



**FOUNDATION INVESTIGATION REPORT  
FOR  
IMPROVEMENTS TO HIGHWAY 401 AND DORCHESTER ROAD  
INTERCHANGE  
SITE NO. 19-303, HIGHWAY 401  
LONDON, ONTARIO  
GWP 3053-11-00  
ASSIGNMENT NO. 3016-E-0009; WORK ORDER NO. 19  
LATITUDE AND LONGITUDE: 42.958500, -81.060900**

PETO MacCALLUM LTD.  
165 CARTWRIGHT AVENUE  
TORONTO, ONTARIO  
M6A 1V5  
Phone: (416) 785-5110  
Fax: (416) 785-5120  
Email:toronto@petomaccallum.com

**Distribution:**

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DWG. No. DR-A – Borehole Location Coordinates & Elevations  
 Notes and References, Legend

DWG. No. DR-1 – Borehole Location Plan

DWG. No. DR-2 – Soil Stratigraphy

Explanation of Terms Used in Report

Record of Borehole Sheets 1 to 26, N, S, C1 and C2

Appendix A – Previous Investigation - MTO GEOCRETS No. 40114-155  
 Record of Borehole Nos. 401 to 404  
 Grain Size Distribution – Figure A-1 to A-6  
 Plasticity Chart – Figure A-7  
 DWG. 1 – Borehole Locations and Soil Strata

Appendix B-1 – Results of Grain Size Distribution Analyses  
 Figures GS-DR1-1A/B, GS-DR1-2, GS-DR1-3  
 Results of Atterberg Limit Tests  
 Figures PC-DR1-1A/B, DR1- PC -2, DR1- PC -3

Appendix B-2 – Results of Grain Size Distribution Analyses  
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Results of Atterberg Limit Tests  
Figures PC-DR6-1A/B, PC-DR6-2
- Appendix B-7 – Results of Grain Size Distribution Analyses  
Figures GS-DR7-1, GS-DR7-2  
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Figures PC-DR7-1, PC-DR7-2
- Appendix C – Results of Chemical Tests Provided by SGS Canada Inc.



**FOUNDATION INVESTIGATION REPORT**

For

Improvements to Highway 401 and Dorchester Road Interchange

Site No. 19-303, Highway 401

London, Ontario

GWP 3053-11-00

Assignment No. 3016-E-0009; Work Order No. 19

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**1. INTRODUCTION**

WSP Canada Group Limited (WSP) has retained Peto MacCallum Ltd. (PML) on behalf of the Ministry of Transportation Ontario (MTO) to conduct the geotechnical investigation in support of the preparation of Design Build Ready Package for Agreement No. 3016-E-0009, Work Order No. 19. The Design Build Ready package under Agreement No. 3016-E-0009-019 includes foundation investigation reports for the proposed four (4) overhead signs along Highway 401 at the intersection of Dorchester Road (formerly Highway 32), replacement of the Dorchester Road underpass, and proposed exit and entry ramps located at the interchange of Highway 401 and Dorchester Road.

A foundation investigation report for the proposed overhead signs along the Highway 401 was completed by PML under a separate cover (GEOCREC No 40I14-191, dated January 22, 2020).

This report summarizes the results of the foundation investigation carried out for the proposed exit and entry ramps, and replacement of the existing underpass located at the interchange of Highway 401 and Dorchester Road in London, Ontario.

The purpose of the investigation was to explore the subsurface conditions expected to influence the design of the replacement structure and proposed exit and entry ramps.

**2. SITE DESCRIPTION**

The existing Highway 401 roadway is slightly depressed from the natural topography, and accommodates a total of six (6) lanes of vehicular traffic; three (3) westbound lanes and three (3) eastbound lanes. The existing Dorchester Road accommodates one (1) northbound and one (1) southbound lane of vehicular traffic and oriented almost perpendicular to Highway 401. The site is generally a flat area, with the exception of the highway and approach embankments. The site is surrounded by tall grass and coniferous forestation with mature trees and shrubs.



The surrounding area is mainly used for farming. A Petro Canada fuel station is located in the southwest quadrant of the Highway 401 and Dorchester Bourne Interchange. Dorchester, Ontario is the residential and commercial core of the Municipality of Thames Centre and is located approximately 5.0 km north of the site where the Dorchester interchange is located.

### **3. FIELD INVESTIGATION PROCEDURES**

#### **3.1 Previous Field Investigation**

Golder Associates (Golder) carried out a preliminary foundation investigation and submitted a design report for the improvements of Highway 401 interchange, including replacement of Dorchester Road (Middlesex Road 32) underpass. The field work for the investigation was carried out between March 5 and March 15, 2013. A total of four (4) boreholes (401 to 404) were drilled by Golder. The results of the Golder investigation are reported in the following report:

*“Preliminary Foundation Investigation and Design Report, Middlesex Road 32 (Dorchester Road) Underpass, Site Number 19-303, Highway 401 Interchange Improvements/Structural Replacements, GWP 3053-11-00, Assignment No. 2 (3011-E-0047)”, dated April 2015 (GEOCRE 40I14-155).*

Refer to Table 3.1 for a summary of the location and depth of boreholes 401 to 404.

**Table 3.1 – Borehole Information<sup>1</sup>**

BOREHOLE ID	BOREHOLE LOCATION	GROUND SURFACE ELEVATION (m)	BOREHOLE DEPTH (m)	COORDINATES (MTM ON-11)	
				NORTHING	EASTING
401	South Abutment	285.5	30.6	4 758 600	422 221
402	South Approach	285.3	9.6	4 758 590	422 223
403	North Approach	286.1	9.6	4 758 679	422 217
404	North Abutment	286.2	28.7	4 758 667	422 220

**Note:** 1. Based on Geocres No. 40I14-155.



The relevant Record of Boreholes and summary of the laboratory tests results from the Golder report are provided in Appendix A. The location of boreholes and soil strata for boreholes 401 to 404 are also presented on Drawing DWG. 1 provided in Appendix A.

### **3.2 Current Field Investigation**

Prior to fieldwork, the proposed locations and depths of boreholes were provided to MTO and WSP for their review and approval. Based on the information provided by WSP and MTO, boreholes 401 and 402 were advanced in the close proximity of the proposed location of the south abutment, and boreholes 403 and 404 were advanced in the close proximity of the proposed location of the north abutment. As a result, these boreholes (GEOCRESS 40114-155) were considered relevant for the design of the underpass structure, and current investigation program was revised as recommended by MTO and WSP to include only one (1) supplementary borehole at each abutment location. Information from boreholes 401 to 404 are also included in the subsoil information provided under Section 5.2, Subsurface Conditions.

The fieldwork for the current investigation was carried out between September 16 and November 22, 2019. A total of 30 boreholes were advanced to depths ranging from 8.2 m to 30.6 m. The Record of Borehole sheets are appended to this report. The borehole coordinates and elevations are presented on DWG. No. DR-A. The borehole location plan is presented on DWG. No. DR-1 and the soil stratigraphic profiles are presented on DWG. Nos. DR-2.

The locations of the boreholes drilled and corresponding coordinates were provided by WSP. The boreholes were laid out by PML engineering staff, in conformance with the locations and coordinates approved by WSP and MTO. Some of the boreholes during the field investigation were relocated due to the presence of underground utilities and/or difficulty to access the planned locations by drill rig.

PML staff used a portable GPS device to establish the location of boreholes in the field. Subsequently, PML carried out the survey of the as-drilled borehole locations and elevations using a Sokkia SHC5000 Differential GPS system, equipped with a GCX3 (Network RTK rover) GNSS Receiver. The vertical and horizontal accuracy of this equipment are within 0.1 m and 0.5 m, respectively, as required by MTO Guidelines. All elevations (EL.) reported in this report are referred



to in MTM NAD 83 Northing and Easting (MTM Zone—ON11) Geodetic datum and expressed in meters. Refer to Drawing DR-A for the details of the borehole location.

Traffic control services where required were provided by Almon Equipment Ltd. of Toronto, Ontario, in accordance with Ontario Traffic Manual, Book 7-Temporary Conditions (2014).

PML engineering staff arranged for the clearance of underground services and appropriate permit applications. The respective utility companies cleared the underground services at the borehole locations. Public and private utility authorities were informed and all of the utility clearance documents were obtained before the commencement of drilling work. Fieldwork was supervised on a full-time basis by PML staff operating under the direction of an engineer.

A summary of the depths and locations of the boreholes with respect to the proposed replacement structures are provided on Table 3.2 below.



**Table 3.2 – Summary of Borehole Depths and Locations**

<b>DORCHESTER ROAD UNDERPASS</b>							
<b>BOREHOLE ID</b>	<b>BOREHOLE LOCATION</b>	<b>GROUND SURFACE ELEVATION (m)</b>	<b>BOREHOLE DEPTH (m)</b>	<b>COORDINATES</b>			
				<b>NORTHING (MTM ON-11)</b>	<b>EASTING (MTM ON-11)</b>	<b>LATITUDE</b>	<b>LONGITUDE</b>
N	North Abutment	286.2	30.6	4 758 664.6	422 208.9	42.958734	-81.060954
C1	Centre Pier	279.3	30.0	4 758 632.7	422 231.3	42.958442	-81.060686
C2	Centre Pier	279.3	30.0	4 758 626.0	422 200.1	42.958388	-81.061071
S	South Abutment	284.5	30.6	4 758 596.0	422 245.3	42.958110	-81.060523
1	Future Highway 401 West - Dorchester Road N/S	283.4	12.8	4 758 533.0	421 948.8	42.957589	-81.064169
2		284.3	12.8	4 758 515.6	422 050.3	42.957416	-81.062929
3		282.7	12.8	4 758 480.8	422 132.7	42.957091	-81.061926
4		282.5	12.8	4 758 462.4	422 224.0	42.956911	-81.060812
6		284.0	12.8	4 758 477.8	422 186.7	42.957056	-81.061265
5	Future Dorchester Road N - Highway 401 E	283.6	15.8	4 758 523.0	422 263.2	42.957450	-81.060319
7		282.6	12.8	4 758 524.9	422 120.0	42.957490	-81.062072
8		278.9	12.8	4 758 595.4	422 166.3	42.958117	-81.061491
9		286.2	12.8	4 758 560.4	422 193.5	42.957798	-81.061165
10		283.4	12.8	4 758 519.6	422 171.5	42.957434	-81.061443



**Table 3.2 – Summary of Borehole Depths and Locations**

<b>DORCHESTER ROAD UNDERPASS</b>							
<b>BOREHOLE ID</b>	<b>BOREHOLE LOCATION</b>	<b>GROUND SURFACE ELEVATION (m)</b>	<b>BOREHOLE DEPTH (m)</b>	<b>COORDINATES</b>			
				<b>NORTHING (MTM ON-11)</b>	<b>EASTING (MTM ON-11)</b>	<b>LATITUDE</b>	<b>LONGITUDE</b>
11	Future Dorchester Road S - Highway 401 E	278.8	9.8	4 758 555.3	422 379.1	42.957723	-81.058892
12		276.7	11.3	4 758 581.6	422 408.2	42.957956	-81.058530
13		274.4	11.3	4 758 612.1	422 440.3	42.958225	-81.058130
14	Future Highway 401 E - Dorchester Road N/S	274.4	12.8	4 758 749.3	422 449.9	42.959459	-81.057983
15		276.0	12.8	4 758 779.9	422 346.9	42.959750	-81.059239
16		283.3	12.8	4 758 808.9	422 256.7	42.960025	-81.060338
17		284.4	12.8	4 758 812.3	422 192.0	42.960065	-81.061130
18		285.0	15.8	4 758 770.0	422 213.3	42.959681	-81.060879
19	Future Dorchester Road S - Highway 401 W	283.8	12.8	4 758 792.1	422 241.1	42.959876	-81.060533
20		282.0	12.8	4 758 779.2	422 279.9	42.959754	-81.060060
21		278.3	12.8	4 758 768.0	422 345.8	42.959643	-81.059255
22		282.5	12.8	4 758 757.1	422 279.5	42.959555	-81.060069
23		275.7	9.8	4 758 671.9	422 315.6	42.958783	-81.059646
24	Future Dorchester Road N - Highway 401 W	283.8	11.3	4 758 748.4	422 117.6	42.959502	-81.062056
25		282.4	9.8	4 758 705.6	422 089.6	42.959121	-81.062407
26		282.8	9.8	4 758 678.3	422 061.0	42.958880	-81.062763



The boreholes were advanced using continuous flight hollow stem augers powered by a track mounted D-50 Turbo and CME-50 Truck mounted drill rigs. The drilling equipment were supplied and operated by London Soil Test Inc. (London Soil), of London, Ontario and PML Field Services Ltd. (PML FS), Toronto, Ontario. London Soil and PML FS are specialist drilling contractors and the drilling crews worked under the full-time supervision of a member of the PML engineering staff.

Representative soil samples were recovered from the boreholes at 0.75 m intervals to a depth of 6.0 m and at 1.5 m intervals to a depth of 20 m, and below 20 m, samples were recovered at 3.0 m interval to the termination depth, using a conventional 51 mm OD split spoon sampler in accordance with the Standard Penetration Test (SPT) procedure (ASTM D-1586). Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. In addition, attempt was made to measure in-situ vane shear strength of clayey soil at depths where SPT values were below about 8 blows/300 mm, using an N-size (MTO) vane.

The soil samples were identified in the field in accordance with the MTO Soil Classification procedures and transported to the Toronto PML laboratory for further visual classification and testing. Index tests (water content determination, grain size distribution and Atterberg limits) were carried out on selected representative samples.

The groundwater conditions at the borehole locations were observed during the drilling operations by visual examination of the soil samples, sampler and drill rods as the samples were retrieved. In addition, water level measurements were taken in the open boreholes upon completion of drilling.

Monitoring wells, consisting of 50 mm outside diameter rigid PVC pipe, were installed in three of the boreholes for groundwater level measurement in the area of the underpass. Water levels were measured using a Solinst flat tape water level reader.

The boreholes and monitoring wells were constructed and abandoned/decommissioned in conformance with the requirements of MTO guidelines and Ontario Regulation 903, amended by Ontario Regulation 372.



## **4. LABORATORY TEST PROCEDURES**

### **4.1 Soil Testing**

Laboratory tests on representative SPT samples recovered during the fieldwork were conducted by the laboratory owned by PML, located in Toronto. The laboratory testing program included the following:

- Natural moisture content determinations (403)
- Grain size distribution analysis (116)
- Hydrometer tests (116)
- Atterberg limit tests (113)

All laboratory tests to determine the index properties were performed in accordance with the MTO test procedures, which follow the American Society for Testing Materials (ASTM) standards, with the exception of specific gravity (LS-705) and hydrometer test (LS-702). All the test results are summarized on the attached Record of Borehole Logs provided with this report.

### **4.2 Chemical Analysis**

Six (6) representative soil samples were sent to SGS Canada Inc. (SGS) in Toronto, Ontario, which is accredited by Canadian Analytical Laboratory Association (CALA) for corrosivity analyses. The corrosivity test results provided by SGS are presented in Appendix C. A summary of the test results is also presented in Table 5.3.

## **5. SITE GEOLOGY AND SUBSURFACE CONDITIONS**

### **5.1 Site Geology**

In general, the project area is located within the Mount Elgin Ridges physiographic region, which consists of a series of ridges and vales, as outlined in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984). The ridges are composed mainly of pale brown calcareous clay or silty clay deposits, and it is common to find alluvium of gravel, sand or silt in the vales. The ridges are well drained, while poor drainage prevails in the hollows.





Based on the Bedrock Geology map (MRD126-REV1, 2011) published by the Ontario Ministry of Northern Development and Mines (MNDM), the project site lies within the Dundee rock formation. The project area consists mainly of middle Devonian limestone, dolostone, and shale bedrock. The Bedrock Surface map (Map 3.3, 2004) published by Conservation Ontario based on the Middlesex-Elgin Groundwater Study, suggests that the bedrock surface in this area is expected to be encountered at about EL. 230.0 to EL. 220.1.

The Quaternary Geology map published by the MNDM indicates that the sub-surface conditions in this area consist of Port Stanley Till comprised of strongly calcareous, moderate to low clast silt to sandy silt.

## **5.2 Subsurface Conditions**

The subsurface conditions encountered during the course of the investigation, together with the field and laboratory test results are shown on the attached Record of Borehole Sheets. The borehole locations are shown on DWG. No. DR-1 and stratigraphic profile sections are provided on DWG. Nos. DR-2. The boundaries between soil strata have been established at the borehole locations only. The boundaries of soil strata between and beyond the boreholes are assumed and may vary from location to location.

The details of the subsoil conditions encountered along the alignment of proposed underpass, future entry and exit ramps and in the area of existing ramps are provided separately in Appendix B. The details of groundwater level observed are also provided under each area of investigation. Groundwater levels are subject to seasonal fluctuations and precipitation patterns.



### 5.2.1 Underpass Structure at the Intersection of Highway 401 and Dorchester Road

Boreholes N, C1, C2 and S were drilled in the area of proposed underpass structure. The approximate locations of the boreholes advanced during the current investigation are shown on DWG. No. DR-1. The stratigraphy profile is presented on DWG. No. DR-2. The subsurface conditions encountered at this location can be categorized into five (5) distinct zones as follows;

- Pavement Structure
- Gravelly Sand (Fill)
- Clayey Silt, Trace/Some Sand, Trace Gravel
- Silty Sand, Some Gravel
- Sandy Clayey Silt, Trace Gravel

#### 5.2.1.1 Pavement Structure

A pavement structure consisting of 400 mm to 600 mm thick asphalt over 1.4 m to 0.9 m of sand and gravel fill was encountered immediately below the existing ground surface in Boreholes C1 and C2 advanced in the area of existing median of Highway 401.

The SPT 'N'-values recorded within the sand and gravel fill layer ranged from 13 to 33 blows, indicating compact to dense state of compactness. The moisture content of samples tested from the sand and gravel fill ranged from 2.5% to 14.3%, with an average value of 7.3%.

#### 5.2.1.2 Gravelly Sand (Fill)

This gravelly sand fill layer was encountered only in Borehole N immediately below the existing ground surface (EL. 286.2) and extends to a depth of 5.2 m (EL. 281.0). In general, the SPT 'N'-values in this fill layer ranged from 6 to 14 blows, with the exception of 50 blows at the surface, indicating loose to compact state of compactness. The moisture content of the samples tested from this layer ranged from 2.9% to 12.2%, with an average value of 5.9%.

#### 5.2.1.3 Clayey Silt, Trace/Some Sand, Trace Gravel

This clayey silt deposit was encountered immediately below the granular fill at EL. 277.5 and EL. 277.8 in Boreholes C1 and C2, respectively. In Borehole N, the layer was encountered immediately below the gravelly sand fill at EL. 281.0. However, in Borehole S, this clayey silt deposit was encountered immediately below the ground surface (EL. 284.5). The thickness of this



deposit ranges from 15.3 m (Borehole C2) to 25.5 m (Borehole S). This layer extends to depths 16.8 m to 25.9 m (EL. 262.5 to EL. 259.0) below the existing ground level of the boreholes.

The SPT 'N'-values recorded within the clayey silt ranged from 5 to 28 blows, indicating firm to very stiff consistency. The moisture content of the samples tested from this deposit ranged from 11.6% to 24.8%, with an average value of 16.9%.

The results of the sieve analysis test performed on 17 representative samples from this deposit are provided on Figures GS-DR1-1A and 1B. The test results indicate that this deposit consists of none to 9% gravel, none to 15% sand, 42% to 75% silt, and 24% to 54% clay. Atterberg limits were performed on the same 17 samples selected for sieve analysis test and the results are presented on Figures PC-DR1-1A and 1B. The test results indicate liquid limit values of 21 to 34, with the exception of Sample SS16 in Borehole C1 (37), plastic limit values of 14 to 19, and the corresponding plasticity index values of 7 to 18. Based on the test results, the soil may be classified as clay of low plasticity (CL) in the Unified Soil Classification System (USCS), and clayey silt in the MTO Soil Classification System.

#### 5.2.1.4 Silty Sand, Some Gravel

The clayey silt deposit in all of the boreholes is underlain by a silty sand deposit with varying proportions of silt and gravel. This sandy deposit was not fully penetrated, with the exception of Borehole C1, to establish the thickness and extends to the termination depths of Boreholes C2, N, and S, ranging from 30.0 m to 30.6 m below the existing ground level, i.e., EL. 255.6 to EL. 249.3. The thickness of this deposit in Borehole C1 was 10.6 m and extends to EL. 250.8.

The SPT 'N'-values recorded generally varied from 8 blows to 38 blows, indicating a loose to dense state of compactness to elevation EL. 252.5. Below EL. 252.5, the SPT 'N'-values recorded were 99 blows to over 100 blows in Borehole C2, indicating very dense state of compactness. The moisture content of the samples tested from this layer ranged from 8.7% to 21.2%, with an average value of 16.0%.

The results of the sieve analysis test performed on six (6) representative samples from this deposit are provided on Figure GS-DR1-2. The test results indicate that this deposit consists of none to 30% gravel, 42% to 85% sand, 5% to 42% silt, and 1% to 10% clay sized particles. Atterberg limit tests were performed on one (1) of the samples selected for sieve analysis test and



the results are presented on Figure PC-DR1-2. The test results indicate a liquid limit value of 14, a plastic limit value of 11, and the corresponding plasticity index value of 3. Based on the test results, the sample may be classified as silty sand (SM) in the USCS.

#### 5.2.1.5 Sandy Clayey Silt, Trace Gravel

Sandy clayey silt was encountered only in Borehole C1 followed by the silty sand deposit, and extends to the termination depth of 30.0 m (EL. 249.3), below the existing ground surface.

The SPT 'N'-values recorded in this deposit were over 100 blows, indicating hard consistency. The moisture content of two (2) samples tested from this deposit was 7% and 9.2%.

The results of the sieve analysis test performed on one (1) representative sample from this deposit are provided on Figure GS-DR1-3. The test results indicate that this deposit consists of 7% gravel, 34% sand, 41% silt, and 18% clay. Atterberg limit tests were performed on the same sample selected for sieve analysis test and the results are presented on Figure PC-DR1-3. The test results indicate a liquid limit value of 20, plastic limit value of 12, and the corresponding plasticity index value of 8. Based on the test results, the soil may be classified as clay of low plasticity (CL) in the USCS and clayey silt in the MTO Soil Classification System.

#### 5.2.1.6 Groundwater

Groundwater was encountered during drilling in boreholes C2, S and N, at depths ranging from 12.6 m to 22.9 m. Groundwater level was measured upon completion of drilling in Boreholes, C2, S and N at a depth of 16.8 m, 19.8 m and 15.0 m. Boreholes C1 was charged with drilling water and groundwater level could not be established. Groundwater levels are shown on the Record of Borehole Sheets.

Groundwater monitoring wells consisting of 50 mm diameter PVC pipe were installed in boreholes C1, N and S. Additional water level measurements from the monitoring wells installed in three of the borehole are shown on the Record of Borehole sheets, as well as in the table below.



**Table 5.2.1.6 Groundwater Level Readings**

BOREHOLE NO.	GROUND SURFACE EL. (m)	GROUNDWATER LEVEL UPON COMPLETION OF DRILLING		DATE OF READING	GROUNDWATER LEVEL ON DEC. 3, 2019		GROUNDWATER LEVEL ON MAR. 5, 2020	
		DEPTH (m)	EL. (m)		DEPTH (m)	EL. (m)	DEPTH (m)	EL. (m)
BH C1	279.3	Not established	Not established	Oct. 10, 2019	Dry	--	n/a	
BH C2	279.3	16.8	262.5	Oct. 09, 2019	n/a		n/a	
BH N	286.2	19.8	266.4	Oct. 08, 2019	Dry	--	Dry	--
BH S	284.5	15.0	269.5	Oct. 11, 2019	Dry	--	Dry	--

**Note:** The monitoring well installed in Boreholes C1 was decommissioned on December 3, 2019. The monitoring wells installed in Boreholes N and S were decommissioned on March 5, 2020.

Groundwater levels may fluctuate due to the influence of precipitation and seasonal change. The groundwater measurements were observed and measured prior to backfilling the boreholes.

#### 5.2.2 Future Highway 401 West - Dorchester Road North/South Ramp

Boreholes 1 to 4 and 6 were drilled along the proposed alignment of future Highway 401 West - Dorchester Road North/South Ramp. The approximate locations of the boreholes advanced during current investigation are shown on DWG. No. DR-1. The subsurface conditions encountered at this location can be categorized into four (4) distinct zones as follows;

- Topsoil
- Clayey Silt, Some Sand, Trace Gravel (Fill)
- Clayey Silt, Trace/Some Sand, Trace Gravel
- Silty Sand, Some Gravel

##### 5.2.2.1 Topsoil

A layer of topsoil, approximately 200 mm to 300 mm in thickness was encountered immediately below the existing ground surface in all five of the boreholes advanced.



#### 5.2.2.2 Clayey Silt, Some Sand, Trace Gravel (Fill)

This clayey silt fill layer was encountered immediately below the topsoil and extends to depths ranging from 0.8 m to 2.7 m (EL. 283.2 to EL. 280.3) below the existing ground surface.

The SPT 'N'-values recorded in the clayey silt fill varied widely from 3 blows to 17 blows, with the exception of one SPT value of 41 blows in Borehole 6, indicating soft to very stiff consistency. The moisture content of samples tested from the clayey silt fill ranged between 6.3% and 26.5%, with an average value of 13.9%.

#### 5.2.2.3 Clayey Silt, Trace/Some Sand, Trace Gravel

This clayey silt deposit was encountered immediately below the clayey silt fill and extends to maximum borehole termination depth of 12.8 m (EL. 269.7 to EL. 271.5), with the exception of Borehole 3. In Borehole 3, this deposit was fully penetrated at a depth of 11.8 m (EL. 270.9) below the existing ground surface. This layer was not fully penetrated in Boreholes 1, 2, 4, and 6 to establish the thickness of the deposit.

The SPT 'N'-values recorded ranged from 8 to 45 blows, indicating stiff to hard consistency. Moisture content of samples tested from this layer ranged from 4.7% to 23.8%, with an average value of 15.1%.

The results of the sieve analysis test performed on 16 representative samples from this deposit are provided on Figures GS-DR2-1A and 1B. The test results indicate that this deposit consists of 1% to 10% gravel, 9% to 16% sand, 47% to 59% silt, and 22% to 37% clay. Atterberg limits were performed on 18 samples and the results are presented on Figures PC-DR2-1A and 1B. The test results indicate liquid limit values of 21 to 33, plastic limit values of 13 to 18, and the corresponding plasticity index values of 8 to 15. Based on the test results, the soil may be classified as clay of low plasticity (CL) in the USCS, and clayey silt in the MTO Soil Classification System.

#### 5.2.2.4 Silty Sand, Some Gravel

This silty sand deposit was encountered immediately below the clayey silt in Borehole 3 and extends to the termination depth of 12.8 m (EL. 269.9).



Only one SPT test was conducted and the “N”-value recorded was 29 blows, indicating a compact state of compactness. The moisture content of one (1) sample tested from this deposit was 12.5%.

The results of the sieve analysis test performed on one (1) representative sample from this deposit are provided on Figure GS-DR2-2. The test results indicate that this deposit consists of 13% gravel, 64% sand, 14% silt and 9% clay sized particles. Based on the test results, the soil may be classified as silty sand (SM) in the USCS.

#### 5.2.2.5 Groundwater

Groundwater was not encountered during or upon completion of drilling in boreholes, with the exception of Borehole 3. Groundwater level was measured upon completion of drilling in Borehole 3 at a depth of 10.7 m (EL. 272.0). Groundwater levels may fluctuate due to the influence of precipitation and seasonal change. The groundwater measurements were taken prior to backfilling the boreholes. The groundwater level is shown on the Record of Borehole Log.

#### 5.2.3 Future Dorchester Road North - Highway 401 East Ramp

Boreholes 5 and 7 to 10 were drilled along the proposed alignment of future Dorchester Road North - Highway 401 East ramp. The approximate locations of the boreholes advanced during the current investigation are shown on DWG. No. DR-1. The subsurface conditions encountered at this location can be categorized into three (3) distinct zones as follows;

- Pavement Structure/Fill
- Clayey Silt, Some Sand, Trace Gravel (Fill)
- Clayey Silt, Trace/Some Sand, Trace/Some Gravel

##### 5.2.3.1 Pavement Structure/Fill

A pavement structure consisting of 200 mm thick asphalt over 1.6 m of sand and gravel was encountered immediately at the existing ground surface in Borehole 5. A 1.1 m thick of gravelly sand fill was encountered immediately at the existing ground surface in Borehole 8.

The SPT ‘N’-values recorded within the sand and gravel/gravelly sand fill layer ranged from 9 to 32 blows, indicating loose to dense state of compactness. The moisture content of one (1) sample tested from the sand and gravel layer was 12.1%.



#### 5.2.3.2 Clayey Silt, Some Sand, Trace Gravel (Fill)

A clayey silt fill layer was encountered only in Borehole 7 immediately below the ground surface and extends to a depth of 1.5 m (EL. 281.1).

The SPT 'N'-values recorded in the clayey silt fill were 9 and 12 blows, indicating stiff consistency. The moisture content of two (2) samples tested from this fill layer was 13.9% and 26.2%.

#### 5.2.3.3 Clayey Silt, Trace/Some Sand, Trace/Some Gravel

The pavement structure/fill in Boreholes 5 and 8, and the clayey silt fill in Borehole 7 are followed by a clayey silt deposit with varying proportions of sand and gravel. This deposit was encountered immediately below the existing ground surface in Boreholes 9 and 10. This deposit extends to the maximum termination depths of boreholes ranging from 12.8 m to 15.8 m (EL. 273.4 to EL. 266.1).

The SPT 'N'-values recorded ranged from 9 to 32 blows, with the exception Sample SS 3 in Borehole 7 (5 blows), indicating stiff to hard consistency. The moisture content of the samples tested from this deposit ranged from 4.4% to as high as 32.2%, with an average value of 15.3%. However, the moisture content of one (1) sample (SS 3 in Borehole 7) containing organics was found to be 102.9%.

The results of the sieve analysis test performed on 17 representative samples from this deposit are provided on Figures GS-DR3-1A and 1B. The test results indicate that this deposit consists of none to 12% gravel, 1% to 17% sand, 46% to 76% silt, and 23% to 41% clay. Atterberg limit tests were performed on the same 17 samples selected for sieve analysis, and an additional two (2) representative samples from this deposit. The results of the Atterberg limit tests results are presented on Figures PC-DR3-1A and 1B. The results indicate liquid limits values of 24 to 35, plastic limit values of 14 to 18, and the corresponding plasticity index values of 9 to 17. Based on the test results, the soil may be classified as clay of low plasticity (CL) in the USCS, and clayey silt in the MTO Soil Classification System.

The results of the sieve analysis test performed on one (1) sample from the sandy clayey silt seam are provided on Figure GS-DR3-2. The test results indicate that the soil consists of 8% gravel, 27% sand, 44% silt, and 21% clay. Atterberg limit tests were performed on the same sample selected for sieve analysis and the test results are presented on Figure PC-DR3-2. The





test results indicate a liquid limit value of 20, plastic limit value of 13, and the corresponding plasticity index value of 8. Based on the test results, the soil may be classified as clay of low plasticity (CL) in the USCS and clayey silt in the MTO Soil Classification System.

#### 5.2.3.4 Groundwater

Groundwater was not encountered during or upon completion of drilling in boreholes, with the exception of Borehole 5. Groundwater level was measured upon completion of drilling in Borehole 5 at a depth of 13.7 m (EL. 269.9). Groundwater levels may fluctuate due to the influence of precipitation and seasonal change. The groundwater measurements were taken prior to backfilling the boreholes. The groundwater level is shown on the Record of Borehole Log.

#### 5.2.4 Future Dorchester Road South - Highway 401 East Ramp

Boreholes 11 to 13 were drilled along the future Dorchester Road South - Highway 401 East ramp. The approximate locations of the boreholes advanced during the current investigation are shown on DWG. No. DR-1. The subsurface conditions encountered at this location can be categorized into three (3) distinct zones as follows:

- Pavement Structure
- Sandy Clayey Silt, Trace/Some Gravel (Fill)
- Sandy Clayey Silt, Trace/Some Gravel

##### 5.2.4.1 Pavement Structure

A pavement structure consisting of 200 mm thick asphalt over 0.2 m to 1.1 m of sand and gravel fill was encountered immediately below the existing ground surface in all three (3) boreholes advanced in this area.

The SPT 'N'-values recorded for the sand and gravel fill layer ranged from 11 to 34, indicating a compact to dense state of compactness. The moisture content of samples tested from the sand and gravel fill ranged from 3.1 % to 11.3%, with an average value of 5.8%.

##### 5.2.4.2 Sandy Clayey Silt, Trace/Some Gravel (Fill)

The pavement structure is immediately underlain by this 2.7 m to 7.9 m thick sandy clayey silt fill, which extends to a maximum depth of 8.5 m (EL. 270.3) in Borehole 11.



The SPT 'N'-values recorded ranged from 9 to as high as 53 blows, indicating firm to hard consistency. Moisture content determinations of the clayey silt fill ranged from 8.4% to 15.8%, with an average moisture content of 11.8%.

The results of the sieve analysis test performed on five (5) representative samples from this fill are provided on Figure GS-DR4-1. The test results indicate that the soil consists of 6% to 23% gravel, 28% to 35% sand, 29% to 42% silt, and 14% to 24% clay. Atterberg limit tests were performed on the same five (5) samples selected for sieve analysis and the results are provided on Figure PC-DR4-1. The results indicate liquid limit values of 26 to 33, plastic limit values of 15 to 17, and the corresponding plasticity index values of 11 to 16. Based on the test results, the soil may be classified as clay of low plasticity (CL) in the USCS, and clayey silt in the MTO Soil Classification System.

#### 5.2.4.3 Sandy Clayey Silt, Trace Gravel

This clayey silt deposit, with varying proportions of sand, was encountered immediately below the sandy clayey silt fill and extends to a maximum termination depth of 11.3 m (EL. 263.1).

The SPT 'N'-values recorded ranged from 9 to 33 blows, indicating a stiff to hard consistency. The moisture content of samples tested from this deposit range from 9.3% to 20.2%, with an average value of 14.2%.

The results of the sieve analysis test performed on two (2) representative samples from this deposit are provided on Figures GS-DR4-2 and GS-DR4-3. The results indicate that the soil consists of 9% gravel, 11% and 26% sand, 46% and 47% silt, and 19% and 33%, clay. Atterberg limit tests were performed on the same two (2) samples selected for sieve analysis and the results are provided on Figures PC DR4-2 and PC-DR4-3. The results indicate liquid limit values of 28 and 29, plastic limit values of 16 and 18, and the corresponding plasticity index values of 12 and 13. Based on the test results, the soil may be classified as clay of low plasticity (CL) in the USCS.

The sieve analysis test results of one (1) sample from the silty clay encountered in Borehole 11 are provided on Figure GS-DR4-4. The test results indicate that the soil consists of 1% gravel, 11% sand, 47% silt, and 41% clay. Atterberg limit tests were performed on the same sample selected for sieve analysis and the test results are presented on Figure PC-DR4-4. The test results indicate a liquid limit value of 37, plastic limit value of 18, and the corresponding plasticity



index value of 19. Based on the test results, the soil may be classified as clay of medium plasticity (CI) in the USCS and silty clay in the MTO Soil Classification System.

#### 5.2.4.4 Groundwater

Groundwater was not encountered during or upon completion of drilling in boreholes, with the exception of Borehole 11. Groundwater level was measured upon completion of drilling in Borehole 11 at a depth of 8.1 m (EL. 270.7). Groundwater levels may fluctuate due to the influence of precipitation and seasonal change. The groundwater measurements were taken prior to backfilling the boreholes. The groundwater level is shown on the Record of Borehole Log.

#### 5.2.5 Future Highway 401 East -Dorchester Road North/South Ramp

Boreholes 14 to 18 were drilled along the proposed alignment of future Highway 401 East - Dorchester Road North/South ramp. The approximate locations of the boreholes advanced during the current investigation are shown on DWG. No. DR-1. The subsurface conditions encountered at this location can be categorized into two (2) distinct zones as follows;

- Pavement Structure/Fill
- Clayey Silt, Trace/Some Sand, Trace Gravel

##### 5.2.5.1 Pavement Structure/Fill

In Borehole 18, a pavement structure consisting of 170 mm thick asphalt over 730 mm of sand and gravel fill was encountered immediately below the existing ground surface extending to EL. 284.1. In the case of Borehole 17, the pavement fill was encountered immediately below the existing ground surface and extends to a depth of 900 mm (EL. 283.5).

The SPT 'N'-values recorded within the sand and gravel fill layer were 15 and 21 blows, indicating compact state of compactness. The moisture content of two (2) samples tested from the fill were 4.5% and 5.2%.

##### 5.2.5.2 Clayey Silt, Trace/Some Sand, Trace Gravel

This clayey silt deposit was encountered immediately below the pavement fill in Boreholes 17 and 18 and in Boreholes 14 to 16, located off-road, the layer is overlain by 200 mm of organics. This



layer extends to the maximum termination depths of boreholes ranging from 12.8 m to 15.8 m (EL. 271.6 to EL. 261.6).

The SPT 'N'-values recorded in this deposit generally range from 9 to 38 blows, with the exception of upper 1.0 m to 1.2 m in Borehole 15 and 17, indicating stiff to hard consistency. The SPT values in the upper 1.0 m to 1.2 in Boreholes 15 and 17 range from 3 blows to 7 blows, indicating soft to firm consistency. The moisture content of samples tested from this deposit range from 7.7% to 24.5%, with an average moisture content of 16.1%.

The results of the sieve analysis test performed on 17 representative samples from this deposit are provided on Figures GS-DR5-1A and 1B. The test results indicate that the soil consists of 1% to 9% gravel, 7% to 19% sand, 47% to 58% silt, and 30% to 41% clay. Atterberg limit tests were performed on the same 17 samples selected for sieve analysis and the results are provided on Figures PC-DR5-1A and 1B. The results indicate liquid limit values of 23 to 33, plastic limit values of 14 to 18, and the corresponding plasticity index values of 9 to 17. Based on the test results, the soil may be classified as clay of low plasticity (CL) in the USCS and clayey silt in MTO Soil Classification System.

The sieve analysis test results of two (2) samples from the sandy clayey silt seams are provided on Figure GS-DR5-2. The test results indicate that the soil consists of 3% and 18% gravel, 23% and 26% sand, 41% and 43% silt, and 18% and 28% clay. Atterberg limit tests were performed on the same two (2) samples selected for sieve analysis and the test results are presented on Figure PC-DR5-2. The test results indicate liquid limit values of 20 and 25, plastic limit values of 13 and 15, and the corresponding plasticity index values of 7 and 10. Based on the test results, the soil may be classified as clay of low plasticity (CL) in the USCS and clayey silt in MTO Soil Classification System.

The sieve analysis test results of one (1) sample from the silty clay seam are provided on Figure GS-DR5-3. The test results indicate that the soil consists of 5% gravel, 13% sand, 46% silt, and 36% clay. Atterberg limit tests were performed on the same sample selected for sieve analysis and the test results are presented on Figure PC-DR5-3. The test results indicate a liquid limit value of 40, plastic limit value of 20, and the corresponding plasticity index value of 20. Based on the test results, the soil may be classified as clay of medium plasticity (CI) in the USCS and silty clay in the MTO Soil Classification System.



#### 5.2.5.3 Groundwater

Groundwater was not encountered during or upon completion of drilling in boreholes, with the exception of Borehole 17. It was encountered only in borehole 17 during drilling at a depth of 3.1 m (EL. 281.3) and was measured upon completion of drilling at a depth of 6.1 m (EL. 278.3) below the ground level. Groundwater levels may fluctuate due to the influence of precipitation and seasonal change. The groundwater measurements were taken prior to backfilling the boreholes. The groundwater levels are shown on the Record of Borehole Log.

#### 5.2.6 Future Dorchester Road South - Highway 401 West Ramp

Boreholes 19 to 23 were drilled along the proposed alignment of future Dorchester Road South - Highway 401 West ramp. The approximate locations of the boreholes advanced during the current investigation are shown on DWG. No. DR-1. The subsurface conditions encountered at this location can be categorized into three (3) distinct zones as follows;

- Pavement Structure
- Clayey Silt, Trace/Some Sand, Trace Gravel
- Sand With Silt and Gravel

##### 5.2.6.1 Pavement Structure

A pavement structure consisting of 200 mm and 300 mm thick asphalt over 600 mm and 500 mm of sand and gravel fill was encountered immediately at the existing ground surface in Boreholes 21 and 23, respectively.

The SPT 'N'-value recorded in the sand and gravel fill layer was 35, indicating dense state of compactness. The moisture content of one (1) sample tested from the sand and gravel fill was 10.3%.

##### 5.2.6.2 Clayey Silt, Trace/Some Sand, Trace Gravel

A layer of organics, approximately 200 mm in thickness, was encountered above the clayey silt layer in Boreholes 19, 20, and 22, which were located off-road. This clayey silt layer was encountered immediately below the pavement structure in borehole 21. The layer extends to a depth of 6.1 m (EL. 269.6) in borehole 23, where it was fully penetrated. This strata was not fully



penetrated in boreholes 19 to 22 to establish the thickness of the deposit and extends to a termination depth of 12.8 m (EL. 271.0 to EL. 265.5).

The SPT 'N'-values recorded in the clayey silt deposit ranged from 8 to 58, indicating stiff to hard consistency. The moisture content of samples tested from the clayey silt ranged from 1.1% to 27.0%, with an average moisture content of 16.3%.

