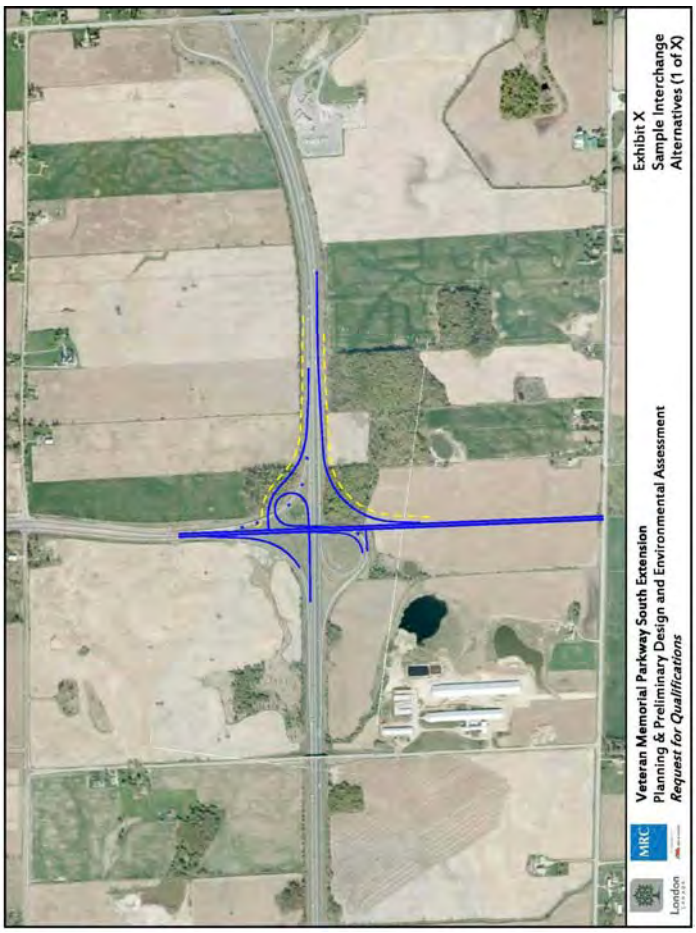
PRELIMINARY
FOUNDATION INVESTIGATION REPORT

PROPOSED HIGHWAY 401 UNDERPASS
& VETERANS MEMORIAL PARKWAY
INTERCHANGE RECONFIGURATION
CITY OF LONDON, COUNTY OF MIDDLESEX

G.W.P. - 3033-11-00
Agreement # 3011-E-0019




MTO GEOCRES No. 40I14-147

I.E.
Group

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# FOUNDATION INVESTIGATION REPORT

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## & VETERANS MEMORIAL PARKWAY
## INTERCHANGE RECONFIGURATION
## CITY OF LONDON, COUNTY OF MIDDLESEX

G.W.P. - 3033-11-00
Agreement # 3011-E-0019

**Prepared for:**

Ministry of Transportation Ontario
659 Exeter Road, First Floor Lobby
London, Ontario, N6E 1L3

Attention: Mr. Robert Mount, P.Eng.

**Prepared by:**

Infrastructure Engineering Group Inc.
39-69 Bessemer Road
London, Ontario
N6E 2V6

July 23, 2012
12-1-IEG1-VMP

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MTO GEOCRES No. 40I14-147

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**Drawings & Appendices**

# PART A – FOUNDATION INVESTIGATION

## 1.0 INTRODUCTION

Infrastructure Engineering Group Inc. (IE Group) has been retained by the Ministry of Transportation Ontario (MTO) to prepare a preliminary foundation investigation and design report for the proposed interchange improvements of the Highway 401 underpass structure at Veterans Memorial Parkway (VMP). It is understood that the new structure may be located offset to the east or west of the existing alignment to facilitate traffic staging.

Seven (7) boreholes were drilled between October 31 and November 6, 1974 by MTO for the existing structure and reported in the MTO GEOCRES Report 40I14-107.

The Client Supplied Materials consists of the following:

1) Seven (7) boreholes were drilled between October 31 and November 6, 1974 by MTO for the existing structure and reported in the MTO GEOCRES Report 40I14-107;

2) Cover Sheet of Book 1, Metric 94-401, MTO Engineering & Title Records, King's Highway 401, Geographic Township Westminster, County Middlesex, 10+000.000 to 33+023.841;

3) ETR Plate No. 94-401/68-0 to 73-0, WP PHOTO DTM, Surveyed in 2006;

4) ETR Plate No. 94-401/68-0 surveyed August 1981, revised June 1982;

5) An exhibit prepared by MRC for the Planning Preliminary Design and Environmental Assessment for VMP South Extension;

6) An undated digital file showing the existing profile of VMP

## 2.0 SITE DESCRIPTION

### 2.1 Site Location and Existing Structure

The location and details of the proposed VMP underpass structure has not been determined yet at the time of preparing this report. The existing VMP structure is identified as Site No. 19-515 located at approximately STA 31+175, approximately 1.6 km west of the Highway 74 interchange. Photographs of the subject site are presented in Appendix E.

Based on the existing VMP profile provided by MTO, the existing pavement of Highway 401 at this location is between Elevations 275 m and 276 m. The existing pavement of VMP ranges

from Elevation 281 m (south side) to 282 m (north side). It is assumed that the proposed realigned structure and Hwy 401 will be maintained after for the interchange reconfiguration.

The existing structure consists of 4 spans, with about 21.95 m (72.95 ft.) for the center spans and 10.36 meters (34 ft.) for the outer spans. The north and south abutments are founded on piled foundation (25 foot long, 12.75 inch diameter tube piles, designed for 25 tons/pile capacity) extending to approximate Elevations of 270.0 m. The three piers are supported on spread footing founded between Elevations 273.1 and 274.0 m, being progressively lower towards the north.

### 2.2 Physiography and Topography

The area of the site is located in the western limit of the physiographic region known as the Westminster Moraine. Geographic information indicates that the general soil conditions at the site consist of the Port Stanley silty clay and clayey silt till with localized lacustrine deposits. The bedrock in this area of the site consists of limestone, dolostone and shale belonging to the Dundee Formation of Middle Devonian Age. The bedrock surface is estimated to be about Elevation 205 m, some 70 m below ground surface.

The existing ground surface on the shoulders of Highway 401, at the location of the proposed structure, is between Elevation 275 m and 276 m. It is assumed that the finished grades of the proposed VMP underpass structure will remain similar to those of the existing pavement surface, with an estimated finished pavement of between Elevation 281 m and 282 m.

## 3.0 INVESTIGATION PROCEDURES

### 3.1 Field Investigation

Two (2) boreholes were drilled and sampled to obtain data for foundation design of the proposed interchange improvements work. The locations of the boreholes are shown on Drawing 1.

A Diedrich D-120 truck-mounted drill rig was used, supplied by ALTECH Drilling and Investigative Services between February 21 and 24, 2012, for drilling and Standard Penetration Testing (SPT, following the procedures of ASTM D 1586). The boreholes were drilled using continuous flight hollow stem augers. Soil samples were retrieved at selected intervals throughout the depths of the boreholes in conjunction with Standard Penetration Tests (SPT). Samples were generally taken at intervals of depth of 1.5 m to 15 m and opened up to 3.0 m to the maximum depth of exploration.

Field pocket penetrometer was used on the retrieved SPT samples, where applicable, to determine the undrained shear strength of the cohesive soil deposits. These undrained shear strengths are used to supplement the properties of the cohesive soils. It is noted that the

measured shear strength value would be slightly lower than the actual value due to sampling disturbance.

The soil samples obtained were placed in labeled containers and transported to IEG's London laboratory for further examination and laboratory testing.

The locations of the boreholes are shown on Drawing 1 and the depths of sampling were as follows:

| Borehole No. | Depth of Sampling (m) |
|---|---|
| 1 | 30.94 |
| 2 | 40.74 |

Borehole 1 was terminated at 30.94 m based on "N"-values of over 90 blows per 300 mm between depths of 15.2 m and 21.3 m, and considered close to practical refusal of over 6 m. Since practical refusal was not achieved after sampling at the 39.62 m interval, Borehole 2 was extended to 40.74 m using dynamic cone penetration as agreed with Mr. David Staseff of MTO.

A monitoring well was installed in each borehole for future monitoring of the groundwater levels. The monitoring wells were constructed as per the requirements of O. Reg. 903 requirements, with a 1.5 m sand packed screen and grouted to the ground surface with a combination of Quickgrout and Holeplug. A flush mount protective casing set in concrete was also provided at the ground surface for protection.

Our field engineer, Mr. Ralph Billings, P. Eng., supervised the fieldwork and worked under the direction of the project engineer, Mr. Eric Chung, P. Eng. Our field staff cleared the location of buried utilities and logged the boreholes.

The MTM coordinates and ground surface elevations at the as drilled borehole locations were surveyed by AGM, OLS, our surveying sub-consultant.

The results of the drilling, sampling, in-situ testing and groundwater observations are summarized on the Record of Borehole sheets and enclosed in Appendix "B".

### 3.2 Laboratory Analysis

Geotechnical laboratory testing consisted of natural moisture content determinations and visual classifications of all retrieved soil samples. In addition, grain size analyses and Atterberg Limit tests were performed on selected soil samples.

