187	185.332	2.208	17.4	LHR 5
09/30/05	6:45 PM	2516.787	6.515774	298.459	1.300	270.759	198.920	178.787	200.748	2.304	22.968	7.511	186.122	3.998	84.0	LHR 6
08/31/05	7:15 PM	2507.345	6.580224	274.854	1.283	277.147	198.571	178.783	200.745	2.958	28.619	6.421	186.742	4.818	97.0	LHR 7
09/01/05	6:18 PM	2509.584	6.808171	281.193	1.290	282.394	188.106	178.821	201.112	3.456	33.899	4.880	187.049	4.925	103.4	LHR 8
09/02/05	05:11 PM	2559.614	6.452666	287.822	1.303	289.125	188.782	178.843	201.129	4.012	40.412	6.512	187.628	5.502	115.5	LHR 9
09/06/05	08:02 AM	2500.466	6.547748	287.249	1.296	288.545	188.733	178.757	200.484	4.127	40.678	0.787	187.615	5.491	115.3	-0.2 LHR 9
09/07/05	06:40 PM	2584.607	6.580224	291.186	1.284	292.480	188.133	178.775	200.687	5.529	44.431	3.262	188.107	6.983	126.8	LHR 10
09/08/05	03:00 PM	2583.532	6.514088	291.907	1.300	293.207	189.209	178.785	200.762	5.944	45.063	0.632	188.218	6.095	128.0	LHR 10
09/09/05	03:00 PM	2584.467	6.512117	291.280	1.300	292.589	189.143	178.786	200.771	4.529	44.428	-0.837	188.001	5.867	125.3	-2.7 LHR 10
09/10/05	01:00 PM	2585.122	6.450122	290.840	1.303	292.143	189.100	178.890	200.812	4.074	43.848	-0.577	188.100	5.878	125.5	0.2 LHR 10
09/12/05	02:00 PM	2568.809	6.520566	288.383	1.298	289.622	188.847	178.770	200.915	4.247	41.695	-2.184	188.007	5.873	125.4	-0.1 LHR 10
09/13/05	05:23 PM	2591.130	6.497705	288.492	1.303	285.105	188.588	178.761	200.923	4.098	40.199	-0.465	188.003	5.869	125.4	-0.1 LHR 10
09/13/05	03:45 PM	2591.130	6.497705	288.492	1.303	285.105	188.588	178.761	200.923	4.098	40.199	-0.465	188.003	5.869	125.4	-0.1 LHR 10
09/15/05	3:37 PM	2591.144	6.499255	288.733	1.301	285.094	188.584	178.759	200.923	4.187	40.290	0.159	188.004	5.870	125.4	0.0 LHR 10
09/18/05	3:21 PM	2592.675	6.496500	288.529	1.301	287.131	188.589	178.750	200.918	4.349	38.330	-0.690	188.004	5.870	125.4	0.0 LHR 10
09/21/05	11:45 AM	2587.922	6.503687	282.724	1.301	283.528	188.222	178.742	200.943	3.989	35.800	-3.568	188.081	5.957	125.1	-0.3 LHR 10
09/29/05	9:24 AM	2505.381	6.481118	277.184	1.303	278.487	187.708	178.791	200.431	3.127	30.873	-5.127	188.099	5.975	125.5	0.4 LHR 10
10/05/05	9:45 AM	2509.379	6.483632	274.478	1.305	275.780	187.432	178.767	200.382	2.856	28.006	-2.867	188.100	5.878	125.5	0.0 LHR 10
10/12/05	9:41 AM	2613.546	6.450485	271.648	1.305	272.953	187.144	178.786	200.801	2.521	24.770	-3.236	188.096	5.872	125.4	-0.1 LHR 10
10/13/05	4:28 PM	2610.319	6.463655	273.838	1.302	275.140	187.367	178.786	200.771	2.781	26.888	2.216	188.433	6.309	125.5	7.1 LHR 11
10/14/05	4:13 PM	2604.737	6.484506	277.629	1.305	278.923	187.732	178.809	200.897	3.113	30.543	3.557	188.866	6.732	141.4	8.9 LHR 12
