

**ADDITIONAL FOUNDATION INVESTIGATION REPORT
PROPOSED HIGHWAY 17 (NEW)
FROM ECHO RIVER TO BAR RIVER ROAD
DISTRICT 62, SAULT STE. MARIE, ONTARIO
G.W.P. 354 AND 352-94-00**

GEOCRES NO. 41K00-063

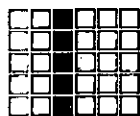
Prepared For:

MARSHALL MACKLIN MONAGHAN LTD.

Prepared by:

SHAHEEN & PEAKER LIMITED

**Project: SPT1055
September 17, 2003**



shaheen & peaker
limited

**20 Meteor Drive
Toronto, Ontario
M9W 1A4**

Tel: (416) 213-1255

Fax: (416) 213-1260

WEB SITE: WWW.SHAHEENPEAKER.CA

Table of Contents

1. INTRODUCTION	1
2. SITE DESCRIPTION AND GEOLOGY	2
3. INVESTIGATION PROCEDURES	3
4. SUBSURFACE CONDITIONS	5
4.1 Site A	5
4.1.1 Topsoil and Peat	5
4.1.2 Surficial Silt	5
4.1.3 Sand and Gravel	6
4.1.4 Clay	6
4.1.5 Silty Sand Till	7
4.1.6 Bedrock	8
4.1.7 Groundwater Conditions	8
4.2 Site B	9
4.2.1 Topsoil and Peat	9
4.2.2 Sand and Gravel	9
4.2.3 Clay	10
4.2.4 Groundwater Conditions	11
4.3 Site C	12
4.3.1 Topsoil	12
4.3.2 Embankment Fill	13
4.3.3 Sand	13
4.3.4 Sandy Silt	13
4.3.5 Clay	14
4.3.6 Groundwater Conditions	15
4.4 Site D	16
4.4.1 Topsoil/Peaty Topsoil	16
4.4.2 Sand	16
4.4.3 Clay	17
4.4.4 Silty Sand Till	18
4.4.5 Groundwater Conditions	19

DRAWINGS

DRAWING No.

BOREHOLE LOCATION PLANS

1, 4, C & D

APPENDICES FOR SITE A

DRAWING: SOIL STRATA

DWG. A

APPENDIX A1: RECORD OF BOREHOLE SHEETS AND TEST PIT LOGS

APPENDIX A2: LABORATORY TEST RESULTS

APPENDIX A3: MEASURED UNDRAINED SHEAR STRENGTH RESULTS

APPENDICES FOR SITE B

DRAWING: SOIL STRATA

DWG. B

APPENDIX B1: RECORD OF BOREHOLE SHEETS

APPENDIX B2: LABORATORY TEST RESULTS

APPENDIX B3: MEASURED UNDRAINED SHEAR STRENGTH RESULTS

APPENDICES FOR SITE C

APPENDIX C1: RECORD OF BOREHOLE SHEETS

APPENDIX C2: LABORATORY TEST RESULTS

APPENDIX C3: MEASURED UNDRAINED SHEAR STRENGTH RESULTS

APPENDICES FOR SITE D

APPENDIX D1: RECORD OF BOREHOLE SHEETS

APPENDIX D2: LABORATORY TEST RESULTS

APPENDIX D3: MEASURED UNDRAINED SHEAR STRENGTH RESULTS

APPENDIX E: EXPLANATION OF TERMS USED IN REPORT

**ADDITIONAL FOUNDATION INVESTIGATION REPORT
PROPOSED HIGHWAY 17 (NEW)
FROM ECHO RIVER TO BAR RIVER ROAD
DISTRICT 62, SAULT STE. MARIE, ONTARIO
G.W.P. 354 AND 352-94-00**

1. INTRODUCTION

Shaheen & Peaker Limited (S&P) was retained by Marshall Macklin Monaghan Ltd. to conduct an additional foundation investigation for a number of cut and fill sections along the proposed realignment of Highway 17 from the Lower Echo River to Bar River Road in Sault Ste. Marie, Ontario. As requested, this investigation was carried out with minimal number of boreholes at generally about 200 m spacing in areas where a previous pavement investigation was performed by others*. In addition, a limited amount of the laboratory testing was performed, as was directed. This Additional Foundation Investigation Report should be read in conjunction with the previous Foundation Investigation Report** prepared by S & P for this project.

The sections investigated which are covered in this Additional Foundation Investigation are designated as Sites A, B, C and D for the purposes of this report and are described as follows:

Site A: Highway 17 (New) Fill Section between Stations 10+360 and 10+700 Westbound Lanes (WBL), between Site Nos. 1 and 2 of the previous investigation by S & P**.

Site B: Highway 17 (New) Fill and Cut Sections between Stations 11+000 and 11+350 EBL and WBL, between Site Nos. 3 and 4.

Site C: Highway 17 (New) Fill Section between Stations 13+400 and 15+470 EBL and WBL, between Site Nos. 5 and 6.

Site D: Highway 17 (New) Fill Section between Stations 16+600 and 17+700 EBL and WBL, between Site No.8 and south limit of project.

* DST Consulting Engineers in Thunder Bay, Ontario

** "Foundation Investigation Report, Proposed Highway 17(New)
From Echo River to Bar River Road, District 62, Sault Ste. Marie, Ontario
G.W.P. 354 and 352-94-00", prepared by S & P dated August 2003.

The findings of the present investigation are presented in this report. It should be noted that subsurface conditions between and beyond the borehole locations could be different from the ones encountered at the boreholes due to greater than normal borehole spacing.

2. SITE DESCRIPTION AND GEOLOGY

The realignment of the proposed Highway 17 (New) is located between the Lower Echo River and Bar River Road and east of the existing Highway 17.

The site is undulating with high ground and low-lying areas. Rock outcrops were observed in high ground areas located south of Echo River and west of the proposed Highway 17 alignment, east of Pioneer Road between Highway 638 and Findlay Hill Road, and east of Government Road and north of the Huron Central Rail (CPR) crossing. Low-lying areas, including a swamp section in the vicinity of Highway 638, are present within the project limits.

According to Map 2108 published by the Ontario Department of Mines, the bedrock at the site consists of Cambrian sandstone of Jacobsville Formation at the interface with Pre-cambrian Lorrain Formation which consists of quartzite, siltstone, greywacke and conglomerate.

Typically, in high ground, bedrock of undifferentiated igneous and metamorphic classifications (Southern Province) are exposed at surface forming shallow hills. These rocks are generally Pre-cambrian formations while some Cambrian unconformities are also noted. The rock generally dips rapidly to below surface and in the relatively higher lying foot-hill areas, the bedrock is covered with some glacial till and/or granular deposits. In the low-lying areas, peat, muck and marl are found, covering glaciolacustrine deposits. The glaciolacustrine deposits typically consist of clay and silt, minor sand deposited in basin and quiet water environments. The depth of clay in areas can exceed 40 m.

The massive bedrock outcrop, which is exposed to the north, northeast of the railway crossing, was identified as sandstone of Cambrian origin. Some Pre-cambrian quartzite is also present in the area.

3. INVESTIGATION PROCEDURES

The fieldwork for the investigation consisted of the following:

- Site A: 5 boreholes and 2 test pits plus 3 dynamic cone penetration tests (DCPT)
- Site B: 2 boreholes plus 1 DCPT
- Site C: 12 boreholes plus 4 DCPT
- Site D: 7 boreholes plus 3 DCPT

The boreholes were advanced using solid and hollow stem continuous flight augers with track-mounted vehicles owned and operated by Colbar Resources of Sudbury, Ontario, under the supervision and direction of Geotechnical Engineers from our office. Sampling in the overburden was effected starting at the ground surface at frequent intervals of depth by the Standard Penetration Test (SPT) method, as specified in ASTM D1586. This consists of freely dropping a 63.5 kg hammer a vertical distance of 0.76 m to drive a 51 mm diameter O.D. split-spoon (split barrel) sampler into the relatively undisturbed ground. The number of blows required to drive the sampler into the ground by a vertical distance of 0.30 m is recorded as the Standard Penetration or the N-value of the soil and this gives an indication of the consistency or the compactness condition of the soil deposit. In the cohesive deposits where the consistency of the soil permitted, the undrained shear strength of the soil was measured in-situ by means of field vane tests using an MTO-type field vane and relatively undisturbed samples were taken by means of thin-walled Shelby tube samplers.

In addition, Dynamic Cone Penetration tests (DCPT) were performed at various borehole locations. This test consists of driving a 51 mm O.D., 60-degree apex cone, screw attached to the tip of an A-size rod, continuously into the undisturbed ground using the same driving energy as the SPT method. By recording the number of blows of the hammer to drive the cone/rod assembly into the soil every 0.3 m, a qualitative record of soil compactness condition is obtained.

Piezometers were installed in a number of boreholes to enable us to monitor the groundwater level over a prolonged period of time without interference from surface water.

The subsurface stratigraphy encountered in the boreholes and test pits, type of samples and sampling depths, N-values and DCPT results are presented on the Record of Borehole Sheets and Test Pit Logs, in Appendices A1, B1, C1 and D1 of this report.

Upon their completion, the boreholes were backfilled to about 6 to 8 m below the ground surface with soils brought up by augering (i.e. auger cuttings). The upper 6 to 8 m of the open boreholes was then grouted using a bentonite or a cement/bentonite mixture.

Test pits were dug on Site A using track-mounted backhoes, under the supervision of S&P technical personnel. The test pit results are shown on the Test Pit Logs in Appendix A1.

The borehole and test pit locations were established in the field by S & P personnel using centerline alignment and the ground surface elevations at the borehole and test pit locations along with co-ordinates were subsequently determined by surveyors from Marshall Macklin Monaghan Ltd.

A laboratory testing programme, consisting of natural moisture content measurement, bulk unit weight determination, Atterberg Limits, consolidation tests and grain-size analyses, was performed on selected soil samples. The results of the laboratory tests are presented on the appropriate Record of Borehole Sheets and also in Appendices A2, B2, C2 and D2.

4. SUBSURFACE CONDITIONS

4.1 SITE A : HIGHWAY 17 (NEW) FILL SECTION BETWEEN STATIONS 10+360 AND 10+700 WESTBOUND LANES

Site A is a relatively low-lying area between Site Nos. 1 and 2 along the westbound lanes (WBL) of the proposed Highway 17(New), near the north end of the project. The site is generally wooded, with bedrock outcrop at the south end of this section (between Stations 10+670 and 10+700).

The existing grade in this fill area varies from about Elevation 182.5 to 188.5m along the WBL centreline. The existing grades are also sloping down towards the left (east) at an average rate of about 7 to 23 %.

The location plan of the boreholes and test pits in this section is shown on Drawing No.1. The stratigraphic profile along WBL is presented in Drawing A.

Five boreholes were drilled, two test pits were dug and three DCPTs were put down in this area. Within the southern portion of this section, i.e., between Stations 10+580 and 10+700, the boreholes and test pits show, below about 0.15 to 0.5 m of topsoil or peat, the presence of bedrock or surficial layers of silt and silty sand till over bedrock. Between Stations 10+350 and about 10+570, the 0.2 to 0.5 m thick topsoil/peat layer is underlain by a clay deposit extending to about 8 m depth below existing grade, at the borehole locations. Below the clay, an about 0.3 to 0.7 m thick layer of silty sand till was contacted, which is further underlain by probable bedrock (inferred by refusal to augering).

Details of the subsurface conditions encountered in the boreholes and test pits are presented on the Record of Borehole Sheets and Test Pit Logs in Appendix A1. The individual strata are briefly described in the following paragraphs.

4.1.1 TOPSOIL AND PEAT

In the boreholes and test pits, topsoil and peat were encountered ranging in thickness between about 0.15 and 0.5 m.

4.1.2 SURFICIAL SILT

Below the topsoil and peat, Borehole 10+635 Lt contacted a surficial 0.5 m thick layer of silt extending to a depth of 1.0 m below existing grade. In Borehole 10+503 Lt, a 0.6 m thick layer of silt was encountered interbedded in the clay deposit at a depth of 0.7 m.

A grain-size distribution analysis was performed on a sample from the silt layer and the results are presented in Figure A2-1, Appendix A2. The results indicate the following particle size distribution:

Gravel =	0%
Sand =	2%
Silt =	71%
Clay =	27%

The above results indicate that this silt layer contains some clay.

Measured N-values in this layer were 6 and 12 blows/0.3 m indicating firm to stiff consistency.

4.1.3 SAND AND GRAVEL

In Borehole 10+460 Lt, a 0.4 m thick sand and gravel layer was contacted below the topsoil extending to a depth of 0.6 m below existing grade.

Measured N-value in this layer was 6 blows/0.3 m indicating loose relative density.

4.1.4 CLAY

Underneath the topsoil/peat and surficial deposits, Boreholes 10+460 Lt, 10+503 Lt and 10+540 Lt, which are located on the north side of the site in the relatively low lying areas away from the rock outcrop, encountered a clay deposit extending to depths of about 5 to 8 m below existing grade under the proposed WBL.

The results of the grain-size distribution analysis performed on one of the selected clay samples are presented in Figure A2-2, Appendix A2. The results indicate the following particle size distribution:

Gravel =	0%
Sand =	0%
Silt =	52%
Clay =	48%

Atterberg Limits tests carried out in the laboratory on two samples from the clay deposit gave the following index values:

Liquid Limit:	63 and 78%
Plastic Limit:	25 and 26%
Plasticity Index:	38 and 53%

As presented in Figure A2-3 in Appendix A2, these values are characteristics of clay soils of high plasticity. The measured natural moisture contents generally range from 33 to 85%.

The clay contains occasional seams / layers or pockets of silt or clayey silt. The measured index values for a sample obtained from such a layer/pocket are as shown in Figure A2-4, Appendix A2, as follows:

Liquid Limit:	32 %
Plastic Limit:	20 %
Plasticity Index:	12 %

These values indicate a clayey soil of low plasticity.

The measured bulk unit weights of the clay range from 14.8 to 17.5 kN/m³.

The results of a consolidation (oedometer) test performed on a sample from the clay deposit taken from Borehole 10+503 Lt are presented in Figure A2-5, Appendix A2. The test results show the probable pre-consolidation pressure (P_c) of about 90 kPa, which is about 60 kPa in excess of the existing effective overburden pressure.

Standard Penetration tests performed in the clay deposit gave N-values varying between 1 and 6 blows/0.3 m were recorded. Field vane tests yielded undrained in-situ shear strength values ranging from about 18 to 46 kPa. Variation of the measured undrained shear strengths with elevation are plotted and this plot is presented in Figure A3-1 in Appendix A3. Figure A3-2 (Appendix A3) shows typical plot of undrained shear strength versus elevation at Borehole 10+460 Lt. These values indicate that the consistency of the material can be described as generally soft to firm.

4.1.5 SILTY SAND TILL

Below the clay in Boreholes 10+460 Lt, 10+503 Lt and 10+540 Lt, silty sand till was encountered at depths ranging from 5.2 to 8.2 m below the ground surface. This deposit was penetrated for a vertical distance of 0.3 to 0.7 m where the borehole was terminated. In Boreholes 10+460 and 10+540, auger refusal was encountered. Surficial silty sand till was also encountered in Boreholes 10+635 Lt and 10+643 Lt. These extended to 1.7 m and 0.8 m below the ground surface where refusal to augering was encountered. This deposit is

a heterogeneous mixture of sand and silt, with some gravel and clay size particles. The presence of cobbles and boulders can also be expected in the glacial till deposits.

A grain-size distribution analysis was performed on a sample from this layer and the results are presented in Figure A2-6, Appendix A2. The results indicate the following particle size distribution:

Gravel =	10%
Sand =	43%
Silt =	34%
Clay =	13%

Measured N-values of greater than 50 blows/0.3 m at Boreholes 10+540 and 10+635 indicate a very dense relative density. However, a low N-value of 5 blows/0.3 m in Borehole 10+503 Lt could possibly caused by disturbance of the soil due to hydrostatic uplift at the bottom of the hole during sampling.

4.1.6 BEDROCK

Boreholes, DCPTs and test pits from this investigation indicate that bedrock and probable bedrock was encountered along the WBL from about Stations 10+580 to 10+670. Beyond or north of Station 10+580 to Station 10+350 (north limit of this section), possible bedrock was encountered at depths of about 6 to 10 m below existing grade. The bedrock in this area is known to consist of quartzite.

4.1.7 GROUNDWATER CONDITIONS

Water level observations in the boreholes were made during drilling and at completion of each borehole. Boreholes 10+635 and 10+643 were dry at completion while in Boreholes 10+460, 10+503, and 10+540, the recorded water levels at completion ranges between 3.0 and 5.5 m below existing grade, but these are unlikely to represent the stabilized water levels.

Based on the above observations and the greyish colour of the clay, the groundwater table is believed to be close to the existing ground surface to the north of Station 10+570. To the south of this station (towards higher ground), the groundwater level is believed to be at or near ground surface. Due to the pervious nature of the surficial sand and gravel, silt and silty sand till layers over the bedrock and the impervious clay deposit, perched water condition could also be expected. The groundwater table can be expected to fluctuate seasonally and in response to weather events.

4.2 SITE B : HIGHWAY 17 (NEW) FILL SECTION BETWEEN STATIONS 11+000 AND 11+190, AND CUT SECTION BETWEEN STATIONS 11+190 AND 11+380

Site B is located between Site Nos. 3 and 4 of the proposed Highway 17(New). The northern portion of this section is a fill section and one borehole (Borehole 11+020 Rt) was drilled in this area. The southern portion is a cut section, and one borehole (Borehole 11+300 Lt) was also drilled to provide a limited subsurface information.

The existing grade in the fill section varies from about Elevation 190.2 to 191.0 m along the EBL and WBL centerlines; while the existing grade in the cut section ranges from about Elevation 187.5 to 192 m.

The location plan of the boreholes at Site B is shown on Drawing No. 1. The stratigraphic profile is presented in Drawing B.

In the fill section, Borehole 11+020 Rt was drilled to a depth of 7.3 m and this showed, below 0.25 m of topsoil, an extensive clay deposit to at least the bottom of the hole. A DCPT was extended from the bottom of the borehole from a depth of 7.3 m to 29.1 m below existing grade, where practical refusal was encountered. In the cut section, Borehole 11+300 Lt was drilled and this indicated, below 0.1 m of topsoil and 0.6 m of sand and gravel fill, the presence of an extensive clay deposit to a depth of at least 7.3 m.

Details of the subsurface conditions encountered in the boreholes are presented on the Record of Borehole Sheets in Appendix B1. The individual strata are briefly described in the following paragraphs.

4.2.1 TOPSOIL

In the boreholes, topsoil was encountered ranging in thickness between about 0.1 and 0.25 m.

4.2.2 SAND AND GRAVEL

In Borehole 11+300 Lt, a 0.6 m thick sand and gravel layer was contacted below the topsoil extending to a depth of 0.7 m below existing grade. The sand and gravel is believed to be a fill material. It also contains occasional cobbles.

A grain-size distribution analysis was performed on a sample from this layer and the results are presented in Figure B2-1, Appendix B2. The results indicate the following particle size distribution:

Gravel	=	50%
Sand	=	45%
Silt & Clay	=	5%

Measured N-value in this layer was greater than 50 blows/0.3 m indicating a very dense relative density.

4.2.3 CLAY

Below the topsoil and surficial deposits, both Boreholes 11+020 Rt and 11+300 Lt encountered a clay deposit extending to a depth of at least 7.3 m below existing grade. The clay contains occasional seams / layers or pockets of silt and clayey silt.

The results of the grain-size distribution analysis performed on a selected clay sample are presented in Figure B2-2, Appendix B2. The curve indicates the following particle size distribution:

Gravel	=	1%
Sand	=	3%
Silt	=	21%
Clay	=	75%

Atterberg Limits tests carried out in the laboratory on two samples from the clay deposit gave the following index values:

Liquid Limit:	60 to 68%
Plastic Limit:	25%
Plasticity Index:	35 to 43%

As presented in Figure B2-3 in Appendix B2, these values are characteristics of clay soils of high plasticity. The measured natural moisture contents generally range from 33 to 90%.

The measured bulk unit weights of the clay range from 14.3 to 18.0 kN/m³.

Standard Penetration tests performed in this deposit gave N-values varying between 2 and 20 blows/0.3 m. Field vane tests yielded undrained in-situ shear strength values ranging from about 56 to greater than 100 kPa within the top 1.5 to 4.5 m depth, indicating stiff to very stiff clay. Values of 24 to 40 kPa were recorded below these depths indicating firm consistency. Variation of measured undrained shear strengths

with elevations are plotted and this plot is presented in Figures B3-1 in Appendix B3. Figure B3-2 shows typical plot of undrained shear strength versus elevation at the location of Borehole 11+020 Rt. These values indicate that the consistency of the material can be described as generally soft to very stiff.

The DCPT at Borehole 11+020 Rt indicates that a 'stiffer' material is encountered at a depth of about 20 m, and a more competent material is probably encountered at a depth of 26 m below existing grade.

4.2.4 GROUNDWATER CONDITIONS

Water level observations in the boreholes were made during drilling and at completion of each borehole.

To enable us to monitor the groundwater level in Borehole 11+300 Lt, a piezometer was installed. Water level in the piezometer was measured two days after the completion of the borehole at a depth of 5.9 m below existing ground surface, or El. 185.1 m. This recorded water level is not believed to have stabilized.

Based on the above observations and the greyish colour of the clay, the groundwater table is believed to be at about 1 m below the ground surface at Borehole 11+020 Rt and at a depth of about 2 m below existing grade at Borehole 11+300 Lt.

The groundwater table can be expected to fluctuate seasonally and in response to weather events. In addition, due to the pervious nature of the granular fill layer over the impervious clay deposit, perched water condition could also be expected where such condition occur.

4.3 SITE C : HIGHWAY 17(NEW) FILL SECTION BETWEEN STATIONS 13+400 AND 15+470

Site C is a relatively low-lying area adjacent to and south of the swamp area (Site No. 5). The grade from the north of this section gradually rises southerly from an elevation of 180 m at about Station 13+400 to about Elevation 187 m at Station 14+500 along the westbound lanes (WBL) alignment and at Station 114+525 along EBL. Further south, the grade is drops to an elevation of about 184.5 to 185 m near Watson Road at about Station 14+550. The grade generally remains at about Elevation 184.5 \pm m (lowest elevation in this area) at about Station 15+100 (just south of the creek). Further to the south, the grade follows the similar pattern such that the grade to the south of this section gradually rises southerly to an elevation of 187 m at about Station 15+450.

A total of 12 boreholes was put down at this site. The locations of the boreholes are shown in Drawings C and 4.

In general, the boreholes drilled along the proposed Highway 17 (New) show the presence of 0.1 to 0.4 m but generally 0.2 to 0.3 m thick topsoil layer. Borehole 14+668 C/L was drilled from the existing Watson Road, and this borehole encountered 0.7 m thick sand and gravel fill, underlain by 1.4 m of sandy silt fill extending to a depth of 2.1 m below existing grade.

Below the topsoil and fill, the boreholes encountered fine sand, sandy silt or silt layers generally to a maximum depth of 3.7 m below the ground surface. In Borehole 14+000 Lt, the sandy silt extends to the full depth of the borehole at a depth of 6.6 m and possibly below. These granular soils or topsoil are underlain by an extensive clay deposit. In two of the boreholes (13+576 Lt and 13+800 Rt), the clay is underlain by alternating layers of sandy silt and clay deposits at depths generally ranging from about 4 to 7 m below the ground surface while others were terminated at depths of up to 16.5 m within the clay deposit, without encountering these lower granular soils.

Details of the subsurface conditions encountered in the boreholes are given on the Record of Borehole Sheets in Appendix C1. The individual strata are briefly described in the following paragraphs.

4.3.1 TOPSOIL

All the boreholes, except for Boreholes 14+668 CL (which were drilled from the embankment of Watson Road) contacted topsoil extending to depths ranging from 0.1 to 0.4 m, but generally 0.2 to 0.3 m.

4.3.2 EMBANKMENT FILL

Borehole 14+668 CL was drilled from the existing Watson Road embankment and therefore, contacted embankment fill. The fill at the borehole location was found to consist of granular material (i.e. sand and gravel) and sandy silt. The depth of the fill at this borehole location was 2.1 m and extended to Elevation 182.9 m. Standard Penetration tests performed within the embankment fill yielded N-values ranging from 33 to 42 blows/0.3 m, indicating that the fill materials have received some systematic compaction when first placed.

4.3.3 SAND

Surficial fine sand to silty sand layers were encountered immediately below the topsoil at four boreholes at the north end of the site (north of Watson Road), in Boreholes 13+415 Rt, 13+576 Lt, 13+800 Rt and 14+000 Lt, and in one borehole drilled at the south end of the site, in Borehole 15+400 Rt.

The deposit was found to be thickest at the north end (3.3 m in Borehole 13+415 Rt) and decreasing towards the south (0.5 m thick in Borehole 14+000 Lt). At the south end of this section at Borehole 15+400 Rt, its thickness was found to be 0.2 m.

The grain-size distribution of a sample from this fine-grained granular deposit is given in Figure C2-1, in Appendix C2.

These indicate:

Sand	=	93 %
Silt	=	7 %
Clay	=	0 %

N-values recorded in this material ranged from 2 to 6 blows/0.3 m. Based on these values, the relative density of the soil is described as very loose to loose.

4.3.4 SANDY SILT

Below the topsoil and/or surficial sand layers, the boreholes, except Boreholes 13+415 Rt, 13+800 Rt, 14+200 Rt and 15+400 Rt, encountered sandy silt layers, which extended to depths of 0.7 m (Boreholes 15+000 Rt and 15+200 Lt) to in excess of 6.6 m (Borehole 14+000 Lt) below existing grade. In Boreholes 13+576 Lt and 13+800 Rt, sandy silt interbeds were encountered within the deep clay deposit.

The grain-size distribution of 3 samples from this deposit is given in Figure C2-2, in Appendix C2. These indicate:

Sand	=	22 – 44 %
Silt	=	48 – 74 %
Clay	=	4 – 12 %

Measured N-values recorded in this material widely ranged from 2 to 23 blows/0.3 m, indicating very loose to compact relative density.

4.3.5 CLAY

Underlying the surficial layers of topsoil, sand and sandy silt, all the boreholes, except for Borehole 14+000 Lt, encountered a major deposit of clay at depths ranging from 0.3 to 3.7 m below the ground surface.

To the south of Station 14+200, the clay extends to the full depth of exploration (i.e. about 7 to 16 m below the ground surface) while Dynamic Cone Penetration tests (DCPT) show probable greater depths. As mentioned before, in the borehole drilled at Station 14+000 the borehole was terminated at a depth of 6.6 m, and no clay was encountered within this depth. To the north of Station 14+000 (north end of site), in Boreholes 13+576 Lt and 13+800 Rt, as mentioned in Section 4.3.4, the clay is interbedded with sandy silt layers in alternating fashion.

DCPTs put down below the bottom of Boreholes 14+200 Rt and 15+400 Rt indicated that the clay probably extends to about 29 m (El. 156 m) and 20 m (El. 167 m), respectively, at these borehole locations.

In general, the clay is a highly plastic (fat) material with some medium and occasional low plasticity (lean) clay structure zones/layers. The grain-size distribution of 2 samples from the site is presented in Figure C2-3, in Appendix C2. These curves show the percentage of clay-size particles is very high (i.e. 77 to 80 %). From the grain-size distribution curves, the clay can be expected to be a practically impervious material.

Index properties of 3 samples from the clay deposit were determined in the laboratory and these indicate the following results,

Liquid Limit :	57 – 73 %
Plastic Limit :	25 – 31 %
Plasticity Index :	32 – 48 %

As shown in Figure C2-4, Appendix C2, these results are characteristic of clays of high plasticity.

The presence of some silty clay zones and clayey silt and silt seams in the clay deposit was also noted. The index values of samples from these seams/zones (as shown in Figure C2-5, Appendix C2) are as follows:

Liquid Limit :	30 to 31 %
Plastic Limit :	15 to 18 %
Plasticity Index :	13 to 16 %

The results of three consolidation (oedometer) tests performed on samples from the clay deposit within this section (including two samples from the culvert site at Station 15+086, which is within Site C) are presented in Figure C2-6 to C2-8, Appendix C2. The test results show the probable pre-consolidation pressure (P_c) ranging from 80 to 190 kPa, which are about 35 to 90 kPa, in excess of the existing effective overburden pressures.

N-values generally ranging from 0 (i.e., sampler sank under the static weight of the hammer plus rods) to 8 blows/0.3 m, were recorded in this deposit. In most cases, however, the recorded values were 0 to 2 blows/0.3 m. Undrained in-situ shear strengths as measured by Field Vane tests ranged from 15 to 78 kPa. These values indicate that the consistency of the material can be described as soft to stiff, but generally very soft to firm. A combined plot of all the in-situ vane test results from all the boreholes is presented in Figure C3-1, in Appendix C3. Figure C3-2 shows typical plot of undrained shear strength versus elevation at the location of Borehole 14+200 Rt.

4.3.6 GROUNDWATER CONDITIONS

The area is generally low lying and poorly drained, consequently, the groundwater can generally be expected at or near the ground surface level.

Based on observations made in the boreholes while drilling, water contents of the samples and the change of the colour of the soil from brown to grey, it is our opinion that the groundwater level at the site was at or very close to the ground surface, except at the north half of this section, where the groundwater level is expected to vary between about the ground surface at Station 13+400 (El. 180 \pm m) to about 2m below existing grade at Station 14+500 (El. 184.5 \pm m).