The grain size distribution results of 17 representative samples from the clayey silt deposit are presented on Figures GS-DR6-1A and 1B. The test results indicate that the soil consists of 1% to 13% gravel, 8% to 13% sand, 44% to 56% silt and 31% to 42% clay. Atterberg limit tests were performed on the same 17 samples selected for sieve analysis and the test results are presented on Figures PC-DR6-1A and 1B. The test results indicate liquid limit values of 26 to 32, plastic limit values of 15 to 18, and the corresponding plasticity index values of 11 to 15. Based on the test results, the soil may be classified as clay of low plasticity (CL) in the USCS and clayey silt in the MTO Soil Classification System.

The sieve analysis test results of one (1) sample from the sandy clayey silt seam are provided on Figure GS-DR6-2. The test results indicate that the soil consists of 1% gravel, 23% sand, 59% silt, and 17% clay sized particles. Atterberg limit tests were performed on the same sample selected for sieve analysis and the test results are presented on Figure PC-DR6-2. The test results indicate a liquid limit value of 19, a plastic limit value of 14, and the corresponding plasticity index value of 5. Based on the test results, the soil may be classified as clay of low plasticity (CL-ML) in the USCS.

#### 5.2.6.3 Sand, With Silt and Gravel, Trace Clay

This gravelly sand deposit was encountered immediately below the clayey silt deposit only in Boreholes 23 at a depth of 6.1 m and extends to the termination depth of this borehole at 8.2 m (EL. 267.5).

The SPT 'N'-values recorded was 42 and 56 blows, indicating dense to very dense state of compactness.



The grain size distribution results of one (1) sample from the gravelly sand deposit are presented on Figure GS-DR6-3. The test results indicate that the soil consists of 28% gravel, 63% sand, 5% silt, and 4% clay sized particles. Based on the test results, the soil may be classified as sand with silt and gravel (SW-SM) in the USCS. The moisture content of two (2) samples tested from this deposit was 17.4% and 19.3%.

#### 5.2.6.4 Groundwater

Groundwater was not encountered during or upon completion of drilling in any of the five boreholes drilled. Groundwater levels may fluctuate due to the influence of precipitation and seasonal change. The groundwater measurements were taken prior to backfilling the boreholes.

#### 5.2.7 Future Dorchester Road North - Highway 401 West Ramp

Boreholes 24 to 26 were drilled along the future Dorchester Road North - Highway 401 West ramp. The approximate locations of the boreholes advanced during current investigation are shown on DWG. No. DR-1. The subsurface conditions encountered at this location can be categorized into two (2) distinct zones as follows;

- Gravelly Sand (Fill)
- Clayey Silt, Some Sand, Trace Gravel

##### 5.2.7.1 Gravelly Sand (Fill)

This gravelly sand fill layer was encountered only in Borehole 24, immediately below the existing ground surface and extends to a depth of 1.3 m (EL. 282.5).

The SPT 'N'-values recorded in the gravelly sand fill layer were 18 and 31 blows, indicating compact to dense state of compactness. The moisture content of two (2) samples tested from this fill was 4.1% and 11.3%.

##### 5.2.7.2 Clayey Silt, Some Sand, Trace Gravel

The clayey silt deposit in Boreholes 25 and 26 is overlain by a layer of 200 mm thick organics and in Borehole 24, it was encountered immediately below the fill. This clayey silt deposit extends to a maximum termination depth of 11.3 m (EL. 272.5), below the existing ground surface.



The SPT 'N'-values recorded in this deposit range from 7 to 22 blows, indicating stiff to very stiff consistency. The moisture content of samples tested from this deposit range from 3.4% to 19.4%, with an average moisture content of 15.0%.

The grain size distribution results of nine (9) representative samples from the clayey silt deposit are presented on Figure GS-DR7-1. The test results indicate that this deposit consists of 1% to 5% gravel, 8% to 12% sand, 49% to 51% silt, and 33% to 39% clay. Atterberg limit tests were performed on the same nine (9) samples selected for sieve analysis and the test results are presented on Figure PC-DR7-1. The test results indicate liquid limit values of 26 to 28, plastic limit values of 15 to 16, and the corresponding plasticity index values of 11 and 12. Based on the test results, the soil may be classified as clay of low plasticity (CL) in the USCS and clayey silt in the MTO Soil Classification System.

The sieve analysis test results of three (3) samples from the sandy clayey silt seams are provided on Figure GS-DR7-2. The test results indicate that the soil consists of 4% to 11% gravel, 24% to 33% sand, 37% to 53% silt, and 19% to 22% clay. Atterberg limit tests were performed on the same three (3) samples selected for sieve analysis and the test results are presented on Figure PC-DR7-2. The test results indicate liquid limit values of 18 to 21, plastic limit values of 12 and 13, and the corresponding plasticity index values of 6 and 8. Based on the test results, the soil may be classified as clay of low plasticity (CL/CL-ML) in the USCS and clayey silt in the MTO Soil Classification System.

#### 5.2.7.3 Groundwater

Groundwater was not encountered during or upon completion of drilling in any of the three boreholes (24 to 26). Groundwater levels may fluctuate due to the influence of precipitation and seasonal change. The groundwater measurements were taken prior to backfilling the boreholes.





### 5.3 Chemical Analysis

A summary of the chemical test results provided by SGS are presented in Tables 5.3. The details of the test results provided by SGS are also presented in Appendix C.

**Table 5.3 - Summary of Corrosivity Results**

BOREHOLE ID		N	N	C2	C1	S	S
SAMPLE NO.		4	7	3	4	3	6
ANALYSIS	UNITS						
CORROSIVITY INDEX	N/A	11.5	14.5	14.5	14.5	1	4.5
SOIL REDOX POTENTIAL	mV	231	209	135	142	260	155
SULPHIDE	%	0.03	0.02	0.09	0.09	< 0.02	0.09
MOISTURE CONTENT	%	4.4	12.7	15.1	15.4	14.7	14.1
pH	pH Units	9.50	8.29	8.44	8.23	8.42	8.49
CHLORIDE	µg/g	310	780	550	470	14	120
SULPHATE	µg/g	19	54	110	71	4.0	37
CONDUCTIVITY	uS/cm	487	1130	839	676	79	227
RESISTIVITY (CALCULATED)	ohms.cm	2050	884	1190	1480	12600	4410



## 6. CLOSURE

Mr. M. Mohamed and Mr. J. Suk O, carried out the field investigations under the supervision of Mr. N. Rahman, P.Eng., Senior Engineer and Ms. N. Leong-Sem, EIT. London Soil Test Inc., of London, Ontario and PML Field Services Ltd. Toronto, Ontario, supplied the drilling equipment for the subsurface exploration. Traffic control services were provided by Almon Equipment Inc. of Toronto, Ontario. Surveying of as-drilled borehole locations were carried out by WSP. The laboratory testing of the selected samples was carried out in the PML laboratory in Toronto. Chemical corrosivity tests were conducted by SGS Canada Inc., of Toronto, Ontario.

This report was prepared by Mr. M. Mohamed, EIT and Ms. N. Leong-Sem, EIT, and reviewed by Mr. N. Rahman, P.Eng., Senior Engineer, Geotechnical Services. Mr. R. Ng, MBA, PhD, P.Eng, MTO Designated Principal Contact, conducted an independent review of the report.

Yours very truly,

Peto MacCallum Ltd.

Natasha Leong-Sem, EIT  
Geotechnical Services

Mahad Mohamed, EIT  
Geotechnical Services



Nazibur Rahman, P.Eng.  
Senior Engineer, Geotechnical Services



Robert Ng, MBA, PhD, P.Eng.  
Foundation Project Manager and  
MTO Designated Principal Contact

NOTES & REFERENCES

NOTES:

1.
- THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCES.

REFERENCES:

THESE DRAWINGS WERE REPRODUCED FROM THE COMPOSITE OF BELOW MENTIONED DRAWINGS RECEIVED FROM **WSP GROUP LIMITED**:

1.
- 17M-00802-13\_XA01, Received on July 3, 2019
2.
- 3053-New Construction (Dorchester) INT, Dated May 2019, Received on February 13, 2020
3.
- 127110 - 09 - 19 - 303GA-CON.dwg, Received on February 21, 2020
4.
- Reduced Linework.dwg, Received on March 25, 2020

LEGEND

LOCATION OF BOREHOLE BY PML

LOCATION OF BOREHOLE FROM GEOCRES 40114-182

N

BLOWS / 0.3 m (STANDARD PENETRATION TEST, 475 J/BLOW)

WATER LEVEL UPON COMPLETION OF DRILLING

WATER LEVEL COULD NOT BE ESTABLISHED

WATER LEVEL NOT ENCOUNTERED UPON COMPLETION OF DRILLING OR IN MONITORING WELL

WATER LEVEL IN PIEZOMETER (PREVIOUS INVESTIGATION)

MONITORING WELL

BOREHOLE LOCATION COORDINATES & ELEVATIONS

BH No.	NORTHINGS	EASTINGS	LATITUDE	LONGITUDE	ELEVATION
N	4 758 664.6	422 208.9	42.958734	−81.060954	286.2
C1	4 758 632.7	422 231.3	42.958442	−81.060686	279.3
C2	4 758 626.0	422 200.1	42.958388	−81.061071	279.3
S	4 758 596.0	422 245.3	42.958110	−81.060523	284.5
1	4 758 533.0	421 948.8	42.957589	−81.064169	283.4
2	4 758 515.6	422 050.3	42.957416	−81.062929	284.3
3	4 758 480.8	422 132.7	42.957091	−81.061926	282.7
4	4 758 462.4	422 224.0	42.956911	−81.060812	282.5
5	4 758 523.0	422 263.2	42.957450	−81.060319	283.6
6	4 758 477.8	422 186.7	42.957056	−81.061265	284.0
7	4 758 524.9	422 120.0	42.957490	−81.062072	282.6
8	4 758 595.4	422 166.3	42.958117	−81.061491	278.9
9	4 758 560.4	422 193.5	42.957798	−81.061165	286.2
10	4 758 519.6	422 171.5	42.957434	−81.061443	283.4
11	4 758 555.3	422 379.1	42.957723	−81.058892	278.8
12	4 758 581.6	422 408.2	42.957956	−81.058530	276.7
13	4 758 612.1	422 440.3	42.958225	−81.058130	274.4
14	4 758 749.3	422 449.9	42.959459	−81.057983	274.4
15	4 758 779.9	422 346.9	42.959750	−81.059239	276.0
16	4 758 808.9	422 256.7	42.960025	−81.060338	283.3
17	4 758 812.3	422 192.0	42.960065	−81.061130	284.4
18	4 758 770.0	422 213.3	42.959681	−81.060879	285.0
19	4 758 792.1	422 241.1	42.959876	−81.060533	283.8
20	4 758 779.2	422 279.9	42.959754	−81.060060	282.0
21	4 758 768.0	422 345.8	42.959643	−81.059255	278.3
22	4 758 757.1	422 279.5	42.959555	−81.060069	282.5
23	4 758 671.9	422 315.6	42.958783	−81.059646	275.7
24	4 758 748.4	422 117.6	42.959502	−81.062056	283.8
25	4 758 705.6	422 089.6	42.959121	−81.062407	282.4
26	4 758 678.3	422 061.0	42.958880	−81.062763	282.8

REVISIONS	REVISIONS	DRAWING	
<div></div>	<div></div>		
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<div></div>	<div></div>	SCALE (HORIZ)	SCALE (VERT)

GEOCRES NO. 40114-193

DRAWN NL 4/27/2020

CHECKED NR 3/25/2020

APPROVED RN 4/27/2020

DORCHESTER ROAD INTERCHANGE

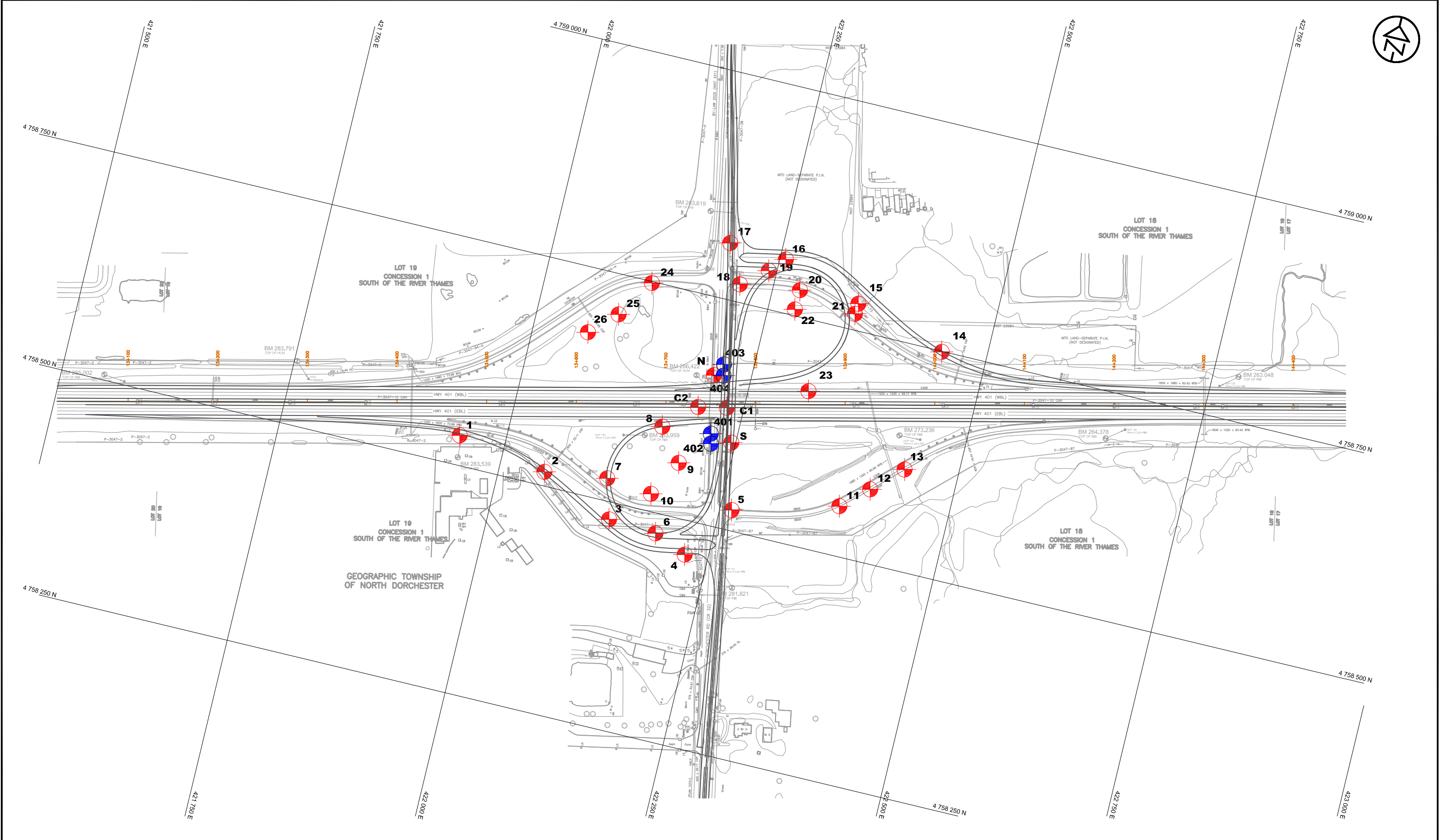
TITLE




NOTES & REFERENCES, LEGEND, AND BOREHOLE LOCATIONS AND ELEVATIONS

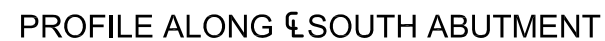
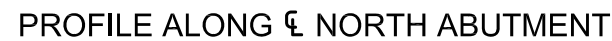
Plot Date: 4/27/2020

Dwg. No. DR-A

Sheet No.



REVISIONS		REVISIONS		DRAWING				 		GEOCRES NO. <u>40114-193</u>		DORCHESTER ROAD INTERCHANGE		Plot Date: 4/28/2020			
										DRAWN <u>NL</u> 4/28/2020		TITLE  BOREHOLE LOCATION PLAN  SITE 19-303 LONDON, ONTARIO					
										CHECKED <u>NR</u> 4/27/2020							
										APPROVED <u>RN</u> 4/28/2020							
SCALE (HORIZ) 		SCALE (VERT) 												Dwg. No. DR-1		Sheet No.	



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	<input type="checkbox"/>	<input type="checkbox"/>		
			SCALE (HORIZ)	SCALE (VERT)



GEOCRE NO. 40114-193

DRAWN NL 4/28/2020

CHECKED NR 4/28/2020

APPROVED RN 4/28/2020

SITE 19-303  
LONDON, ONTARIO

Dwg. No. DR-2	Sheet No.
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## 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.

**COMPOSITION:** SECONDARY SOIL COMPONENTS ARE DESCRIBED ON THE BASIS OF PERCENTAGE BY MASS OF THE WHOLE SAMPLE AS FOLLOWS:

PERCENT BY MASS	0 - 10	10 - 20	20 - 30	30 - 40	> 40
	TRACE	SOME	WITH	ADJECTIVE (SILTY)	AND (AND SILT)

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

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

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

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

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

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

**MODIFIED RECOVERY:** SUM OF THOSE INTACT CORE PIECES, 100mm\* IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), 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

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
F V	FIELD VANE		

### STRESS AND STRAIN

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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	m <sup>2</sup> /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{v0}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_i$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	kg/m <sup>3</sup>	DENSITY OF SOLID PARTICLES	n	1, %	POROSITY	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE
$\gamma_s$	kN/m <sup>3</sup>	UNIT WEIGHT OF SOLID PARTICLES	w	1, %	WATER CONTENT	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\rho_w$	kg/m <sup>3</sup>	DENSITY OF WATER	$S_r$	%	DEGREE OF SATURATION	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\gamma_w$	kN/m <sup>3</sup>	UNIT WEIGHT OF WATER	$w_L$	%	LIQUID LIMIT	D	mm	GRAIN DIAMETER
$\rho$	kg/m <sup>3</sup>	DENSITY OF SOIL	$w_p$	%	PLASTIC LIMIT	$D_n$	mm	n PERCENT - DIAMETER
$\gamma$	kN/m <sup>3</sup>	UNIT WEIGHT OF SOIL	$w_s$	%	SHRINKAGE LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\rho_d$	kg/m <sup>3</sup>	DENSITY OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	h	m	HYDRAULIC HEAD OR POTENTIAL
$\gamma_d$	kN/m <sup>3</sup>	UNIT WEIGHT OF DRY SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	q	m <sup>3</sup> /s	RATE OF DISCHARGE
$\rho_{sat}$	kg/m <sup>3</sup>	DENSITY OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	v	m/s	DISCHARGE VELOCITY
$\gamma_{sat}$	kN/m <sup>3</sup>	UNIT WEIGHT OF SATURATED SOIL	DTPL		DRIER THAN PLASTIC LIMIT	i	1	HYDRAULIC GRADIENT
$\rho'$	kg/m <sup>3</sup>	DENSITY OF SUBMERGED SOIL	APL		ABOUT PLASTIC LIMIT	k	m/s	HYDRAULIC CONDUCTIVITY
$\gamma'$	kN/m <sup>3</sup>	UNIT WEIGHT OF SUBMERGED SOIL	WTP		WETTER THAN PLASTIC LIMIT	j	kN/m <sup>3</sup>	SEEPAGE FORCE
e	1, %	VOID RATIO						

RECORD OF BOREHOLE No C-1

1 OF 3

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 632.7 N; 422 231.3 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.10.10 LATITUDE 42.958442 LONGITUDE -81.060686 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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	20	40	60		
279.3	Ground															
0.0	400 mm ASPHALT over SAND and GRAVEL		1	SS	33											
	Dense to compact, Brown, Moist (PAVEMENT STRUCTURE)		2	SS	13											
277.5	CLAYEY SILT, trace sand, trace gravel		3	SS	8											
1.8	Stiff to very stiff, Grey, Moist		4	SS	10											
			5	SS	12											
			6	SS	14											
			7	SS	13											
			8	SS	14											
			9	SS	14											
			10	SS	20											
			11	SS	18											
			12	SS	17											
			13	SS	20											
			14	SS	15											
264.3																

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+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No C-1

2 OF 3

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 632.7 N; 422 231.3 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.10.10 LATITUDE 42.958442 LONGITUDE -81.060686 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE									
264.3 15.0	CLAYEY SILT, trace sand Stiff, Grey, Moist	(Cont'd)	15	SS	14		264											
							263											
			16	SS	14		262								0 5 42 53			
261.4 17.9	SILTY SAND, trace silt, trace clay, trace gravel Compact, Grey, Wet		17	SS	30		261											
							260											
			18	SS	20		259								30 64 5 1			
							258											
							257											
			19	SS	17		256											
							255											
							254											
			20	SS	10		253											
							252											
							251											
250.8 28.5	sandy CLAYEY SILT, trace gravel Hard, Grey, Moist		21	SS	101/23cm		250								7 34 41 18			
			22	SS	100/25cm													
249.3																		

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



# RECORD OF BOREHOLE No C-1

3 OF 3

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 632.7 N; 422 231.3 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.10 LATITUDE 42.958442 LONGITUDE -81.060686 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>							
249.3 30.0	End of borehole																					
<p>NOTES:</p> <p>1. Borehole was charged with drilling water at a depth of 3.8 m (El. 278.8) below the existing ground surface, thus groundwater level could not be established during or upon completion of drilling.</p> <p>2. Borehole caved-in at a depth of 18.9 m (El. 263.7) below the existing ground surface, upon extraction of hollow stem augers.</p> <p>Monitoring Well Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth (m)</th> <th>Elev.</th> </tr> </thead> <tbody> <tr> <td>Dec.03/19</td> <td>Dry</td> <td>---</td> </tr> </tbody> </table> <p>Monitoring Well Legend:</p> <ul style="list-style-type: none"> <li>Flush Mount</li> <li>Bentonite</li> <li>Filter Sand</li> <li>19 mm PVC Screen</li> <li>Filter Bottom</li> <li>Cave-In</li> </ul>																	Date	Depth (m)	Elev.	Dec.03/19	Dry	---
Date	Depth (m)	Elev.																				
Dec.03/19	Dry	---																				

RECORD OF BOREHOLE No C-2

1 OF 3

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 626.0 N; 422 200.1 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.10.09 LATITUDE 42.958388 LONGITUDE -81.061071 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
279.3	Ground													
0.0	600 mm ASPHALT over SAND and GRAVEL		1	SS	31		279							
	Dense to compact, Brown, Moist (PAVEMENT STRUCTURE)		2	SS	14		278							
277.8	CLAYEY SILT, trace/some sand, trace gravel		3	SS	10		277							3 9 48 40
1.5	Stiff, Grey, Moist		4	SS	11		276							
			5	SS	10		275							1 8 48 43
			6	SS	11		274							
			7	SS	10		273							6 12 47 35
			8	SS	9		272							
			9	SS	10		271							
			10	SS	12		270							
			11	SS	11		269							
			12	SS	13		268							
			13	SS	8		267							
			14	SS	15		266							
264.3							265							

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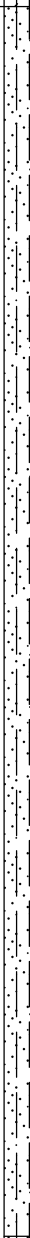
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No C-2

2 OF 3

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 626.0 N; 422 200.1 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.10.09 LATITUDE 42.958388 LONGITUDE -81.061071 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>	WATER CONTENT (%)								
								SHEAR STRENGTH kPa										
								○ UNCONFINED + FIELD VANE										
						● QUICK TRIAXIAL × LAB VANE												
264.3 15.0	CLAYEY SILT, trace sand  Stiff, Grey, Moist						264							kN/m <sup>3</sup>	GR SA SI CL			
			15	SS	13												0 1 68 31	
262.5 16.8	SILTY SAND, trace clay, trace gravel  Compact, Grey, Wet		16	SS	37		262											
			17	SS	20		261											
			18	SS	15		260											
			19	SS	24		259											
						</												

Continued Next Page



+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No C-2

3 OF 3

**METRIC**

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 626.0 N; 422 200.1 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.09 LATITUDE 42.958388 LONGITUDE -81.061071 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W <sub>p</sub>	W	W <sub>L</sub>		
							20	40	60	80	100						
249.3 30.0	End of Borehole   Groundwater level observed during drilling  Groundwater level measured upon completion of drilling  NOTE: Borehole caved-in at a depth of 18.3 m (El. 261.0) below the existing ground surface, upon extraction of hollow stem augers.																

# RECORD OF BOREHOLE No N

1 OF 3

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 664.6 N; 422 208.9 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.10.08 LATITUDE 42.958734 LONGITUDE -81.060954 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
286.2 0.0	Ground gravelly SAND  Compact to loose, Brown, Moist (FILL)		1	SS	50		286							
			2	SS	14		285							
			3	SS	8		284							
			4	SS	8		283							
			5	SS	6		282							
			6	SS	9		281							
			7	SS	11		280							
281.0 5.2	CLAYEY SILT, trace/some sand, trace gravel  Stiff to very stiff, Grey, Moist		8	SS	17		279							
			9	SS	16		278							
			10	SS	10		277							
			11	SS	14		276							
			12	SS	9		275							
			13	SS	10		274							
			14	SS	16		273							
271.2							272							

Continued Next Page





+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No N

2 OF 3

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 664.6 N; 422 208.9 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.08 LATITUDE 42.958734 LONGITUDE -81.060954 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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											
								20   40   60   80   100									20   40   60		
271.2 15.0	CLAYEY SILT, Trace/some sand, trace gravel  Stiff to very stiff, Grey, Moist						271										1   11   54   34		
			15	SS	15		270												
			16	SS	14		269												
			17	SS	19		268												
			18	SS	17		267												
			19	SS	9		266												
							265												
							264												
							263												
							262												
260.3 25.9	SILTY SAND, trace clay  Loose to compact, Grey, Moist		20	SS	8		260										0   74   20   6		
							259												
							258												
			21	SS	29		257												
256.2																			

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No N

3 OF 3

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 664.6 N; 422 208.9 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.08 LATITUDE 42.958734 LONGITUDE -81.060954 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>											
256.2 30.0	SILTY SAND, trace clay Dense, Grey, Moist		22	SS	38		256											0 71 19 10								
255.6 30.6	End of Borehole																									
<p> Groundwater level observed during drilling</p> <p> Groundwater measured upon completion of drilling</p> <p>NOTE: Borehole caved-in at a depth of 10.0 m (El. 276.2) below the existing ground surface, upon extraction of hollow stem augers.</p> <p>Monitoring Well Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth (m)</th> <th>Elev.</th> </tr> </thead> <tbody> <tr> <td>Dec.03/19</td> <td>Dry</td> <td>---</td> </tr> <tr> <td>Mar.05/20</td> <td>Dry</td> <td>---</td> </tr> </tbody> </table> <p>Monitoring Well Legend:</p> <ul style="list-style-type: none"> <li> Flush Mount</li> <li> Bentonite</li> <li> Filter Sand</li> <li> 19 mm PVC Screen</li> <li> Filter Bottom</li> <li> Cave-In</li> </ul>																		Date	Depth (m)	Elev.	Dec.03/19	Dry	---	Mar.05/20	Dry	---
Date	Depth (m)	Elev.																								
Dec.03/19	Dry	---																								
Mar.05/20	Dry	---																								

ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No S

1 OF 3

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 596.0 N; 422 245.3 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.10.11 LATITUDE 42.95811 LONGITUDE -81.060523 CHECKED BY N.R.

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				WATER CONTENT (%)				
								20	40	60	80	100	W <sub>p</sub>	W		
284.5	Ground							○ UNCONFINED	+	FIELD VANE						
0.0	CLAYEY SILT, some sand, trace gravel							● QUICK TRIAXIAL	×	LAB VANE						
	Stiff to very stiff, Brown, Moist		1	SS	5		284						○			
			2	SS	12		283						○			
			3	SS	17		282						○			
			4	SS	14		281						○			
			5	SS	17		280						○			
			6	SS	17		279						○			
			7	SS	16		278						○			
			8	SS	13		277						○			
			9	SS	17		276						○			
			10	SS	14		275						○			
			11	SS	28		274						○			
			12	SS	18		273						○			
			13	SS	17		272						○			
			14	SS	18		271						○			
							270									

Continued Next Page

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



# RECORD OF BOREHOLE No S

2 OF 3

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 596.0 N; 422 245.3 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.10.11 LATITUDE 42.95811 LONGITUDE -81.060523 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
269.5	CLAYEY SILT, trace sand, trace gravel Stiff to very stiff, Grey, Moist						269							1 10 53 36
15.0			15	SS	17		268							
			16	SS	16		267							
			17	SS	14		266							
							265							
			18	SS	10		264							
	SILTY SAND, trace clay, trace gravel Dense to compact, Grey, Moist						263							0 1 75 24
			19	SS	26		262							
							261							
							260							
							259							
			20	SS	33		258							
259.0	SILTY SAND, trace clay, trace gravel Dense to compact, Grey, Moist						257							1 85 10 4
25.5							256							
							255							
			21	SS	16									
254.5														

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No S

3 OF 3

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 596.0 N; 422 245.3 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.11 LATITUDE 42.95811 LONGITUDE -81.060523 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
254.5																	
30.0	SILTY SAND, trace clay, trace gravel Compact, Grey, Moist		22	SS	10												
253.9																	
30.6	End of borehole																
	Groundwater level observed during drilling Groundwater measured upon completion of drilling NOTE: Borehole caved-in at a depth of 19.8 m (El. xxx.x) below the existing ground surface, upon extraction of hollow stem augers. Monitoring Well Readings: Date Depth (m) Elev. Dec.03/19 Dry --- Mar.05/20 Dry ---																

Monitoring Well Legend:

Stick-up Monument

Bentonite

Filter Sand

19 mm PVC Screen

Filter Bottom

Cave-In

# RECORD OF BOREHOLE No 1

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 533.0 N; 421 948.8 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.09.17 LATITUDE 42.957589 LONGITUDE -81.064169 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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 (%)
283.4	Ground		1	SS	9		283									GR SA SI CL	
283.2	TOPSOIL																
0.2	CLAYEY SILT, some sand, trace gravel																
	Stiff to firm, Brown, Moist																
282.3	(FILL)		2	SS	4		282										
1.1	CLAYEY SILT, some sand, trace gravel																
	Stiff to very stiff, Brown to grey, Moist		3	SS	12												
			4	SS	15		281									2 12 56 30	
			5	SS	13		280										
			6	SS	13												
			7	SS	16		279										
			8	SS	13		278										
			9	SS	13		277										
							276										
			10	SS	16		275										
							274										
							273										
			12	SS	22		272									3 16 59 22	
							271										
270.6	End of borehole		13	SS	45												
12.8	NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. Borehole caved-in at a depth of 11.7 m (El. 271.7) below the existing ground surface, upon extraction of hollow stem augers.																

ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 2

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 515.6 N; 422 050.3 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.09.16 LATITUDE 42.957416 LONGITUDE -81.062929 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
284.3	Ground													
284.1	TOPSOIL													
0.2	CLAYEY SILT, some sand, trace gravel		1	SS	17		284							
	Stiff to very stiff, Brown, Moist													
	(FILL)		2	SS	8		283							
			3	SS	8									
			4	SS	10		282							
281.6	CLAYEY SILT, some sand, trace gravel													
2.7	Stiff to very stiff, Grey, Moist		5	SS	12		281							
			6	SS	22		280							4 10 53 33
			7	SS	23									
			8	SS	15		279							3 12 52 33
			9	SS	13		278							
							277							
			10	SS	23		276							
			11	SS	18		275							1 13 53 33
							274							
			12	SS	33		273							
			13	SS	25		272							
271.5	End of borehole													
12.8	NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. Borehole caved-in at a depth of 11.7 m (El. 272.6) below the existing ground surface, upon extraction of hollow stem augers.													

ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

## METRIC


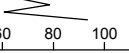
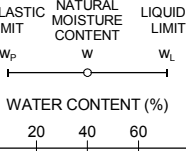
+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No 4

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 462.4 N; 422 224.0 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.10.21 LATITUDE 42.956911 LONGITUDE -81.060812 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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 (%)										
282.5	Ground																											
282.3	TOPSOIL																											
0.2	CLAYEY SILT, some sand, some gravel		1	SS	10																							
	Soft, Brown, Moist																											
	(FILL)	2	SS	3																								
		3	SS	4																								
280.3	CLAYEY SILT, some sand, trace gravel																											
2.2	Stiff to very stiff, Brown, Moist																											
			4	SS	8																							
			5	SS	9																							
			6	SS	21																							
			7	SS	14																							
			8	SS	17																							
			9	SS	16																							
			10	SS	14																							
			11	SS	16																							
			12	SS	15																							

# RECORD OF BOREHOLE No 5

1 OF 2

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 523.0 N; 422 263.2 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.10.22 LATITUDE 42.95745 LONGITUDE -81.060319 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
283.6	Ground													
0.0	200 mm ASPHALT over SAND and GRAVEL		1	SS	29		283							
	Compact to dense, Brown, Moist (PAVEMENT STRUCTURE)		2	SS	32									
281.8							282							
1.8	CLAYEY SILT, trace sand, trace gravel		3	SS	11									
	Stiff to very stiff, Brown/grey, Moist		4	SS	9		281							
			5	SS	18		280							
			6	SS	20									
			7	SS	16		279							
			8	SS	11		278							
			9	SS	11		277							
			10	SS	10		276							
			11	SS	16		275							
			12	SS	15		274							
			13	SS	15		273							
			14	SS	12		272							
							271							
							270							
							269							

Continued Next Page


+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No 5

2 OF 2

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 523.0 N; 422 263.2 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.22 LATITUDE 42.95745 LONGITUDE -81.060319 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
268.6 15.0	CLAYEY SILT, trace sand, trace gravel (Cont'd)																
267.8 15.8	Very stiff, Grey, Moist		15	SS	15												
	End of borehole																
	 Groundwater level measured upon completion of drilling NOTE: No cave-in was noted upon extraction of hollow stem augers.																

ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20



# RECORD OF BOREHOLE No 6

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 477.8 N; 422 186.7 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.21 LATITUDE 42.957056 LONGITUDE -81.061265 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
284.0	Ground													
0.0	TOPSOIL													
283.7														
0.3	CLAYEY SILT, some gravel, trace sand Hard, Brown, Moist (FILL)		1	SS	41									
283.2	CLAYEY SILT, some sand, trace gravel Stiff to hard, Brown/grey, Moist		2	SS	9		283							
0.8			3	SS	15		282							
			4	SS	18		281							3 13 50 34
			5	SS	30		280							
			6	SS	37		279							
			7	SS	15		278							10 9 47 34
			8	SS	15		277							
			9	SS	14		276							7 10 49 34
			10	SS	15		275							
			11	SS	14		274							
			12	SS	19		273							
			13	SS	18		272							4 12 50 34
271.2	End of borehole													
12.8	NOTES: 1. Groundwater not encountered during or upon completion of drilling. 2. Borehole caved-in at a depth of 12.0 m (El. 272.0) below the existing ground surface, upon extraction of hollow stem augers.													


















ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 7

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 524.9 N; 422 120.0 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.09.18 LATITUDE 42.95749 LONGITUDE -81.062072 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE	20	40	60						80	100	20
282.6 0.0	Ground CLAYEY SILT, some sand, trace gravel Stiff, Brown, Moist  (FILL)		1	SS	12		282													
			2	SS	9															
281.1 1.5	Organics, black		3	SS	5		281								102.9					
			4	SS	12		280										3 13 54 30			
			5	SS	16		279													
			6	SS	20		278										3 10 52 35			
			7	SS	22															
			8	SS	12		277													
			9	SS	14		276													
							275										6 11 49 34			
			10	SS	12		274													
																				
			11	SS	14		273													
																				
			12	SS	13		272													
							271													
			13	SS	15		270										8 17 49 26			
269.8 12.8	End of borehole NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. Borehole caved-in at a depth of 11.8 m (El. 270.8) below the existing ground surface, upon extraction of hollow stem augers.																			














ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 8

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 595.4 N; 422 166.3 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.09.20 LATITUDE 42.958117 LONGITUDE -81.061491 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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												
278.9 0.0	Ground gravelly SAND Compact, Brown, Moist (PAVEMENT FILL)		1	SS	21		278													
277.8 1.1	CLAYEY SILT, some sand, trace gravel Stiff to very hard, Brown, Moist		2	SS	9		277									2 15 54 29				
			3	SS	12		276													
			4	SS	16		275													
			5	SS	15		274													
			6	SS	16		273													
			7	SS	15		272													
			8	SS	17		271									1 10 56 33				
			9	SS	22		270													
			10	SS	19		269													
			11	SS	30		268													
			12	SS	30		267													
266.1 12.8	End of borehole NOTES: 1. Groundwater was not encountered during or upon completion of drilling.		13	SS	21															

ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 9

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 560.4 N; 422 193.5 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.09.19 LATITUDE 42.957798 LONGITUDE -81.061165 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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								
286.2 0.0	Ground																		

ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 10

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 519.6 N; 422 171.5 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.09.17 LATITUDE 42.957434 LONGITUDE -81.061443 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			W <sub>p</sub> W      W <sub>L</sub>				
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE	WATER CONTENT (%)						
283.4 0.0	Ground _____ organics						20 40 60 80 100	20 40 60							
	CLAYEY SILT, some sand, trace gravel Stiff to very stiff, Brown to grey, Moist		1	SS	11		283					○			
			2	SS	8		282					○			
			3	SS	14		281					○			
			4	SS	14		280					○			
			5	SS	18		279					○			
			6	SS	12		278					○			
			7	SS	9		277					○			
			8	SS	11		276					○			
			9	SS	13		275					○			
			10	SS	22		274					○			
			11	SS	21		273					○			
			12	SS	28		272					○			
			13	SS	27		271					○			
270.6 12.8	End of borehole														
NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. Borehole caved-in at a depth of 11.9 m (El. 271.5) below the existing ground surface, upon extraction of hollow stem augers.															

ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 11

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 555.3 N; 422 379.1 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.09.23 LATITUDE 42.957723 LONGITUDE -81.058892 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL				
								○ UNCONFINED      + FIELD VANE									○							17	33	36	14
								● QUICK TRIAXIAL      × LAB VANE																			
278.8 0.0	Ground						20	40	60	80	100																
278.2 0.6	200 mm ASPHALT over SAND and GRAVEL Compact, Brown, Moist (PAVEMENT STRUCTURE) sandy CLAYEY SILT, trace/some gravel Stiff to hard, Brown, Moist (FILL)		1	SS	14								○														
			2	SS	20								○														
			3	SS	47																						
			4	SS	21								○	├─┤													
			5	SS	34								○														
			6	SS	12																						
			7	SS	13								○														
			8	SS	13								○	├─┤													
			9	SS	28								○														
			10	SS	53								○														
270.3 8.5	sandy SILTY CLAY, some gravel Very stiff, Grey, Moist																										
269.0 9.8	End of borehole		11	SS	16								○	├─┤													



Groundwater level measured  
upon completion of drilling

NOTE: Borehole caved-in at a depth of  
8.5 m (El. 270.3) below the  
existing ground surface, upon  
extraction of hollow stem  
augers.

ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 12

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 581.6 N; 422 408.2 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.09.24 LATITUDE 42.957956 LONGITUDE -81.05853 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE									
276.7 0.0	Ground						20	40	60	80	100						
276.3 0.4	200 mm ASPHALT over SAND and GRAVEL Compact, Brown, Moist (PAVEMENT STRUCTURE) sandy CLAYEY SILT, some gravel  Very stiff, Brown to grey, Moist  (FILL)		1	SS	26								○				
			2	SS	23								○				
			3	SS	17								○				
			4	SS	18								○				
			5	SS	21								○				
			6	SS	22								○	├─┤			15 30 35 20
			7	SS	18								○				
271.1 5.6	sandy CLAYEY SILT, trace gravel  Stiff to very stiff, Grey, Moist		8	SS	12								○	├─┤			15 35 32 18
			9	SS	12								○				
			10	SS	11								○				
			11	SS	14								○	├─┤			9 26 46 19
265.4 11.3	End of borehole		12	SS	17								○				
<div>NOTES:</div> <div>1. Groundwater was not encountered during or upon completion of drilling.</div> <div>2. No cave-in was noted upon extraction of hollow stem augers.</div>																	

# RECORD OF BOREHOLE No 13

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 612.1 N; 422 440.3 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.09.23 LATITUDE 42.958225 LONGITUDE -81.05813 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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							
274.4 0.0	Ground 200 mm ASPHALT over SAND and GRAVEL  Dense to compact, Brown, Moist  (PAVEMENT STRUCTURE)		1	SS	34													
273.1 1.3	sandy CLAYEY SILT, trace gravel  Stiff to very stiff, Brown, Moist  (FILL)  _____ gravelly		2	SS	11													
			3	SS	9													
			4	SS	12													
			5	SS	19													
270.4 4.0	CLAYEY SILT, trace sand, trace gravel  Stiff to hard, Grey, Moist  _____ silty clay		6	SS	28													
			7	SS	24													
			8	SS	29													
			9	SS	9													
			10	SS	33													
			11	SS	32													
263.1 11.3	End of borehole		12	SS	14													
NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.																		

ONTARIO MTO 19KF028A-DORCHESTER ROAD GPJ ONTARIO MTO.GDT 3/6/20



# RECORD OF BOREHOLE No 14

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 749.3 N; 422 449.9 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.23 LATITUDE 42.959459 LONGITUDE -81.057983 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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	20	40	60
274.4 0.0	Ground																		
	CLAYEY SILT, trace/some sand, trace gravel		1	SS	11		274												
	Stiff to very stiff, Brown, Moist		2	SS	14														
			3	SS	26		273												
			4	SS	19		272								1 11 49 39				
			5	SS	22		271												
			6	SS	15		270								3 11 47 39				
			7	SS	22														
			8	SS	11		269												
			9	SS	11		268								9 12 49 30				
							267												
			10	SS	12		266												
			11	SS	20		265												
							264												
			12	SS	26		263								1 9 56 34				
			13	SS	25		262												
261.6 12.8	End of borehole																		
	NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.																		