The results of the laboratory testing are presented on the Record of Borehole sheets (Appendix "B"), and Laboratory Test Results (Figures 1 to 7, Appendix "C").

## 4.0 SUBSURFACE CONDITIONS

### 4.1 General Subsurface Conditions

Reference is made to the Record of Borehole sheets (Appendix "B") and Laboratory Test Results (Appendix "C") for detailed subsurface soil and groundwater conditions encountered in the boreholes. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling and, consequently, represent transitions between soil types rather than exact planes of geological change. The soil profiles depicting the subsurface conditions on Drawing 1 will vary between and beyond the borehole locations.

Based on the existing VMP profile provided by MTO, the existing pavement of Highway 401 at this location is between Elevation 275 m and 276 m. The existing pavement of VMP ranges from Elevation 281 m (south side) to 282 m (north side). It is assumed that the proposed realigned structure and Hwy 401 will be maintained after for the interchange reconfiguration.

The subsurface deposits at the site consist of 1.52 to 2.13 m loose to compact fill (bottom Elevations between 272.74 m and 273.92 m) placed on an upper deposit of stiff to hard, clayey silt to silty clay till with random, compact silt layers, extending to between Elevations 262.37 m and 264.01 m.

The upper silty/clay till deposit is underlain by a 4.26 to 5.49 m thick deposit of saturated, compact to very dense sand to silty sand extending to between Elevations 258.11 m and 258.52 m.

The sand to silty sand deposit is underlain by an intermediate layer of hard clayey silt to silty clay till which extends to depths of between 26.21 m and 28.96 m below the present ground surface (between Elevations 246.48 m and 248.66 m).

The intermediate silt/clay till is further underlain by a dense to very dense sand and silt to sandy silt to silt deposit which extends beyond the vertical limit of Borehole 1 at the maximum depth of 30.94 m below the present ground surface at (Elevation 244.50 m), and extends to 35.05 m below the present ground surface of Borehole 2 (at Elevation 239.82 m). The sand/silt deposit in Borehole 2 is in turn underlain by a lower clayey silt to silty clay till which extends beyond the vertical limit of Borehole 2 at a maximum depth of 41.05 m below the present ground surface (at Elevation 233.82 m).

Groundwater was measured in the installed monitoring wells on May 31, 2012 at depths of 12.8 m and 8.9 m below the present ground surface of Boreholes 1 and 2, respectively. The monitoring wells were developed by bailing after the water level measurements on May 31, 2012. Groundwater was measured in the monitoring wells on June 2, 2012 at depths of 16.1 m and 11.5 m below the present ground surface of Boreholes 1 and 2, respectively.

The groundwater table may not have stabilized yet for the water level measurements on June 2, 2012.

The following is a detailed description of the subsurface conditions encountered.

### 4.1.1 Topsoil & Fill

The ground surface of the boreholes is covered with a 150 mm and 300 mm thick layer of organic topsoil. The topsoil is underlain by a 1.52 m to 2.13 m thick layer of mixed fill (bottom Elevations between 272.74 m and 273.92 m). The mixed fill is considered variable and consist of sand, silt, silty clay, topsoil and organics.

Two (2) grain size distribution analyses were carried out on the mixed fill and the results are shown on Figure 1 of Appendix “C”.

Standard penetration tests taken on the fill layers yielded two “N”-values of 9 and 21 blows per 0.3 m indicating a loose to compact condition. Moisture content of two samples of the fill material yielded results of 5% and 12% indicating a moist to wet condition at the time of the investigation.

### 4.1.2 Upper Clayey silt to Silty Clay Till

The fill layer is underlain by an upper layer of clayey silt to silty clay with embedded sand and gravel (till). The upper silt/clay till in Borehole 1 has a brown colour which changes to grey at a depth of 4.9 m below the present ground surface; and has a grey colour in Borehole 2. Random silt layers are present within the upper silt/clay till in both boreholes. The upper clayey silt to silty clay till extends to depths of 11.43 m and 12.5 m (Elevations 264.01 m and 262.37 m) in Boreholes 1 and 2, respectively.

Six (6) grain size distribution analyses and six (6) Atterberg determinations were carried out on the upper silt/clay till deposit and the results are shown on Figures 4, 5, 6 and 7 of Appendix "C". Two (2) grain size distribution analyses were carried out on the silt layer within the upper silt/clay till and the results are presented in Figure 3 of Appendix "C".

Atterberg limits determinations carried out on the upper silt/clay till yielded the following results:

| Atterberg Limits | Minimum | Maximum | Average |
|---|---|---|---|
| **Liquid Limit ($W_L$), %** | 18 | 35 | 26.2 |
| **Plastic Limit ($W_P$), %** | 12 | 23 | 15.3 |
| **Plasticity Index ($I_p$), %** | 6 | 18 | 10.5 |

Standard penetration tests taken on the upper silt/clay till measured "N"-values of between 14 and 33 blows per 0.3 m. Pocket penetrometer reading yielded unconfined shear strengths of 75 to over 225 kPa. Based on these test results and tactile examination, the upper silt/clay till has a stiff to hard consistency.

Standard penetration tests taken on the random silt layers within the upper silt/clay till yielded "N"-values of between 12 and 28 blows per 0.3 m indicating a compact condition.

Moisture content determinations carried out on the upper silt/clay till deposit yielded results of between 12% and 25%, indicating a generally moist condition. Moisture content determinations of the silt layers within the upper silt/clay till deposit yielded values between 19% and 23%, indicating a saturated condition.

### 4.1.3 Sand to Silty Sand

The upper silt/clay till is underlain by a 4.26 to 5.49 m thick deposit of sand to silty sand layer extending to between Elevations 258.11 m and 258.52 m. Three (3) grain size distribution analyses were carried out and the results are presented on Figure 2.

Standard penetration tests taken on the sand to silty sand layer yielded "N"-values of between 22 and 98, indicating a compact to very dense condition. Moisture content ranges from 3% to 25 % indicating a moist to saturated condition.

### 4.1.4 Intermediate Clayey Silt to Silty Clay Till

The silt to silty sand layer is underlain by an intermediate layer of clayey silt to silty clay with frequent wet silty sand seams and embedded sand and gravel (till) which extends to depths of between 26.21 m and 28.96 m below the present ground surface (between Elevations 246.48 m and 248.66 m).

Four (4) grain size distribution analyses and four (4) Atterberg determinations were carried out on the intermediate silt/clay till deposit and the results are presented on

Figures 4, 5, 6 and 7 of Appendix "C". Atterberg limits determinations carried out on the intermediate silt/clay till yielded the following results:

| Atterberg Limits | Minimum | Maximum | Average |
|---|---|---|---|
| **Liquid Limit ($W_L$), %** | 16 | 19 | 18.0 |
| **Plastic Limit ($W_P$), %** | 10 | 13 | 11.5 |
| **Plasticity Index ($I_p$), %** | 4 | 8 | 6.5 |

Standard penetration tests taken on the intermediate silt/clay till measured "N"-values from 43 to 95 blows per 0.3 m. Pocket penetrometer reading yielded unconfined shear strengths of over 225 kPa. Based on these test results and tactile examination, the intermediate silt/clay till has a hard consistency.

Moisture content determinations carried out on the intermediate silt/clay till yielded results of between 10% and 18%, indicating a moist to wet condition.

### 4.1.5 Sand and Silt to Silt

The intermediate silt/clay till is further underlain by a sand and silt to sandy silt to silt deposit which extends beyond the vertical limit of Borehole 1 at the maximum depth of 30.94 m below the present ground surface at (Elevation 244.50 m), and extends to 35.05 m below the present ground surface of Borehole 2 (at Elevation 239.82 m). Three (3) grain size distribution analyses were carried out on the sand/silt deposit and the results are present on Figure 3 of Appendix "C".

Standard penetration tests taken on the sand/silt deposit measured "N"-values from 31 to 94 blows per 0.3 m, indicating compact to very dense condition. Moisture content of the sand/silt deposit was between 14% and 20%, indicating wet to saturated condition.

### 4.1.6 Lower Clayey Silt to Silty Clay Till

The sand and silt to silt layer in Borehole 2 is in turn underlain by a lower deposit of clayey silt to silty clay with embedded sand and gravel (till) which extends beyond the vertical limit of Borehole 2 at a maximum depth of 41.05 m below the present ground surface (at Elevation 233.82 m).

A single grain size distribution analysis and a single Atterberg Limits determination were carried out on the lower silt/clay till deposit and the results are presented on Figures 6 and 7 of Appendix "C". The results indicate a Liquid Limit of 21%, Plastic Limit of 12% with a Liquidity Index of 9%.

Standard penetration tests taken on the lower silt/clay till measured "N"-values of 52 and 84 blows per 0.3 m. Pocket penetrometer reading yielded unconfined shear strengths of over 225 kPa. Dynamic cone penetration tests between 40.08 m and 41.05 depths yielded results of between 99 and 150 blows per 0.3 m. Based on these test results and tactile examination, the lower silt/clay till has a hard consistency.

Moisture content determinations carried out on the intermediate silt/clay till yielded results of between 17% and 23%, indicating moist to wet condition.