It should be pointed out that both surface and groundwater levels can be expected to fluctuate seasonally and in response to major weather events. In addition, due to the pervious nature of the surficial sand layer over the impervious clay deposit, perched water condition could also be expected.

4.4 SITE D : HIGHWAY 17(NEW) FILL SECTION BETWEEN STATIONS 16+600 AND 17+700

Site D is a low-lying area located to the south of Site No. 8, at the south end of the project. The existing grade from the north of this section is generally level at Elevation $187.5 \pm$ m for about 300 m to about at Station 16+900 where it starts to decrease. Further south, the grade gradually drops to an elevation of about 182.5 m. The grade generally remains at about Elevation $182.5 \pm$ m (lowest elevation in this area) from about Station 17+250 to Station 17+450. Further to the south, the grade follows the similar pattern and rises southerly to an elevation of 183.5 m at about Station 17+700. The low-lying area generally extends from about Station 17+000 to Station 17+680.

A total of 7 boreholes were drilled in this section of the site. The locations of the boreholes are shown in Drawing D.

In general, the boreholes show the presence of 0.2 to 0.4 m thick topsoil or peaty topsoil layer. Underlying the topsoil, Boreholes 16+650 Lt, 16+800 Rt, 17+000 Lt and 17+600 Lt encountered fine sand to silty sand layer to depths of 0.7 and 2.1 m below the ground surface. Underneath the topsoil and sand layers, all the boreholes contacted an extensive clay deposit to the full depth of the boreholes, except for Borehole 17+200 Rt, where the clay extends to a depth of 14.2 m followed by a silty sand till to the remaining depth of the borehole (15.7 m).

Details of the subsurface conditions encountered in the boreholes are given on the Record of Borehole Sheets in Appendix D1. The individual strata are briefly described in the following paragraphs.

4.4.1 TOPSOIL / PEATY TOPSOIL

All the boreholes contacted a topsoil or peaty topsoil layer extending to depths of 0.2 to 0.4 m.

4.4.2 SAND

Surficial fine sand to silty sand layers were encountered immediately below the topsoil at three boreholes at the north end of the site (in Boreholes 16+650 Lt, 16+800 Rt and 17+000 Lt) and in one borehole drilled at the south end of the site (in Borehole 17+600 Lt).

The thickness of the deposit varies from about 0.5 m at the north end of this section to 1.7 m at the south end (in Borehole 17+600 Lt).

The grain-size distribution of three samples from this fine-grained granular deposit is given in Figure Nos. D2-1 and D2-2, in Appendix D2.

These indicate:

Gravel	=	0 to 2 %
Sand	=	63 to 93 %
Silt & Clay	=	7 to 37 %

N-values recorded in this material ranged from 3 to 14 blows/0.3 m. Based on these values, the relative density of the soil is described as very loose to compact.

4.4.3 CLAY

Underlying the surficial layers of topsoil/peaty topsoil and sand, all the boreholes encountered a major deposit of clay at depths ranging from 0.2 to 2.1 m below the ground surface.

The clay extends to the full depth of exploration (i.e. about 7 to 16 m below the ground surface) except in Borehole 17+200 Rt, where the clay extends to a depth of 14.2 m.

DCPTs put down below the bottom of Boreholes 16+800 Rt and 17+450 Rt indicated that the clay probably extends to about 13 m (El. 175 m) and 24 m (El. 158 m), respectively, at these borehole locations.

In general, the clay is a highly plastic (fat) material with some medium and occasional low plasticity (lean) clay structure zones/layers or seams.

Index properties of 4 samples from the clay deposit were determined in the laboratory and these indicate the following results,

Liquid Limit :	55 – 69 %
Plastic Limit :	25 – 28 %
Plasticity Index :	30 – 41 %

As shown in Figure D2-3, Appendix D2, these results are characteristic of clays of high plasticity.

The results of two consolidation (oedometer) tests performed on samples from the clay deposit within this section are presented in Figure Nos. D2-4 and D2-5, Appendix D2. The test results show the probable pre-consolidation pressure (P_c) ranged from 33 to 98 kPa, which are about 18 to 30 kPa, in excess of the existing effective overburden pressure.

N-values generally ranging from 0 to 10 blows/0.3 m were recorded in this deposit. In most cases, however, the recorded values were 0 to 2 blows/0.3 m. Undrained in-situ shear strengths as measured by field vane tests ranged from 12 to 66 kPa. These values indicate that the consistency of the material can be described as very soft to stiff, but generally very soft to firm. A combined plot of all the in-situ vane test results from all the boreholes is presented in Figure D3-1, in Appendix D3. Figure D3-2 shows typical plot of undrained shear strength versus elevation at the location of Borehole 17+300 Lt.

Dynamic Cone Penetration Tests (DCPT) performed from the bottom of Boreholes 16+800 Rt and 17+450 Rt showed the probable presence of a more competent layer below depths of about 14 m and 24.5 m, respectively. The DCPT showed refusal at 17.2 m and 26.6 m at these two borehole locations, respectively.

4.4.4 SILTY SAND TILL

Below the clay in Borehole 17+200 Rt, a silty sand till was encountered at a depth of 14.2 m and this extends to the remaining depth of the borehole (15.7 m). This deposit is a heterogeneous mixture of silt and sand with gravel and clay size particles.

A grain-size distribution analysis was performed on a sample from this layer and the results are presented in Figure D2-6, Appendix D2. The results indicate the following particle-size distribution:

Gravel	=	30%
Sand	=	43%
Silt & Clay	=	27%

Measured N-value of 16 blows/0.3 m was recorded in the silty sand till indicating a compact relative density. However, DCPT performed from the bottom of the borehole showed the possible presence of a weak zone (i.e., probably loose to very loose) at a dept of 17 m. The test recorded refusal at a depth of 2 m below this or at a depth of 19 m below the ground surface.

4.4.5 GROUNDWATER CONDITIONS

The area is generally low lying and poorly drained, consequently, the groundwater can generally be expected at or near the ground surface level.

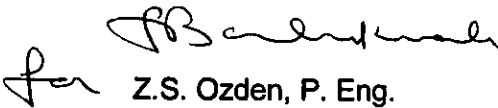
Based on observations made in the boreholes while drilling, water contents of the samples and the colour of the clay being reddish grey to grey, it is our opinion that the groundwater level at the site was at or very close to the ground surface.

It should be pointed out that both surface and groundwater levels can be expected to fluctuate seasonally and in response to major weather events. In addition, due to the pervious nature of the surficial sand layer overlying the impervious clay deposit, perched water condition could also be expected.

SHAHEEN & PEAKER LIMITED

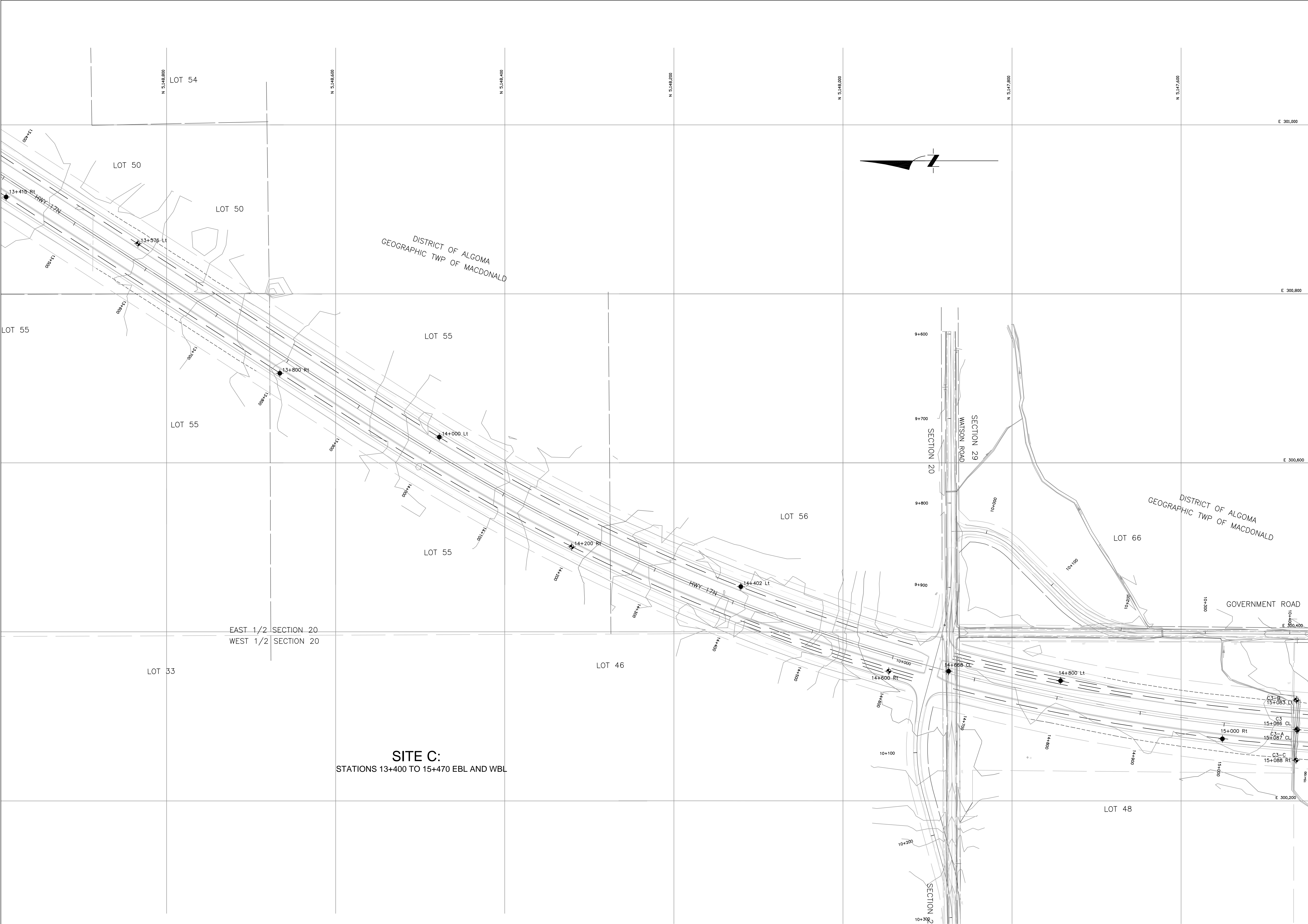

R. Miranda, P. Eng.




Z.S. Ozden, P. Eng.



Drawings



LEGEND

◆

Bore Hole

◆

Bore Hole & Cone

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
13+415 Rt	180.2	5 148 989.8	300 914.6
13+576 Lt	180.9	5 148 833.9	300 859.4
13+800 Rt	182.5	5 148 666.2	300 706.1
14+000 Lt	183.8	5 148 477.5	300 630.6
14+200 Rt	184.7	5 148 320.8	300 500.7
14+402 Lt	186.4	5 148 120.8	300 453.6
14+600 Rt	184.8	5 147 945.8	300 353.5
14+668 CL	185.0	5 147 875.0	300 353.5
14+800 Lt	184.3	5 147 742.6	300 342.2
15+000 Rt	184.5	5 147 551.1	300 273.5
C3-B	184.6	5 147 463.6	300 319.3
C3	184.4	5 147 463.3	300 284.2
C3-A	184.5	5 147 462.3	300 284.1
C3-C	184.5	5 147 464.0	300 248.2

1	DRAFT	Sep.2003
NO.	DESCRIPTION	DATE

REVISION

shaheen & peaker
limited

consulting geotechnical, environmental,
transportation & building science engineers

20 Meteor Drive, Toronto, Ontario, M9W 1A4
T: 416.213.1255 F: 416.213.1255
email: info@shaheenpeaker.ca

DIST. OF ALGOMA

1:5

KEY PLAN

N.T.S.

Ontario

HIGHWAY 17 (NEW)
ECHO RIVER TO
BAR RIVER ROAD

SAULT SAINT MARIE, DIST. 62

TITLE:
BOREHOLE LOCATION PLAN

SCALE: 1:2000	DATE: Sep.2003
DRAWN BY: JZ	PROJECT NO.: SPT1055
APPROVED BY: ZO	DRAWING NO.: C

APPENDICES

FOR SITE A

Drawing

(Soil Strata)

Appendix A1

Site A

Record of Borehole Sheets and Test Pit Logs

RECORD OF BOREHOLE No 10+460; 20 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 151 736.6; E 301 489.3 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY Y.L.
DATUM Geodetic DATE 6/3/2003 CHECKED BY R.A.

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 (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
182.6	Ground Surface							20 40 60 80 100						
0.0	0.2 m Topsoil		1	SS	6	**	182	○ UNCONFINED + FIELD VANE						** Low recovery, auger sample taken
182.0	SAND and GRAVEL grey/brown, wet, loose		2	SS	2		181	● POCKET PENETR. x LAB VANE						
0.6			3	SS	2		180							
	CLAY occasional silt seams and pockets reddish grey, wet soft to firm		4	SS	3		179							
			5	TW	PH		178							
			6	SS	3		177							
			7	SS	4		176							
174.4							175							
8.2	SILTY SAND TILL		8	AS	-									
174.1	grey, wet													
8.5	End of Borehole.													
	Dynamic Cone Penetration Test (D.C.P.T) performed from 7.3 m to 8.4 m.													
	Auger refusal at 8.5 m													
	* Water level at 4.9 m (not stabilized), and hole open to full depth on completion.													

SPT 1055

RECORD OF BOREHOLE No 10+460; 36 m Lt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 151 747.1; E 301 481.4 ORIGINATED BY Y.L.
 DIST 62 HWY 17 (New) BOREHOLE TYPE D.C.P.T. COMPILED BY Y.L.
 DATUM Geodetic DATE 8/3/2003 CHECKED BY R.A.

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					
182.0 0.0	Ground Surface						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE	20 40 60					
182													
181													
180													
179													
178													
177													
176													
175													
174													
173													
172.6 9.4	End of D.C.P.T. Dynamic Cone Penetration Test (D.C.P.T.) performed from 0 m to 9.4 m.												

SPT 1055

RECORD OF BOREHOLE No 10+503; 22 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 151 704.7; E 301 499.2 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY Y.L.
DATUM Geodetic DATE 6/3/2003 CHECKED BY R.A.

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			SHEAR STRENGTH kPa						
182.5	Ground Surface							20 40 60 80 100						
0.0	0.2 m Peaty Topsoil		1	SS	2		182	○ UNCONFINED + FIELD VANE						
181.8	CLAY reddish grey, damp							● POCKET PENETR. × LAB VANE						
0.7	SILT some clay, grey, wet, firm		2	SS	6		181	WATER CONTENT (%)						
181.2								20 40 60						
1.3	CLAY reddish grey, wet soft to firm		3	SS	6		180	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
			4	TW	PH		179	W P W W L						
			5	SS	1		178							
			6	SS	2		177							
176.4	SILTY SAND TILL grey, wet		7	SS	5*		176							
6.1														
175.8														
6.7	End of Borehole.													
	* Water level at 5.5 m (not stabilized), and hole open to full depth on completion.													

+³ × 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 10+540; 20 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 151 673.7; E 301 521.1 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY Y.L.
DATUM Geodetic DATE 6/3/2003 CHECKED BY R.A.

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			SHEAR STRENGTH kPa						
182.8	Ground Surface							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE						
0.0	PEAT		1	SS	2		182						12.1	
182.0	dark brown to black, wet, soft		2	SS	4								17.5	
0.5	CLAY		3	SS	3		181						16.1	
	occasional silt seams and pockets wet, soft to firm		4	SS	3		180							
	reddish gray gray, with silt layers		5	SS	2		179							
177.4			6	SS	2		178							
5.2	SILTY SAND TILL		7	AS	-		177							
176.6	gry, wet		8	SS	100/0									10 43 34 13
5.9	End of Borehole.													
	Auger refusal at 5.9 m, probably on a cobble or boulder. Moved to Sta. 10+542; 20m Lt, auger refusal at 5.9 m; moved to Sta. 10+538; 20 m Lt, auger refusal at 5.8 m.													
	* Water level at 3.0 m (not stabilized), and hole open to full depth on completion.													
	** Unable to push vane below 5.2 m.													
	*** Rod and Sampler bouncing, refusal probably on a cobble or boulder.													

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 10+635; 20 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 151 591.9; E 301 574.5 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Solid Stem Augers COMPILED BY Y.L.
DATUM Geodetic DATE 6/3/2003 CHECKED BY R.A.

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 (%)
FLEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
184.6	Ground Surface												
0.0	PEAT and TOPSOIL with rootlets, dark brown to black		1	SS	7								
184.1													
0.5	SILT some clay below 0.9 m grey, moist, firm to stiff		2	SS	12								
183.6													
1.0	Heterogeneous mixture of silt, sand and gravel, grey, moist, compact to dense (SILTY SAND TILL)		3	SS	100/0								
183.0													
1.7	End of Borehole. Auger refusal at 1.7 m, probably on a boulder or bedrock. Moved to Sta. 10+635; 22m Lt, auger refusal at 1.5 m; moved to Sta. 10+635; 18 m Lt, auger refusal at 1.7 m. * Borehole dry (not stabilized), and open to full depth on completion. ** Rod and Sampler bouncing, refusal probably on a boulder or bedrock. Auger sample collected.												

+ 3, x 3; Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 10+643; 20 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 151 584.7; E 301 578.5 ORIGINATED BY Y.L.
DIST 62 HWY 17 (New) BOREHOLE TYPE Solid Stem Augers COMPILED BY Y.L.
DATUM Geodetic DATE 6/3/2003 CHECKED BY R.A.

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			20	40	60	80	100	W _p	W	W _L		
185.0	Ground Surface																
0.0	0.15 m Topsoil		1	SS	100/25												
184.2	Heterogeneous mixture of silt, sand and gravel, grey, moist, very dense (SILTY SAND TILL)		2	SS	100/0												
0.8	End of Borehole. Auger refusal at 0.8 m, probably on bedrock. Moved to Sta. 10+642; 20m Lt, auger refusal at 0.3 m; moved to Sta. 10+643; 20 m Lt, auger refusal at 0.3 m. * Borehole dry (not stabilized), and open to full depth on completion. ** Rod and Sampler bouncing, auger sample collected.																

TEST PIT LOGS

SITE A

HIGHWAY 17 (New), Sault Ste. Marie
(Offset distances are from median centreline)

Highway 17 (New)

10+580 19m Lt C/L (El. 184.4m)

0	-	150	Tps mixed with Sa and Gr, Moist
		150	NFP BR

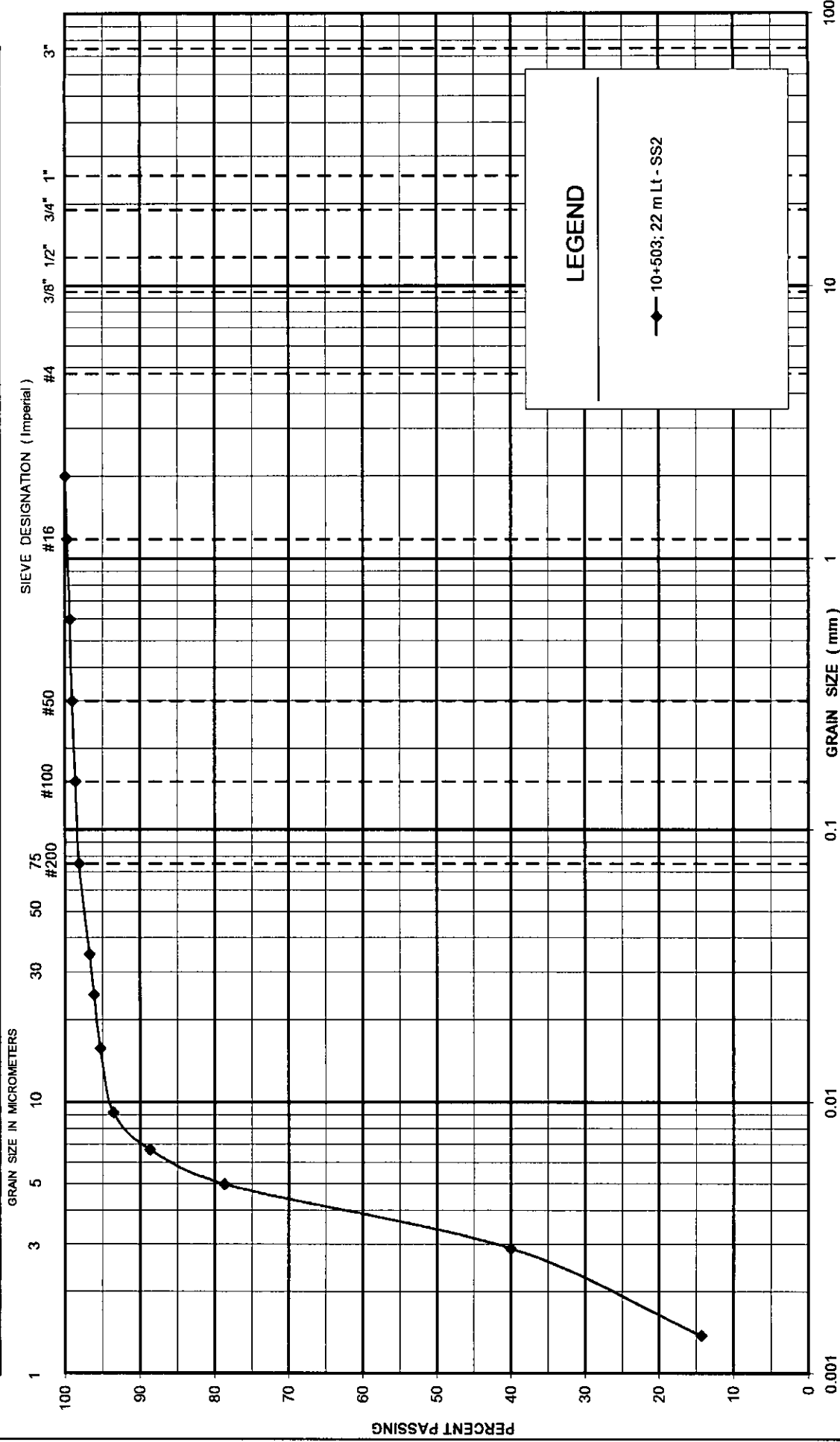
10+590 C/L (El. 189.3m)

0	-	300	Tps, Rootlets with Blds
		300	NFP BR

Appendix A2 Site A Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM

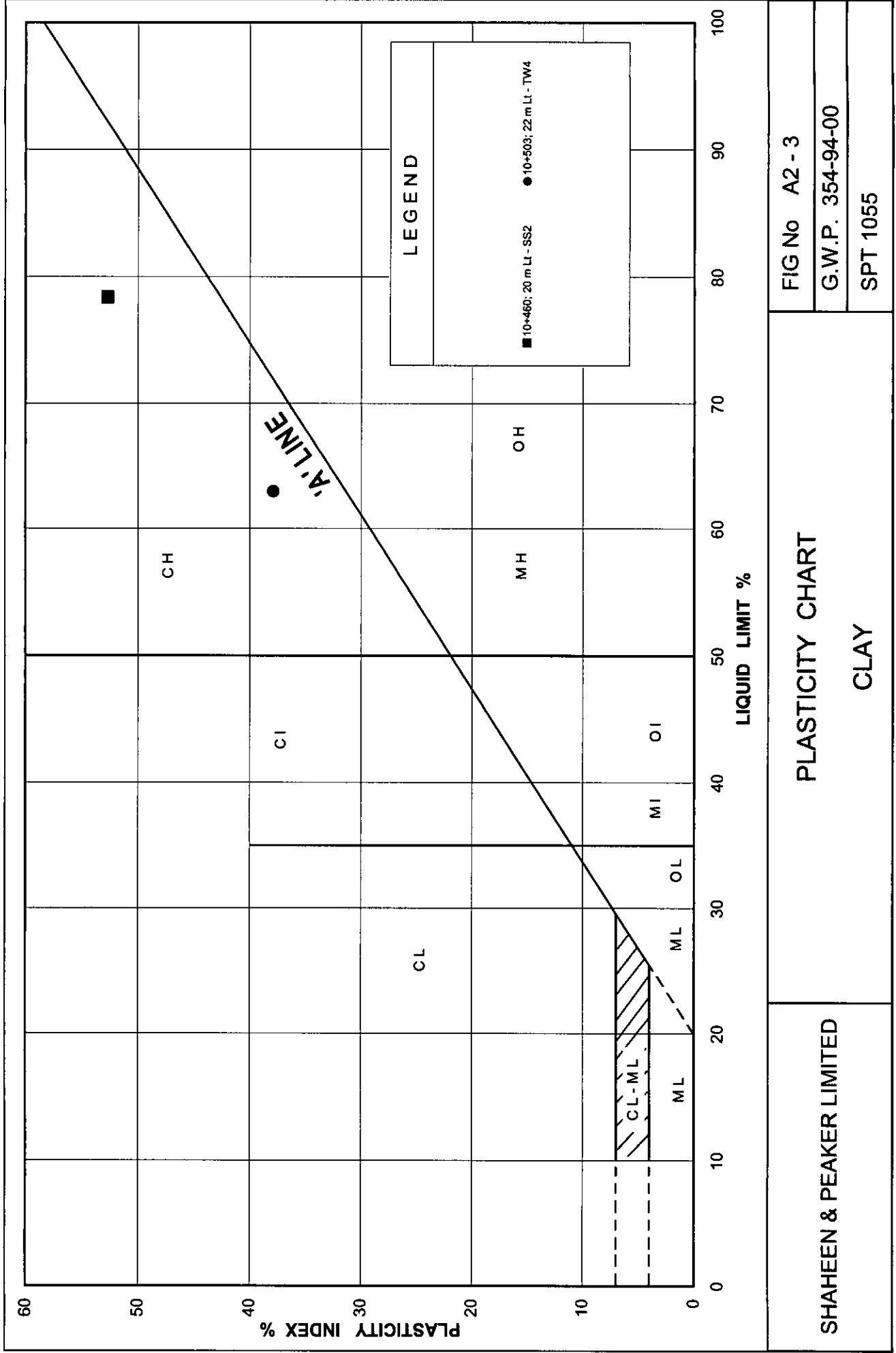
CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	

