

ADDENDUM NO. 1²

FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 2001- 3011

*NOTE: This F.I.R. shall be read in conjunction with the original F.I.R distributed to plan takers . This report is considered to precede the F.I. Addendum Report **

*(* See page 103 of the original F.I.R.)*

**FOUNDATION INVESTIGATION ~~AND DESIGN~~ REPORT
PROPOSED E-S RAMP STRUCTURE
STRUCTURE 33-393
W.P. 363-94-00, AGREEMENT NO. 9730-7411-3178
HWY8/CONESTOGA PARKWAY INTERCHANGE AND
HWY 8 FROM CONESTOGA PARKWAY TO FERGUS AVENUE**

Submitted to:

**Mr. Doug Hoffman, Principal
Morrison Hershfield Limited
4 Lansing Square
North York, Ontario
M2J 1T1**

**August 27, 1999
Project No.: TK98-10-3**

Geocres: 40P8-119

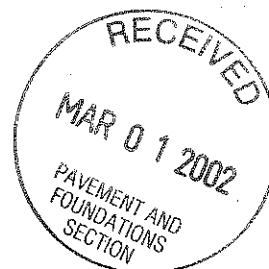


TABLE OF CONTENTS

	PAGE
1. INTRODUCTION.....	1
2. SITE DESCRIPTION	2
2.1 SITE LOCATION	2
2.2 PHYSIOGRAPHY AND TOPOGRAPHY	2
3. INVESTIGATION PROCEDURES	2
3.1 FIELD INVESTIGATION	2
3.2 LABORATORY ANALYSIS	4
4. SUBSURFACE CONDITIONS.....	4
4.1 SOUTH RETAINING WALL/EMBANKMENT (BOREHOLES 98-01 TO 98-10).....	4
4.1.1 Pavement, Fill, Topsoil.....	5
4.1.2 Sand.....	5
4.1.3 Upper Silt.....	6
4.1.4 Upper Silty Clay.....	6
4.1.5 Lower Silt.....	7
4.1.6 Lower Silty Clay.....	7
4.1.7 Silt Till.....	8
4.2 SEVEN SPAN BRIDGE STRUCTURE (BOREHOLES 98-10 TO 98-18).....	8
4.2.1 Pavement, Fill, Topsoil.....	8
4.2.2 Sand and Silty Sand.....	9
4.2.3 Silty Clay.....	9
4.2.4 Lower Silt.....	10
4.2.5 Lower Silty Clay.....	10
4.2.6 Silt Till.....	11
4.3 EAST RETAINING WALL/EMBANKMENT (BOREHOLES 98-16 TO 98-37).....	12
4.3.1 Topsoil and Fill.....	12
4.3.2 Sand/Silt.....	13
4.3.3 Upper Silty Clay.....	13
4.3.4 Lower Silty Clay.....	14
4.3.5 Silt Till.....	15
4.4 GROUNDWATER CONDITIONS.....	16
5. DISCUSSION AND RECOMMENDATIONS.....	18
 5.1 GENERAL.....	18
 5.2 SEVEN SPAN BRIDGE STRUCTURE.....	19
 5.2.1 Pile Foundation.....	19
 5.2.1.1 Axial Pile Capacity.....	19
 5.2.1.2 Negative Skin Friction.....	20
 5.2.1.3 Lateral Resistance For Piles.....	21
 5.2.1.4 Pile Driving.....	21
 5.2.2 Spread Footing for South Abutment.....	22
 5.3 SOUTH RETAINING WALL/EMBANKMENT.....	22
 5.3.1 Spread Footings.....	22
 5.3.2 Storm Sewer Construction.....	24
 5.4 EAST RETAINING WALL/EMBANKMENT.....	25
 5.4.1 Embankment Stability.....	25
 5.4.2 Spread Footings.....	26
 5.5 SLIDING RESISTANCE.....	27

5.6 INTERNAL EARTH PRESSURES	27
5.7 RETAINED SOIL SYSTEM (RSS)	29
5.8 APPROACH EMBANKMENTS	29
5.9 EXCAVATION, GROUNDWATER CONTROL AND TEMPORARY SHORING	30
5.10 EROSION PROTECTION	32
6. STATEMENT OF LIMITATION	33

Explanation of Terms Used in Report

Drawings A, B, C and D

Borehole Locations and Soil Data

Appendix "A"	Record of Borehole Sheets
Appendix "B"	Laboratory Test Results, South Retaining Wall/Embankment
Appendix "C"	Laboratory Test Results, Seven Span Bridge Structure
Appendix "D"	Laboratory Test Results, East Retaining Wall/Embankment
Appendix "E"	Shear Box Test Results
Appendix "F"	Removal of Unsuitable Soils from Beneath Approach Fills
Appendix "G"	Statement of Limitations

1. INTRODUCTION

This report presents the results of a foundation investigation carried out by AGRA Earth & Environmental Limited (AGRA) on behalf of Morrison Hershfield Limited at the site of the proposed E-S Ramp Structure (Structure 33-393). The structure will carry 2 lanes of traffic from the westbound traffic lanes on Conestoga Parkway (KW Expressway) onto the southbound lanes of Highway 8.

The purpose of the investigation was to obtain information about the subsurface conditions at the site by means of boreholes and, based on this information, to provide geotechnical recommendations for the foundation elements of:

- the E-S Ramp retaining wall/embankment adjacent to Montgomery Creek (east end of the site),
- the new 7 span overpass bridge structure over the KW Expressway, and
- the E-S Ramp retaining wall/embankment in the Highway 8 median (south end of the site).

The E-S Ramp is a "third level", 7 span, and approximately 390 m long (Station 10+338 to 10+728) bridge structure. The structure will be 13.5 m wide and approximately 13 m above the adjacent ground surface at the proposed east abutment adjacent to Montgomery Creek. The proposed structure will be constructed of post-tensioned concrete, double cell box girder.

The two-lane exit ramp from the westbound KW Expressway will be approximately 340 m long (from Station 10+000 to 10+338). The roadway is elevated from the westbound lanes of the KW Expressway along the south side of Montgomery Creek. As the exit ramp approaches the east abutment of the overpass bridge structure, the height reaches 13 m, necessitating construction of retaining wall on both sides to support the elevated roadway. The total length of the retaining wall is approximately 325 m along Montgomery Creek. The portion of the retaining wall along the KW Expressway side is shorter, with the length yet to be finalized.

At the south end of the E-S Ramp structure, the approach embankment will be approximately 6 m high. Due to the limited space available in the Highway 8 median, retaining walls on both sides will be required. The retaining wall system will be approximately 200 m long each side.

A new storm water sewer, ranges in depth from 3 to 6 m, will be constructed along the new Highway 8 median to replace the existing storm system. The new storm sewer will be typically 1.5 m in diameter and will be located immediately adjacent to the east side of the retaining wall.

The work presented herein was undertaken under MTO W.P. 363-94-00, Agreement No. 9730-7411-3178, and authorized by Morrison Hershfield Limited, in a letter dated November 2, 1998.

Previous investigation work at this site for the existing KW Expressway overpass structures was undertaken by E.M. Peto and Associates in 1964 and Terraprobe Limited in 1995. This information was reviewed to supplement the present investigation.

2. SITE DESCRIPTION

2.1 Site Location

The site is located in the City of Kitchener at the intersection of Highway 8 and KW Expressway. The existing overpass structures over King Street and Weber Street were constructed in 1966-1967. Widening of the KW Expressway involving the widening of the King Street and Weber Street bridges is presently being carried out by Dufferin Construction under MTO Contract 98-05.

Based on available drawings, the two existing bridge structures are supported on driven pile foundations.

The proposed "third level" overpass structure will span over the KW Expressway. The east approach abutment will be located immediately south of Montgomery Creek within the existing KW Expressway embankment. The invert of Montgomery Creek is near Elevation 314 m whereas the grade at KW Expressway is between Elevations 320 and 325 m. At the Highway 8 median, the grade is between Elevations 322 and 324 m.

2.2 Physiography and Topography

The site is located within the Physiographic Region known as the Waterloo Sandhills. The area is characterized by a flat topography, heavy textured soil and poor drainage (Chapman and Putnam, 1984). The area also has a preponderance of fine sand, particularly on the surface. The hilly region is an extensive area of alluvial terraces of the Grand River spillway system which, although more nearly horizontal, contains similar but more uniform sandy and gravelly materials. Several till sheets underlie the area and are, in order from oldest to youngest, the Catfish Creek Till, Maryhill Till, and Port Stanley Till.

3. INVESTIGATION PROCEDURES

3.1 Field Investigation

Between December 14, 1998 and February 7, 1999, a CME 75 drill rig was used on site for drilling and Standard Penetration Testing (SPT, following the procedures of ASTM D 1586). The drilling involved twenty-eight (28) boreholes along Highway 8, at the KW Expressway and along Montgomery Creek. It is noted that a borehole could not be drilled in the centerline of KW Expressway (proposed Pier 3 of the bridge structure) due to traffic restriction.

Subsequently, nine (9) shallow boreholes (numbered 98-29 to 98-37) were drilled and sampled manually to obtain soil data at the edge of Montgomery Creek (toe of existing embankment).

The locations of the boreholes are shown on Drawings A, B, C and D.

The boreholes were numbered 98-01 through 98-37. The stations and depths of the boreholes are as follows:

Borehole No.	Station No.	Depth of Borehole (m)
98-01	10 + 998 9.0 LT	6.4
98-02	10 + 958 11.5 LT	6.6
98-03	10 + 933 11.0 LT	7.3
98-04	10 + 909 12.0 LT	8.0
98-05	10 + 877 Centerline	8.1
98-06	10 + 850 0.5 RT	8.8
98-07	10 + 825 Centerline	9.6
98-08	10 + 800 Centerline	9.6
98-09	10 + 766 Centerline	11.2
98-10	10 + 733 1.0 RT	30.6
98-11	10 + 689 6.0 RT	29.0
98-12	10 + 619 1.0 RT	26.1
98-13	10 + 560 3.0 RT	26.0
98-14	10 + 457 8.5 LT	27.0
98-15	10 + 370 Centerline	18.4
98-16	10 + 338 Centerline	18.4
98-17	10 + 248 2.0 RT	19.8
98-18	10 + 335 2.0 RT	11.9
98-19	10 + 315 2.0 RT	15.7
98-20	10 + 292 0.5 LT	14.2
98-21	10 + 272 2.5 LT	13.3
98-22	10 + 221 6.0 RT	12.7
98-23	10 + 198 7.5 RT	11.7
98-24	10 + 175 8.0 RT	11.0
98-25	10 + 137 7.0 RT	9.6
98-26	10 + 110 3.0 RT	8.1
98-27	10 + 079 1.0 LT	8.0
98-28	10 + 060 1.0 RT	5.8
98-29	10 + 356 18.5 RT	1.7
98-30	10 + 336 18.0 RT	2.3
98-31	10 + 316 18.0 RT	1.7
98-32	10 + 290 11.0 RT	1.8
98-33	10 + 253 19.0 RT	1.2
98-34	10 + 220 19.0 RT	1.7
98-35	10 + 185 22.0 RT	1.1
98-36	10 + 130 18.0 RT	1.2
98-37	10 + 082 14.0 RT	1.1

The boreholes were drilled using hollow stem augers. Water and/or drilling mud were used to counter-balance the hydrostatic pressure within the hollow stem augers to prevent "blow back" of sands and silts during the borehole advancement and sampling operations.

Soil samples were retrieved at selected intervals of depths throughout the boreholes in conjunction with Standard Penetration Tests (SPT). Samples were generally taken at intervals of 0.75 m in the upper 6 m and thereafter at intervals of 1.5 m to the maximum depth of exploration.

Seepage and water levels were noted in each borehole during and at the completion of drilling and sampling. Standpipe piezometers were installed in Boreholes 98-11, 98-13, 98-14 and 98-17 to 98-28 for future monitoring of the groundwater levels. All boreholes were grouted with bentonite mix at completion of sampling.

The fieldwork was supervised by a member of our field engineering staff under the direction of the project engineer. Our field staff cleared the location of buried utilities and logged the boreholes. The soil samples obtained were placed in labeled containers and transported to our Waterloo Office for further examination and laboratory testing.

The stations, offsets and ground surface elevations at the as drilled borehole locations were surveyed by Morrison Hershfield Limited and provided to AGRA for the purpose of this report.

The results of the drilling, sampling, in-situ testing and water level measurements are summarized on the Record of Borehole sheets, enclosed in Appendix "A".

3.2 Laboratory Analysis

Geotechnical laboratory testing consisted of natural moisture content determinations and visual classifications of all retrieved soil samples. In addition, grain size analyses, unit weight determinations, quick triaxial compression tests, Atterberg Limits and shear box tests were performed on selected samples.

The results of the laboratory testing are summarized on the Record of Borehole presented in Appendix "A" and in Figures 1 to 29 in Appendices "B", "C", "D" and "E".

4. SUBSURFACE CONDITIONS

4.1 South Retaining Wall/Embankment (Boreholes 98-01 to 98-10)

The E-S Ramp retaining wall/embankment, which is located at the south end of the site, was investigated by ten (10) boreholes and the geotechnical information is summarized on Drawing A.

In general, the subsurface deposits within the upper 6 to 10 m at the site consist of the existing pavement structure and fill which are underlain, in turn, by sand, an upper silt,

an upper silty clay and a lower silt layer. Underlying these near surface deposits, Borehole 98-10, which was drilled to a greater depth, contacted lower silty clay and an underlying silt till deposit.

The upper sand and silt deposits range in thickness from 0.8 m at Borehole 98-10 to over 6.4 m at Borehole 98-01, increasing in a southerly direction. An upper silty clay stratum in Boreholes 98-04 to 98-10 underlies these cohesionless deposits, with measured thickness of 1.7 to over 3.5 m.

A lower silt deposit in Boreholes 98-07 to 98-10 follows the upper silty clay, with measured thickness of 8.5 m locally in the deep Borehole 98-10. In Borehole 98-10, the silt is underlain by a lower silty clay stratum (contacted at Elevation 309.0 m), followed by the basal silt till at Elevation 294.7 m.

4.1.1 Pavement, Fill, Topsoil

All boreholes were drilled within the pavement of Highway 8. The pavement structure consists of 160 to 320 mm of asphalt underlain by granular fill to depths between 0.8 and 2.3 m.

The upper 200 to 500 mm thick granular fill is crushed granular road base material and is underlain by a sand and gravel fill, which is assessed to be the granular sub-base course. A grain size distribution of the granular fill material is shown in Figure 1 of Appendix "B".

The granular fill appears to have received compaction as indicated by "N" values in the range of 15 to 56 blows per 0.3 m. Locally at Borehole 98-04, a dark brown sandy silt to sandy silt fill was contacted to 2.3 m depth. This fill was in very loose condition as indicated by an "N" value of 2 blows per 0.3 m.

The fill materials were generally damp to moist with natural moisture contents measured between 3 and 15 %, with an average of 7%.

4.1.2 Sand

A major sand deposit was encountered in all the boreholes immediately underlying the granular fill materials. It extended to depths ranging between 2.6 and in excess of 6.6 m below the ground surface or to elevations ranging from 319.5 and 317.3 m. The measured thickness at the borehole locations ranged from 0.8 to in excess of 6 m.

It is a predominantly fine to medium sand with traces to some silt. However, there are silty and gravelly seams within the sand deposit. Nine (9) grain size analyses were performed on samples obtained from this granular deposit and the results are shown in Figures 2 and 3 of Appendix "B".

Standard penetration tests yielded "N" values from 10 to 100 blows per 0.3 m. The majority of the "N" values are however in the range of 30 to 50, indicative of a dense

condition. There are however occasional compact layers in the upper zones of the deposit, generally immediately below the fill soils.

The sand deposit was in damp to moist condition above the water table with moisture contents recorded in the range of 3 to 8 %, with an average of 5%. Below the water table, the material was wet to saturated with moisture contents measured between 10 and 20 %, with an average of 16 %.

4.1.3 Upper Silt

Immediately underlying the sand deposit in Boreholes 98-01 and 98-03 is a layer of grey silt. This layer was encountered below Elevations 318 to 319 m and was not fully penetrated at the borehole termination depths.

One (1) grain size analysis was performed and the results are shown in Figure 4 of Appendix "B".

Standard penetration tests conducted in this basically fine grained granular (i.e. cohesionless) deposit yielded "N" values from 48 to 115 blows per 0.3 m indicating a dense to very dense condition. The silt was saturated with moisture contents measured between 11 and 20 %, with an average of 16 %.

4.1.4 Upper Silty Clay

A stratum of grey silty clay was contacted underlying the upper sand in Boreholes 98-04 to 98-10 below Elevations 318 to 319 m, with measured thickness of 1.7 to over 3.5 m.

Seven (7) grain size analyses were performed and the results are shown in Figures 5 and 6 of Appendix "B".

The Liquid Limit and Plastic Limit were determined on seven (7) samples (see Figure 9 of Appendix "B") and the results are summarized below:

Liquid Limit	27.0 to 36.3 %, average at 32%
Plastic Limit	16.4 to 18.9 %, average at 17%
Plasticity Index	9.9 to 17.8 %, average at 15%

These results are characteristic of clayey soils of low plasticity. The measured natural moisture contents of samples from the deposit range from 12 to 21 % and as such are close to or below the measured Plastic Limits. Based on the results of natural moisture content and Atterberg Limits, the material can therefore be expected to be pre-consolidated.

Four (4) unconfined compression tests and four (4) unit weight tests were conducted and the results are as follows:

Borehole No.	Sample No.	Undrained Shear Strength (kPa)	Unit Weight (kN/m ³)
98-05	5	585	22.5
98-06	6	550	22.4
98-07	7	573	23.2
98-10	4	313	22.0

Standard penetration tests yielded "N" values from 17 to in excess of 100 blows per 0.3 m. Based on the "N" values and other laboratory test results, the silty clay deposit has a very stiff to hard, but generally hard consistency.

4.1.5 Lower Silt

A lower silt deposit was encountered underlying the upper silty clay below Elevations 315 to 319 m in Boreholes 98-07 to 98-10. Boreholes 98-07, 98-08 and 98-09 were terminated in this deposit while in Borehole 98-10 (i.e. the deep borehole) the deposit is underlain by a lower silty clay deposit at Elevation 309.0 m

Four (4) grain size analyses were performed and the results are shown in Figure 7 of Appendix "B".

Standard penetration tests conducted in this basically fine grained granular deposit gave "N" values from 14 to 120 blows per 0.3 m, indicating a compact to very dense condition. The measured natural moisture contents were between 12 and 22 % (with an average of 17%), indicative of moist to wet moisture condition.

4.1.6 Lower Silty Clay

A stratum of grey silty clay was contacted below the lower silt and above the basal till layer in Borehole 98-10. This deposit was encountered at Elevation 309.0 m and extended to Elevation 294.7 m (i.e., 14.3 m thick).

One (1) grain size analysis was performed in this cohesive deposit and the results are shown in Figure 8 of Appendix "B".

Standard penetration tests yielded "N" values from 58 to 105 blows per 0.3 m indicating a hard consistency. The measured natural moisture contents are in the range of 6 to 15 %, indicative of damp to moist condition. The Liquid Limit and Plastic Limit were determined on one sample (Sample 11 of Borehole 10, see Figure 9 of Appendix "B") to be 30.5 and 17.2 %, respectively. Based on the results of natural moisture content and Atterberg Limits, the deposit is therefore considered to be pre-consolidated.

4.1.7 Silt Till

A heterogeneous mixture of sandy silt, gravel and clay (glacial till) was contacted in Borehole 98-10 at Elevation 294.7 m. The basically granular silt till was penetrated 3.5 m where the borehole was terminated. "N" values in excess of 100 blows per 0.3 m were measured in this deposit and based on these test results, the silt till is classified as very dense.

The measured natural moisture contents were between 5 and 10 %, with an average of 7%.

Boulders and/or cobbles are frequently embedded within glacial till deposits. The very high blow counts and augering resistance within the silt till may infer the presence of cobbles and boulders.

4.2 Seven Span Bridge Structure (Boreholes 98-10 to 98-18)

The seven (7) span bridge structure was investigated by eight (8) boreholes and the geotechnical information is summarized on Drawing B.

In general, the subsurface conditions at the site consist of the existing pavement and embankment fills which are underlain by an upper sand to silty sand interbedded with silty clay, a lower silt, a lower silty clay layer and an underlying silt till.

The upper sand to silty sand deposits range in thickness from 0.8 m at Borehole 98-10 to approximately 8 m at Borehole 98-16, increasing in thickness in a northeasterly direction. These cohesionless materials are interbedded with silty clay layers in Boreholes 98-10 and 98-16, with measured thickness between 1 and 3 m. The upper sand to silty sand is followed by a 4 to 8 m thick lower silt deposit in Boreholes 98-10, 98-11, 98-13 and 98-14.

Underlying the sand and silt deposits, a lower silty clay deposit was contacted all in boreholes, with measured thickness of 6.3 to 18.5 m, followed by the basal silt till which was contacted at elevations ranging from 302.5 m at Borehole 98-15 to 294.7 m at Borehole 98-10.

4.2.1 Pavement, Fill, Topsoil

The boreholes were drilled either within the pavement or from the embankment of Highway 8 and KW Expressway. The pavement structure (Borehole 98-10) consists of 190 mm of asphalt underlain by granular fill to a depth of 1.8 m.

Boreholes 98-11, 98-15, 98-16 and 98-18 contacted typically 200 mm of topsoil at the ground surface.

Below the pavement and topsoil layers, fill was encountered which ranges in thickness from 1.2 to 6.4 m. The thickest (i.e. 6.4 m) was encountered in Borehole 98-14. This borehole was drilled within KW Expressway and consequently was located at a higher elevation compared with the other boreholes. In fact, the fill in this borehole extends to a similar elevation as the remaining boreholes.

The embankment fill materials consist of sand to silty sand. Two (2) typical grain size distributions are shown in Figure 10 of Appendix "C".

The granular fill was generally compact to very dense as indicated by "N" values in the range of 7 to 78 blows per 0.3 m. Local loose layers were contacted at Boreholes 98-11 and 98-18.

The fill materials were generally in damp to moist condition with natural moisture contents measured between 2 and 12 %, with an average of 8 %.

4.2.2 Sand and Silty Sand

The major native soil deposit underlying the fill at the site is a sand to silty sand deposit, which is predominantly fine to medium sand with traces to some silt. There are however some silty and gravelly seams within the sand deposit. The sand deposit extends to depths of 4.3 m (Borehole 98-10) to 12.5 m (Borehole 98-14) or to elevations ranging from 312.1 to 317.5 m.

Figure 11 of Appendix "C" shows a typical grain size distribution of the sand deposit. Figure 12 of Appendix "C" shows a typical grain size distribution of a silt layer, which is interbedded within the sand deposit.

Standard penetration tests yielded "N" values from 10 to 68 blows per 0.3 m. The majority of the "N" values are in the range of 20 to 50, indicative of a compact to dense condition, with occasional compact layers in the upper stratum of the deposit, generally immediately below the fill soils.

The sand deposit was in damp to moist condition above the water table with moisture contents recorded in the range of 3 to 8 %, with an average of 5%. Below the water table, the material was wet to saturated with moisture contents measured between 10 and 20 %, with an average of 16%.

4.2.3 Silty Clay

The upper cohesionless deposits are interbedded with silty clay layers in Boreholes 98-10 and 98-16 between Elevations 309 and 319 m, with measured thickness between 1 and 3 m.

Two (2) grain size analyses were performed and the results are shown in Figure 13 of Appendix "C".

The Liquid Limit and Plastic Limit were determined on two (2) samples (see Figure 17 of Appendix "C") and the results are summarized below:

Liquid Limit	29.9 and 38.0 %
Plastic Limit	16.4 and 21.3 %
Plasticity Index	13.5 and 16.7 %

One (1) unconfined compression test and one (1) unit weight test were conducted and the results are as follows:

Borehole No.	Sample No.	Undrained Shear Strength (kPa)	Unit Weight (kN/m ³)
98-10	4	313	22.0

Standard penetration tests yielded "N" values from 19 to 49 blows per 0.3 m. Based on the "N" values and laboratory test results, the silty clay deposit is considered to have a very stiff to hard consistency.