10/17/05	4:02 PM	2568.800	6.470563	281.632	1.304	282.936	188.162	178.826	201.167	3.509	34.386	3.843	189.130	7.098	147.1	5.9 LHR 13
10/18/05	04:09 PM	2590.580	6.453808	287.172	1.305	288.728	188.728	178.721	200.131	4.718	40.992	6.978	189.619	7.395	155.3	8.2 LHR 13
10/20/05	03:36 PM	2593.258	6.450615	285.195	1.304	285.490	188.223	178.728	200.424	4.871	40.824	8.824	189.074	7.150	149.2	7.2 LHR 13
10/20/05	04:08 PM	2793.161	6.498714	295.179	1.295	286.719	188.729	178.729	200.327	5.162	50.841	9.817	190.256	8.132	178.9	10.0 LHR 16
10/21/05	04:19 PM	2670.095	6.475100	300.358	1.284	311.960	190.079	178.811	199.055	5.629	55.222	4.881	190.490	8.374	175.9	5.1 LHR 17
10/24/05	09:28 AM	2670.549	6.446298	300.894	1.287	301.991	190.085	178.810	199.048	5.655	55.474	4.291	190.484	8.380	175.8	-0.3 LHR 17
10/25/05	03:42 PM	2569.485	6.454383	301.304	1.306	302.810	190.187	178.719	200.017	5.818	55.110	-0.363	190.732	8.688	190.8	5.2 Final LHR
10/26/05	12:14 PM	2585.015	6.465462	290.912	1.306	292.217	190.168	178.714	200.065	4.564	44.769	-10.341	190.682	8.538	179.3	-1.5 Final LHR
11/24/05	11:57 AM	2583.845	6.422366	284.874	1.299	288.283	188.563	178.797	199.896	3.968	38.904	-5.885	190.684	8.570	180.0	0.7 Final LHR
12/08/05	4:21 PM	2595.818	6.500738	283.644	1.301	284.945	188.306	178.707	199.836	3.628	37.666	-1.338	190.684	8.570	180.0	0.0 Final LHR
12/20/05	3:32 PM	2602.019	6.487424	279.458	1.290	280.762	187.840	178.687	199.804	3.443	33.778	-3.781	190.694	8.570	180.0	0.0 Final LHR
01/09/06	1:10 PM	2608.780	1.325162	274.882	1.816	275.780	187.526	178.663	199.566	3.033	29.753	-4.023	190.694	8.570	180.0	0.0 Final LHR
01/23/06	1:40 PM	2613.676	6.548629	271.580	1.296	272.588	187.134	178.683	199.885	2.641	25.909	-3.844	190.694	8.570	180.0	0.0 Final LHR
02/02/06	2:20 PM	2617.137	6.557035	269.208	1.296	270.953	186.894	178.664	199.878	2.400	23.546	-2.363	190.684	8.570	180.0	0.0 Final LHR
03/07/06	2:30 PM	2657.182	6.589282	265.971	1.292	267.293	186.984	178.654	199.875	2.070	20.308	-3.240	190.684	8.570	180.0	0.0 Final LHR
04/04/06	8:30 AM	2655.217	6.626740	263.794	1.291	264.664	186.966	178.644	199.864	1.819	18.918	-3.114	190.684	8.570	180.0	0.0 Final LHR
04/09/06	1:52 PM	2627.085	6.620718	261.731	1.289	263.129	186.970	178.721	200.134	1.519	14.903	-3.210	190.681	8.417	176.8	-3.2 Final LHR
04/20/06	1:44 PM	2630.586	6.649457	260.091	1.286	261.978	186.954	178.856	201.458	1.278	12.837	-2.268	190.541	8.417	176.8	0.0 Final LHR
05/29/06	2:21 PM	2636.026	7.512963	258.131	1.290	257.813	185.978	178.858	201.458	0.884	8.872	-3.885	190.541	8.417	176.8	0.0 Final LHR