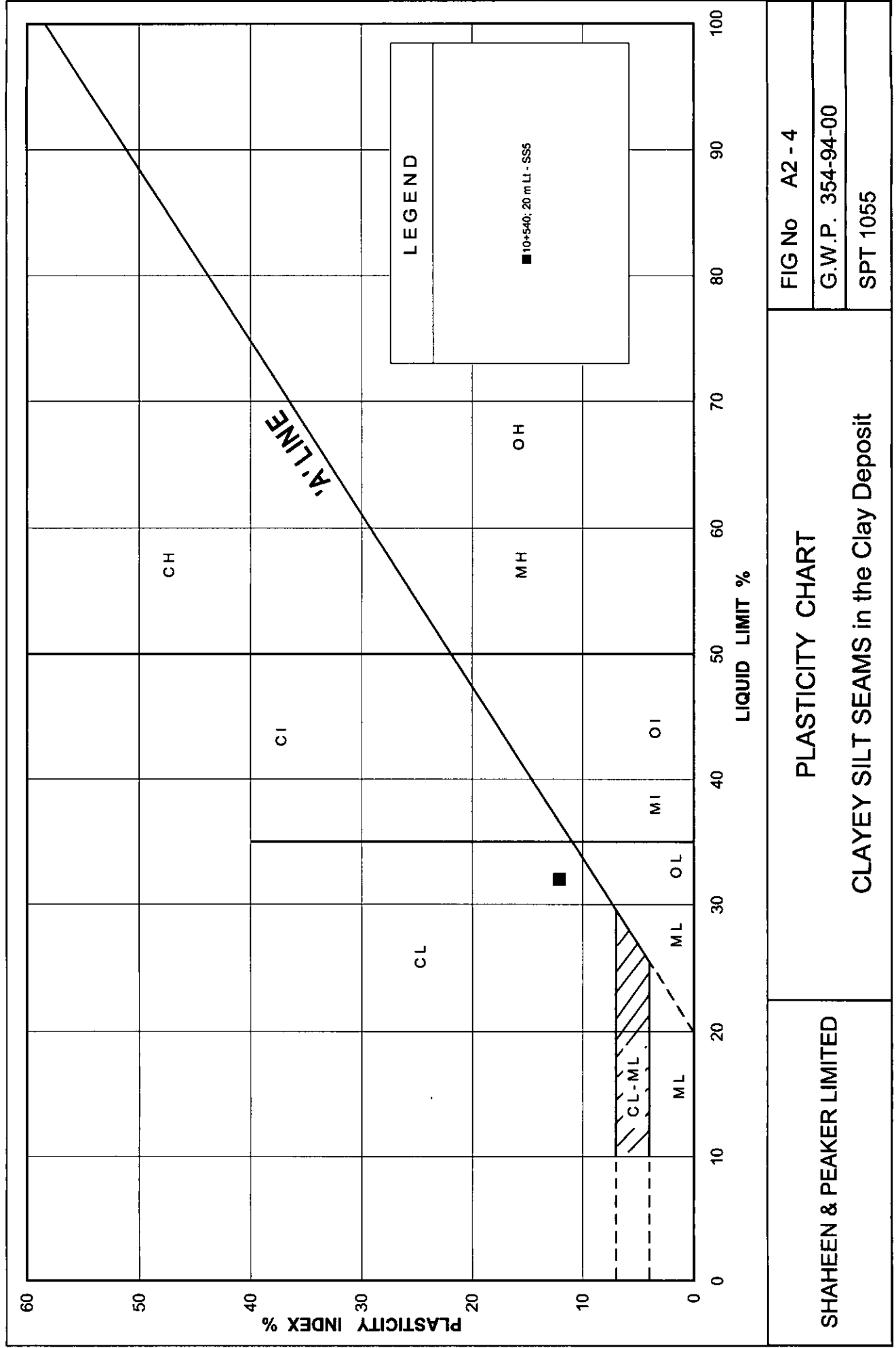


GRAIN SIZE DISTRIBUTION
SILT, some clay

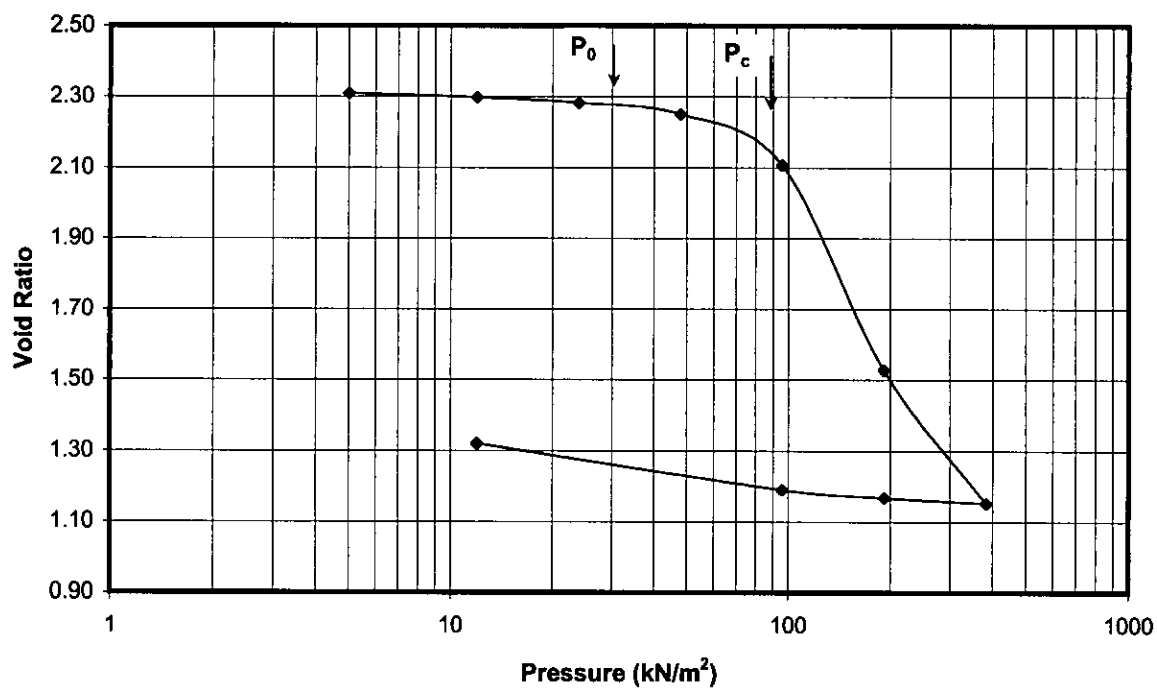
SHAHEEN & PEAKER LIMITED

FIGURE No. A2 - 1
REF. No. SPT 1055
GWP: 354-94-00

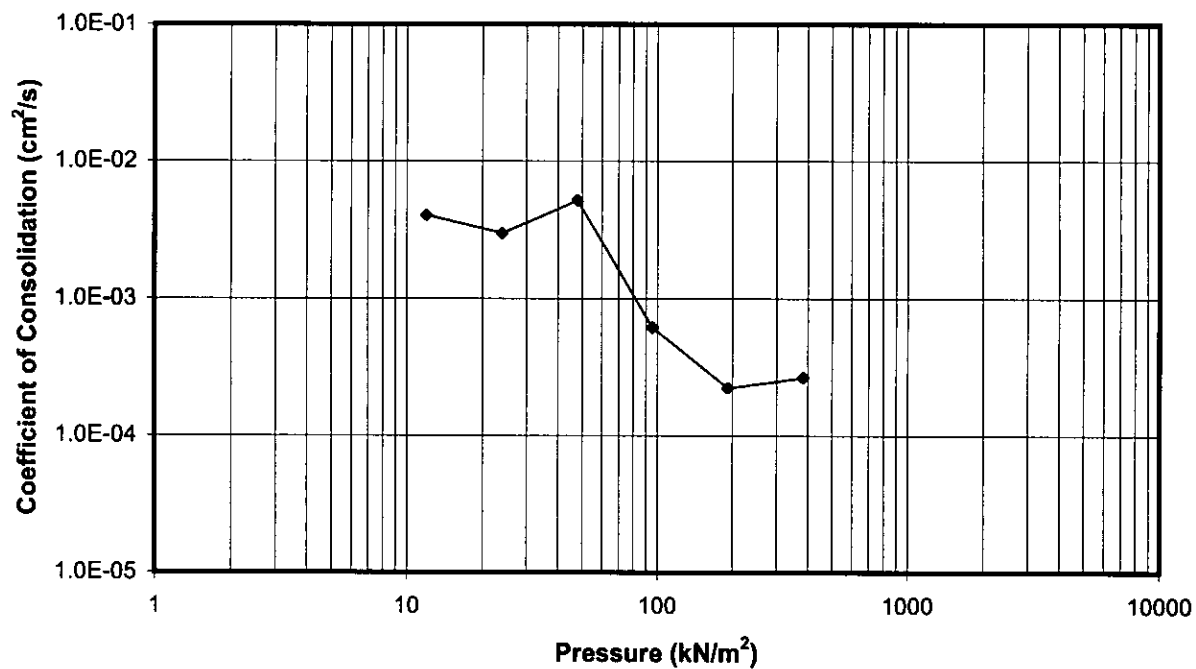




Void Ratio versus Pressure

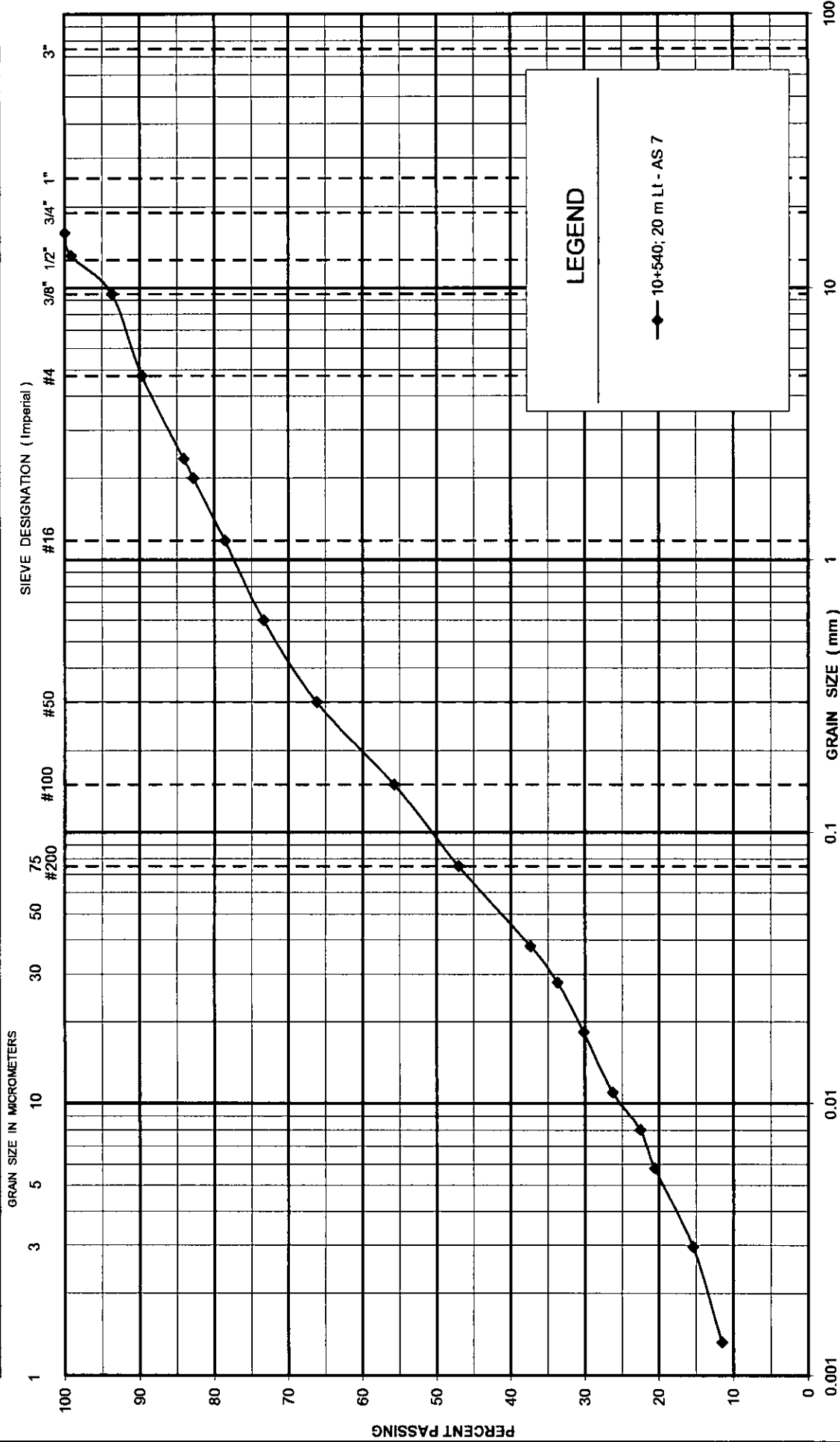


Coefficient of Consolidation vs. Pressure



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	



Appendix A3

Site A

Measured Undrained Shear Strength Results

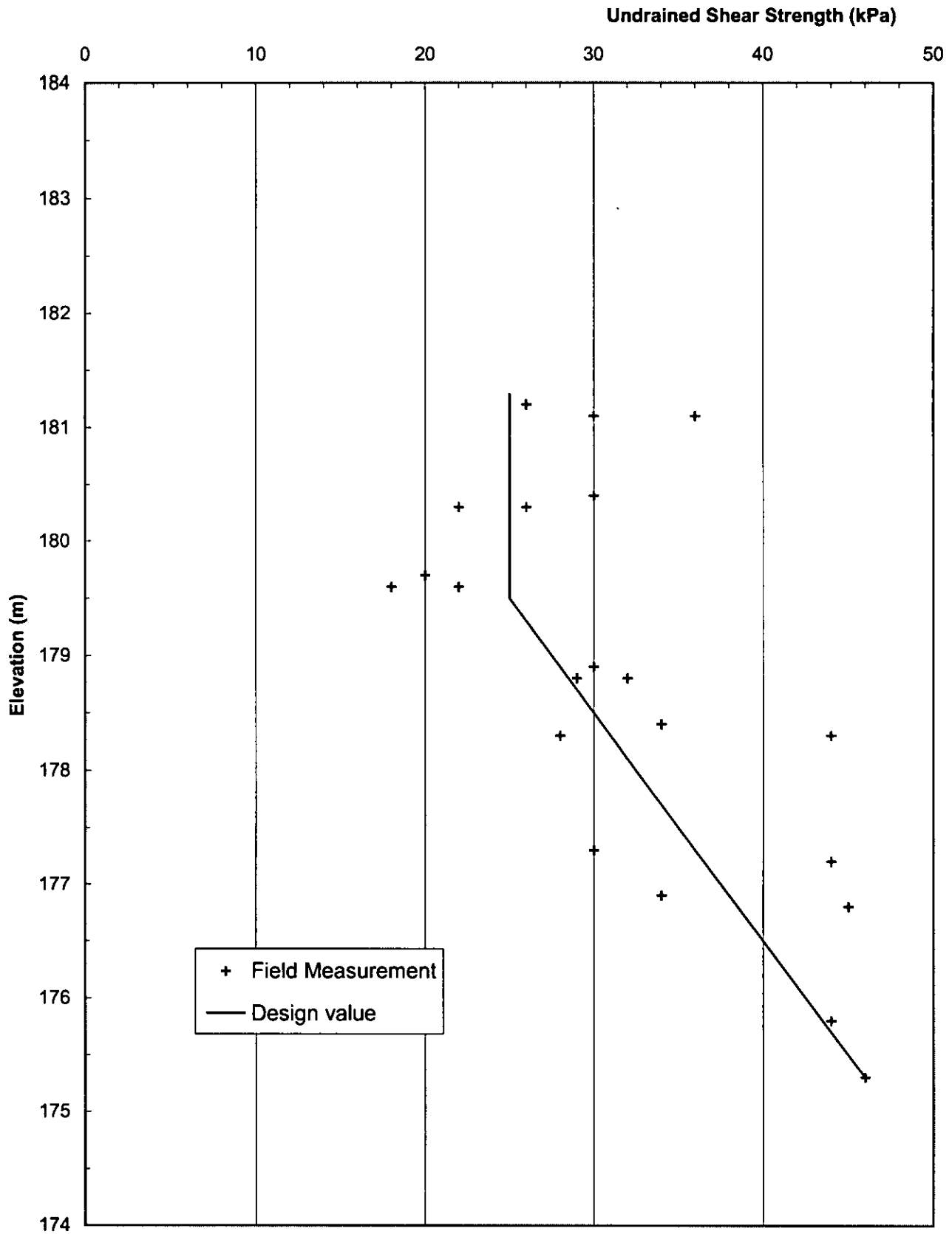


Fig. A3-1: Variation of Undrained Shear Strength (as measured by field vane tests) and the design value with Elevation in clay deposit

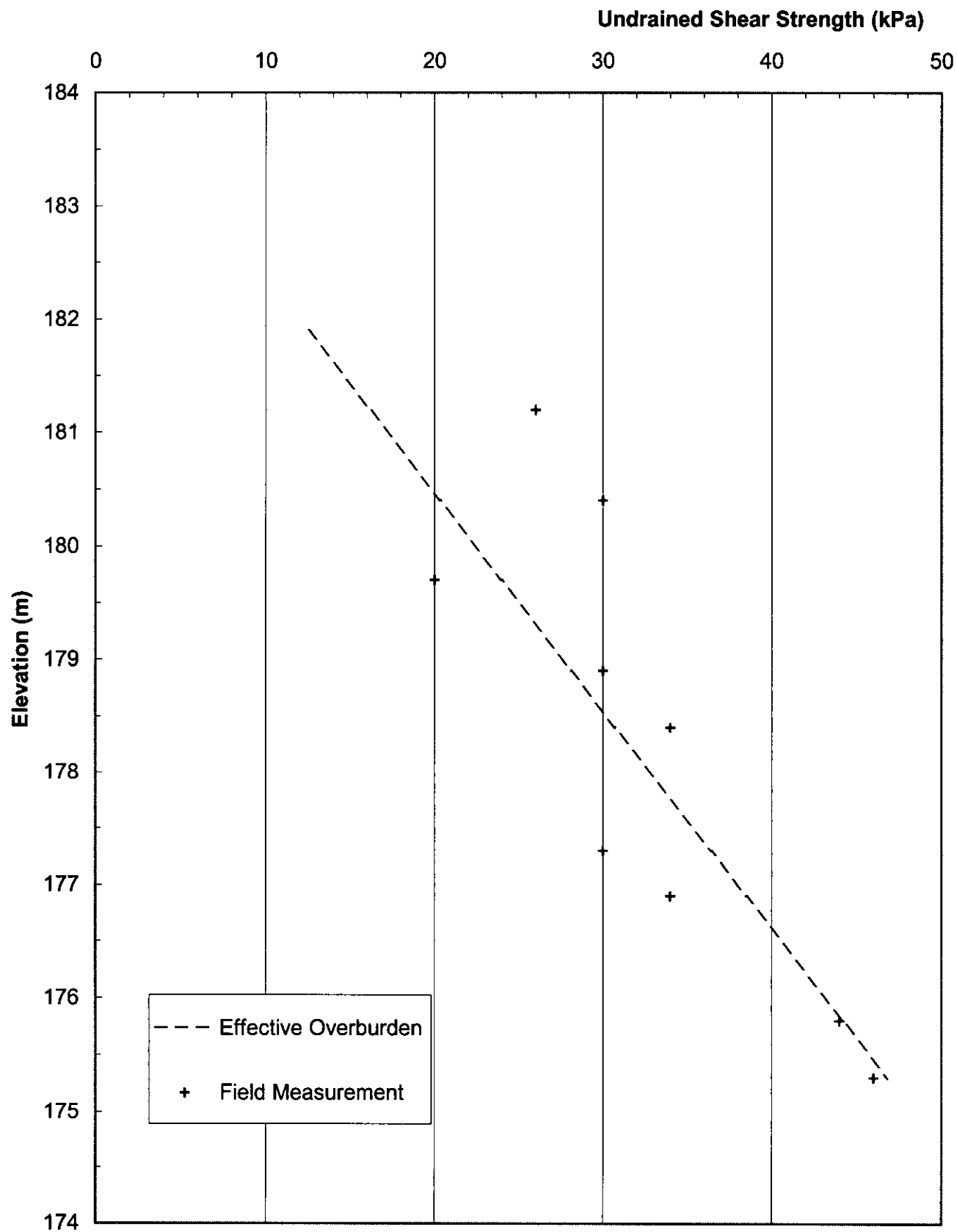


Fig. A3-2: Variation of Undrained Shear Strength (as measured by field vane tests) with Elevation (Boreholes 10+460; 20 m Lt)

APPENDICES

FOR SITE B

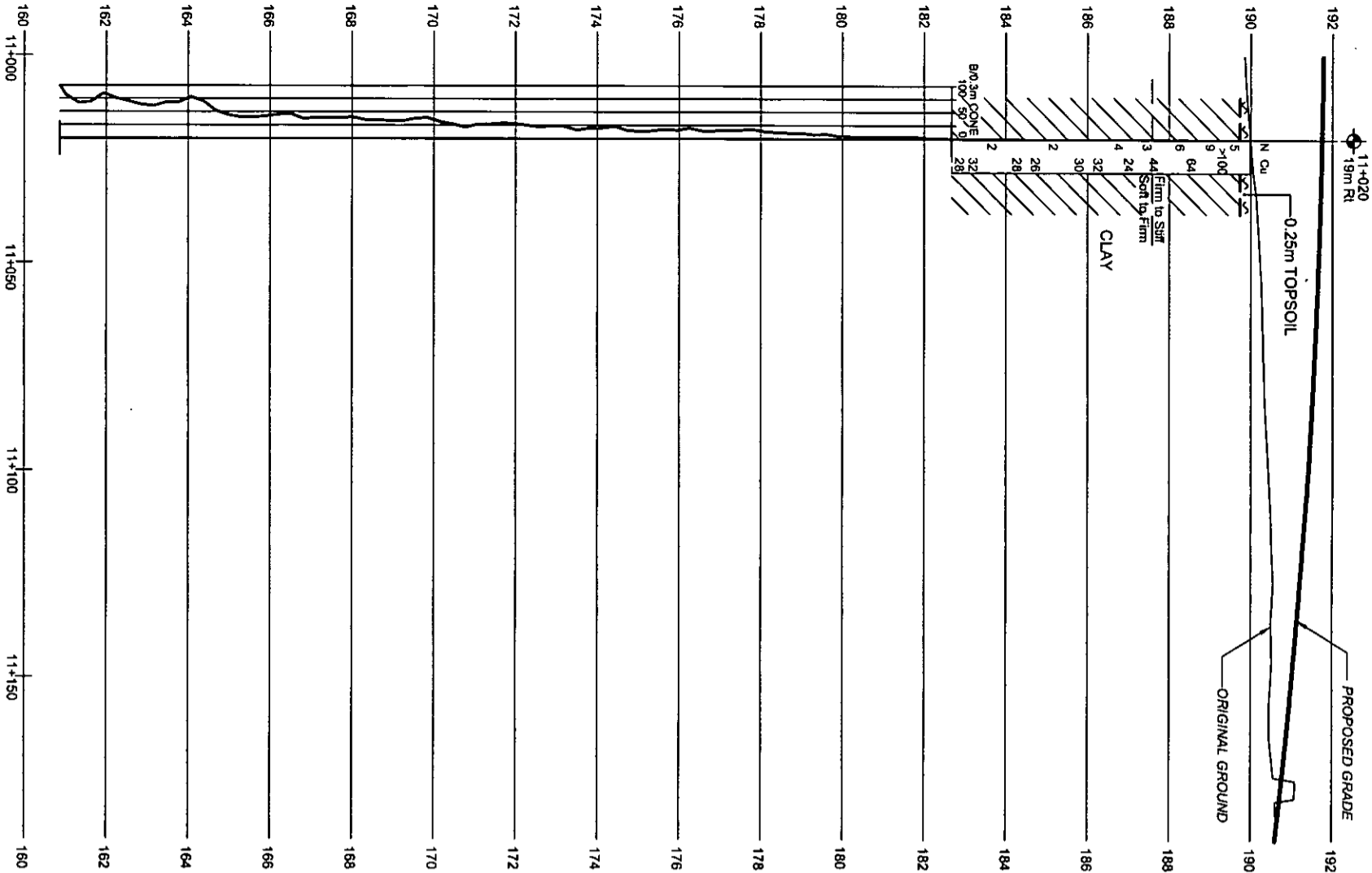
Drawing

(Soil Strata)

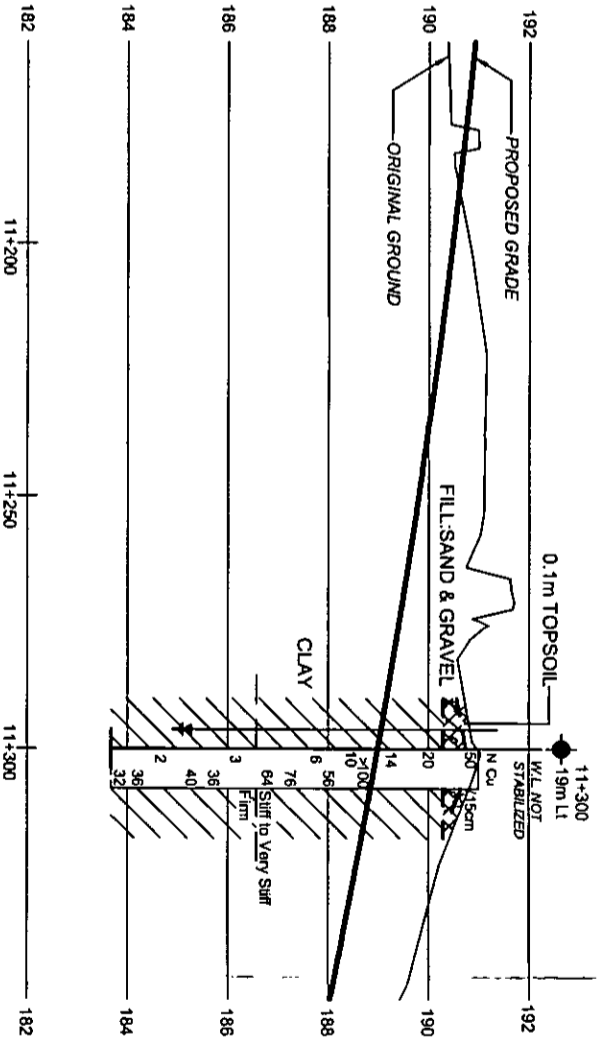
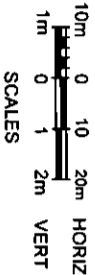
METRIC

NOTE:
FOR DETAILED SUBSURFACE CONDITIONS OF ALL
BOREHOLES REFER TO RECORD OF BOREHOLE
SHEETS.

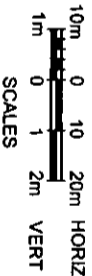
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
ARE IN KILOMETRES + METRES.



PROFILE EASTBOUND LANES



PROFILE WESTBOUND LANES

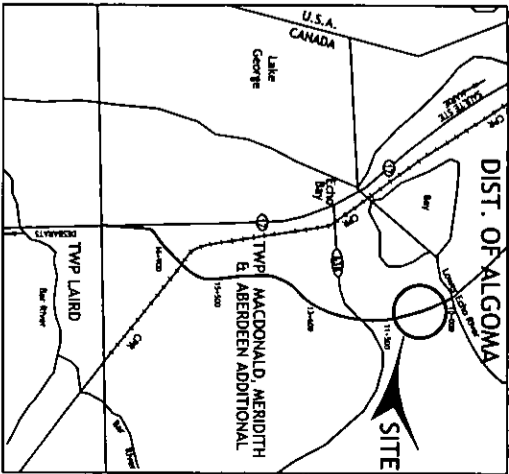


CONT NO.

GWP: 354-94-00

HIGHWAY 17 (NEW)
ECHO RIVER TO BAR RIVER ROAD
ADDITIONAL WORK STA. 11+000 TO 11+350
BORE HOLE SOIL STRATA

SHAHEEN & PEAKER LIMITED



KEY PLAN
N.T.S.

LEGEND

- Bore Hole
- Bore Hole & Cone
- N Blows/0.3m (Std. Pen. Test, 475 Jblow)
- Cu Undrained Shear Strength measured by Field Vane Test
- Water Level in Piezometer Jun., 2002
- Piezometer

No.	ELEV.	CO-ORDINATES	
		NORTH	EAST
11+020 RI	190.0	5 151 213.2	301 626.5
11+300 LI	191.0	5 150 931.9	301 632.2

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.

DATE	BY	DESCRIPTION

Geocores No. 41K00-063

HWY No. 17 (New)			DIST 82
SUBM'D ZO	CHECKED RM	DATE Sep. 2003	SITE
DRAWN IZ	CHECKED	APPROVED	DWG B

Appendix B1

Site B

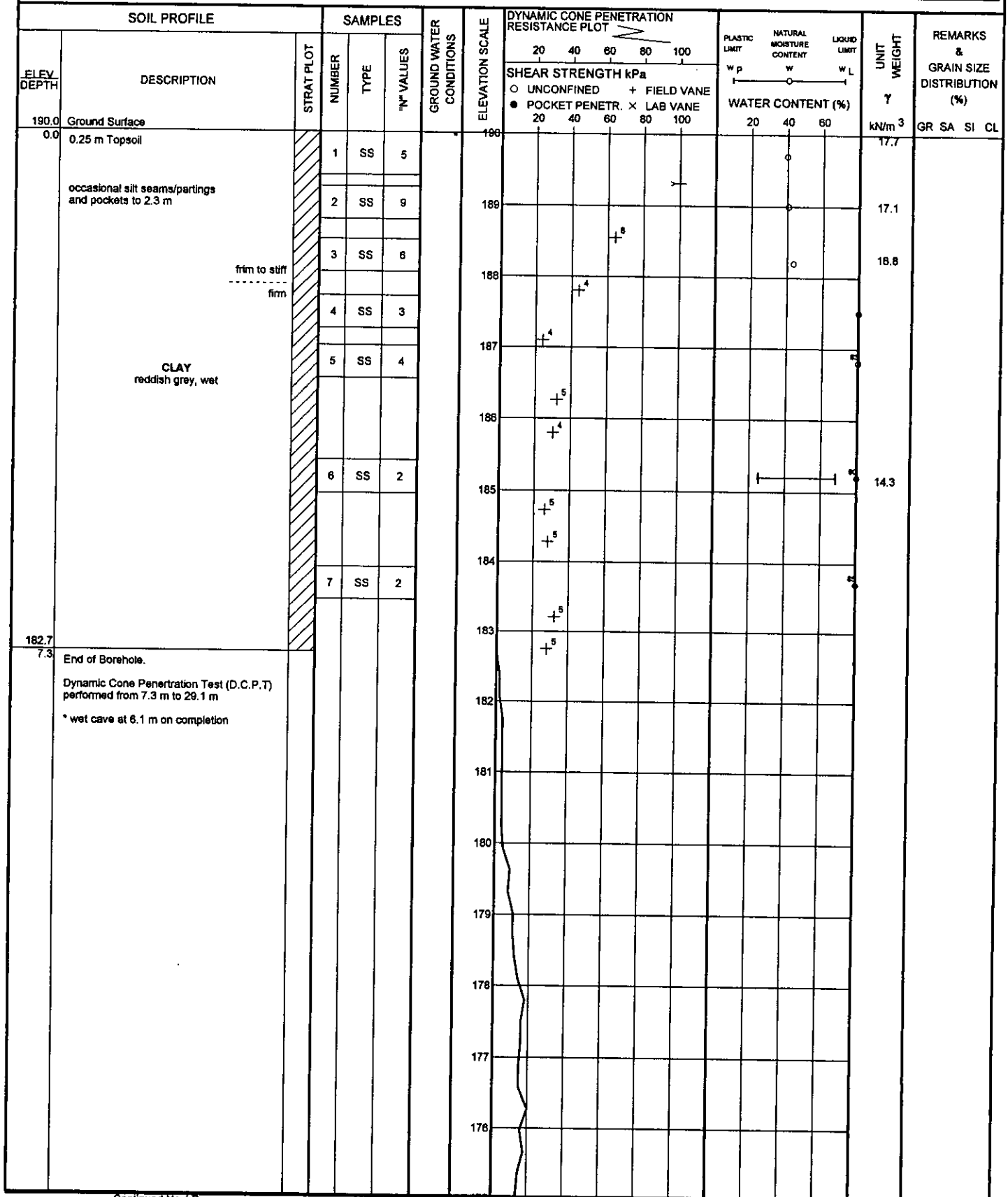
Record of Borehole Sheets

SPT1055

RECORD OF BOREHOLE No 11+020; 19 m Rt 1 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie, ON - Coords: N 5 151 213.2; E 301 626.5 ORIGINATED BY G.I.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY Y.L.
DATUM Geodetic DATE 6/2/2003 CHECKED BY R.A.