The natural moisture contents were in the range of 15 to 22 % (with an average of 18%), indicative of moist condition. Therefore, this deposit is considered to be pre-consolidated.

4.2.4 Lower Silt

A lower silt deposit was encountered below the sand to silty sand deposits in Boreholes 98-10, 98-11, 98-13 and 98-14 between Elevations 311 and 317 m. The thickness of this stratum ranges from 4.4 to 8.5 m and it is underlain by lower silty clay deposit at elevations ranging from 309 and 306 m.

Two (2) grain size analyses were performed and the results are shown in Figure 14 of Appendix "C".

Standard penetration tests yielded "N" values from 49 to 120 blows per 0.3 m, indicating dense to generally very dense condition. The measured natural moisture content values are between 6 and 22 %, indicative of moist to wet moisture condition.

4.2.5 Lower Silty Clay

A major stratum of grey silty clay was contacted below the sand and silt strata and above the basal till layer across the site. This deposit was generally contacted between Elevations 310 and 306 m, except in Borehole 98-12 where it was encountered locally at

a considerably higher elevation of 314.7 m. The thickness of the deposit at the borehole locations range from 6.3 to 18.5 m.

Three (3) grain size analyses were performed and the results are shown in Figure 15 of Appendix "C".

The Liquid Limit and Plastic Limit were determined on four (4) samples (see Figure 17 of Appendix "C") and the results are summarized below:

Liquid Limit	30.5 to 38.3 %, average at 34.0%
Plastic Limit	16.5 to 19.3 %, average at 17.5%
Plasticity Index	13.3 to 19.0 %, average at 16.5%

These results are indicative of clayey soils of generally low plasticity. The measured natural moisture contents of samples retrieved from the deposit range from 6 to 15 % (with an average of 11 %) and are below the measured Plastic Limits, indicating that the material is pre-consolidated.

Six (6) unconfined compression tests and six (6) unit weight tests were conducted and the results are as follows:

Borehole No.	Sample No.	Undrained Shear Strength (kPa)	Unit Weight (kN/m ³)
98-11	12	400	21.5
98-11	13	403	21.9
98-15	10	273	21.6
98-18	8	240	22.3
98-18	9	405	22.6
98-18	11	440	22.4

Standard penetration tests yielded "N" values from 35 to 105 blows per 0.3 m indicating a hard consistency.

A "shear box" test was conducted on Sample 6 of Borehole 98-12. The results are presented on Figures 28 and 29 of Appendix "E".

4.2.6 Silt Till

A heterogeneous mixture of sandy silt, gravel and clay (glacial till) was contacted in all the deep boreholes at Elevation 302.0 m at Borehole 98-16 to Elevation 294.7 m at Borehole 98-10, or at depths ranging from 16 to 27 m below ground surface. Borehole 98-18 which was terminated at a higher elevation (i.e. at 11.4 m depth or Elevation 306.9 m) did not encounter this deposit.

The silt till was penetrated 2.0 to 4.5 m where the boreholes were terminated. Standard penetration tests yielded "N" values over 100 blows per 0.3 m. Natural moisture contents were between 5 and 10 %. Based on these test results, the silt till is classified as very dense.

Boulders and/or cobbles are frequently embedded within glacial till deposits. The presence of cobbles and boulders may be inferred from the very high blow counts and the augering resistance while drilling. In any event, due to their mode of formation, the presence of cobbles and boulders can always be expected in the glacial till deposits.

4.3 East Retaining Wall/Embankment (Boreholes 98-16 to 98-37)

The east retaining wall/embankment area was investigated by thirteen (13) deep boreholes and nine (9) shallow manually advanced boreholes. The geotechnical information is summarized on Drawings C and D.

The 13 deep boreholes (Boreholes 98-16 to 98-28) were located along the centerline of the future ramp/embankment, in about the mid-height of the existing KW Expressway embankment. The 9 shallow boreholes (Boreholes 98-29 to 98-37) were advanced at the toe of the existing embankment (on the south side of Montgomery Creek) to determine the thickness of topsoil and fill at the creek bed level.

In general, the subsurface deposits at the site consist of the existing embankment fill which is underlain by sand and gravel, fine sand, silty sand, sandy silt to silt deposits in the upper 5 to 10 m zone. An upper grey silty clay deposit was found within these cohesionless deposits with measured thickness between 1 and 7 m. The above soil strata are underlain by a lower silty clay layer (contacted near Elevations 308 and 309 m) and the underlying silt till (contacted near Elevation 302 m) in Boreholes 98-16 and 98-17 (i.e. deep boreholes).

The boreholes drilled along the south bank at the toe of Montgomery Creek penetrated typically 200 to 450 mm topsoil/peat over a discontinuous layer of granular fill, followed by native sand, sand and gravel and silty clay deposits.

4.3.1 Topsoil and Fill

All boreholes were drilled within the existing embankment of KW Expressway and as such contacted a veneer of topsoil. The surficial topsoil at the borehole locations ranges in thickness from 200 to 300 mm. Along the edge of Montgomery Creek, the topsoil/peat was 200 to 450 mm thick.

The topsoil is underlain by embankment fill, which consist predominantly sand to silty sand with traces of gravel. There are sand and gravel layers within the sand fill materials. The fill contains traces of topsoil, and there are occasional topsoil layers within the fill materials.

The fill ranges in thickness from 0.8 to 5.2 m, decreasing in thickness towards the east where the existing embankment crosses over Montgomery Creek. The fill extends at the borehole locations to elevations generally ranging from 317.9 to 315.8 m. Locally at Borehole 98-21, the 5.2 m thick fill (Elevation 315.6 m) is probably related to backfilling of the existing concrete pipe culvert that crosses KW Expressway.

Two typical grain size distributions are shown in Figure 18 of Appendix "D". Six unit weight determinations were conducted on the fill materials. The unit weight ranges from 19.3 to 20.7 kN/m³, with an average of 20.0 kN/m³.

Standard Penetration Tests provided "N" values in the range of 7 to 49 blows per 0.3 m, generally between 15 and 35 blows per 0.3 m. The fill can therefore be considered in a compact to dense condition, with local loose layers

The fill materials were generally in moist to saturated condition with natural moisture contents measured between 8 and 25 %, with an average of 14 %.

4.3.2 Sand/Silt

The native soil deposits immediately underlying the embankment fill consist of predominately fine sand to sandy silt, with minor inclusions of sand and gravel and silt layers. The native soil deposits generally exist between Elevations 316.5 and 317.5 m and range in thickness from 5 to 10 m. These soil strata were not fully penetrated in Boreholes 98-20 through 98-25.

Twelve (12) grain size analyses were performed and the results are shown in Figures 19, 20 and 21 of Appendix "D". Seven unit weight determinations were conducted on the sand/silt materials. The unit weight ranges from 18.6 to 22.7 kN/m³, with an average of 21.0 kN/m³.

Standard penetration tests yielded "N" values from 8 to 99 blows per 0.3 m. The majority of the "N" values are in the range of 30 to 60, indicative of a dense to very dense condition. There are, however, occasional loose to compact layers in the upper stratum of the deposit, generally immediately below the fill soils.

The sand/silt deposit was in damp to moist condition above the water table with natural moisture contents recorded in the range of 3 to 8 %, with an average of 5 %. Below the water table, the material was wet to saturated with moisture contents measured between 10 and 20 %, with an average of 16 %.

4.3.3 Upper Silty Clay

A major layer of grey silty clay was contacted within the upper sand/silt layers in Boreholes 98-16, 98-17, 98-19, 98-20 to 98-24, and 98-26 to 98-28 as well as the shallow boreholes at the toe of the embankment along Montgomery Creek.

This layer is about 1 to 5 m thick and was encountered approximately between Elevations 313 and 311 m. In Boreholes 98-19 and 98-21, the silty clay lies immediately beneath the embankment fill. Boreholes 98-26 to 98-28 were terminated within this upper silty clay deposit.

Ten (10) grain size analyses were performed and the results are shown in Figures 22 and 23 of Appendix "D".

The Liquid Limit and Plastic Limit were determined on ten (10) samples (see Figures 26 and 27 of Appendix "D") and the results are summarized below:

Liquid Limit	26.3 to 44.1 %, average at 35%
Plastic Limit	14.4 to 21.4 %, average at 17%
Plasticity Index	11.9 to 23.2 %, average at 18%

These results are indicative of clayey soils of generally low plasticity. The measured natural moisture contents obtained from the deposit range from 12 to 21 % (with an average of 17 %) which are very close to or below the measured Plastic Limits and this indicates that the material is likely to be pre-consolidated.

Six (6) unconfined compression tests and six (6) unit weight tests were conducted and the results are as follows:

Borehole No.	Sample No.	Undrained Shear Strength (kPa)	Unit Weight (kN/m ³)
98-17	6	310	21.8
98-19	4	140	21.1
98-19	7	255	21.8
98-20	6	143	21.1
98-23	7	179	20.8
98-27	7	455	22.8

Standard penetration tests yielded "N" values from 19 to 88 blows per 0.3 m. Based on the "N" values, the laboratory test results together with a visual and tactile examination of the soil samples, the silty clay deposit is considered to have a very stiff to hard consistency.

4.3.4 Lower Silty Clay

A major stratum of grey silty clay was contacted below the upper sand/silt and upper silty clay strata in the relatively deep boreholes (Boreholes 98-16, 98-17, 98-18 and 98-19) between Elevations 307 and 310 m. Boreholes 98-18 and 98-19 were terminated in this deposit at depth ranging between 12 and 16 m thick below the ground surface (Elevation 306.4 and 302.9 m) while in Boreholes 98-16 and 98-17, it extended to about 16 to 18 m or about Elevation 302 m.

One (1) grain size analysis was performed and the results are shown in Figure 24 of Appendix "D".

The Liquid Limit and Plastic Limit were determined on three (3) samples (see Figures 26 and 27 of Appendix "D") and the results are summarized below:

Liquid Limit	31.0 to 37.5 %, average at 34.5%
Plastic Limit	15.5 to 19.3 %, average at 17.5%
Plasticity Index	15.5 to 18.2 %, average at 17.0%

These index values indicate clayey soils of low plasticity and from the measured natural moisture contents of 5 to 16 % (with an average of 13 %). This material is at or below the measured Plastic Limits and, therefore, it can be inferred that the material is pre-consolidated.

Three (3) unconfined compression tests and three (3) unit weight tests were conducted and the results are as follows:

Borehole No.	Sample No.	Undrained Shear Strength (kPa)	Unit Weight (kN/m ³)
98-18	8	240	22.3
98-18	9	405	22.6
98-18	11	440	22.4

Standard penetration tests yielded "N" values from 50 to 110 blows per 0.3 m indicating a hard consistency.

A "shear box" test was conducted on Sample 9 of Borehole 98-18. The results are presented in Figures 28 and 29 of Appendix "E".

4.3.5 Silt Till

A heterogeneous mixture of sandy silt, gravel and clay (glacial till) was contacted in Boreholes 98-16 and 98-17 (i.e. two deepest boreholes), below about Elevation 302 m. The silt till was penetrated 2 m where the boreholes were terminated. Standard penetration tests in this basal till deposit yielded "N" values over 100 blows per 0.3 m. Based on these test results, the silt till is classified as very dense. The measured natural moisture contents were between 5 and 10 %.

Boulders and/or cobbles are frequently embedded within glacial till deposits. The very high blow counts and augering resistance within the silt till may infer the presence of cobbles and boulders.

4.4 Groundwater Conditions

On completion of drilling, the following observations of groundwater levels were made:

Borehole No.	Depth of Borehole (m)	Station No.	Observation
98-01	6.4	10 + 998 9.0 LT	Free water at 4.7 m, Elevation 318.9 m upon completion
98-02	6.6	10 + 958 11.5 LT	Free water at 5.5 m, Elevation 318.3 m upon completion
98-03	7.3	10 + 933 11.0 LT	Free water at 5.5 m, Elevation 318.4 m upon completion
98-04	8.0	10 + 909 12.0 LT	Free water at 6.1 m, Elevation 317.7 m upon completion
98-05	8.1	10 + 877 Centerline	Free water at 7.5 m, Elevation 316.3 m upon completion
98-06	8.8	10 + 850 0.5 RT	No free water upon completion
98-07	9.6	10 + 825 Centerline	Free water at 8.7 m, Elevation 314.6 m upon completion
98-08	9.6	10 + 800 Centerline	Free water at 6.1 m, Elevation 316.9 m upon completion
98-09	11.2	10 + 766 Centerline	Free water at 6.7 m, Elevation 315.7 m upon completion
98-10	30.6	10 + 733 1.0 RT	Free water at 4.3 m, Elevation 317.5 m upon completion
98-11	29.0	10 + 689 6.0 RT	Water at 5.1 m, Elevation 315.5 m on 2/2/99, in standpipe
98-12	26.1	10 + 619 1.0 RT	No free water upon completion
98-13	26.0	10 + 560 3.0 RT	Water at 6.4 m, Elevation 314.1 m on 2/2/99, in standpipe
98-14	27.0	10 + 457 8.5 LT	Water at 9.1 m, Elevation 315.5 m on 2/2/99, in standpipe
98-15	18.4	10 + 370 Centerline	Free water at 3.5 m, Elevation 315.0 m upon completion
98-16	18.4	10 + 338 Centerline	Free water at 3.4 m, Elevation 315.0 m 24 hours after completion
98-17	19.8	10 + 248 2.0 RT	Water at 4.1 m, Elevation 316.3 m on 2/2/99, in standpipe
98-18	11.9	10 + 335 2.0 RT	Water at 3.7 m, Elevation 314.6 m on 2/2/99, in standpipe
98-19	15.7	10 + 315 2.0 RT	Water at 3.7 m, Elevation 314.9 m on 2/2/99, in standpipe
98-20	14.2	10 + 292 0.5 LT	Water at 3.9 m, Elevation 316.1 m on 2/2/99, in standpipe
98-21	13.3	10 + 272 2.5 LT	Water at 4.5 m, Elevation 316.3 m on 2/2/99, in standpipe

98-22	12.7	10 + 221 6.0 RT	Water at 2.9 m, Elevation 317.1 m on 2/2/99, in standpipe
98-23	11.7	10 + 198 7.5 RT	Water at 2.7 m, Elevation 317.0 m on 2/2/99, in standpipe
98-24	11.0	10 + 175 8.0 RT	Water at 2.1 m, Elevation 317.2 m on 2/2/99, in standpipe
98-25	9.6	10 + 137 7.0 RT	Water at 1.7 m, Elevation 317.2 m on 2/2/99, in standpipe
98-26	8.1	10 + 110 3.0 RT	Free water at 3.4 m, Elevation 315.2 m upon completion
98-27	8.0	10 + 079 1.0 LT	Water at 2.7 m, Elevation 315.7 m on 2/2/99, in standpipe
98-28	5.8	10 + 060 1.0 RT	Water at 2.8 m, Elevation 315.4 m on 2/2/99, in standpipe
98-29	1.7	10 + 356 18.5 RT	Free water at 0.3 m, Elevation 314.3 m upon completion
98-30	2.3	10 + 336 18.0 RT	Free water at 0.3 m, Elevation 314.2 m upon completion
98-31	1.7	10 + 316 18.0 RT	Free water at 0.3 m, Elevation 314.9 m upon completion
98-32	1.8	10 + 290 11.0 RT	Free water at 0.3 m, Elevation 314.9 m upon completion
98-33	1.2	10 + 253 19.0 RT	Free water at 0.3 m, Elevation 315.4 m upon completion
98-34	1.7	10 + 220 19.0 RT	Free water at 0.3 m, Elevation 315.2 m upon completion
98-35	1.1	10 + 185 22.0 RT	Free water at 0.3 m, Elevation 315.2 m upon completion
98-36	1.2	10 + 130 18.0 RT	Free water at 0.3 m, Elevation 315.4 m upon completion
98-37	1.1	10 + 082 14.0 RT	Free water at 0.3 m, Elevation 315.4 m upon completion

The recorded water levels were some 4.3 to 8.7 m below the Highway 8 grade (Boreholes 90-01 to 98-10), corresponding to Elevations 314.6 to 318.9 m. These water levels indicate that the groundwater flows in a northwest direction towards Montgomery Creek.

Along Montgomery Creek, the creek bed is near Elevation 314 m with the water level in the creek near Elevation 314.5 m. Boreholes along the existing embankment revealed water level at the time of investigation typically 3 to 4 m below grade, corresponding to Elevations 315 to 317 m. The observed water levels indicate the shallow groundwater table, and the level of ground saturation due to capillary action.

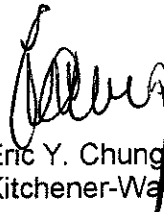
Fluctuations in the groundwater table can be expected seasonally and in response to major weather events.

6. STATEMENT OF LIMITATION

We recommend that once the details of the proposed structure are finalized, our recommendations should be reviewed for their specific applicability.

The Limitation of Report, as quoted in Appendix "G", is an integral part of this report.

Yours truly,
AGRA Earth & Environmental Limited


Eric Y. Chung, M.Eng., P.Eng.
Kitchener-Waterloo Branch Manager





Zuhtu S. Ozden, P.Eng.
Designated MTO Contact



EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING			MECHANICAL PROPERTIES OF SOIL		
S S	SPLIT SPOON	T P	THINWALL PISTON	m_v	kPa^{-1} COEFFICIENT OF VOLUME CHANGE
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE	C_c	1 COMPRESSION INDEX
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE	C_s	1 SWELLING INDEX
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY	C_a	1 RATE OF SECONDARY CONSOLIDATION
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY	c_v	m^2/s COEFFICIENT OF CONSOLIDATION
T W	THINWALL OPEN	F S	FOIL SAMPLE	H	m DRAINAGE PATH
STRESS AND STRAIN			T_v	1	TIME FACTOR
u_w	kPa		U	%	DEGREE OF CONSOLIDATION
r_u	1		σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ	kPa		σ'_p	kPa	PRECONSOLIDATION PRESSURE
σ'	kPa		τ_f	kPa	SHEAR STRENGTH
τ	kPa		c'	kPa	EFFECTIVE COHESION INTERCEPT
$\sigma_1, \sigma_2, \sigma_3$	kPa		ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
ϵ	%		c_u	kPa	APPARENT COHESION INTERCEPT
$\epsilon_1, \epsilon_2, \epsilon_3$	%		ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
E	kPa		τ_R	kPa	RESIDUAL SHEAR STRENGTH
G	kPa		τ_r	kPa	REMOULDED SHEAR STRENGTH
μ	1		S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

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

APPENDIX “A”

Record of Borehole Sheets

RECORD OF BOREHOLE No 98-01

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4810976N, 227744E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 29.12.98 - 29.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
323.6	ASPHALT 300mm Crushed Granular 200 mm sand and gravel FILL						323										
322.9																	
0.8	Dense, brown Fine SAND, trace gravel damp	o	1	SS	35								o				
322.1		o															
1.5	Compact to Dense, brown Fine SAND, trace silt damp		2	SS	23		322						o				0 90 10 0
			3	SS	40		321						o				
320.6																	
3.1	Dense, brown medium-fine SAND damp		4	SS	36		320						o				
318.9							319										
4.7	grey saturated		5	SS	46												
318.3																	
5.3	Very Dense, grey SILT, trace to some fine sand wet						318										
			6	SS	115								o				
317.2																	
6.4	END OF BOREHOLE @ 6.4 m NOTE: Water Level @ 4.7 m Upon Completion																

EXPRESS: 33-393 GPJ EXPRESS GOT 24/08/99

RECORD OF BOREHOLE No 98-02

1 OF 1

METRIC

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4810994N, 227708E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 29.12.98 - 29.12.98 CHECKED BY EYC

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			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%) w _p w w _L				
323.8 0.0	ASPHALT 320 mm Crushed Granular 200 mm							20	40	60	80	100					
323.3 0.5	Dense brown, sand and gravel FILL damp		1	SS	31		323										
322.3 1.5	Compact to Dense, brown Fine SAND, trace silt damp		2	SS	18		322										
			3	SS	38		321										0 87 13 0
			4	SS	46		320										
319.1 4.7	Very Dense, brown medium-fine SAND wet		5	SS	59		319										
318.3 5.5	grey, trace gravel saturated						318										
317.3 6.6	END OF BOREHOLE @ 6.6 m NOTE: Water Level @ 5.5 m Upon Completion																

RECORD OF BOREHOLE No 98-03

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4610999N, 227697E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 29.12.98 - 29.12.98 CHECKED BY EYC

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									
								20 40 60 80 100									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
WATER CONTENT (%)					10 20 30												
323.9 0.0	ASPHALT 310 mm Crushed Granular 200 mm Compact, brown sand and gravel FILL damp		1	SS	24		323										0 93 7 0
322.4 1.5	Compact to Very Dense, brown Fine SAND, trace silt damp		2	SS	26		322										
			3	SS	32		321										
			4	SS	42		320										
319.0 4.9	Dense to Very Dense grey, SILT, trace fine sand wet to saturated		5	SS	74		319										0 16 82 2
			6	SS	110		318										
316.6 7.3	END OF BOREHOLE @ 7.3 m NOTE: Water Level @ 5.5 m Upon Completion		7	SS	48		317										

RECORD OF BOREHOLE No 98-04

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811017N, 227665E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 29.12.95 - 29.12.98 CHECKED BY EYC

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									WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE						
323.8							20	40	60	80	100	10	20	30			
0.0	ASPHALT 170 mm Crushed Granular 200 mm Compact, dark brown sandy silt to silty sand FILL damp		1	SS	15												
	Very loose		2	SS	2												
321.5																	
2.3	Dense to Very Dense, brown medium-fine SAND, trace silt and gravel damp		3	SS	32												
			4	SS	53												
			5	SS	100												
317.7																	
6.1	Very Dense, grey Silty Fine SAND saturated		6	SS	80												
316.8																	
7.0	Hard, grey Silty CLAY moist																
			7	SS	100												
315.8																	
8.0	END OF BOREHOLE @ 8.0 m NOTE: Water Level @ 6.1 m Upon Completion																

RECORD OF BOREHOLE No 98-05

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811017N, 227632E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 20.01.99 - 20.01.99 CHECKED BY EYC

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									
								20	40	60	80	100					
										</							

EXPRESS: 33-393 GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-06

1 OF 1

METRIC

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4811029N, 227605E ORIGINATED BY SW
DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
DATUM Geodetic DATE 20.01.99 - 20.01.99 CHECKED BY EYC

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						
323.5								20 40 60 80 100						GR SA SI CL
0.0	ASPHALT 250 mm Crushed Granular 500 mm						323							
322.8							322							
0.8	Compact, brown medium fine SAND		1	SS	10									
			2	SS	15									
			3	SS	24		321							
320.4							320							
3.1	Dense													13 78 9 0
319.6			4	SS	36		319							
4.0	trace to some gravel damp													
318.2							318							0 28 44 28
5.3	Hard, grey Silty CLAY moist		5	SS	60		317							
			6	SS	42		316							
			7	SS	34		315							
314.7														
8.8	END OF BOREHOLE @ 8.8 m NOTE: No Free Water @ Completion													

EXPRESS 33-393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-07

1 OF 1

METRIC

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4811039N, 227563E ORIGINATED BY SY
DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
DATUM Geodetic DATE 21.01.99 - 21.01.99 CHECKED BY EYC

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							
								20 40 60 80 100							
323.3							323								
0.0	ASPHALT 175 mm sand and gravel FILL 400 mm Compact, dark brown to black medium-fine sand FILL, trace gravel moist		1	SS	27		322								
321.8															
1.5	Dense, brown medium SAND, trace gravel damp		2	SS	27		321								0 95 5 0
			3	SS	43										
			4	SS	49		320								
319.8															
3.5	wet to saturated		5	SS	47		319								
318.9							318								
4.4	Hard, grey Silty CLAY moist		6	SS	65										
			7	SS	65		317						23.2	0 4 51 45 573 kPa	
							316								
315.5			8	SS	26		315								0 48 44 8
7.8	Compact, grey SILT, trace sand wet														
314.6							314								
8.7	saturated		9	SS	22										
313.7															
9.6	END OF BOREHOLE @ 9.6 m NOTE: Water Level @ 8.7 m Upon Completion														