# RECORD OF BOREHOLE No 15

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 779.9 N; 422 346.9 E ORIGINATED BY J.O.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.22 LATITUDE 42.95975 LONGITUDE -81.059239 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
276.0 0.0	Ground _____ organics CLAYEY SILT, trace/some sand, trace gravel Firm, Brown, Moist _____ silty clay _____ stiff to hard _____ grey		1	SS	4									
			2	SS	4		275							
			3	SS	7		274							5 13 46 36
			4	SS	13									
			5	SS	26		273							
			6	SS	25		272							1 11 54 34
			7	SS	33		271							
			8	SS	17		270							
			9	SS	13		269							1 8 51 40
			10	SS	17		268							
			11	SS	20		267							
			12	SS	15		266							
			13	SS	17		265							8 11 47 34
263.2 12.8	End of borehole NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.						264							

# RECORD OF BOREHOLE No 16

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 808.9 N; 422 256.7 E ORIGINATED BY J.O.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.10.21 LATITUDE 42.960025 LONGITUDE -81.060338 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
283.3 0.0	Ground _____ organics CLAYEY SILT, trace sand, trace gravel Hard to stiff, Brown to grey, Moist		1	SS	15		283							
			2	SS	33		282							
			3	SS	30		281							
	_____ sandy, some gravel		4	SS	27		280							18 23 41 18
			5	SS	22		279							
	_____ grey		6	SS	11		278							7 10 48 35
			7	SS	12		277							
			8	SS	12		276							
			9	SS	12		275							3 8 48 41
			10	SS	14		274							
			11	SS	17		273							
			12	SS	16		272							
			13	SS	15		271							2 10 57 31
270.5 12.8	End of borehole NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.													

ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 17

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 812.3 N; 422 192.0 E ORIGINATED BY J.O.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.22 LATITUDE 42.960065 LONGITUDE -81.06113 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
284.4 0.0	Ground gravelly SAND Compact, Brown, Moist		1	SS	15		284							
283.5 0.9	(PAVEMENT FILL) CLAYEY SILT, trace/some sand, trace gravel Soft to firm, Brown, Moist		2	SS	3		283							
			3	SS	5		282							
			4	SS	18		281							
			5	SS	19		280							
			6	SS	27		279							
			7	SS	23		278							
			8	SS	9		277							
			9	SS	11		276							
			10	SS	14		275							
			11	SS	13		274							
			12	SS	21		273							
			13	SS	14		272							
271.6 12.8	End of borehole													
	Groundwater level observed during drilling													
	Groundwater level measured upon completion of drilling													
	NOTE: No cave-in was noted upon extraction of hollow stem augers.													



ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 18

1 OF 2

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 770.0 N; 422 213.3 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.10.22 LATITUDE 42.959681 LONGITUDE -81.060879 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W <sub>P</sub>	W	W <sub>L</sub>		GR	SA	SI	CL	
								○ UNCONFINED   + FIELD VANE												
								● QUICK TRIAXIAL   × LAB VANE												
285.0	Ground																			
0.0	170 mm ASPHALT over SAND and GRAVEL Compact, Brown, Moist (PAVEMENT STRUCTURE)		1	SS	21								○							
284.1	CLAYEY SILT, trace sand, trace gravel  Very stiff to hard, Brown, Moist		2	SS	15								○							
0.9			3	SS	17									○						
			4	SS	28									○	11					
			5	SS	25									○						
			6	SS	13									○						
			7	SS	15									○						
			8	SS	15									○	11					
			9	SS	18									○						
			10	SS	20									○						
			11	SS	19									○	11					
			12	SS	32									○						
	13	SS	29									○								

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No 18

2 OF 2

**METRIC**

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 770.0 N; 422 213.3 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.22 LATITUDE 42.959681 LONGITUDE -81.060879 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W <sub>p</sub> W W <sub>L</sub> 20 40 60						
270.0 15.0	CLAYEY SILT, trace sand, trace gravel (Cont'd)																
269.2 15.8	Hard, Brown, Moist		15	SS	36												
	End of borehole NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.																

## METRIC

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No 20

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 779.2 N; 422 279.9 E ORIGINATED BY J.O.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.22 LATITUDE 42.959754 LONGITUDE -81.06006 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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									
282.0 0.0	Ground CLAYEY SILT, trace sand, trace gravel Very stiff to stiff, Brown, Moist  <																			

ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20



# RECORD OF BOREHOLE No 21

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 768.0 N; 422 345.8 E ORIGINATED BY J.O.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.21 LATITUDE 42.959643 LONGITUDE -81.059255 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
278.3 0.0	Ground 200 mm ASPHALT over gravelly SAND Dense, Brown, Moist (PAVEMENT STRUCTURE)		1	SS	35		278							
277.5 0.8	CLAYEY SILT, some sand, trace gravel Stiff to very stiff, Brown, Moist		2	SS	10		277							
			3	SS	8		276							
			4	SS	10		275							
			5	SS	11		274							
			6	SS	14		273							
			7	SS	20		272							
			8	SS	31		271							
			9	SS	30		270							
			10	SS	18		269							
			11	SS	15		268							
			12	SS	16		267							
			13	SS	18		266							
265.5 12.8	End of borehole NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.													

ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 22

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 757.1 N; 422 279.5 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.11.22 LATITUDE 42.959555 LONGITUDE -81.060069 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w <sub>p</sub>	w	w <sub>L</sub>					
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE												
282.5 0.0	Ground						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
	CLAYEY SILT, some sand, trace gravel Stiff to very soft, Brown, Moist		1	SS	11															
			2	SS	15															
			3	SS	14															
			4	SS	15															
			5	SS	17															
			6	SS	11															
			7	SS	10															
			8	SS	9															
			9	SS	10															
			10	SS	21															
			11	SS	10															
			12	SS	14															
			13	SS	24															
269.7 12.8	End of borehole																			
	NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.																			



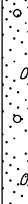
ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 23

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 671.9 N; 422 315.6 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.11.21 LATITUDE 42.958783 LONGITUDE -81.059646 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE															
275.7 0.0	Ground 300 mm ASPHALT over SAND and GRAVEL Brown, Moist		1	SS																			
274.9 0.8	CLAYEY SILT, trace/some sand, trace gravel Stiff, Brown, Moist		2	SS	11								○										
			3	SS	9								○										
	_____ hard		4	SS	58								○					3 9 55 33					
			5	SS	53								○										
	_____		6	SS	12								○					2 11 56 31					
			7	SS	14								○										
			8	SS	26								○										
269.6 6.1	gravelly SAND, trace silt, trace clay Dense to very dense, Grey, Moist (TILL)		9	SS	42								○					28 63 5 4					
267.5 8.2	End of borehole		10	SS	56								○										

NOTES:

- Groundwater was not encountered during or upon completion of drilling.
- No cave-in was noted upon extraction of hollow stem augers.

ONTARIO MTO 19KF028A-DORCHESTER ROAD.GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 24

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 748.4 N; 422 117.6 E ORIGINATED BY M.M.  
DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
DATUM Geodetic DATE 2019.10.15 LATITUDE 42.959502 LONGITUDE -81.062056 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
283.8 0.0	Ground gravelly SAND Compact to dense, Brown, Moist		1	SS	18		283							
282.5 1.3	CLAYEY SILT, some sand, trace gravel Stiff to very stiff, Brown, Moist		2	SS	31		282							
			3	SS	16		281							
			4	SS	12		280							
			5	SS	11		279							
			6	SS	8		278							
			7	SS	7		277							
			VANE				276							
			8	SS	8		275							
			9	SS	11		274							
			10	SS	15		273							
			11	SS	15									
272.5 11.3	End of borehole													
NOTES: 1. Groundwater not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.														

ONTARIO MTO 19KF028A-DORCHESTER ROAD GPJ ONTARIO MTO.GDT 3/6/20

# RECORD OF BOREHOLE No 25

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 705.6 N; 422 089.6 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.15 LATITUDE 42.959121 LONGITUDE -81.062407 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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									
282.4 0.0	Ground							20	40	60	80	100		20	40	60		GR SA SI CL		
	CLAYEY SILT, some sand, trace gravel Stiff to very stiff, Brown, Moist	<div><div>organics</div><div>sandy</div><div></div><div></div><div>grey</div></div>	1	SS	8		282											4 24 53 19		
			2	SS	15		281													
			3	SS	12		280													
			4	SS	11		279													
			5	SS	12		278													
			6	SS	12		277													
			7	SS	14		276													
			8	SS	14		275													
			9	SS	17		274													
			10	SS	21		273													
			11	SS	21															
272.6 9.8	End of borehole																			
NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.																				

# RECORD OF BOREHOLE No 26

1 OF 1

METRIC

G.W.P. 3016-E-0009 LOCATION Coords: 4 758 678.3 N; 422 061.0 E ORIGINATED BY M.M.  
 DIST West Region HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.  
 DATUM Geodetic DATE 2019.10.15 LATITUDE 42.95888 LONGITUDE -81.062763 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W <sub>p</sub> W                      W <sub>L</sub>				
								○ UNCONFINED                      + FIELD VANE ● QUICK TRIAXIAL                      × LAB VANE	WATER CONTENT (%)							
282.8 0.0	Ground															
	CLAYEY SILT, some sand, trace gravel		1	SS	15											
	Stiff to very stiff, Brown, Moist															
			2	SS	16											
			3	SS	13											
			4	SS	11											
			5	SS	14											
			6	SS	11											
			7	SS	11											
			8	SS	15											
			9	SS	18											
			10	SS	22											
			11	SS	15											
273.0 9.8	End of borehole															
NOTES: 1. Groundwater was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.																

NOTES:

- Groundwater was not encountered during or upon completion of drilling.
- No cave-in was noted upon extraction of hollow stem augers.



## **APPENDIX A**

### **PREVIOUS INVESTIGATION - MTO GEOCRES No. 40114-155**

Record of Borehole Nos. 401 to 404

Grain Size Distribution – Figures A-1 to A-6

Plasticity Chart – Figure A-7

DWG. 1 – Borehole Locations and Soil Strata



**April 2015**

## **PRELIMINARY FOUNDATION INVESTIGATION AND DESIGN REPORT**

**Middlesex Road 32 (Dorchester Road) Underpass  
Site Number 19-303**

**Highway 401 Interchange Improvements/  
Structural Replacements**

**GWP 3053-11-00, Assignment No. 2 (3011-E-0047)  
Ministry of Transportation, Ontario – West Region**

**Submitted to:**

Mr. Brad R. Craig, P.Eng., Partner  
Dillon Consulting Limited  
130 Dufferin Avenue, Suite 1400  
London, Ontario  
N6A 5R2

**REPORT**



**A world of  
capabilities  
delivered locally**

**Report Number:** 12-1132-0076-2001-R02

**Geocres No.** 40114-155

**Distribution:**

8 Copies - Dillon Consulting Limited  
2 Copies - Golder Associates Ltd.





## LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

### I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

### III. SOIL DESCRIPTION

#### (a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

### II. PENETRATION RESISTANCE

#### Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split spoon sampler for a distance of 300 mm (12 in.)

#### (b) Cohesive Soils

##### Consistency

	$c_u, s_u$	
	<b>kPa</b>	<b>psf</b>
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

#### Dynamic Cone Penetration Resistance; $N_d$ :

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

**PH:** Sampler advanced by hydraulic pressure

**PM:** Sampler advanced by manual pressure

**WH:** Sampler advanced by static weight of hammer

**WR:** Sampler advanced by weight of sampler and rod

#### Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm<sup>2</sup> pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance ( $Q_t$ ), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

### IV. SOIL TESTS

w	water content
$w_p$	plastic limit
$w_l$	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
$D_R$	relative density (specific gravity, $G_s$ )
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
$SO_4$	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
$\gamma$	unit weight

**Note:** 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

## LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

### I. General

$\pi$	3.1416
$\ln x$ ,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
F	factor of safety
V	volume
W	weight

### II. STRESS AND STRAIN

$\gamma$	shear strain
$\Delta$	change in, e.g. in stress: $\Delta \sigma$
$\epsilon$	linear strain
$\epsilon_v$	volumetric strain
$\eta$	coefficient of viscosity
$\nu$	poisson's ratio
$\sigma$	total stress
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )
$\sigma'_{vo}$	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
$\sigma_{oct}$	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
$\tau$	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

### III. SOIL PROPERTIES

#### (a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
$\gamma'$	unit weight of submerged soil ( $\gamma' = \gamma - \gamma_w$ )
$D_R$	relative density (specific gravity) of solid particles ( $D_R = \rho_s / \rho_w$ ) (formerly $G_s$ )
e	void ratio
n	porosity
S	degree of saturation

#### (a) Index Properties (continued)

w	water content
$w_L$	liquid limit
$w_p$	plastic limit
$I_p$	plasticity index $= (w_L - w_p)$
$w_s$	shrinkage limit
$I_L$	liquidity index $= (w - w_p) / I_p$
$I_C$	consistency index $= (w_L - w) / I_p$
$e_{max}$	void ratio in loosest state
$e_{min}$	void ratio in densest state
$I_D$	density index $= (e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

#### (b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

#### (c) Consolidation (one-dimensional)

$C_c$	compression index (normally consolidated range)
$C_r$	recompression index (over-consolidated range)
$C_s$	swelling index
$C_a$	coefficient of secondary consolidation
$m_v$	coefficient of volume change
$c_v$	coefficient of consolidation
$T_v$	time factor (vertical direction)
U	degree of consolidation
$\sigma'_p$	pre-consolidation pressure
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

#### (d) Shear Strength

$\tau_p, \tau_r$	peak and residual shear strength
$\phi'$	effective angle of internal friction
$\delta$	angle of interface friction
$\mu$	coefficient of friction $= \tan \delta$
$c'$	effective cohesion
$c_u, s_u$	undrained shear strength ( $\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
$p'$	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 + \sigma_3)/2$ or $(\sigma'_1 + \sigma'_3)/2$
$q_u$	compressive strength $(\sigma_1 + \sigma_3)$
$S_t$	sensitivity

- Notes:**
- 1  $\tau = c' + \sigma' \tan \phi'$
  - 2 shear strength  $= (\text{compressive strength})/2$
  - \* density symbol is  $\rho$ . Unit weight symbol is  $\gamma$  where  $\gamma = \rho g$  (i.e. mass density x acceleration due to gravity)

**RECORD OF BOREHOLE No 401**

1 OF 3

**METRIC**

PROJECT 12-1132-0076  
W.P. 3053-11-00 LOCATION N 4758600.3 , E 422220.7 ORIGINATED BY BT  
DIST HWY 401 BOREHOLE TYPE POWER AUGER, HOLLOW STEM / WASH BORING, CASED COMPILED BY WF/LK/AG  
DATUM GEODETIC DATE March 5, 2013 - March 6, 2013 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20   40   60   80   100	20   40   60   80   100	W <sub>P</sub> W   W <sub>L</sub>	WATER CONTENT (%)	GR		
285.51	PAVEMENT SURFACE													
0.00	ASPHALT													
0.21	FILL, granular base		1	SS	65		285							
284.90														
0.61	FILL, sand and gravel, trace to some silt, with cobbles Loose to compact Brown		2	SS	25		284							
			3	SS	6		283							
			4	SS	12		282							
			5	SS	9		281							
			6	SS	8		280							
			7	SS	16		279							
280.33			8	SS	21		278							
5.18	CLAYEY SILT TILL, trace to some sand, trace gravel, with cobbles Very stiff to hard Brown becoming grey at about elev. 279.0m		9	SS	100/ 140mm		277							
	Cobble/boulder at about elev. 279.3m		10	SS	29		276							
			11	SS	22		275							
			12	SS	22		274							
			13	SS	24		273							
			14	SS	25		272							
			15	SS	29		271							

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

**RECORD OF BOREHOLE No 402**

1 OF 1

**METRIC**

PROJECT 12-1132-0076  
W.P. 3053-11-00 LOCATION N 4758589.5 , E 422223.2 ORIGINATED BY BT  
DIST HWY 401 BOREHOLE TYPE POWER AUGER, HOLLOW STEM COMPILED BY WF/LK/AG  
DATUM GEODETIC DATE March 7, 2013 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
285.34 0.00	PAVEMENT SURFACE ASPHALT							20	40	60	80	100					
0.27	FILL, granular base Brown																
284.58 0.76	FILL, sand and gravel, trace silt, with cobbles Brown		1	SS	10												
	SILT, trace to some sand, trace gravel, with clayey silt layers Compact to very dense Brown		2	SS	19												
			3	SS	26												
			4	SS	57												
281.68 3.66	CLAYEY SILT TILL, trace to some sand, trace gravel Stiff to very stiff Grey		5	SS	28												
			6	SS	23												
			7	SS	14												
			8	SS	20												
			9	SS	25												
275.74 9.60	END OF BOREHOLE		10	SS	23												
	Groundwater not established during drilling on March 7, 2013.																
	Standpipe dry on March 8, 2013.																
	Installation missing/destroyed on April 3, 2013.																

**RECORD OF BOREHOLE No 403**

1 OF 1

**METRIC**

PROJECT 12-1132-0076  
W.P. 3053-11-00 LOCATION N 4758678.9 , E 422216.9 ORIGINATED BY BT  
DIST HWY 401 BOREHOLE TYPE POWER AUGER, HOLLOW STEM COMPILED BY WF/LK/AG  
DATUM GEODETIC DATE March 7, 2013 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
								○ UNCONFINED	+	FIELD VANE									
286.14	PAVEMENT SURFACE						● QUICK TRIAXIAL	×	LAB VANE	WATER CONTENT (%)									
0.00	ASPHALT						20	40	60	80	100	10	20	30					
0.24	FILL, granular base																		
0.43	Brown																		
	FILL, sand and gravel, some silt, with cobbles		1	SS	20														
284.77	Compact Brown																		
1.37	SILT, trace clay, trace sand		2	SS	13														
284.01	Compact Brown																		
2.13	CLAYEY SILT, trace sand		3	SS	20														
283.24	Very stiff Brown																0 1 74 25		
2.90	CLAYEY SILT TILL, trace to some sand, trace gravel		4	SS	29														
	Very stiff to hard																		
	Brown becoming grey at about elev. 281.0m		5	SS	31														
			6	SS	31														
			7	SS	26														
			8	SS	20														
			9	SS	20														
276.54	END OF BOREHOLE		10	SS	27														
9.60	Groundwater not established during drilling on March 7, 2013.																		

**RECORD OF BOREHOLE No 404**

1 OF 2

**METRIC**

PROJECT 12-1132-0076  
W.P. 3053-11-00 LOCATION N 4758666.6 , E 422219.5 ORIGINATED BY DH  
DIST HWY 401 BOREHOLE TYPE POWER AUGER, HOLLOW STEM / WASH BORING, CASED COMPILED BY WF/LK/AG  
DATUM GEODETIC DATE March 12, 2013 - March 13, 2013 CHECKED BY

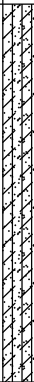


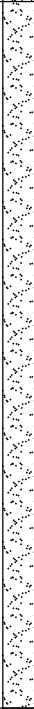
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20   40   60   80   100	20   40   60   80   100	W <sub>P</sub> W   W <sub>L</sub>	WATER CONTENT (%)			
286.17	PAVEMENT SURFACE													
0.00	ASPHALT													
0.21	FILL, granular base													
0.37	FILL, sand and gravel, trace to some silt, with cobbles Loose to compact Brown		1	SS	28									
			2	SS	8									
			3	SS	6									
			4	SS	7									
			5	SS	10									
			6	SS	12									
281.17	TOPSOIL, clayey Black													
5.00	CLAYEY SILT TILL, trace to some sand, trace gravel Very stiff to hard Brown becoming grey at about elev. 279.2m		7	SS	28									
5.18			8	SS	24									7   9   51   33
			9	SS	30									
			10	SS	24									
			11	SS	36									4   11   52   33
			12	SS	71									
			13	SS	48									
			14	SS	45									1   9   53   37

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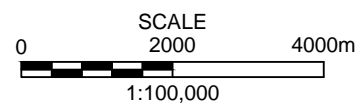
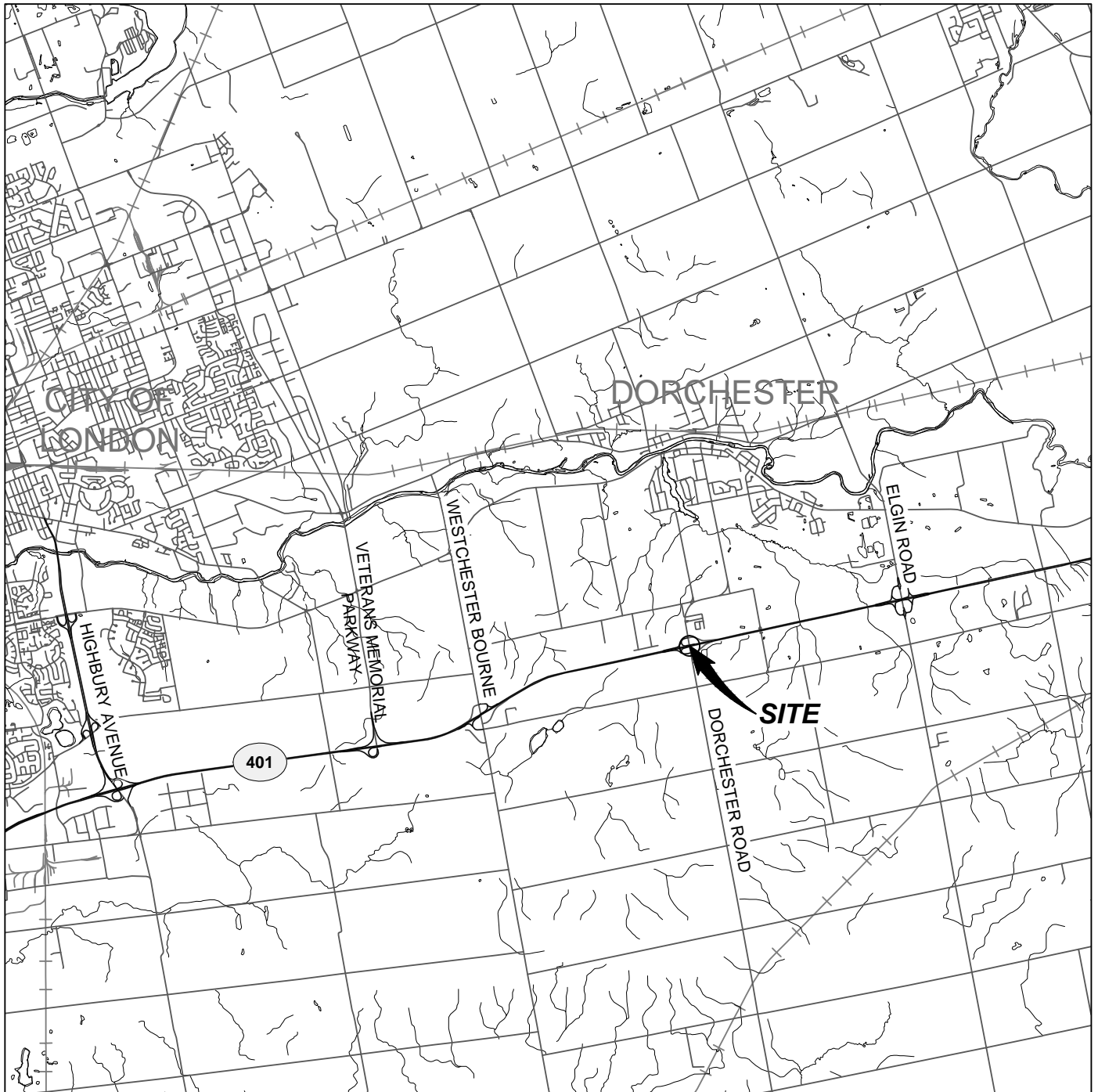
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



PROJECT <u>12-1132-0076</u>		<b>RECORD OF BOREHOLE No 404</b>		2 OF 2		<b>METRIC</b>	
W.P. <u>3053-11-00</u>		LOCATION <u>N 4758666.6 , E 422219.5</u>		ORIGINATED BY <u>DH</u>			
DIST <u>          </u> HWY <u>401</u>		BOREHOLE TYPE <u>POWER AUGER, HOLLOW STEM / WASH BORING, CASED</u>		COMPILED BY <u>WF/LK/AG</u>			
DATUM <u>GEODETIC</u>		DATE <u>March 12, 2013 - March 13, 2013</u>		CHECKED BY <u>                    </u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT  w <sub>p</sub>	NATURAL MOISTURE CONTENT  w	LIQUID LIMIT  w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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						○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL
	CLAYEY SILT TILL, trace to some sand, trace gravel Very stiff to hard Brown becoming grey at about elev. 279.2m						271													
			15	SS	48		270													
							269													
			16	SS	37		268													
267.42							267													
18.75	CLAYEY SILT, trace sand Very stiff to hard Grey		17	SS	38		266													
							265													
			18	SS	26		264													
264.53							263													
21.64	SAND, fine to medium, some silt, trace to some gravel Dense to very dense Grey		19	SS	33		262													
							261													
			20	SS	30		260													
							259													
			21	SS	100/ 275mm		258													
			22	SS	100/ 275mm															
257.52			23	SS	100															
28.65	END OF BOREHOLE																			
	Groundwater encountered at about elev. 264.5m during drilling on March 13, 2013.																			

LDN\_MTO\_06 12-1132-0076-2001.GPJ LDN\_MTO.GDT 20/11/13



## REFERENCE

PLAN BASED ON CANMAP STREETFILES V.2008.5.

## NOTE

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

PROJECT

MIDDLESEX ROAD 32 UNDERPASS, SITE 19-303  
HIGHWAY 401 INTERCHANGE IMPROVEMENTS  
GWP 3053-11-00

TITLE

## KEY PLAN



PROJECT No. 12-1132-0076		FILE No. 1211320076-2001-F02001	
CADD	LMK/AMG	AUG. 14/13	SCALE AS SHOWN
CHECK			REV. 0

**FIGURE 1**

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

CONT No.  
WP No. 3053-11-00



COUNTY RD. 32 (Dorchester Rd)  
HIGHWAY 401 INTERCHANGE IMPROVEMENTS

SHEET

BOREHOLE LOCATIONS AND SOIL STRATA



**Golder Associates Ltd.**  
LONDON, ONTARIO, CANADA



KEY PLAN

SCALE IN KILOMETRES  
0 1 2

### LEGEND

- Borehole - Current Investigation
- Seal
- Standpipe
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test. 475 j/blow)
- WL measured on June 5, 2013
- WL encountered during drilling
- DRY Water level not established

No.	ELEVATION	CO-ORDINATES (MTM ZONE 11)	
		NORTHING	EASTING
401	285.51	4 758 600.3	422 220.7
402	285.34	4 758 589.5	422 223.2
403	286.14	4 758 678.9	422 216.9
404	286.17	4 758 666.6	422 219.5

### NOTES

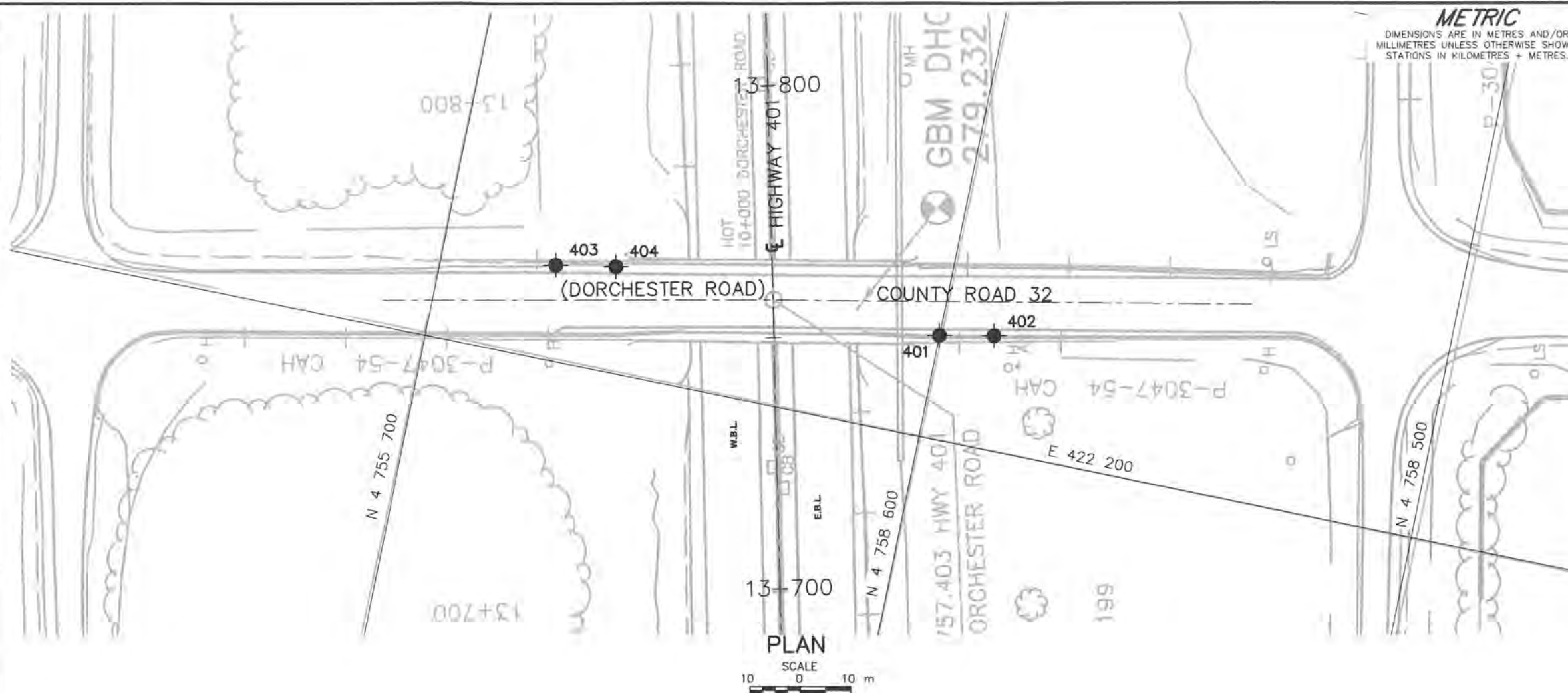
This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

### REFERENCE

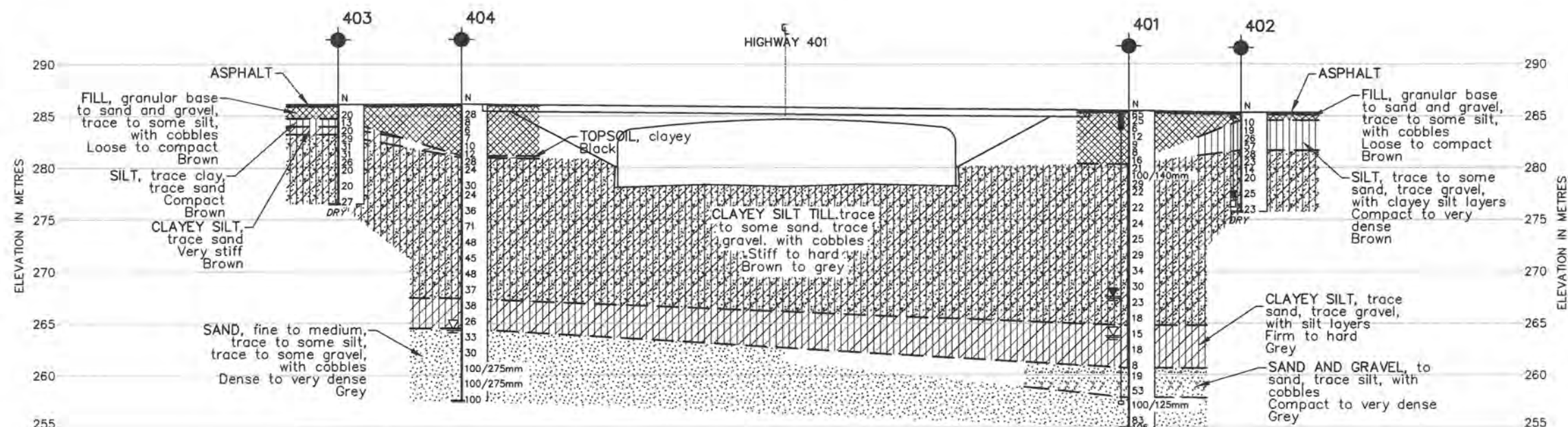
Base plans based on ETR Plate 92-401/17-0.

NO.	DATE	BY	REVISION
Geocres No.	40114-155		
HWY.	401	PROJECT NO.	12-1132-0076
SUBM'D.	NG	CHKD.	DUP
DRAWN:	WDF	CHKD.	AMH
		DATE:	Apr 17/15
		APPD.	FJH
		SITE:	19-303
		DWG.	1



PLAN

SCALE  
0 10 m



PROFILE ALONG COUNTY ROAD 32 (DORCHESTER ROAD)

HORIZONTAL SCALE  
5 0 5m

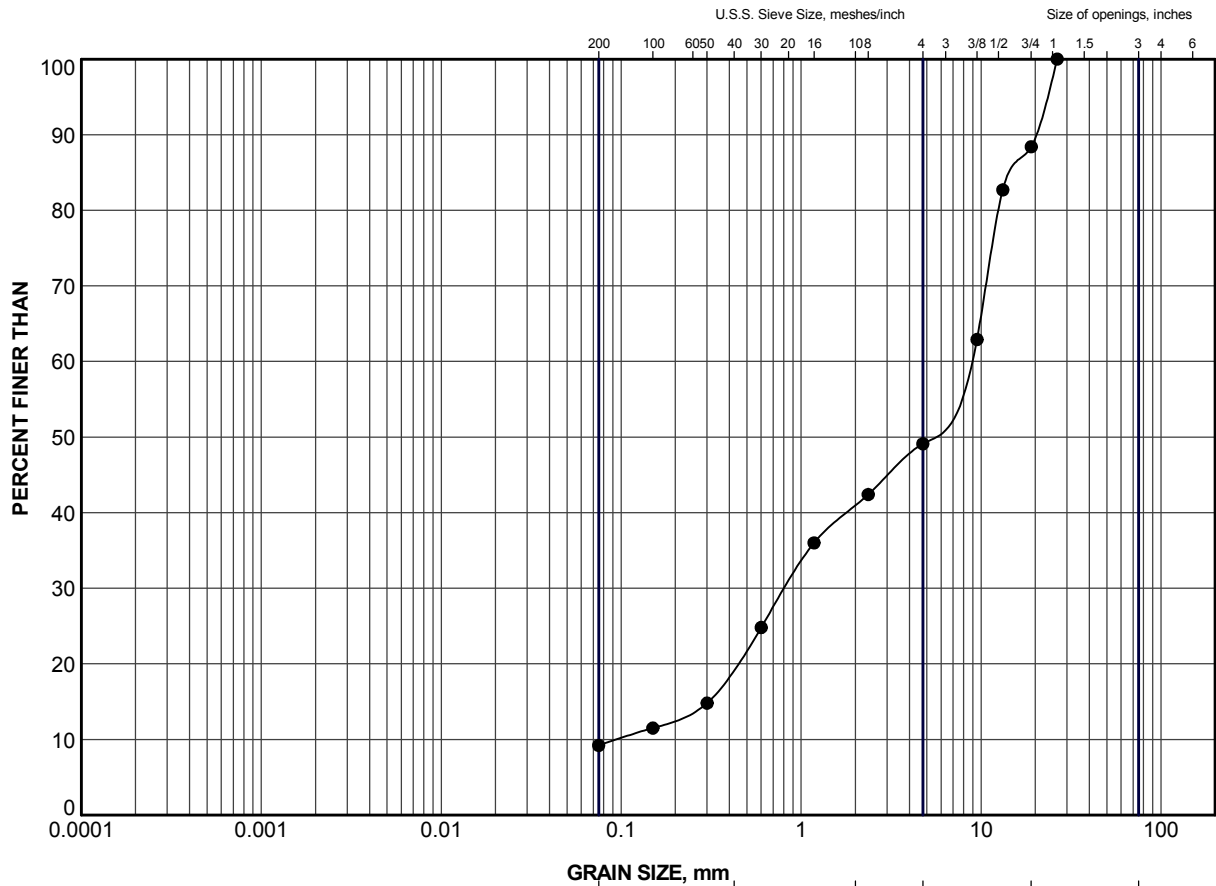
VERTICAL SCALE  
5 0 5m






# **APPENDIX A**

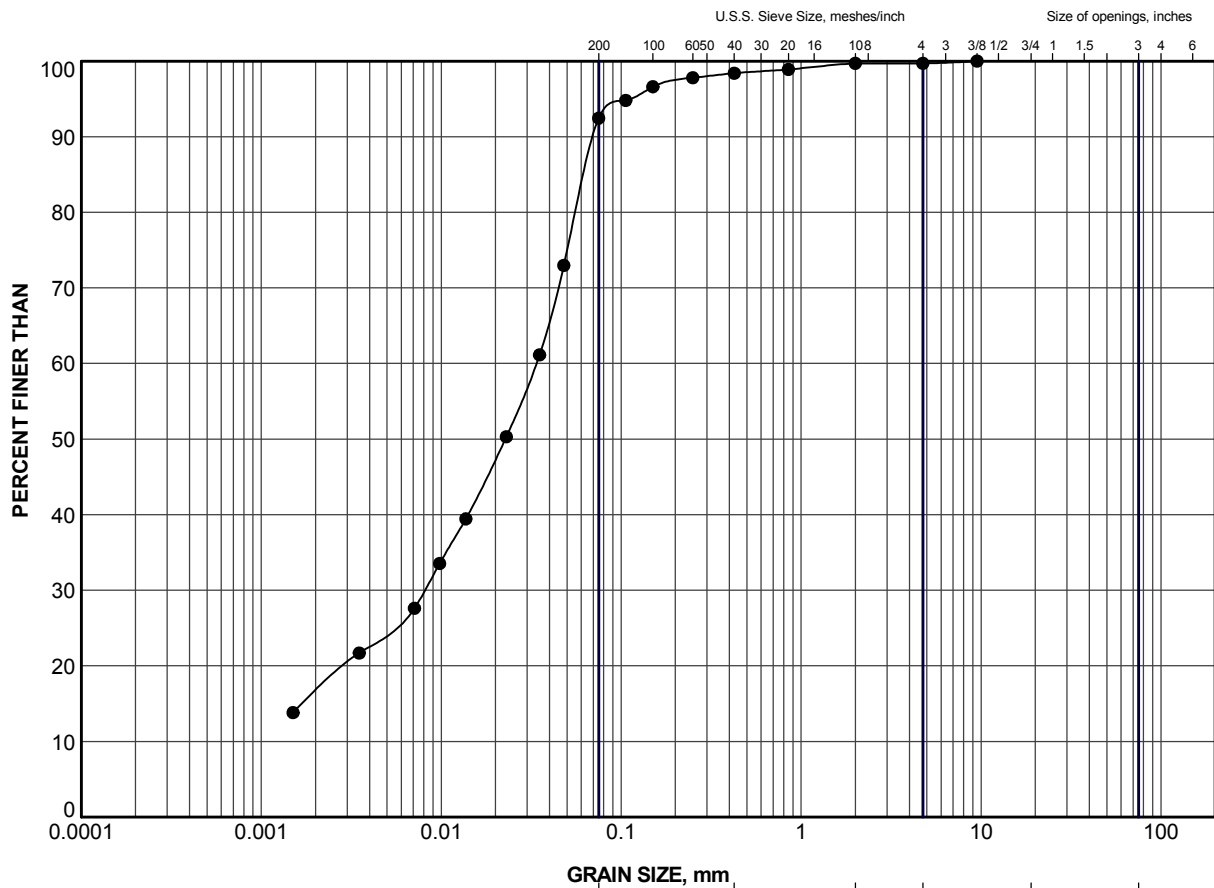
## **Laboratory Test Data**



CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	401	4	283.0

PROJECT				MIDDLESEX ROAD 32 UNDERPASS, SITE 19-303 HIGHWAY 401 INTERCHANGE IMPROVEMENTS GWP 3053-11-00					
TITLE									
GRAIN SIZE DISTRIBUTION  FILL									
 <b>Golder Associates</b> LONDON, ONTARIO				PROJECT No.12-1132-0076-2001		FILE No. 1211320076-2001-F020A1			
							SCALE	N/A	REV.
				DRAWN	WDF	Apr 04/13	<b>FIGURE A-1</b>		
				CHECK					