Continued Next Page

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

SPT1055

RECORD OF BOREHOLE No 11+020; 19 m Rt 2 OF 2

METRIC

GWP 354-04-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie, ON - Coords: N 5 151 213.2; E 301 626.5 ORIGINATED BY G.I.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY Y.L.
DATUM Geodetic DATE 6/2/2003 CHECKED BY R.A.

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			T _v VALUES	SHEAR STRENGTH kPa					
							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE 20 40 60 80 100	20 40 60					
175													
174													
173													
172													
171													
170													
169													
168													
167													
166													
165													
164													
163													
162													
161													
160.9 28.1	End of D.C.P.T.												

SPT1055

RECORD OF BOREHOLE No 11+300; 19 m Lt 1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie, ON - Coords: N 5 150 931.9; E 301 632. 2 ORIGINATED BY G.I.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY Y.L.
DATUM Geodetic DATE 6/2/2003 CHECKED BY R.A.

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			SHEAR STRENGTH kPa					
191.0	Ground Surface							20 40 60 80 100					
0.0	0.1 m Topsoil		1	SS	50/15*		191	○ UNCONFINED + FIELD VANE					
190.3	FILL: Gravel and Sand, some silt, occasional cobbles, brown, dry							● POCKET PENETR. × LAB VANE					
0.7			2	SS	20		190	WATER CONTENT (%)					
			3	SS	14		189	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT					
	CLAY		4	SS	10		188	WP WL					
	occasional sandy silt seams and partings to 4.4 m, reddish gray		5	SS	6		187						
			7	SS	3		186						
	moist to damp		8	SS	2		185						
	stiff to very stiff						184						
	damp to wet												
	firm												
183.7	End of Borehole.												
7.3	Piezometer installed to 6.1 m. Water level on: June 4, 2003 - 5.9 m (El. 185.1 m)(not stabilized) * High blow count probably due to a cobble.												

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

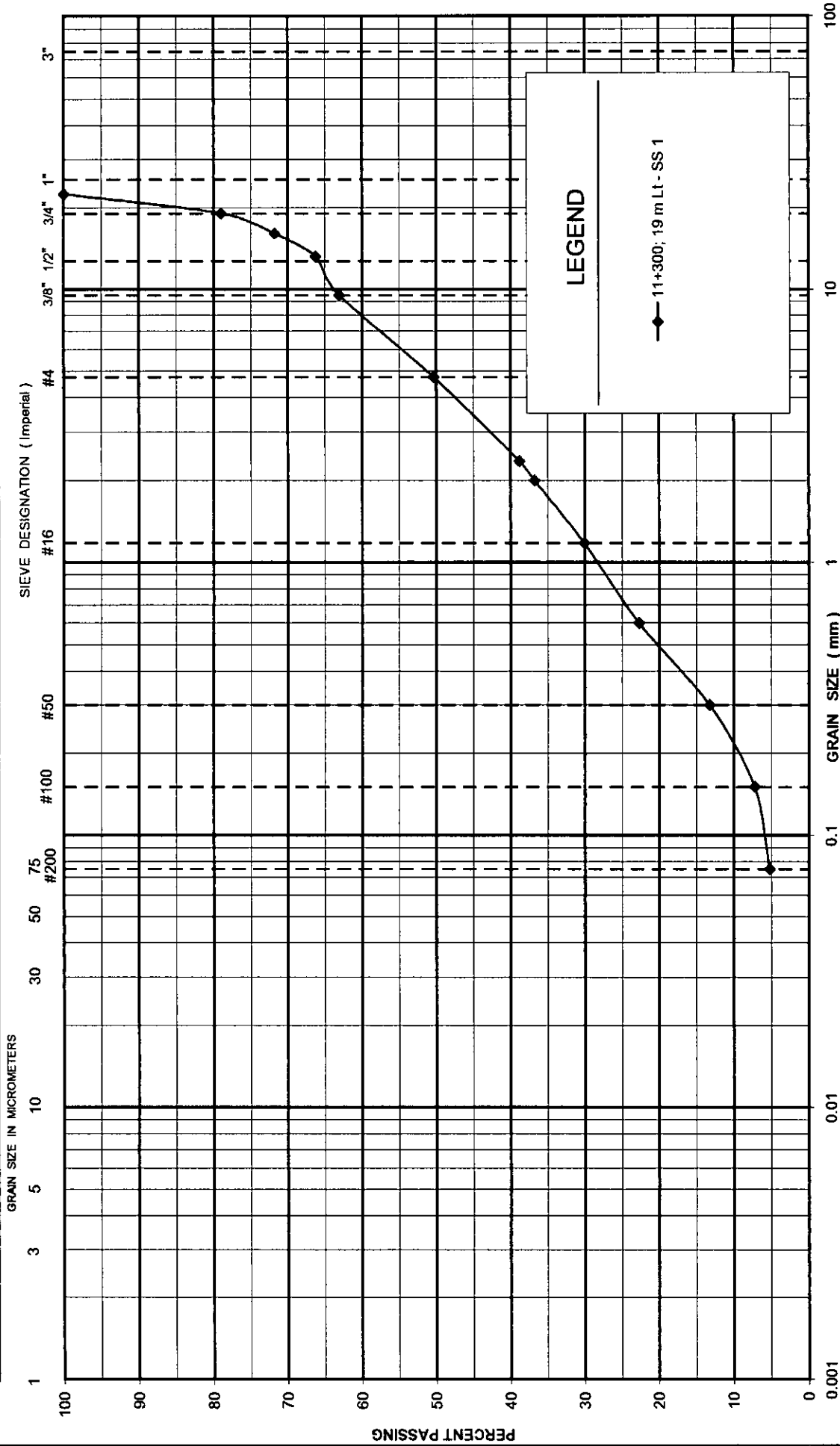
Appendix B2

Site B

Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	



SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION
SAND AND GRAVEL

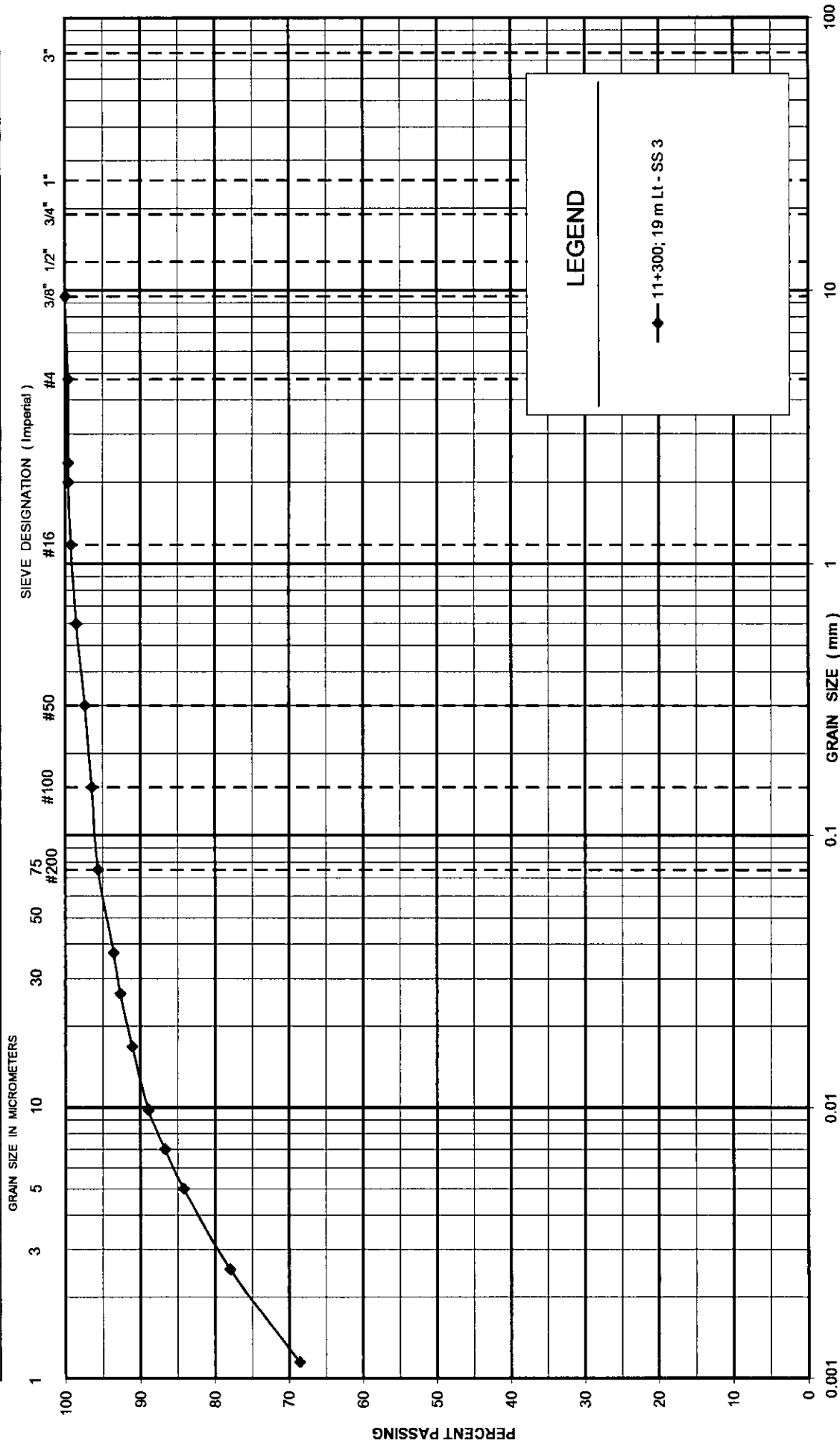
FIGURE No. B2 - 1

REF. No. SPT 1055

GWP: 354-94-00

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	



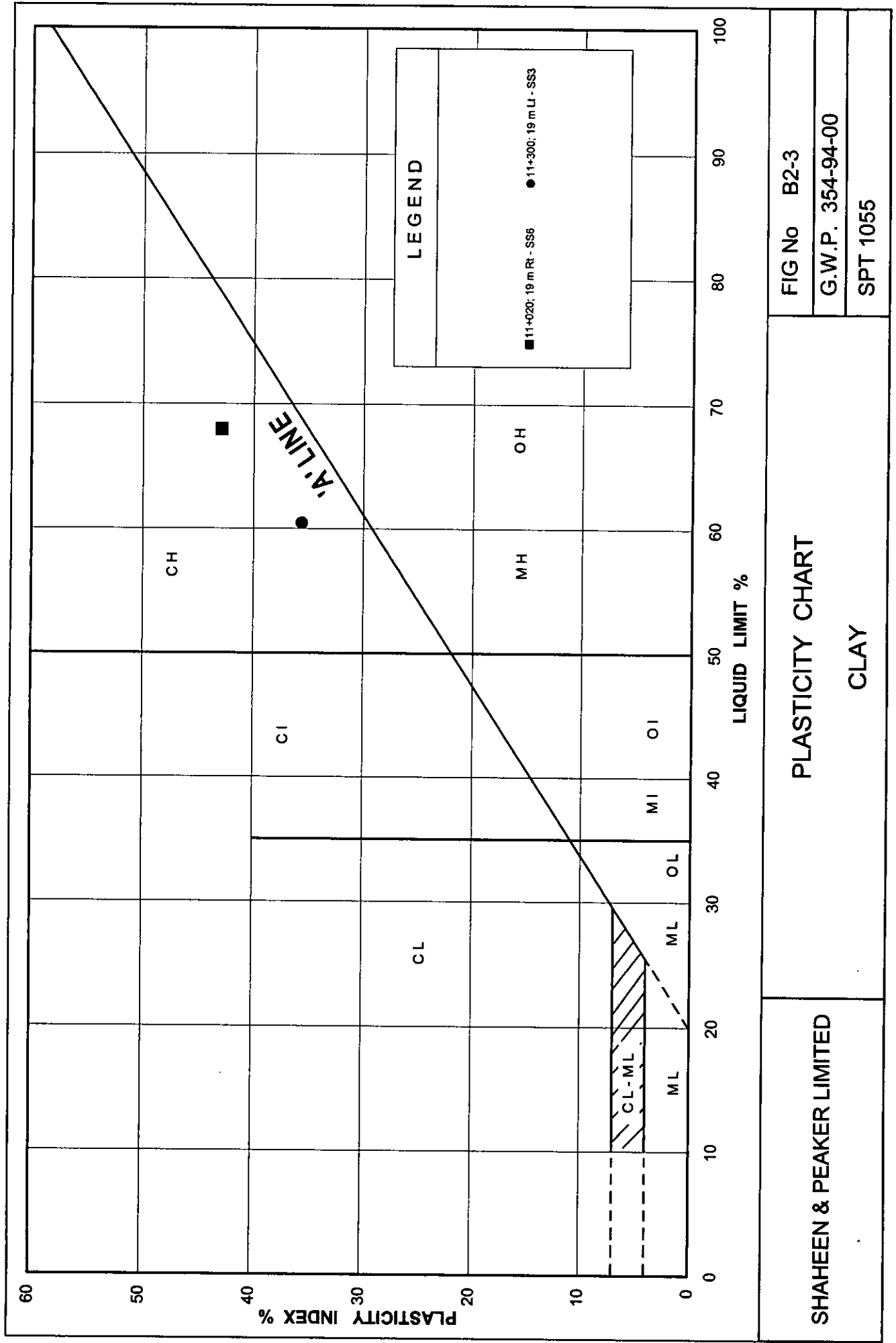
SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION
CLAY

FIGURE No. B2 - 2

REF. No. SPT 1055

GWP: 354-94-00



Appendix B3

Site B

Measured Undrained Shear Strength Results

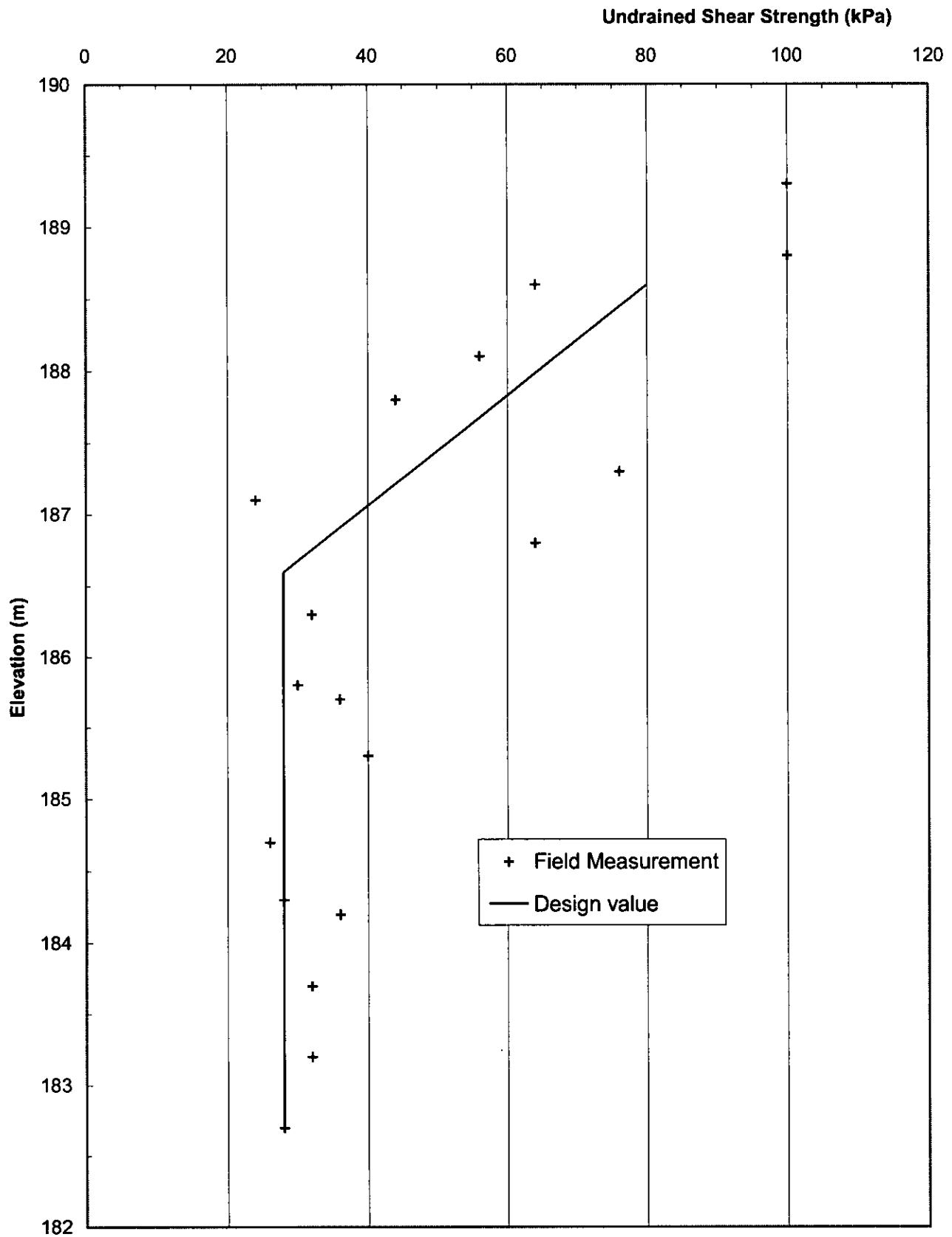


Fig. B3-1: Variation of Undrained Shear Strength (as measured by field vane tests) and the design value with Elevation in clay deposit

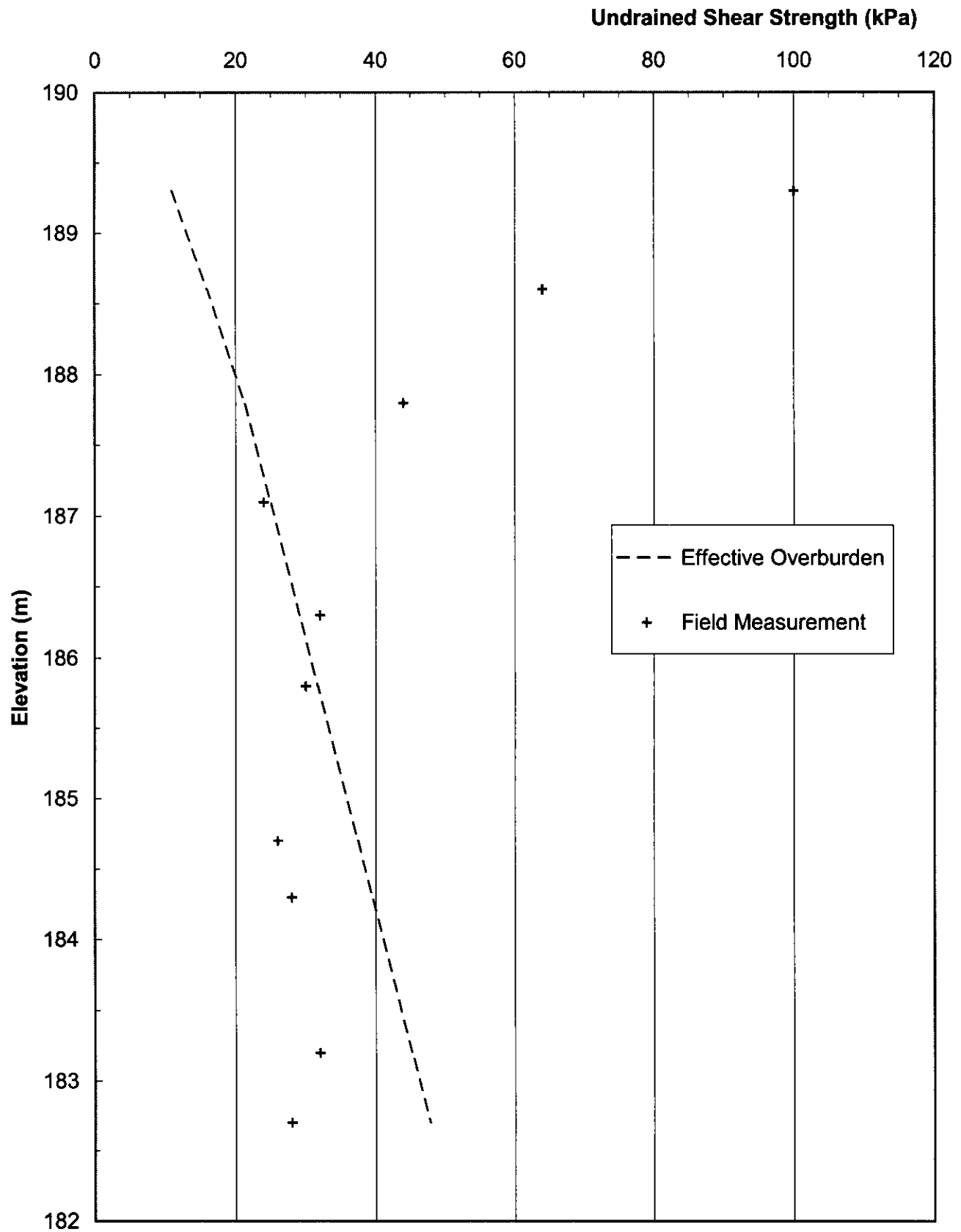


Fig. B3-2: Variation of Undrained Shear Strength (as measured by field vane tests) with Elevation (Boreholes 11+020; 19 m Rt)

APPENDICES

FOR SITE C

Appendix C1 Site C Record of Borehole Sheets

RECORD OF BOREHOLE No 13+415; 19 m Rt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 148 989.8; E 300 914.6 ORIGINATED BY G.I.
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
 DATUM Geodetic DATE 5/27/2003 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		SHEAR STRENGTH kPa					
180.2 0.0	Ground Surface						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE					
	0.3m TOPSOIL		1	SS	4	180						
	FINE SAND trace to some silt brown to grey brown moist to wet, very loose		2	SS	5	179						
			3	SS	2	178						
			4	SS	3	177						
176.6 3.6			5	SS	3	176						
	frequent silt seams/partings		6	SS	2	175						
			7	TW	PH	174						
	CLAY grey, firm		8	SS	1	173						
172.9 7.3	End of Borehole.											
	* Water level at 1.5m (not stabilized) and hole open to 1.8m on completion											

RECORD OF BOREHOLE No 13+576; 19 m Lt 1 OF 3 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 148 833.9; E 300 859.4 ORIGINATED BY G.I.
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY J.Z.
 DATUM Geodetic DATE 5/27/2003 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W P W L			
180.9	Ground Surface							20 40 60 80 100		20 40 60			GR SA SI CL
0.0	0.3m TOPSOIL		1	SS	4								
	FINE SAND trace silt brown, wet, very loose		2	SS	4		180						0 93 (7)
			3	SS	2		179						
178.8			4	SS	3		178						
2.1	SANDY SILT grey, wet and dilatant very loose		5	SS	2		177						0 44 48 8
177.2			6	SS	1		176					14.8	
3.7			7	SS	2		175						
	frequent silt seams/partings		8	SS	2		174					15.3	
	CLAY reddish grey soft to firm		9	SS	2		173						
173.6			10	SS	2		172						
7.3	SANDY SILT grey, wet and dilatant very loose		11	SS	23		171						
172.3			12	SS	16		170						0 22 74 4
8.6	SILTY CLAY occasional sandy silt seams grey, firm		13	SS	4		169						
170.4							168						
10.5	SANDY SILT grey, wet and dilatant						167						
							166						low N value probably due to hydrostatic uplift

Continued Next Page

+³, ×³: Numbers refer to Sensitivity 20 15 10 (5) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13+576; 19 m Lt 2 OF 3

METRIC

GWP 354-84-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 148 833.9; E 300 859.4 ORIGINATED BY G.I.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 5/27/2003 CHECKED BY R.M.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PENETR. × LAB VANE	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _P — W — W _L WATER CONTENT (%)	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
165.5	SANDY SILT										
15.4	SILTY CLAY occasional silt seams/partings reddish grey, firm		14	SS	1						
164.4											
16.5	End of Borehole. Dynamic Cone Penetration Test (D.C.P.T.) performed from 16.2m to 30.5m										

Continued Next Page

+ 3 . × 3 : Numbers refer to
Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13+576; 19 m Lt 3 OF 3 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 148 833.9; E 300 859.4 ORIGINATED BY G.I.
 DIST 82 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY J.Z.
 DATUM Geodetic DATE 5/27/2003 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 Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		W _p	W		
150.4							20 40 60 80 100						
30.5	End of D.C.P.T.						20 40 60 80 100						
	* Wet caved at 3.0m on completion					150							

RECORD OF BOREHOLE No 13+800; 19 m Rt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 148 866.2; E 300 706.1 ORIGINATED BY G.I.
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
 DATUM Geodetic DATE 5/26/2003 CHECKED BY R.M.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100	
182.5 0.0	Ground Surface											
	0.3m TOPSOIL		1	SS	4							
	FINE SAND trace silt wet, very loose		2	SS	4							
	brown ----- grey		3	SS	3							
			4	SS	2							
179.6 2.9	CLAY occasional sandy silt seams/partings grey, soft		5	SS	2							
178.7 3.8	SANDY SILT reddish grey wet and dilatant		6	SS	15							
			7	SS	16							
176.9 5.6	CLAY occasional silt seams/partings grey, soft		8	SS	2							
175.6 6.9	End of Borehole.											
	* Water level at 5.2 m (not stabilized) and hole open to 5.5 m on completion											
	**Attempted vane test at 7.3m. Unable to push vane beyond 6.9m											

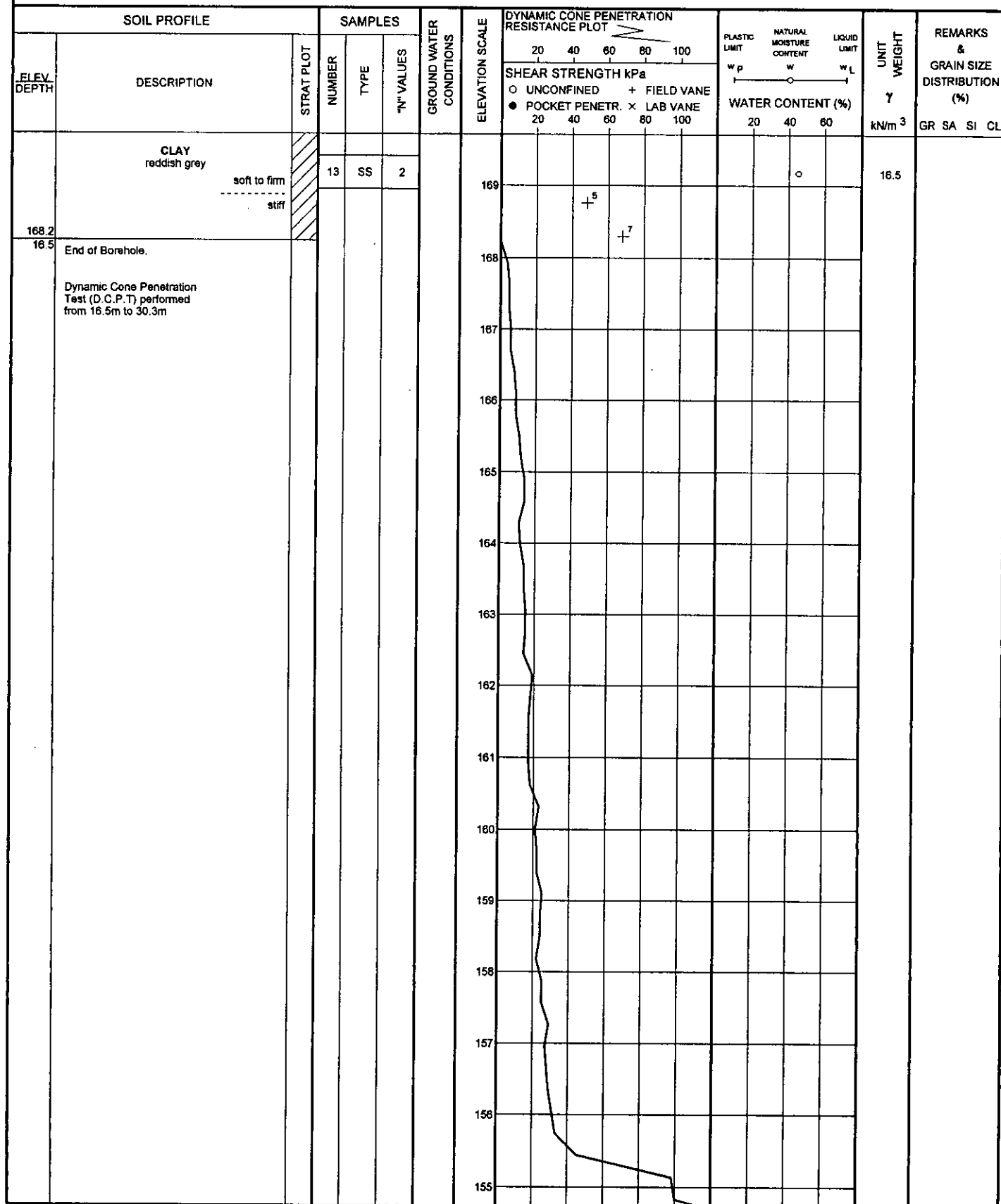
RECORD OF BOREHOLE No 14+000; 19 m Lt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 148 477.5; E 300 630.6 ORIGINATED BY G.I.
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
 DATUM Geodetic DATE 5/26/2003 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 (%)
FLEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
183.8	Ground Surface							20	40	60	80	100		
0.0	0.2m TOPSOIL		1	SS	6									
183.1	FINE SAND													
0.7	some silt seams, brown, wet, loose													
	SANDY SILT		2	SS	5		183							
	with silt zones, brown to 1.4m, grey below													
	wet and dilatant		3	SS	2		182							
	very loose to loose													
	compact		4	SS	18		181							
			5	SS	21		180							
			6	SS	15		179							
			7	SS	7		178							
177.2	loose													
6.6	occasional clay pockets		8	SS	10									
	End of Borehole.													
	* Water level at 3.4 m (not stabilized) and hole open to 3.7 m on completion													

RECORD OF BOREHOLE No 14+200; 19 m Rt 2 OF 3 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 148 320.8; E 300 500.7 ORIGINATED BY G.I.
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY J.Z.
 DATUM Geodetic DATE 5/25/2003 CHECKED BY R.M.