Manual ABC Factors	A= (kPa)	-0.00013283		
	B= (kPa)	0.034833		
	C= (kPa)	1083.8		
Temp. Coefficients	m=(PSI/°C)	-0.0103	-0.070967 (kPa/°C)	
	b= (PSI)	0.24	1.8536 (kPa)	
Temp. Offset	(°C)	-0.2		
Original Ground Surface		162.616	162.16	
Tip Elevation (m)		173.120		
Assumed Initial Standpipe GWL reading:		67.228 kPa		
Assumed Initial VWP reading:		70.372 kPa		
Assumed Embankment Unit Weight:		21,000 kN/m ³		
Notes (*) :	Standpipe Piezometer readings not taken necessarily on the same day of VW readings			
			Excess Pore Pressure Offset:	1.144 kPa
			Excess Piezometric Head Offset:	0.320 m

[illegible]

Manual ABC Factors	A= (kPa)	-0.0001339	
	B= (kPa)	0.040653	
	C= (kPa)	1052.4	
Temp. Coefficients	m=(PSI/°C)	-0.0047	-0.032383 (kPa/°C)
	b= (PSI)	0.112	0.77168 (kPa)
Temp. Offset	(°C)	-0.1	

Original Ground Surface	182.510	182.39		
Tip Elevation (m)	185.170			
Assumed Initial Standpipe GWL reading:	145.217 kPa	} Excess Pore Pressure Offset:	20.467 kPa	
Assumed Initial VWP reading:	165.684 kPa		Excess Piezometric Head Offset:	2.096 m
Assumed Embankment Unit Weight:	21.000 kN/m ³			

Notes (†): Standpipe Piezometer readings not taken necessarily on the same day of VW readings

Notes (*): Standpipe Piezometer readings not taken necessarily on the same day of VW readings

[illegible]

Manual ABC Factors	A= (kPa)	-0.00013418	
	B= (kPa)	0.018140	
	C= (kPa)	1136.7	
Temp. Coefficients	m=(PSI/°C)	-0.0128	-0.080182 (kPa/sl °C)
	b= (PSI)	0.32	2.2048 (kPa)
Temp. Offset	(°C)	-0.3	

Original Ground Surface	183.471 (MODIFIED TO ACCOUNT FOR STRIPPING)	
Tip Elevation (m)	172.400	
Assumed Initial Standpipe GWL reading:	81.436 kPa	} Excess Pore Pressure Offset: -0.933 kPa
Assumed Initial VWP reading:	80.503 kPa	
Assumed Embankment Unit Weight:	21.000 kN/m ³	Excess Piezometric Head Offset: -0.995 m

Notes (*): Standpipe Piezometer readings not taken necessarily on the same day of VW readings

[illegible]

Original Ground Surface	183.471 m		
Tip Elevation (m)	168.940 m		
Assumed Initial Standpipe GWL reading:	134.999 kPa	}	Excess Pore Pressure Offset: -0.041 kPa
Assumed Initial VWP reading:	134.958 kPa		Excess Piezometric Head Offset: -0.004 m
Assumed Embankment Unit Weight:	21.000 kN/m ³		

Notes (*): Standpipe Piezometer readings not taken necessarily on the same day of VW readings