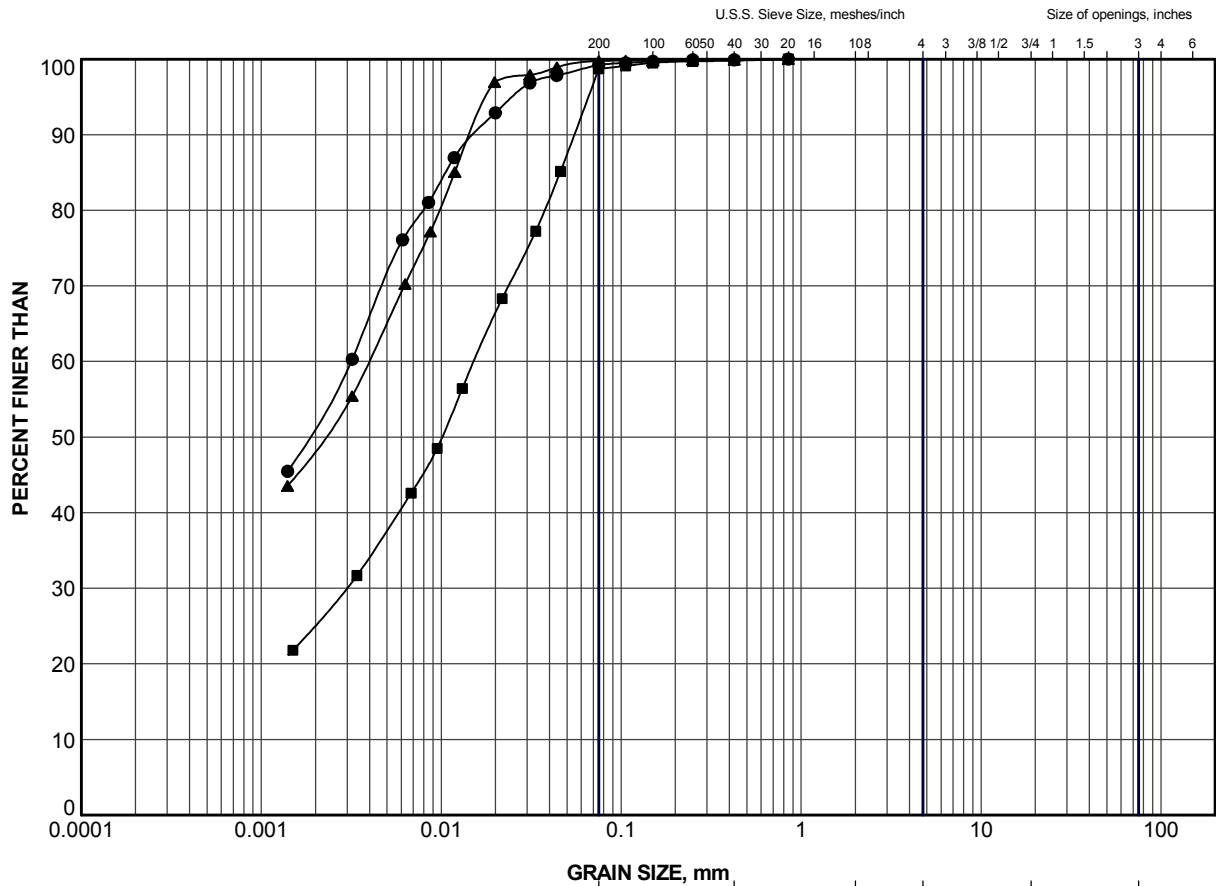


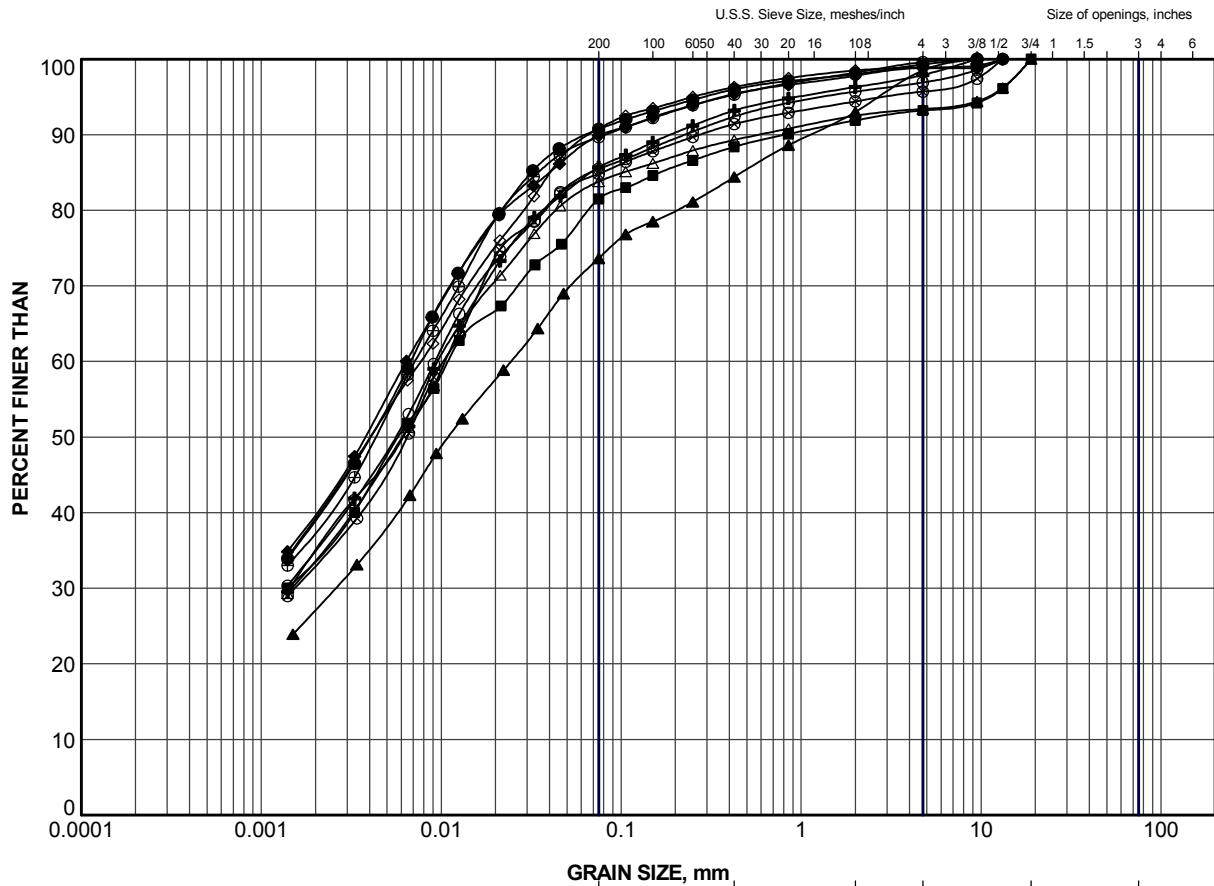
### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	402	3	282.8

PROJECT				MIDDLESEX ROAD 32 UNDERPASS, SITE 19-303 HIGHWAY 401 INTERCHANGE IMPROVEMENTS GWP 3053-11-00			
TITLE				GRAIN SIZE DISTRIBUTION SILT			
PROJECT No. 12-1132-0076-2001				FILE No. 1211320076-2001-F020A2			
DRAWN		WDF		Apr 04/13		SCALE N/A REV.	
CHECK						FIGURE A-2	








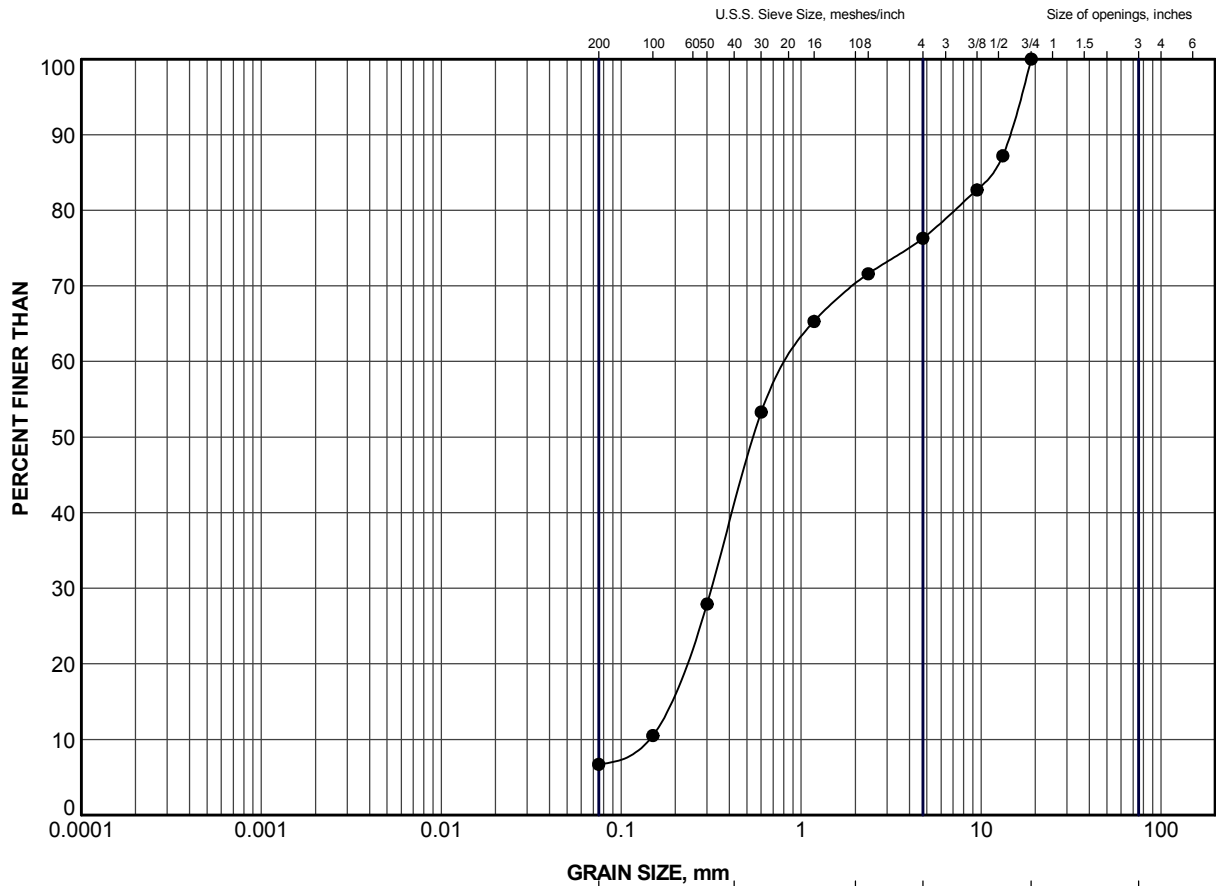
GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	401	8	279.9
■	401	14	273.1
▲	401	17	268.5
+	402	6	280.5
◆	402	8	279.0
◇	403	7	280.5
○	403	9	278.3
△	404	8	279.9
⊗	404	11	275.9
⊕	404	14	271.3

PROJECT			
MIDDLESEX ROAD 32 UNDERPASS, SITE 19-303 HIGHWAY 401 INTERCHANGE IMPROVEMENTS GWP 3053-11-00			
TITLE			
GRAIN SIZE DISTRIBUTION CLAYEY SILT TILL			
PROJECT No.12-1132-0076-2001		FILE No. 1211320076-2001-F020A4	
DRAWN	WDF	Apr 04/13	SCALE N/A REV.
CHECK			
 <b>Golder Associates</b> LONDON, ONTARIO			<b>FIGURE A-4</b>



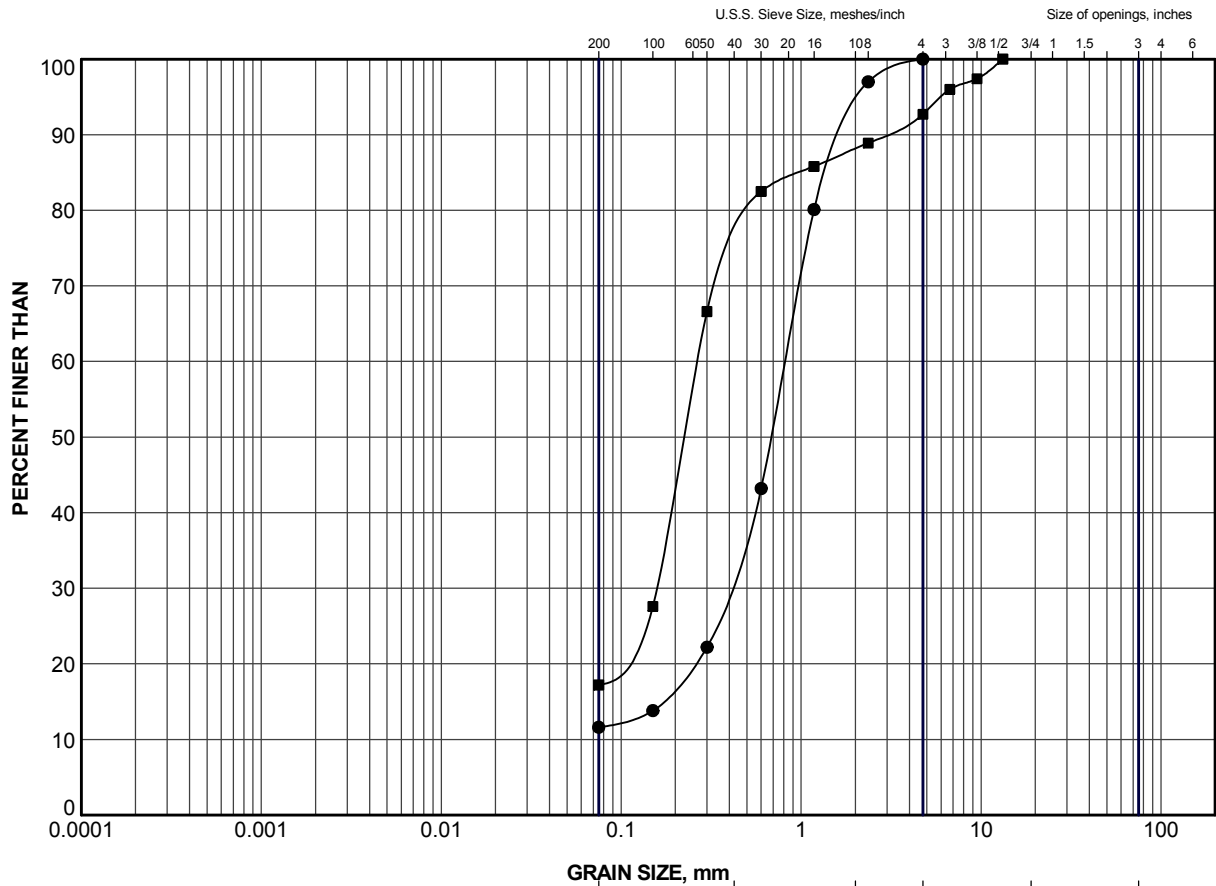


CLAY AND SILT	GRAVEL SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	401	23	260.0


PROJECT				MIDDLESEX ROAD 32 UNDERPASS, SITE 19-303 HIGHWAY 401 INTERCHANGE IMPROVEMENTS GWP 3053-11-00			
TITLE				GRAIN SIZE DISTRIBUTION SAND AND GRAVEL			
PROJECT No.12-1132-0076-2001				FILE No. 1211320076-2001-F020A5			
DRAWN		WDF		Apr 04/13		SCALE N/A REV.	
CHECK						FIGURE A-5	
 <b>Golder Associates</b> LONDON, ONTARIO							

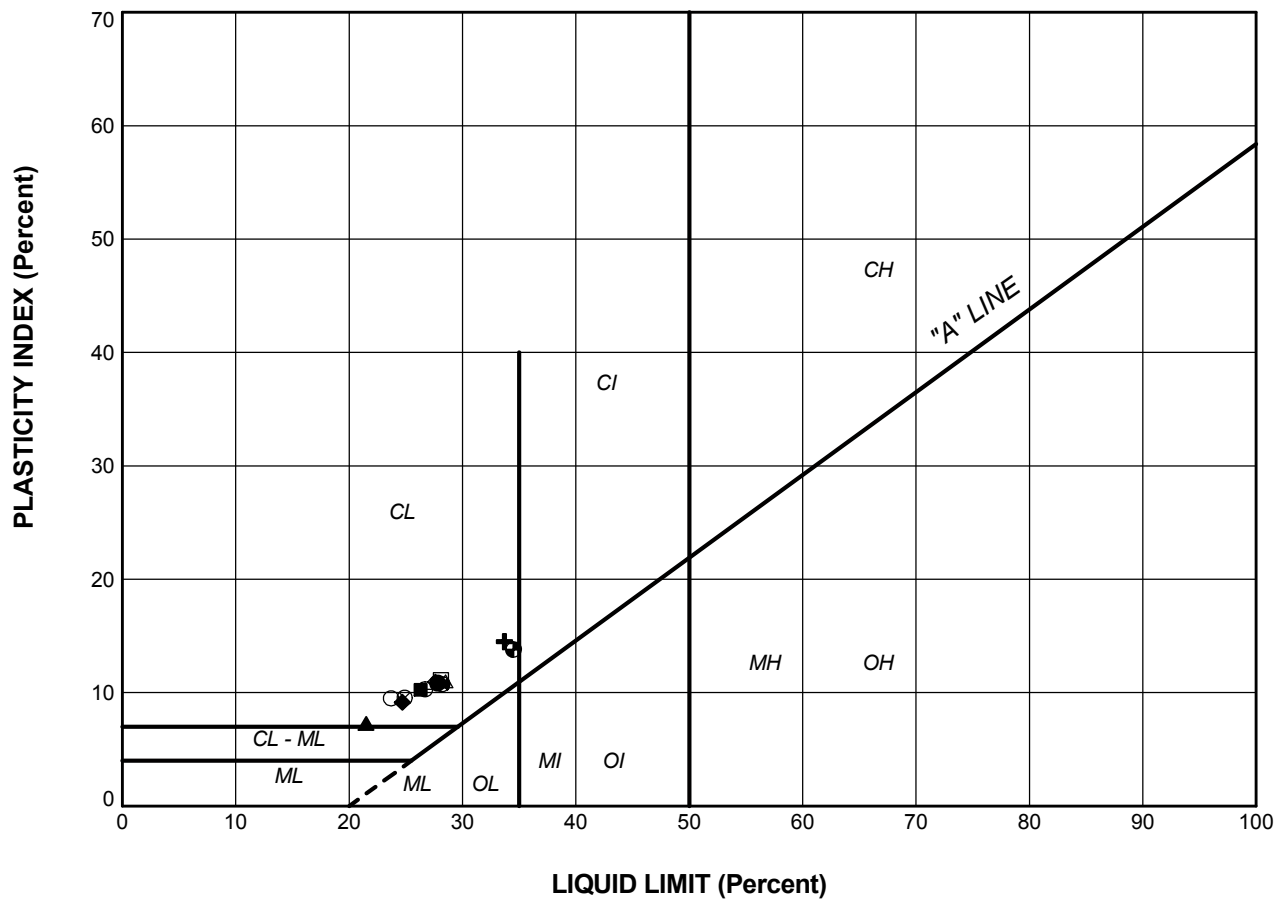


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	401	25	257.1
■	404	21	260.7

PROJECT				MIDDLESEX ROAD 32 UNDERPASS, SITE 19-303 HIGHWAY 401 INTERCHANGE IMPROVEMENTS GWP 3053-11-00			
TITLE				GRAIN SIZE DISTRIBUTION SAND			
PROJECT No.12-1132-0076-2001				FILE No. 1211320076-2001-F020A6			
DRAWN		LMK		Jun 14/13		SCALE N/A REV.	
CHECK						FIGURE A-6	
 <b>Golder Associates</b> LONDON, ONTARIO							



### LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
<b>CLAYEY SILT TILL</b>					
●	401	8	27.8	17.0	10.9
■	401	14	26.3	16.1	10.3
▲	401	17	21.5	14.2	7.3
◆	402	6	24.7	15.6	9.2
◇	402	8	27.6	16.7	11.0
△	403	7	28.5	17.5	11.0
⊗	403	9	24.9	15.4	9.6
⊕	404	8	26.7	16.4	10.3
□	404	11	28.1	17.0	11.1
⊙	404	14	28.2	17.5	10.8
<b>CLAYEY SILT</b>					
+	401	21	33.7	19.2	14.5
○	403	3	23.7	14.2	9.5
⊙	404	18	34.5	20.7	13.8

PROJECT				MIDDLESEX ROAD 32 UNDERPASS, SITE 19-303 HIGHWAY 401 INTERCHANGE IMPROVEMENTS GWP 3053-11-00			
TITLE							
<b>PLASTICITY CHART</b>							
PROJECT No.12-1132-0076-2001				FILE No. 1211320076-2001-F020A7			
DRAWN	WDF/AMG	AUG. 14/13	SCALE	N/A	REV.		
CHECK			<b>FIGURE A-7</b>				



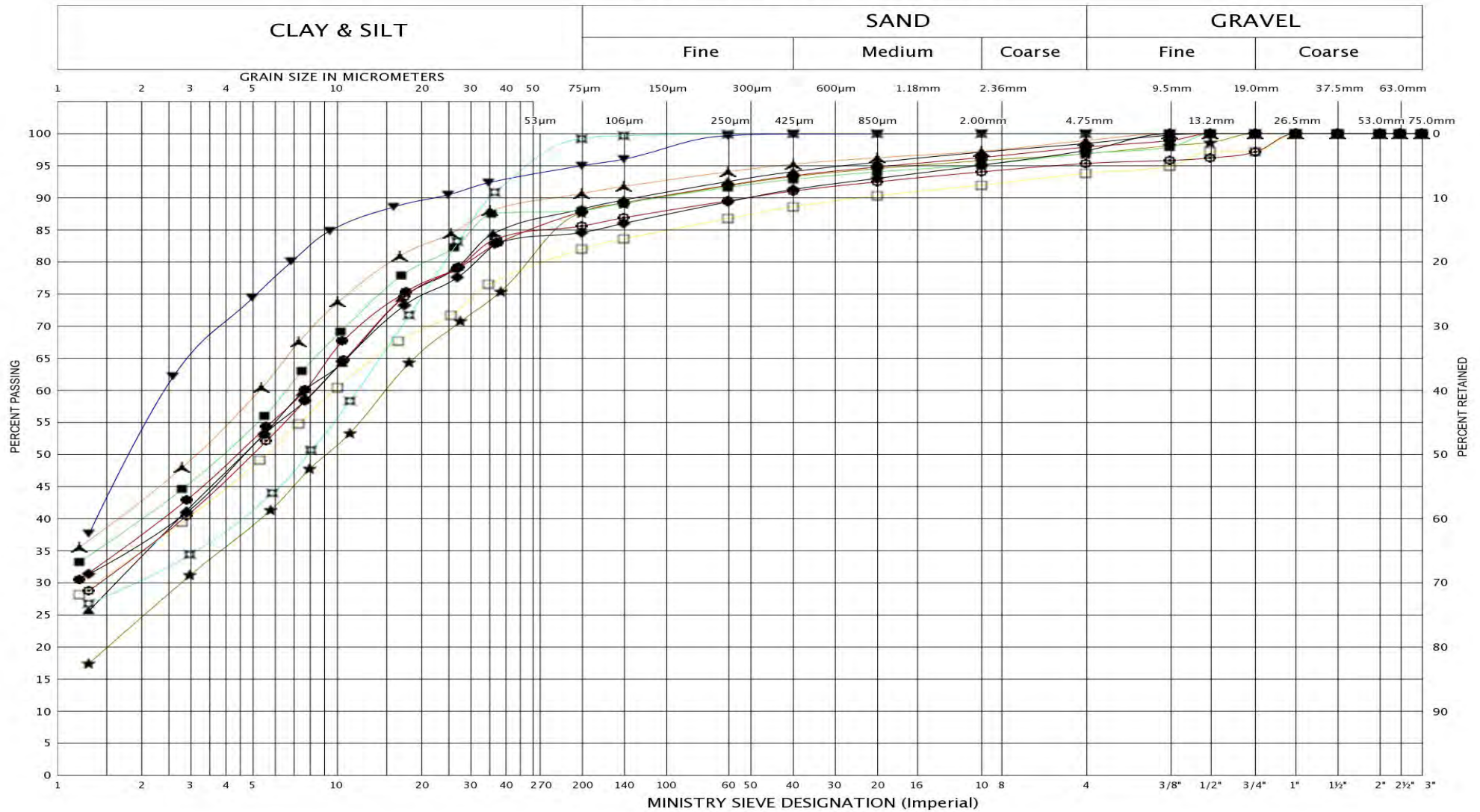


## **APPENDIX B-1**

Results of Grain Size Distribution Analyses:  
Figures GS-DR1-1A/B, GS-DR1-2, GS-DR1-3

Results of Atterberg Limit Tests:  
Figures PC-DR1-1A/B, DR1- PC -2, DR1- PC -3

# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	C1	C1	C1	C1	C2	C2	C2	C2	N	N
	SAMPLE	4	8	12	16	3	6	9	15	8	13
	SYMBOL	●	▲	★	▼	■	▲	□	⊠	⊕	◆



## GRAIN SIZE DISTRIBUTION

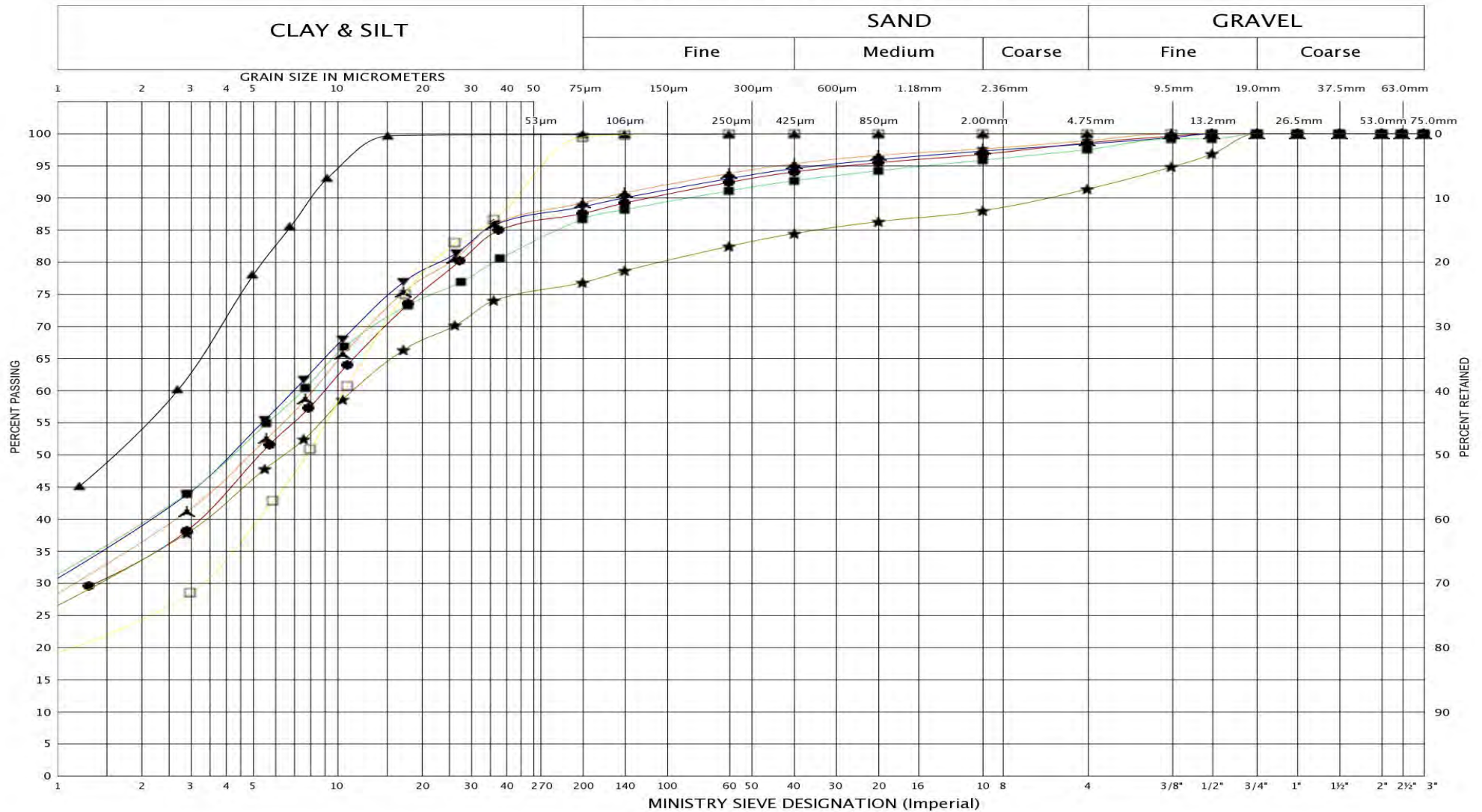
Clayey Silt, Trace/Some Sand, Trace Gravel

FIG No.: GS-DR1-1A

HWY : 401

GWP 3016-E-2009

# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	N	N	S	S	S	S	S
	SAMPLE	16	19	4	9	12	15	18
	SYMBOL	●	▲	★	▼	■	▲	□