Continued Next Page

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

RECORD OF BOREHOLE No 14+402; 19 m Lt 1 OF 1 METRIC

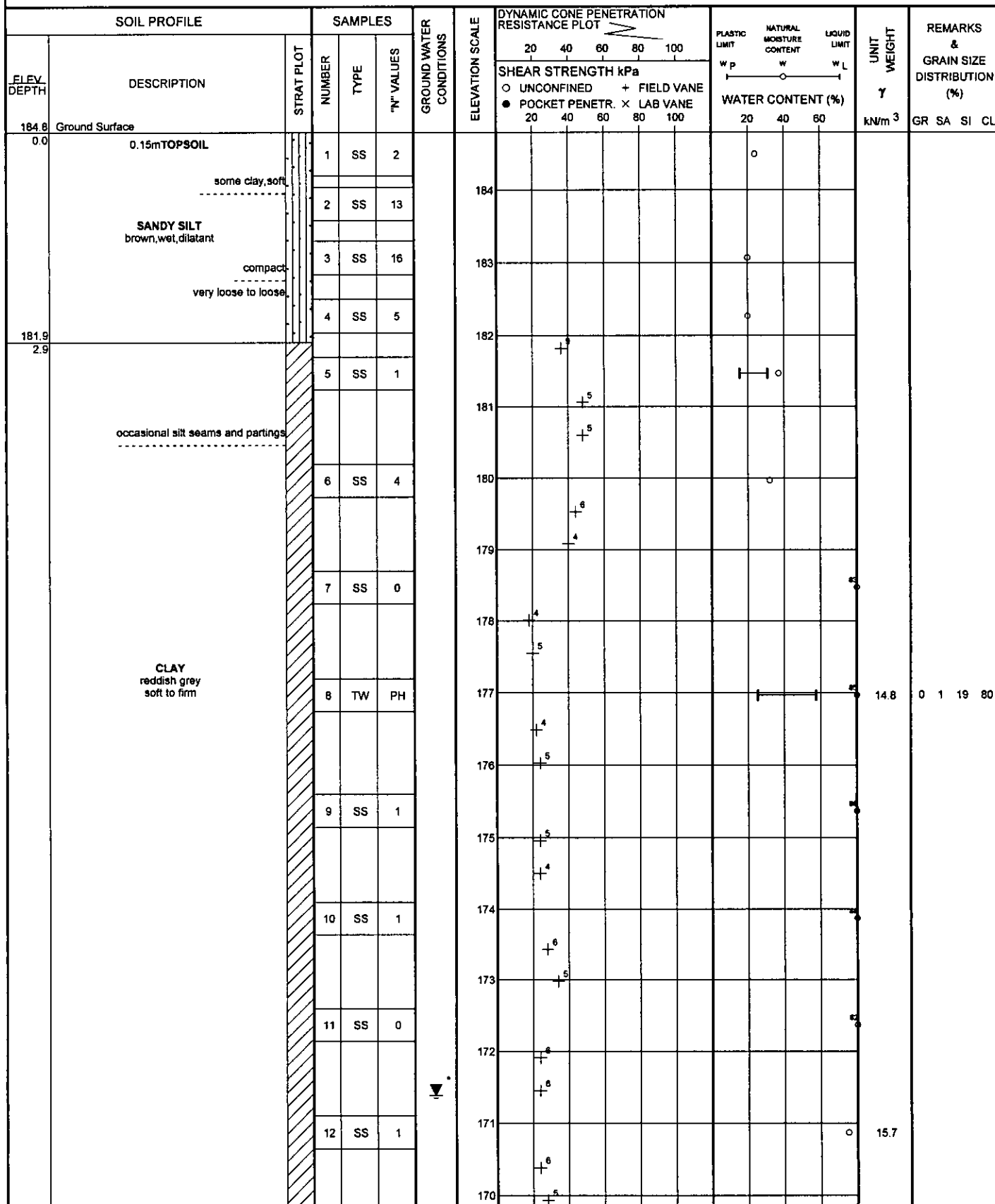
GWP 354-84-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 148 120.8; E 300 453.6 ORIGINATED BY G.I.
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
 DATUM Geodetic DATE 5/25/2003 CHECKED BY R.M.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		WATER CONTENT (%)		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	W P W L		
186.4	Ground Surface											
0.0	0.1m TOPSOIL SANDY SILT wet and dilatant loose to compact		1	SS	5							
			2	SS	12							
			3	SS	18							
	brown grey		4	SS	8							
183.5			5	SS	2							
2.9	SILTY CLAY occasional silt seams/partings 100mm brown sand seam at 4.6m firm to stiff		6	SS	8							
	grey/brown reddish grey		7	SS	3							
179.1												
7.3	End of Borehole. * Water level at 5.5 m (not stabilized) and hole open to 5.8 m on completion											

RECORD OF BOREHOLE No 14+600; 19 m Rt 1 OF 3

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 147 945.8 ; E 300 353.5 ORIGINATED BY G.I.
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY J.Z.
 DATUM Geodetic DATE 5/25/2003 CHECKED BY R.M.



Continued Next Page

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

RECORD OF BOREHOLE No 14+600; 19 m Rt 2 OF 3

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 147 945.8 ; E 300 353.5 ORIGINATED BY G.I.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 5/25/2003 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 (%)					
168.3	CLAY reddish grey soft to firm		13	SS	1								15.0	
16.5														
	End of Borehole.													
	Dynamic Cone Penetration Test (D.C.P.T) performed from 16.5m to 30.5m													

Continued Next Page

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

RECORD OF BOREHOLE No 14+668 CL

1 OF 1

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 147 875.0; E 300 353.5 ORIGINATED BY G.I.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
DATUM Geodetic DATE 6/1/2003 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			20	40	60	80	100		
185.0	Ground Surface												
0.0	FILL: SAND & GRAVEL brown, moist, dense	o	1	SS	42	185							
184.3		o											
0.7	FILL: SANDY SILT brown, wet, dilatant compact to dense	o	2	SS	33	184							
182.9		o	3	SS	35	183							
2.1	SANDY SILT trace clay, reddish grey moist to wet, compact	o	4	SS	14	182							
182.1		o											
2.9	CLAY reddish grey soft to firm	o	5	SS	2	181							
		o	6	SS	7	180							
		o	7	SS	2	179							
177.7		o				178							
7.3	End of Borehole. Borehole caved @ 3.7m on completion												

RECORD OF BOREHOLE No 14+800 19 m Lt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 147 742. 7; E 300 342.2 ORIGINATED BY G.I.
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
 DATUM Geodetic DATE 5/24/2003 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	20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
184.3	Ground Surface												
0.0	0.2m TOPSOIL SANDY SILT moist to wet, brown		1	SS	4		184					19.8	
	very loose		2	SS	19		183						
	compact		3	SS	14		182						
182.2			4	SS	3		181						
2.1	CLAY reddish grey		5	SS	3		180						
			6	SS	2		179						
			7	SS	1		178						
							177						
177.0	End of Borehole.												
7.3													
	* Water level at 5.2 m (not stabilized) and hole open to 6.1 m on completion												

RECORD OF BOREHOLE No 15+000; 19 m Rt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 147 551.1; E 300 273.5 ORIGINATED BY G.I.
 DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
 DATUM Geodetic DATE 5/23/2003 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			SHEAR STRENGTH kPa						
184.5	Ground Surface							20 40 60 80 100						
0.0	0.2m TOPSOIL SANDY SILT grey/brown, moist, very loose		1	SS	2		184	+	5					
183.8			2	SS	2		183	+	5					
0.7	CLAY reddish grey 0.15m organic seam		3	SS	2		182	+	4					
			4	SS	2		181	+	2					
			5	SS	4		180	+	3					
			6	SS	1		179	+	4					
			7	SS	1		178	+	4					
177.2	End of Borehole.													
7.3	* Wet caved at 4.3m on completion													

RECORD OF BOREHOLE No 15+200; 19 m Lt 1 OF 1 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 147 349.0; E 300 297.4 ORIGINATED BY G.I.
 DIST 82 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY J.Z.
 DATUM Geodetic DATE 5/24/2003 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	20 40 60 80 100	20 40 60		
185.7 0.0	Ground Surface											
185.0 0.7	0.2m TOPSOIL SANDY SILT grey/brown, moist, very loose		1	SS	2							
	CLAY trace rootlets to 1.2m reddish grey		2	SS	4						18.6	
			3	SS	2							
			4	SS	2						17.0	
			5	SS	1							
			6	SS	0							
			7	SS	1							
178.4 7.3	End of Borehole.											
	* Wet cave at 5.5m on completion											

RECORD OF BOREHOLE No 15+400; 19 m Rt 1 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 147 149.6; E 300 258.1 ORIGINATED BY G.I.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 5/23/2003 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		
187.0	Ground Surface											
0.0	0.4m TOPSOIL		1	SS	4		187					
186.4	SILTY SAND		2	SS	4		186				18.9	
0.6	brown, wet, loose		3	SS	4		185				18.4	
			4	SS	1		184					
			5	TW	PH		183					
			6	SS	0		182					
			7	SS	1		181					
			8	SS	1		180					
			9	SS	2		179					
			10	SS	2		178					
			11	SS	1		177					
			12	SS	2		176					
							175					
							174					
							173					

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15 10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 15+400; 19 m Rt 2 OF 2 METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 147 149.8; E 300 258.1 ORIGINATED BY G.I.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY J.Z.
DATUM Geodetic DATE 5/23/2003 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	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PENETR. X LAB VANE	WATER CONTENT (%) 20 40 60			
170.5	CLAY reddish grey soft to firm		13	SS	3		172					
167.1	soft to firm firm to stiff occasional silt seams/partings						171					
165.5	End of Borehole.						170					
167.1	Dynamic Cone Penetration Test (D.C.P.T) performed from 16.5m to 19.9m						169					
19.9	End of D.C.P.T						168					
	* Wet cave at 14.3m on completion											

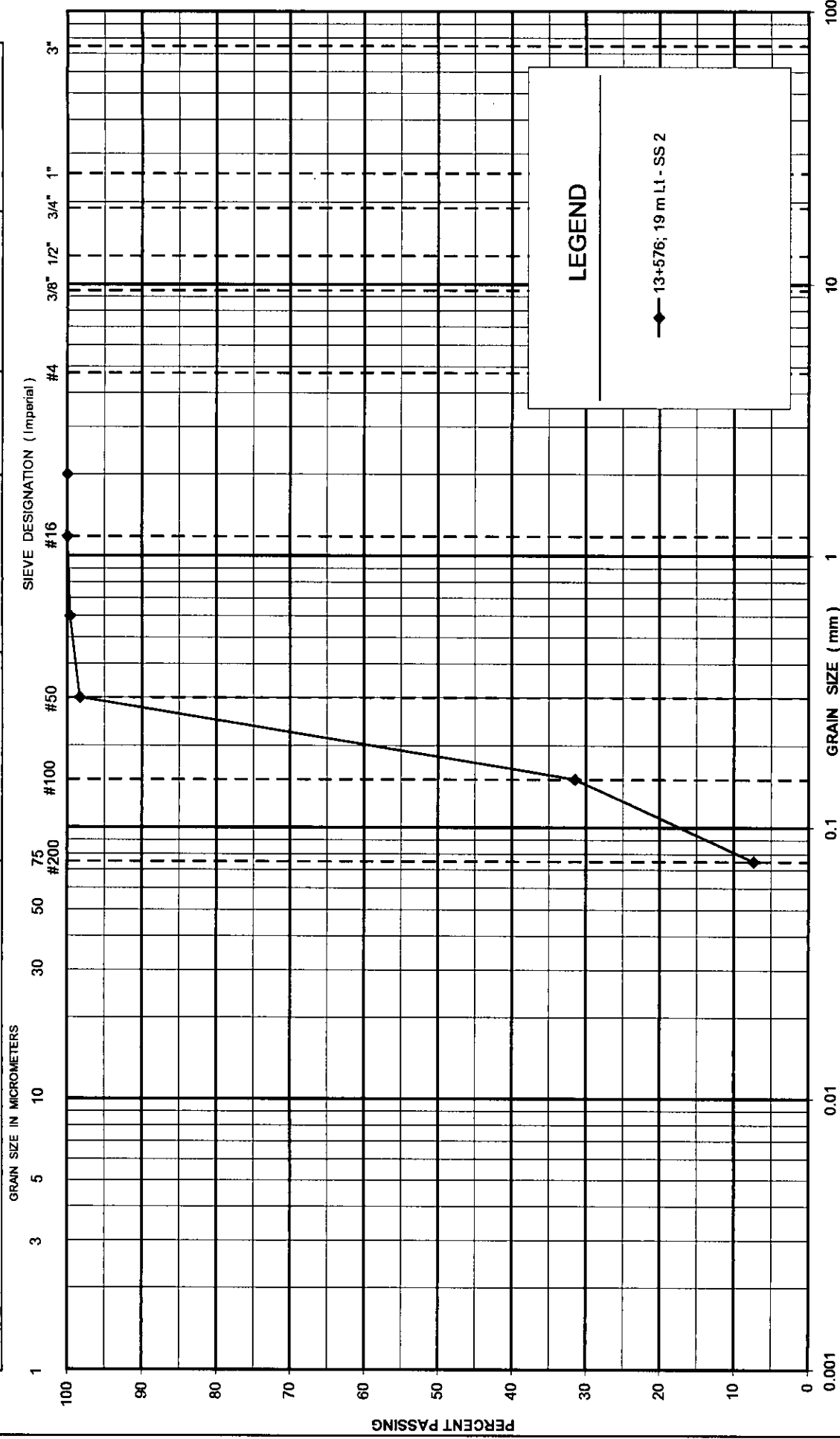
+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

Appendix C2 Site C Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	



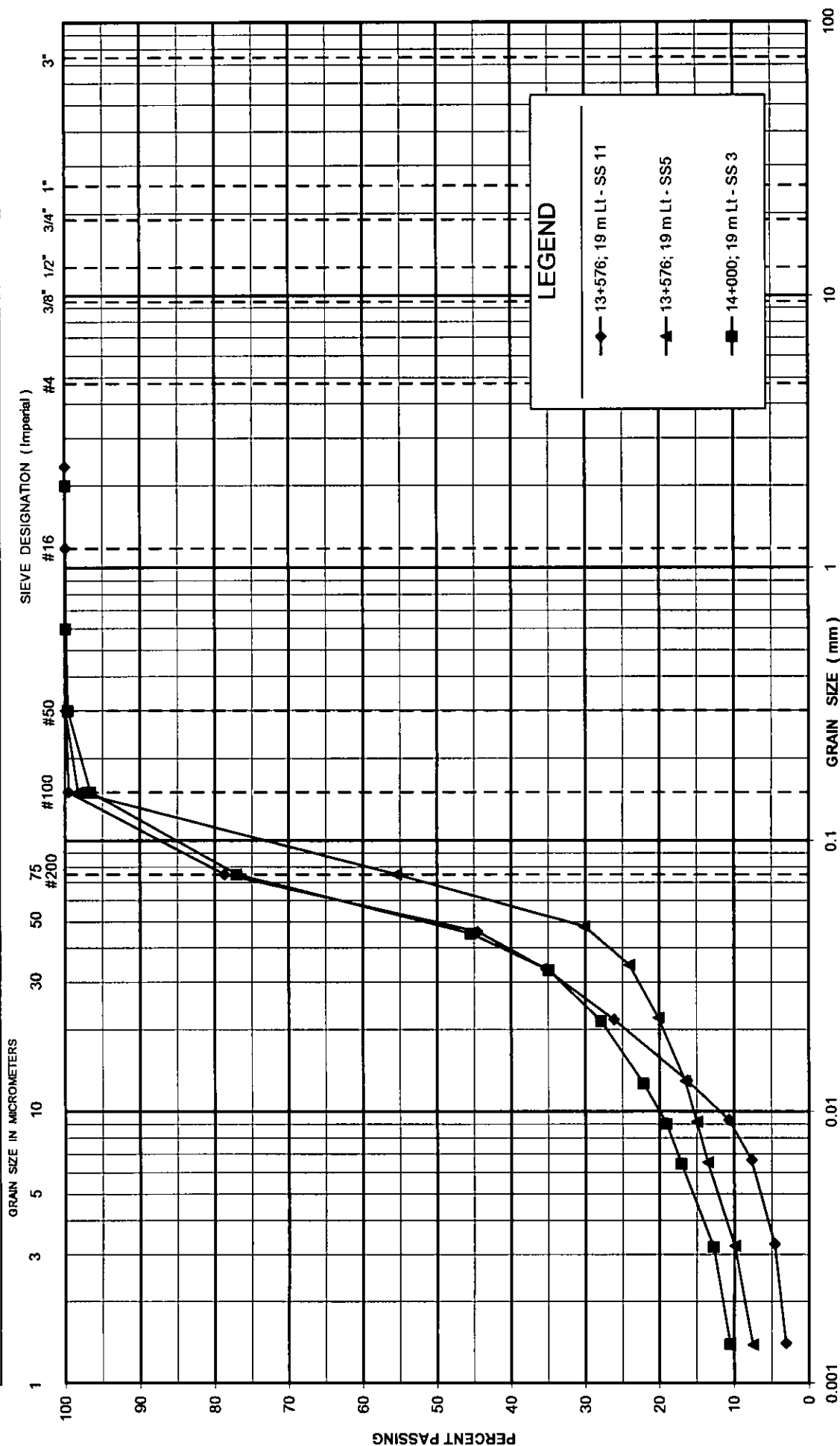
GRAIN SIZE DISTRIBUTION
FINE SAND, trace silt

SHAHEEN & PEAKER LIMITED

FIGURE No. C2 - 1
REF. No. SPT 1055
GWP: 354-94-00

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	



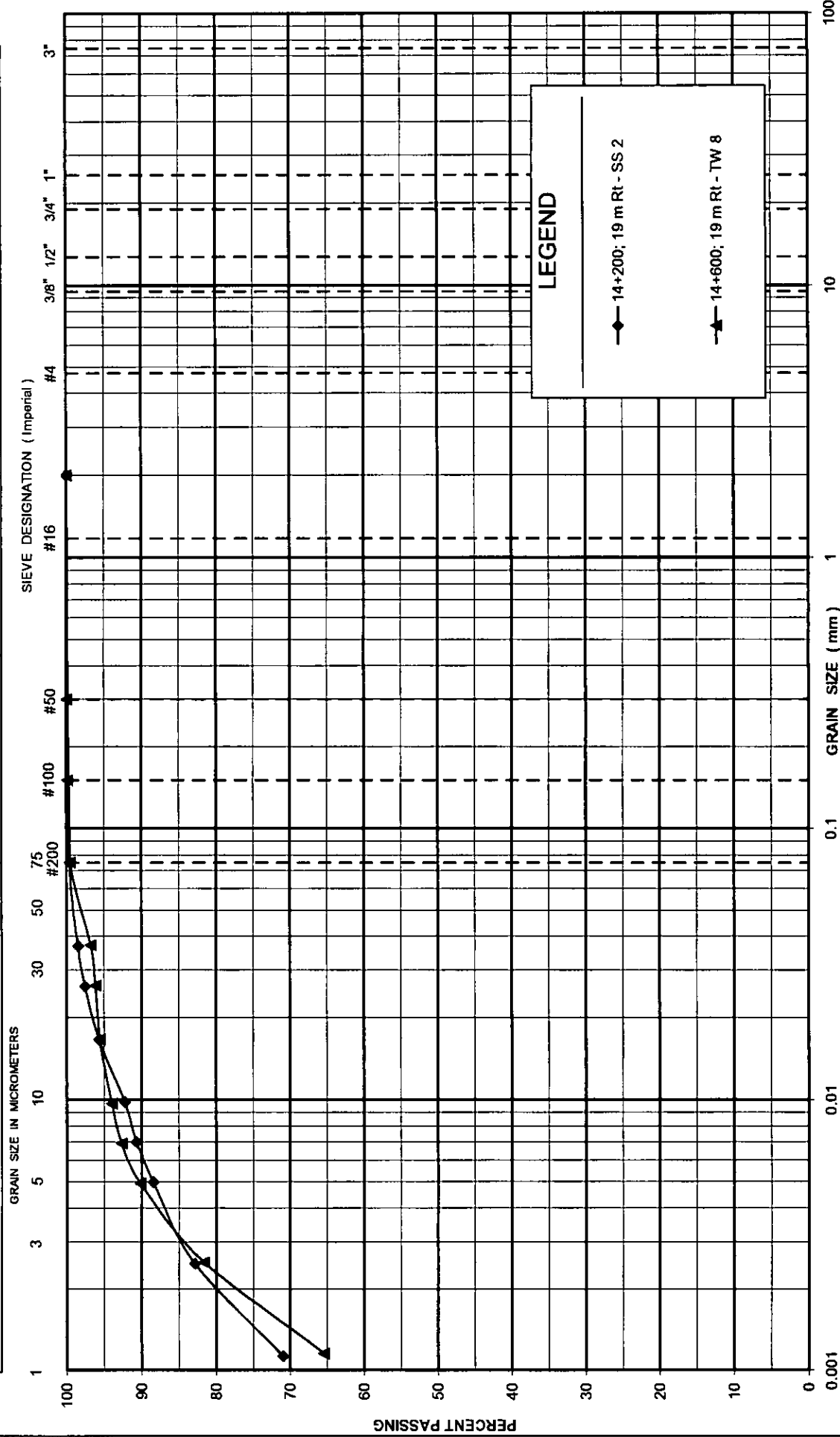
GRAIN SIZE DISTRIBUTION SANDY SILT

SHAHEEN & PEAKER LIMITED

FIGURE No. C2 - 2
REF. No. SPT 1055
GWP: 354-94-00

UNIFIED SOIL CLASSIFICATION SYSTEM

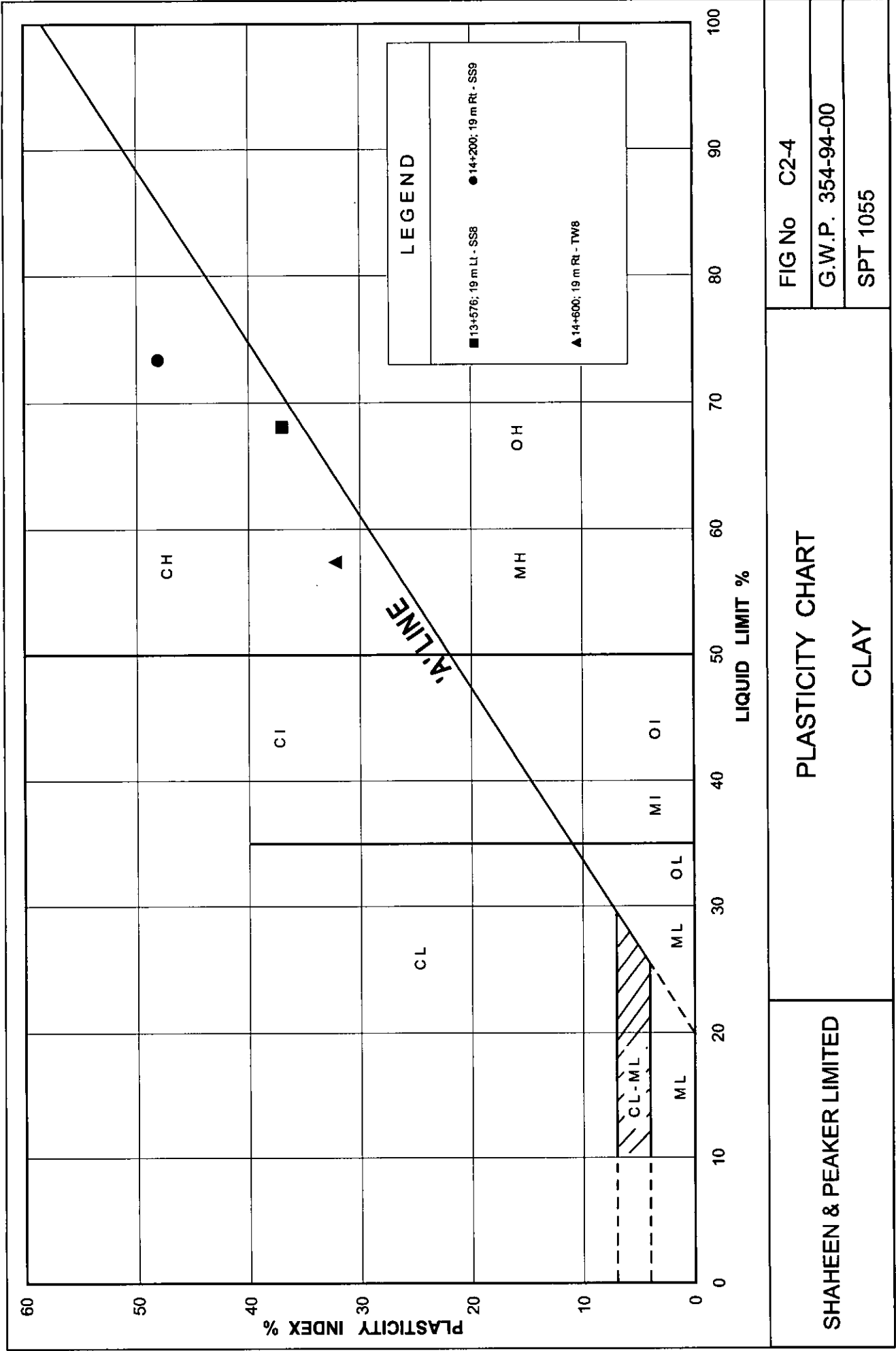
CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	