### 4.2 Groundwater Conditions

Groundwater was measured in the installed monitoring wells on May 3 31, 2012 prior to purging. The monitoring wells were developed by bailing after initial measurements. Groundwater was measured on June 2, 2012 at depths of 16.10 m and 11.50 m below the present ground surface of Boreholes 1 and 2, respectively. The groundwater table may not have stabilized yet.

The following table summarizes the water levels recorded during the monitoring events:

| Borehole | Date of Monitoring | Water Level in Borehole, m (Elevation/Depth) | Remarks |
|---|---|---|---|
| 1 | May 31, 2012<br>June 2, 2012 | 262.64 / 12.8<br>259.34 / 16.1 | Monitoring well installed with screen between 15.24 m and 16.76 m below ground surface (Elevation 260.20 m and 258.68 m). Top of casing at Elevation 275.40 m. |
| 2 | May 31, 2012<br>June 2, 2012 | 265.97 / 8.9<br>263.37 / 11.5 | Monitoring well installed with screen between 14.63 m and 16.15 m below ground surface (Elevation 260.24 m and 258.72 m). Top of casing at Elevation 274.94 m. |

The subsoil changes from brown to grey at depths of between 3.05 m and 4.7 m below the present ground surface (Elevations 272.39 m and 270.17 m). The brown to grey interface likely reflects a level of permanent saturation. It should be noted that the groundwater level will fluctuate seasonally and in response to weather events.

## 5.0 STATEMENT OF LIMITATION

A foundation investigation should be carried out during the detail design stage as per MTO standards and to confirm the preliminary recommendations provided in this report.

The Limitations of Report, as Quoted in Appendix D, is an integral part of this report.

We trust that we have completed the assignment within the Terms of Reference for this project. If there are any questions concerning this report, please do not hesitate to contact our office.

Yours truly,
**Infrastructure Engineering Group Inc.**

Eric Y. Chung, M.Eng., P.Eng.
Designated MTO Contact

Joseph Law, P.Eng.
Project Manager

Tom O'Dwyer, P. Eng.
Quality Review Engineer

# Drawing 1

## Borehole Locations and Soil Strata

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

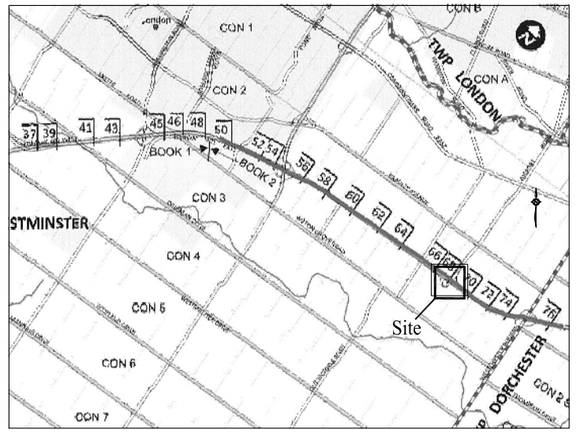
CONT No xxxx–xxxx
WP No GWP 3033–11–00

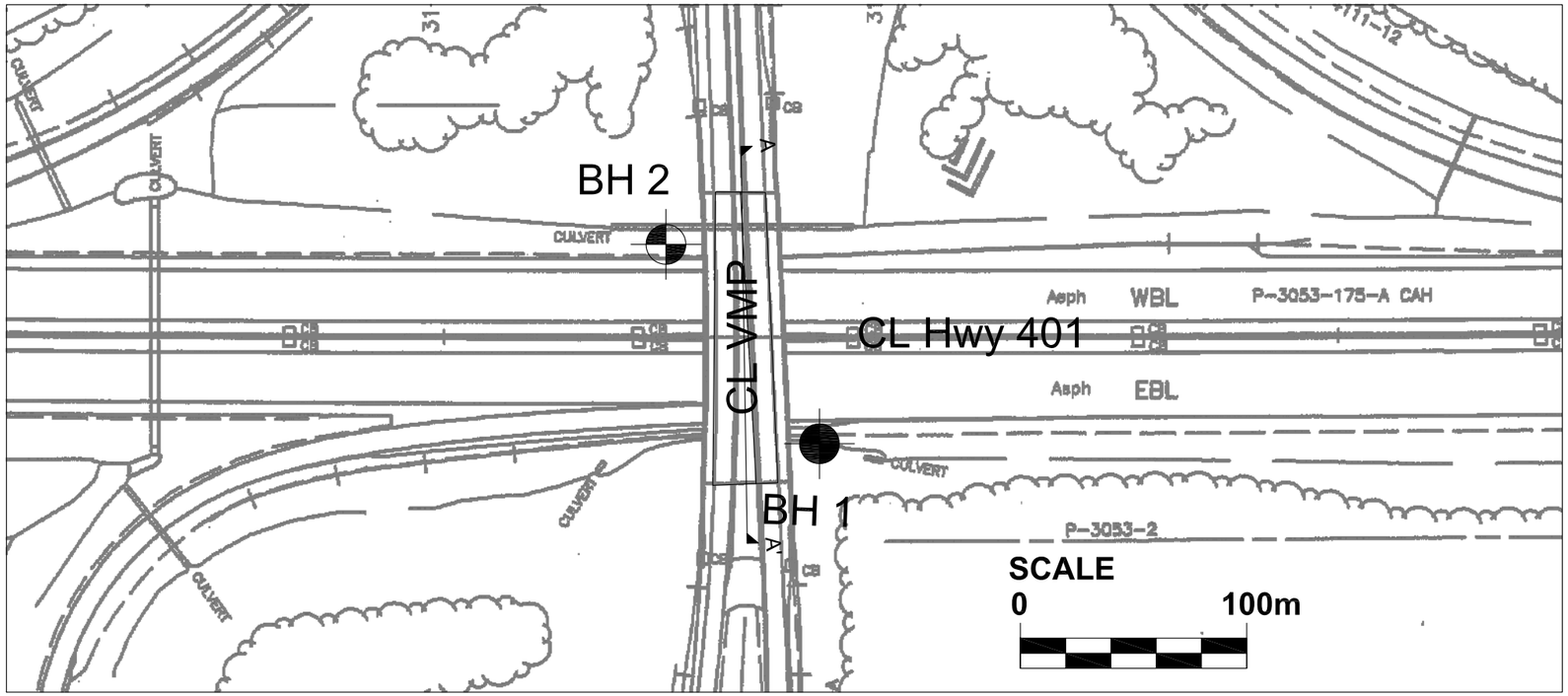
Veterans Memorial Parkway
Highway 401 Underpass
BOREHOLE LOCATION PLAN & PROFILE

SHEET 1

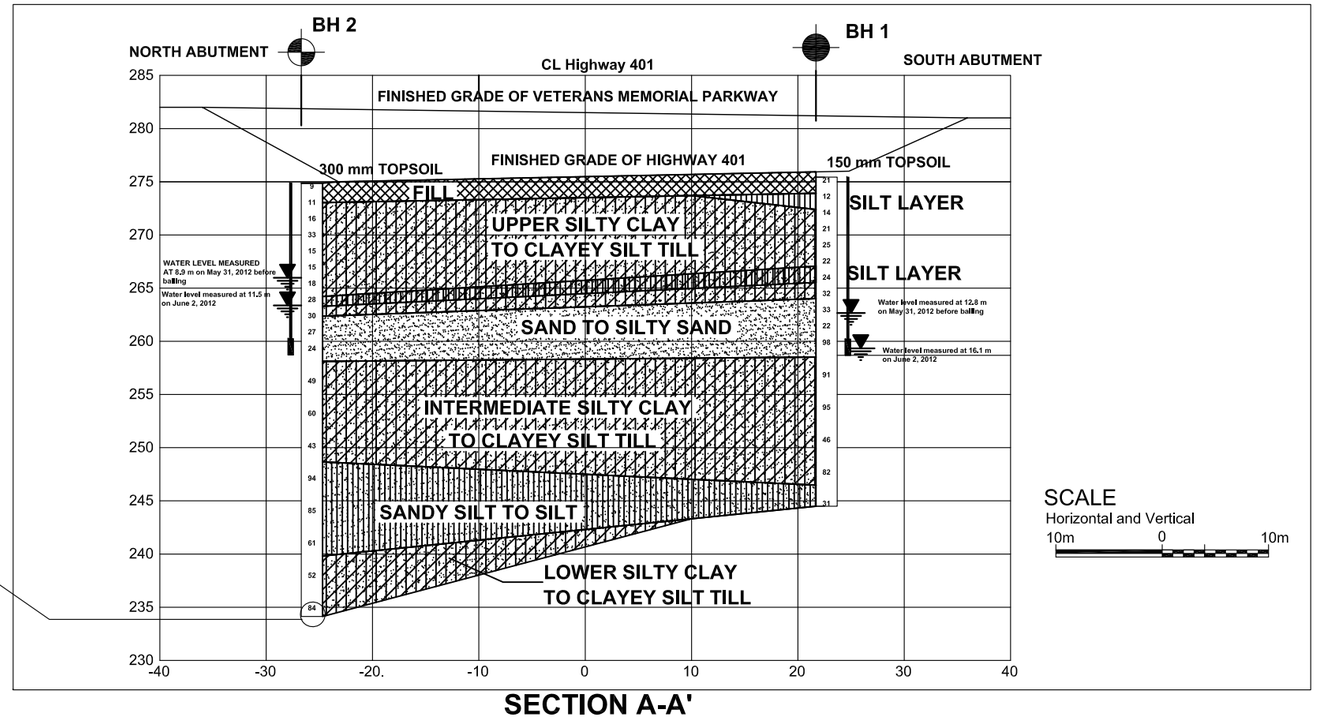
I.E. Group — Infrastructure Engineering Group Inc. Pavement & Construction Materials Consulting Engineers
GTA • Kitchener • London • Windsor