## GRAIN SIZE DISTRIBUTION

Clayey Silt, Trace/Some Sand, Trace Gravel

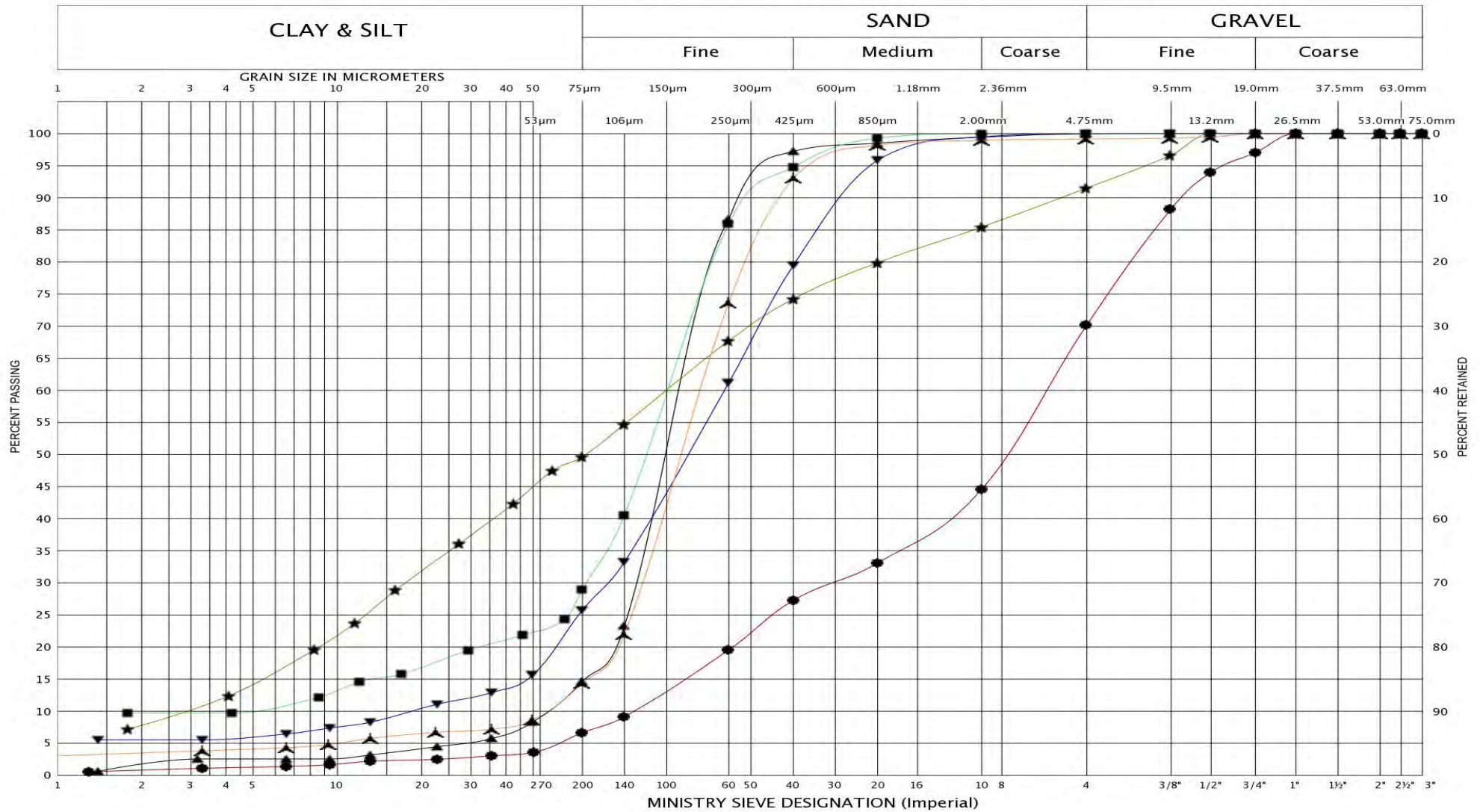
FIG No.: GS-DR1-1B

HWY : 401

GWP 3016-E-2009



# UNIFIED SOIL CLASSIFICATION SYSTEM



## GRAIN SIZE DISTRIBUTION

Silty Sand, Trace Clay, Trace Gravel/Gravelly

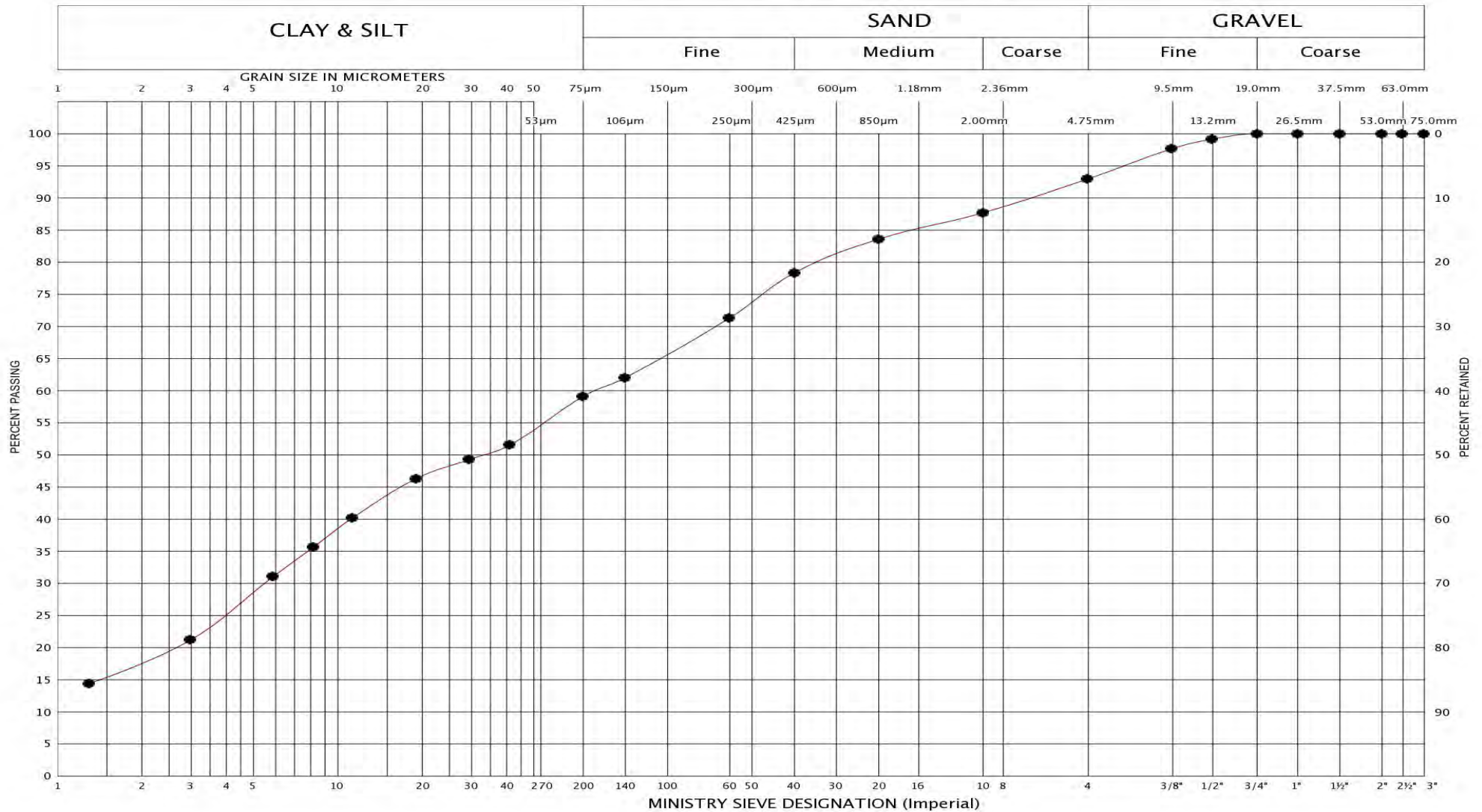
FIG No.: GS-DR1-2

HWY : 401

GWP 3016-E-2009



# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	C1
	SAMPLE	21
	SYMBOL	•



## GRAIN SIZE DISTRIBUTION

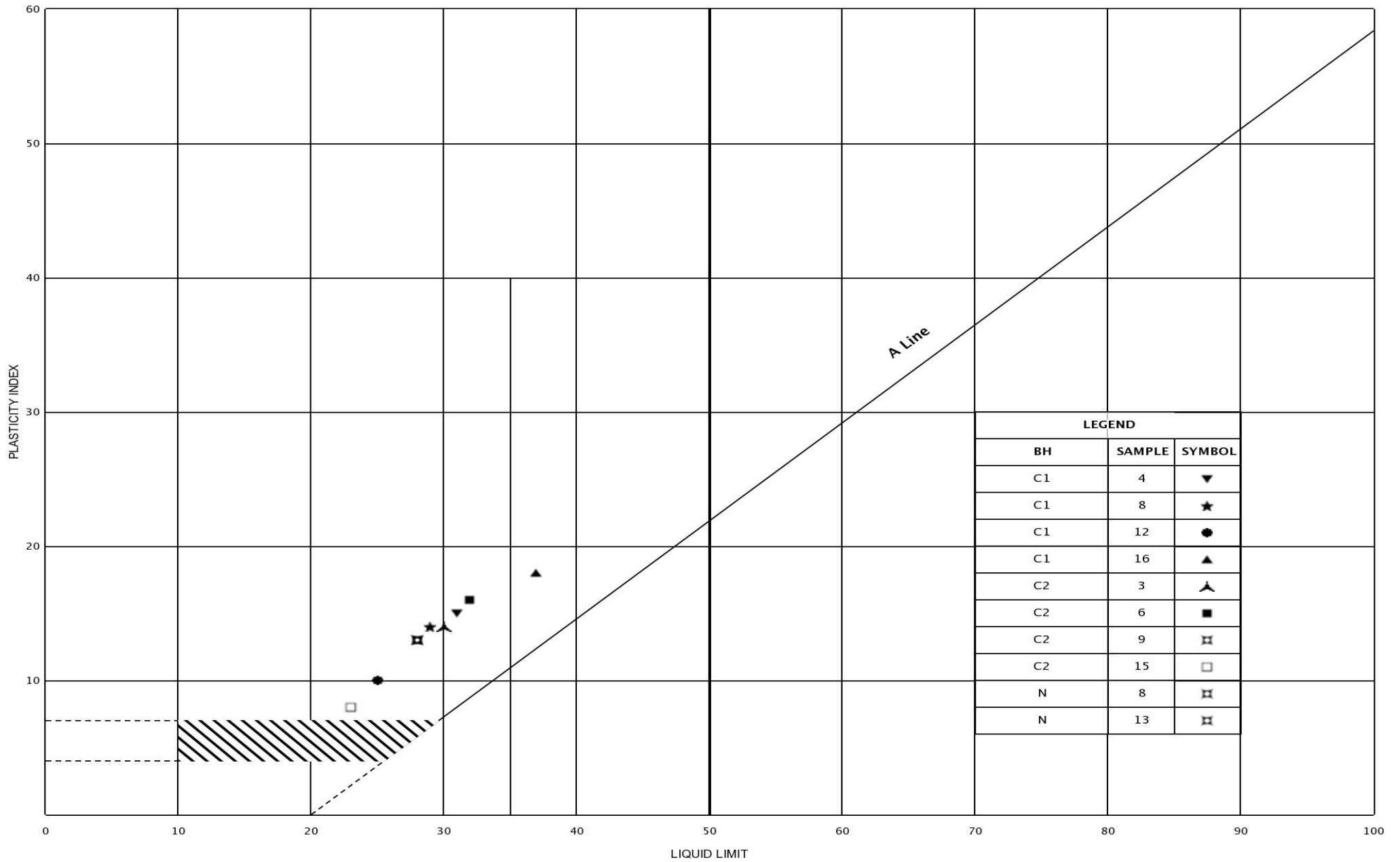
Sandy Clayey Silt, Trace Gravel

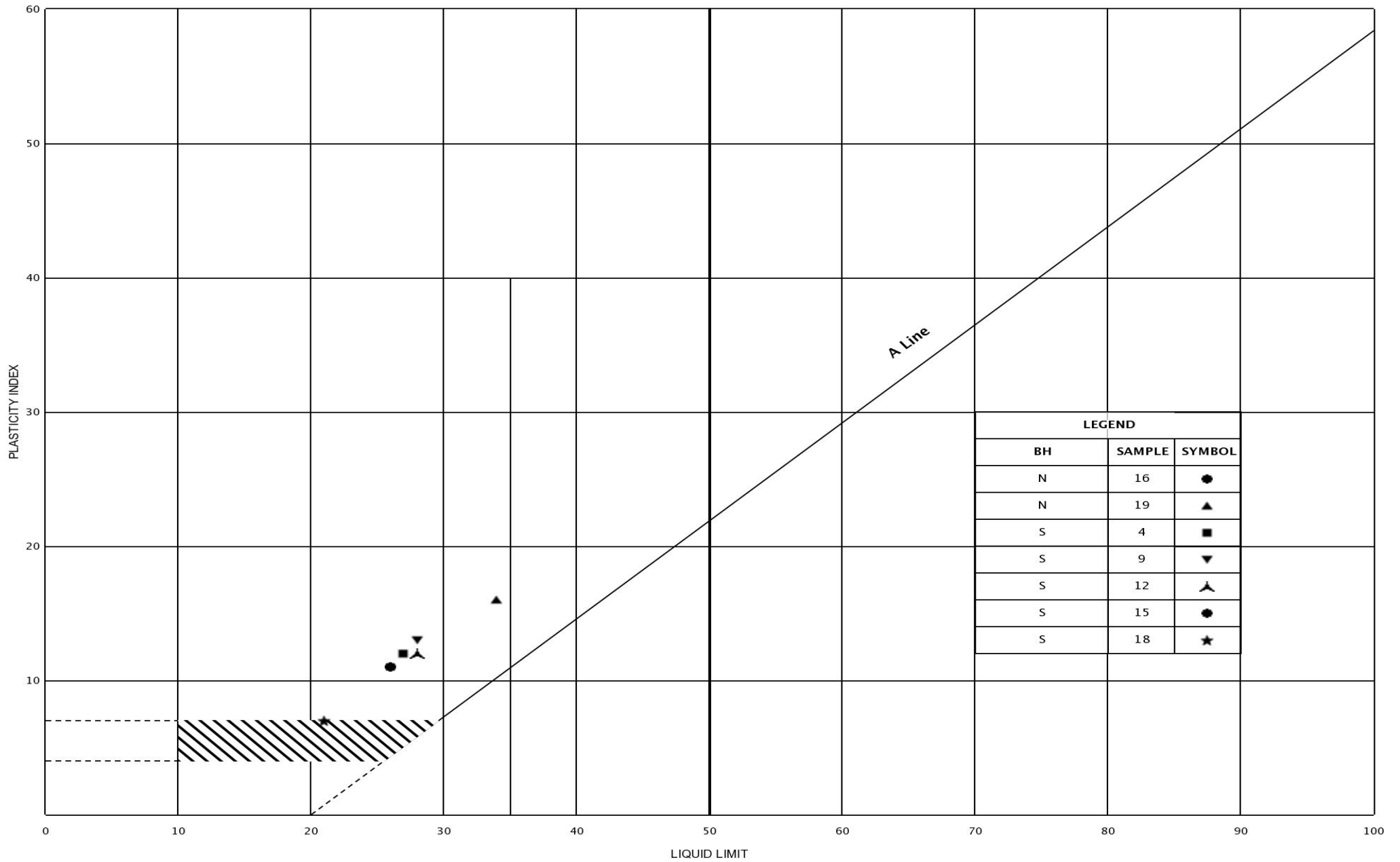
FIG No.: GS-DR1-3

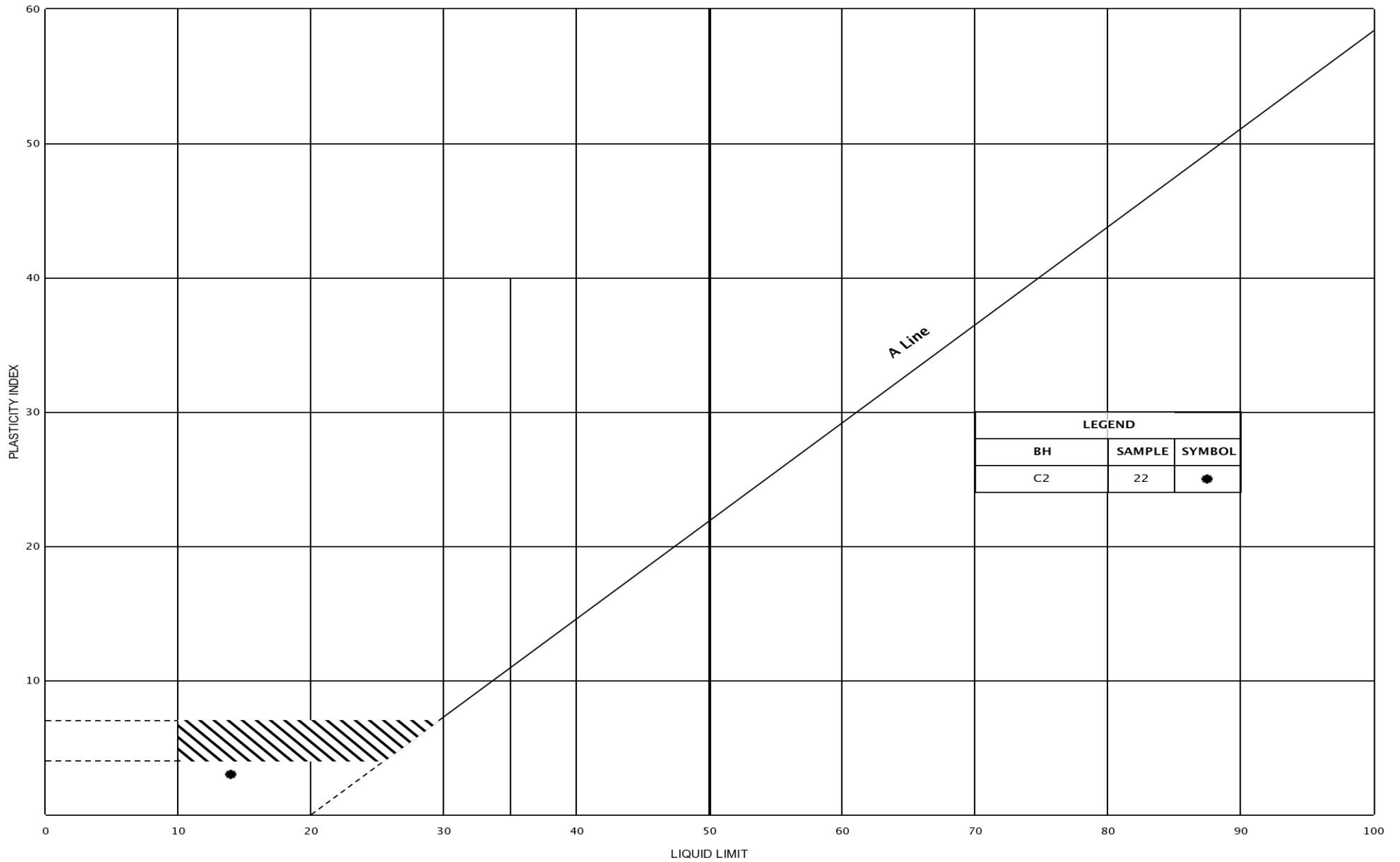
HWY : 401

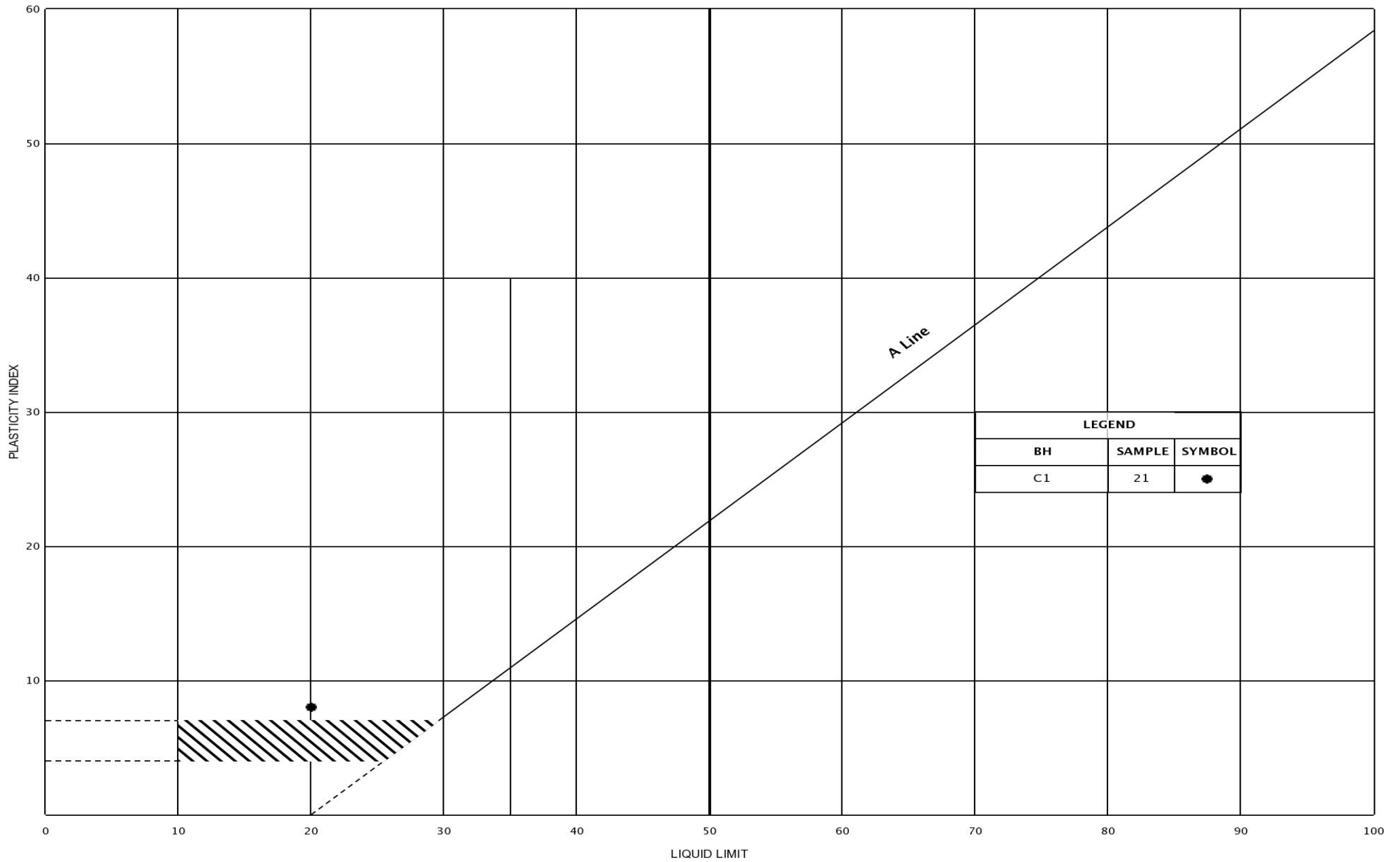
GWP 3016-E-2009













## **APPENDIX B-2**

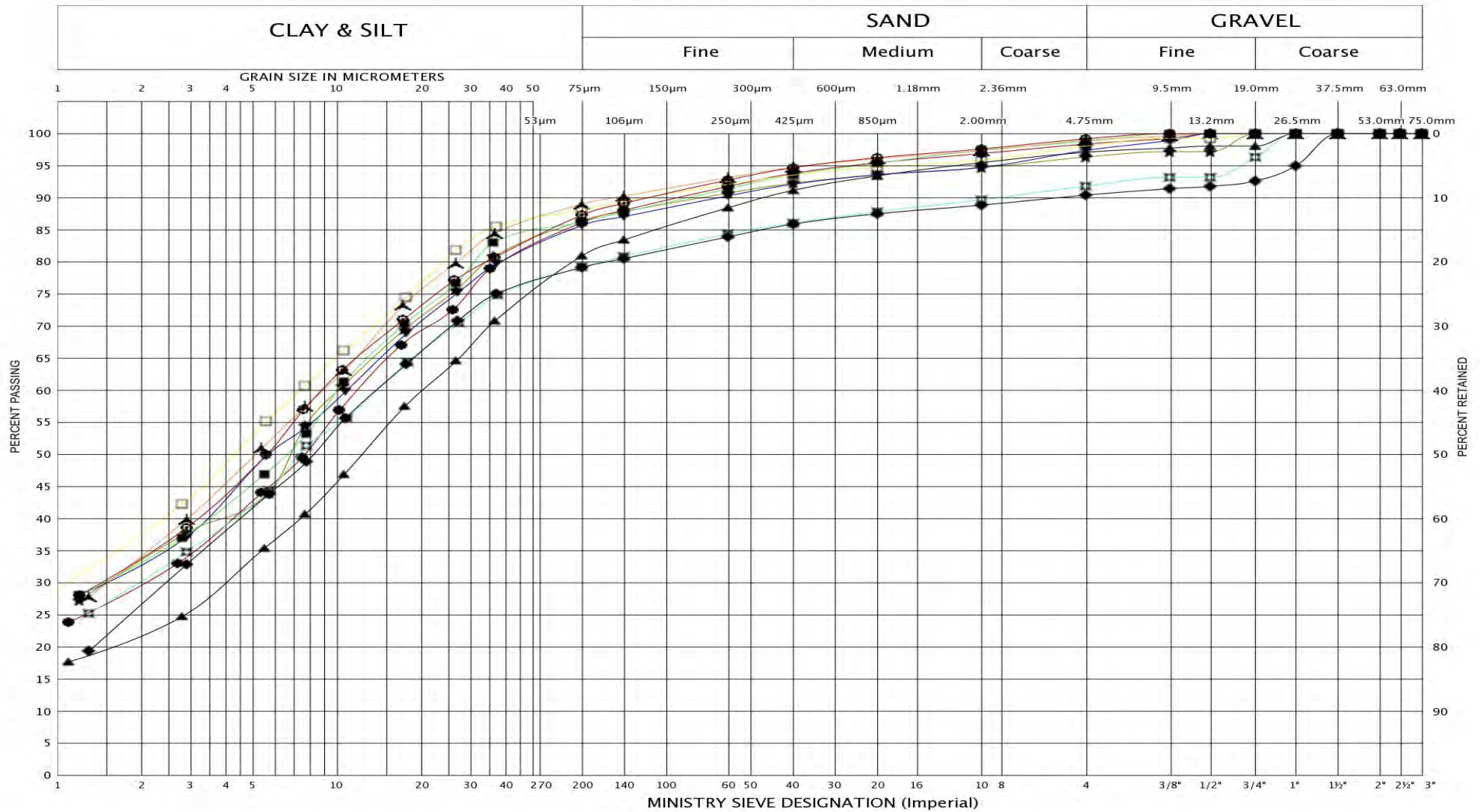
Results of Grain Size Distribution Analyses:

Figures GS-DR2-1A/B, GS-DR2-2

Results of Atterberg Limit Tests:

Figures PC-DR2-1A/B

# UNIFIED SOIL CLASSIFICATION SYSTEM



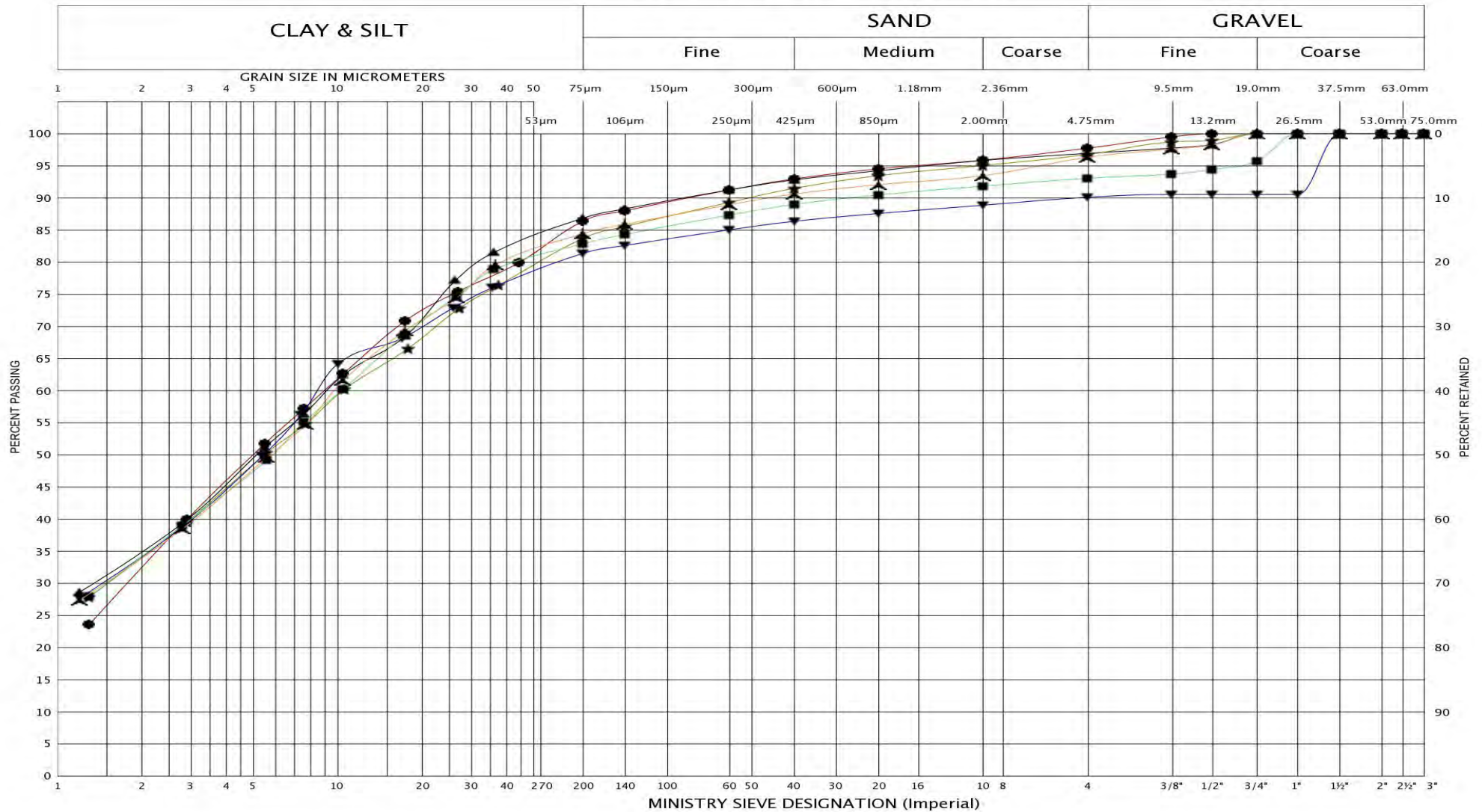
LEGEND	BH	1	1	2	2	2	3	3	3	4	4
	SAMPLE	4	12	6	8	11	3	7	11	5	7
	SYMBOL	●	▲	★	▼	■	▲	□	⊠	⊕	◆



**GRAIN SIZE DISTRIBUTION**  
Clayey Silt, Trace/Some Sand, Trace Gravel

FIG No.: GS-DR2-1A  
HWY : 401  
GWP 3016-E-2009

# UNIFIED SOIL CLASSIFICATION SYSTEM



## GRAIN SIZE DISTRIBUTION

Clayey Silt, Trace/Some Sand, Trace Gravel

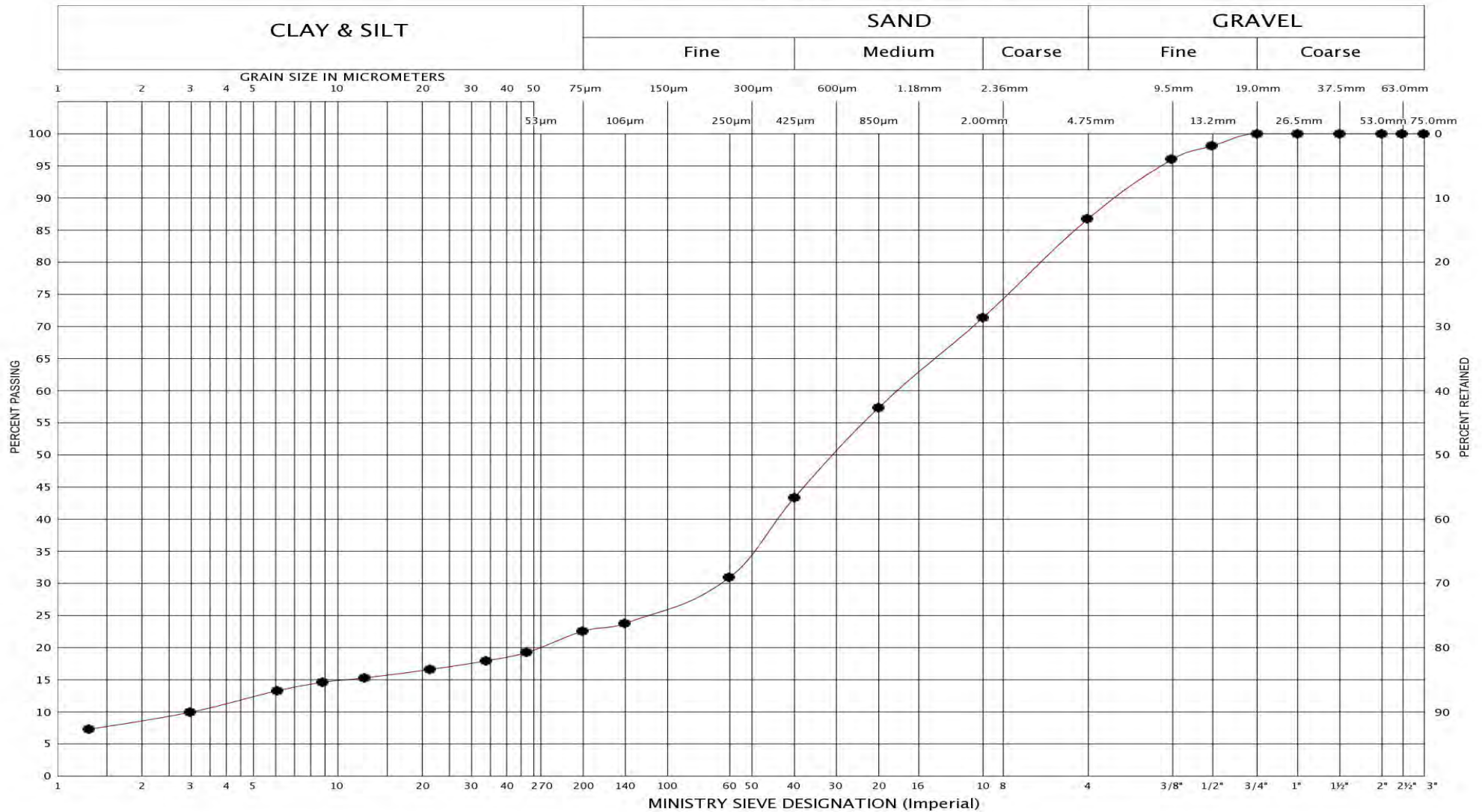
FIG No.: GS-DR2-1B

HWY : 401

GWP 3016-E-2009



# UNIFIED SOIL CLASSIFICATION SYSTEM



## GRAIN SIZE DISTRIBUTION

Silty Sand, Some Gravel

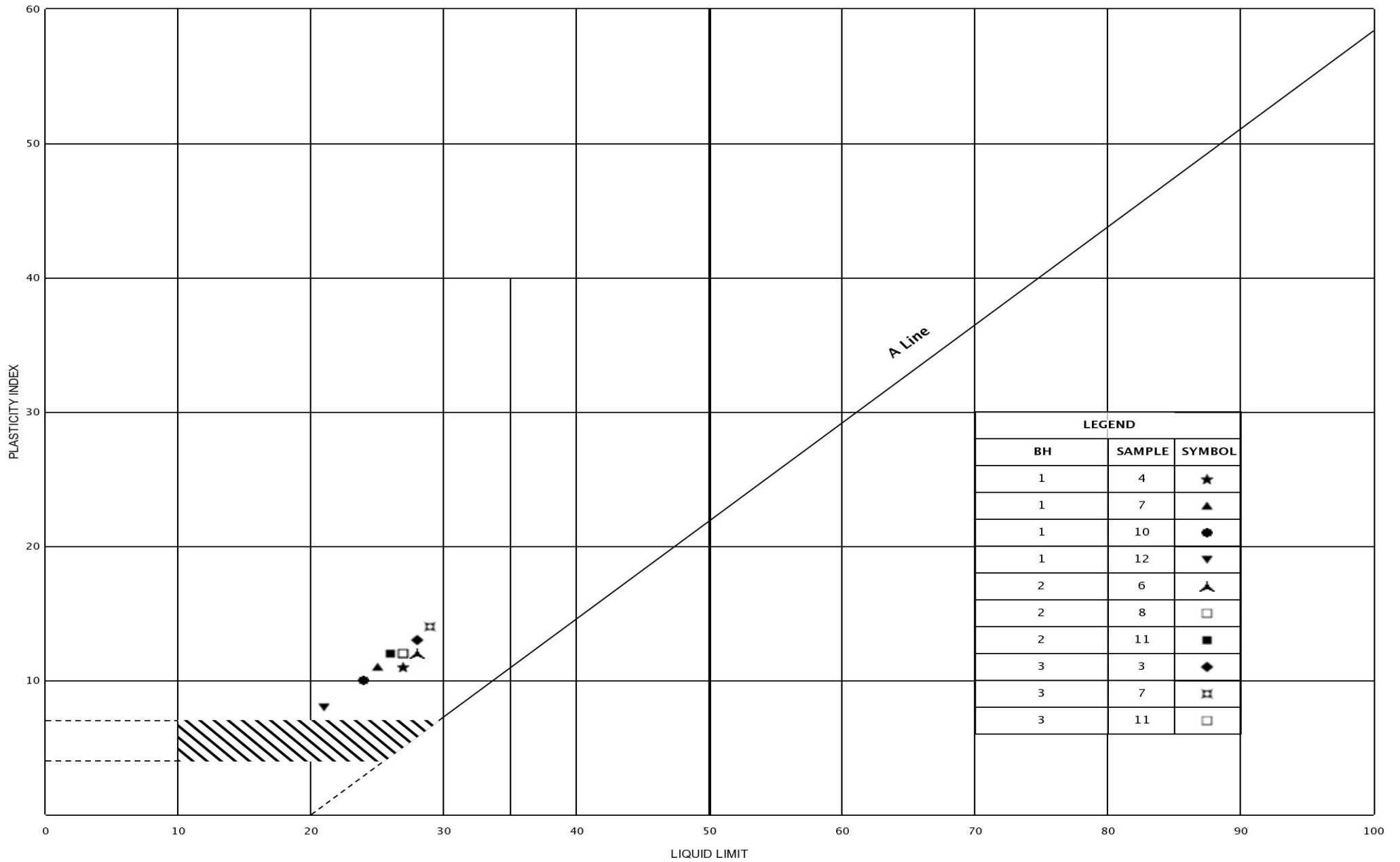
FIG No.: GS-DR2-2

HWY : 401

GWP 3016-E-2009







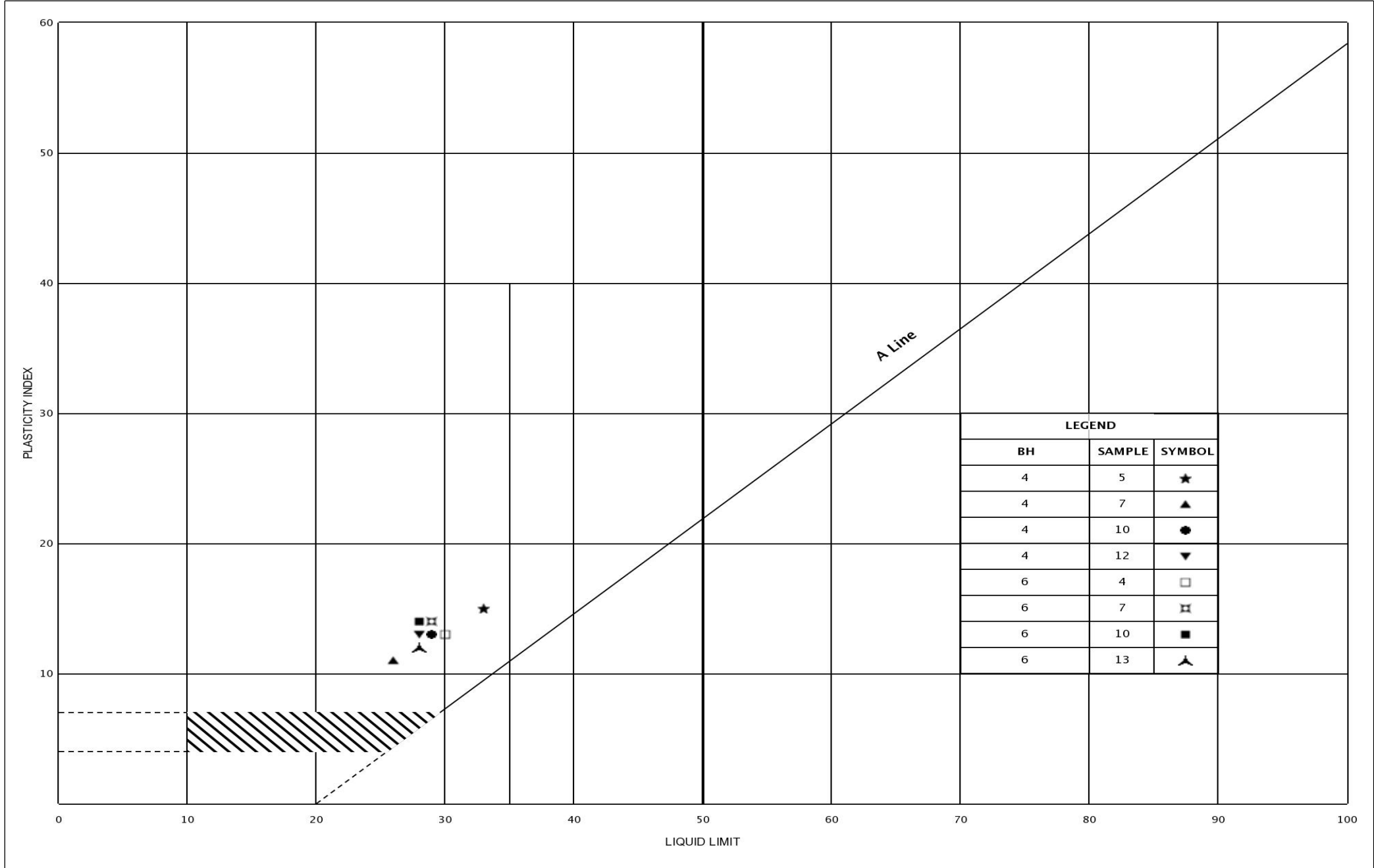
### PLASTICITY CHART

Clayey Silt, Trace/Some Sand, Trace Gravel

FIG No.: PC-DR2-1A

HWY.: 401

GWP 3016-E-2009



### PLASTICITY CHART

Clayey Silt, Trace/Some Sand, Trace Gravel

FIG No.: PC-DR2-1B

HWY.: 401

GWP 3016-E-2009



### **APPENDIX B-3**

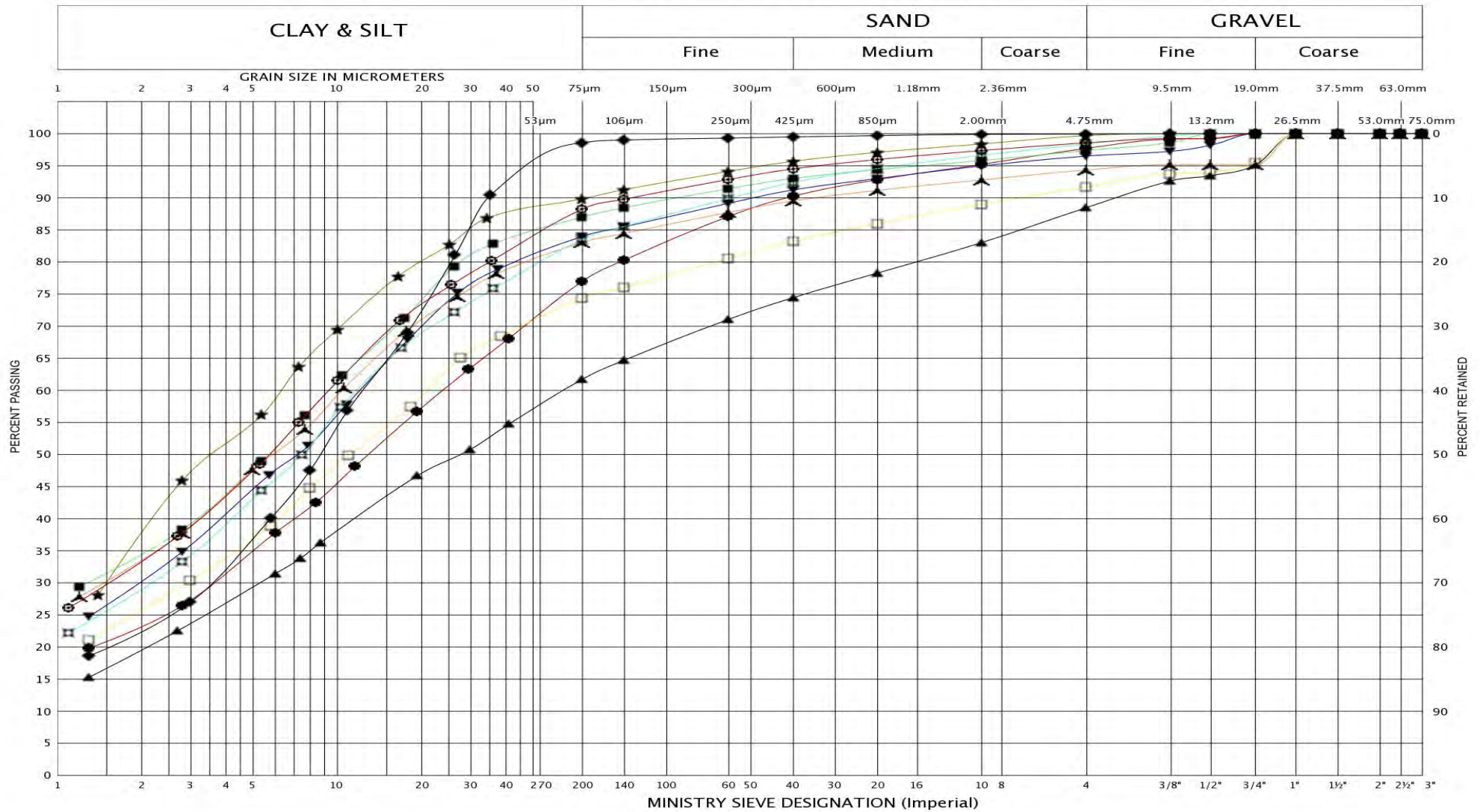
Results of Grain Size Distribution Analyses:

Figures GS-DR3-1A/B, GS-DR3-2

Results of Atterberg Limit Tests:

Figures PC-DR3-1A/B, PC-DR3-2

# UNIFIED SOIL CLASSIFICATION SYSTEM



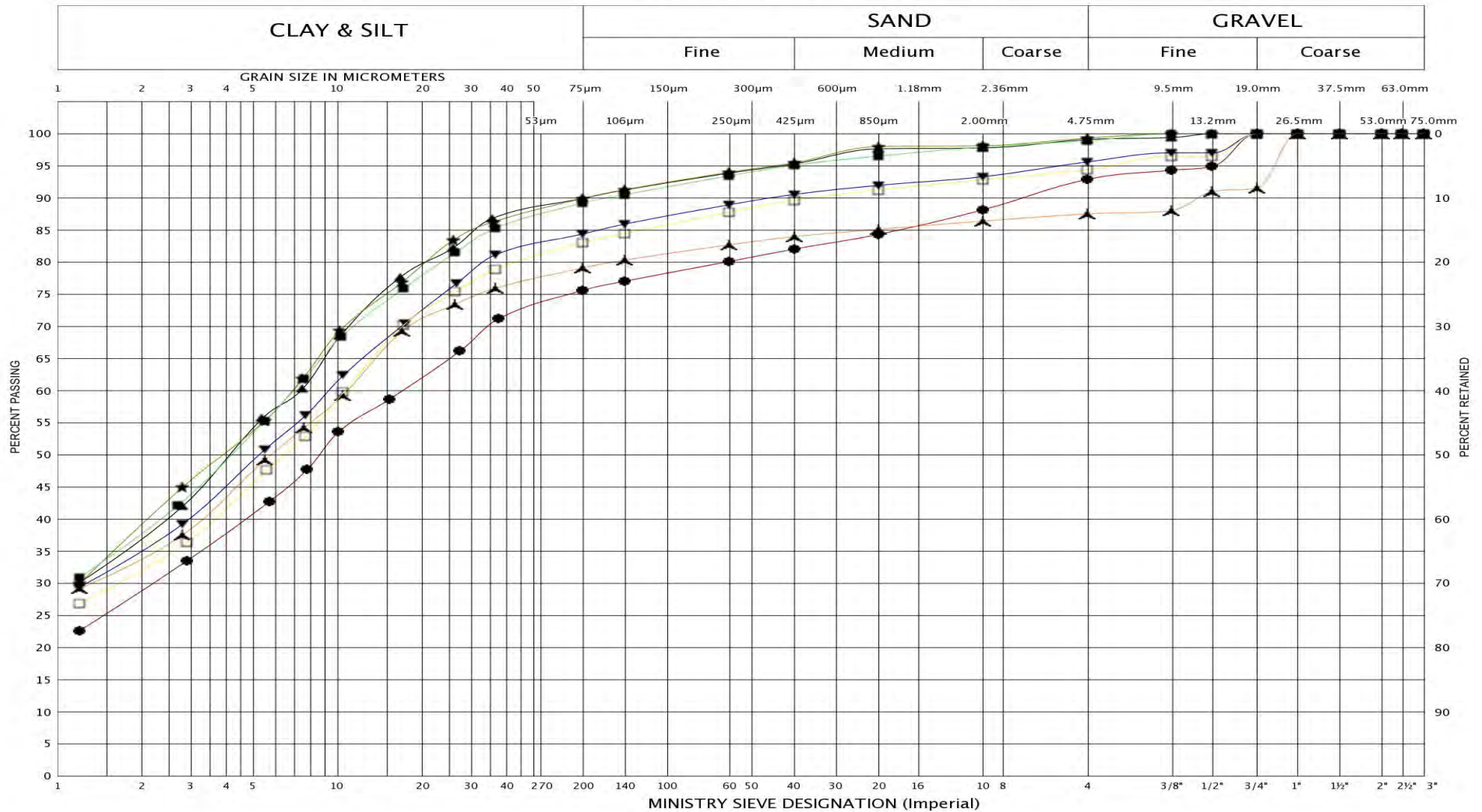
LEGEND	BH	5	5	5	7	7	7	7	8	8	9
	SAMPLE	6	9	12	4	7	10	13	3	10	4
	SYMBOL	●	▲	★	▼	■	▲	□	⊠	⊕	◆



**GRAIN SIZE DISTRIBUTION**  
Clayey Silt, Trace/Some Sand, Trace/Some Gravel

FIG No.: GS-DR3-1A  
HWY : 401  
GWP 3016-E-2009

# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	9	9	9	10	10	10	10
	SAMPLE	6	9	12	4	7	9	12
	SYMBOL	●	▲	★	▼	■	▲	□



## GRAIN SIZE DISTRIBUTION

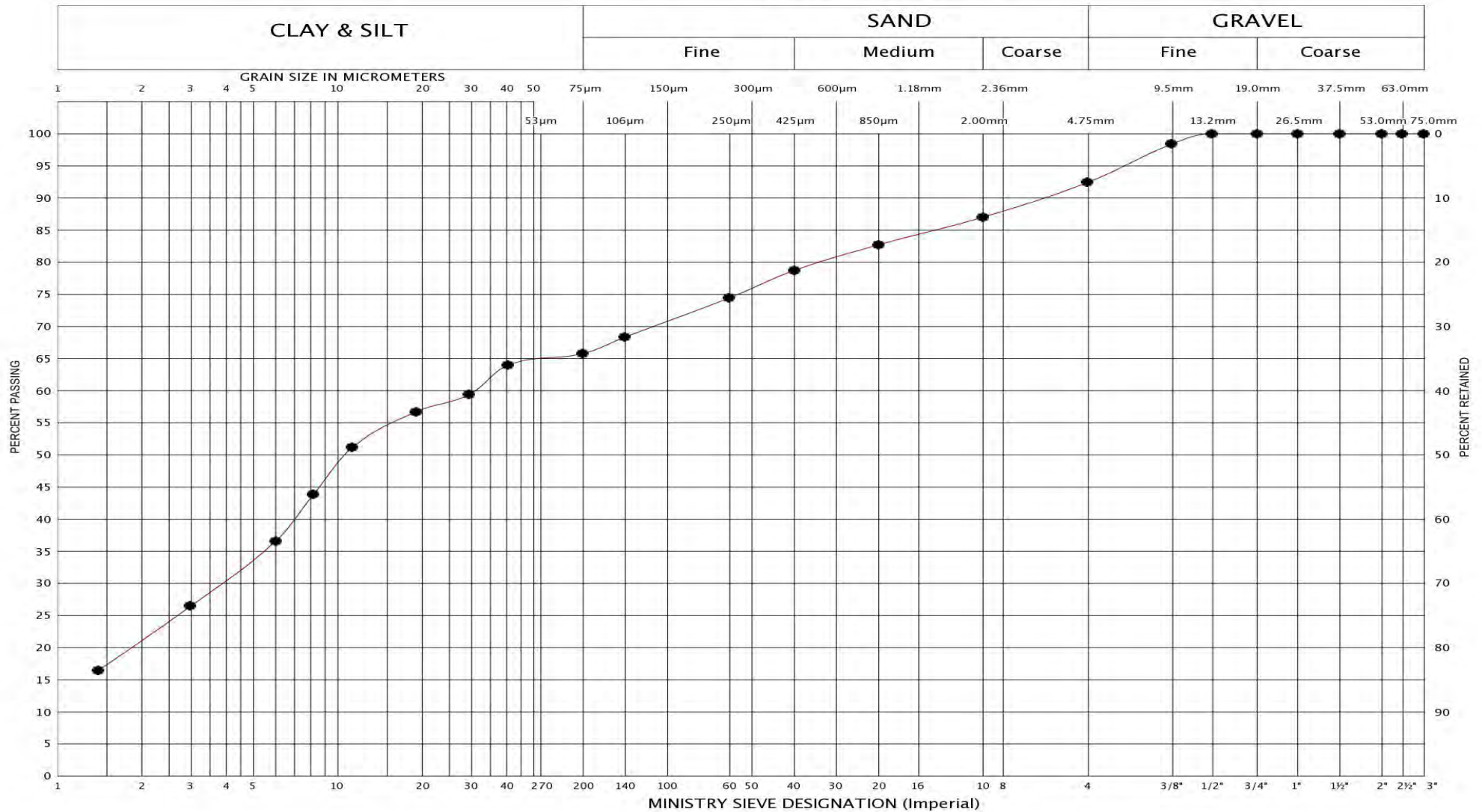
Clayey Silt, Trace/Some Sand, Trace/Some Gravel