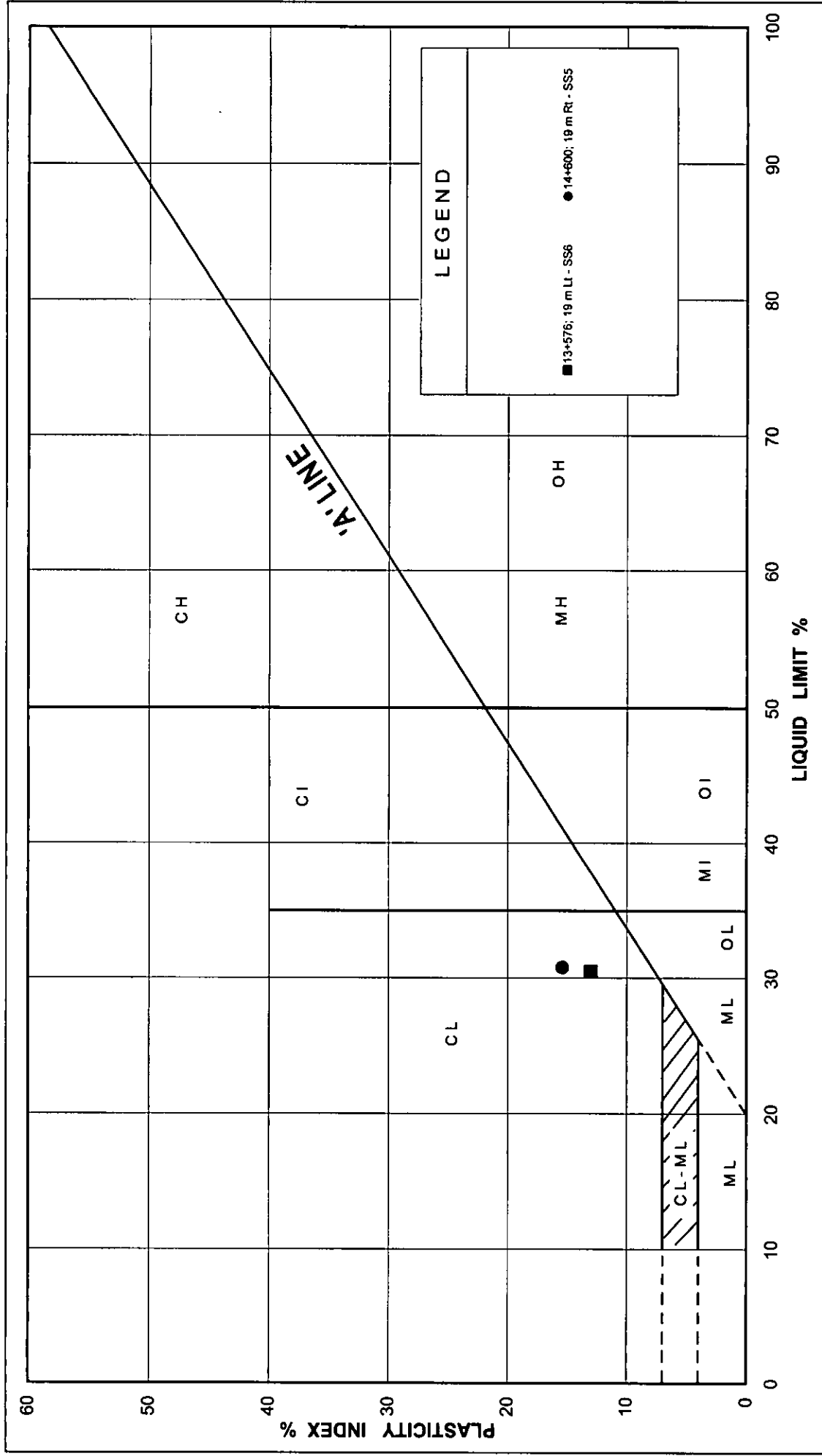


GRAIN SIZE DISTRIBUTION CLAY

SHAHEEN & PEAKER LIMITED

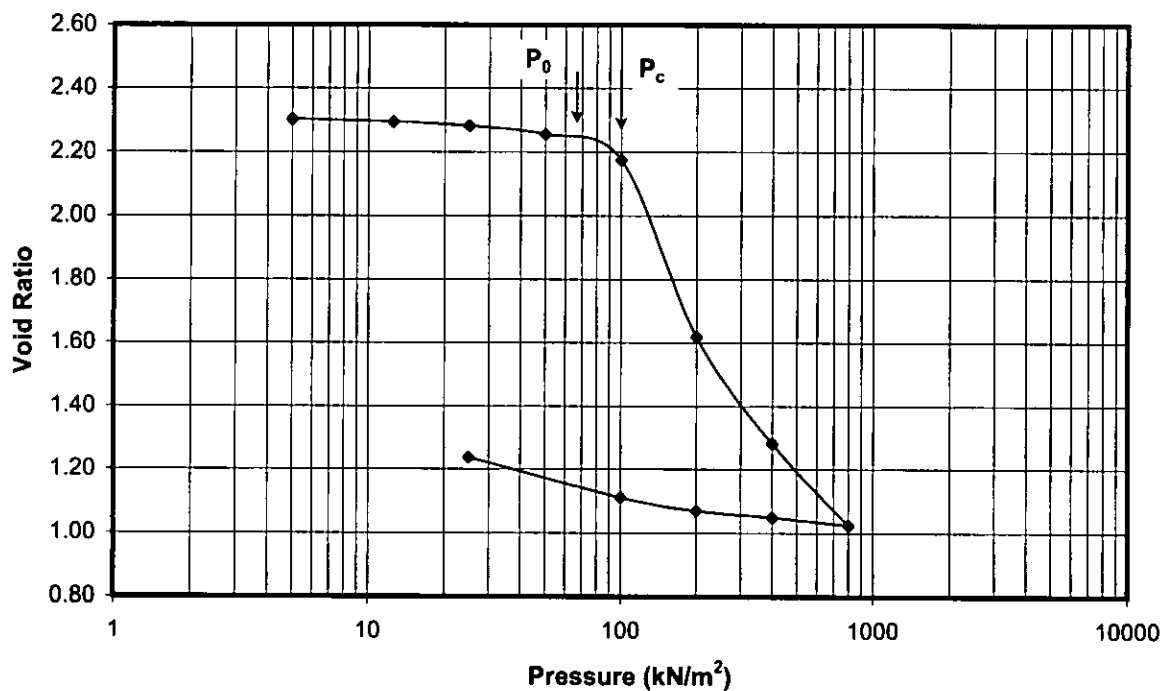
FIGURE No. C2 - 3
REF. No. SPT 1055
GWP: 354-94-00



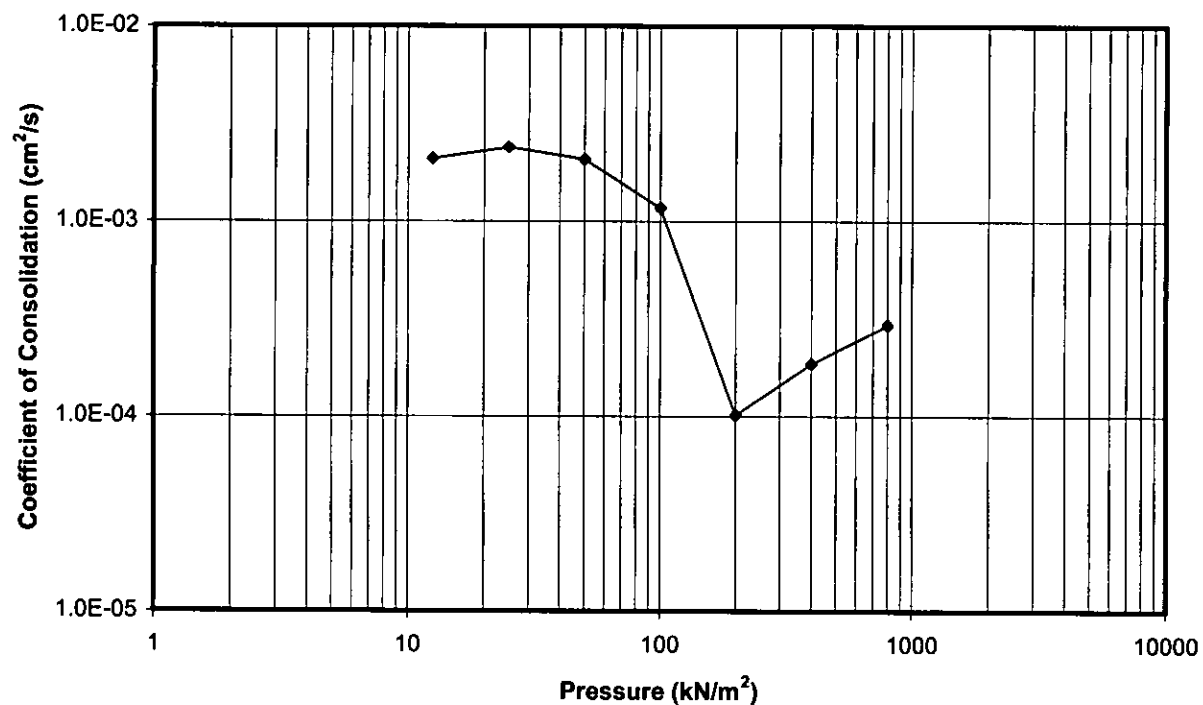


SHAHEEN & PEAKER LIMITED	PLASTICITY CHART		FIG No	C2-5
	CLAYEY SILT SEAMS in the Clay Deposit		G.W.P.	354-94-00
			SPT	1055

Void Ratio versus Pressure



Coefficient of Consolidation vs. Pressure

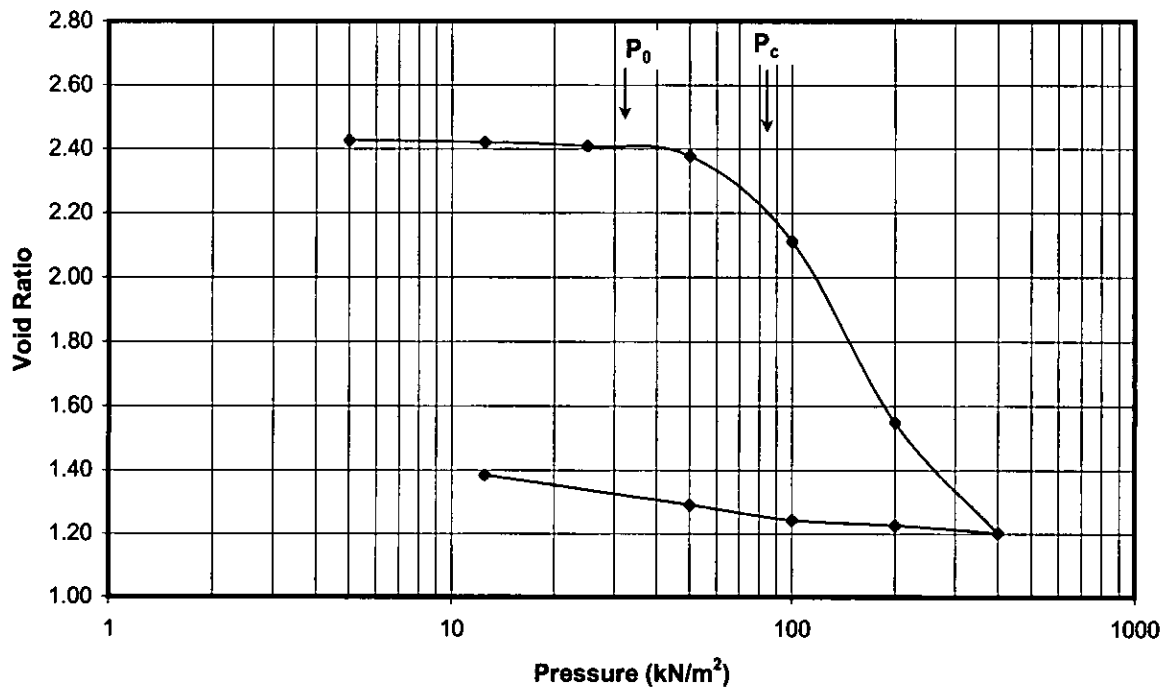


BH: C3-B

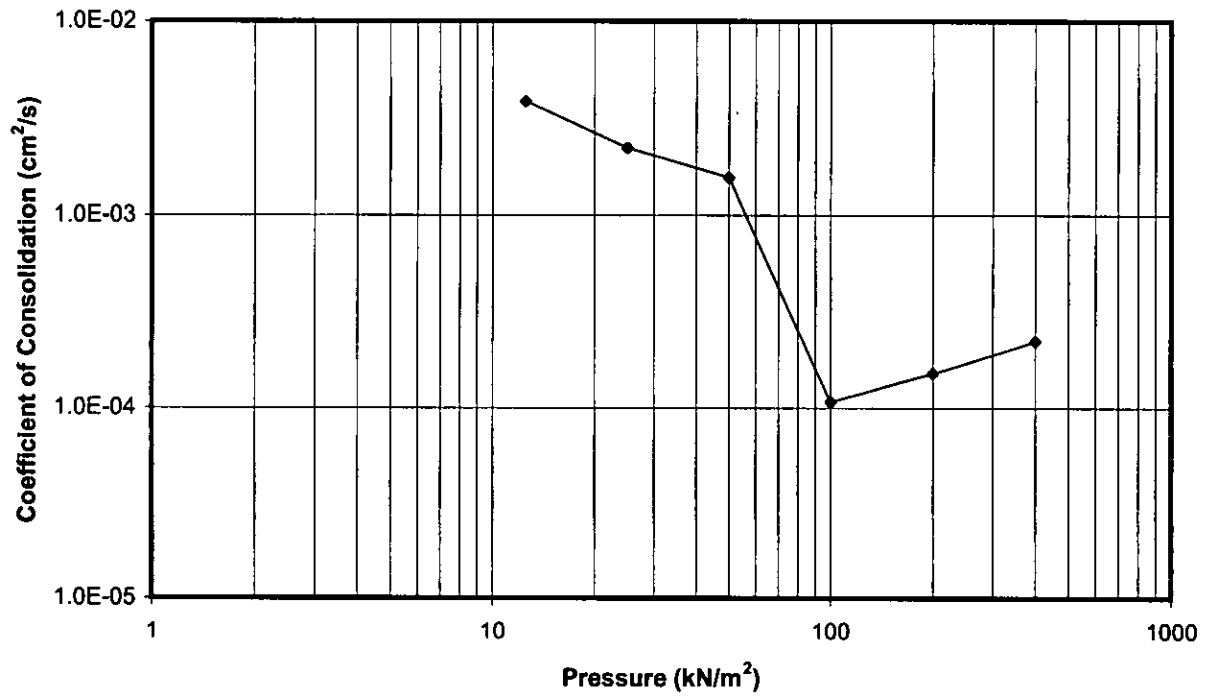
TW 7 Depth 4.8

Fig.C2-7

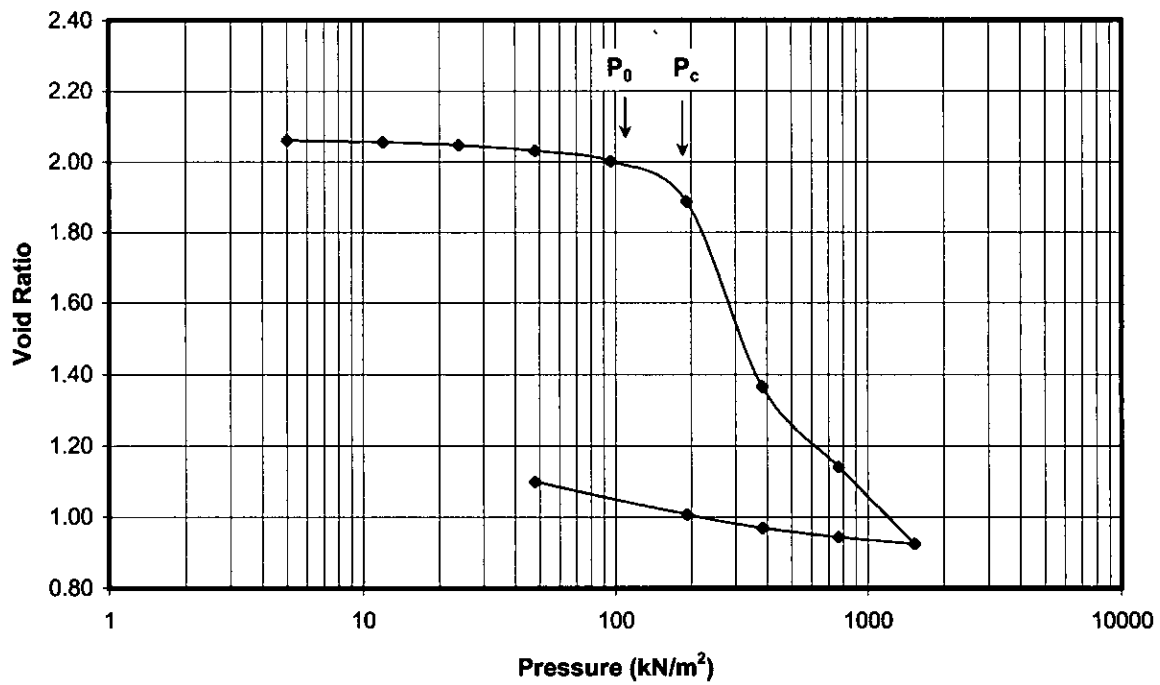
Void Ratio versus Pressure



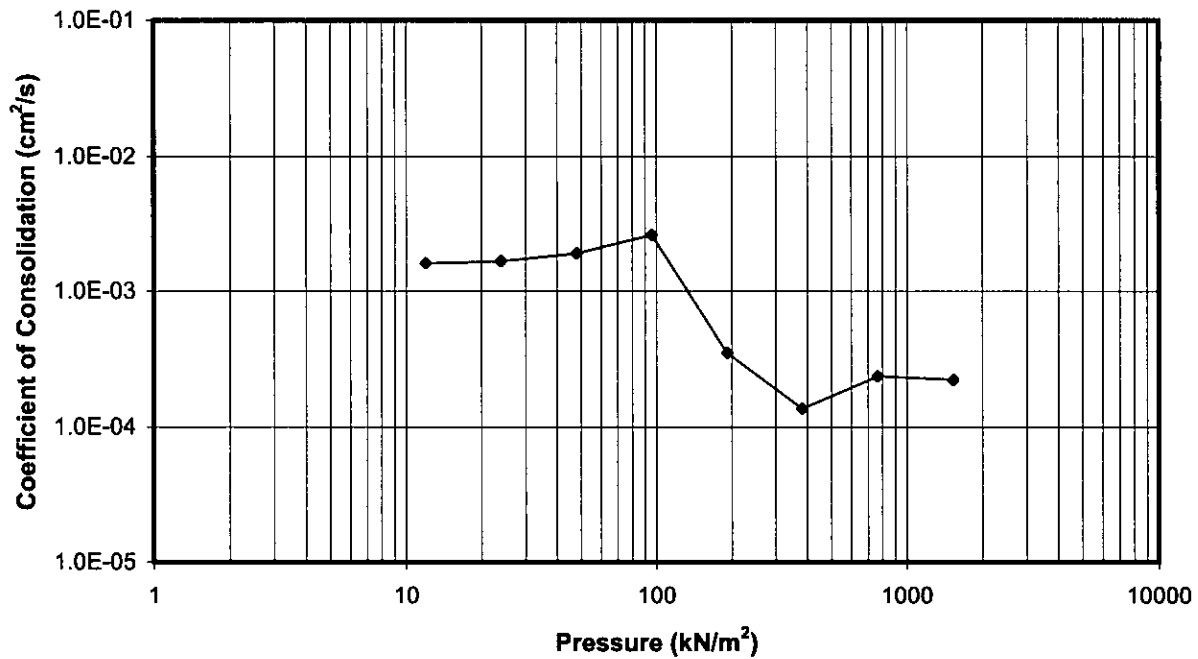
Coefficient of Consolidation vs. Pressure



Void Ratio versus Pressure



Coefficient of Consolidation vs. Pressure



Appendix C3

Site C

Measured Undrained Shear Strength Results

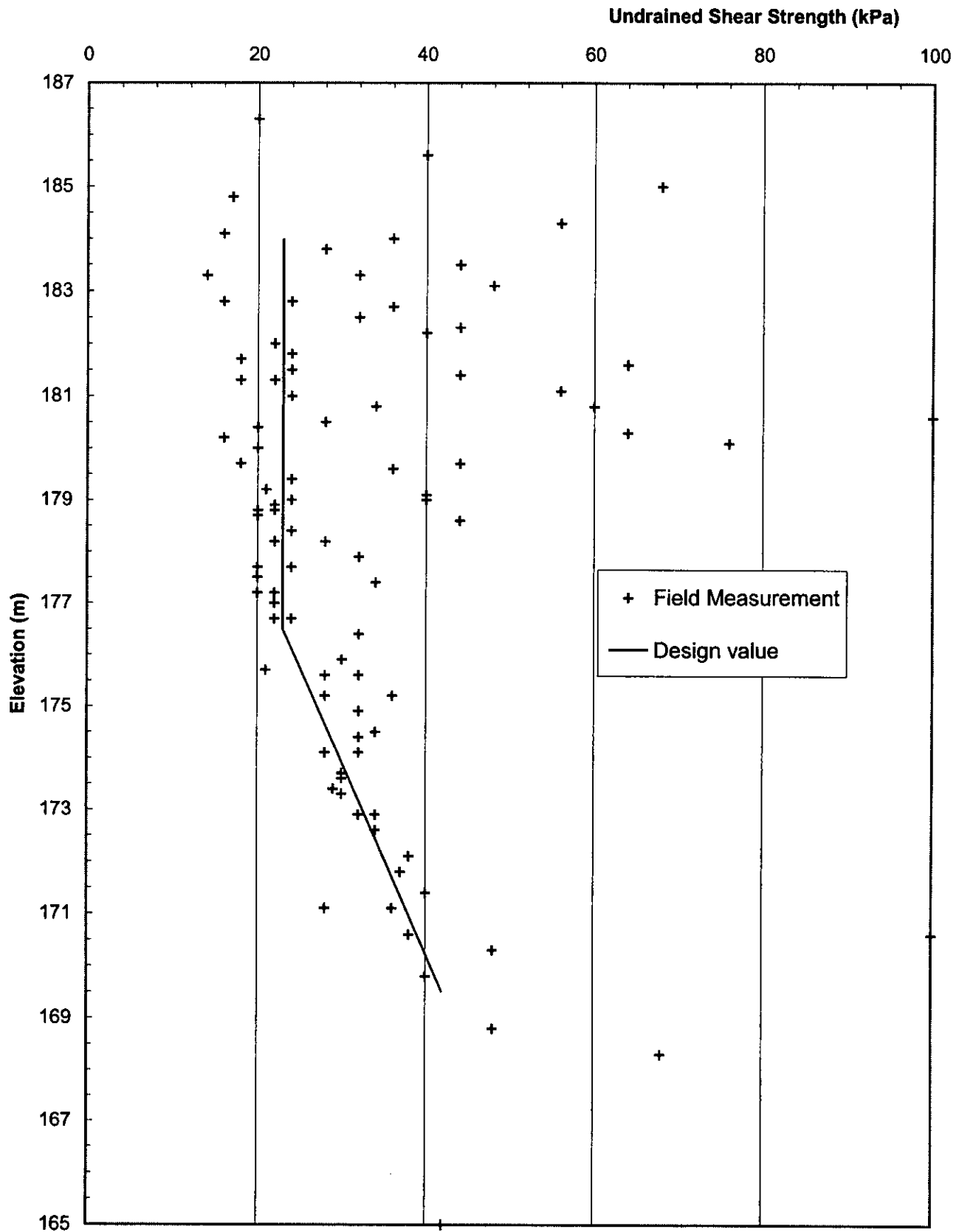


Fig. C3-1: Variation of Undrained Shear Strength (as measured by field vane tests) and the design value with Elevation in clay deposit

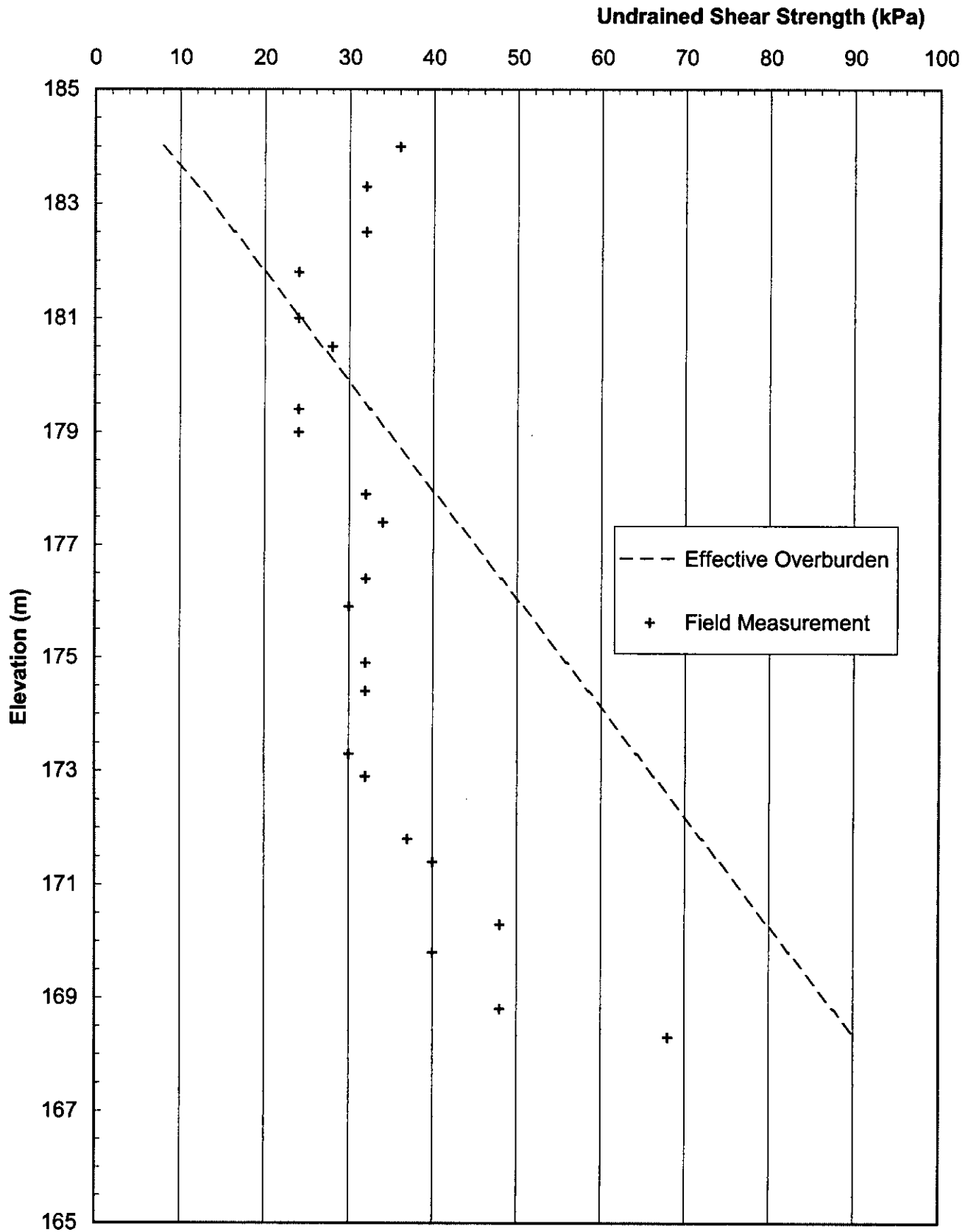


Fig. C3-2: Variation of Undrained Shear Strength (as measured by field vane tests) with Elevation (Boreholes 14+200; 19 m Rt)

APPENDICES

FOR SITE D

Appendix D1 Site D Record of Borehole Sheets

SPT 1055

RECORD OF BOREHOLE No 16+800; 19 m Rt 2 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 145 819.2; E 300 027.4 ORIGINATED BY G.I.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY Y.L.
DATUM Geodetic DATE 5/30/2003 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					
170.2															
17.2	End of D.C.P.T. Dynamic Cone Penetration Test (D.C.P.T.) performed from 7.3 m to 17.2 m. * Water level at 5.2 m (not stabilized), and hole open to 10.7 m on completion.														

+ 3, x 3: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

SPT 1055

RECORD OF BOREHOLE No 17+300; 19 m Lt 2 OF 2

METRIC

GWP 354-94-00 LOCATION Echo River to Bar River Road, Sault Ste. Marie - Coords: N 5 145 409.1; E 299 742.5 ORIGINATED BY G.I.
DIST 62 HWY 17 (New) BOREHOLE TYPE Hollow Stem Augers COMPILED BY Y.L.
DATUM Geodetic DATE 5/29/2003 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 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					
168.1	CLAY reddish grey, stiff		13	SS	2		167							
16.5	End of Borehole. * Water level at 12.8 m (not stabilized), and hole open to 13.1 m on completion.													