KEYPLAN NTS

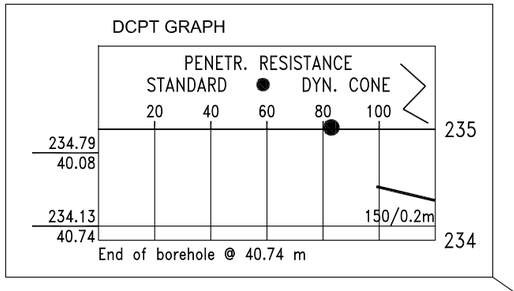



## BOREHOLE LOCATION PLAN




## SECTION A-A'




LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N — Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE — Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation
- Standpipe

NOTES
1. THE COMPLETE FOUNDATION INVESTIGATION AND DESIGN REPORT FOR THIS PROJECT AND OTHER RELATED DOCUMENTS MAY BE EXAMINED AT THE ENGINEERING MATERIALS OFFICE, DOWNSVIEW. INFORMATION CONTAINED IN THIS REPORT AND RELATED DOCUMENTS ARE SPECIFICALLY EXCLUDED IN ACCORDANCE WITH THE CONDITIONS OF SECTION GC2.01 of OPS GEN. COND.
2. THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES AND BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE.
3. SUBGRADE ELEVATION OF THE EXISTING FOOTING NOT KNOWN AND IS ESTIMATED TO BE AT A MINIMUM OF 1.2m BELOW THE FINISHED GRADE.
4. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.

| BOREHOLE NO. | ELEVATION | MTM:11 CO–ORDINATES NORTH | EAST |
|---|---|---|---|
| 1 | 275.44 | 4756823 | 416987 |
| 2 | 274.87 | 4756861 | 416949 |

| REVISIONS | | | |
|---|---|---|---|
| 16/07/12 | J.L. | Final |
| 02/06/12 | J.L. | Draft |
| DATE | BY | DESCRIPTION |

Geocres : 40I14–147

| | | | |
|---|---|---|---|
| HWY No. HWY 401 | | | DIST LONDON |
| SUBM'D J.L. | CHECKED E.C. | DATE 24/05/12 | SITE 19–515 |
| DRAWN J.L. | CHECKED J.L. | APPROVED E.C. | DWG 1 |

ONTARIO MINISTRY OF TRANSPORTATION

# Appendix A

## MTO GEOCRES REPORT NO. 40I14-107

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

40I14-107
GEOCRES No.

MEMORANDUM

TO: Mr. A. P. Watt, (2)
Regional Structural Planning Engineer,
Southwestern Region,
London, Ontario.

FROM: Soil Mechanics Section
Geotechnical Office
Downsview, Ontario

ATTENTION:

DATE: December 17, 1974

OUR FILE REF.

IN REPLY

DEC 18 1974

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
London East Industrial Access Road
and
Highway 401 Interchange Bridge,
Township of Westminster, District #2,
London
W.P. - 32 - 73 - 02 Site - 19 - 515
Cont. 76-36

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above-mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our office.

K. G. Selby,
Supervising Engineer

KGS:jw
cc E.J. Orr
B.R. Davis
A. Wittenberg
L.E. Walker
B.J. Giroux
J.R. Roy
G.A. Wrong
P. Lewycky

Files
Documents

FOUNDATION INVESTIGATION REPORT

For

London East Industrial Access Road

and

Highway 401 Interchange Bridge ,

Township of Westminster, District 2, London

W.P. - 32 - 73 - 02  Site - 19 - 515

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1. INTRODUCTION:

A request for a foundation investigation for a structure at the above-mentioned site was received from Mr. A. P. Watt, Regional Structural Planning Engineer, South-Western Region, London.

A field investigation was subsequently carried out by the Soil Mechanics Section to determine the subsoil conditions existing at the site. This report contains the results of our field and laboratory investigations, together with our recommendations relating to the design of the proposed structure foundations.

2. DESCRIPTION OF THE SITE

The proposed site is located on Highway 401 approximately one mile west of the Highway 74 interchange. The surrounding area is gently rolling farm land with an occasional mixed hardwood bush.

Physiographically, the site is located in a region referred to as the Mount Elgin Ridges.

3. FIELD AND LABORATORY INVESTIGATION

A total of seven sampled boreholes and five dynamic cone penetration tests were carried out during the course of the field work. Boring was achieved by means of a continuous flight auger mounted on a bombardier.

Disturbed samples were obtained using a 2 inch O.D. split-spoon sampler driven according to the specifications for the Standard Penetration Test.

Dynamic cone penetration tests were carried out

.....2

adjacent to five boreholes. Driving energy used to advance th cones was 350 ft-lb per blow. All boreholes were surveyed in the field by personnel from London Region Engineering Surveys Section. The locations and elevations of the borings are shown on Drawing No. 327302-A which accompanies this report.

All samples were visually examined and classified at the site as well as in the laboratory. Following this inspection, laboratory tests were carried out on selected representative samples to determine the following physical properties:

Atterberg Limits
Natural Moisture Content
Grain-size Distribution

The test results are summarized on the Record of Borehole sheets contained in the Appendix of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

Subsoil at the site consists of four distinct layers. The surface layer consists of a heterogeneous mixture of clayey silt, some sand and traces of gravel approximately 35 feet in thickness. This is followed by a layer of 15 to 20 feet of fine sand. Underlying this layer is a further 35 to 40 feet consisting of a heterogeneous mixture of clayey silt some sand, traces of gravel which is in turn underlain by a layer of fine to medium sand with silt. The deepest boreholes at the site were terminated in this fine to medium sand with silt layer.

The boundaries between the different deposits are shown on the attached record of Borehole sheets. The estimated stratigraphical profile shown on Drawing # 327302-A is based upon this information.

From ground level downwards, the different soil deposits are described as follows:

4.2) Clayey Silt some sand traces of gravel

This layer was found in all boreholes and extends to a depth of approximately 35 feet. It consists of a heterogeneous mixture of clayey silt some sand traces of gravel of glacial origin. Its consistancy is stiff to hard

.....3

and has a moisture content varying from 11% to 16.5%.

Grain size analysis are plotted in an envelope form on Fig. (1).

A Plot of Plasticity Index versus Liquid Limit is shown on Fig. (2) of the appendix. The points fall within the clayey silt zone (i.e. C L) on the plasticity chart.

4.3) Fine Sand

This layer is sandwiched between two clayey silt glacial till layers and varies from 15 to 20 feet in thickness. Its density varies from dense to compact and has a moisture content of from (3% to 22%).

4.4) Clayey Silt some sand traces of gravel

This stratum consists of 30 to 35 feet of a heterogeneous mixture of clayey silt, sand and gravel of glacial origin. Its consistancy is hard and has a moisture content varying from (7.5%) to (11%).

A Plot of Plasticity Index versus liquid limit show most points to fall just above the CL - ML zone on the plasticity chart clayey silt range and are plotted on Fig.#3.

Grain size analysis are plotted in an envelope form on Fig. (4).

4.5) Fine Sand with Silt

This stratum of fine sand with silt was encountered at depths of 80 and 92 feet in the two deeper boreholes which were terminated in this layer at depths of 96 and 101 feet. It has a compact density and a moisture content of from (20.5%) to (21.5%).

4.6) Groundwater

Groundwater was encountered in the fine sand and fine sand with silt layers which rose to a level within 4 feet of the ground surface.