FIG No.: GS-DR3-1B

HWY : 401

GWP 3016-E-2009

# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	5
	SAMPLE	14
	SYMBOL	●



## GRAIN SIZE DISTRIBUTION

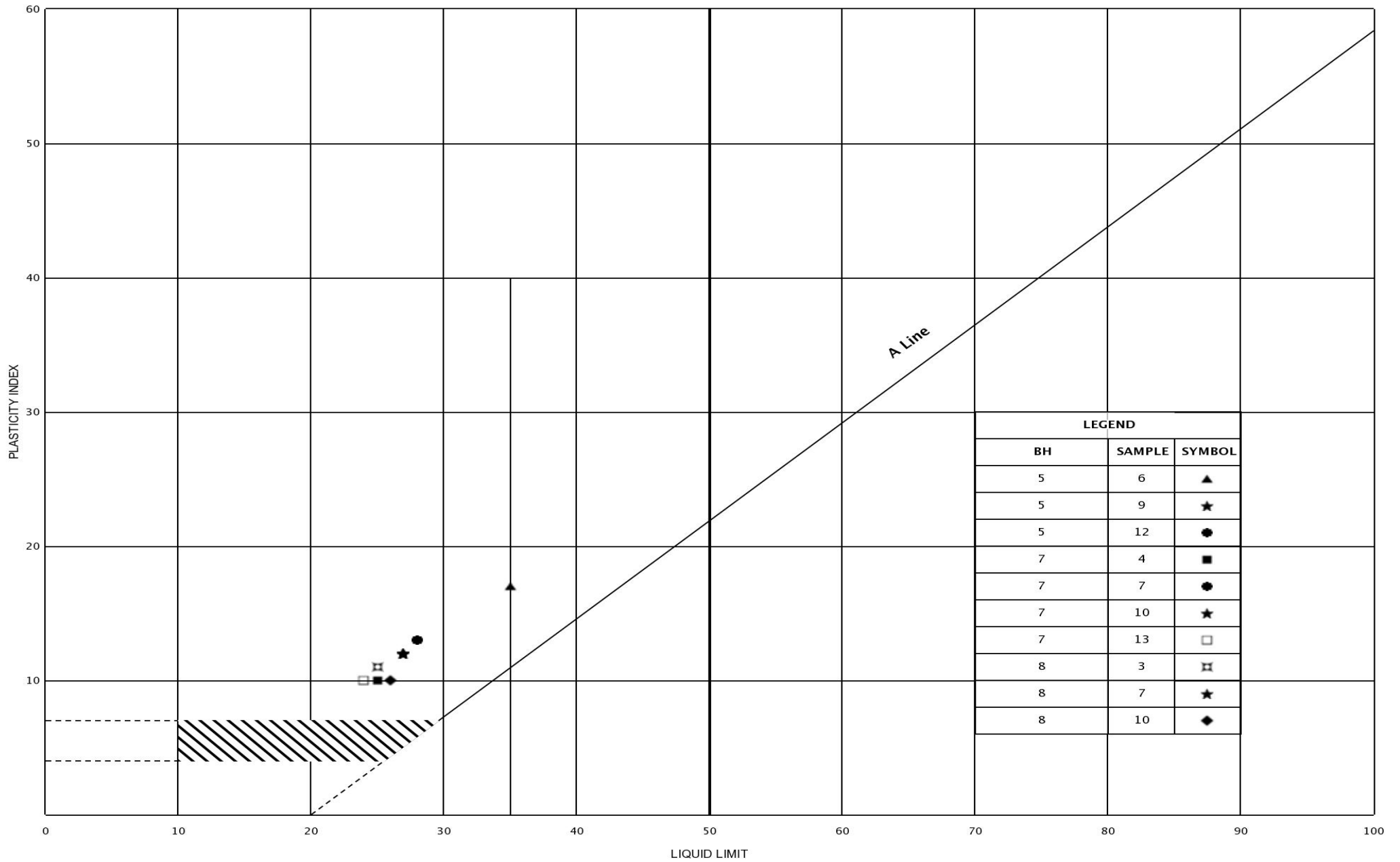
Sandy Clayey Silt, Trace Gravel

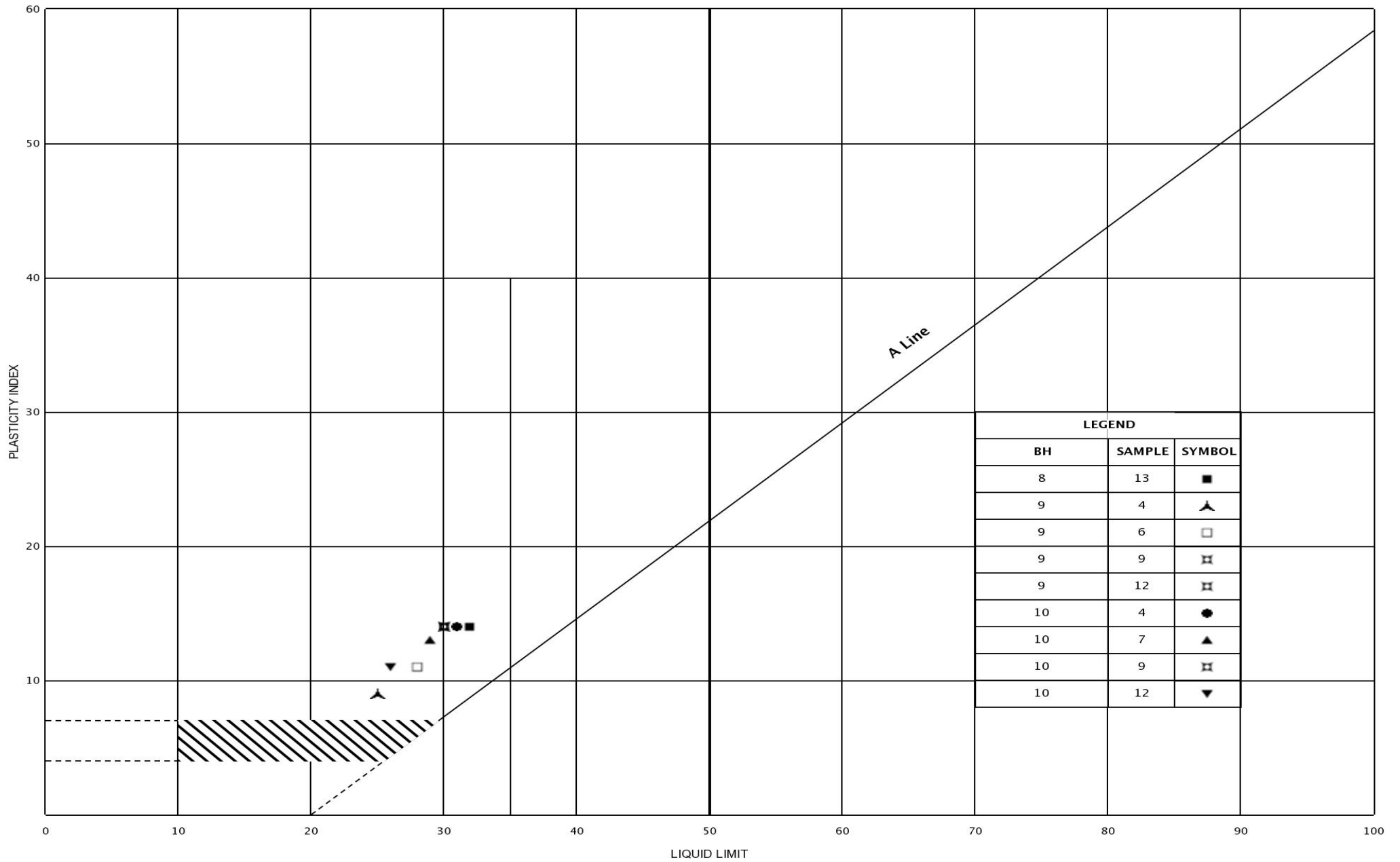
FIG No.: GS-DR3-2

HWY : 401

GWP 3016-E-2009



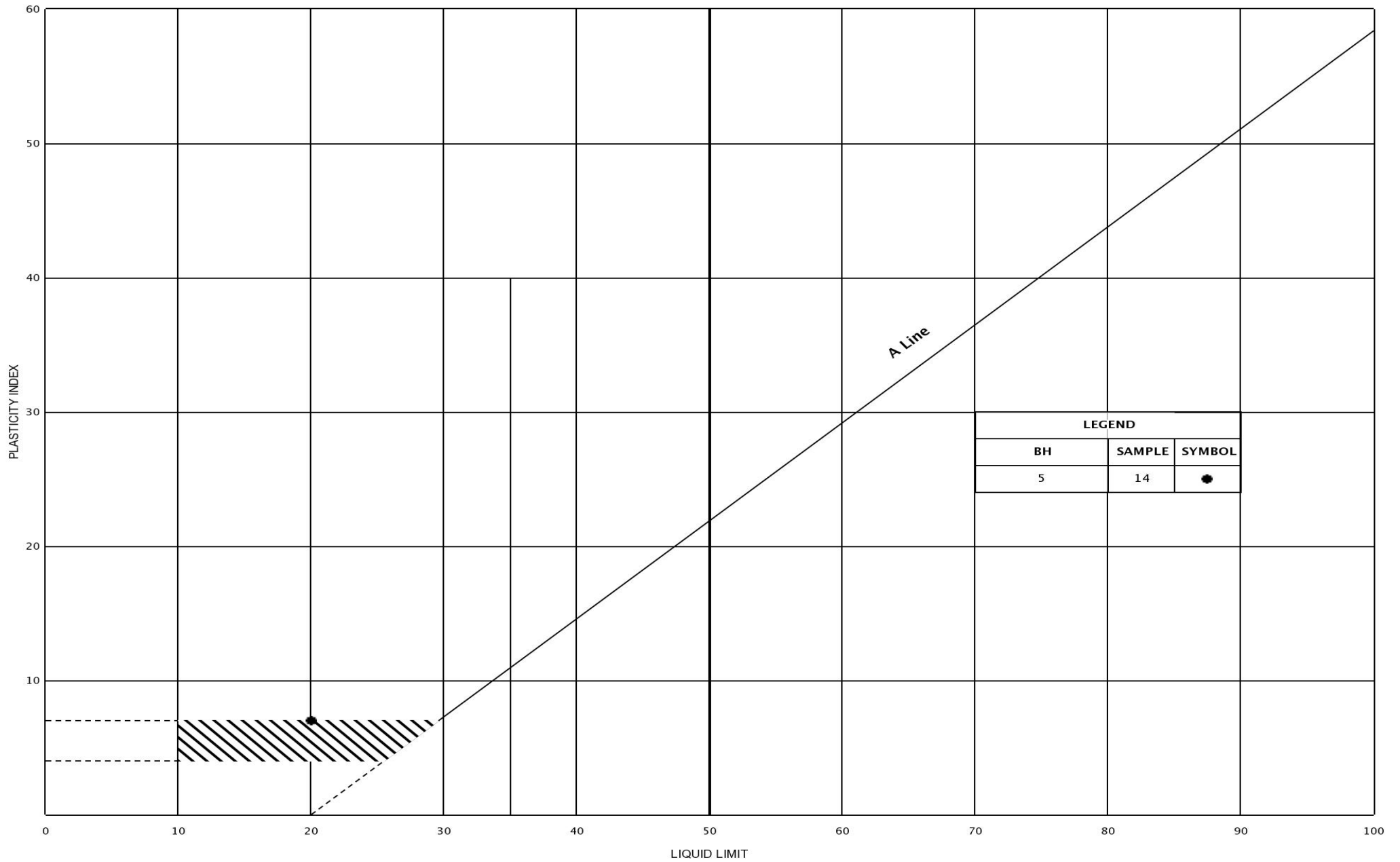




**PLASTICITY CHART**  
Clayey Silt, Trace/Some Sand, Trace/Some Gravel

FIG No.: PC-DR3-1B  
HWY.: 401  
GWP 3016-E-2009





**PLASTICITY CHART**  
Sandy Clayey Silt, Trace Gravel

FIG No.:	PC-DR3-2
HWY.:	401
GWP	3016-E-2009



## **APPENDIX B-4**

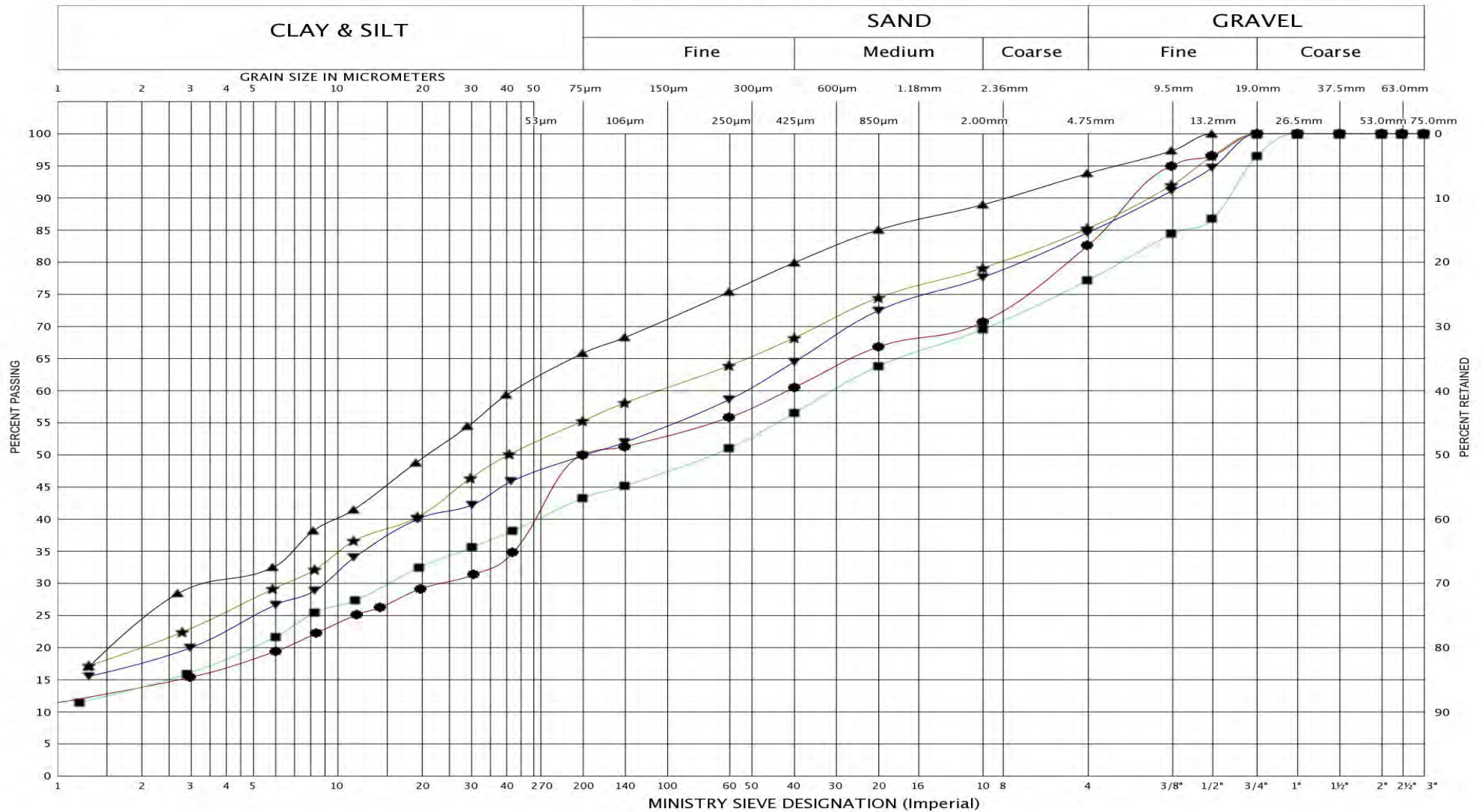
Results of Grain Size Distribution Analyses:

Figures GS-DR4-1, GS-DR4-2, GS-DR4-3, GS-DR4-4

Results of Atterberg Limit Tests:

Figures PC-DR4-1, PC-DR4-2, PC-DR4-3, PC-DR4-4

# UNIFIED SOIL CLASSIFICATION SYSTEM



## GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt, Trace/Some Gravel Fill

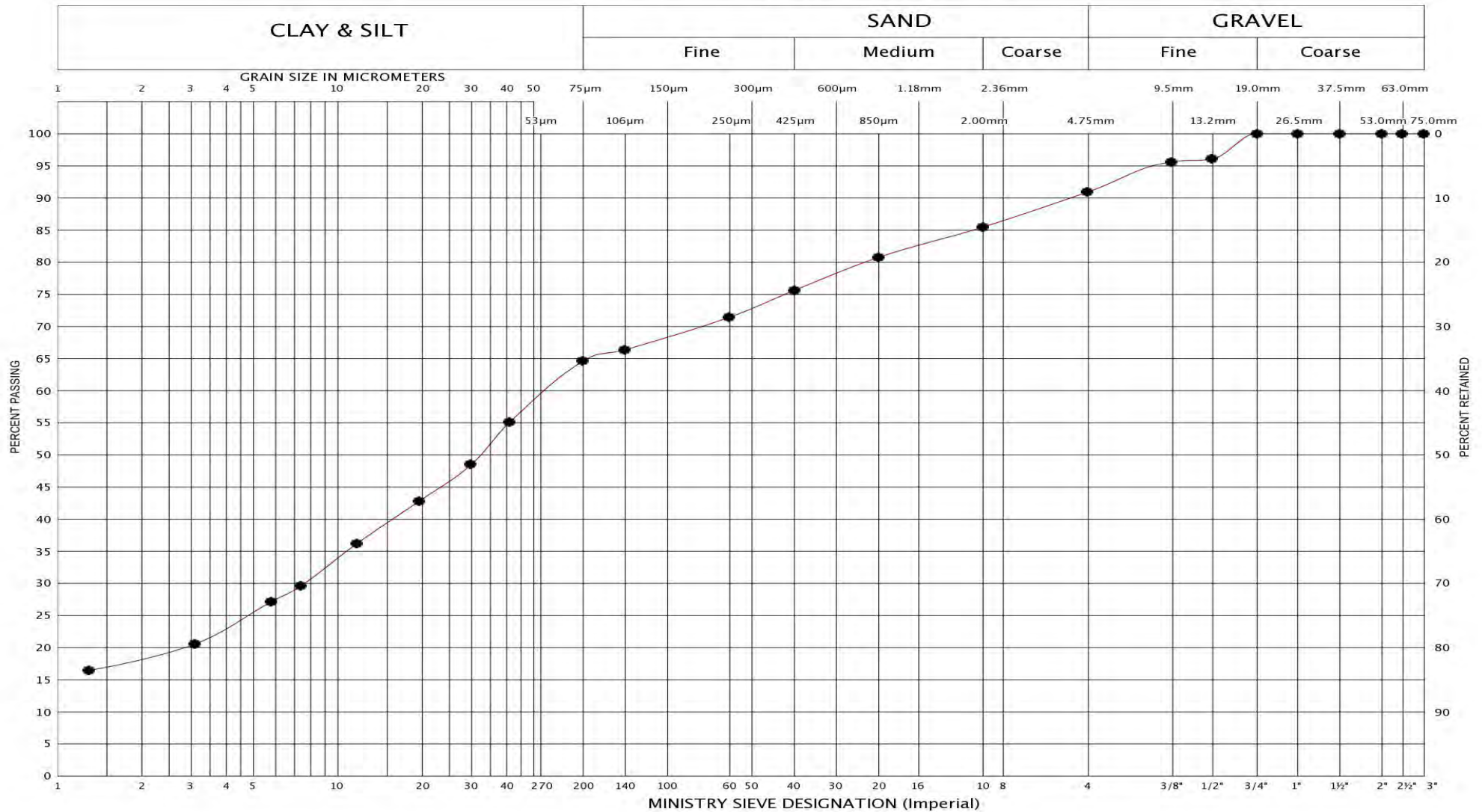
FIG No.: GS-DR4-1

HWY : 401

GWP 3016-E-2009



# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	12
	SAMPLE	11
	SYMBOL	●



## GRAIN SIZE DISTRIBUTION

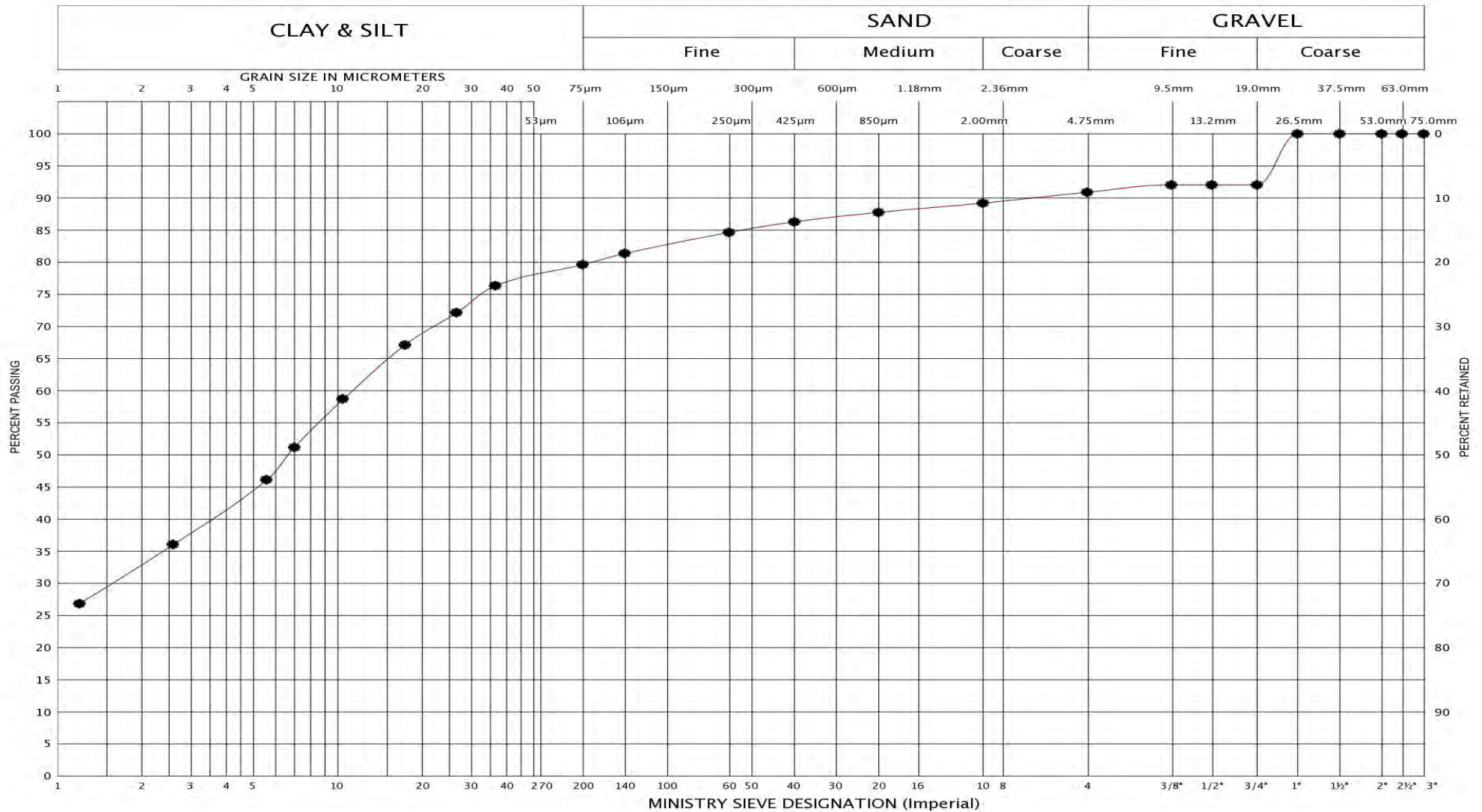
Sandy Clayey Silt, Trace Gravel

FIG No.: GS-DR4-2

HWY : 401

GWP 3016-E-2009

# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	13
	SAMPLE	12
	SYMBOL	●

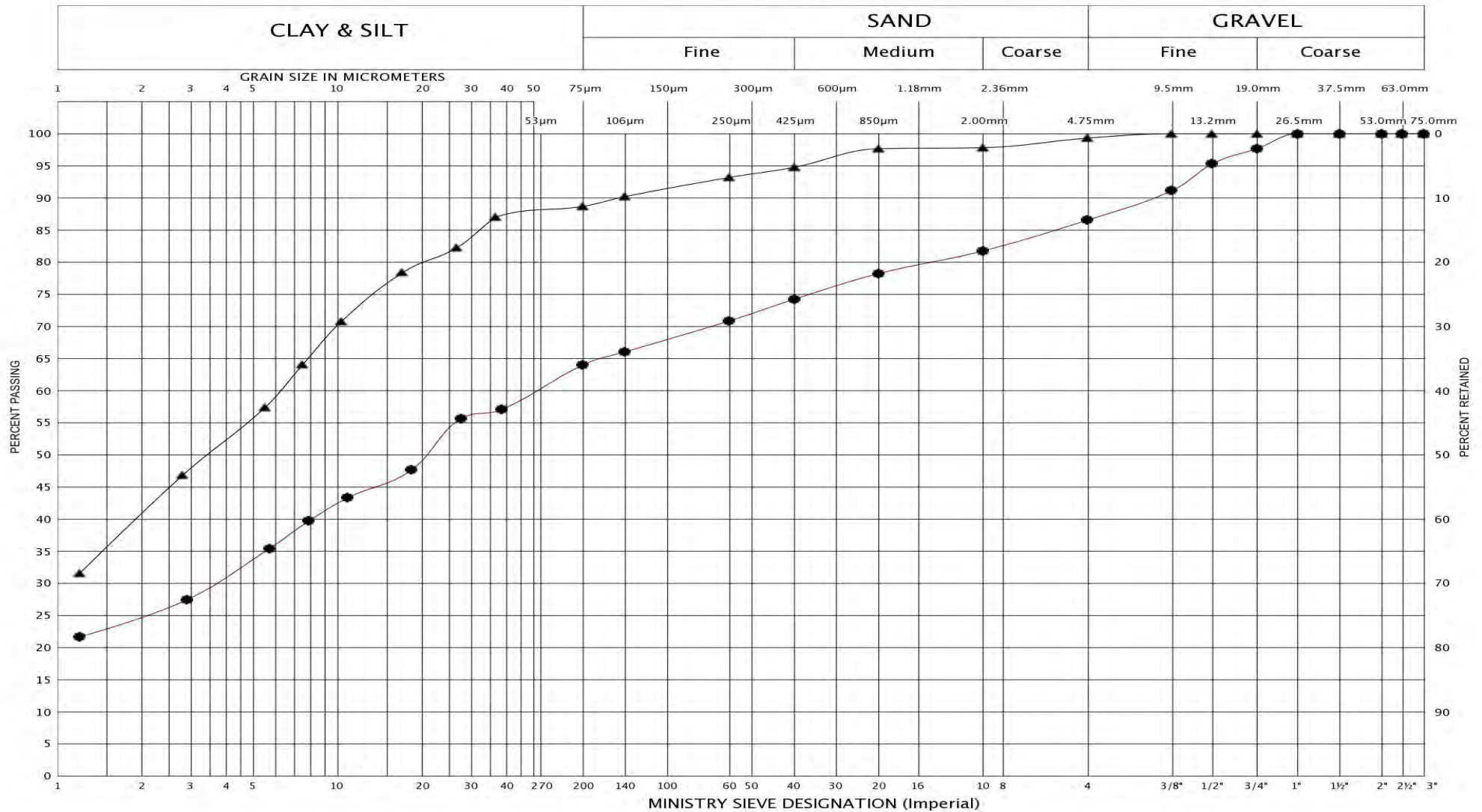


**GRAIN SIZE DISTRIBUTION**  
Clayey Silt, Some Sand, Trace Gravel

FIG No.: GS-DR4-3  
HWY : 401  
GWP 3016-E-2009



# UNIFIED SOIL CLASSIFICATION SYSTEM



## GRAIN SIZE DISTRIBUTION

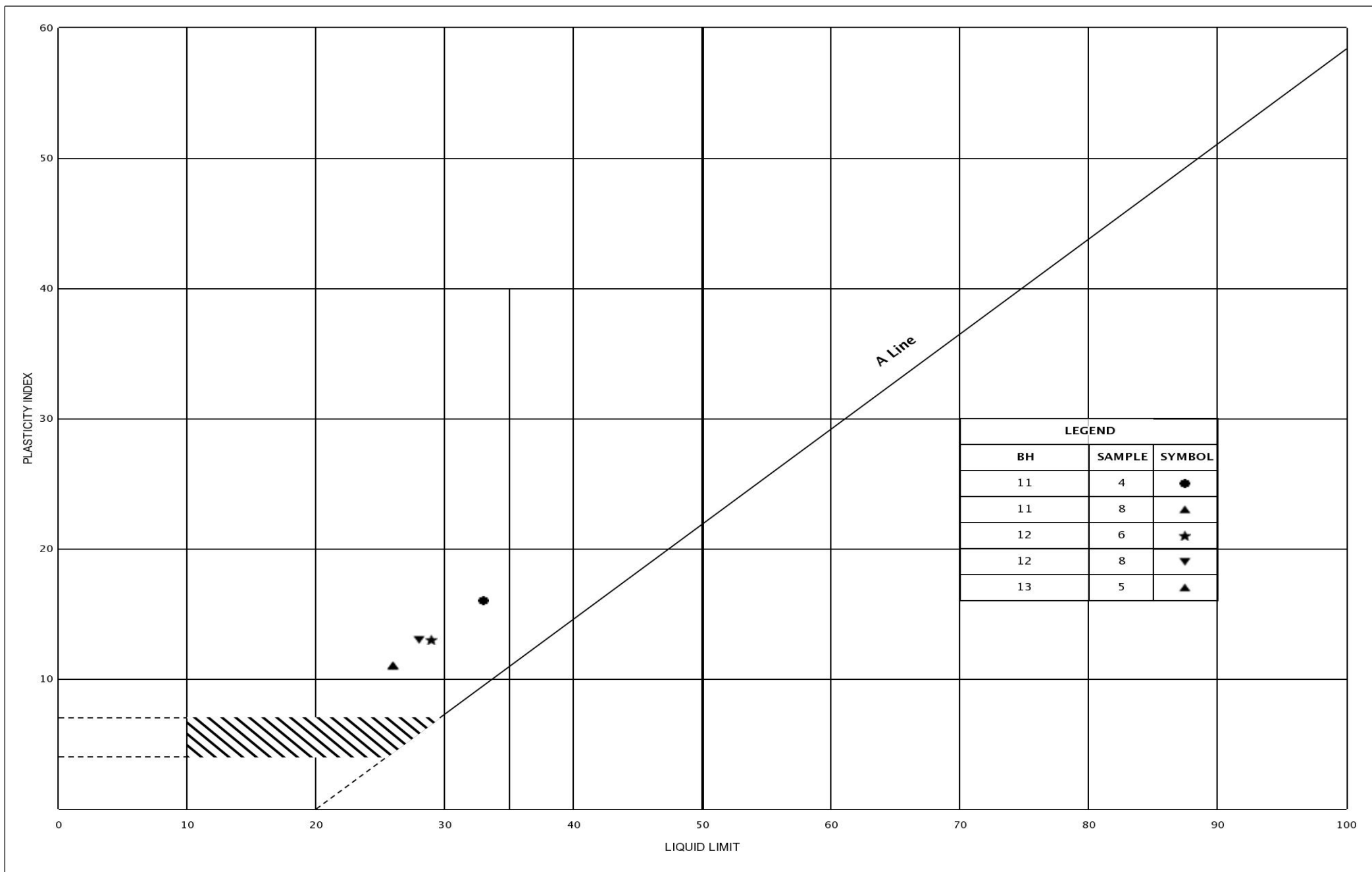
Silty Clay, Some Sand, Trace Gravel

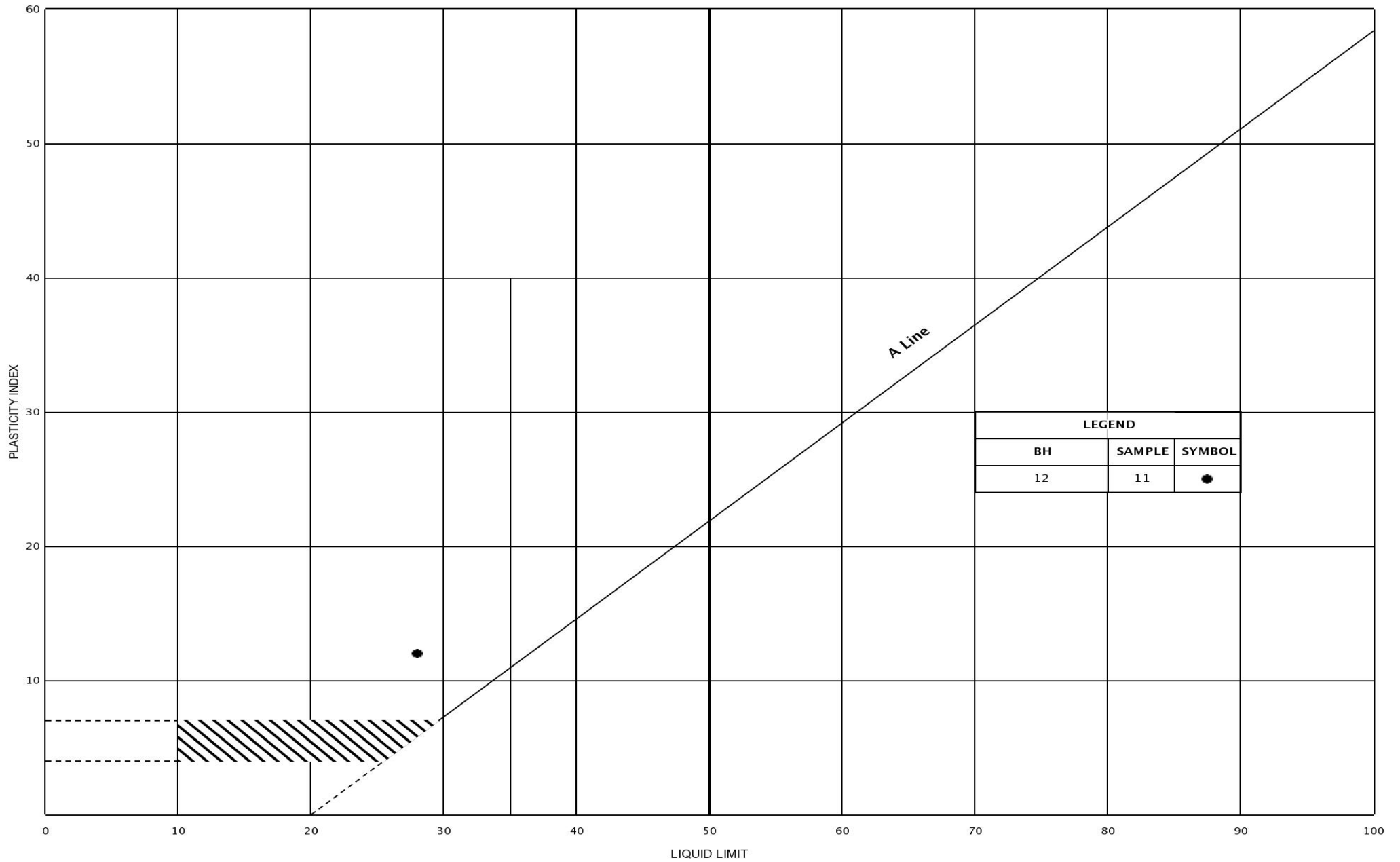
FIG No.: GS-DR4-4

HWY : 401

GWP 3016-E-2009



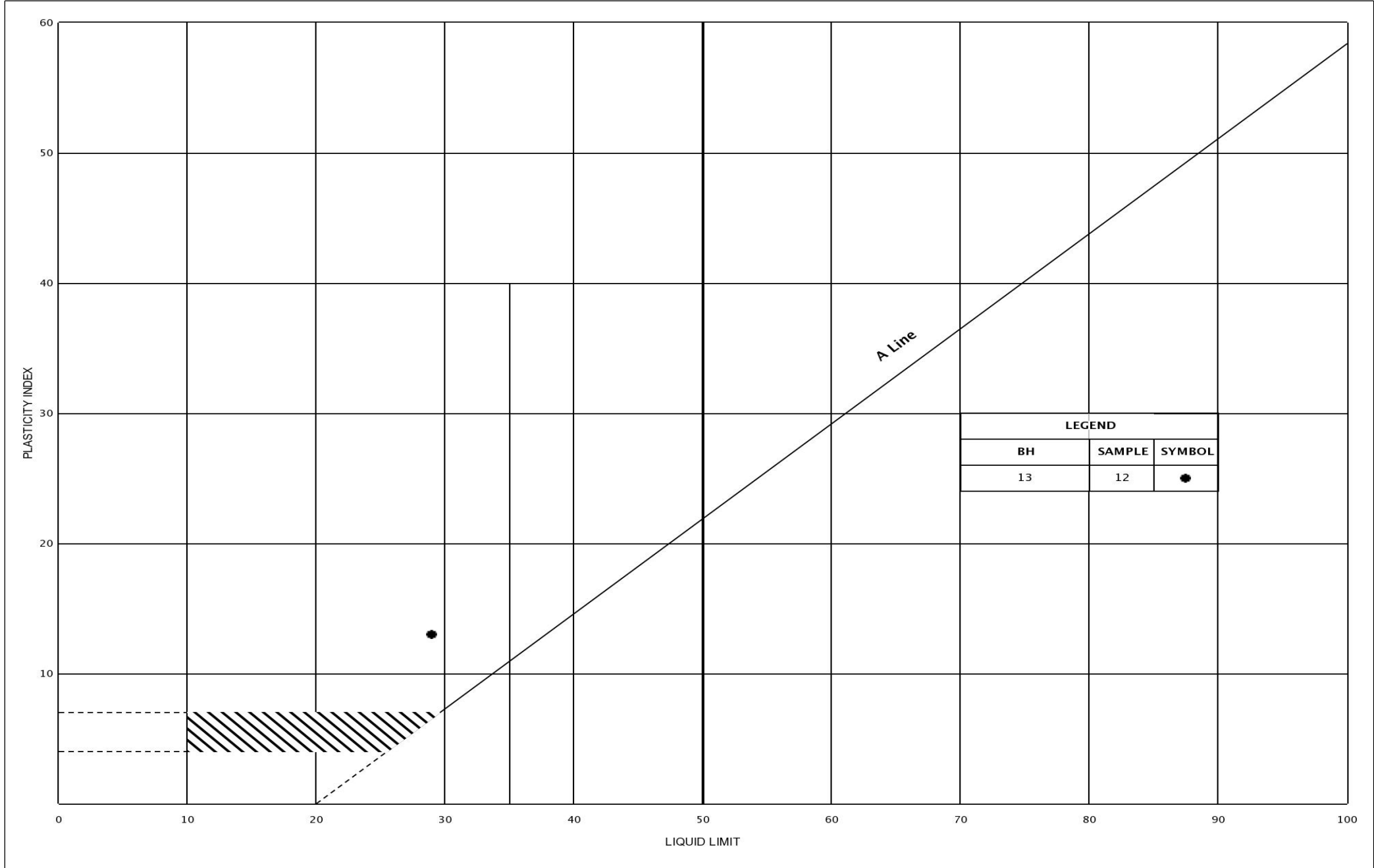




**PLASTICITY CHART**  
Sandy Clayey Silt, Trace Gravel

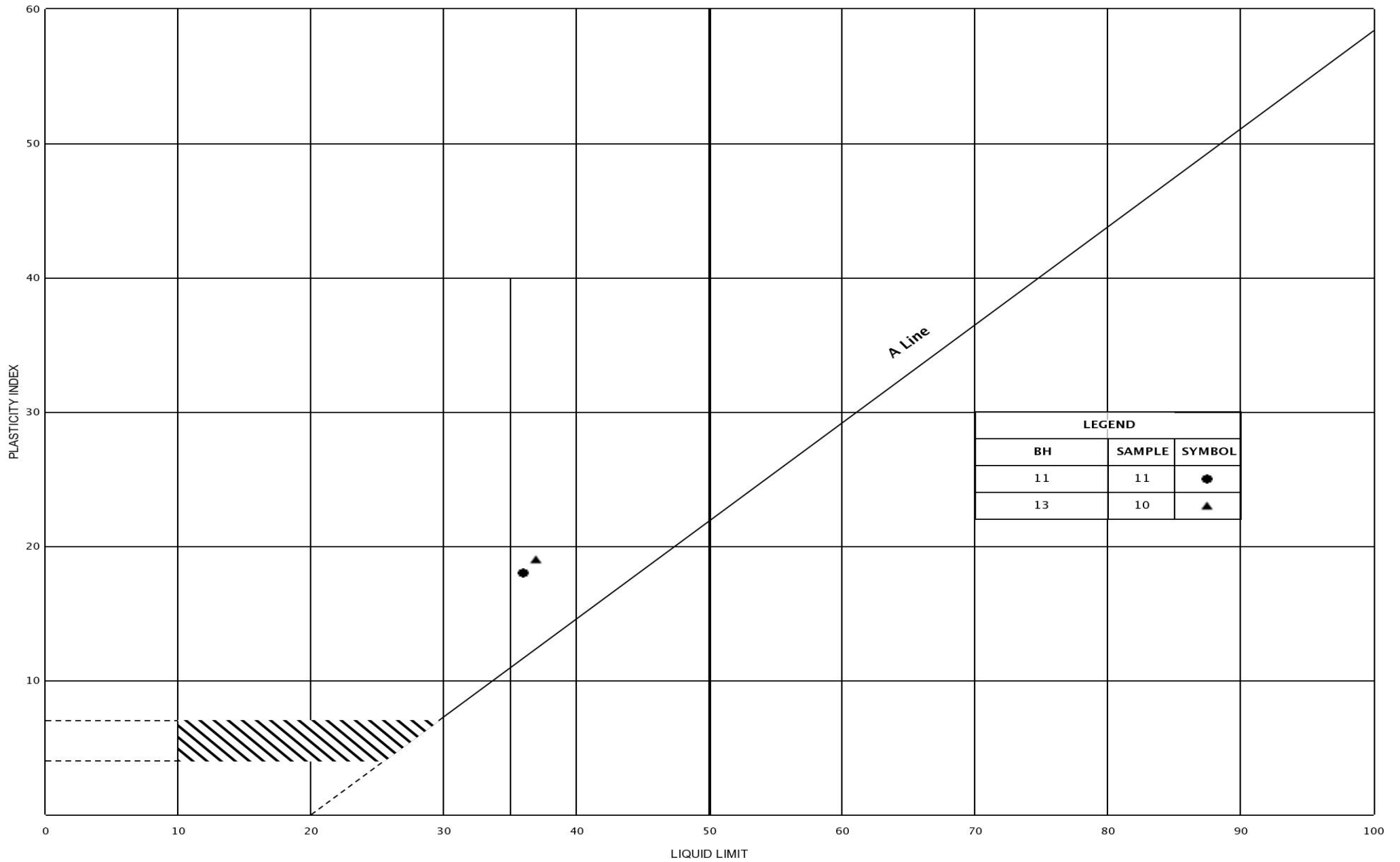
FIG No.:	PC-DR4-2
HWY.:	401
GWP	3016-E-2009