Date	Time	WYBANK (WYBANK)				GULFPORT (GULFPORT)				BAYVIEW (BAYVIEW)				PACIFIC (PACIFIC)				SANDWICH (SANDWICH)				Comments
		WYBANK (WYBANK)	WYBANK (WYBANK)	WYBANK (WYBANK)	WYBANK (WYBANK)	GULFPORT (GULFPORT)	GULFPORT (GULFPORT)	GULFPORT (GULFPORT)	GULFPORT (GULFPORT)	BAYVIEW (BAYVIEW)	BAYVIEW (BAYVIEW)	BAYVIEW (BAYVIEW)	BAYVIEW (BAYVIEW)	PACIFIC (PACIFIC)	PACIFIC (PACIFIC)	PACIFIC (PACIFIC)	PACIFIC (PACIFIC)	SANDWICH (SANDWICH)	SANDWICH (SANDWICH)	SANDWICH (SANDWICH)	SANDWICH (SANDWICH)	
08/17/05	8:33 AM	2761.561	6.894485	133.531	1.427	134.895	190.887	190.701	134.899	0.000	0.000	183.471	0.000	0.000	183.471	0.000	0.000	0.000	0.000	Baseline Reading		
08/22/05	8:09 AM	2780.207	6.892281	134.557	1.430	135.987	190.802	190.811	134.678	0.005	0.000	-0.050	183.819	0.248	7.3	7.3	183.819	0.248	7.3	LWR 1		
08/22/05	10:28 AM	2759.678	6.855301	134.774	1.431	136.204	190.811	190.811	134.678	0.017	0.167	0.217	183.819	0.248	7.3	0.0	183.819	0.248	7.3	LWR 1		
08/23/05	8:41 AM	2756.650	6.851382	136.802	1.431	138.232	191.031	190.830	134.346	0.196	1.927	1.760	183.829	0.358	7.5	0.2	183.829	0.358	7.5	LWR 2 Stage 1		
08/24/05	7:45 AM	2750.570	6.846390	140.778	1.431	142.269	191.436	191.122	139.129	0.318	3.121	1.194	183.930	0.459	9.6	2.1	183.930	0.459	9.6	LWR 2 Stage 2		
08/25/05	8:11 PM	2742.717	6.836315	145.938	1.432	147.370	191.862	190.817	136.137	1.149	11.274	6.153	184.242	0.771	16.2	6.6	184.242	0.771	16.2	LWR 3		
08/26/05	5:08 PM	2737.328	6.837003	149.471	1.432	150.904	192.323	190.817	136.137	1.509	14.808	5.334	184.810	1.339	28.1	11.9	184.810	1.339	28.1	LWR 4		
08/29/05	9:00 AM	2742.800	6.823822	145.883	1.433	147.317	191.957	190.760	135.577	1.201	11.780	-3.028	184.810	1.339	28.1	0.0	184.810	1.339	28.1	LWR 4		
08/29/05	8:27 PM	2741.388	6.823822	146.811	1.433	148.244	192.852	190.771	135.882	1.285	12.603	0.823	184.948	1.477	31.0	2.9	184.948	1.477	31.0	LWR 5		
08/30/05	8:45 PM	2734.774	6.823822	151.142	1.433	152.575	192.843	190.840	136.356	1.658	16.260	3.657	185.386	1.915	40.2	9.2	185.386	1.915	40.2	LWR 6		
08/31/05	7:13 PM	2729.183	6.817930	154.786	1.434	156.230	192.866	190.874	136.689	1.996	19.581	3.321	186.064	2.593	54.5	14.2	186.064	2.593	54.5	LWR 7		
09/01/05	6:18 PM	2724.358	6.814903	157.943	1.434	159.377	193.106	190.890	136.853	2.300	22.585	2.984	186.464	2.983	62.9	8.4	186.464	2.983	62.9	LWR 8		
09/02/06	8:11 PM	2718.374	6.811966	161.873	1.434	161.738	193.583	190.941	137.350	2.647	25.964	3.399	187.064	3.593	75.5	12.6	187.064	3.593	75.5	LWR 9		
09/06/05	11:15 AM	2729.362	6.800645	154.679	1.482	156.161	192.859	190.772	135.692	2.891	20.510	-4.54	187.050	4.029	75.2	-0.3	187.050	4.029	75.2	LWR 9		