EXPRESS 33-383 GPJ EXPRESS GDT 24/09/99

RECORD OF BOREHOLE No 98-08

1 OF 1

METRIC

W.P. 383-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811049N, 227560E ORIGINATED BY SY
DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
DATUM Geodetic DATE 20.01.99 - 20.01.99 CHECKED BY EYC

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 (%)		
								20 40 60 80 100										
								20 40 60 80 100										
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
323.0																		
0.0	ASPHALT 215 mm sand and gravel FILL 385mm Dense to Very Dense, dark brown to black cobbly sand and gravel FILL damp		1	SS	56		322											
321.2			2	SS	46													
1.8	Dense, brown medium-fine SAND damp		3	SS	32		321											
			4	SS	30		320								0 85 15 0			
318.7							319											
4.3	Hard, grey Silty CLAY, occasional silt partings moist		6	SS	50		318								0 3 60 37			
316.6			7	SS	24		317											
6.4	Compact, grey SILT, trace sand saturated		8	SS	14		316								0 55 45 0			
							315											
313.4			9	SS	18		314											
9.6	END OF BOREHOLE @ 9.6 m NOTE: Water Level @ 8.7 m Upon Completion																	

RECORD OF BOREHOLE No 98-09

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811063N, 227530E ORIGINATED BY SY
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 20.01.99 - 20.01.99 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
							WATER CONTENT (%)										
							20 40 60 80 100					10 20 30					
322.4							322										
0.0	ASPHALT 175 mm sand and gravel FILL Compact to Dense, dark brown to black cobbly silty sand and gravel FILL damp		1	SS	37												
320.7			2	SS	28		321										
1.7	Compact to Dense, brown medium-fine SAND damp		3	SS	34		320										
319.5																	
2.9	Very Stiff, brown Silty CLAY		4	SS	17		319								0 3 62 35		
319.1																	
3.4	grey moist		5	SS	17		318										
317.8			6	SS	22		317										
4.6	Compact to Very Dense, grey SILT, trace sand moist																
			7	SS	50		316								0 37 60 3		
315.7																	
6.7	saturated		8	SS	55		315										
							314										
			9	SS	57		313										
							312										
			10	SS	55												
311.2																	
11.2	END OF BOREHOLE @ 11.2 m NOTE: Water Level @ 6.7 m Upon Completion																

EXPRESS 33-393 GPJ EXPRESS GDT 24/08/99

RECORD OF BOREHOLE No 98-10

1 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811077N, 227500E ORIGINATED BY SY/SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 21.01.99 - 05.02.99 CHECKED BY EYC

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								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL							× LAB VANE	
321.8							20	40	60	80	100	10	20	30	GR SA SI CL			
0.0	190 mm ASPHALT sand and gravel FILL 610mm Compact, dark brown to black cobbley sand and gravel FILL		1	SS	29													
320.0			2	SS	19													
1.8	Compact, brown Medium SAND damp		3	SS	22													
319.2			4	SS	49													
2.6	Hard, grey Silty Clay moist																	
	Silt Seam		5	SS	58													
317.5			6	SS	49													
4.3	Dense to Very Dense, grey SILT, trace sand wet to saturated		7	SS	88													
			8	SS	79													
312.6			9	SS	85													
9.2	occasional saturated sand seams		10	SS	120													
			11	SS	78													
309.0			12	SS	105													
12.8	Hard, grey Silty Clay moist																	



Continued Next Page

+ 3, 3. Numbers refer to 3% STRAIN AT FAILURE
Sensitivity

EXPRESS 33-393.GPJ EXPRESS.GDT 24/08/99

METRIC

ELEV DEPTH	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 (%)
	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80		
							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL < LAB VANE						
							20 40 60 80 100 WATER CONTENT (%) 10 20 30						

294.7 27.1	Hard, grey Silty CLAY moist		13	SS	64																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
---------------	--------------------------------	---	----	----	----	---	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

EXPRESS, 33-393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-11

1 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811094N, 227458E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 21.01.99 - 05.02.99 CHECKED BY EYC

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								
								○ UNCONFINED + FIELD VANE								
								● QUICK TRIAXIAL × LAB VANE								
				WATER CONTENT (%)												
				20 40 60 80 100				10 20 30								
320.6																GR SA SI CL
0.0	TOPSOIL 200mm sand and gravel FILL damp		1	AUGER												38 44 18 0
			2	SS	8											
319.1																
1.5	Compact to Dense, brown Medium Fine SAND, trace to some gravel damp		3	SS	10											
			4	SS	31											
			5	SS	26											
	</															

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/08/99

Continued Next Page

+ 3 3. Numbers refer to
Sensitivity

3% STRAIN AT FAILURE

1 OF 2

METRIC

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 (%)	
								○ UNCONFINED ● QUICK TRIAXIAL							+ FIELD VANE × LAB VANE
319.1 0.0	sand and gravel FILL 500 mm Dense, dark brown to black sandy silt FILL moist					319									
			1	SS	46	318									
317.6 1.5	Dense to Very Dense, brown SAND, some gravel damp		2	SS	47	317									
			3	SS	68	316									
315.6 3.5	Fine SAND saturated		4	SS	56	315									
314.7 4.4	Hard, grey Silty CLAY moist					314									
			5	SS	53	313									
			6	TW		312									
			7	SS	56	311									
						310									
			8	SS	59	309									
						308									
		9	SS	51	307										
					306										
					305										
		10	SS	56	304										

Continued Next Page

+ 3. 3. Numbers refer to Sensitivity 3% STRAIN AT FAILURE

EXPRESS. 33.393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-12

2 OF 2

METRIC

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4811142N, 227407E ORIGINATED BY SW
DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
DATUM Geodetic DATE 06.02.99 - 06.02.99 CHECKED BY EYC

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 Y 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					
	Hard, grey Silty CLAY																
			11	SS	57												
			12	SS	53												
296.2			13	SS100/1250mm													
22.9	Very Dense grey, Sandy SILT TILL damp																
			14	SS100/1500mm													
293.0			15	SS 100/50mm													
26.1	END OF BOREHOLE @ 26.1 m NOTE: No Free Water @ Completion																

EXPRESS 33-393.GPJ EXPRESS.GDT 24/06/99

RECORD OF BOREHOLE No 98-13

1 OF 2

METRIC

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4811188N, 227370E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 07.02.99 - 07.02.99 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
320.5 0.0	Dark brown silty sand FILL, some gravel, topsoil seam						320							
319.7 0.8	Compact to Very Dense, brown gravelly sand FILL moist		1	SS	55		319							
			2	SS	24		318							
316.7 3.8	Dense, brown, Fine SAND, trace to some gravel wet to saturated						317							
			3	SS	36		316							
			4	SS	42		315							
			5	SS	48		314							
							313							
311.3 9.2	Very Dense, grey SILT saturated		6	SS	52		312							
							311							
							310							
							309							
							308							
306.1 14.3	Hard, grey Silty CLAY moist						307							
			7	SS	62		306							
							305							

EXPRESS, 33-393 GPJ EXPRESS.GDT 24/08/99

Continued Next Page

+ 3 3 Numbers refer to Sensitivity 3% STRAIN AT FAILURE

METRIC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w_p w w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa				
								○ UNCONFINED ● QUICK TRIAXIAL				+ FIELD VANE * LAB VANE
							20 40 60 80 100 					
							20 40 60 80 100 					
								WATER CONTENT (%) 10 20 30				

[illegible]

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

EXPRESS, 33-393.GPJ EXPRESS.GDT 24/08/99

METRIC

Continued Next Page

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

RECORD OF BOREHOLE No 98-14

2 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811287N, 227344E ORIGINATED BY SY
DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
DATUM Geodetic DATE 06.02.99 - 06.02.99 CHECKED BY EYC

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			SHEAR STRENGTH kPa								WATER CONTENT (%)	
								20	40	60	80	100					
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
								20	40	60	80	100	10	20	30		GR SA Si CL
307.7							308										
16.9	Hard, grey Silty CLAY moist		6	SS	55		307										
							306										
							305										
			7	SS	60		304										
							303										
							302										
							301										
300.6							300										
24.0	Very Dense, grey Sandy SILT TILL damp		8	SS100/125mm			299										
							298										
297.6			9	SS100/125mm													
27.0	END OF BOREHOLE @ 27.0 m NOTE: Water Level @ 6.4 m on 02/02/99																

EXPRESS 33-393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-15

1 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811372N 227333E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 31.12.98 - 31.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
318.5																	
0.0	TOPSOIL 200 mm Dense, dark grey silty sand FILL moist		1	SS	47		318										
316.8							317										
1.7	Dense, brown fine sand FILL wet		2	SS	45												
316.2							316										
2.3	Dense, mottled brown SAND, some gravel saturated		3	SS	41												
315.6							315										0 48 52 0
2.9	Compact, grey SILT and Fine SAND saturated		4	SS	19												
313.9							314										
4.8	Dense to Very Dense, grey medium-fine SAND saturated		5	SS	30		313										
							312										
			6	SS	56												
							311										
			7	SS	51		310										
309.5																	
9.0	Hard, grey Silty CLAY		8	SS	42		309										0 2 58 40
							308										
307.8							307										
10.7	trace imbedded coarse sand moist		9	SS	54												
							306									21.6	273 kPa
			10	SS	35												
							305										
			11	SS	75		304										
							303										
			12	SS	50												
302.5																	

EXPRESS 33-393.GPJ EXPRESS.GDT 24/08/99

Continued Next Page

3 3 Numbers refer to 3% STRAIN AT FAILURE
Sensitivity

RECORD OF BOREHOLE No 98-15

2 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811372N, 227333E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 31.12.98 - 31.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
16.0	Very Dense, grey Sandy SILT TILL damp		13	SS1	20/150mm		302										
							301										
300.1 18.4	END OF BOREHOLE @ 18.4 m NOTE: Water Level @ 3.5 m Upon Completion		14	SS1	15/125mm												

EXPRESS, 33-393 GPJ EXPRESS, GDT, 24/08/99

RECORD OF BOREHOLE No 98-16

1 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811404N, 227339E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 30.12.98 - 30.12.98 CHECKED BY EYC

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							WATER CONTENT (%)			
318.4							20	40	60	80	100							
0.0	TOPSOIL 200 mm dark grey to black sandy silt and silty sand FILL wet																	
317.2			1	AS														
1.2	Dense, brown SAND wet		2	SS	31													
316.3																		
2.1	Very Stiff, grey Silty CLAY moist		3	SS	28													
			4	SS	19													
313.3			5	SS	28													
5.0	Dense to Very Dense, gray Fine SAND saturated																	
			6	SS	30													
310.6																		
7.8	Hard, grey Silty CLAY moist		7	SS	105													
309.3																		
9.1	Very Dense, grey SAND saturated		8	SS	62													
308.3																		
10.1	Hard, grey Silty CLAY		9	SS	75													
306.2																		
12.2	trace to some imbedded coarse sand moist		10	SS	95													
			11	SS	81													
			12	SS	78													

EXPRESS: 33-393.GPJ EXPRESS.GDT: 24/08/99

Continued Next Page

+ 3 . 3. Numbers refer to ϕ 3% STRAIN AT FAILURE
Sensitivity

RECORD OF BOREHOLE No 98-16

2 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811404N, 227339E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 30.12.98 - 30.12.98 CHECKED BY EYC

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			20	40	60	80	100					
302.0						302										
16.4	Very Dense, grey Sandy SILT TILL		13	SS150/125mm		301										
300.0			14	SS100/100mm		300										
18.4	END OF BOREHOLE @ 18.4 m NOTE: Water Level @ 3.4 m 24 hrs After Completion															

EXPRESS 33-393 GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-17

1 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811498N, 227365E ORIGINATED BY SW
DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
DATUM Geodetic DATE 15.12.98 - 16.12.98 CHECKED BY EYC

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			20	40	60	80	100					
320.4																	
0.0	TOPSOIL 200 mm Compact to Dense, dark brown silty sand FILL, trace to some gravel, occasional cobbles, occasional topsoil layer moist		1	SS	23		320										
			2	SS	39		319										
			3	SS	15		318										
317.8			4	SS	28		317										
2.6	Compact to Dense, grey Fine SAND wet to saturated		5	SS	38		316										
316.6			6	SS	23		315										
3.8	some gravel		7	SS	57		314										
315.8			8	SS	36		313										
4.6	Very Stiff to Hard, grey Silty CLAY moist		9	SS	55		312										
			10	SS	78		311										
311.3			11	SS	87		310										
9.1	Very Dense, grey Sandy SILT saturated		12	SS	93		309										
309.7			13	SS	75		308										
10.7	Very Dense, grey Fine SAND, trace to some silt saturated						307										
307.9							306										
12.5	Hard, grey Silty CLAY moist						305										

EXPRESS 33-393 GPJ EXPRESS GDT 24/08/99

Continued Next Page

+ 3 3. Numbers refer to 3% STRAIN AT FAILURE
Sensitivity

2 OF 2

METRIC

ORIGINATED BY SW

COMPILED BY SY

CHECKED BY EYC

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

RECORD OF BOREHOLE No 98-18

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811387N, 227334E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 05.01.99 - 05.01.99 CHECKED BY EYC

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		
318.3 0.0	TOPSOIL 200 mm Compact, brown silty sand FILL moist to wet		1	SS	18		318							
316.8 1.5	loose		2	SS	7		317							
316.3 1.8	Compact brown Fine SAND, occasional grey clay seams wet		3	SS	22		316							
315.3 3.1	saturated, grey		4	SS	19		315							
							314							
313.1 5.2	Dense grey Silty SAND saturated		5	SS	15		313							
			6	SS	38		312							
			7	SS	30		311							
309.8 8.5	Hard, grey Silty CLAY, layers and pockets of silt		8	SS	42		310							
			9	TW			309						22.3	240 kPa
			10	SS	60		308						22.6	405 kPa
			11	SS	82		307						22.4	440 kPa
306.9 11.4	moist silt		12	TW			306						21.8	75 kPa
306.4 11.9	END OF BOREHOLE @ 11.9 m NOTE: Water Level @ 3.7m on 02/02/99													

EXPRESS, 33-393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-19

1 OF 2

METRIC

W.P. 383-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811426N, 227344E ORIGINATED BY SW
DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
DATUM Geodetic DATE 14.12.98 - 14.12.98 CHECKED BY EYC

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			SHEAR STRENGTH kPa							WATER CONTENT (%)				
								○ UNCONFINED	+ FIELD VANE										
								● QUICK TRIAXIAL	× LAB VANE										
318.6							20	40	60	80	100								
0.0	TOPSOIL 200 mm Compact, brown fine sand FILL moist to wet																		
			1	SS	24														
			2	SS	18														
			3	SS	15														
315.8																			
2.8	Very Stiff to Hard, brown/grey Silty CLAY, occasional saturated sand and silt seams moist		4	SS	29														
			5	SS	46														
			6	SS	30														
			7	SS	40														

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/08/99

Continued Next Page

2 OF 2

METRIC

ELEV DEPTH	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 (%)
	DESCRIPTION		NUMBER	TYPE			"N" VALUES	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)			
							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100			10 20 30		GR SA SI C	

NOTE: Water Level @ 3.7m on
02/02/99

EXPRESS. 33-393 GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-20

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811448N, 227353E ORIGINATED BY SW
DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
DATUM Geodetic DATE 14.12.98 - 14.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40						60	80	100	20	40	60
320.0	TOPSOIL, 200 mm Compact to Dense, dark brown silty sand, fine sand, sandy silt FILL moist to wet																			
0.0			1	SS	23															
318.2			2	SS	31															
1.8	topsoil FILL seam medium-fine sand FILL																			
317.4			3	SS	35															
2.8	Dense, grey fine sand FILL, very cobbly																			
317.0			4	SS	26															
3.1	Compact to Dense, grey Silty Fine SAND, trace to some silt seams wet																			
316.1																				
3.9	saturated																			
315.1			5	SS	31															
4.9	Dense, grey medium-fine SAND																			
314.5																				
5.5	cobbly/gravelly																			
314.1																				
5.9	Very Stiff, grey Silty CLAY moist		6	SS	25															
313.3																				
6.7	Very Dense, grey Sandy SILT saturated																			
313.3			7	SS	78															
			8	SS	84															
			9	SS	85															
			10	SS	85															
			11	SS	87															
305.8																				
14.2	END OF BOREHOLE @ 14.2 m NOTE: Water Level @ 3.9m on 02/02/99																			

RECORD OF BOREHOLE No 98-21

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811466N, 227361E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 15.12.98 - 15.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
320.8	TOPSOIL 200 mm mixed gravel and topsoil FILL																
320.2																	
319.7	0.6 Compact, brown gravelly sand FILL		1	SS	16		320										
319.1	1.1 topsoil FILL @ 1.1 m moist		2	AUGER	11		319										
318.5																	
318.2	2.3 Compact to Dense, black stained sandy silt FILL, some gravel, wood fragments wet		3	SS	47		318									19.9	
317.0			4	SS	23												
317.0							317									19.3	
316.2	3.8 Compact, grey sand FILL, some cobbles wet		5	SS	27												
315.8	4.6 Dense, grey medium-coarse sand and gravel FILL saturated		6	SS	44		316										
315.8	5.2 Hard, grey Silty CLAY, trace gravel moist		7	SS	48												0 5 63 32
312.6							315										
312.6																	
312.6							314										
312.6			8	SS	88												
312.6							313										
312.6																	
312.6							312										
312.6																	
312.6							311										
312.6																	
312.6							310										
312.6																	
312.6							309										
312.6																	
312.6							308										
312.6																	
309.4	11.4 Very Dense		11	SS	87												
307.5																	
307.5			12	SS	88												
13.3	END OF BOREHOLE @ 13.3 m NOTE: Water Level @ 4.5m on 02/02/99 Borehole Adjacent to Culvert																

EXPRESS 33-393 GPJ EXPRESS GDT 24/09/99

RECORD OF BOREHOLE No 98-22

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811517N, 227366E ORIGINATED BY SW
DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
DATUM Geodetic DATE 16.12.98 - 16.12.98 CHECKED BY EYC

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			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								20 40 60 80 100									10 20 30		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
320.0																			
0.0	TOPSOIL 300 mm Compact, dark brown silt FILL, some sand and topsoil moist to wet		1	SS	20														
			2	SS	25														
317.9	topsoil FILL @ 1.8 m																		
2.1	Compact, dark brown fine sand FILL wet to saturated		3	SS	26										19.3				
316.8																			
3.2	Very Dense, SAND and GRAVEL saturated		4	SS	84														
316.2																			
3.8	Compact, grey SAND, some silt saturated		5	SS	22														
315.1			6	SS	29										21.3				
4.9	Hard, grey Silty CLAY moist																		
			7	SS	44											0 2 54 44			
			8	SS	32														
311.8																			
8.2	Compact, grey Fine SAND saturated																		
			9	SS	28														
310.2																			
9.8	sandy silt layer																		
309.6																			
10.4	Very Dense, SAND, occasional silt seam saturated		10	SS	86														
			11	SS	93														
307.3																			
12.7	END OF BOREHOLE @ 12.7 m NOTE: Water Level @ 2.9m on 02/02/99																		

EXPRESS 33-393 GPJ EXPRESS GDT 24/08/99

RECORD OF BOREHOLE No 98-23

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811539N, 227370E ORIGINATED BY SW
DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
DATUM Geodetic DATE 16.12.98 - 16.12.98 CHECKED BY EYC

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			20	40	60	80	100					
319.7																	
0.0	TOPSOIL 250 mm Compact to Dense, dark brown silty sand FILL, occasional gravel layers damp						319									19.7	
318.6			1	SS	47												
1.1	topsoil FILL																
318.2																	
1.5	Compact, fine sand FILL moist		2	SS	18		318									19.7	
	topsoil @ 2.3 m		3	SS	26		317										
316.8																	
2.9	Loose to Dense, grey Sandy SILT damp to moist		4	SS	8		316									22.6	10 30 52 8
			5	SS	35												
315.0							315										
4.7	Very Stiff to Hard, grey Silty CLAY moist		6	SS	42		314										
							313									20.8	0 0 40 60 179 kPa
			7	SS	39		312										
311.8																	
7.9	wet seam		8	SS	29		311										
309.9							310										
9.8	Very Dense, grey medium-fine SAND saturated		9	SS	55		309										
308.0			10	SS	79												
11.7	END OF BOREHOLE @ 11.7 m NOTE: Water Level @ 2.7m on 02/02/99																

EXPRESS: 33-393.GPJ EXPRESS GDT: 24/08/99

RECORD OF BOREHOLE No 98-24

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811563N, 227374E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 17.12.98 - 17.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
319.3	TOPSOIL 200 mm Compact, dark brown sandy silt FILL						319										
317.9	topsoil FILL @ 1.1m		1	SS	14		318										0 75 25 0
316.2	Compact to Dense, brown Fine SAND, some silt to silty wet to saturated		2	SS	36		317										0 40 50 10
			3	SS	15		316										
			4	SS	16		315										
			5	SS	19		314										
			6	SS	23		313										0 4 56 40
			7	SS	28		312										
			8	SS	47		311										
			9	SS	99		310										
			10	SS	79		309										
308.3	END OF BOREHOLE @ 11.0 m NOTE: Water Level @ 2.1m on 02/02/99																

EXPRESS 33-393 GPJ EXPRESS GDT 24/08/99

RECORD OF BOREHOLE No 98-26

1 OF 1

METRIC

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4811625N, 227388E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 18.12.96 - 18.12.98 CHECKED BY EYC

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		
318.6														
0.0	TOPSOIL 200mm Dense, dark brown sandy silt and fine sand FILL, trace gravel moist													
317.4			1	SS	39									
1.2	Dense, brown cobbly sand and gravel FILL moist		2	SS	49									
316.3														
2.3	Compact grey Fine SAND, some gravel moist		3	SS	15									
315.2														
3.4	Compact grey Silty SAND, trace gravel saturated		4	SS	15									
314.3														
4.3	Compact to Dense, Fine SAND, trace silt saturated		5	SS	13									
311.0														
7.6	Dense, grey Silty CLAY, some silt seams. moist		6	SS	41									
310.5														
8.1	END OF BOREHOLE @ 8.1 m NOTE: Water level @ 3.4 m upon completion standpipe broken below ground level at second reading													

EXPRESS 33-393 GPJ EXPRESS GDT 24/08/99

1 OF 1

METRIC

LOCATION _____ E-S Ramp, 4811657N, 227394E

ORIGINATED BY SW

DIST 2 HWY 7 & 8

BOREHOLE TYPE Hollow Stem Auger

COMPILED BY SY

DATUM Geodetic

DATE 17.12.98 - 17.12.98

CHECKED BY EYC

+ 3, 3: Numbers refer to Sensitivity () 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 98-28

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811676N 227394E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY
 DATUM Geodetic DATE 17.12.98 - 17.12.98 CHECKED BY EYC

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		
318.2 0.0	TOPSOIL 200 mm Compact, brown sand and gravel FILL moist						318							
317.1 1.1	Compact to Dense, brown to grey Sandy SILT moist		1	SS	20		317							
			2	SS	16									
315.6 2.6	Dense Fine SAND saturated		3	SS	33		316							
315.2														
3.1	Dense grey Silt, trace sand saturated		4	SS	39		315							0 10 90 0
314.4 3.8	Very Dense		5	SS	84		314							
313.5 4.7	Hard, grey Silty CLAY, thin saturated sand seams moist		6	SS	52		313							0 40 60 0
312.4 5.8	END OF BOREHOLE @ 5.8 m NOTE: Water Level @ 2.9m on 02/02/99		7	SS	60									

EXPRESS 33-393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-29

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811387N, 227321E
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer
 DATUM Geodetic DATE 21.12.98 - 21.12.98
 ORIGINATED BY SW
 COMPILED BY SY
 CHECKED BY EYC

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			20	40	60	80	100					
314.6	TOPSOIL 200 mm															
0.0																
314.4																
0.2	Loose, brown Sand, trace gravel saturated		1	SS	9											
313.9						314										
0.8	Compact to Dense, grey Sandy SILT saturated		2	SS	22											0 20 80 0
			3	SS	38											
312.9						313										
1.7	END OF HANDHOLE @ 1.7 m NOTE: Water Level @ 0.3 m Upon Completion *Blow Counts Converted to SPT Values															

EXPRESS, 33-393 GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-30

1 OF 1

METRIC

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4811409N, 227322E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