**PLASTICITY CHART**  
Clayey Silt, Some Sand, Trace Gravel

FIG No.:	PC-DR4-3
HWY.:	401
GWP	3016-E-2009



### PLASTICITY CHART

Silty Clay, Some Sand, Trace Gravel

FIG No.:	PC-DR4-4
HWY.:	401
GWP	3016-E-2009

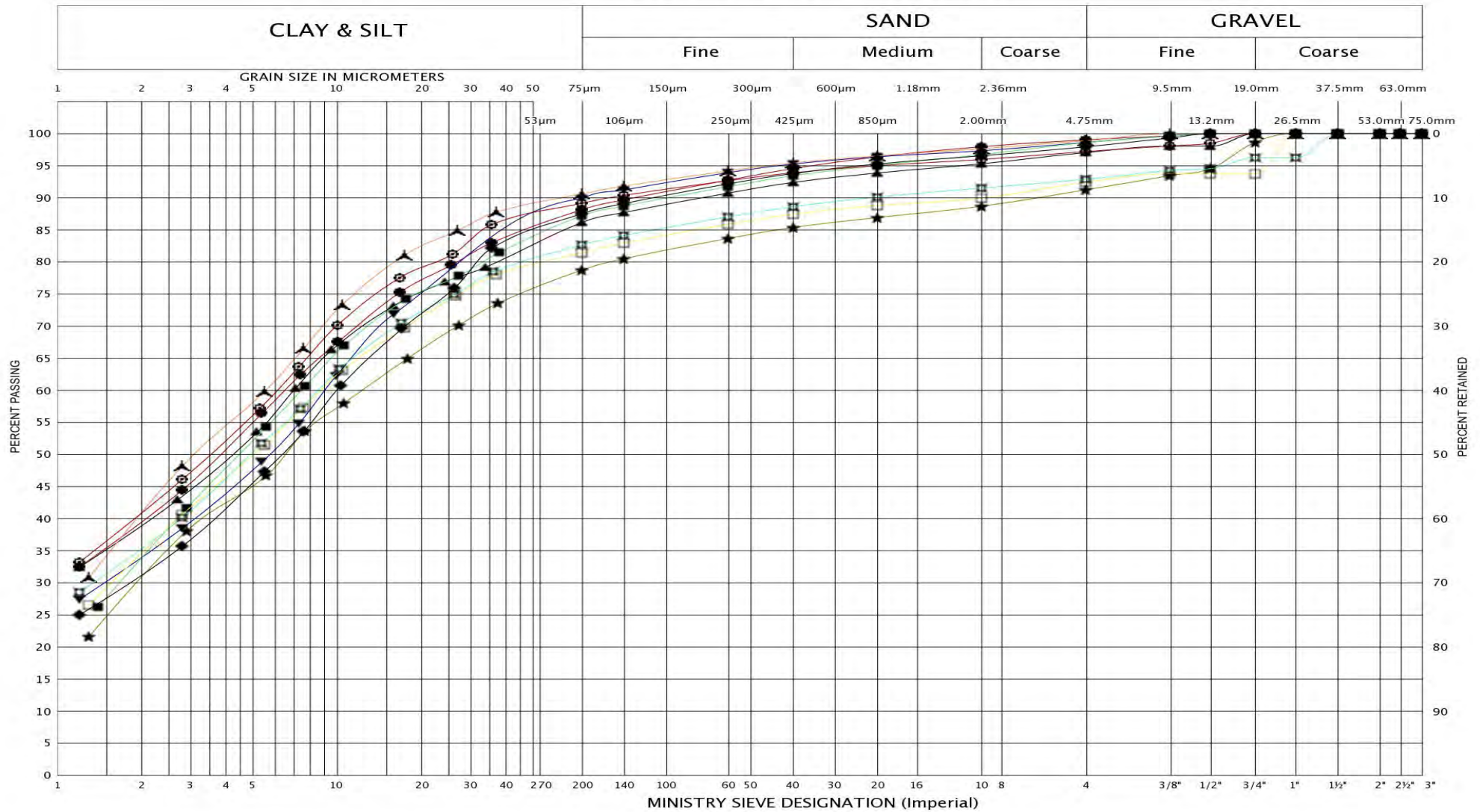


## **APPENDIX B-5**

Results of Grain Size Distribution Analyses:  
Figures GS-DR5-1A/B, GS-DR5-2, GS-DR5-3

Results of Atterberg Limit Tests:  
Figures PC-DR5-1A/B, PC-DR5-2, PC-DR5-3

# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	14	14	14	14	15	15	15	16	16	16
	SAMPLE	4	6	9	12	6	9	12	8	10	13
	SYMBOL	●	▲	★	▼	■	▲	□	✕	⊕	◆



## GRAIN SIZE DISTRIBUTION

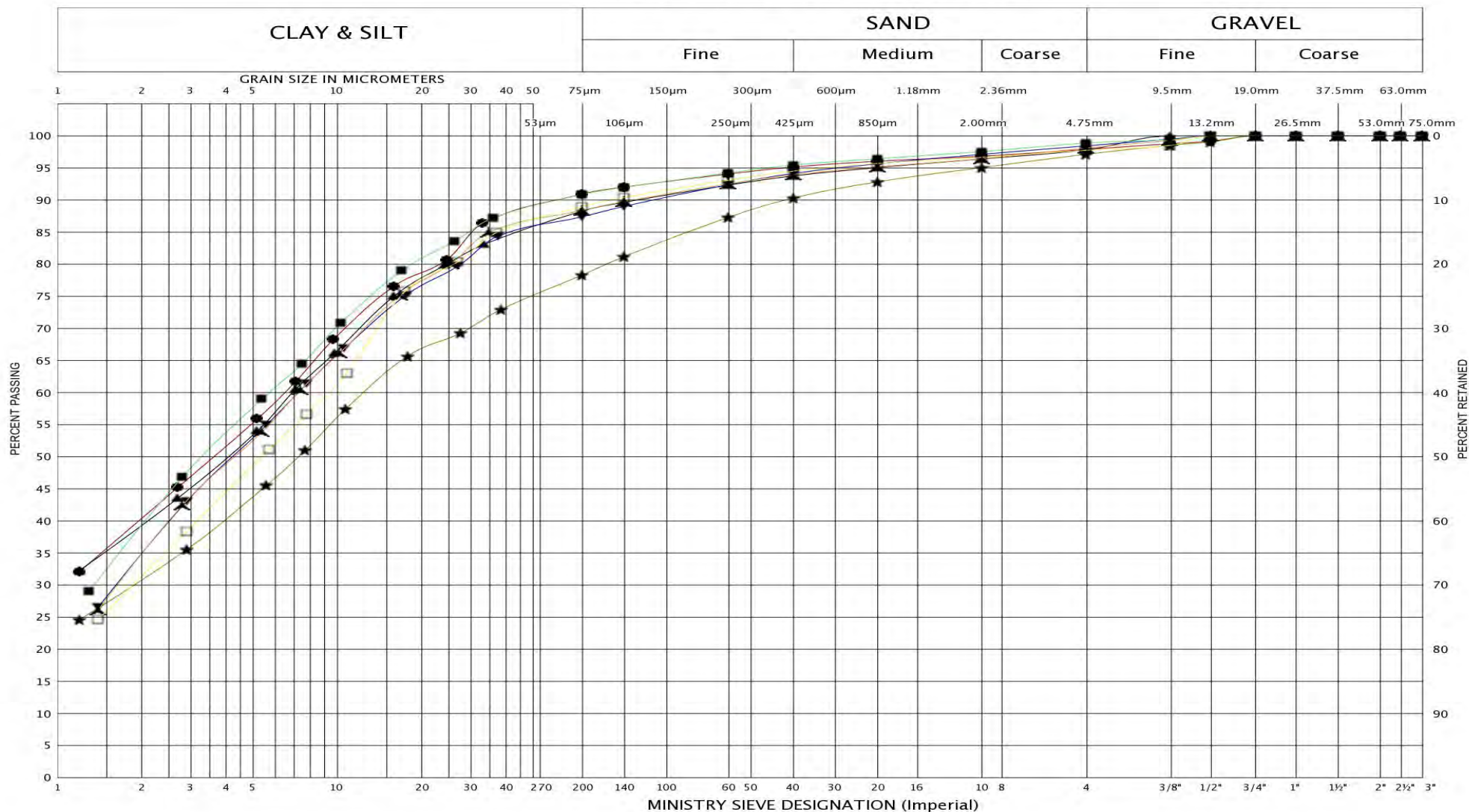
Clayey Silt, Trace/Some Sand, Trace Gravel

FIG No.: GS-DR5-1A

HWY : 401

GWP 3016-E-2009

## UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	17	17	17	18	18	18	18
	SAMPLE	7	9	11	4	8	11	14
	SYMBOL	♣	♠	♣	♠	♣	♠	♣



## GRAIN SIZE DISTRIBUTION

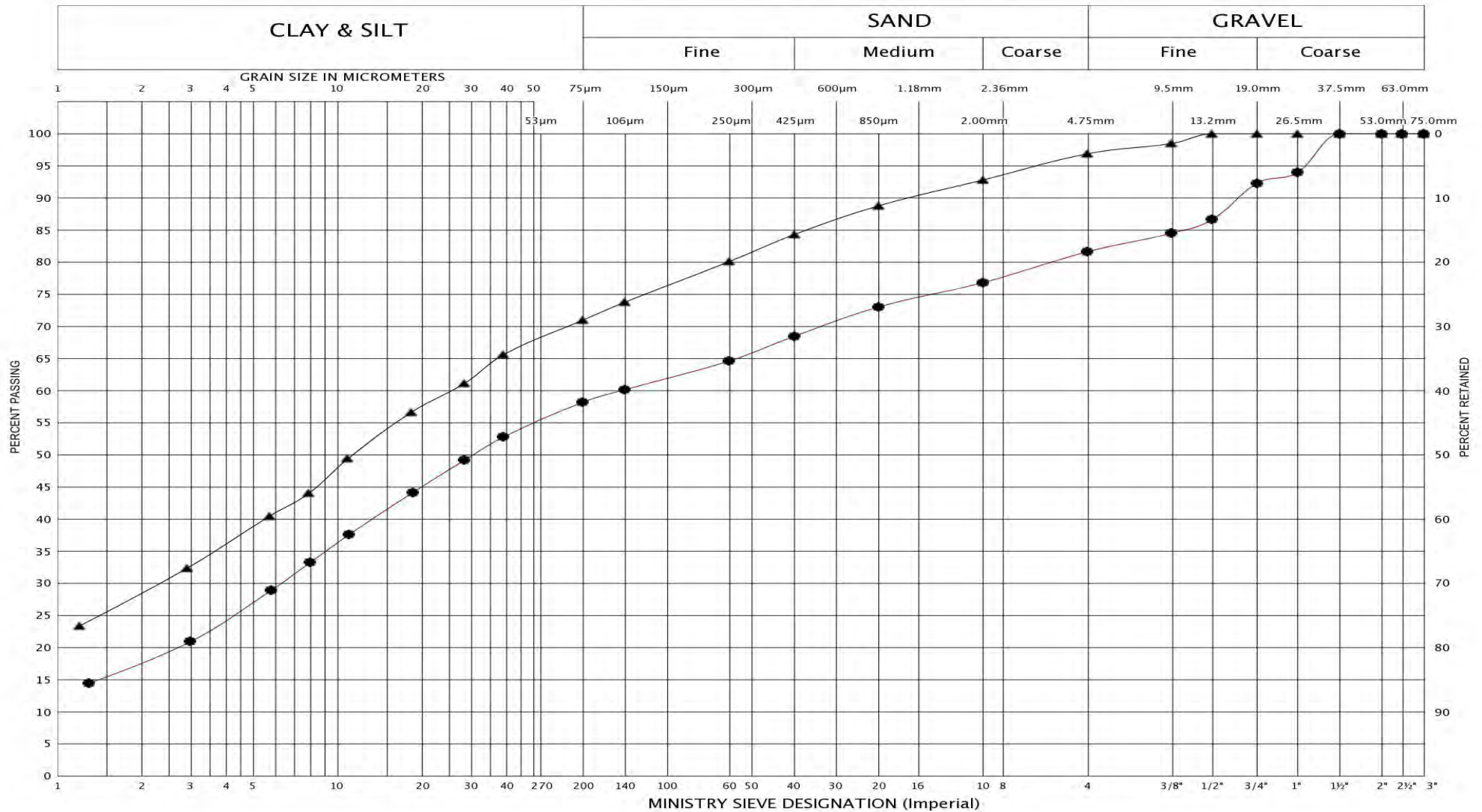
Clayey Silt, Trace/Some Sand, Trace Gravel

FIG No.: GS-DR5-1B

HWY :	401
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GWP	3016-E-2009
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# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	16	17
	SAMPLE	5	5
	SYMBOL	●	▲

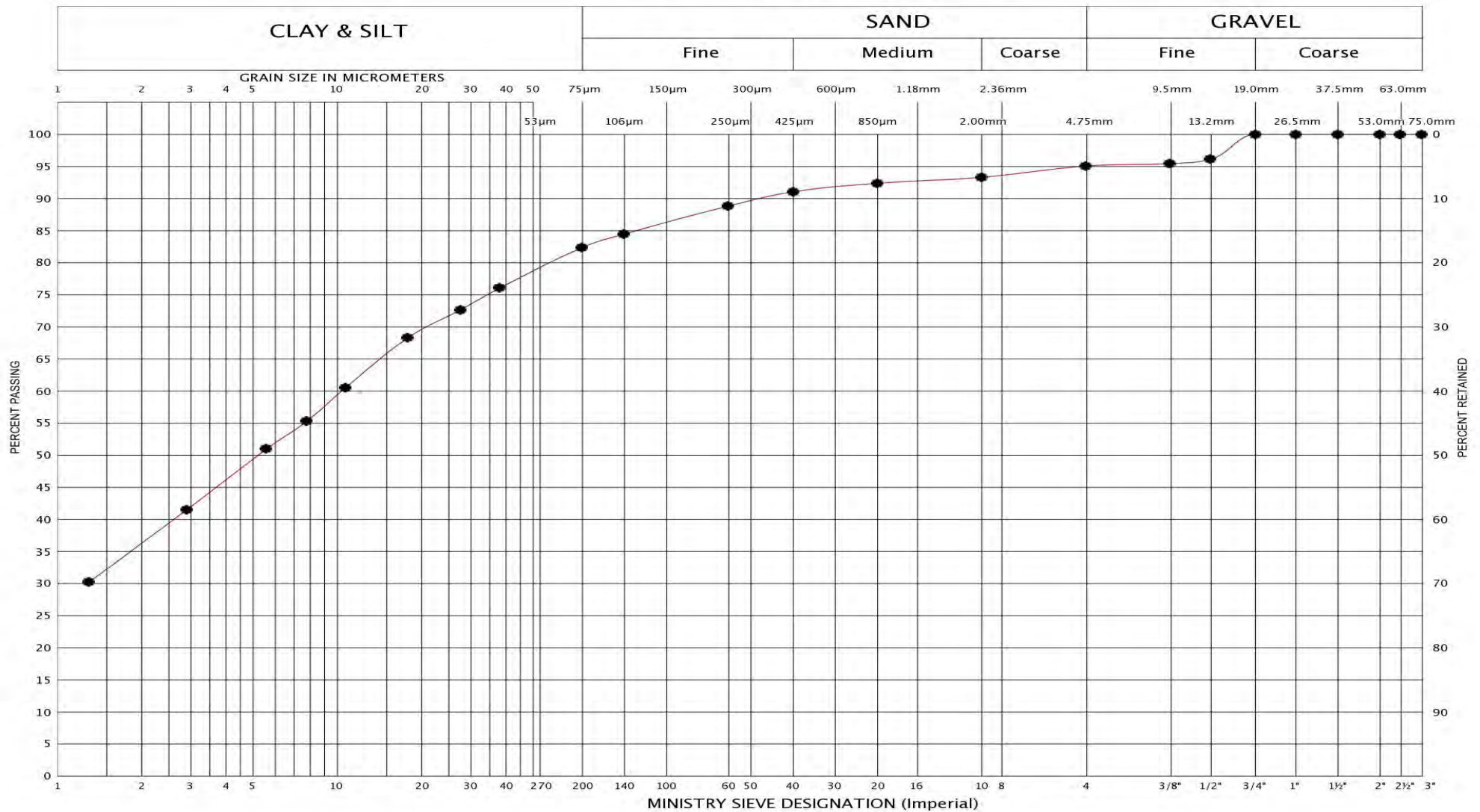


**GRAIN SIZE DISTRIBUTION**  
Sandy Clayey Silt, Trace/Some Gravel

FIG No.: GS-DR5-2  
HWY : 401  
GWP 3016-E-2009



# UNIFIED SOIL CLASSIFICATION SYSTEM

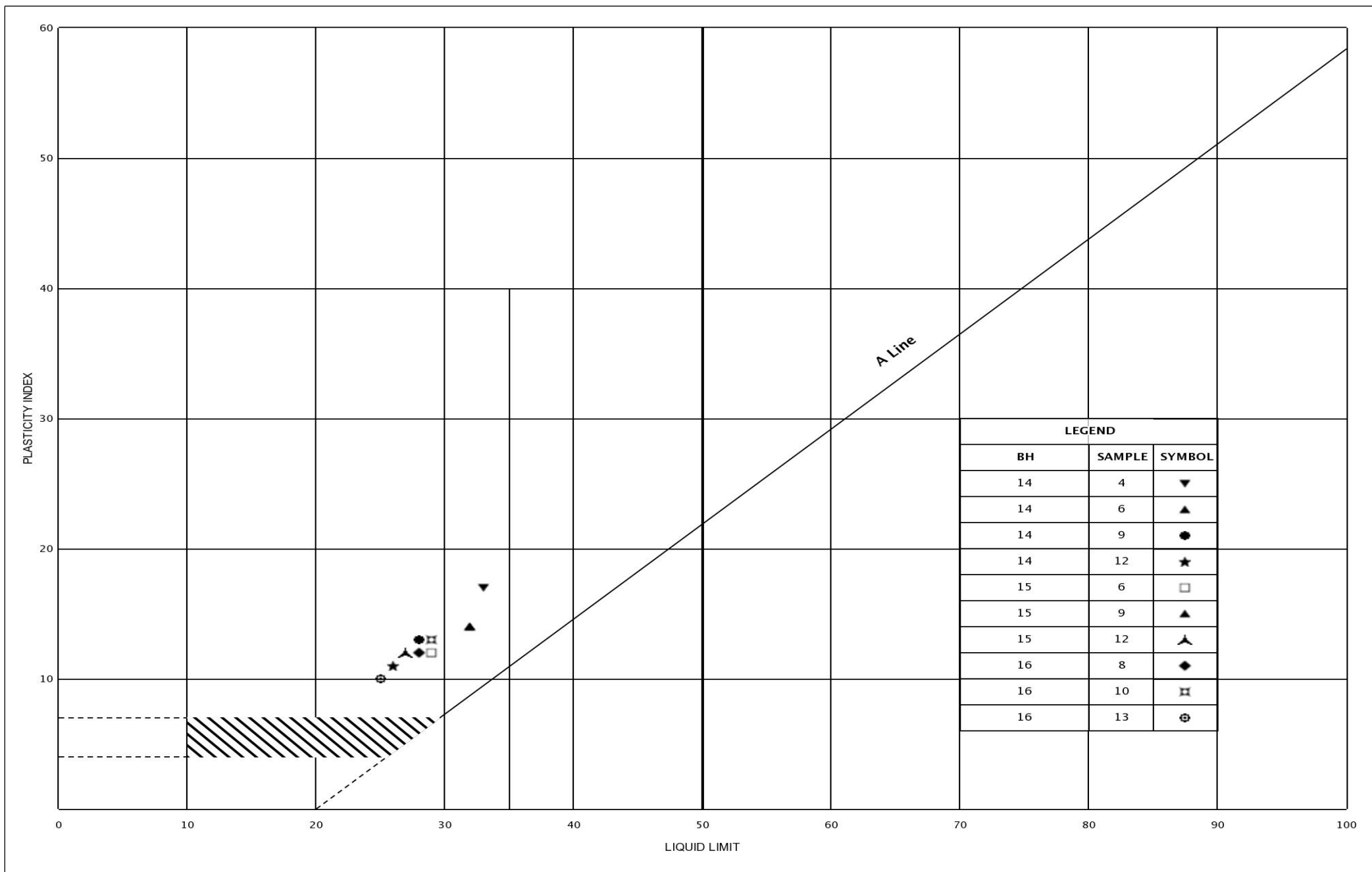


LEGEND	BH	15
	SAMPLE	3
	SYMBOL	●

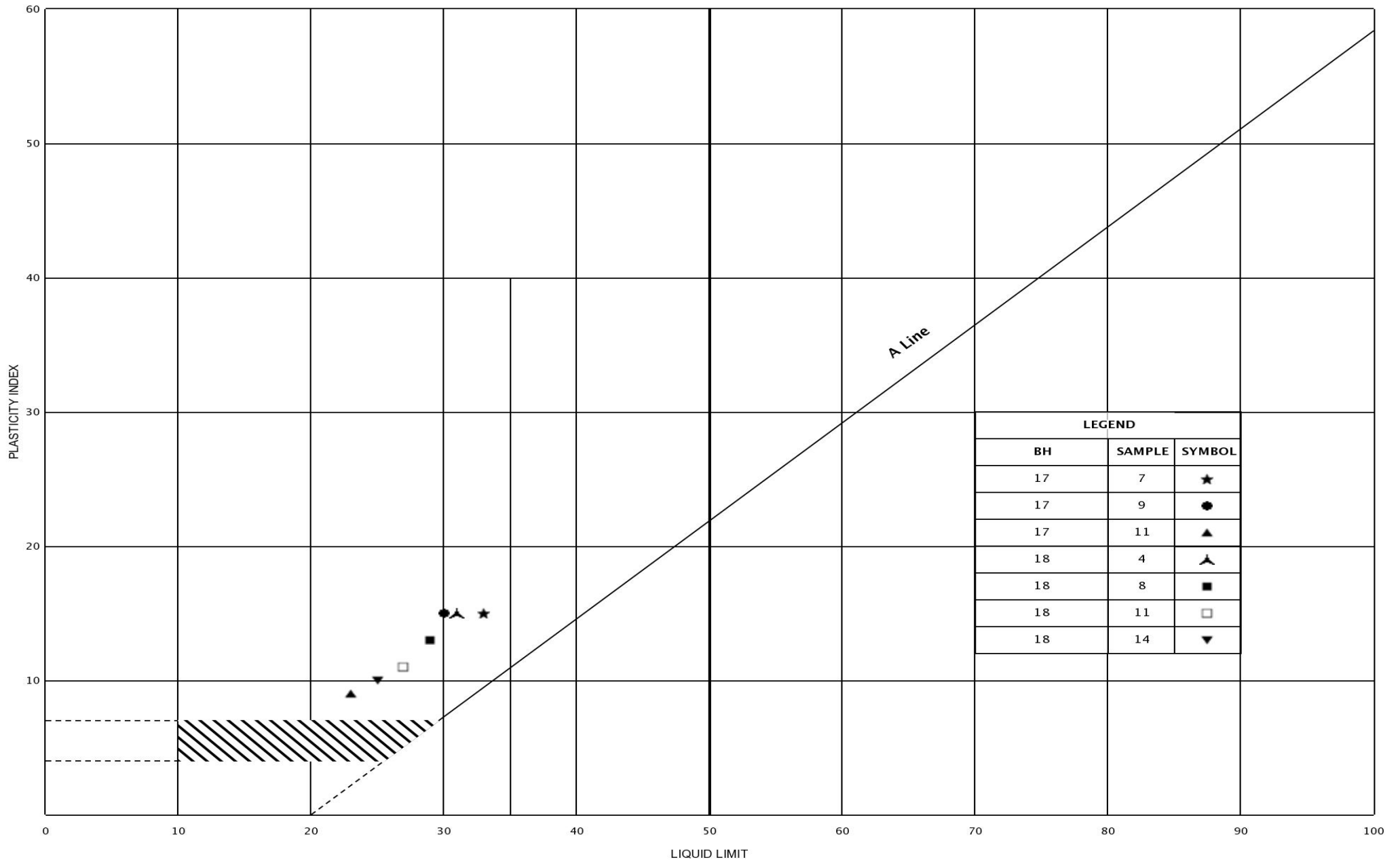


**GRAIN SIZE DISTRIBUTION**  
Silty Clay, Some Sand, Trace Gravel

FIG No.:	GS-DR5-3
HWY :	401
GWP	3016-E-2009







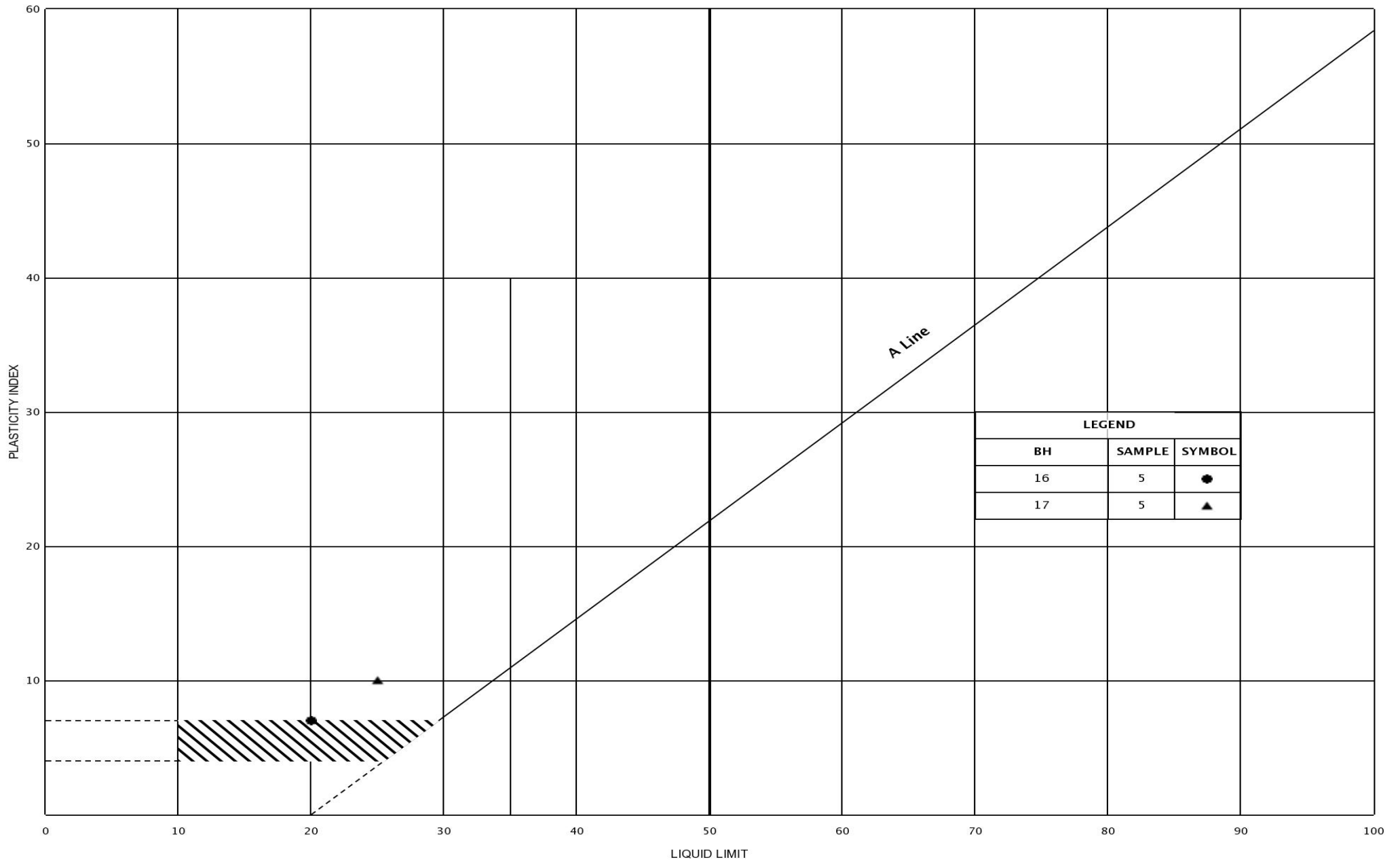
### PLASTICITY CHART

Clayey Silt, Trace/Some Sand, Trace Gravel

FIG No.: PC-DR5-1B

HWY.: 401

GWP 3016-E-2009



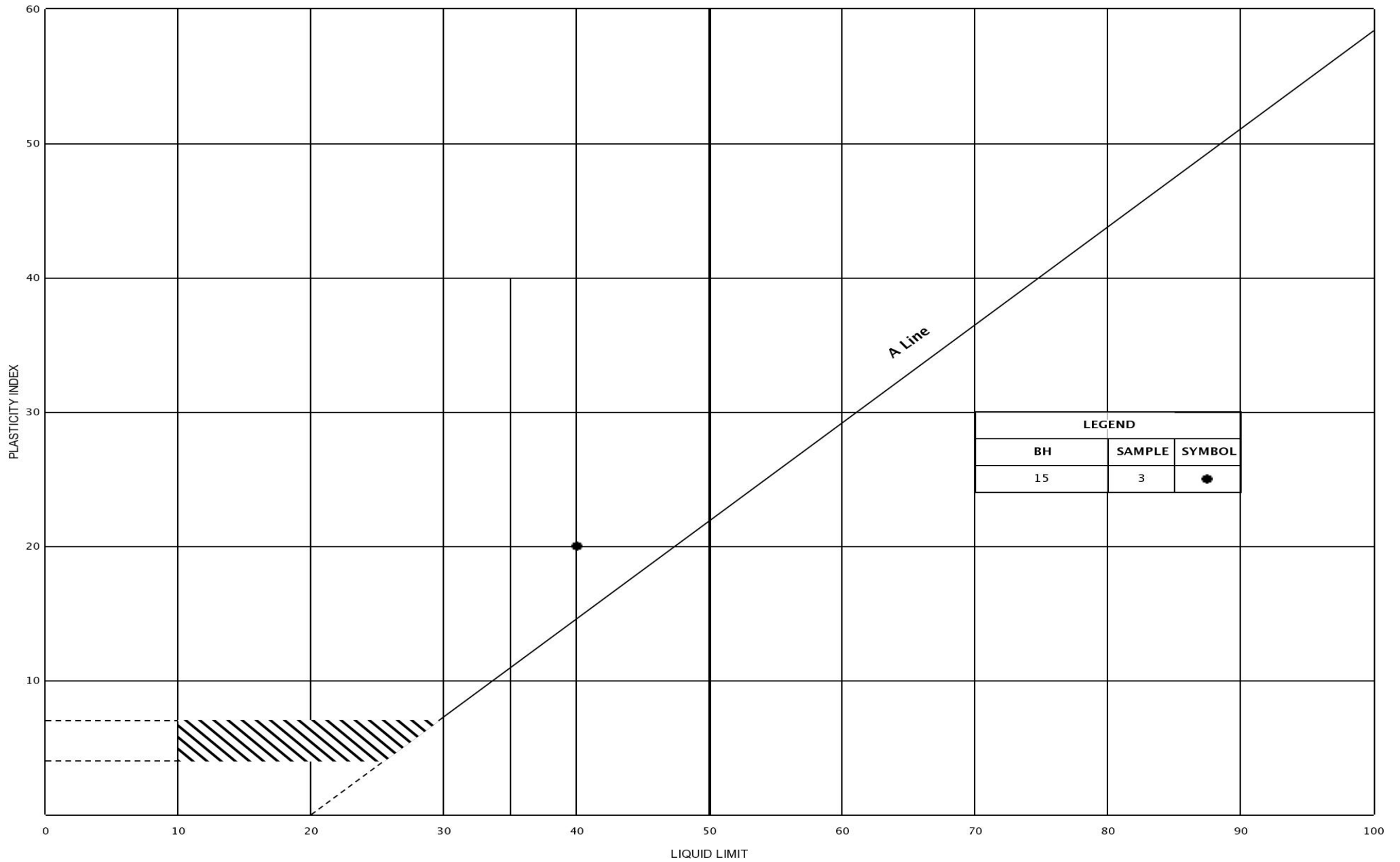
**PLASTICITY CHART**

Sandy Clayey Silt, Trace/Some Gravel

FIG No.: PC-DR5-2

HWY.: 401

GWP 3016-E-2009



### PLASTICITY CHART

Silty Clay, Some Sand, Trace Gravel

FIG No.:	PC-DR5-3
HWY.:	401
GWP	3016-E-2009

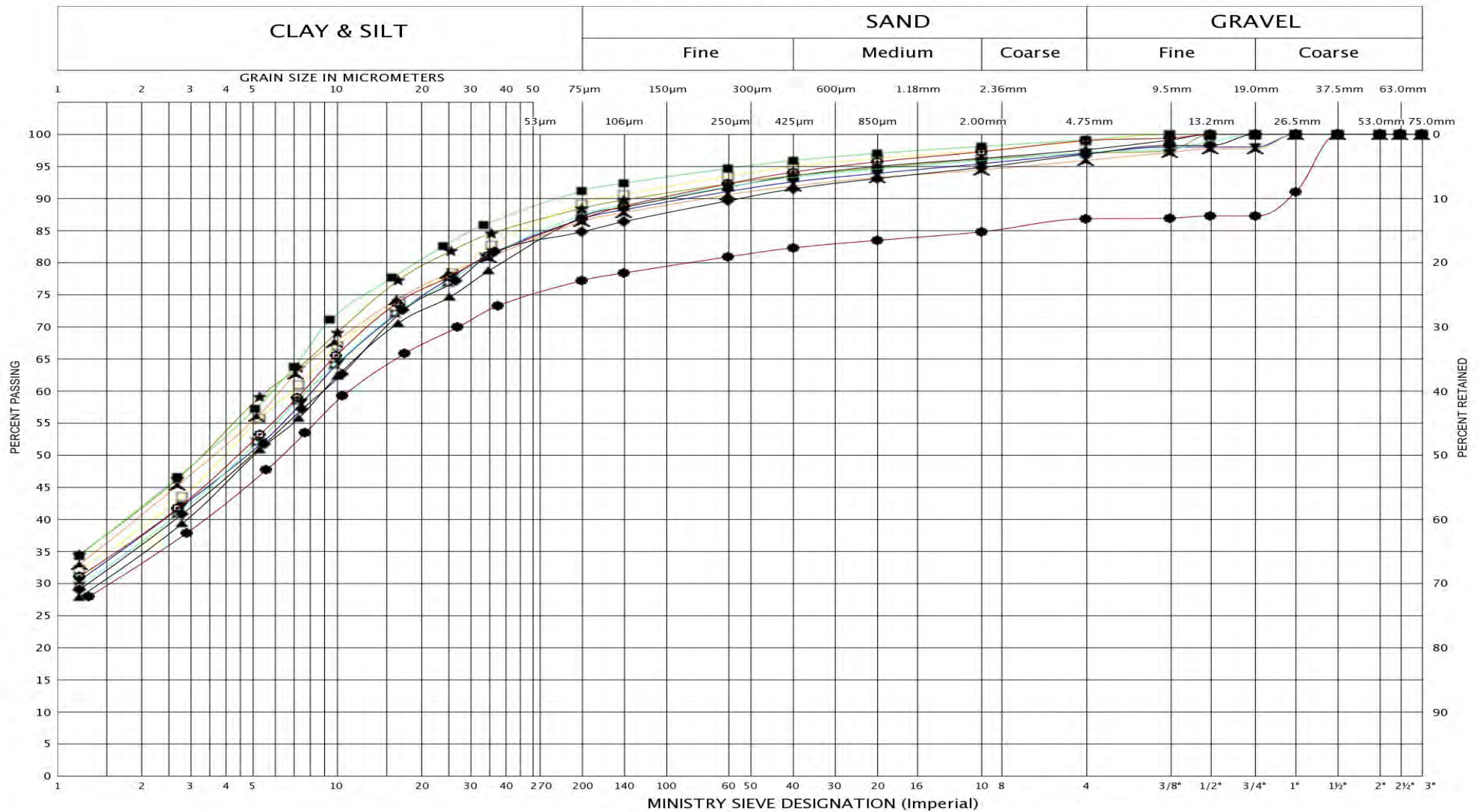


## **APPENDIX B-6**

Results of Grain Size Distribution Analyses:  
Figures GS-DR6-1A/B, GS-DR6-2, GS-DR6-3

Results of Atterberg Limit Tests:  
Figures PC-DR6-1A/B, PC-DR6-2

# UNIFIED SOIL CLASSIFICATION SYSTEM



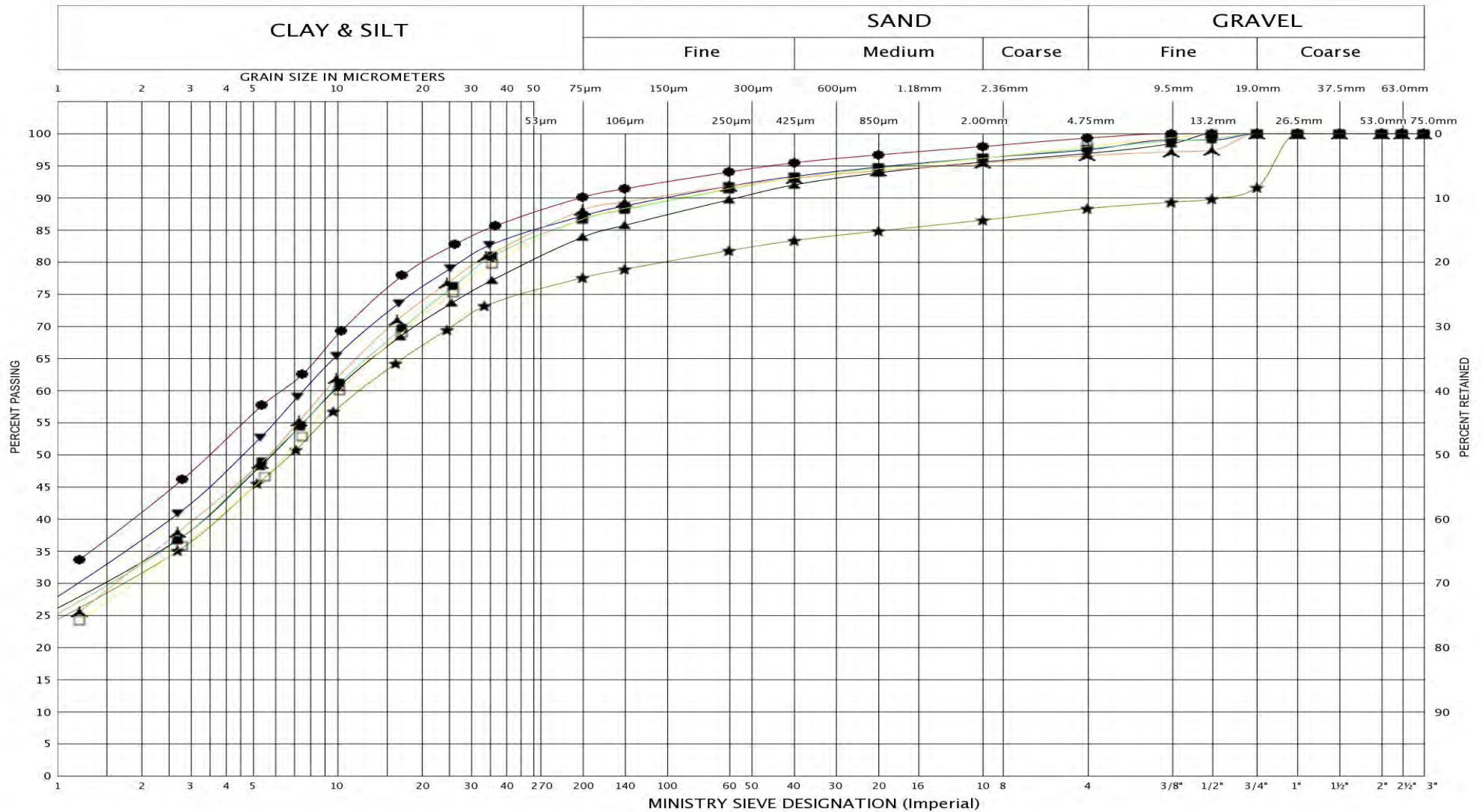
LEGEND	BH	19	19	19	19	20	20	20	20	21	21
	SAMPLE	4	6	9	12	5	8	10	12	6	11
	SYMBOL	●	▲	★	▼	■	▲	□	⊠	⊕	◆