09/07/05	8:40 PM	2725.004	6.596263	157.522	1.435	158.957	193.144	190.833	136.290	2.315	22.708	2.198	187.473	4.502	84.0	8.9	187.473	4.502	84.0	LWR 10		
09/08/05	03:13 PM	2725.732	6.600015	157.947	1.435	158.483	193.095	190.820	136.163	2.279	22.361	-0.347	187.499	4.028	84.6	0.5	187.499	4.028	84.6	LWR 10		
09/09/05	03:00 PM	2728.535	6.596582	155.219	1.436	156.654	192.909	190.823	136.192	2.080	20.503	-1.858	187.534	4.023	85.3	0.7	187.534	4.023	85.3	LWR 10		
09/10/05	01:13 PM	2730.443	6.598050	153.973	1.435	155.408	192.782	190.763	135.604	2.023	19.846	-0.857	187.504	4.033	84.7	-0.6	187.504	4.033	84.7	LWR 10		
09/12/05	03:03 PM	2734.968	6.464390	151.015	1.447	152.462	192.481	190.730	135.280	1.756	17.223	-2.623	187.503	4.032	84.7	0.0	187.503	4.032	84.7	LWR 10		
09/13/05	03:27 PM	2737.192	6.580418	149.599	1.436	150.995	192.332	190.725	135.228	1.611	15.908	-1.415	187.501	4.030	84.6	0.0	187.501	4.030	84.6	LWR 10		
09/14/05	03:49 PM	2739.314	6.593418	148.169	1.436	149.605	192.190	190.716	135.143	1.478	14.503	-1.395	187.501	4.030	84.6	0.0	187.501	4.030	84.6	LWR 10		
09/15/05	3:41 PM	2738.963	6.590107	148.485	1.436	149.801	192.220	190.701	134.992	1.524	14.950	0.446	187.500	4.029	84.6	0.0	187.500	4.029	84.6	LWR 10		
09/16/05	3:24 PM	2739.989	6.590495	147.727	1.436	149.183	192.145	190.685	134.937	1.454	14.267	-0.882	187.496	4.025	84.5	-0.1	187.496	4.025	84.5	LWR 10		
09/21/05	11:45 AM	2743.274	6.592075	145.672	1.436	147.008	191.826	190.882	134.904	1.238	12.145	-2.122	187.494	4.023	84.5	0.0	187.494	4.023	84.5	LWR 10		
09/26/05	9:30 AM	2748.959	6.570679	143.192	1.438	144.590	191.679	190.704	135.022	0.980	9.869	-2.536	187.492	4.021	84.4	0.0	187.492	4.021	84.4	LWR 10		
10/05/05	9:45 AM	2748.951	6.579484	143.158	1.437	144.595	191.680	191.000	137.932	0.883	8.704	-2.906	187.434	3.963	83.2	-1.2	187.434	3.963	83.2	LWR 10		
10/12/05	9:47 AM	2747.480	6.569598	142.810	1.438	144.248	191.644	191.014	138.063	0.835	8.226	-0.478	187.417	3.946	82.9	-0.4	187.417	3.946	82.9	LWR 10		
10/13/05	4:32 PM	2745.184	6.570832	144.332	1.438	145.789	191.799	190.904	136.987	0.899	8.823	2.597	187.797	4.326	90.8	8.0	187.797	4.326	90.8	LWR 11		
10/14/05	4:17 PM	2740.580	6.571429	147.382	1.438	148.630	192.111	190.955	137.487	1.160	11.383	2.560	188.309	4.635	101.5	10.7	188.309	4.635	101.5	LWR 12		
10/17/05	4:07 PM	2739.581	6.569012	148.007	1.438	148.445	192.174	190.987	137.898	1.181	11.587	0.294	188.278	4.607	100.9	-0.6	188.278	4.607	100.9	LWR 13		
10/18/05	04:11 PM	2735.470	6.559109	150.686	1.439	152.125	192.447	191.014	138.069	1.437	14.097	2.510	188.272	4.601	100.8	-0.1	188.272	4.601	100.8	LWR 14		