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							
314.5 0.0	PEAT 300 mm							20 40 60 80 100							
314.2 0.3	Loose, Fine SAND, occasional peat layers, some cobbles saturated		1	SS	4		314								
			2	SS	4										
313.3 1.2	Compact, grey Silty SAND saturated		3	SS	29		313								0 79 21 0
312.5 2.0	Hard, grey Silty CLAY moist		4	SS	37										
312.2 2.3	END OF HANDHOLE @ 2.3 m NOTE: Water Level @ 0.3 m Upon Completion *Blow Counts Converted to SPT Values														

EXPRESS: 33-393 GPJ EXPRESS GDT 24/08/99

RECORD OF BOREHOLE No 98-31

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811429N, 227327E ORIGINATED BY SW
 DIST 2 HWY 7 & 6 BOREHOLE TYPE Hand Hammer COMPILED BY SY
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

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			SHEAR STRENGTH kPa									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
						20	40	60	80	100	10	20	30				
314.6 0.0	PEAT 300 mm																
314.3 0.3	Loose, grey SAND saturated		1	SS	26												
313.7 0.9	trace Cobbles below 0.9 m		2	SS	4												
313.1 1.5	Very Stiff, grey Silty CLAY, thin sand seams moist		3	SS	26												
312.9 1.7	END OF HANDHOLE @ 1.7 m NOTE: Water Level @ 0.3 m Upon Completion *Blow Count Converted to SPT Values																

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/08/98

RECORD OF BOREHOLE No 98-32

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811452N, 227337E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

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			20	40	60	80	100					
315.2 0.0	Loose to Compact, brown, sand FILL saturated		1	SS	4		315										
314.1 1.1	Compact, medium SAND, some gravel saturated		2	SS	13												31 69 0 0
313.7 1.5	Very Stiff, grey Silty CLAY moist		3	SS	17		314										
313.4 1.8	END OF HANDHOLE @ 1.8 m NOTE: Water Level @ 0.3 m Upon Completion *Blow Counts Converted to SPT Values																

EXPRESS, 33-393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-33

1 OF 1

METRIC

W.P. 383-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811486N, 227345E ORIGINATED BY SW
DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY
DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
315.2 0.0	TOPSOIL 200 mm																
315.0 0.2	Firm, grey Silty CLAY, occasional sand seams wet		1	SS	4												
314.6 0.6	Hard moist		2	SS	37												
314.0 1.2	END OF HANDHOLE @ 1.2 m NOTE: Water Level @ 0.3 Upon Completion *Blow Counts Converted to SPT Values																





EXPRESS: 33-393.GPJ EXPRESS.GDT 24/09/99

RECORD OF BOREHOLE No 98-34

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811523N, 227355E ORIGINATED BY SW
DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY
DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

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			SHEAR STRENGTH kPa											
315.7 0.0	Very loose dark brown sand FILL		1	SS	5		315									0 92 8 0			
315.4 0.3	Loose to Compact, brown medium-fine SAND saturated																		
314.8 0.9	Compact, grey Sandy SILT, some gravel saturated							2	SS	18									
314.2 1.5	Hard, grey Silty CLAY moist		3	SS	45		314												
314.0 1.7	END OF HANDHOLE @ 1.7 m NOTE: Water Level @ 0.3 Upon Completion *Blow Counts Converted to SPT Values																		

EXPRESS 33-393 GPJ EXPRESS GDT 24/08/99

RECORD OF BOREHOLE No 98-35

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811555N, 227380E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
315.5	TOPSOIL 450 mm		1	SS	2												
315.1	Very Loose SAND saturated						315										
314.9	Compact, grey Sandy SILT, trace clay saturated		2	SS	28												
314.5			3	SS	28												0 46 44 10
1.1	END OF HANDHOLE @ 1.1 m NOTE: Water Level @ 0.3 Upon Completion *Blow Counts Converted to SPT Values																

EXPRESS: 33-393 GPJ EXPRESS GDT 24/09/98

RECORD OF BOREHOLE No 98-36										1 OF 1		METRIC				
W.P. 363-94-00 SITE: 33-393		LOCATION E-S Ramp, 4811607N, 227372E				ORIGINATED BY SW										
DIST 2 HWY 7 & 8		BOREHOLE TYPE Hand Hammer				COMPILED BY SY										
DATUM Geodetic		DATE 21.12.98 - 21.12.98				CHECKED BY EYC										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
315.5 0.0	TOPSOIL 300 mm															
315.2 0.3	Loose, SAND saturated		1	SS	5											10 77 13 0
314.9 0.6	Compact, grey Sandy SILT, some gravel saturated		2	SS	29											
314.3 1.2	END OF HANDHOLE @ 1.2 m NOTE: Water Level @ 0.3 Upon Completion *Blow Counts Converted to SPT Values															

EXPRESS, 33-393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-37

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811652N, 227382E ORIGINATED BY SW
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
315.7 0.0	TOPSOIL 300 mm																
315.4 0.3	Compact, grey SILT, trace sand saturated		1	SS	10												
315.1 0.6	Dense, grey Sandy SILT, some gravel saturated		2	SS	47		315										
314.8 1.1	END OF HANDHOLE @ 1.1 m NOTE: Water Level @ 0.3 Upon Completion *Blow Counts Converted to SPT Values																

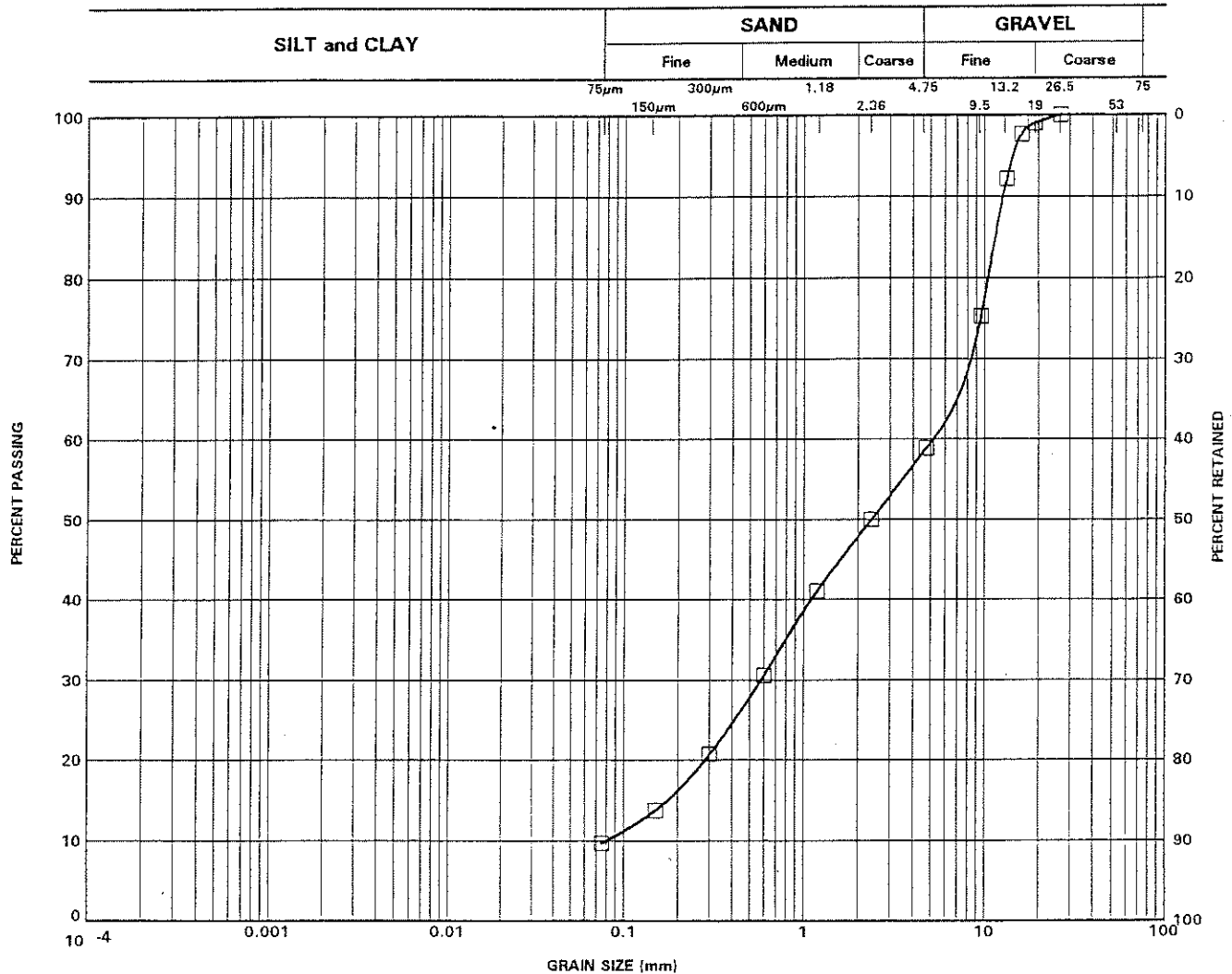
EXPRESS, 33-393.GPJ EXPRESS.GDT 24/08/99

APPENDIX “B”

Laboratory Test Results South Retaining Wall/Embankment

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-05	0.2

SAND and GRAVEL FILL

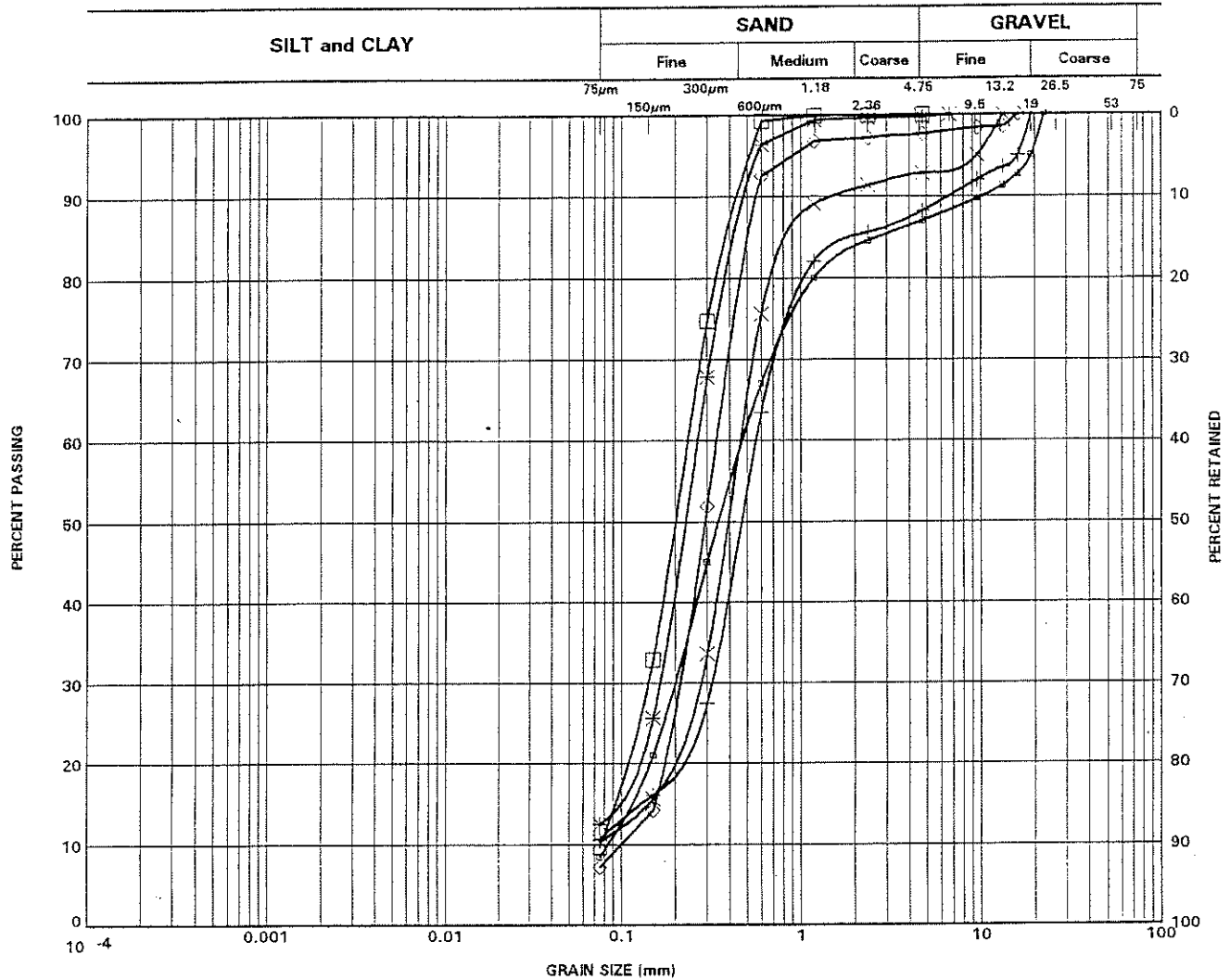
WP 363-94-00

SITE 33-393

Figure No. 1

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

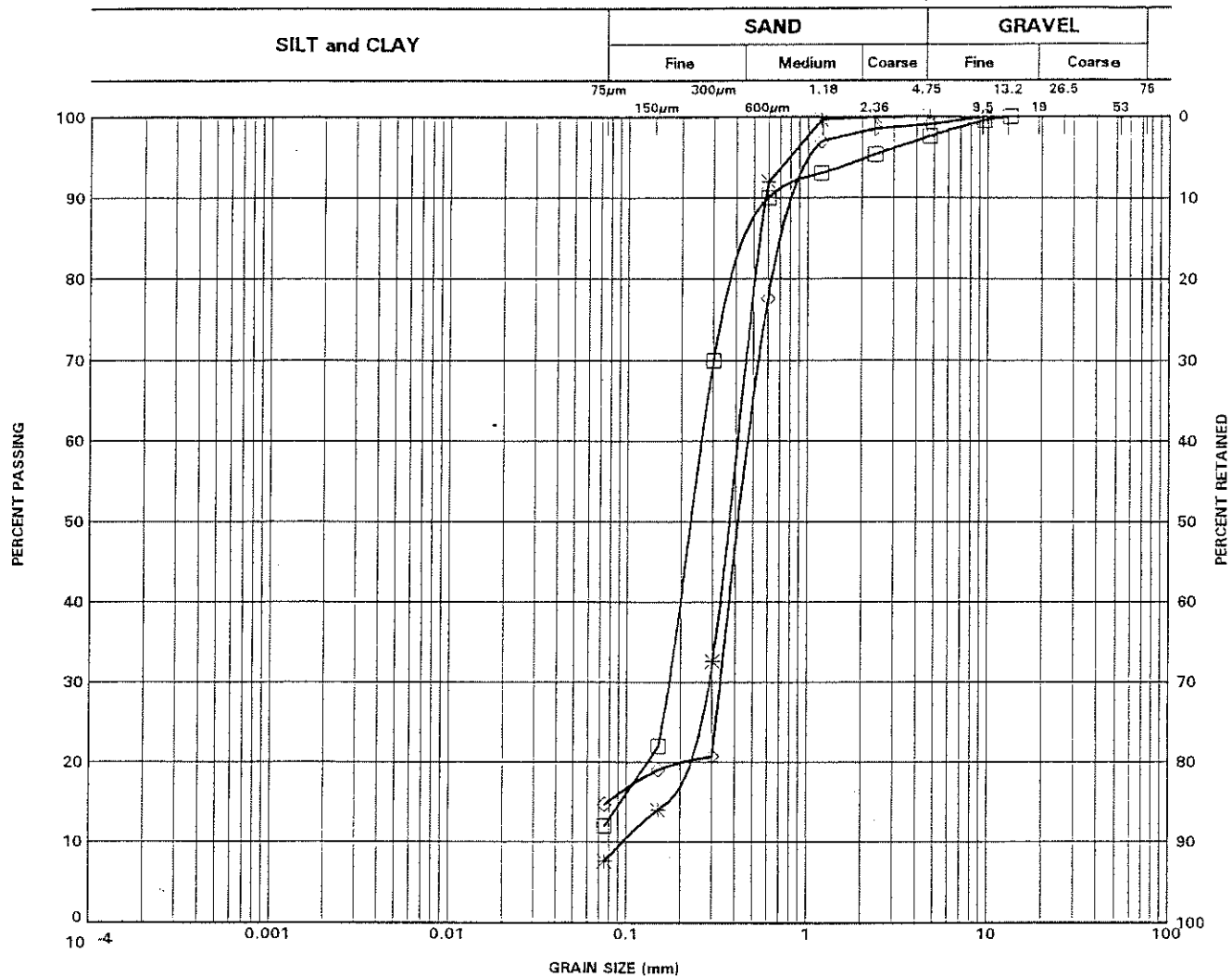


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-01	1.5
*	98-02	2.3
◇	98-03	2.3
×	98-04	3.1
+	98-05	4.7
◻	98-06	4.0

SAND

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

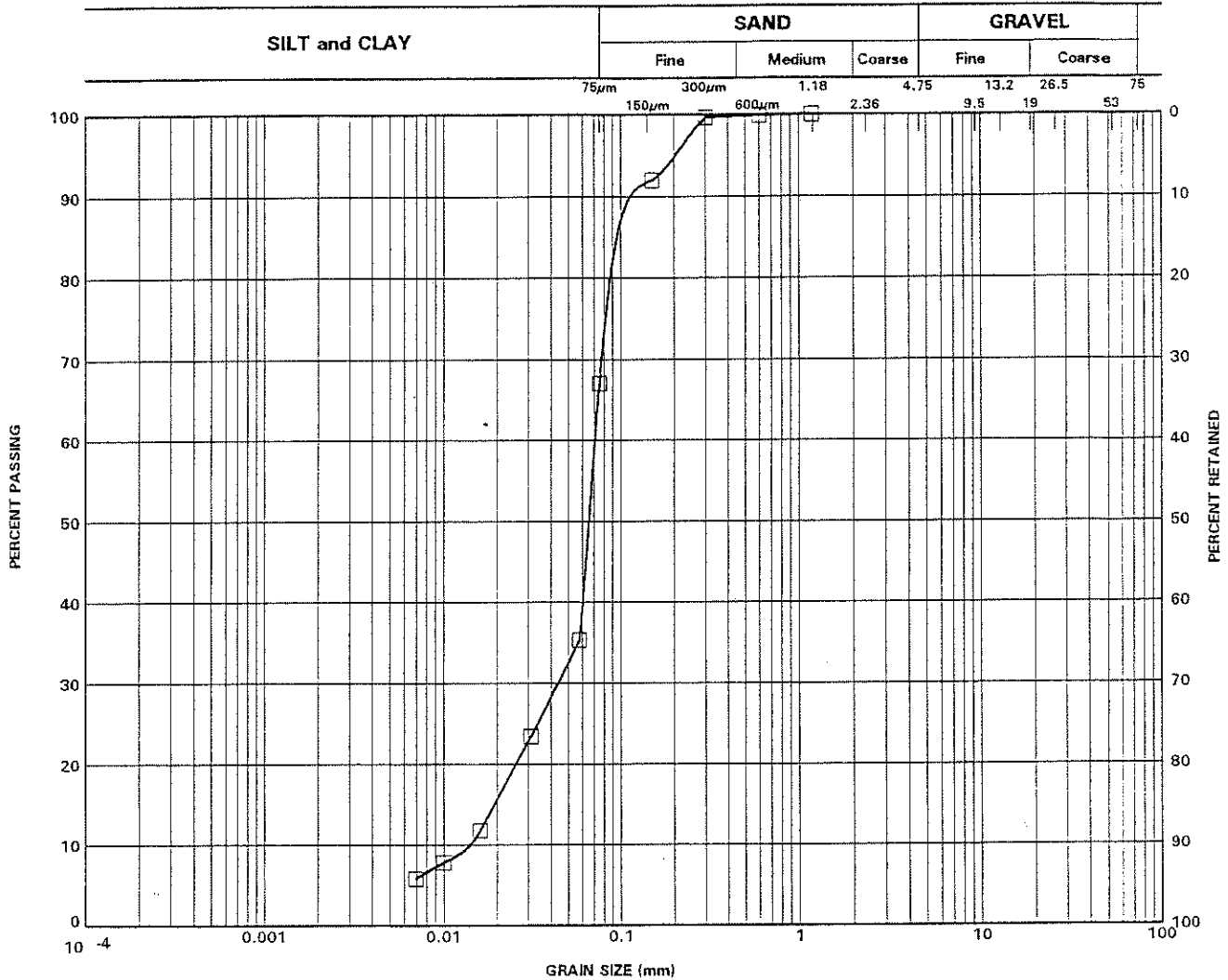


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-06	2.3
*	98-07	2.3
◇	98-08	3.1