# APPENDIX

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

# RECORD OF BOREHOLE No 1

W.P. 32-73-02 LOCATION Co-ords. 15,605,824 N; 1,367,952 E. ORIGINATED BY PJS

DIST. 2 HWY. Local BORING DATE October 31, 1974 COMPILED BY PJS

DATUM Geodetic BOREHOLE TYPE Solid Auger and Cone Test CHECKED BY

| ELEV. / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES 'N' VALUES | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) | LIQUID LIMIT $w_L$, PLASTIC LIMIT $w_P$, WATER CONTENT $w$ / WATER CONTENT % (10 20 30) | UNIT WEIGHT $\gamma$ P.C.F. | REMARKS % GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|
| 899.0 | Ground Level | | | | | | | | | |
| 0.0 | Brown / Grey Clayey silt, some sand, traces of gravel (Glacial Till) Very Stiff to Hard | | 1 | SS | 20 | | | | | |
| | | | 2 | SS | 22 | | | | | 5 18 58 19 |
| | | | 3 | SS | 31 | | | | | |
| | | | 4 | SS | 29 | 890 | | | | |
| | | | 5 | SS | 21 | | | | | |
| | | | 6 | SS | 20 | 880 | | | | 2 18 49 31 |
| | | | 7 | SS | 23 | | | | | |
| | | | 8 | SS | 27 | 870 | | | | |
| 863.5 | | | | | | | | | | |
| 862.1 | F.Sand Very Dense | | 9 | SS | 68 | | | | | 0 94 (6) |
| 36.5 | End of Borehole | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

# RECORD OF BOREHOLE Nº 2

W.P. 32-73-02 LOCATION Co-ords. 15,605,799 N; 1,367,970 E. ORIGINATED BY PJS

DIST. 2 HWY. Local BORING DATE October 31, 1974 COMPILED BY PJS

DATUM Geodetic BOREHOLE TYPE Solid Auger & Cone Test CHECKED BY GP

| SOIL PROFILE ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | TYPE | 'N' VALUES | GROUND WATER ELEV. | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) | LIQUID LIMIT $w_L$ / PLASTIC LIMIT $w_P$ / WATER CONTENT $w$ ($w_P$ — $w$ — $w_L$) / WATER CONTENT % (10 20 30) | UNIT WEIGHT $\gamma$ | REMARKS % GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|
| 899.2 | Ground Level | | | | | | | | | |
| 0.0 | | | 1 | SS | 13 | | | | | |
| | | | 2 | SS | 20 | | | | | |
| | | | 3 | SS | 24 | 890 | | | | |
| | Brown / Grey | | 4 | SS | 23 | | | | | |
| | | | 5 | SS | 23 | | | | | |
| | Clayey silt, some sand, traces of gravel (Glacial Till) | | 6 | SS | 24 | | | | | 1 19 54 26 |
| | | | 7 | SS | 21 | 880 | | | | |
| | | | 8 | SS | 26 | | | | | |
| | Stiff to Hard | | | | | 870 | | | | |
| | | | 9 | SS | 36 | | | | | |
| 862.8 | silty clay | | 10 | SS | 20 | | | | | 0 0 45 55 |
| 36.4 859.2 | Fine sand. Grey | | | | | 860 | | | | |
| 40.0 | End of Borehole | | | | | | | | | |

20 / 15 ◇ 5 / 10 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

# RECORD OF BOREHOLE No 3

W.P. 32-73-02 LOCATION Co-ords. 16,605,780 N: 1,367,936 E. ORIGINATED BY PJS

DIST. 2 HWY. Local BORING DATE November 6, 1974 COMPILED BY PJS

DATUM Geodetic BOREHOLE TYPE Follow Stem Auger CHECKED BY

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | TYPE | 'N' VALUES | GROUND WATER ELEV. | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) | LIQUID LIMIT $w_L$ / PLASTIC LIMIT $w_P$ / WATER CONTENT $w$ — WATER CONTENT % (10 20 30) | UNIT WEIGHT $\gamma$ | REMARKS / % GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|
| 897.9 | Ground Level | | | | | | | | | |
| 0.0 | Brown Grey Clayey silt, some sand, traces of gravel (Glacial Till) Stiff to Hard — clayey silt | | 1 | SS | 21 | 890 | | | | W.L. not established |
| | | | 2 | SS | 23 | | | | | 3 15 70 12 |
| | | | 3 | SS | 29 | | | | | |
| | | | 4 | SS | 26 | | | | | 3 21 52 24 |
| | | | 5 | SS | 18 | 880 | | | | |
| | | | 6 | SS | 20 | | | | | |
| | | | 7 | SS | 25 | 870 | | | | 0 4 69 27 |
| 862.4 | | | 8 | SS | 37 | | | | | |
| 35.5 | Fine Sand Dense to Compact Grey | | 9 | SS | 51 | 860 | | | | |
| | | | 10 | SS | 17 | | | | | 0 96 (4) |
| 847.7 | | | 11 | SS | 22 | 850 | | | | |
| 50.2 | Clayey silt, some sand, traces of gravel (Glacial Till) Hard Grey | | 12 | SS | 67 | | | | | |
| | | | 13 | SS | 95 | | | | | 3 24 61 12 |
| | | | 14 | SS | 105 | 840 | | | | |
| | | | 15 | SS | 60 | 830 | | | | 5 22 58 15 |
| 816.4 | | | 16 | SS | 103 | 820 | | | | |
| 81.5 | Fine to medium sand with silt. Compact Grey | | 17 | SS | 20 | 810 | | | | |
| 796.4 | | | 18 | SS | 22 | 800 | | | | 0 72 (28) |
| 101.5 | End of Borehole | | | | | | | | | |

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

# RECORD OF BOREHOLE No 4

W.P. 32-73-02 LOCATION Co-ords. 16,605,718 N; 1,367,974 E. ORIGINATED BY PJS

DIST. 2 HWY. Local BORING DATE November 6, 1974 COMPILED BY PJS

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone CHECKED BY

| ELEV. / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES N VALUES | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE | LIQUID LIMIT $w_L$ / PLASTIC LIMIT $w_P$ / WATER CONTENT $w$ ($w_P$ — $w$ — $w_L$) / WATER CONTENT % (10 20 30) | UNIT WEIGHT $\gamma$ | REMARKS % GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|
| 901.7 | Ground Level | | | | | | | | | |
| 0.0 | Clayey silt, some sand, traces of gravel (Glacial Till) Very Stiff to Hard | | 1 | SS | 28 | 900 | | | | |
| | | | 2 | SS | 18 | | | | | 5 21 58 16 |
| | | | 3 | SS | 25 | | | | | |
| | | | 4 | SS | 26 | 890 | | | | |
| | Brown silty sand: Grey | | 5 | SS | 22 | | | | | 3 57 31 9 |
| | | | 6 | SS | 28 | 880 | | | | |
| | | | 7 | SS | 34 | | | | | 1 21 47 31 |
| 870.2 | | | 8 | SS | 32 | | | | | |
| 31.5 | End of Borehole | | | | | | | | | |

Note: Water level not established.

OFFICE REPORT ON SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

# RECORD OF BOREHOLE No 5

W.P. 32-73-02 LOCATION Co-ords. 15,605,644 N; 1,367,970 E. ORIGINATED BY PJS

DIST. 2 HWY. Local BORING DATE November 4, 1974 COMPILED BY PJS

DATUM Geodetic BOREHOLE TYPE Solid Auger and Cone CHECKED BY

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES 'N' VALUES | GROUND WATER ELEV. | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) | LIQUID LIMIT $w_L$ / PLASTIC LIMIT $w_P$ / WATER CONTENT $w$ ($w_P$ $w$ $w_L$) / WATER CONTENT % (10 20 30) | UNIT WEIGHT $\gamma$ | REMARKS % GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|
| 900.1 | Ground Level | | | | | | | | | |
| 0.0 | Brown / Grey Clayey silt, some sand, traces of gravel (Glacial Till) Stiff to Hard | | 1 | SS | 13 | | | | | |
| | | | 2 | SS | 26 | | | | | |
| | | | 3 | SS | 12 | | | | | 0 18 56 26 |
| | | | 4 | SS | 18 | 890 | | | | |
| | | | 5 | SS | 26 | | | | | 0 16 68 16 |
| | | | 6 | SS | 19 | | | | | |
| | | | 7 | SS | 31 | 880 | | | | |
| | | | 8 | SS | 25 | | | | | 6 19 60 15 |
| 868.6 | | | 9 | SS | 35 | 870 | | | | |
| 31.5 | End of Borehole | | | | | | | | | |

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY O TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

# RECORD OF BOREHOLE Nº 6

W.P. 32-73-02 LOCATION Co-ords. 16,605,655N: 1,368,002 E. ORIGINATED BY PJS

DIST 2 HWY. Local BORING DATE November 5, 1974 COMPILED BY PJS

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | LIQUID LIMIT $w_L$, PLASTIC LIMIT $w_P$, WATER CONTENT $w$; $w_P$ $w$ $w_L$; WATER CONTENT % 10 20 30 | UNIT WEIGHT $\gamma$ | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| ELEV. / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | ELEV. | | | | % GR SA SI CL |
| 901.2 | Ground Level | | | | | | | | | |
| 0.0 | | | | | | 900 | | | | |
| | | | 1 | SS | 23 | | | | | |
| | | | 2 | SS | 32 | | | | | |
| | Brown / Grey | | 3 | SS | 34 | 890 | | | | 2 18 50 30 |
| | Clayey silt, some sand, traces of gravel (Glacial Till) | | 4 | SS | 41 | | | | | |
| | | | 5 | SS | 24 | | | | | |
| | | | 6 | SS | 32 | 880 | | | | 1 15 59 25 |
| | Very Stiff to Hard | | 7 | SS | 28 | | | | | |
| 869.7 | | | 8 | SS | 40 | 870 | | | | |
| 31.5 | End of Borehole | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

15 20 10 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

# RECORD OF BOREHOLE No 7

W.P. 32-73-02 LOCATION Co-ords. 16,605,610 N; 1,367,995 E. ORIGINATED BY PJS

DIST. 2 HWY. Local BORING DATE November 1, 1974 COMPILED BY PJS

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger and Cone CHECKED BY EP.