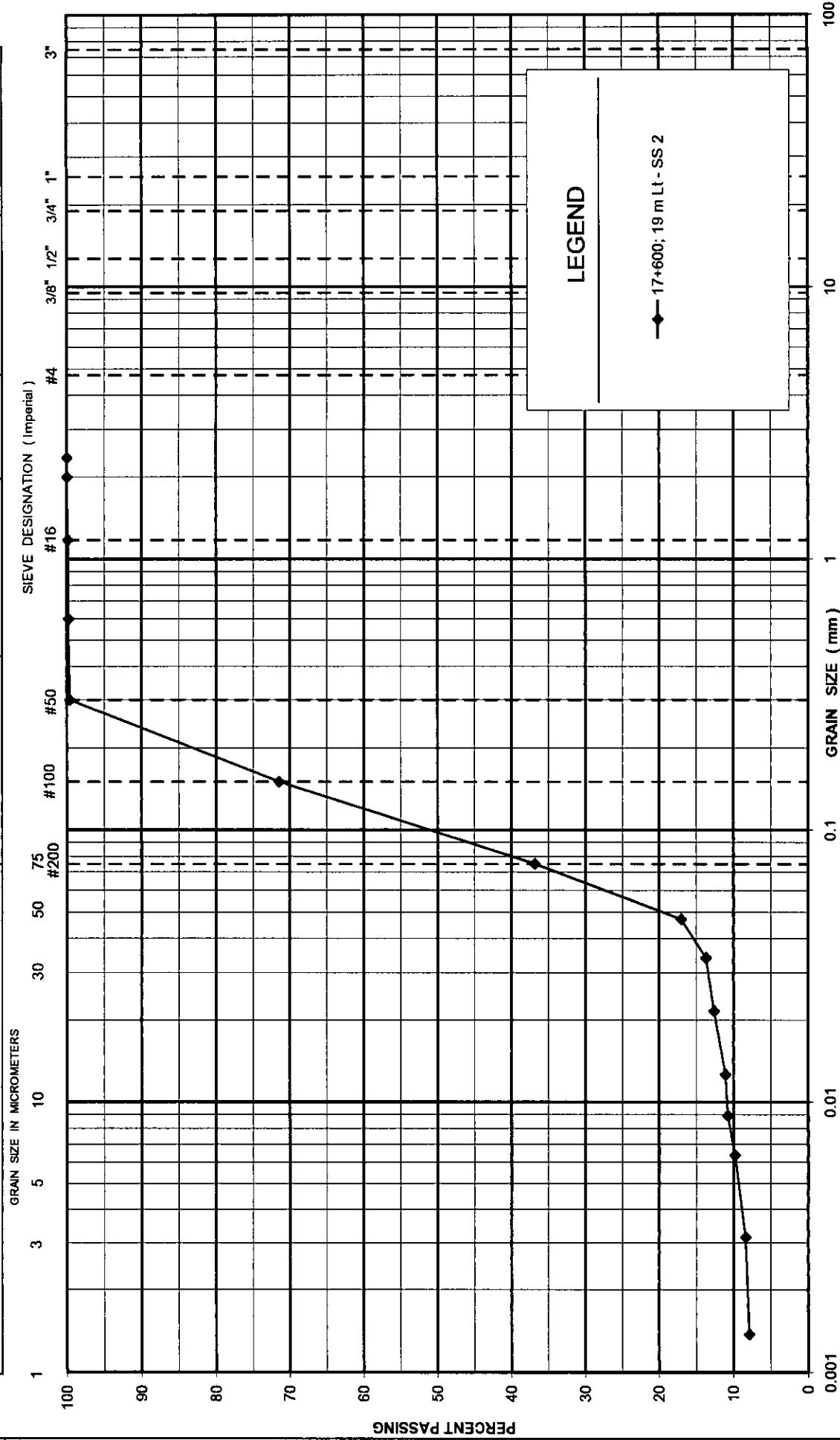
+ 3 . x 3 : Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

Appendix D2 Site D Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	



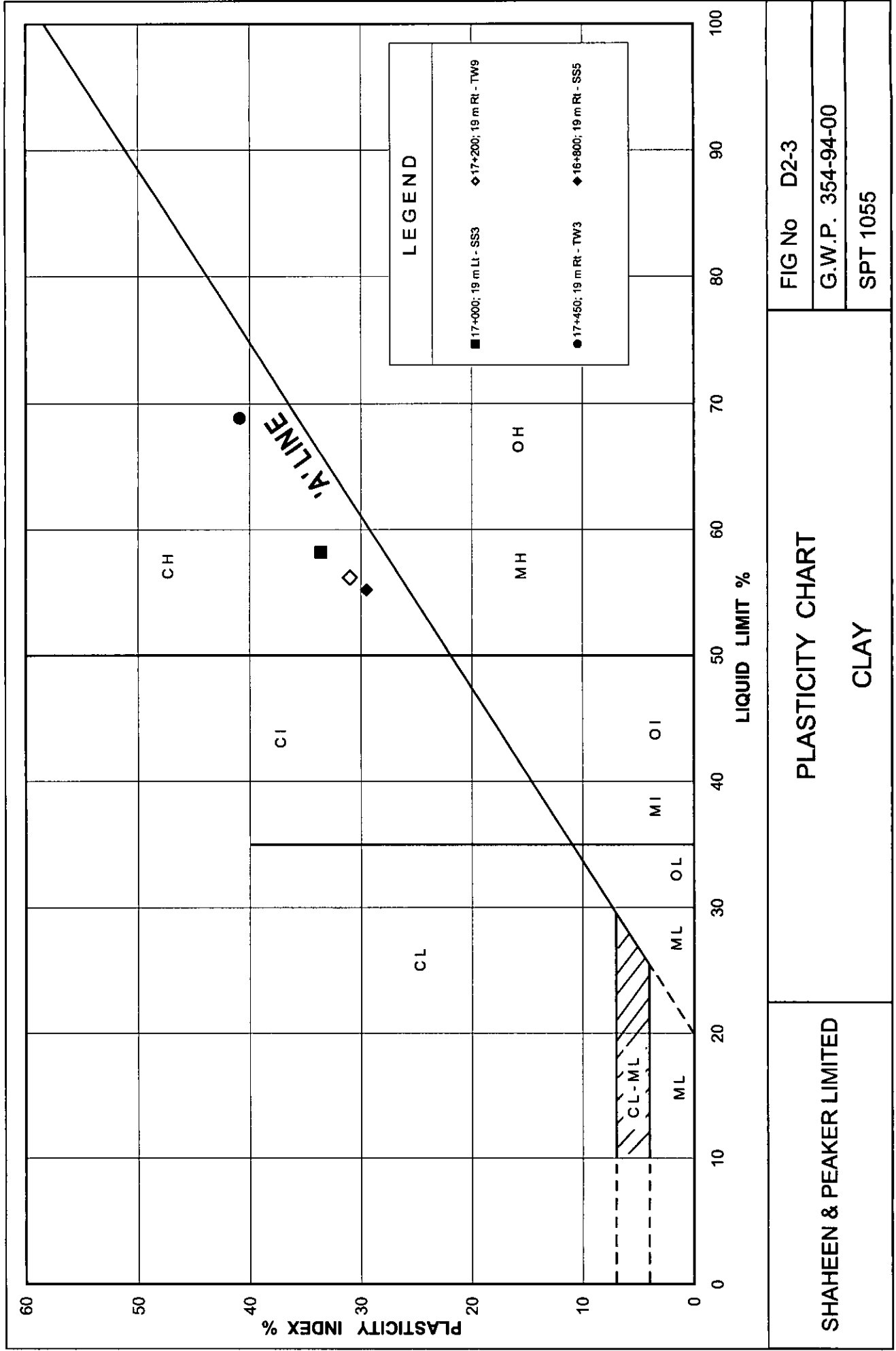
GRAIN SIZE DISTRIBUTION
SILTY SAND

SHAHEEN & PEAKER LIMITED

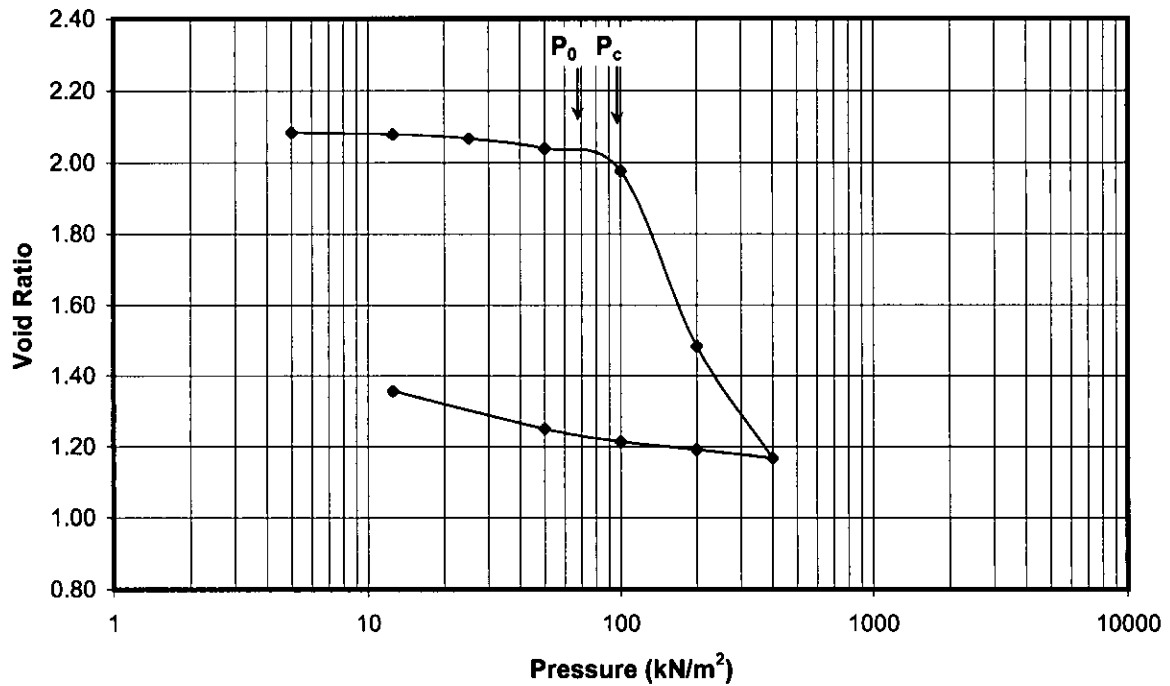
FIGURE No. D2 - 2

REF. No. SPT 1055

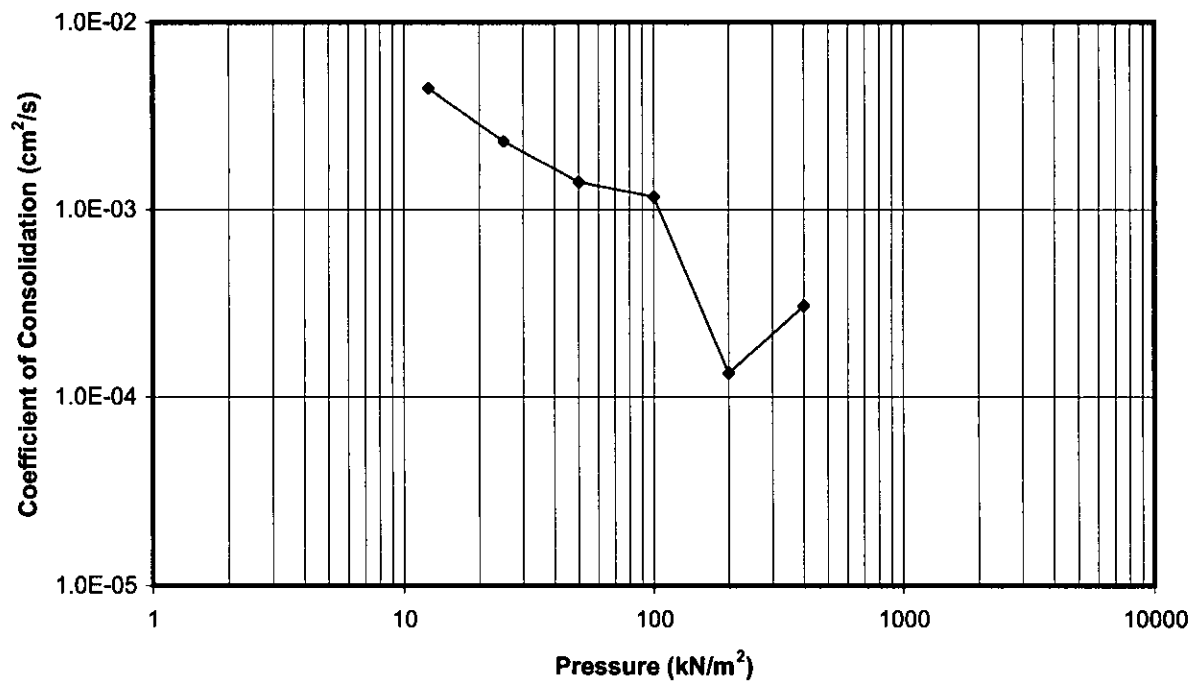
GWP: 354-94-00



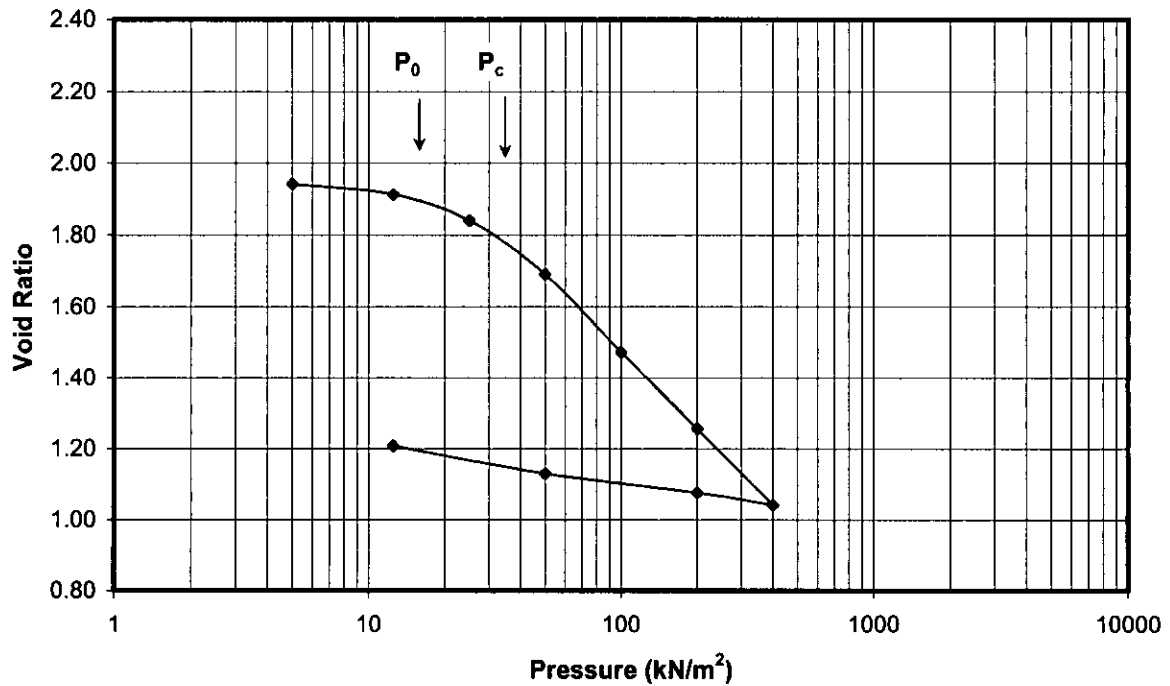
Void Ratio versus Pressure



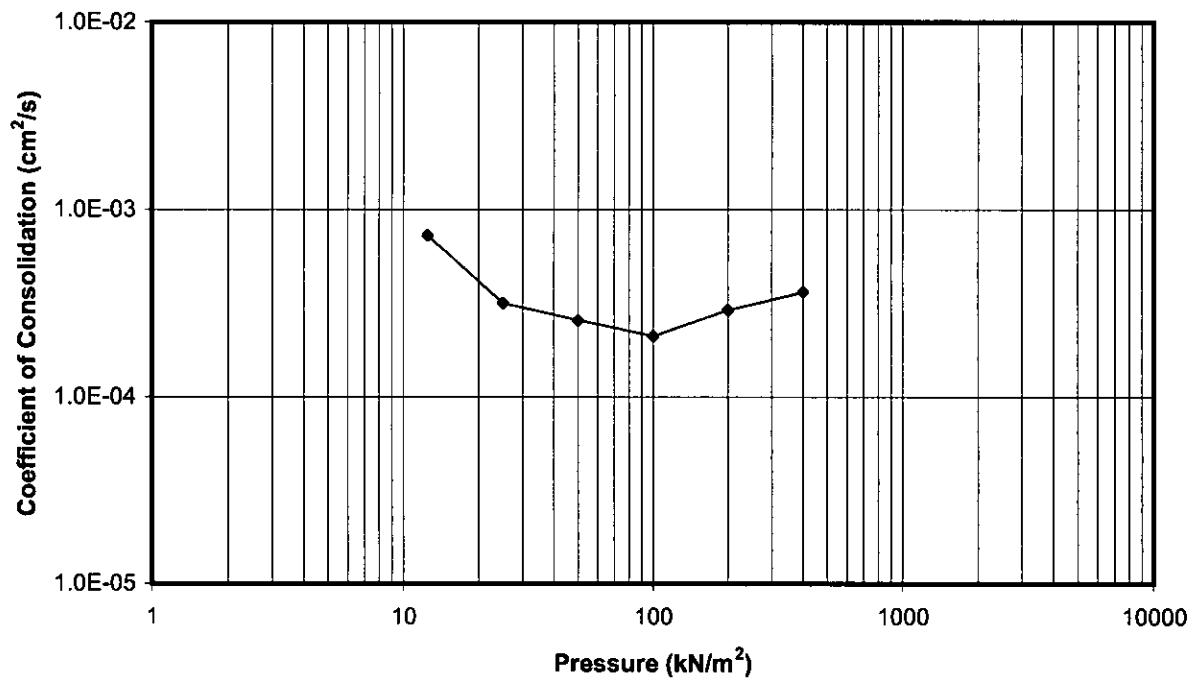
Coefficient of Consolidation vs. Pressure



Void Ratio versus Pressure

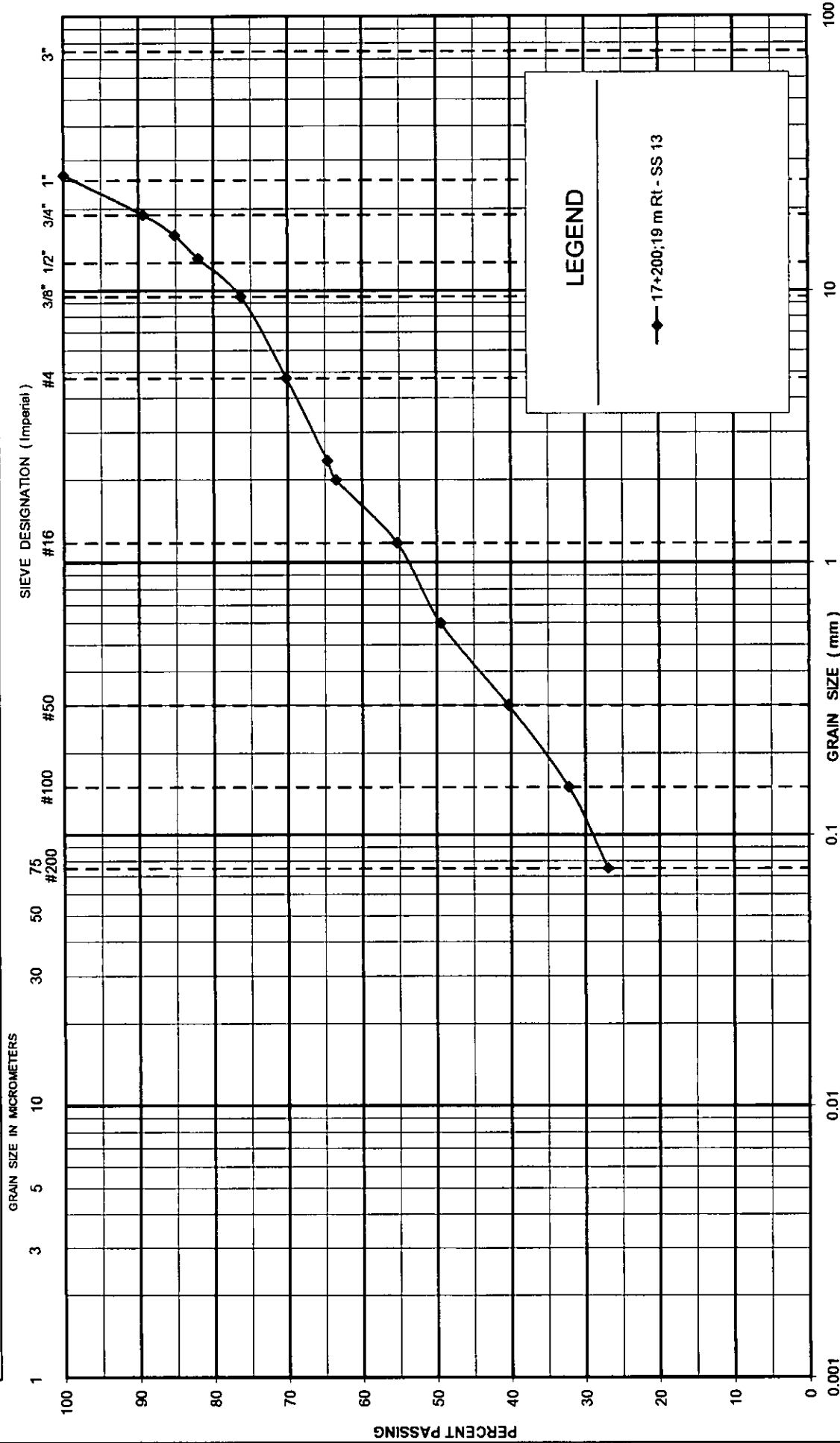


Coefficient of Consolidation vs. Pressure



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	



SHAHEEN & PEAKER LIMITED

FIGURE No. D2 - 6
REF. No. SPT 1055
GWP: 354-94-00

Appendix D3 Site D Measured Undrained Shear Strength Results

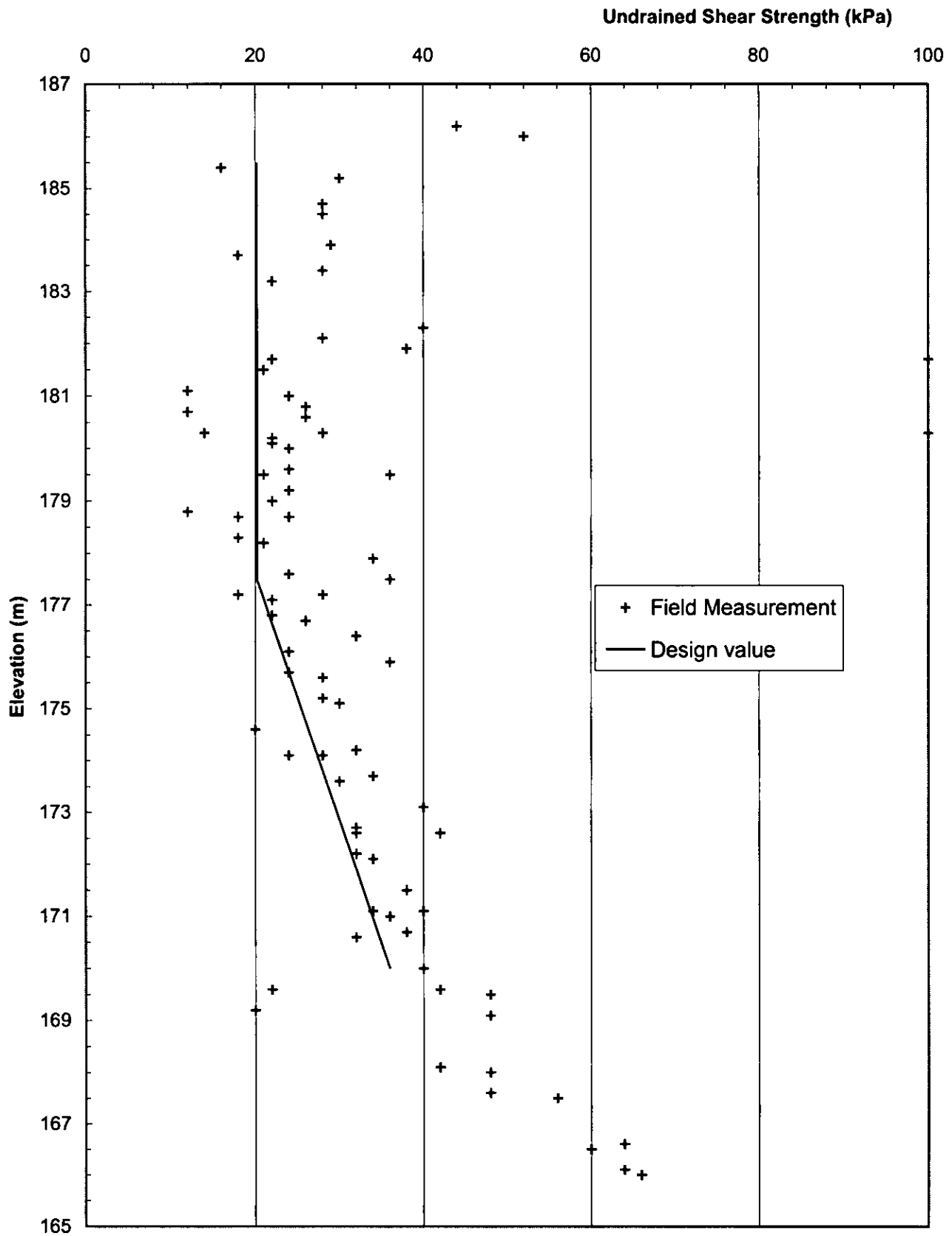


Fig. D3-1: Variation of Undrained Shear Strength (as measured by field vane tests) and the design value with Elevation in clay deposit

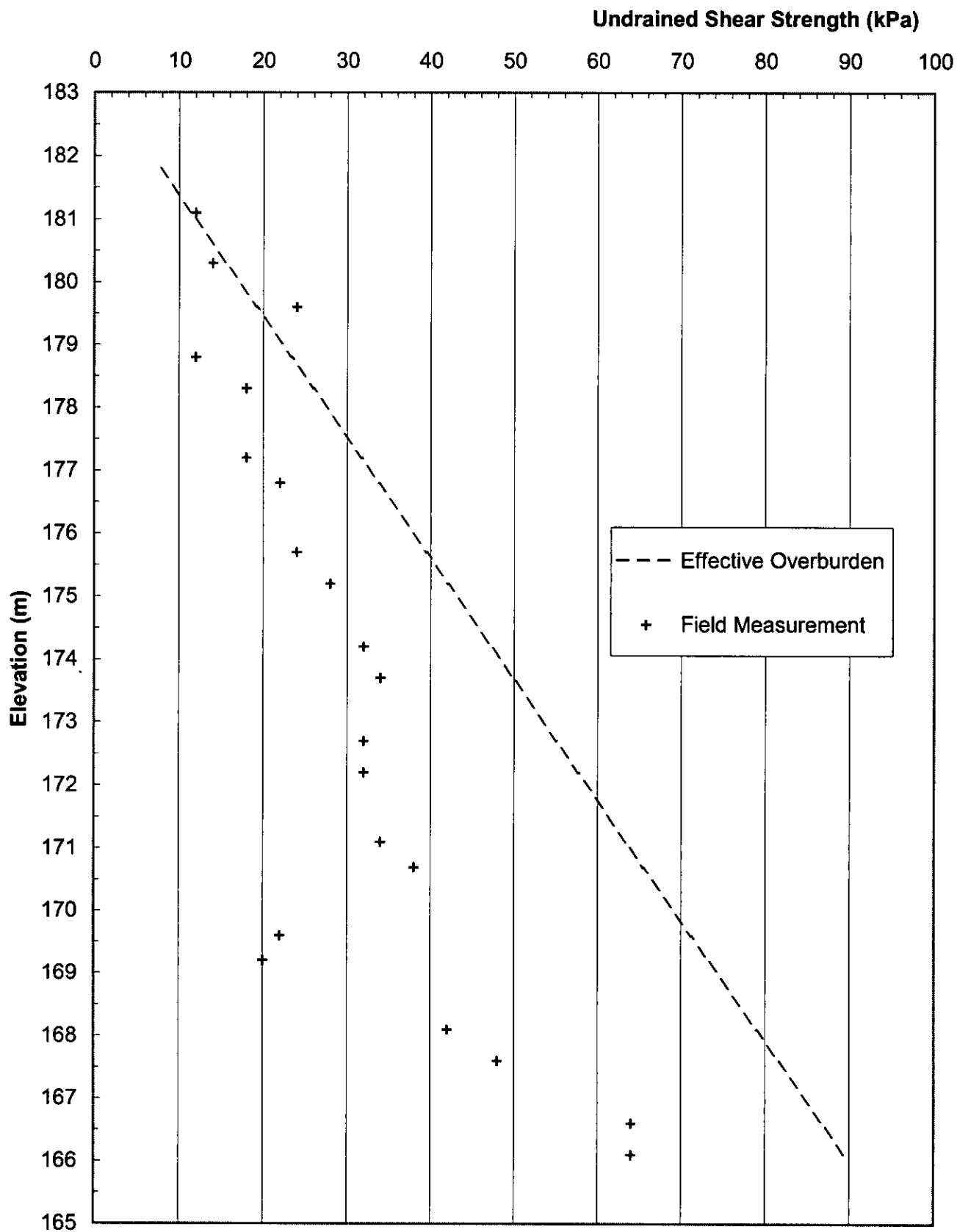


Fig. D3-2: Variation of Undrained Shear Strength (as measured by field vane tests) with Elevation (Boreholes 17+300; 19 m Lt)

Appendix E

Explanation of Terms Used in Report

**ADDITIONAL FOUNDATION DESIGN REPORT
PROPOSED HIGHWAY 17 (NEW)
FROM ECHO RIVER TO BAR RIVER ROAD
DISTRICT 62, SAULT STE. MARIE, ONTARIO
G.W.P. 354 AND 352-94-00**

GEOCRES NO. 41K00-063

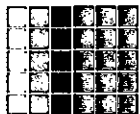
Prepared For:

MARSHALL MACKLIN MONAGHAN LTD.

Prepared by:

SHAHEEN & PEAKER LIMITED

**Project: SPT1055
September 17, 2003**



**20 Meteor Drive
Toronto, Ontario
M9W 1A4**

Tel: (416) 213-1255

Fax: (416) 213-1260

WEB SITE: WWW.SHAHEENPEAKER.CA

Table of Contents

5. DISCUSSION AND RECOMMENDATIONS	20
6. CLOSURE	26

APPENDIX F: SLOPE STABILITY ANALYSIS RESULTS

APPENDIX G: LIMITATIONS OF REPORT

**ADDITIONAL FOUNDATION DESIGN REPORT
PROPOSED HIGHWAY 17 (NEW)
FROM ECHO RIVER TO BAR RIVER ROAD
DISTRICT 62, SAULT STE. MARIE, ONTARIO
G.W.P. 354 AND 352-94-00**

5. DISCUSSION AND RECOMMENDATIONS

The sections investigated which are covered in this Additional Foundation Investigation are designated as Sites A, B, C and D for the purposes of this report and are described as follows:

Site A: Highway 17 (New) Fill Section between Stations 10+360 and 10+700 Westbound Lanes (WBL), between Site Nos. 1 and 2 of the previous investigation by S & P*.

This site is a fill section along WBL and the proposed heights of fill (along road centerline) within this section vary from 0 to about 4 m over existing grades.

Site B: Highway 17 (New) Fill and Cut Sections between Stations 11+000 and 11+350 EBL and WBL, between Site Nos. 3 and 4.

The fill section of the site is from Station 11+000 to about 11+190 and the proposed maximum height of fill (along road centerline) is about 2 m over existing grade. The cut section is from about Station 11+190 to 11+350 and up to about 2 m of cut is anticipated in this area.

Site C: Highway 17 (New) Fill Section between Stations 13+400 and 15+470 EBL and WBL, between Site Nos. 5 and 6.

The proposed heights of fill in this 2 km section vary from about 1.1 to 2.9 m, the maximum height of fill being at about Station 14+600, just north of Watson Road.

Site D: Highway 17 (New) Cut and Fill Section between Stations 16+600 and 17+700 EBL and WBL, between Site No.8 and south limit of project.

Between Stations 16+600 and 16+800, the proposed heights of fill in this section vary from about 2 to 2.5 m at Station 16+600 to zero fill at Station 16+800. Towards south from Station 16+800, the profile drawing indicates cut section (maximum cut of about 0.8 m along EBL and 0.3 m along WBL) to Station 17+000. Further south from Station 17+000 to the south limit is a fill section with a maximum fill height of about 2.8 m.