SAND

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-03	5.8

UPPER SILT

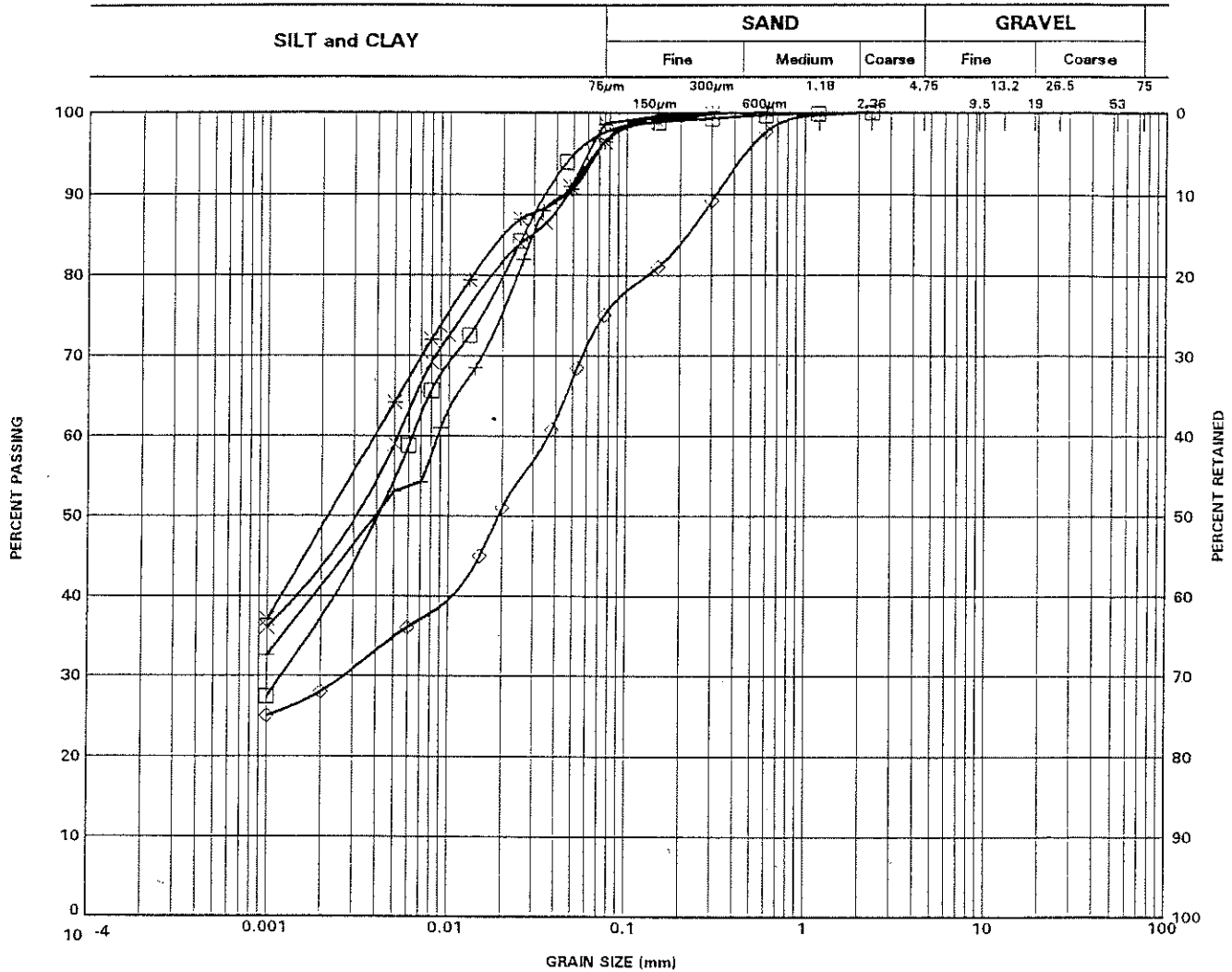
WP 363-94-00

SITE 33-393

Figure No. 4

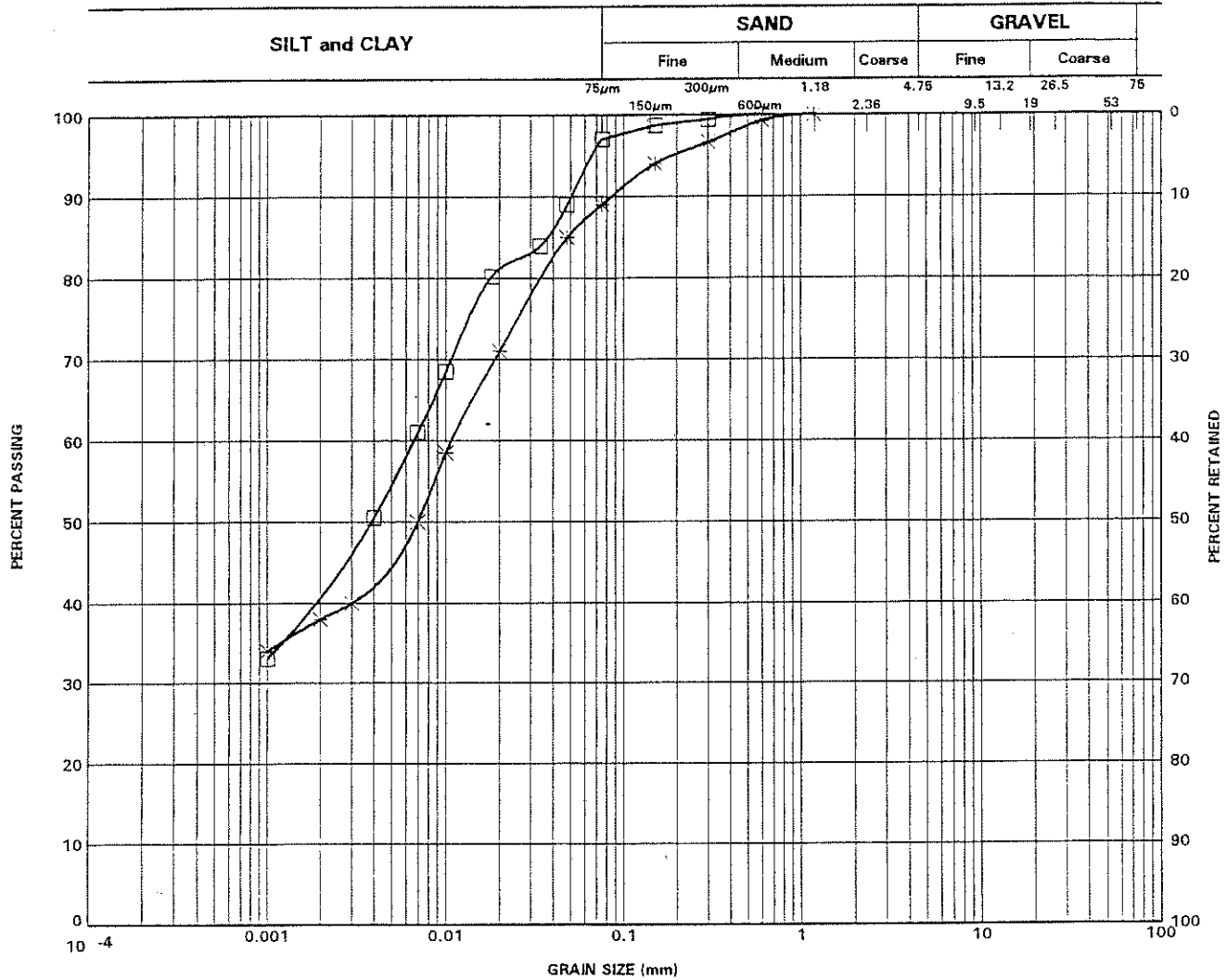
GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-09	3.1
*	98-10	3.1

UPPER SILTY CLAY

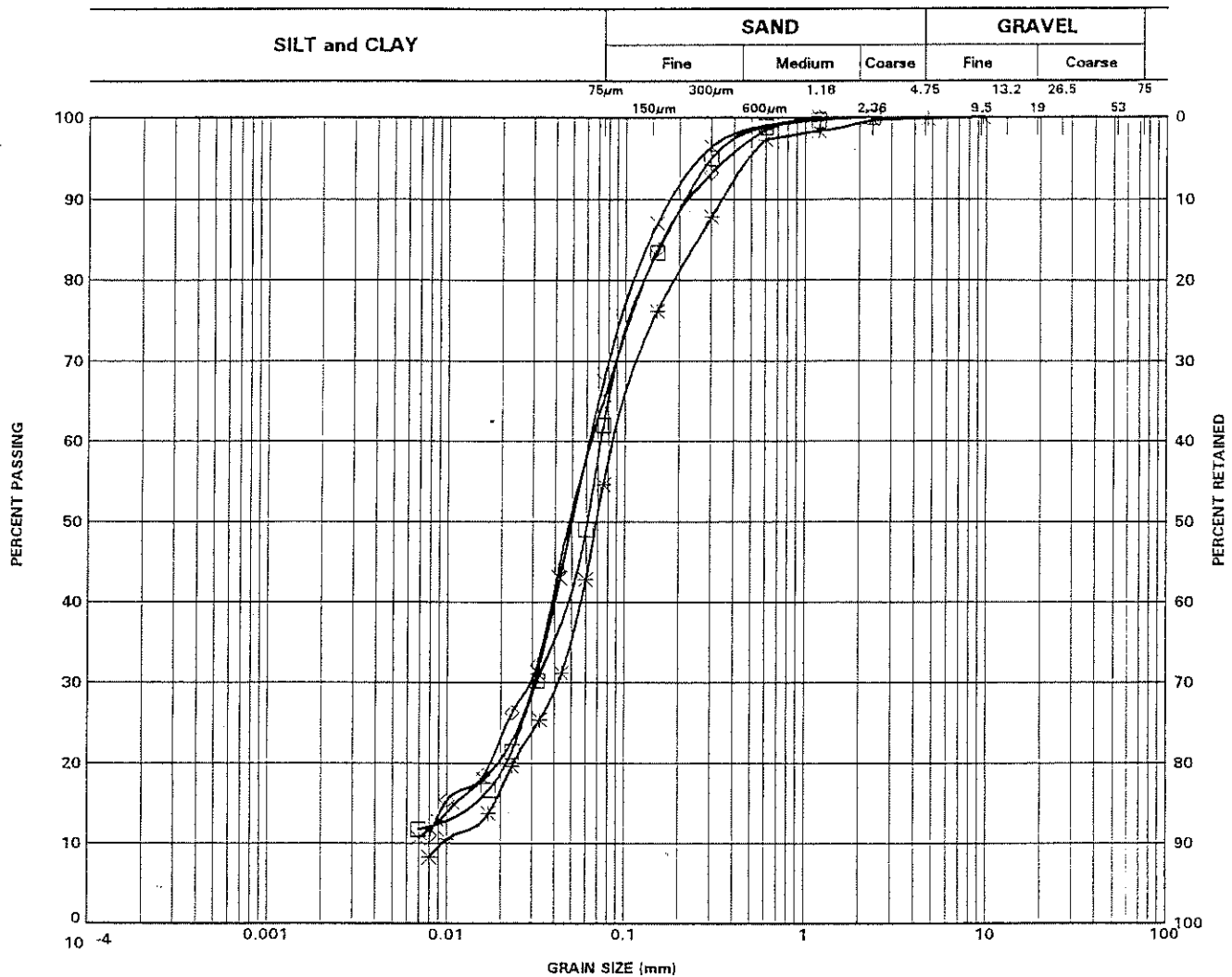
WP 363-94-00

SITE 33-393

Figure No. 6

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

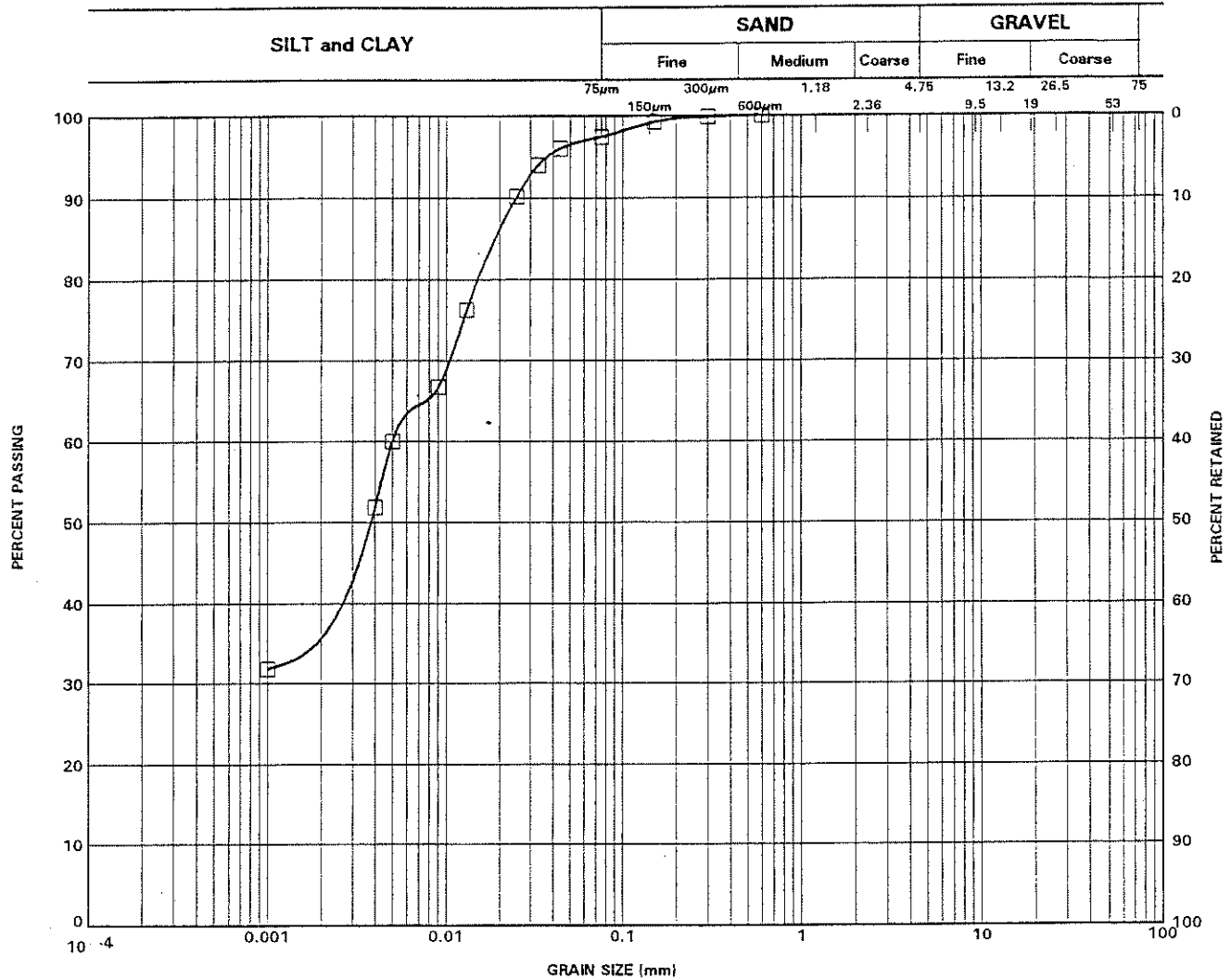


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-07	7.8
*	98-08	4.6
◇	98-09	6.1
×	98-10	4.6

LOWER SILT

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



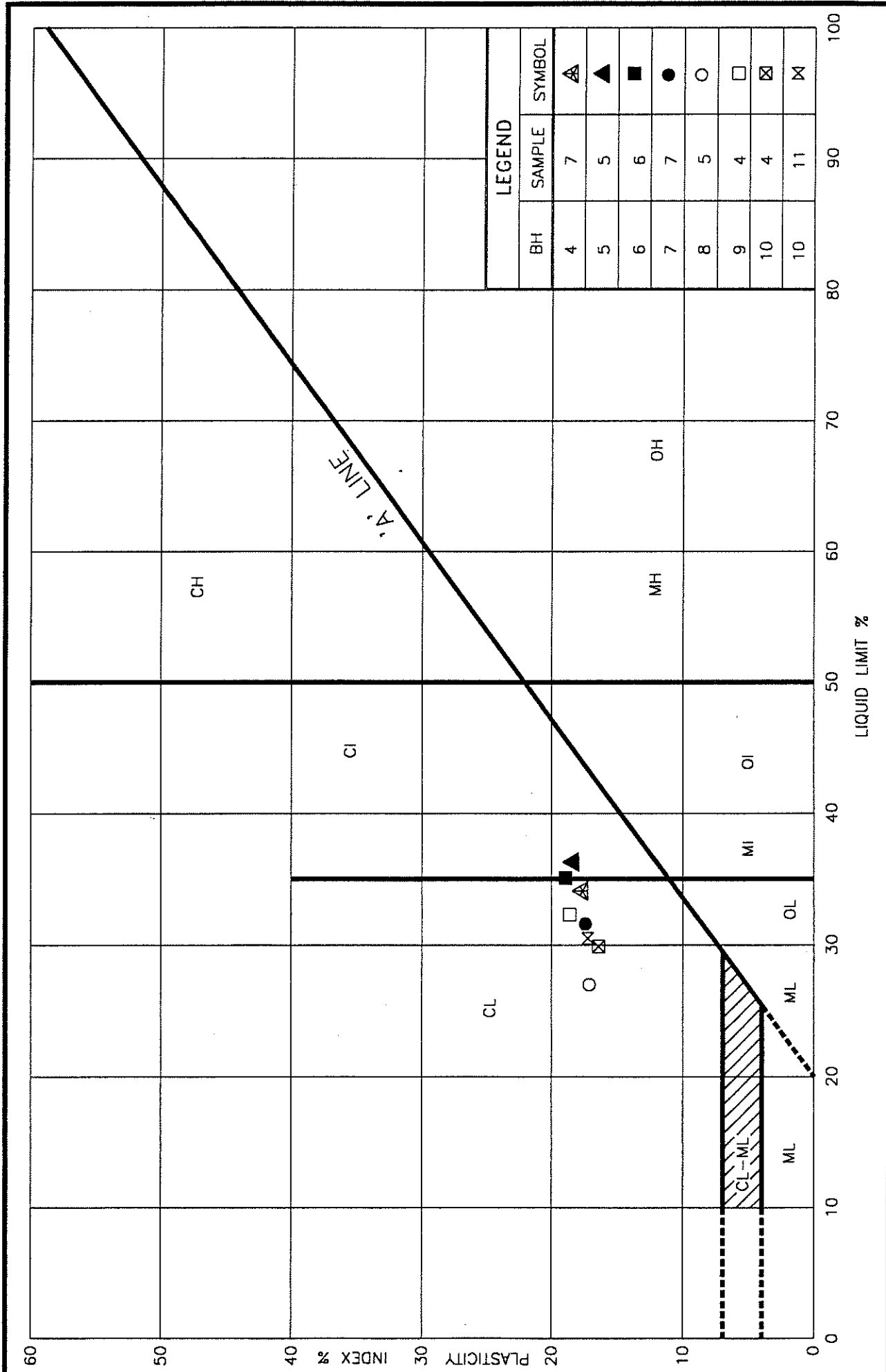
LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-10	13.7

LOWER SILTY CLAY

WP 363-94-00

SITE 33-393

Figure No. 8





AGRA
ENGINEERING GLOBAL SOLUTIONS

Silty Clay

FIG No.: 9

W P 363-94-00

Site: 33-393

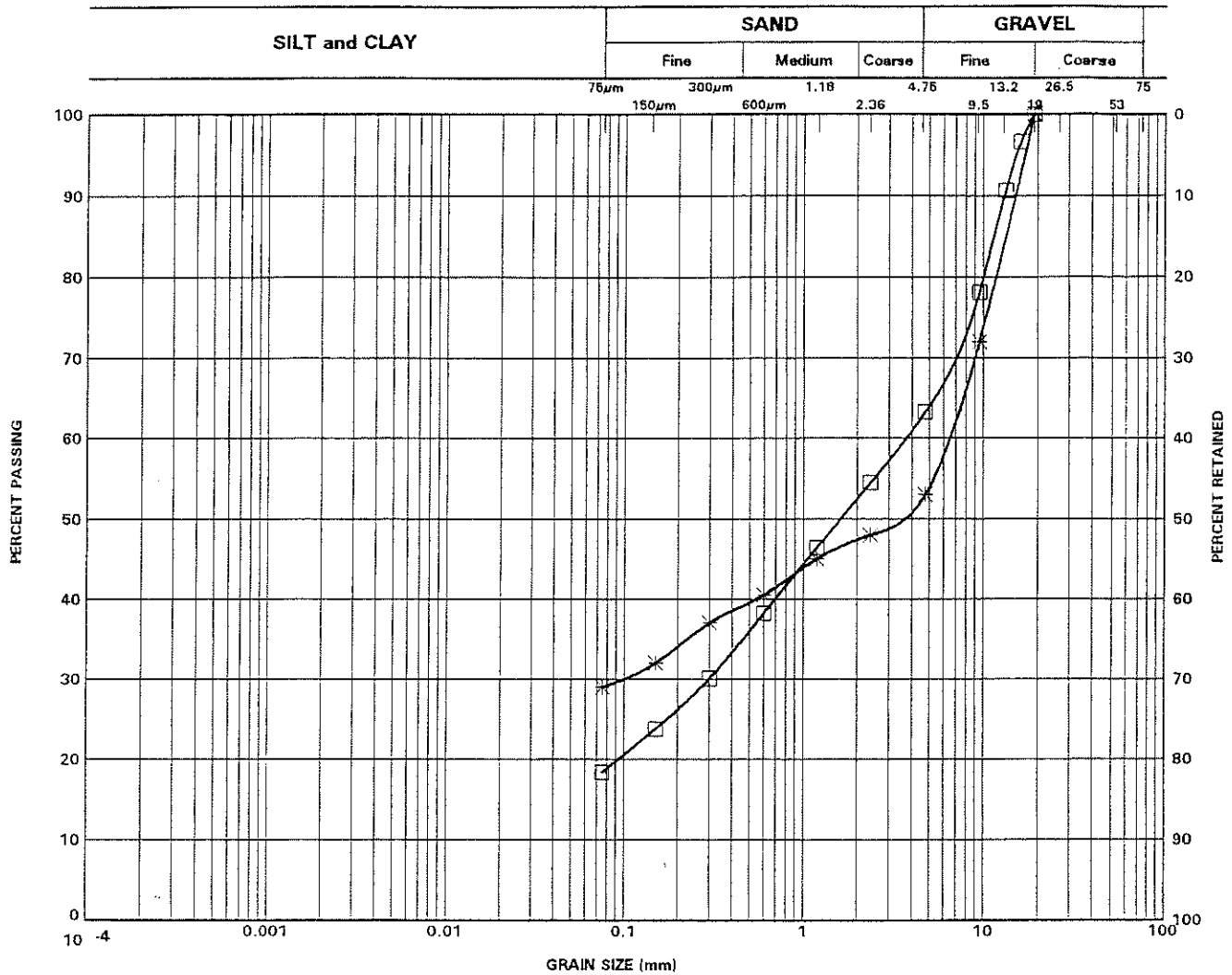
APPENDIX “C”