| ELEV / DEPTH | SOIL PROFILE: DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | TYPE | 'N' VALUES | GROUND WATER ELEV. | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) | LIQUID LIMIT $w_L$ / PLASTIC LIMIT $w_p$ / WATER CONTENT $w$ ($w_p$ $w$ $w_L$) / WATER CONTENT % (10 20 30) | UNIT WEIGHT γ | REMARKS % GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|
| 902.6 | Ground Level | | | | | | | | | |
| 0.0 | Brown / Grey Clayey silt, some sand, traces of gravel (Glacial Till) Stiff to Hard | | 1 | SS | 7 | 900 | | | | |
| | | | 2 | SS | 20 | | | | | |
| | | | 3 | SS | 29 | | | | | 1 18 58 23 |
| | | | 4 | SS | 29 | | | | | |
| | | | 5 | SS | 23 | 890 | | | | |
| | | | 6 | SS | 20 | | | | | |
| | | | 7 | SS | 26 | | | | | |
| | | | 8 | SS | 33 | 880 | | | | |
| | | | 9 | SS | 35 | | | | | 4 11 58 27 |
| 866.6 | | | 10 | SS | 50 | 870 | | | | |
| 36.0 | Fine Sand Dense to Compact Grey | | 11 | SS | 34 | | | | | |
| | | | 12 | SS | 23 | 860 | | | | 1 98 ( 1 ) |
| | | | 13 | SS | 12 | | | | | |
| 846.6 | | | | | | 850 | | | | |
| 56.0 | Clayey silt, some sand, traces of gravel (Glacial Till) Hard Grey | | 14 | SS | 98 | | | | | |
| | | | 15 | SS | 97 | 840 | | | | 1 19 59 21 |
| | | | 16 | SS | 100/5" | | | | | |
| | | | 17 | SS | 57 | 830 | | | | 3 16 61 20 |
| | | | 18 | SS | 115 | | | | | |
| | | | 19 | SS | 56 | 820 | | | | |
| 810.6 | | | | | | | | | | |
| 92.0 | Fine sand with silt Compact | | 20 | SS | 12 | 810 | | | | 0 79 ( 21) |
| 806.1 | | | | | | | | | | |
| 96.5 | End of Borehole Note: Water level not established. | | | | | | | | | |