**GRAIN SIZE DISTRIBUTION**  
Clayey Silt, Trace/Some Sand, Trace/Some Gravel

FIG No.: GS-DR6-1A  
HWY : 401  
GWP 3016-E-2009

# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21	22	22	22	22	23	23
	SAMPLE	13	5	7	10	12	4	6
	SYMBOL	●	▲	★	▼	■	▲	□



## GRAIN SIZE DISTRIBUTION

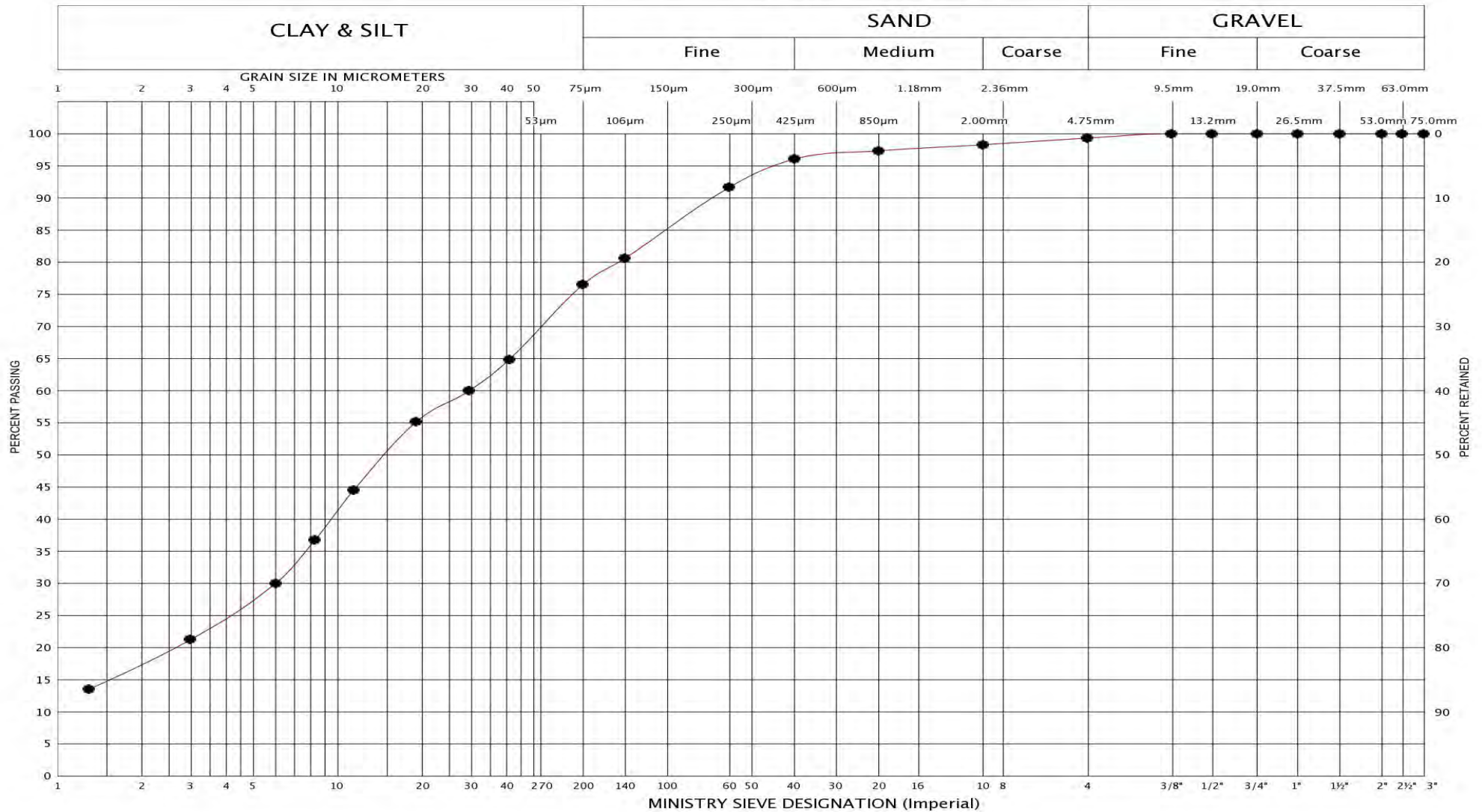
Clayey Silt, Trace/Some Sand, Trace/Some Gravel

FIG No.: GS-DR6-1B

HWY : 401

GWP 3016-E-2009

# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21
	SAMPLE	8
	SYMBOL	•



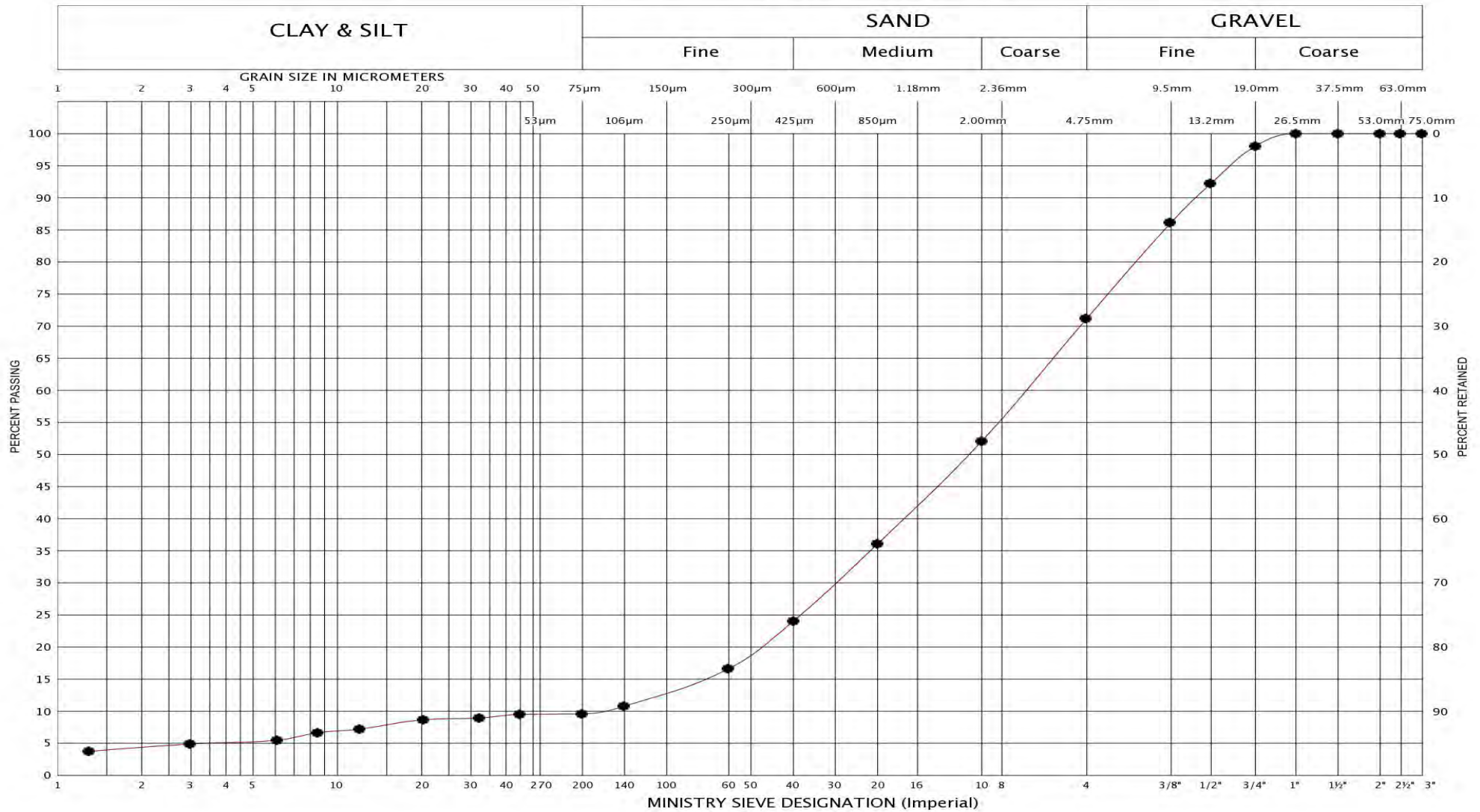
## GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt, Trace Gravel

FIG No.: GS-DR6-2  
 HWY : 401  
 GWP 3016-E-2009



# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	23
	SAMPLE	9
	SYMBOL	•



## GRAIN SIZE DISTRIBUTION

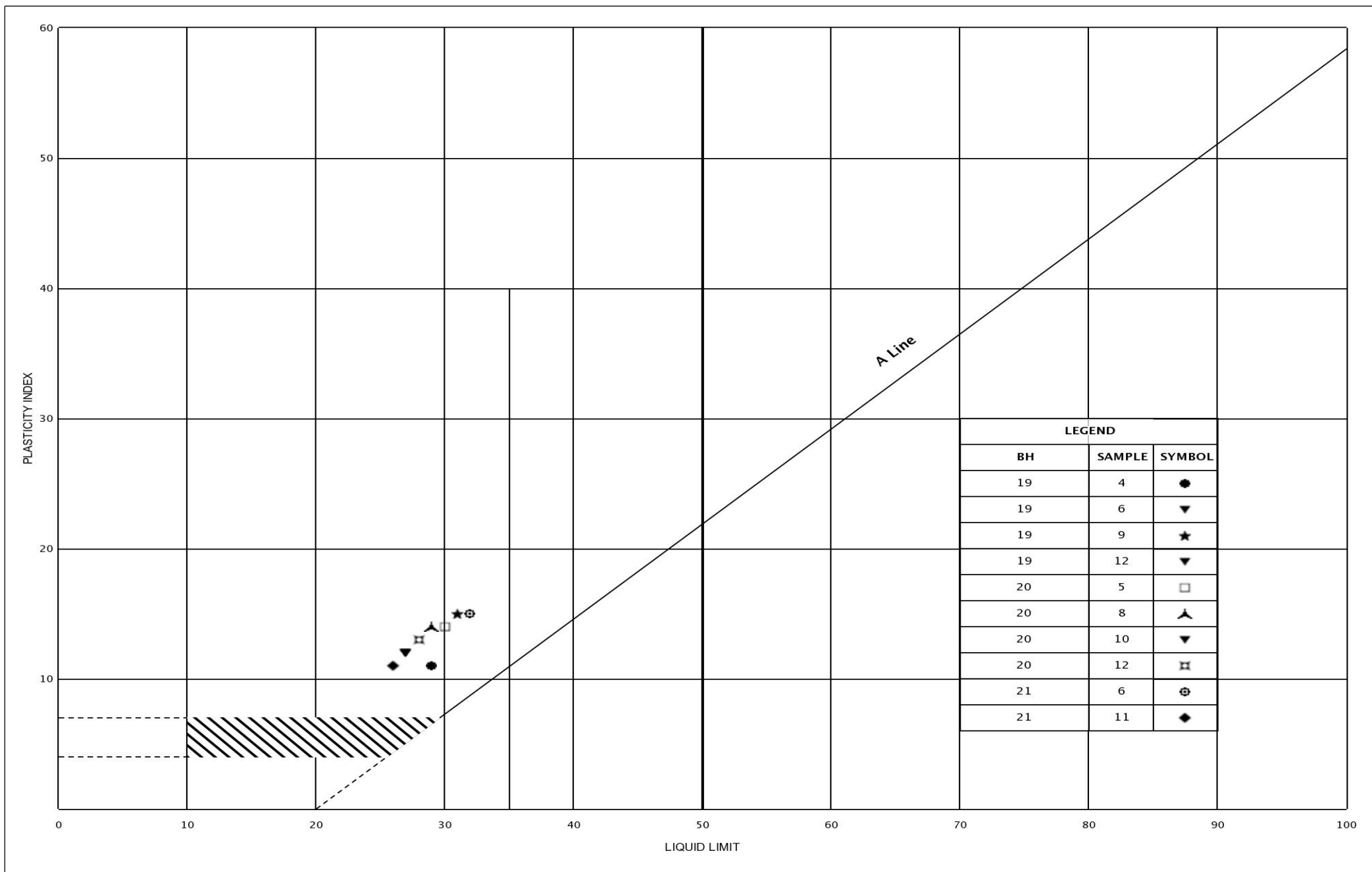
Sand, With Silt and Gravel

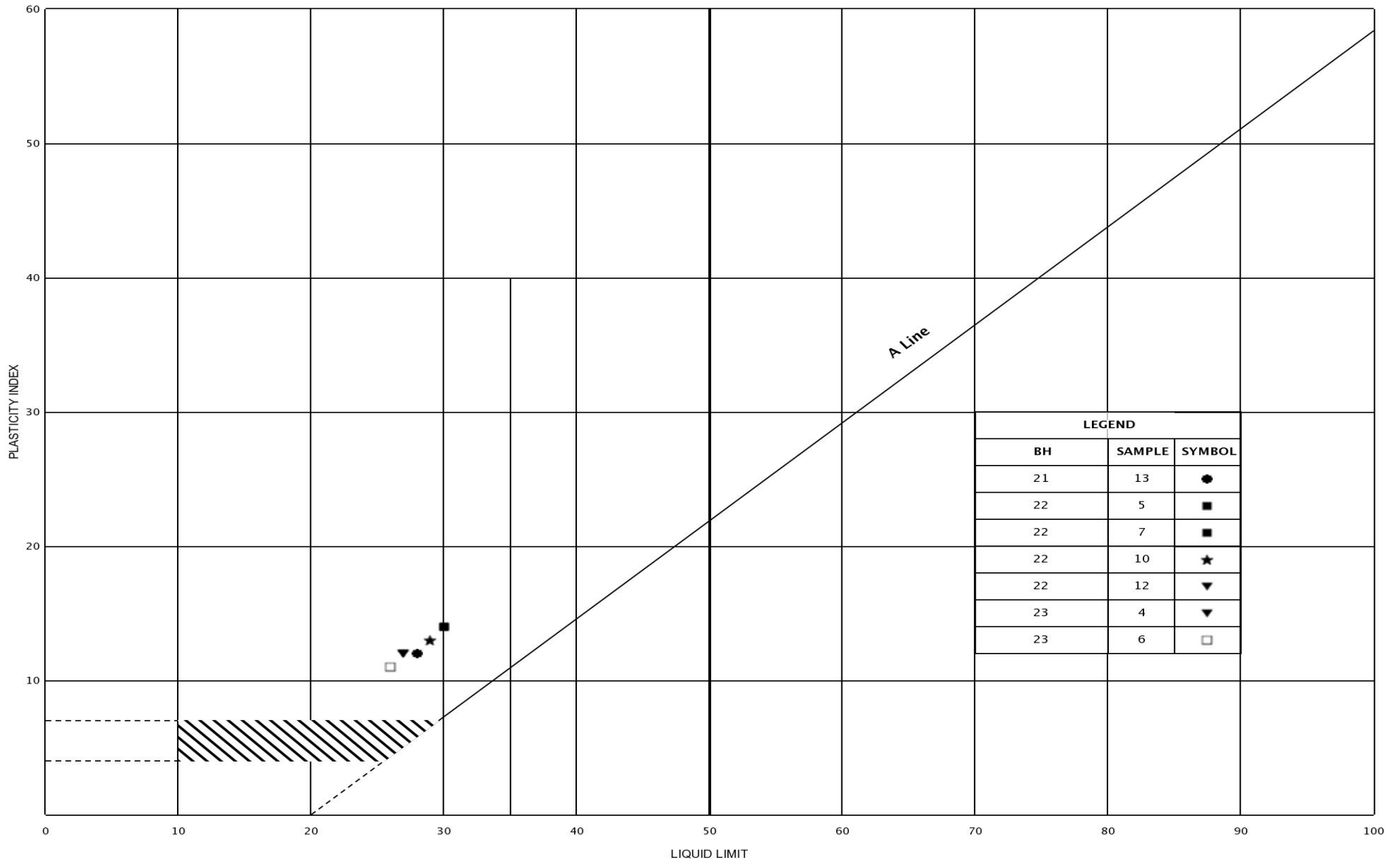
FIG No.: GS-DR6-3

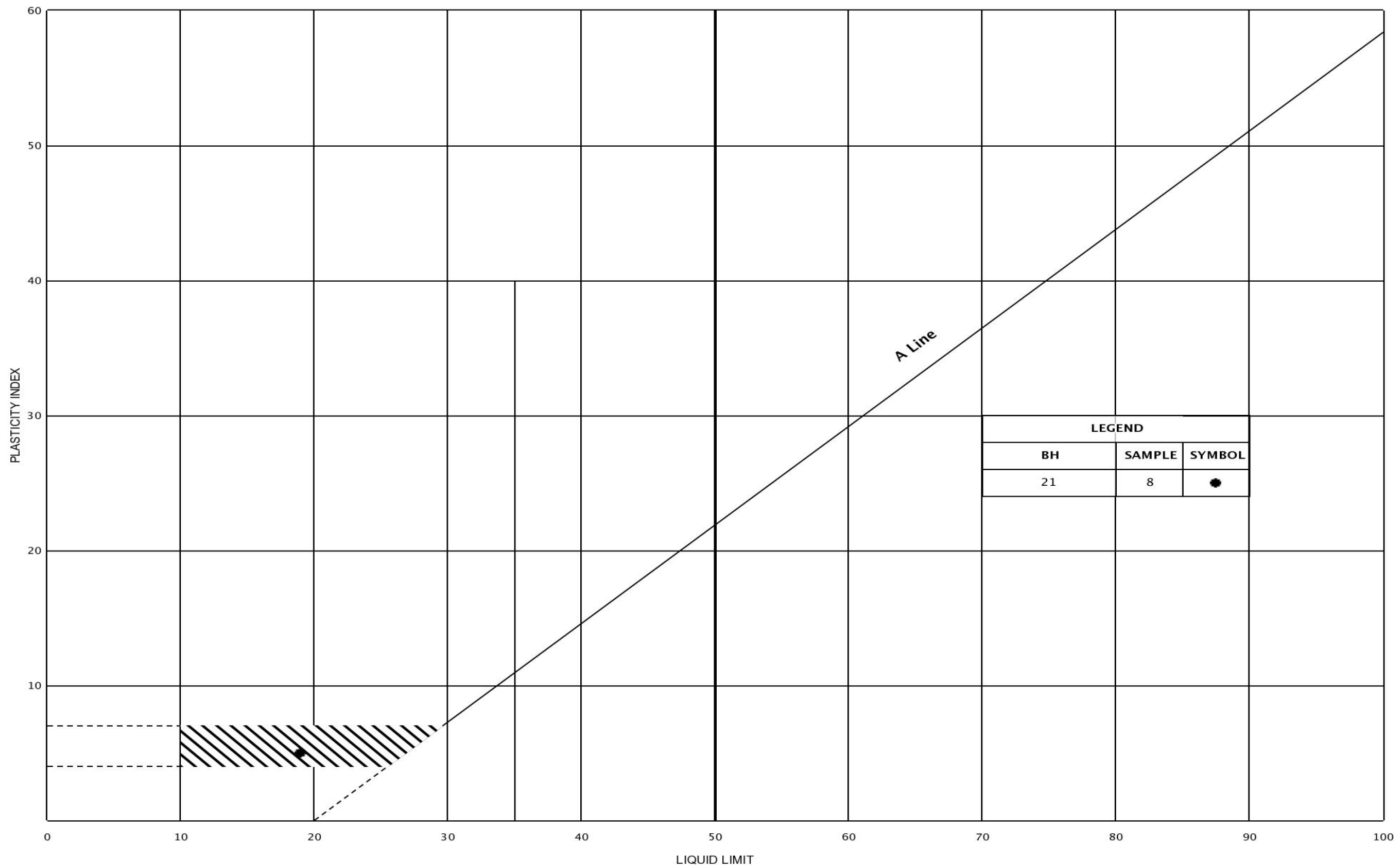
HWY : 401

GWP 3016-E-2009









**PLASTICITY CHART**  
Sandy Clayey Silt, Trace Gravel

FIG No.:	PC-DR6-2
HWY.:	401
GWP	3016-E-2009



## **APPENDIX B-7**

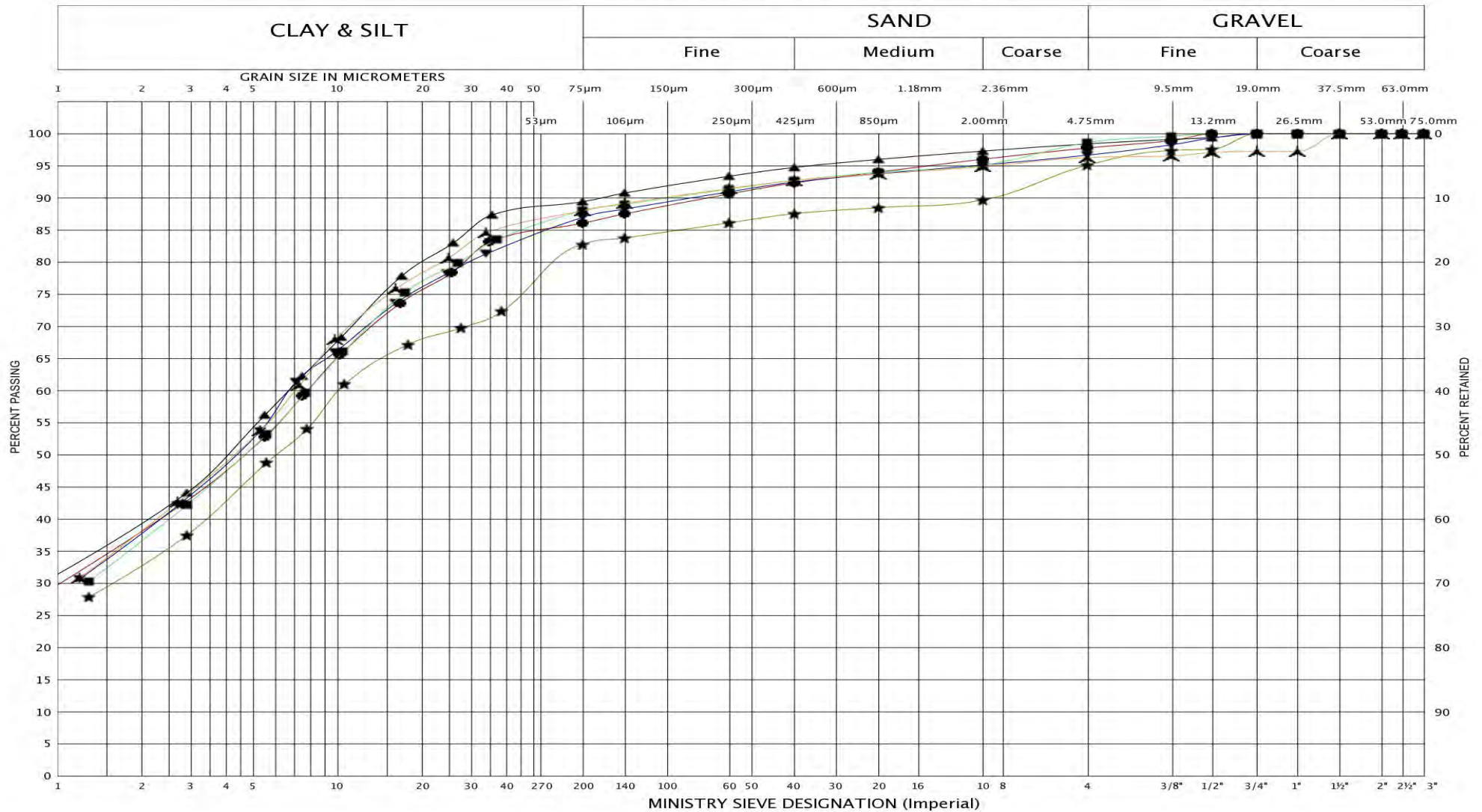
Results of Grain Size Distribution Analyses:

Figures GS-DR7-1, GS-DR7-2

Results of Atterberg Limit Tests:

Figures PC-DR7-1, PC-DR7-2

# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	24	24	25	25	26	26
	SAMPLE	8	11	6	10	4	7
	SYMBOL	●	▲	★	▼	■	▲

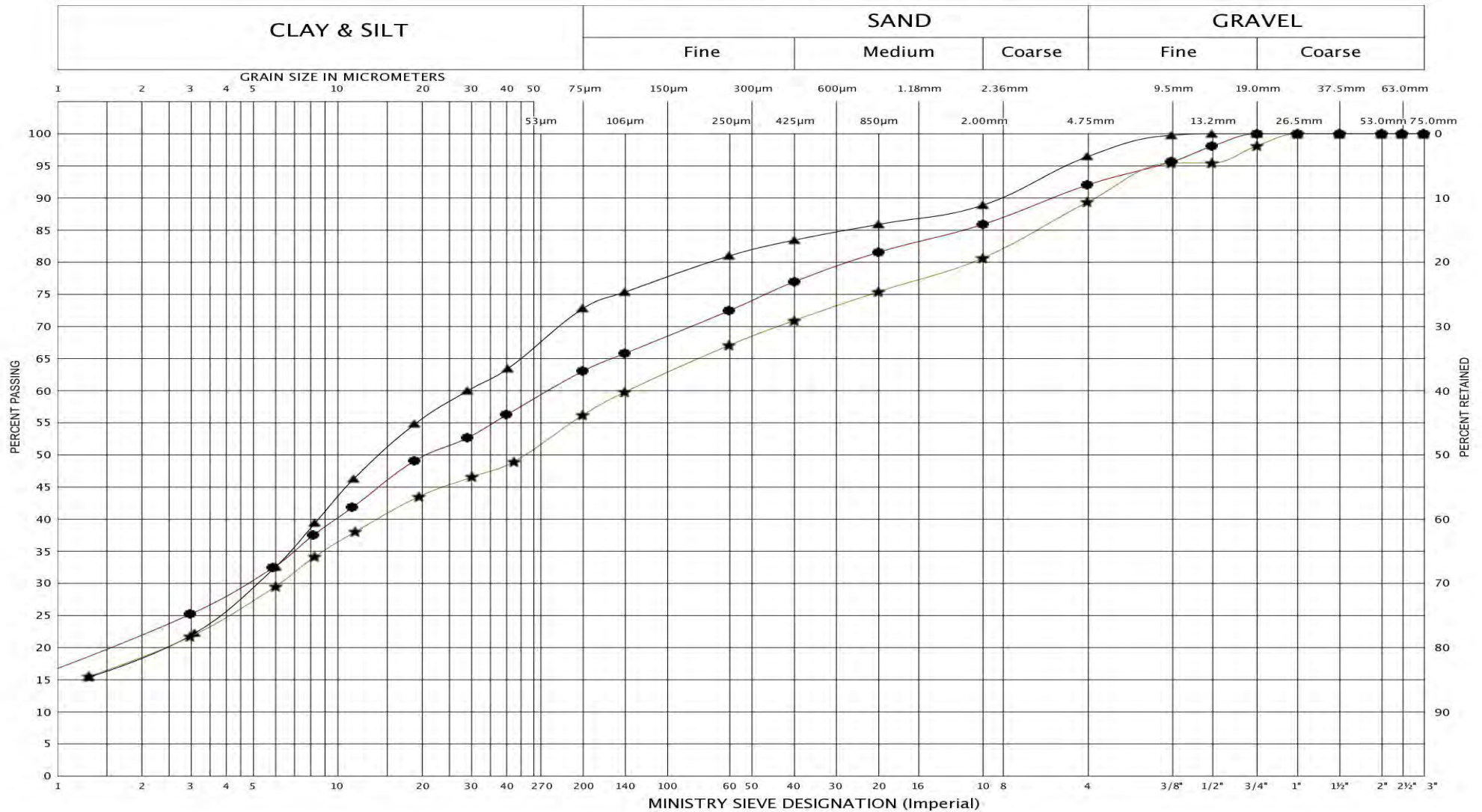


## GRAIN SIZE DISTRIBUTION

Clayey Silt, Trace/Some Sand, Trace Gravel

FIG No.: GS-DR7-1  
 HWY : 401  
 GWP 3016-E-2009

# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	24	25	26
	SAMPLE	5	3	11
	SYMBOL	●	▲	★



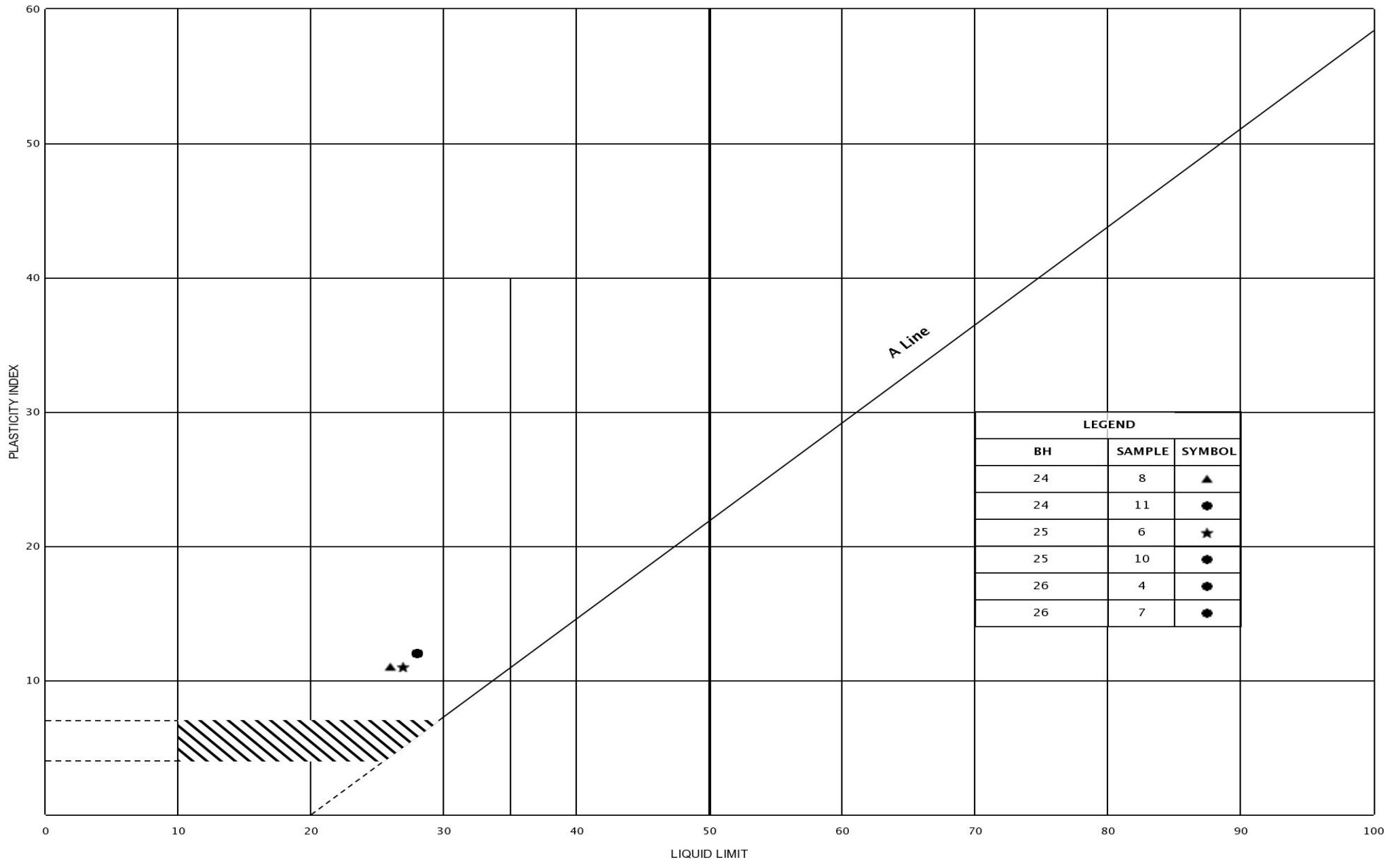
## GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt, Trace Gravel

FIG No.: GS-DR7-2

HWY : 401

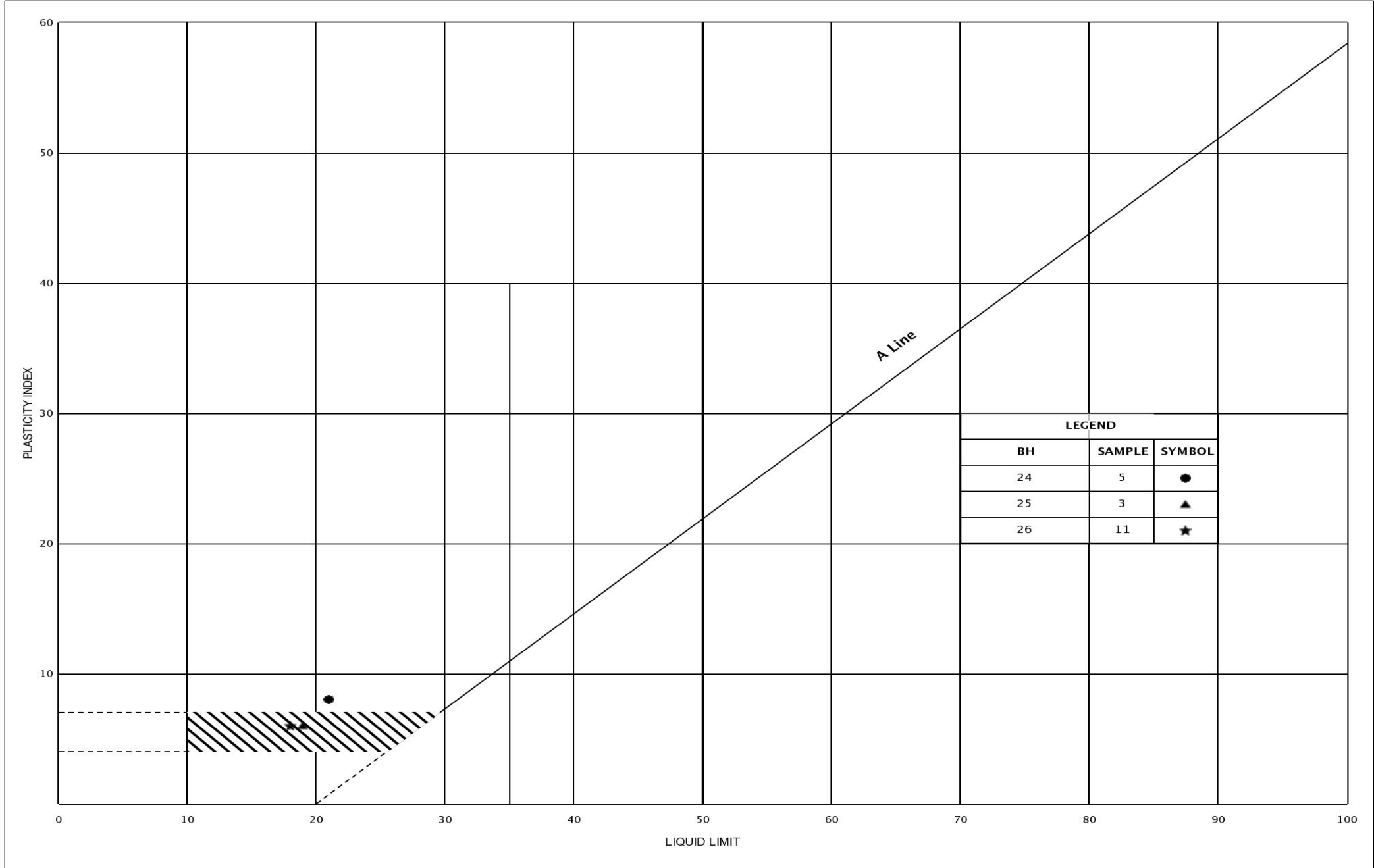
GWP 3016-E-2009



### PLASTICITY CHART

Clayey Silt, Trace/Some Sand, Trace Gravel

FIG No.:	PC-DR7-1
HWY.:	401
GWP	3016-E-2009



**PLASTICITY CHART**  
Sandy Clayey Silt, Trace Gravel

FIG No.:	PC-DR7-2
HWY.:	401
GWP	3016-E-2009





## **APPENDIX C**

Results of Chemical Tests Provided by SGS Canada Inc.



## FINAL REPORT

CA14603-OCT19 R1

19KF028A, Hwy 401, Dorchester

Prepared for

**Peto MacCallum Ltd**



# FINAL REPORT

CA14603-OCT19 R1

## First Page

### CLIENT DETAILS

Client Peto MacCallum Ltd

Address 165 Cartwright Ave  
Toronto, ON  
M6A 1V5, Canada

Contact Nazibur Rahman

Telephone 416-785-5110

Facsimile 416-785-5120

Email nrahman@petomacallum.com

Project 19KF028A, Hwy 401, Dorchester

Order Number

Samples Soil (6)

### LABORATORY DETAILS

Project Specialist Jill Campbell, B.Sc.,GISAS

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 2165

Facsimile 705-652-6365

Email jill.campbell@sgs.com

SGS Reference CA14603-OCT19

Received 10/18/2019

Approved 10/23/2019

Report Number CA14603-OCT19 R1

Date Reported 10/23/2019

### COMMENTS

Temperature of Sample upon Receipt: 9 degrees C

Cooling Agent Present:Yes

Custody Seal Present:Yes

Chain of Custody Number:002711

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

### SIGNATORIES

Jill Campbell, B.Sc.,GISAS





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# FINAL REPORT

CA14603-OCT19 R1

**Client:** Peto MacCallum Ltd

**Project:** 19KF028A, Hwy 401, Dorchester

**Project Manager:** Nazibur Rahman

**Samplers:** Jinsuko

## PACKAGE: - Corrosivity Index (SOIL)

Sample Number	5	6	7	8	9	10
Sample Name	N, SS4 (7.5-9.5')	N, SS7 (15-17')	C2, SS3 (5-7')	C1, SS4 (7.5-9.5')	S, SS3 (5-7')	S, SS6 (12.5-14.5')
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	15/10/2019	15/10/2019	15/10/2019	18/10/2019	18/10/2019	18/10/2019

Parameter	Units	RL		Result	Result	Result	Result	Result	Result
<b>Corrosivity Index</b>									
Corrosivity Index	none	1		11.5	14.5	14.5	14.5	1	4.5
Soil Redox Potential	mV	-		231	209	135	142	260	155
Sulphide	%	0.02		0.03	0.02	0.09	0.09	< 0.02	0.09
pH	pH Units	0.05		9.50	8.29	8.44	8.23	8.42	8.49
Resistivity (calculated)	ohms.cm	-9999		2050	884	1190	1480	12600	4410

## PACKAGE: - General Chemistry (SOIL)

Sample Number	5	6	7	8	9	10
Sample Name	N, SS4 (7.5-9.5')	N, SS7 (15-17')	C2, SS3 (5-7')	C1, SS4 (7.5-9.5')	S, SS3 (5-7')	S, SS6 (12.5-14.5')
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	15/10/2019	15/10/2019	15/10/2019	18/10/2019	18/10/2019	18/10/2019

Parameter	Units	RL		Result	Result	Result	Result	Result	Result
<b>General Chemistry</b>									
Conductivity	uS/cm	2		487	1130	839	676	79	227

## PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6	7	8	9	10
Sample Name	N, SS4 (7.5-9.5')	N, SS7 (15-17')	C2, SS3 (5-7')	C1, SS4 (7.5-9.5')	S, SS3 (5-7')	S, SS6 (12.5-14.5')
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	15/10/2019	15/10/2019	15/10/2019	18/10/2019	18/10/2019	18/10/2019

Parameter	Units	RL		Result	Result	Result	Result	Result	Result
<b>Metals and Inorganics</b>									
Moisture Content	%	0.1		4.4	12.7	15.1	15.4	14.7	14.1



# FINAL REPORT

CA14603-OCT19 R1

**Client:** Peto MacCallum Ltd

**Project:** 19KF028A, Hwy 401, Dorchester

**Project Manager:** Nazibur Rahman

**Samplers:** Jinsuko

## PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6	7	8	9	10
Sample Name	N, SS4 (7.5-9.5')	N, SS7 (15-17')	C2, SS3 (5-7')	C1, SS4 (7.5-9.5')	S, SS3 (5-7')	S, SS6 (12.5-14.5')
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	15/10/2019	15/10/2019	15/10/2019	18/10/2019	18/10/2019	18/10/2019

Parameter	Units	RL		Result	Result	Result	Result	Result	Result
Metals and Inorganics (continued)									
Sulphate	µg/g	0.4		19	54	110	71	4.0	37

## PACKAGE: - Other (ORP) (SOIL)

Sample Number	5	6	7	8	9	10
Sample Name	N, SS4 (7.5-9.5')	N, SS7 (15-17')	C2, SS3 (5-7')	C1, SS4 (7.5-9.5')	S, SS3 (5-7')	S, SS6 (12.5-14.5')
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	15/10/2019	15/10/2019	15/10/2019	18/10/2019	18/10/2019	18/10/2019

Parameter	Units	RL		Result	Result	Result	Result	Result	Result
Other (ORP)									
Chloride	µg/g	0.4		310	780	550	470	14	120



FINAL REPORT

CA14603-OCT19 R1

QC SUMMARY

Anions by IC  
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0403-OCT19	µg/g	0.4	<0.4	0	20	98	80	120	110	75	125
Sulphate	DIO0403-OCT19	µg/g	0.4	<0.4	6	20	95	80	120	89	75	125

Carbon/Sulphur  
Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	ECS0032-OCT19	%	0.02	<0.02	4	20	113	80	120			

Conductivity  
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0356-OCT19	uS/cm	2	< 0.002	0	10	99	90	110	NA		





FINAL REPORT

CA14603-OCT19 R1

QC SUMMARY

pH  
Method: SM 4500 | Internal ref.: ME-CA-|ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0356-OCT19	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

**Multielement Scan Qualifier:** as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

**Duplicate Qualifier:** for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

**Matrix Spike Qualifier:** for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.



## LEGEND

## FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

**NA** The sample was not analysed for this analyte

**ND** Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at [http://www.sgs.com/terms\\_and\\_conditions.htm](http://www.sgs.com/terms_and_conditions.htm). The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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