Laboratory Test Results

Seven Span Bridge Structure

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-11	0.2
*	98-14	0.2

FILL

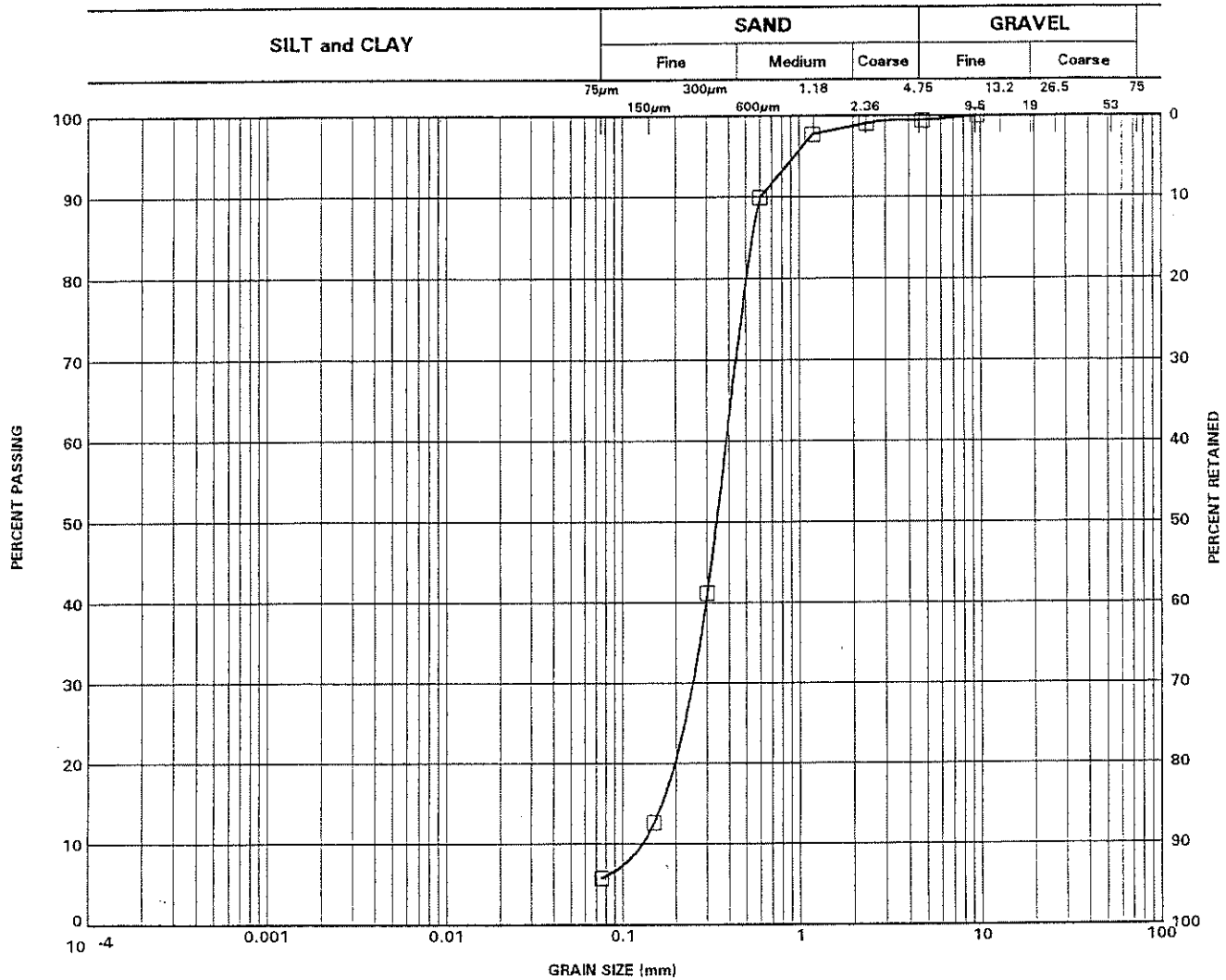
WP 363-94-00

SITE 33-393

Figure No. 10

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-11	6.1

SAND

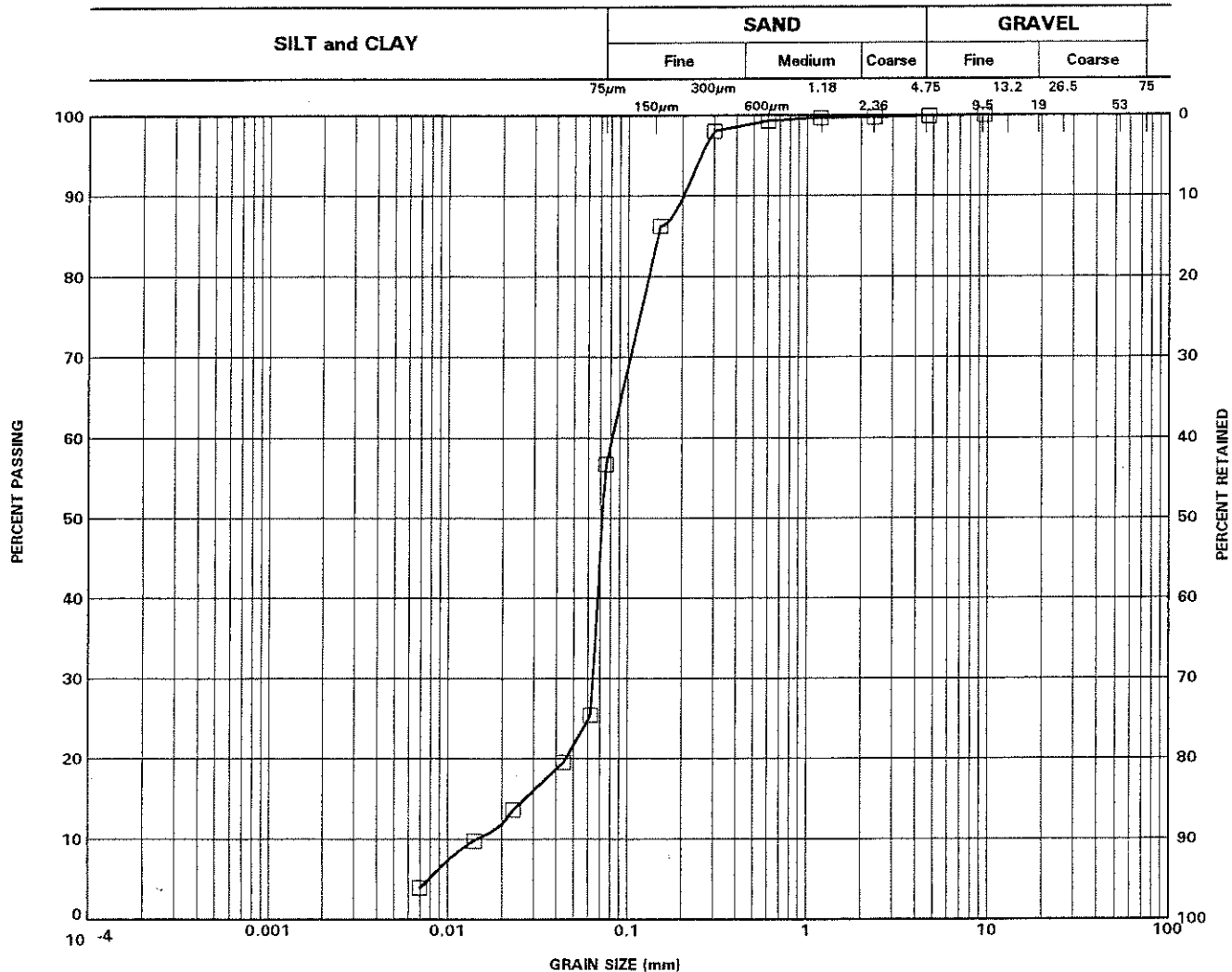
WP 363-94-00

SITE 33-393

Figure No. 11

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-15	3.1

SILT

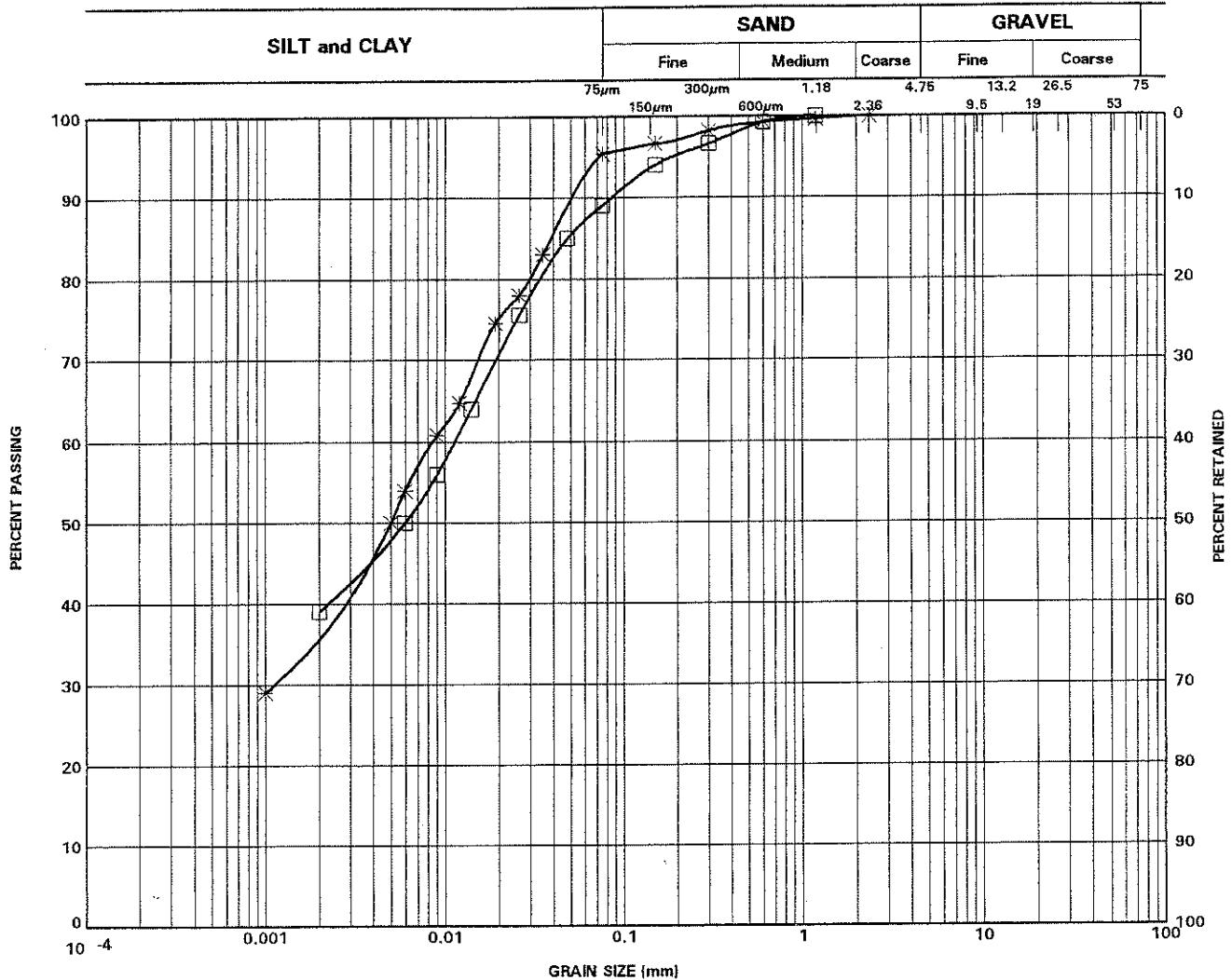
WP

SITE

Figure No. 12

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



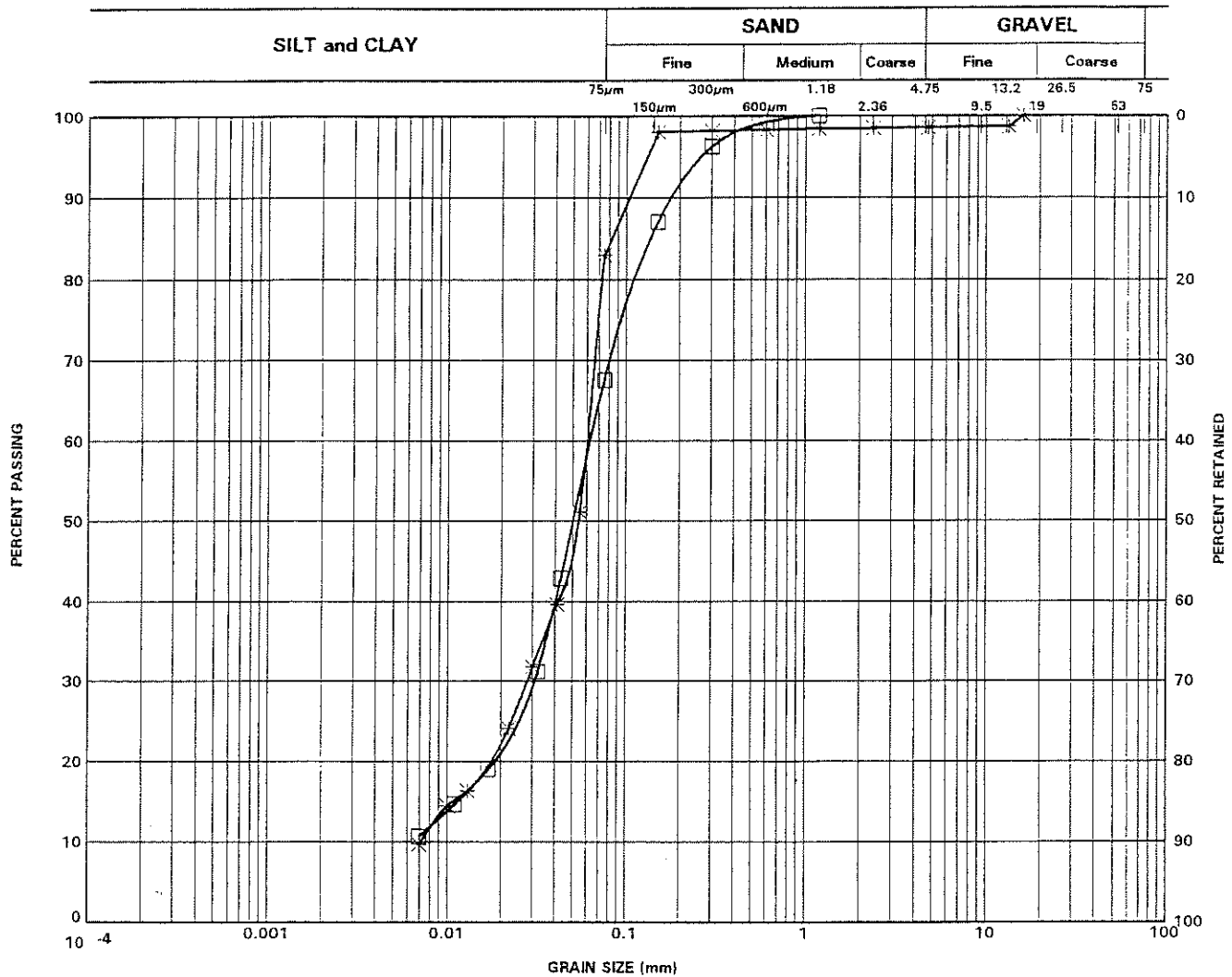
LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-10	3.1
*	98-16	2.3

SILTY CLAY



GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



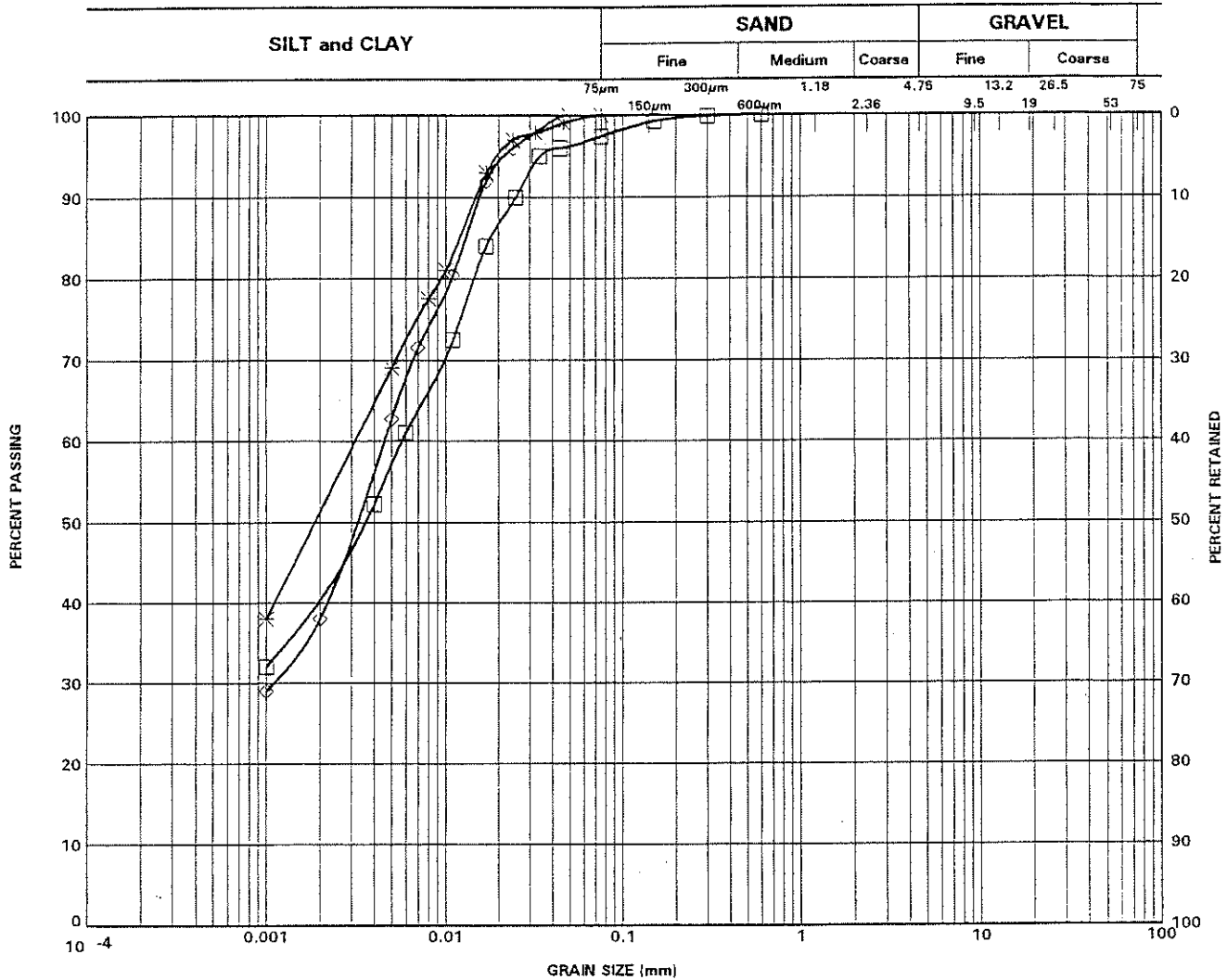
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)
□	98-10	4.6
*	98-11	9.2

LOWER SILT

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-10	13.7
*	98-11	15.3
◇	98-15	9.3

LOWER SILTY CLAY

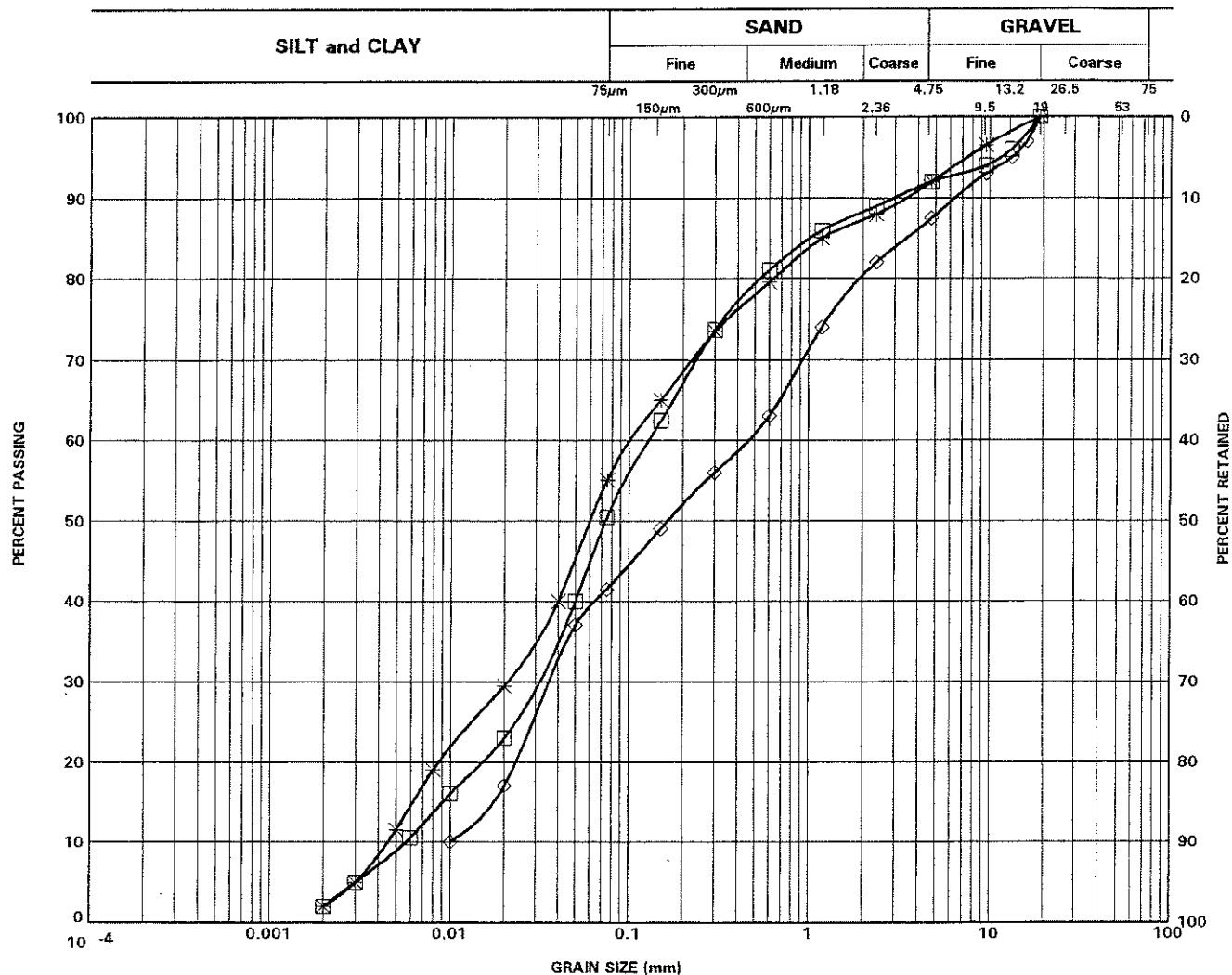
WP 363-94-00

SITE 33-393

Figure No. 15

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



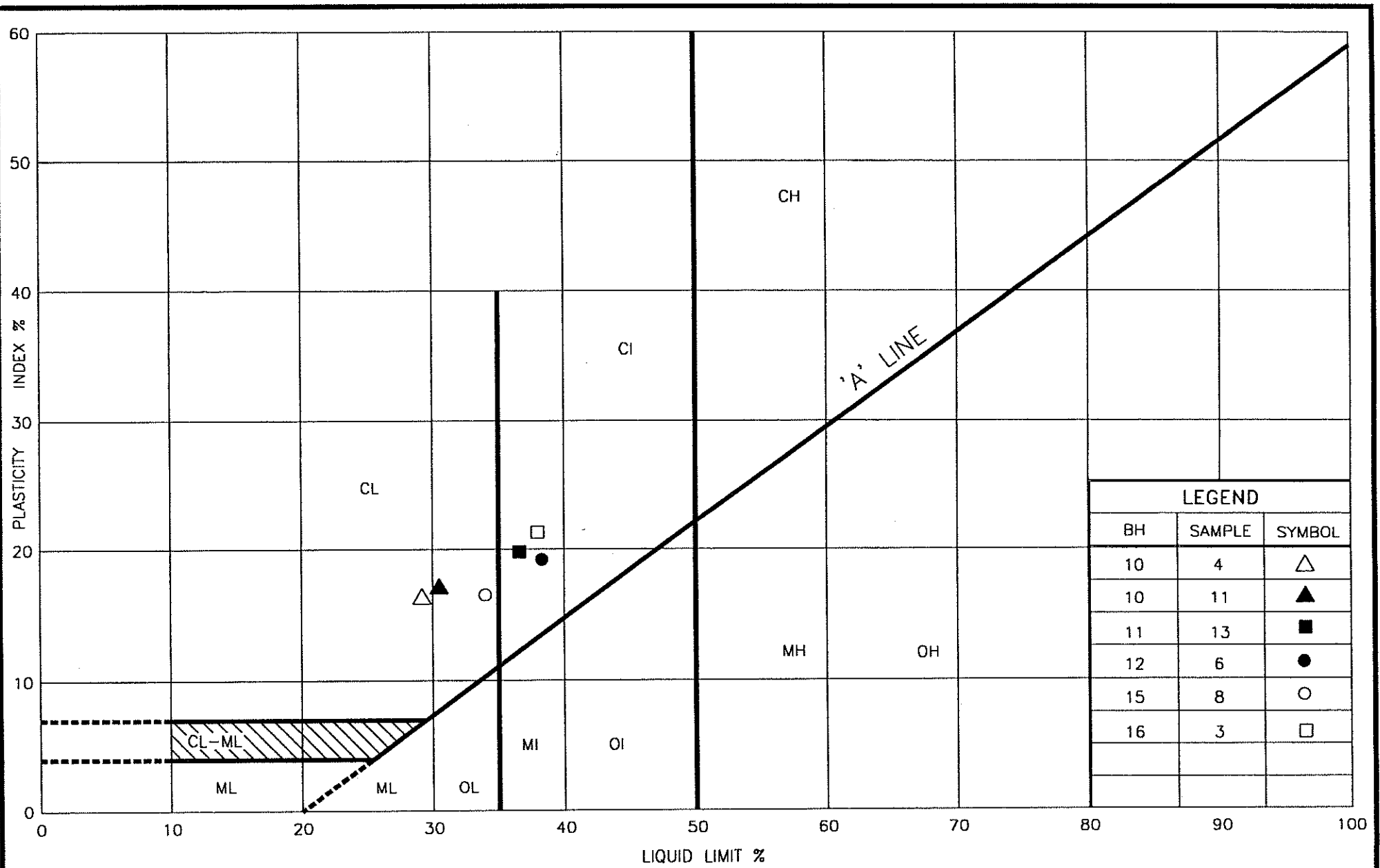
LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-12	24.5
*	98-13	23.0
◇	98-17	18.3