The recommendations presented in this report are summarized in Table 1. This Additional Foundation Design Report should be read in conjunction with previous Foundation Design Report* prepared by S & P for this project.

Slope stability analyses were conducted at each section. For the undrained (short-term) stability analyses, undrained shear strengths (c-values) of the clay were utilized based on the Field Vane Tests results, assuming angle of internal friction (ϕ) of the soil being zero. For the drained (long-term) analyses, an estimated ϕ -angle together with a small value of shear strength (c) were used. The analyses were performed using limit state equilibrium (Bishop's Simplified Method by the computer program Slope/W). Typical embankment slope stability sections are presented in Appendix F.

Settlement analyses were performed based on the heights of fill taken from the vertical profile provided to us and any surcharge that we recommended.

Based on the above analyses, the design recommendations for each site are presented in Table 1.

In any event, surcharging at Site-C and D should be carried out with proper instrumentation for field monitoring. It is furthermore recommended that the surcharge be placed gradually (i.e., preferably at least 3 layers, starting from one end of the site and proceeding to the other end), to allow excess pore pressures to dissipate.

Fills at the above section should be provided with a widened cross-section to allow for settlements of the underlying soils and a future grade raise. In this case, we recommend that the road platform should be widened by at least 2 m on each side of the centreline (total of 4 m), or otherwise noted. This is also in accordance with the Northern Region Engineering Directive NRE 98-200. At Site A between Stations 10+370 and 10+570, Site C (between Stations 13+400 and 15+470), and Site D (from Station 16+600 to 17+500), platform widening of at least 3 m should be provided on each side of the road centerline.

* "Foundation Design Report, Proposed Highway 17(New)

From Echo River to Bar River Road, District 62, Sault Ste. Marie, Ontario

G.W.P. 354 and 352-94-00", prepared by S & P, dated August 2003.

Table 1 Summary Table of Design Recommendations

SITE A

Station to Station	Lane	Approx. Maximum Embankment Height (m)	Embankment Type or (Cut Material)	Average Stripping Depth (m)	Side Slopes	Surcharge	Remarks	Estimated Maximum Post-Construction Settlement after Min. 1.5 years of Surcharging (mm)		
								0 ~ 5 Yrs	5 ~ 10 Yrs	10 ~ 20 Yrs
10+360 to 10+700	WBL	4.0	EF	0.5	3H : 1V*	From Station 10+360, gradually increase surcharge to 1.0 m at Station 10+370 Maintain 1.0 m surcharge between Stations 10+370 and 10+570 Gradually reduce surcharge to zero at Station 10+580	Prompt Seed and Cover or Sodding	30	10	10

Notes: 1. * The recommended side slopes could be flattened to 4H:1V; surplus material can be used for this purpose, if desired.
2. We recommend at least 3 m platform widening on left side of the road centreline and at least 2 m platform widening on right side of the road centreline.

LEGEND: EF - Earthfill RF - Rockfill
EBL - Eastbound Lanes WBL - Westbound Lanes
() - for Cut Sections/Slopes

SITE B

Station to Station	Lane	Approx. Maximum Embankment Height (m)	Embankment Type or (Cut Material)	Average Stripping Depth (m)	Side Slopes	Surcharge	Remarks	Estimated Maximum Post-Construction Settlement after Min. 1.5 years of Surcharging (mm)		
								0 ~ 5 Yrs	5 ~ 10 Yrs	10 ~ 20 Yrs
11+000 to 11+190	EBL	1.8	EF	0.3	2H : 1V*	Continuing from north of Station 11+000, maintain 1.7 m surcharge between Stations 11+000 and 11+040 Gradually reduce surcharge to zero at Station 11+100	Prompt Seed and Cover or Sodding			
	WBL	1.9						30	10	10
11+190 to 11+350	EBL	(2.0)**	(Earth)	N / A	(3H : 1V)	N / A	Erosion Control Blanket	---	---	---
	WBL									

Note: 1. * The recommended side slopes could be flattened to 4H:1V; surplus materials could be used for this purpose, if desired.

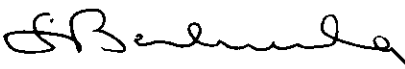
6. CLOSURE

The Limitations of Report, as quoted in Appendix G, are an integral part of this report. It should be noted that the recommendations presented in this report are based on widely spaced (generally 200 m) boreholes and subsurface conditions in between and beyond the borehole locations could vary from the ones encountered at the boreholes and therefore the recommendations given may not be applicable if found different.

SHAHEEN & PEAKER LIMITED


R. Miranda, P.Eng.



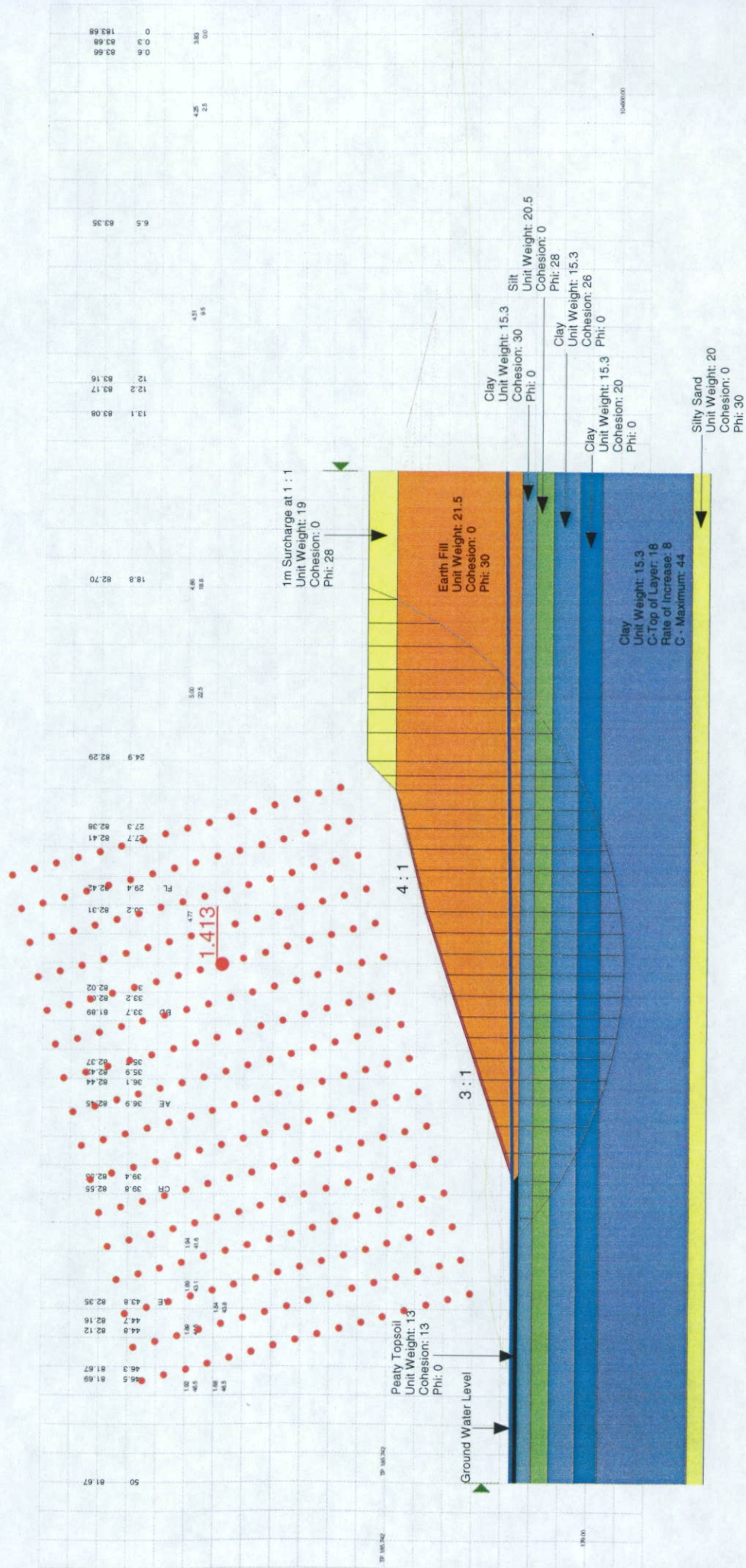

for Z.S. Ozden, P.Eng



Appendix F

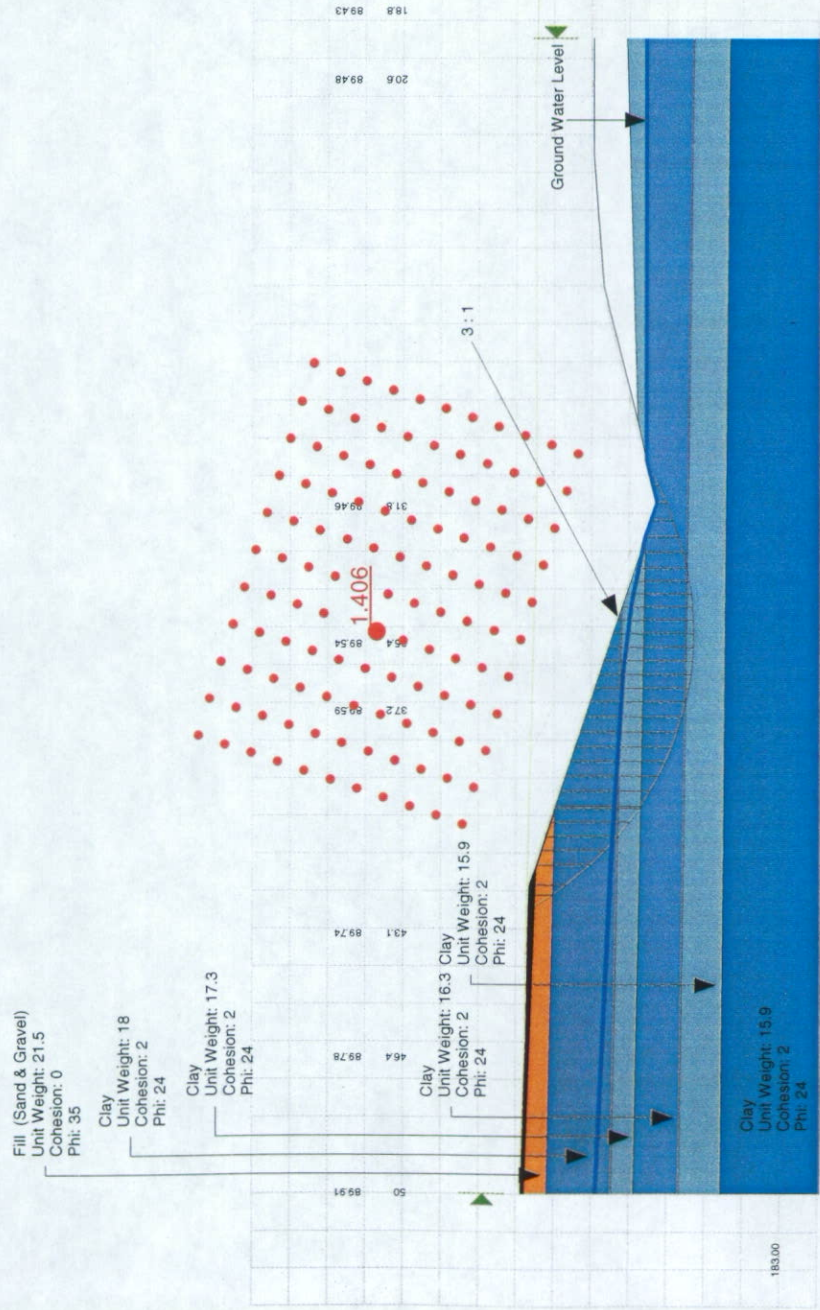
Slope Stability Analysis Results

SPT 1055, Highway 17 (New), Sault Ste. Marie Station 10+500, WBL, 4.0m High, Earth Fill Embankment (Plus 1.0m Surcharge) Undrained Case (Total Stress Analysis)



SPT 1055, Highway 17 (New), Sault Ste. Marie Cut Section - 11+350 Drained Case (Effective Stress Analysis)

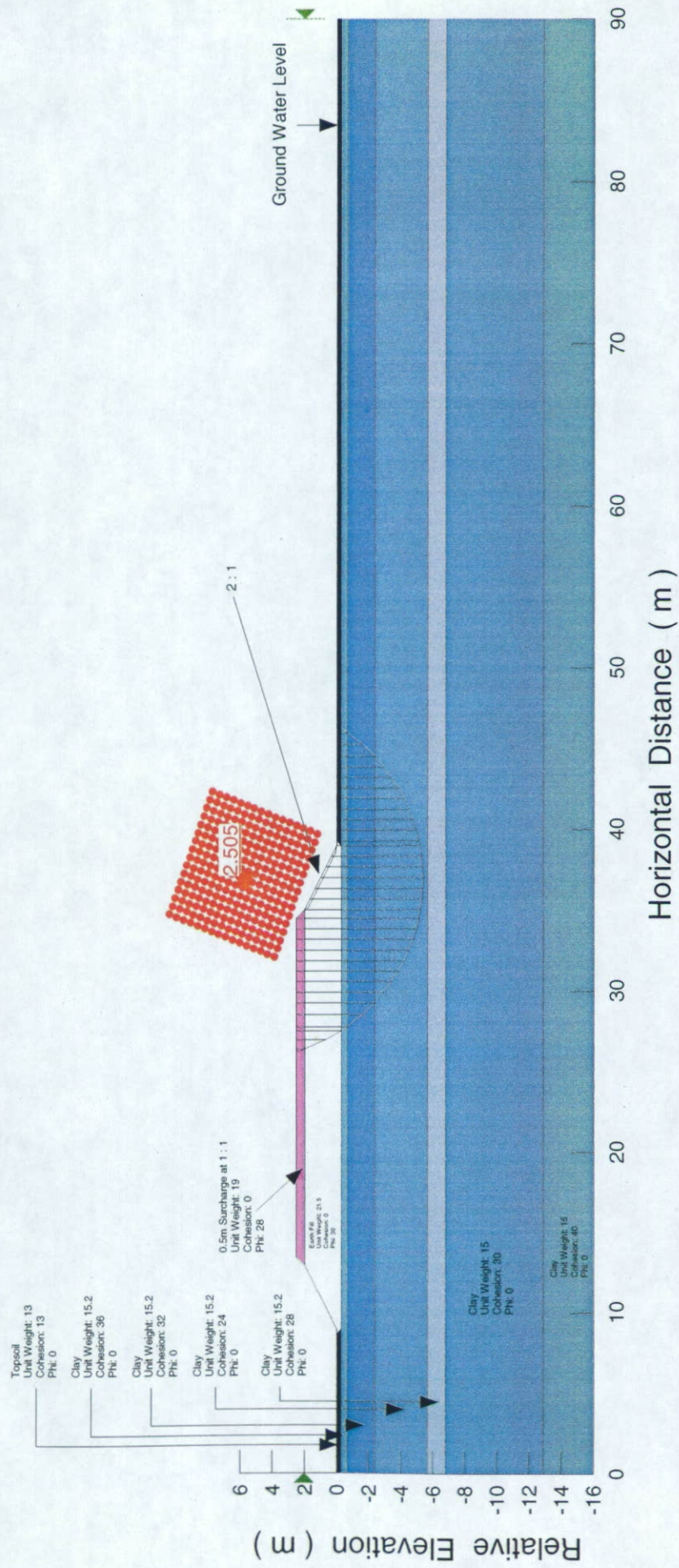
Subsurface Conditions:
 Inferred from Borehole 11+300 Lt



CDE-MED WP-TRAINED 06/01 11:350.00

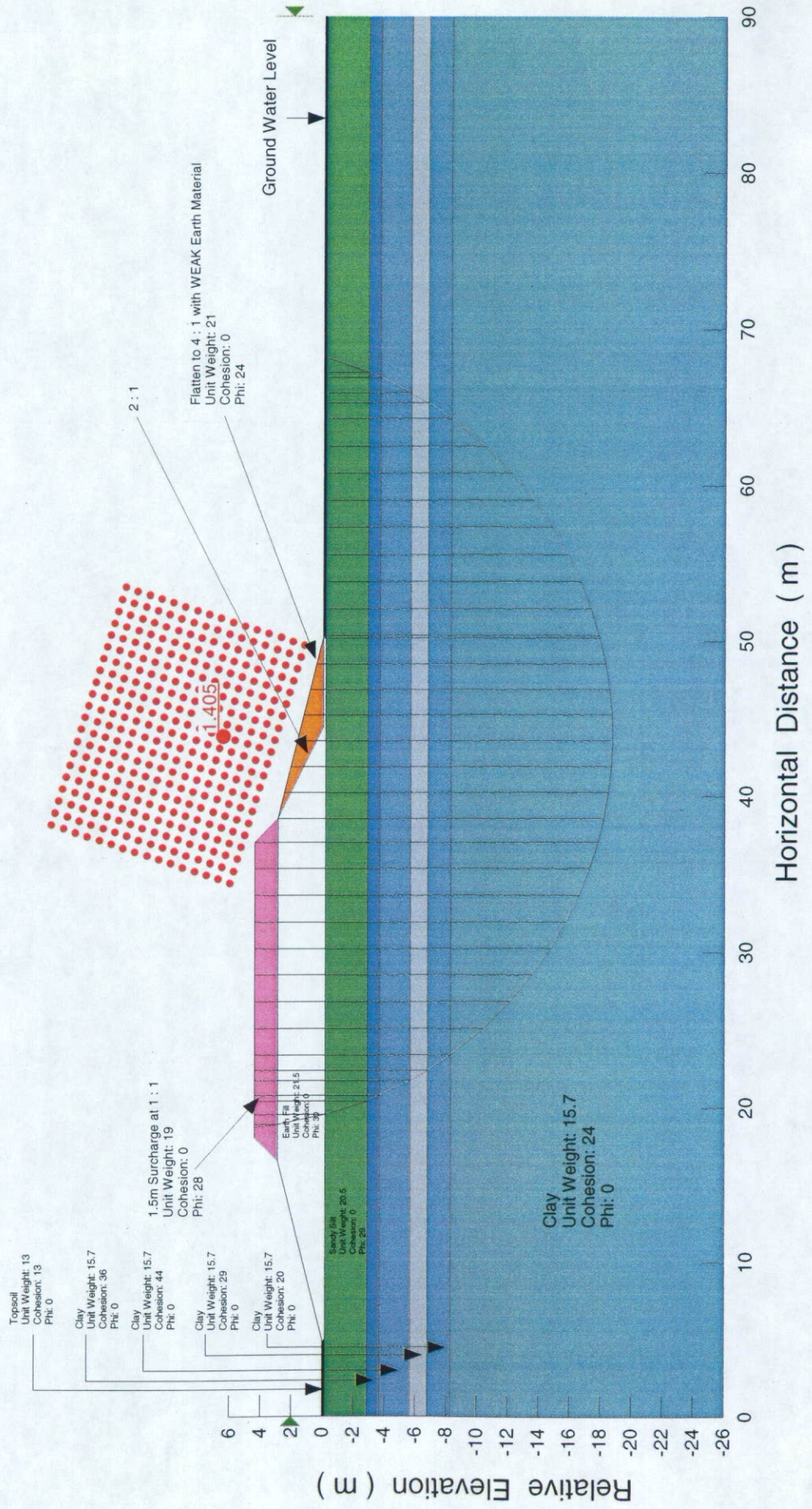
SPT 1055, Highway 17 (New), Sault Ste. Marie
 Station 14+200, EBL, 2.0m High, Earth Fill Embankment (Plus 0.5m Surcharge)
 Undrained Case (Total Stress Analysis)

Platform Width = 22m

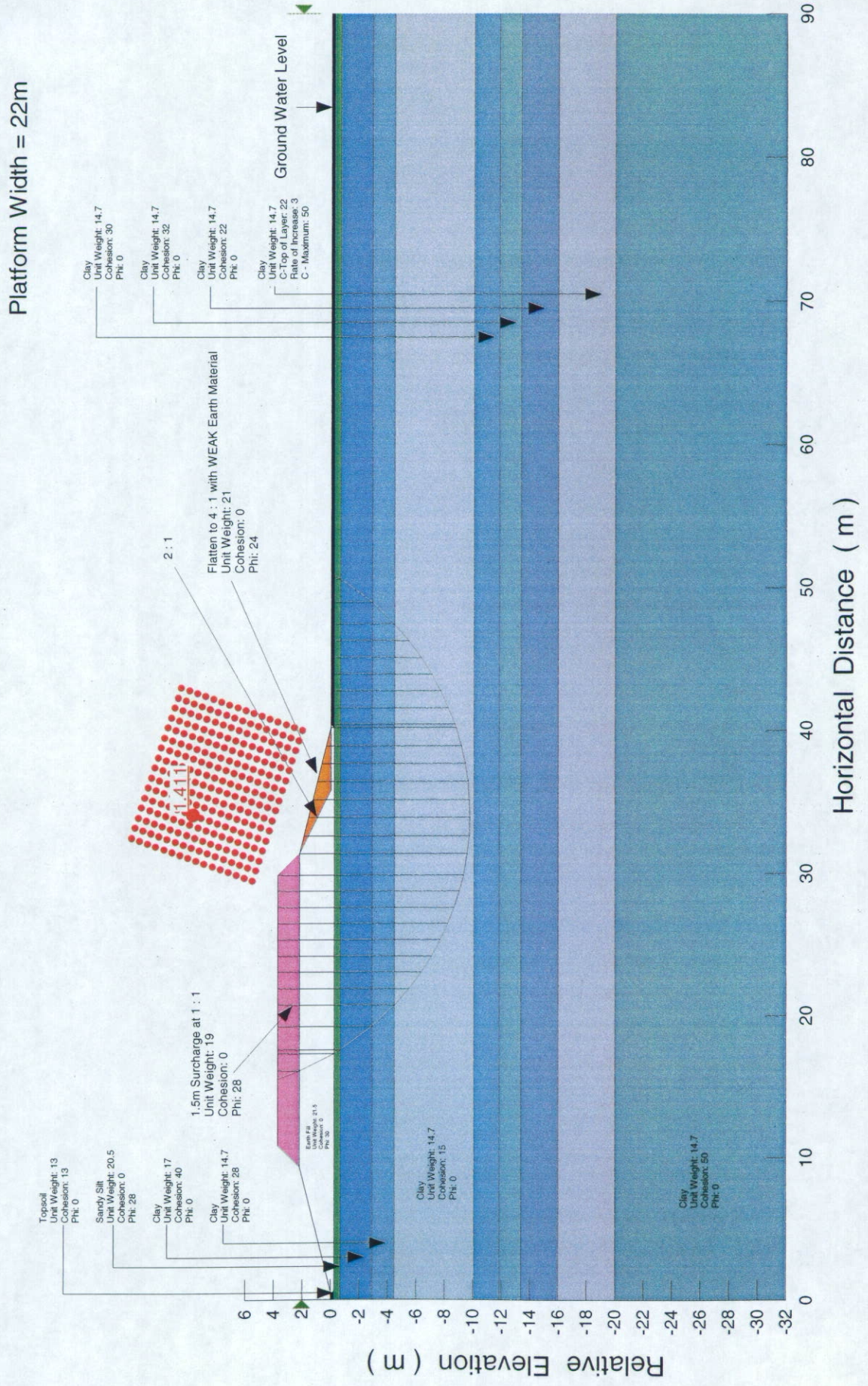


SPT 1055, Highway 17 (New), Sault Ste.Marie
 Station 14+600, EBL, 2.9m High, Earth Fill Embankment (Plus 1.5m Surcharge)
 Undrained Case (Total Stress Analysis)

Platform Width = 22m



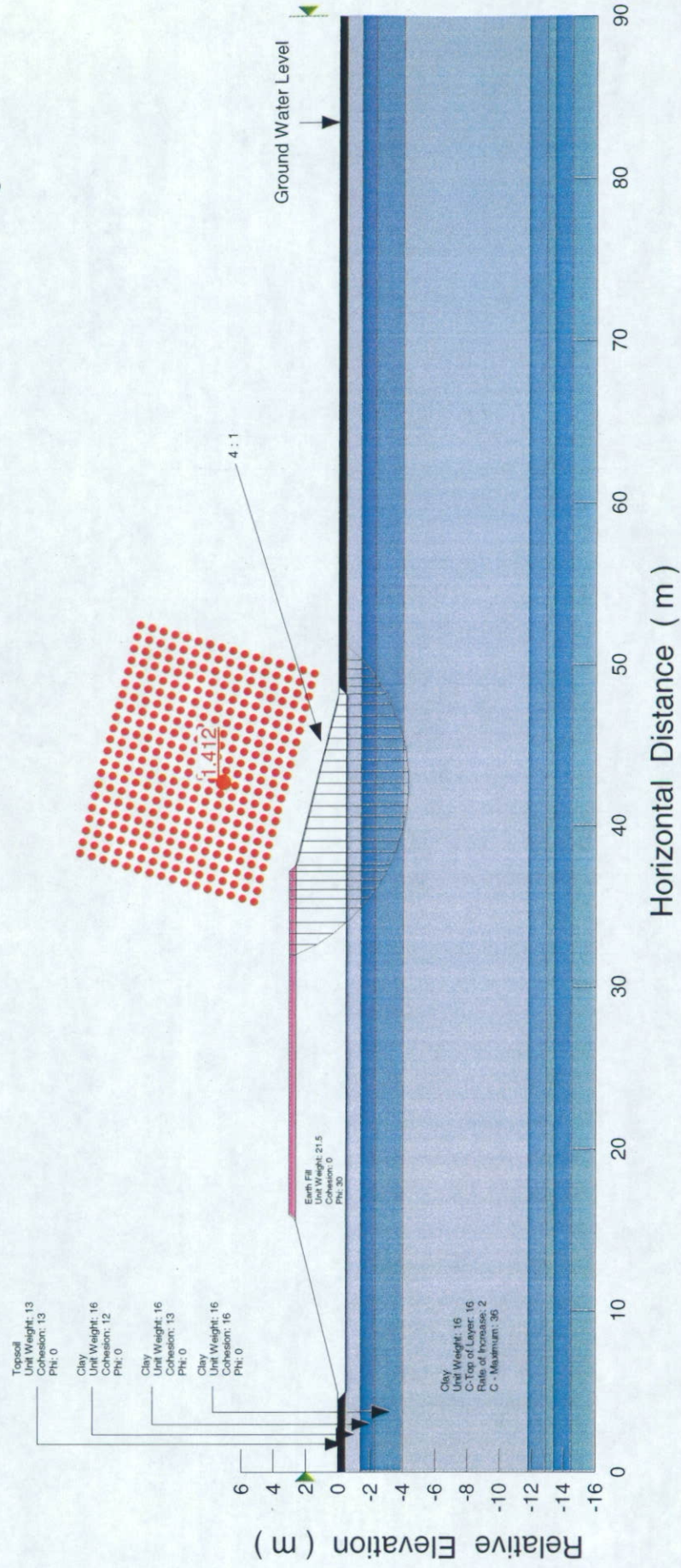
SPT 1055, Highway 17 (New), Sault Ste. Marie Station 15+083, WBL, 2.2m High, Earth Fill Embankment (Plus 1.5m Surcharge) Undrained Case (Total Stress Analysis)



SPT 1055, Highway 17 (New), Sault Ste.Marie
 Station 17+300, WBL, 2.65m High, Earth Fill Embankment (i.e. 0.8m Grade Drop)
 Undrained Case (Total Stress Analysis)

Platform Width = 22m

0.4m Surcharge



Appendix G

Limitations of Report

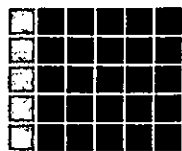
LIMITATIONS OF REPORT

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.



shaheen & peaker *limited*
consulting engineers
20 Meteor Drive
Toronto, Ontario, M9W 1A4
T: 416.213.1255
F: 416.213.1260
INFO@SHAHEENPEAKER.CA

Our Reference No. SPT 1055

September 18, 2003

Ministry of Transportation, Ontario
Pavements and Foundations Section
Room 232, Building C
Downsview, Ontario

Attention: Ms. Anna Piascik, P. Eng.
Foundation Engineer

Re: Draft Additional Foundation Investigation and Design Reports
Highway 17 (New) from Echo River to Bar River Road
GWP 354-94-00, Sault Ste. Marie

Dear Sirs:

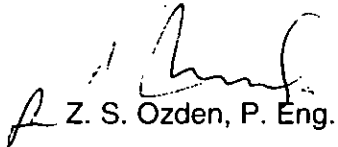
Further to your memorandum dated September 11, 2003, regarding your review of the above captioned report, the following is our response.

1. The Geocres Number you have provided will be shown on the cover page of the final Foundation Investigation and Design Reports and on the Drawings.
2. Project details will be removed from Section 2 of the Investigation Report.
3. In Section 3, boreholes were backfilled to about 6 to 8 m below ground surface with soils brought up by augering (auger cuttings) and the upper 6 to 8 m of the open borehole was then grouted using a bentonite or a cement/bentonite mixture.
4. The attached Soil Strata Drawings were re-drawn to MTO standards. Key Plans were prepared with larger fonts for better legibility.
5. The Appendices in the Foundation Investigation Report will be placed at the end of the report.
6. On Drawings 1, 4, C and D, limits of the present investigation will be shown.
7. In Table 1 of the Design Report, the estimated maximum post construction settlements will be revised to account for the secondary consolidation.

We thank you for your fair review of our draft report and hope to be of service to you on similar projects in the near future.

Yours very truly,

Shaheen & Peaker Limited



Z. S. Ozden, P. Eng.

ZSO/rm:TSPT1055\AdditionalWorks-Comments