10/19/05	03:29 PM	2731.554	6.564387	153.247	1.438	154.686	192.708	190.750	135.478	1.962	19.247	5.190	188.263	4.792	100.6	-0.2	188.263	4.792	100.6	LWR 15		
10/20/05	04:12 PM	2728.327	6.574002	155.355	1.438	156.792	193.055	191.108	136.985	1.919	17.848	-1.399	188.263	4.792	100.6	-0.2	188.263	4.792	100.6	LWR 16		
10/21/05	04:24 PM	2728.995	6.573009	156.961	1.438	158.011	193.419	191.010	138.011	1.983	18.449	-0.801	188.263	4.792	100.6	-0.2	188.263	4.792	100.6	LWR 17		
10/24/05	02:29 AM	2728.779	6.569813	156.399	1.438	157.807	193.025	191.000	138.226	2.000	19.622	-0.133	188.224	4.753	99.8	-0.7	188.224	4.753	99.8	LWR 17		
10/25/05	03:46 PM	2727.419	6.558259	155.947	1.439	157.386	192.993	191.021	138.135	1.967	19.292	-0.730	188.223	4.752	99.8	0.0	188.223	4.752	99.8	Final LWR		
11/06/05	12:18 PM	2736.438	6.561405	148.744	1.439	150.183	192.249	191.872	138.638	1.181	11.586	-7.706	188.179	4.708	98.9	-0.9	188.179	4.708	98.9	Final LWR		
11/24/05	12:03 PM	2741.307	6.573396	146.863	1.438	148.300	192.037	191.870	138.615	0.991	9.726	-1.860	188.229	4.758	99.9	1.1	188.229	4.758	99.9	Final LWR		
12/08/05	4:25 PM	2738.518	6.570592	148.691	1.438	150.129	192.244	191.870	138.615	1.178	11.554	1.828	188.229	4.758	99.9	0.0	188.229	4.758	99.9	Final LWR		
12/20/05	3:38 PM	2741.717	6.580710	146.594	1.436	148.030	192.030	191.064	138.556	0.970	9.515	-2.040	188.229	4.758	99.9	0.0	188.229	4.758	99.9	Final LWR		
01/05/06	3:16 PM	2744.458	6.591938	144.796	1.438	146.232	191.846	191.062	138.537	0.788	7.736	-1.778	188.229	4.758	99.9	0.0	188.229	4.758	99.9	Final LWR		
01/23/06	1:53 PM	2745.850	6.634562	143.881	1.432	145.313	191.062	191.062	138.537	0.695	6.817	-0.919	188.229	4.758	99.9	0.0	188.229	4.758	99.9	Final LWR		
02/02/06	2:27 PM	2747.556	6.675053	142.781	1.429	144.189	191.638	191.050	138.419	0.582	5.811	-1.006	188.229	4.758	99.9	0.0	188.229	4.758	99.9	Final LWR		
03/07/05	2:37 PM	2747.472	6.765980	142.815	1.421	144.236	191.643	190.820	134.201	1.027	10.076	4.265	188.229	4.758	99.9	0.0	188.229	4.758	99.9	Final LWR		
03/24/06	9:01 AM	2747.804	6.796113	142.597	1.418	144.615	191.620	190.830	134.298	0.985	9.757	-0.319	188.229	4.758	99.9	0.0	188.229	4.758	99.9	Final LWR		
04/06/06	1:57 PM	2749.073	6.845545	141.783	1.414	143.773	191.659	190.830	138.507	0.940	4.710	-5.047	188.599	5.128	107.7	7.8	188.599	5.128	107.7	Final LWR		
04/20/06	1:50 PM	2749.360	6.882813	141.574	1.411	142.983	191.515	190.909	137.039	0.610	5.986	1.276	188.599	5.128	107.7	0.0	188.599	5.128	107.7	Final LWR		
05/29/06	2:31 PM	2751.040	7.729958	140.468	1.337	141.806	191.395	190.828	136.241	0.571	5.605	-0.381	188.599	5.128	107.7	0.0	188.599	5.128	107.7	Final LWR		