SANDY SILT TILL

WP 363-94-00

SITE 33-393

Figure No. 16

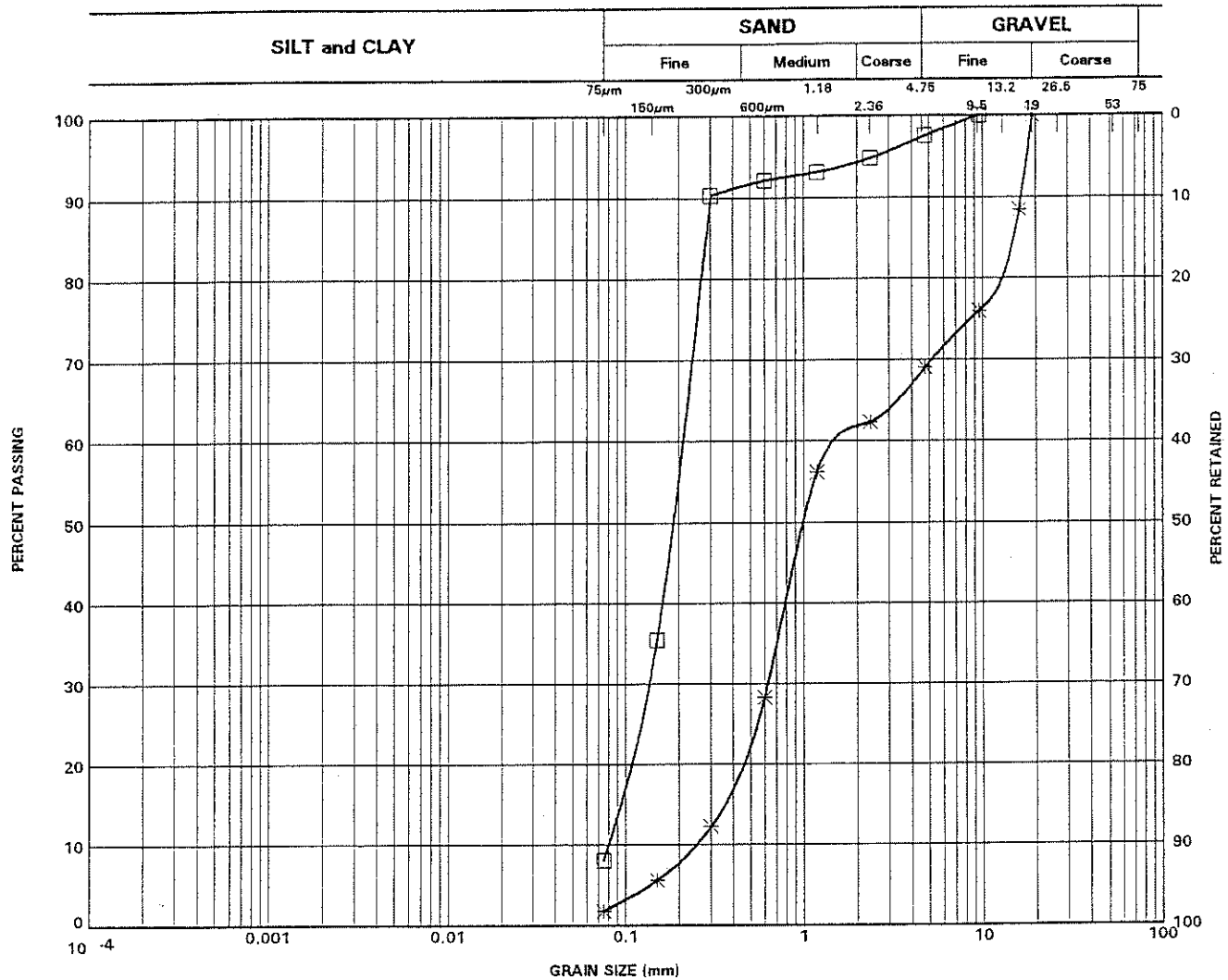


APPENDIX “D”

Laboratory Test Results East Retaining Wall/Embankment

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-25	1.5
*	98-32	0.8

FILL

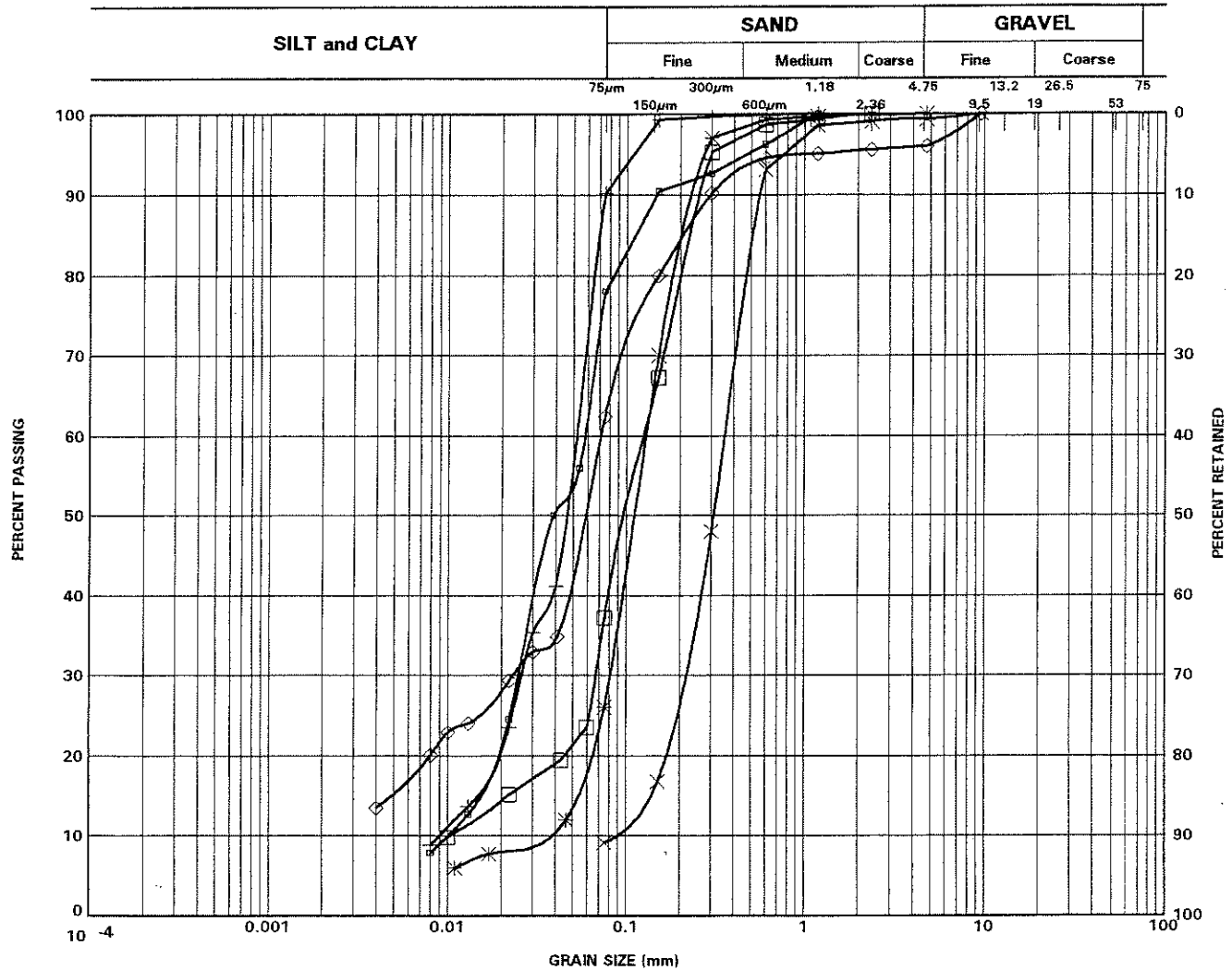
WP 363-94-00

SITE 33-393

Figure No. 18

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)
□	98-20	3.1
*	98-24	1.5
◇	98-24	3.1
×	98-26	4.6
+	98-28	3.1
◻	98-29	1.0

SILT / SAND

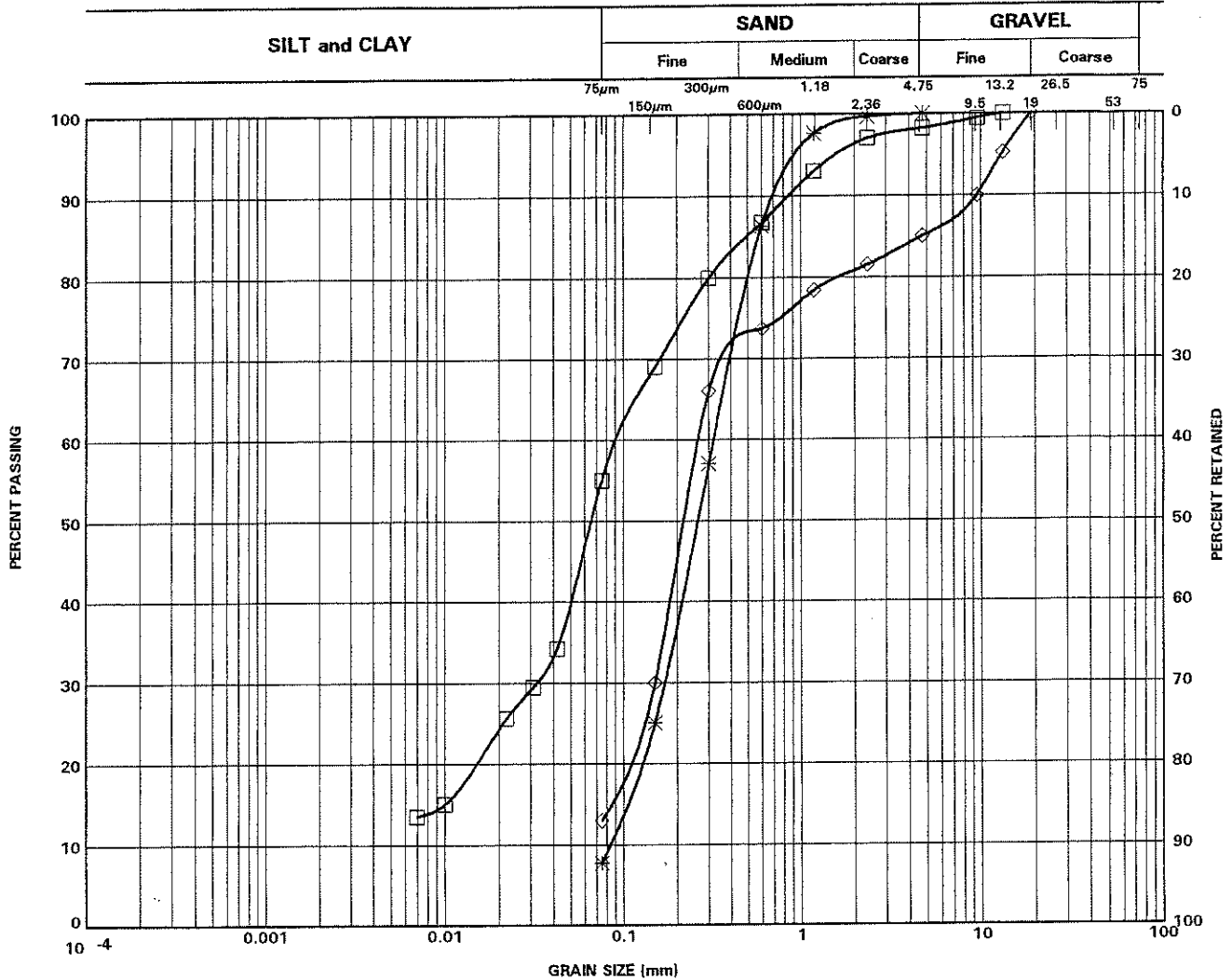
WP 363-94-00

SITE 33-393

Figure No. 19

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-30	1.4
*	98-34	1.0
◇	98-36	0.4

--

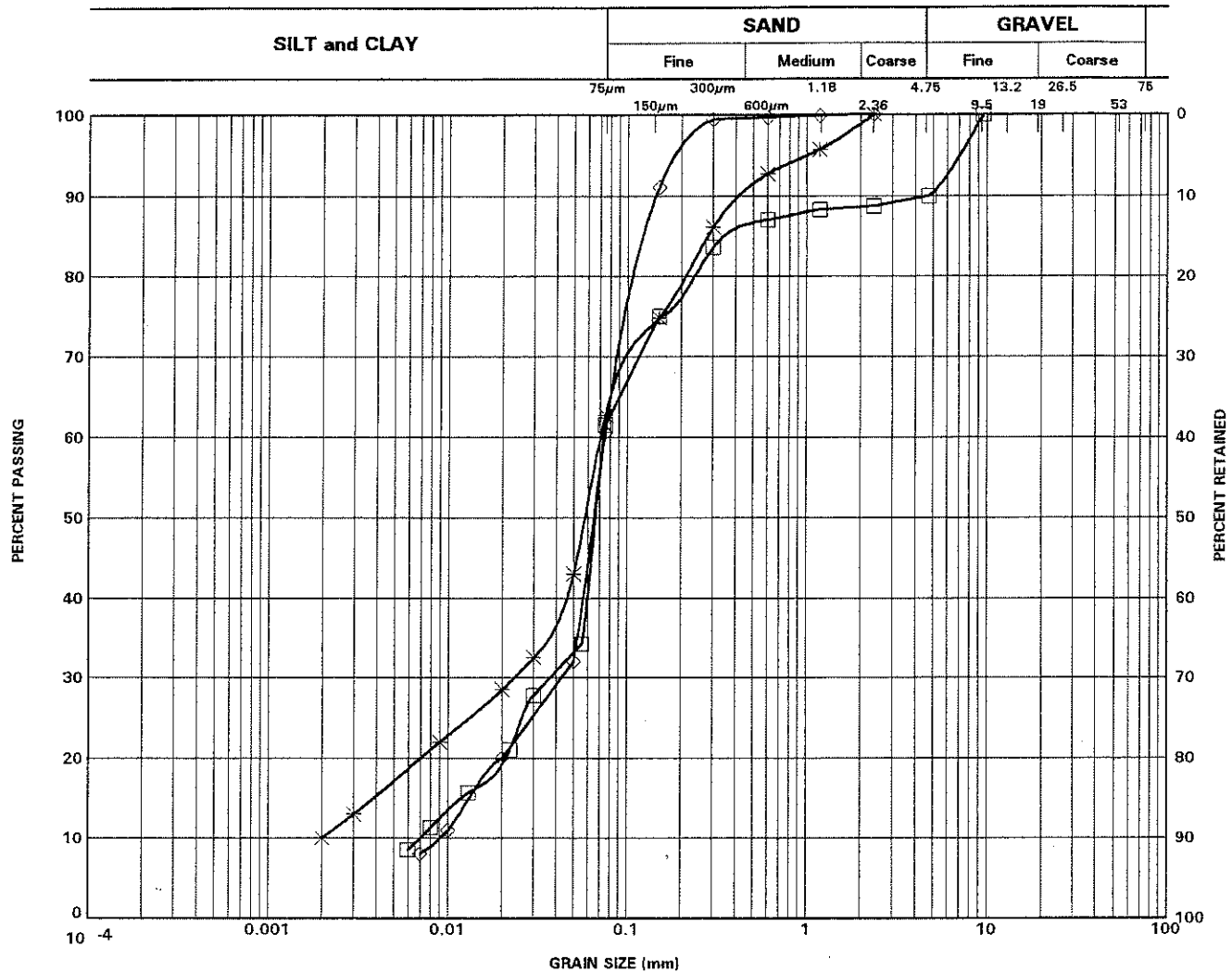
WP 363-94-00

SITE 33-393

Figure No. 20

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

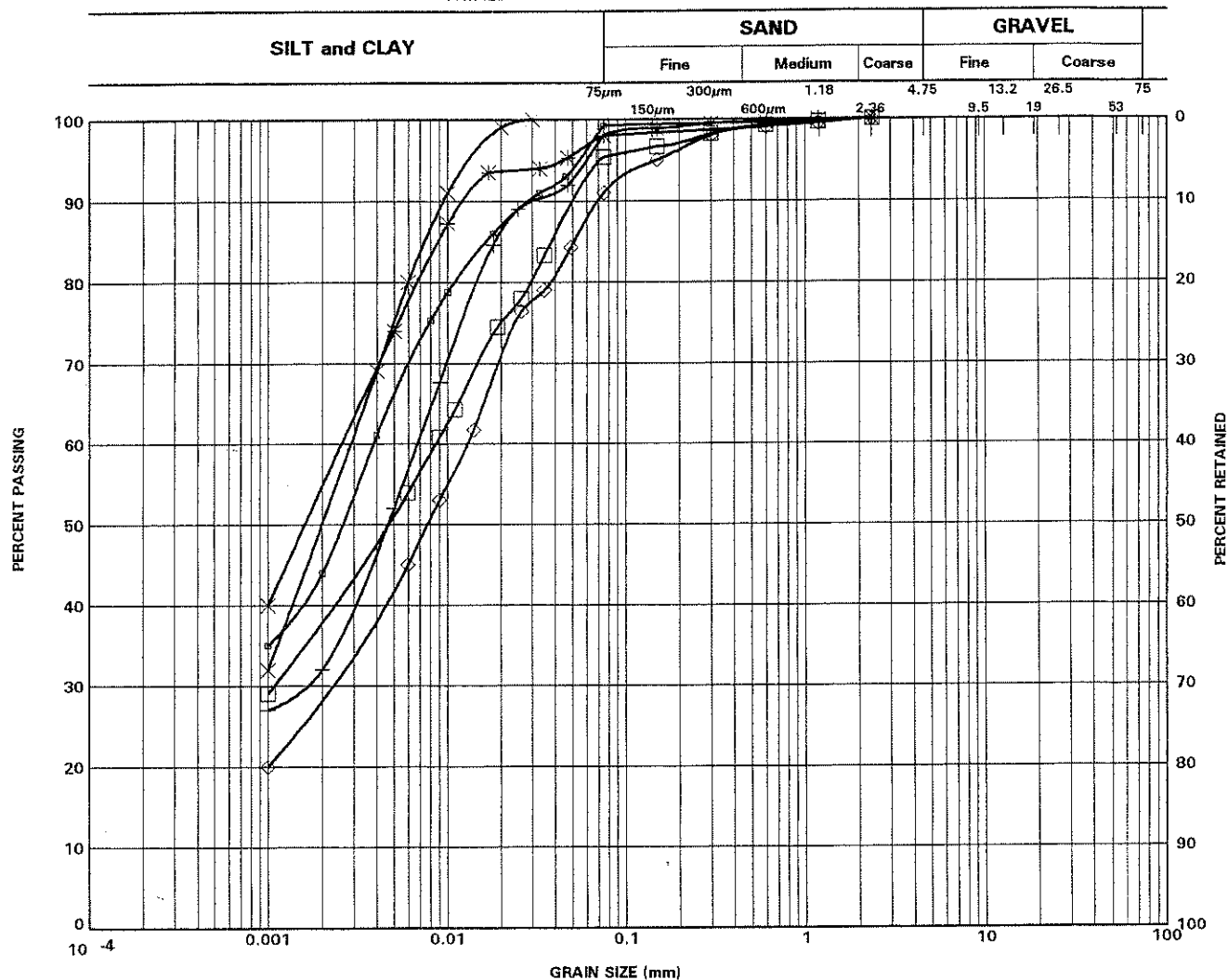


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-23	3.1
*	98-25	7.6
◇	98-28	5.4

SILT / SAND

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

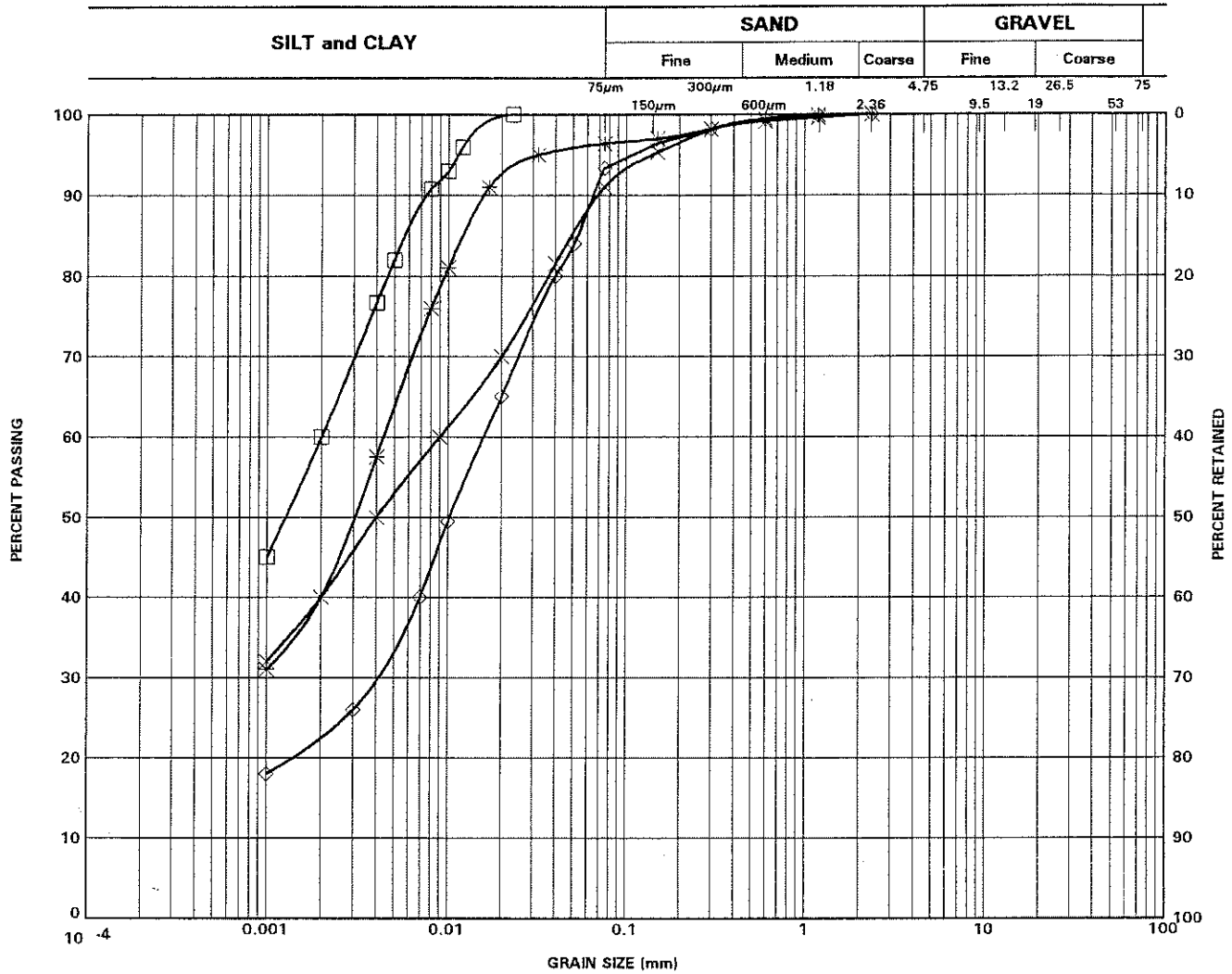


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-16	2.3
*	98-17	4.6
◇	98-19	3.8
×	98-20	6.1
+	98-21	5.3
◻	98-22	6.1

UPPER SILTY CLAY

GRAIN SIZE DISTRIBUTION

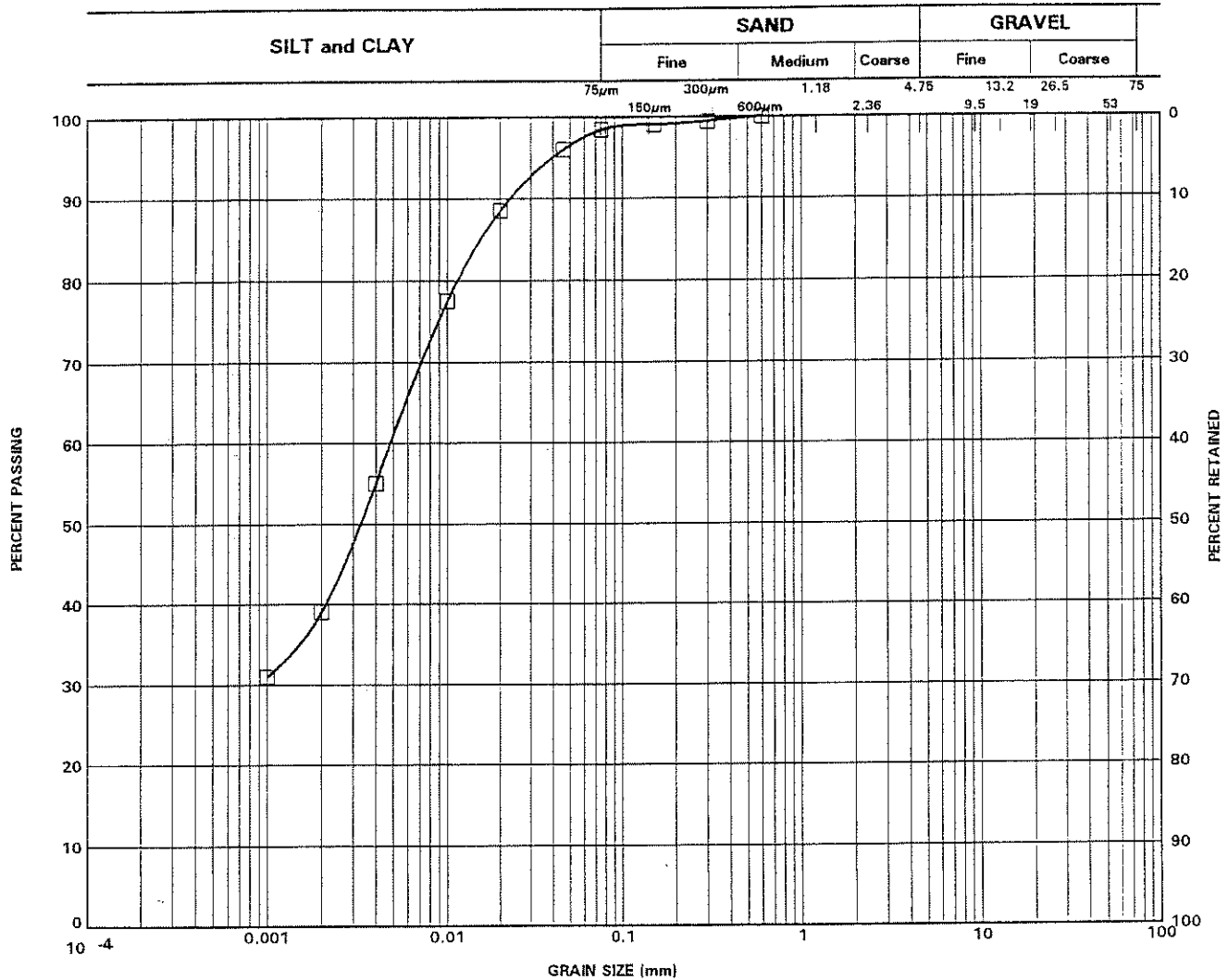
UNIFIED SOIL CLASSIFICATION SYSTEM





GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND

SYMBOL



BOREHOLE

98-19

DEPTH (m)

12.3

LOWER SILTY CLAY

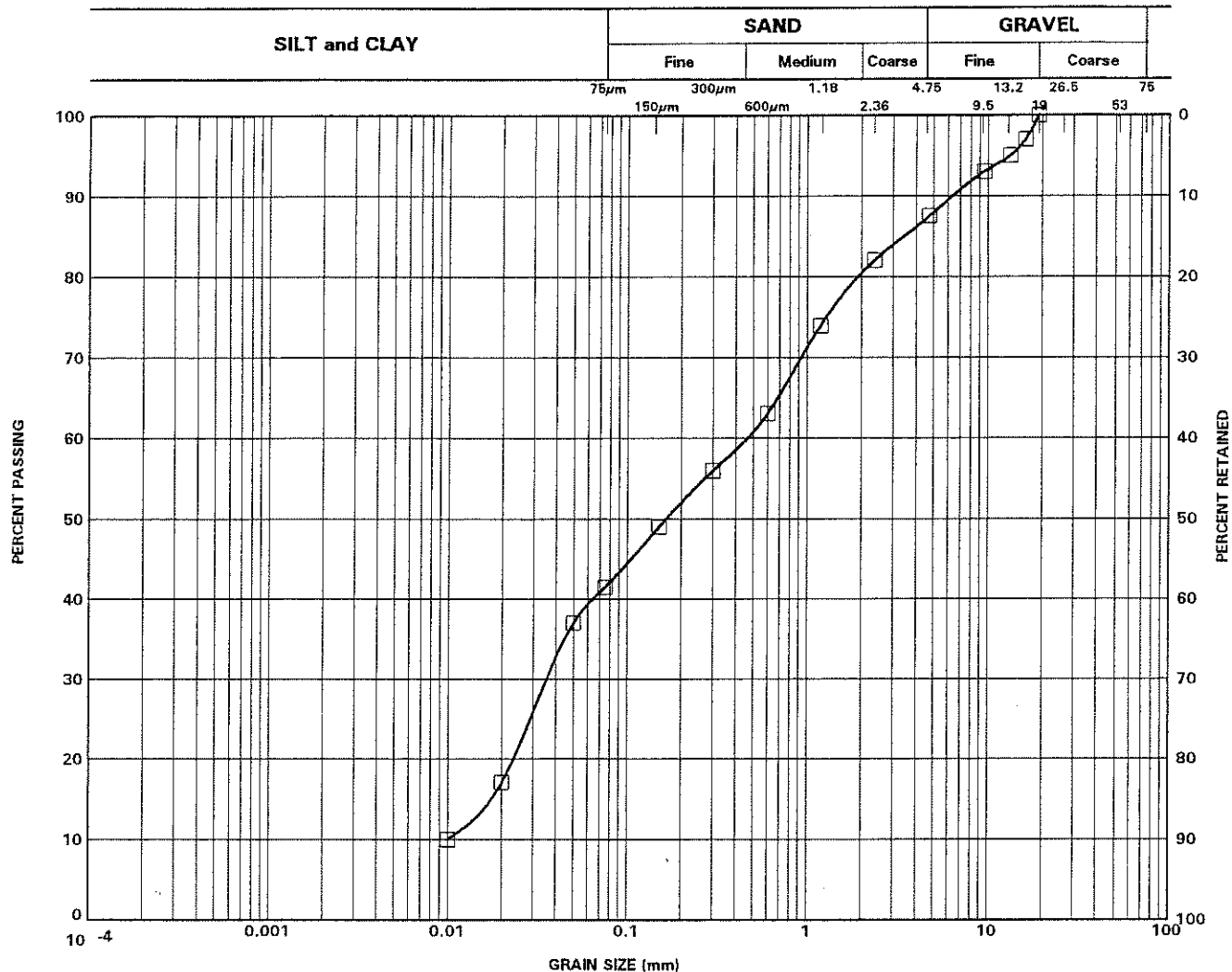
WP 363-94-00

SITE 33-393

Figure No. 24

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



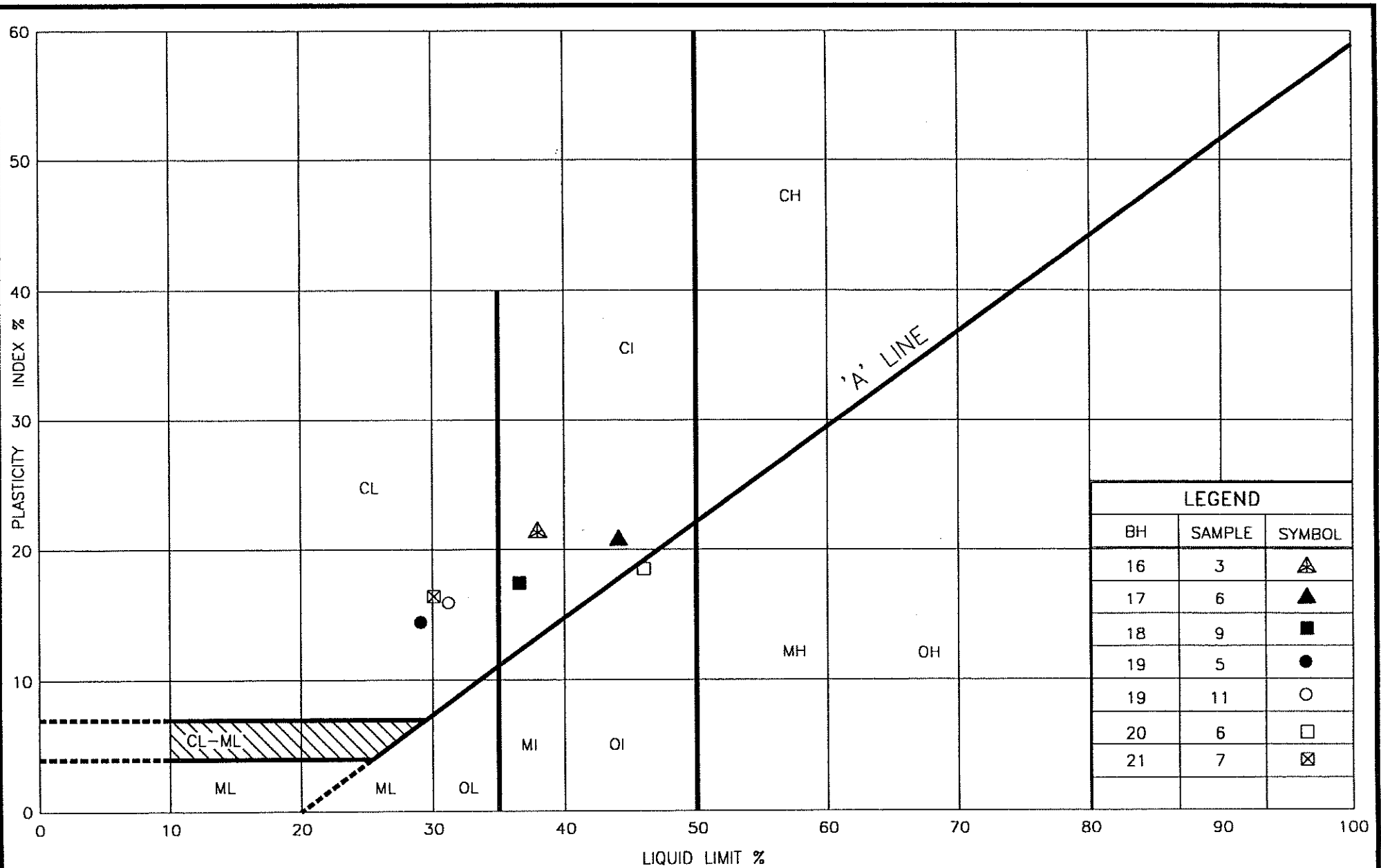
LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-17	18.3

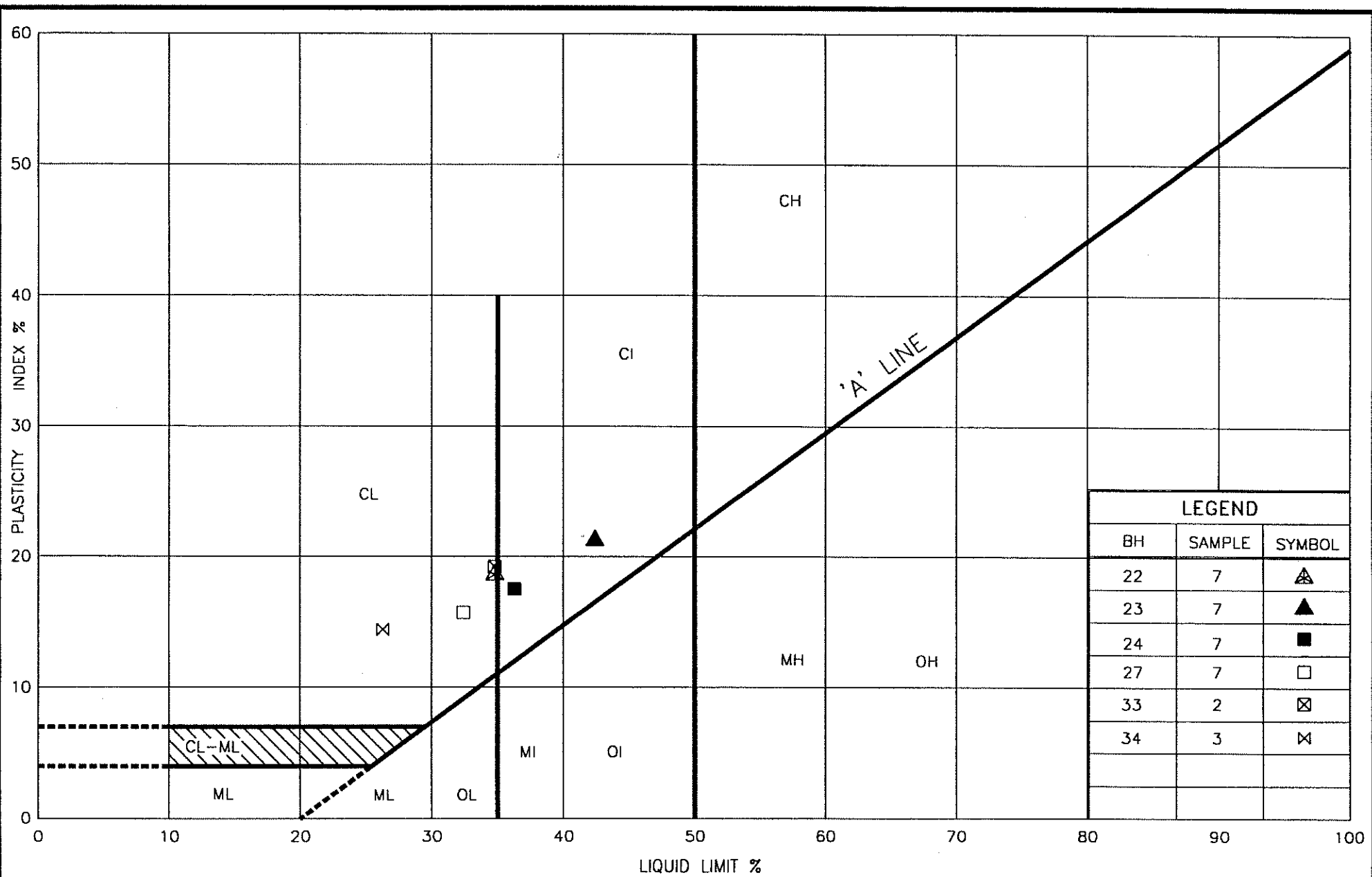
SANDY SILT TILL

WP 363-94-00

SITE 33-393

Figure No. 25





APPENDIX “E”

Shear Box Test Results

Project Name :- Hwy 7 & 8
Client :- Agra- Waterloo

Job #:- TK98-10-3
Date :- March 16, 1999.

Characteristic Properties of Soil

BH #	Sample No.	Atterberg Limits			Specimen #	Unit Weight kN/m ³	Initial Moisture Content%	Remarks
		Plastic Limit %	Liquid Limit %	Plasticity Index %				
18	TW9 (@ 9.2m depth)	17.4	36.6	19.2	A1	19.8	15.0	TW9 is being denoted as 'A'
					A2	20.1	15.1	
					A3	21.0	16.1	
					A4	20.7	15.9	
12	TW6 (@ 4.8 to 5.2m depth)	19.2	38.3	19.1	C1	20.2	18.6	TW6 is being denoted as 'C'
					C2	21.6	14.3	
					C3	21.3	13.7	
					C4	21.5	15.0	

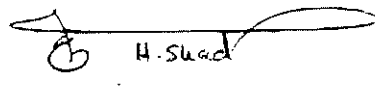
Test Conditions

BH #	Sample No.	Specimen #	Settlement during initial consolidation (mm)	Final Moisture Content%	Normal Loading (kPa)	Shear Rate (mm/min)	Remarks
18	TW9 (@ 9.2m depth)	A1	1.462	19.2	180	2.0	TW9 is being denoted as 'A'
		A2	1.504	19.3	180	0.008	
		A3	2.496	17.4	550	2	
		A4	2.838	17.7	550	0.008	
12	TW6 (@ 4.8 to 5.2m depth)	C1	2.054	20.6	180	2	TW6 is being denoted as 'C'
		C2	0.842	16.1	180	0.008	
		C3	3.010	15.0	550	2	
		C4	2.416	17.5	550	0.008	

Prepared By

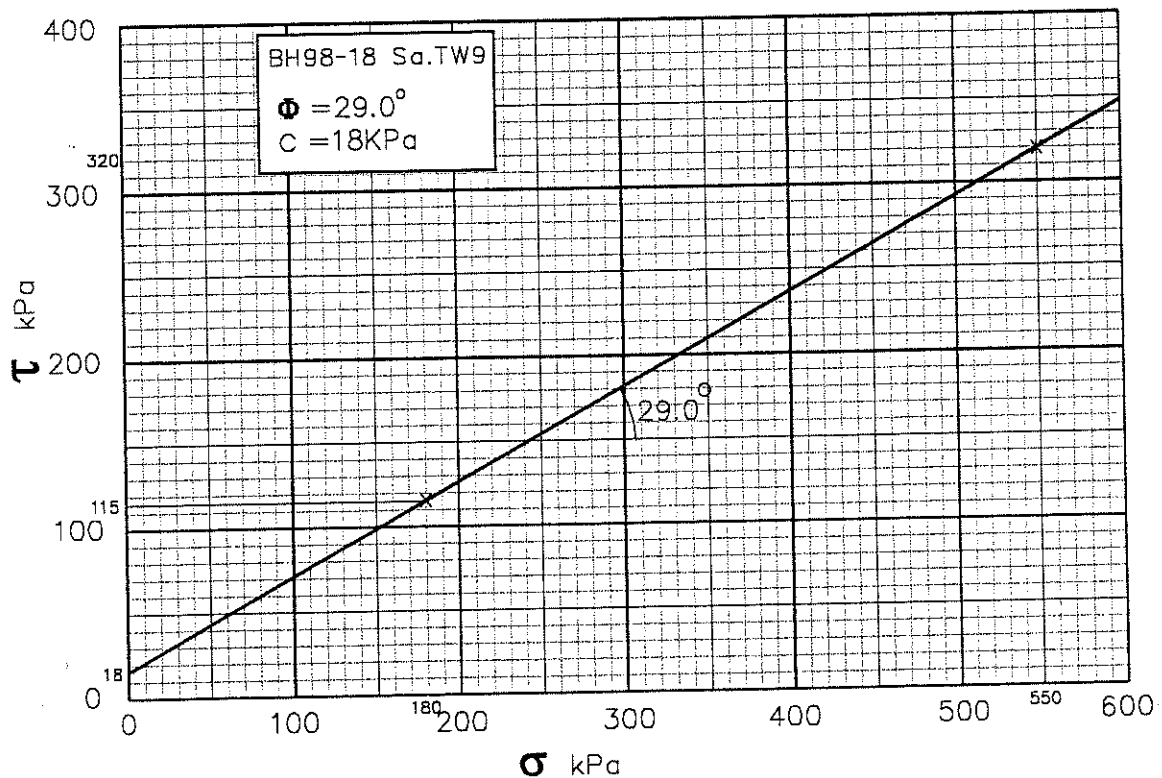
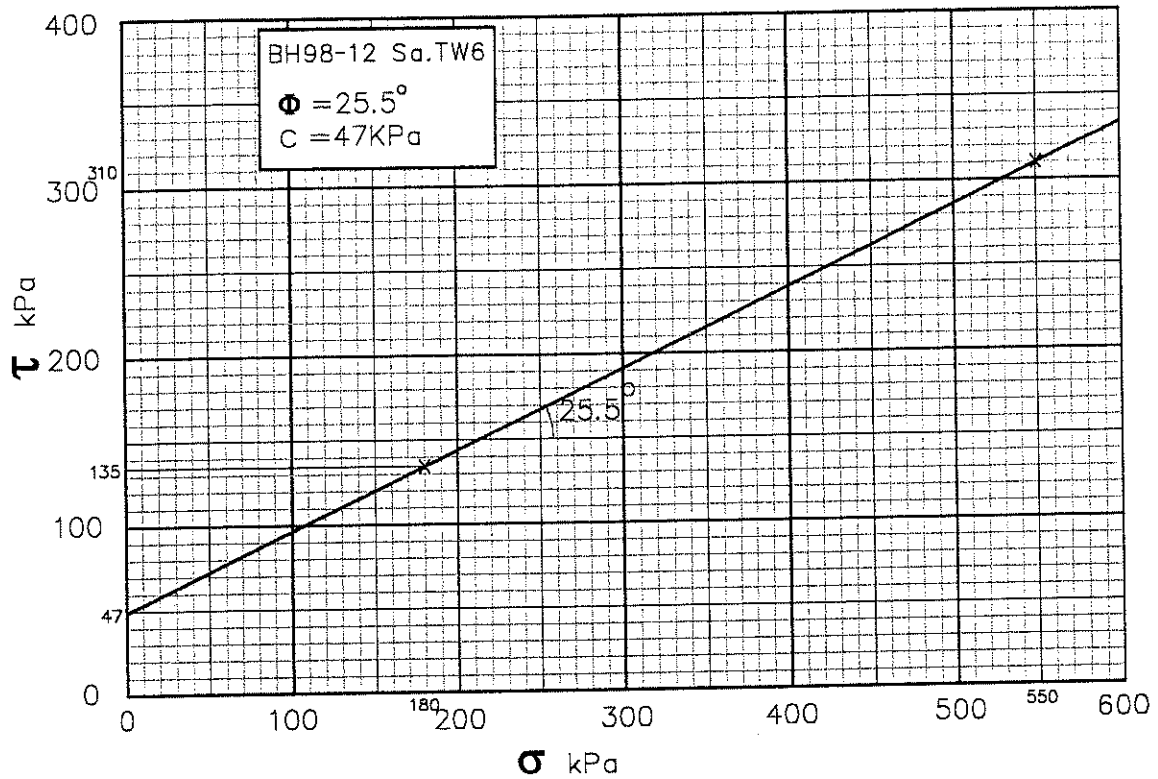

S. Baskaran P. Eng.

Reviewed By


Houshang Shad Ph.D.

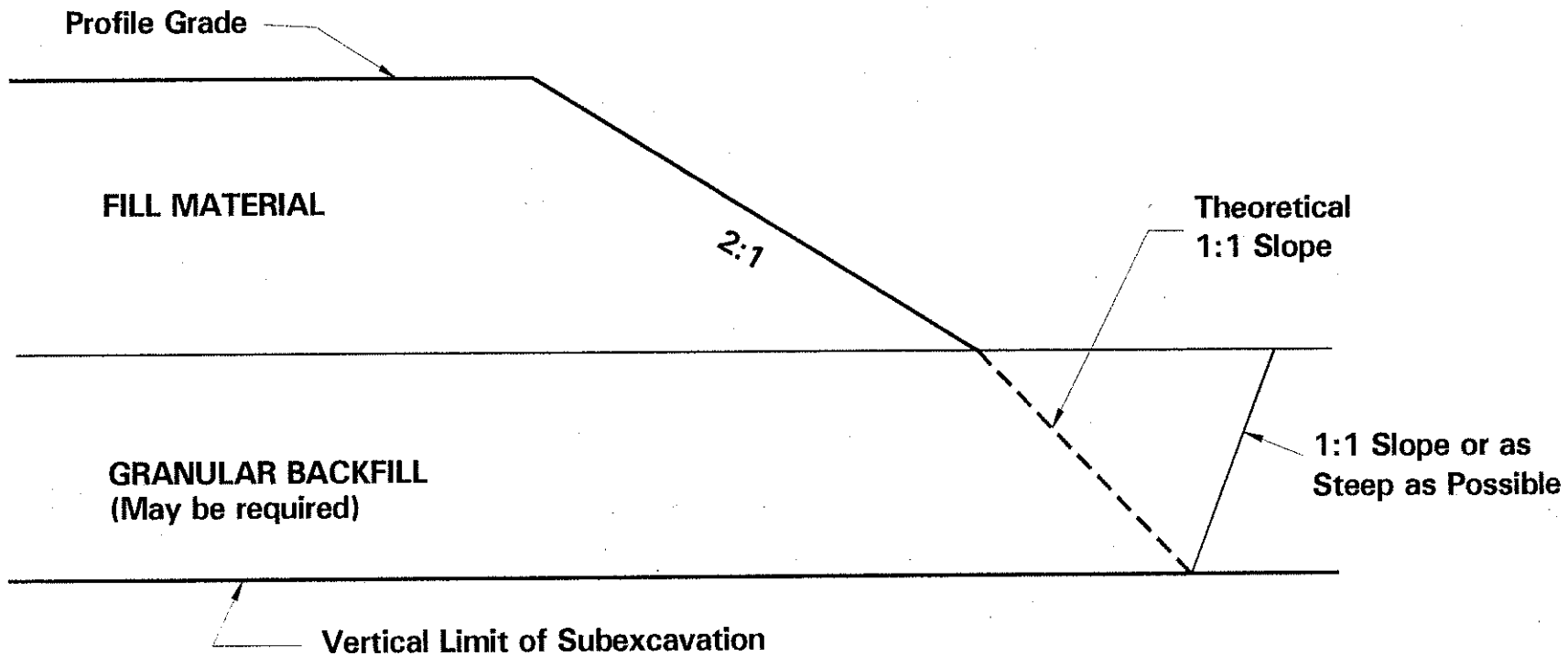
SHEAR BOX TEST RESULTS

(Drained Condition)



APPENDIX “F”

Removal of Unsuitable Soils from Beneath Approach Fills



REMOVAL OF UNSTABLE SOILS FROM BENEATH APPROACH FILLS

NTS

APPENDIX “G”

Statement of Limitations

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

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 conclusion as to how the subsurface conditions may affect their work.

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

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. AGRA Earth & Environmental 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.

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