15 20/10 5 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

# GRAIN SIZE DISTRIBUTION

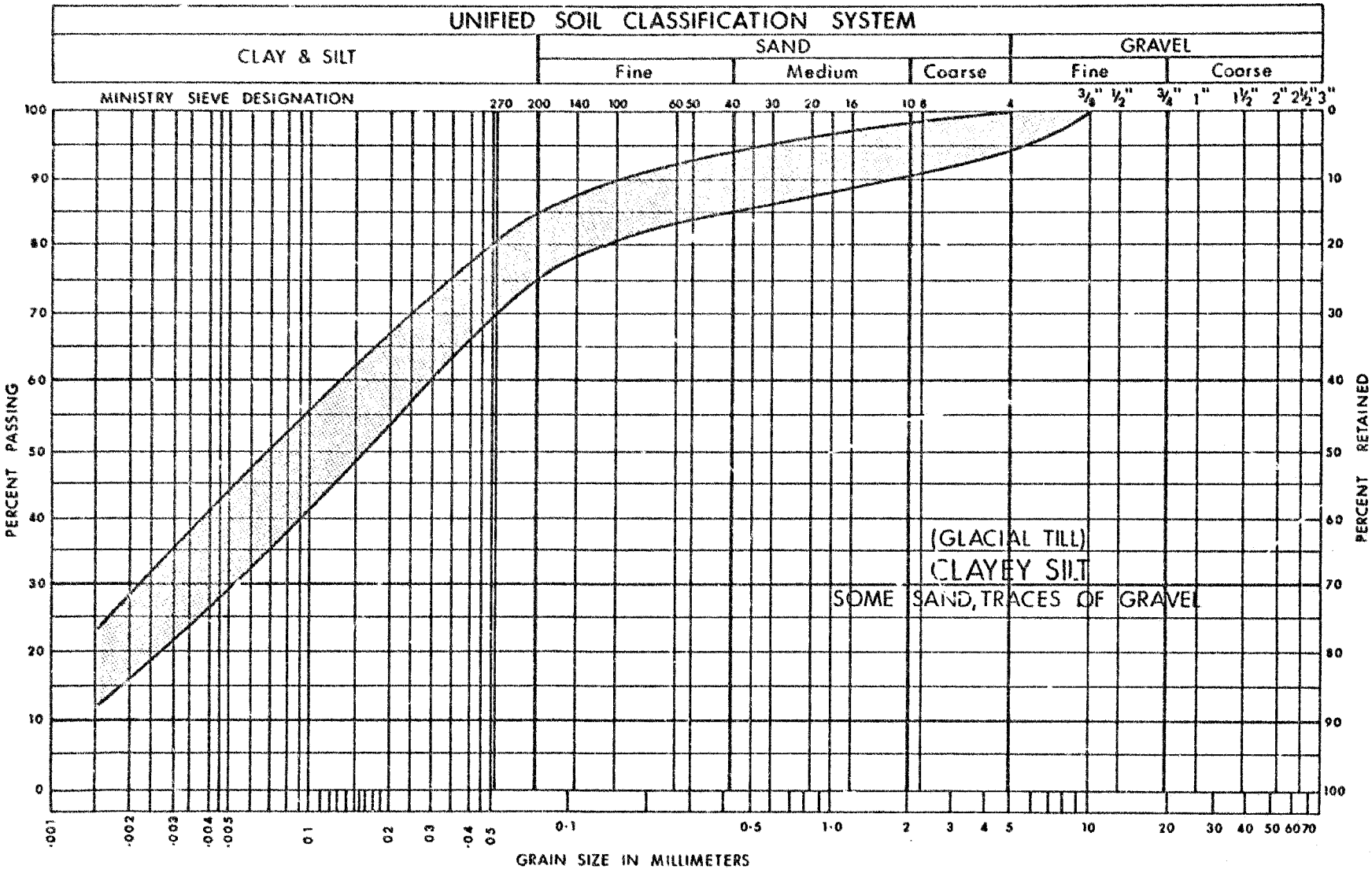



FIG. 1

W.P. 32-73-02

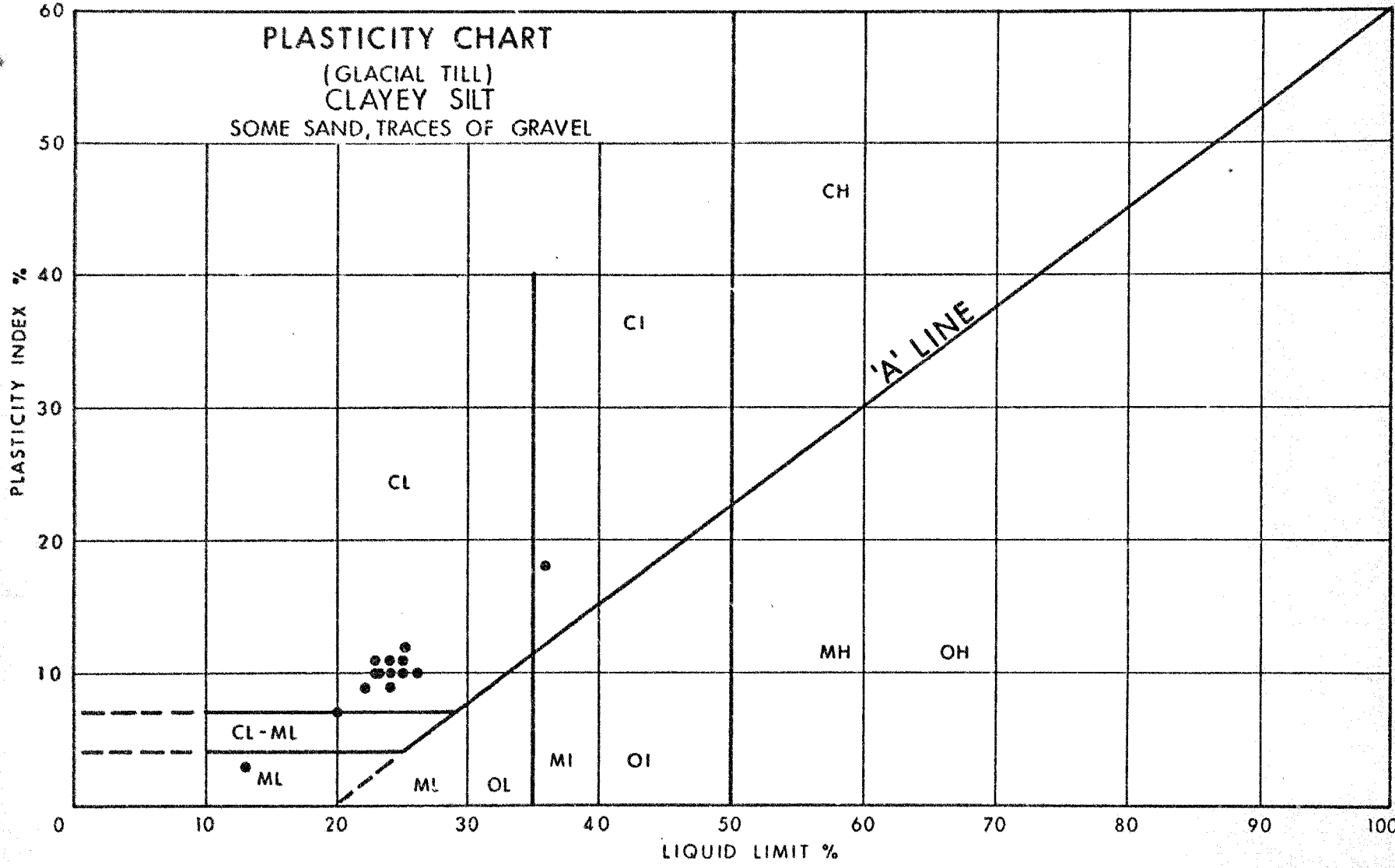



FIG. 2

W.P. 32-73-02

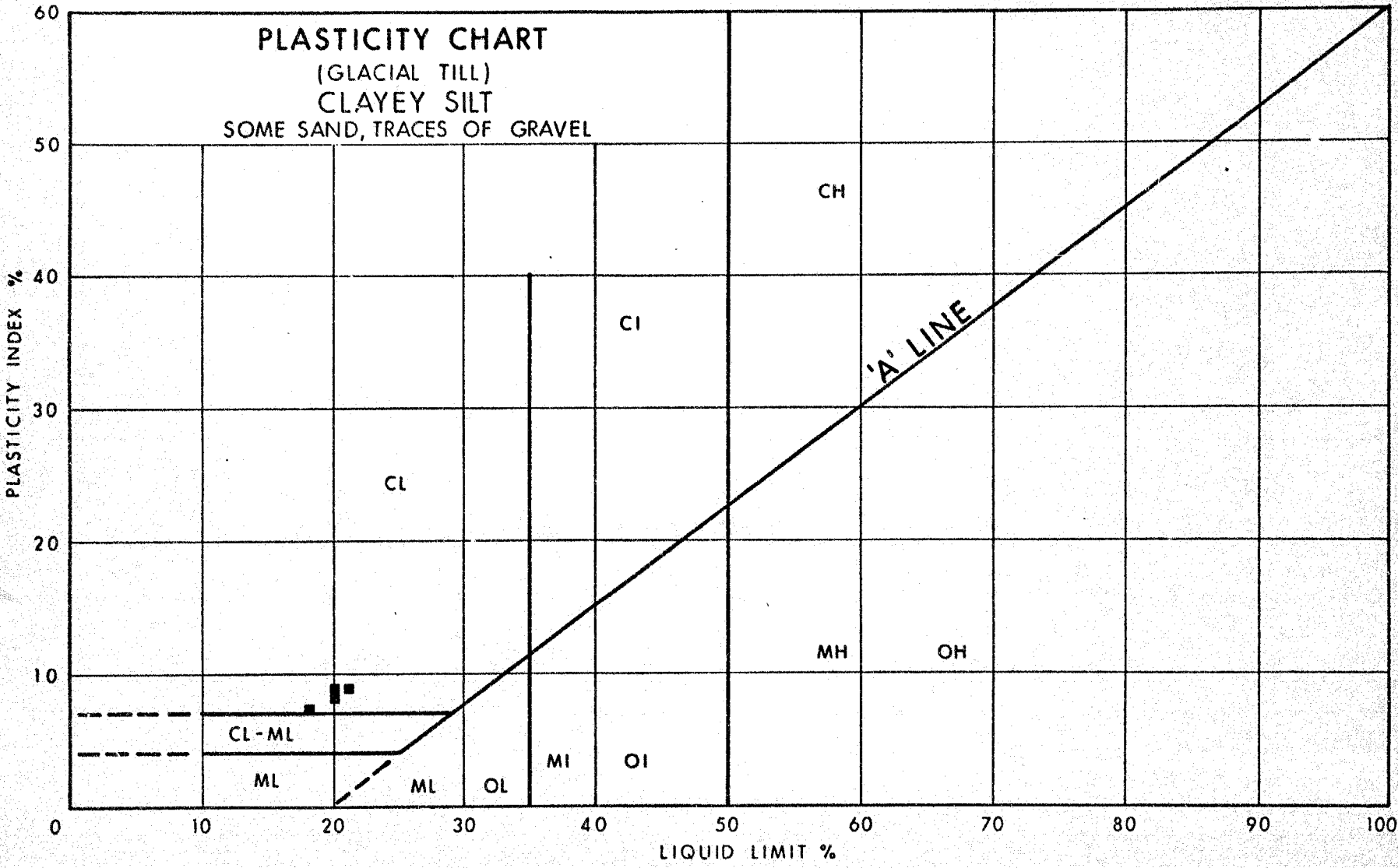



FIG. 3

W.P. 32-73-02

# GRAIN SIZE DISTRIBUTION

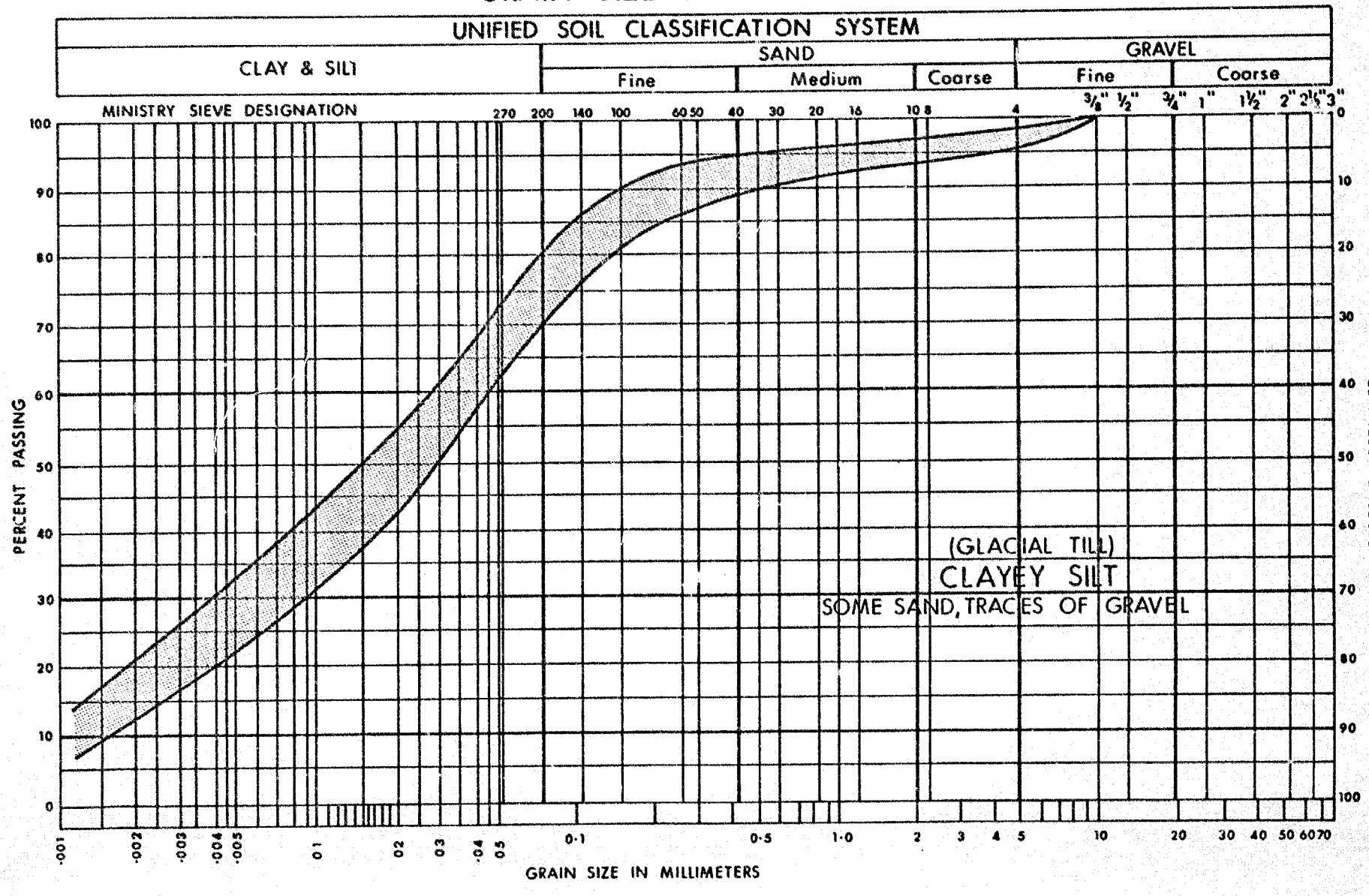



FIG. 4

W.P. 32-73-02

ED-9a (Rev Jan.

# ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

## PENETRATION RESISTANCE

'N'-STANDARD PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

## DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

| CONSISTENCY | c LB./SQ.FT. | DENSENESS | 'N' BLOWS / FT. |
|---|---|---|---|
| VERY SOFT | 0 - 250 | VERY LOOSE | 0 - 4 |
| SOFT | 250 - 500 | LOOSE | 4 - 10 |
| FIRM | 500 - 1000 | COMPACT | 10 - 30 |
| STIFF | 1000 - 2000 | DENSE | 30 - 50 |
| VERY STIFF | 2000 - 4000 | VERY DENSE | > 50 |
| HARD | > 4000 | | |

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

## TYPE OF SAMPLE

| | | | |
|---|---|---|---|
| S.S. | SPLIT SPOON | T.W. | THINWALL OPEN |
| W.S. | WASHED SAMPLE | T.P. | THINWALL PISTON |
| S.T. | SLOTTED TUBE SAMPLE | O.S. | OESTERBERG SAMPLE |
| A.S. | AUGER SAMPLE | F.S. | FOIL SAMPLE |
| C.S. | CHUNK SAMPLE | R.C. | ROCK CORE |

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

## SOIL TESTS

| | | | |
|---|---|---|---|
| U | UNCONFINED COMPRESSION | L.V. | LABORATORY VANE |
| UU | UNCONSOLIDATED UNDRAINED TRIAXIAL | F.V. | FIELD VANE |
| CIU | CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL | C | CONSOLIDATION |
| CID | " " DRAINED " | S | SENSITIVITY |
| CAU | " ANISOTROPIC UNDRAINED " | | |
| CAD | " " DRAINED " | | |

FD-9b (Rev. Jan. 73)

# ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

## SOIL PROPERTIES

| | |
|---|---|
| $\gamma$ | UNIT WEIGHT OF SOIL (BULK DENSITY) |
| $\gamma_s$ | UNIT WEIGHT OF SOLID PARTICLES |
| $\gamma_w$ | UNIT WEIGHT OF WATER |
| $\gamma_d$ | UNIT DRY WEIGHT OF SOIL (DRY DENSITY) |
| $\gamma'$ | UNIT WEIGHT OF SUBMERGED SOIL |
| G | SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$ |
| e | VOID RATIO |
| n | POROSITY |
| w | WATER CONTENT |
| $S_r$ | DEGREE OF SATURATION |
| $w_L$ | LIQUID LIMIT |
| $w_p$ | PLASTIC LIMIT |
| $I_p$ | PLASTICITY INDEX |
| $w_s$ | SHRINKAGE LIMIT |
| $I_L$ | LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$ |
| $I_C$ | CONSISTENCY INDEX $= \frac{w_L - w}{I_p}$ |
| $e_{max}$ | VOID RATIO IN LOOSEST STATE |
| $e_{min}$ | VOID RATIO IN DENSEST STATE |
| $I_D$ | DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$ |
| | RELATIVE DENSITY $D_r$ IS ALSO USED |
| h | HYDRAULIC HEAD OR POTENTIAL |
| q | RATE OF DISCHARGE |
| v | VELOCITY OF FLOW |
| i | HYDRAULIC GRADIENT |
| k | COEFFICIENT OF PERMEABILITY |
| j | SEEPAGE FORCE PER UNIT VOLUME |
| $m_v$ | COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta \sigma'}$ |
| $c_v$ | COEFFICIENT OF CONSOLIDATION |
| $C_c$ | COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma}$ |
| $T_v$ | TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH) |
| U | DEGREE OF CONSOLIDATION |
| $\tau_f$ | SHEAR STRENGTH |
| $c'$ | EFFECTIVE COHESION INTERCEPT |
| $\phi'$ | EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION |
| | IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$ |
| $c_u$ | APPARENT COHESION |
| $\phi_u$ | APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION |
| | IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$ |
| $\mu$ | COEFFICIENT OF FRICTION |
| $S_t$ | SENSITIVITY |

## GENERAL

| | |
|---|---|
| $\pi$ | = 3·1416 |
| e | BASE OF NATURAL LOGARITHMS 2·7183 |
| $\log_e \sigma$ OR $\ln \sigma$ | NATURAL LOGARITHM OF $\sigma$ |
| $\log_{10} \sigma$ OR $\log \sigma$ | LOGARITHM OF $\sigma$ TO BASE 10 |
| t | TIME |
| g | ACCELERATION DUE TO GRAVITY |
| V | VOLUME |
| W | WEIGHT |
| M | MOMENT |
| F | FACTOR OF SAFETY |

## STRESS AND STRAIN

| | |
|---|---|
| u | PORE PRESSURE |
| $\sigma$ | NORMAL STRESS |
| $\sigma'$ | NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED) |
| $\tau$ | SHEAR STRESS |
| $\varepsilon$ | LINEAR STRAIN |
| $\gamma$ | SHEAR STRAIN |
| $\nu$ | POISSON'S RATIO ($\mu$ IS ALSO USED) |
| E | MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS) |
| G | MODULUS OF SHEAR DEFORMATION |
| K | MODULUS OF COMPRESSIBILITY |
| $\eta$ | COEFFICIENT OF VISCOSITY |

## EARTH PRESSURE

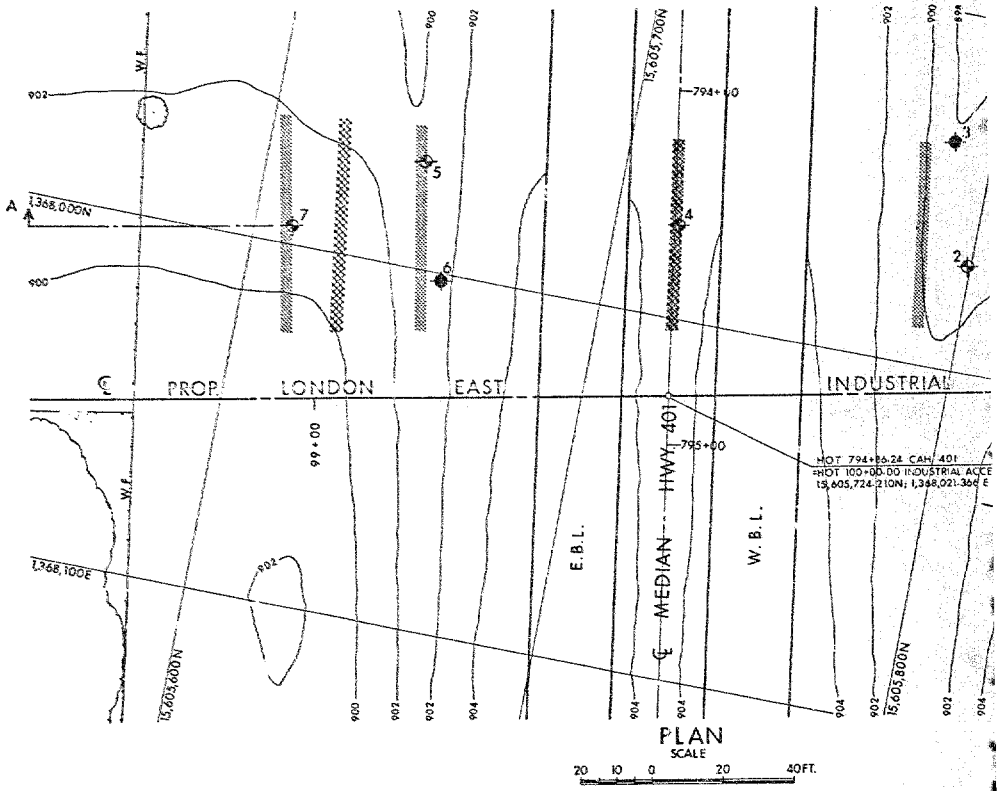
| | |
|---|---|
| d | DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE |
| $\delta$ | ANGLE OF WALL FRICTION |
| K | DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS |
| $K_o$ | COEFFICIENT OF EARTH PRESSURE AT REST |

## FOUNDATIONS

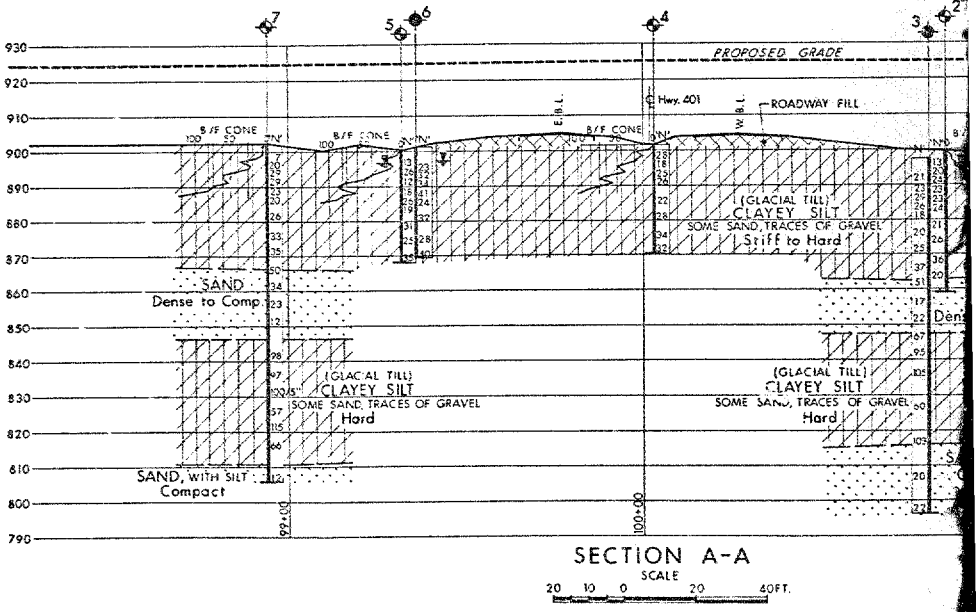
| | |
|---|---|
| B | BREADTH OF FOUNDATION |
| L | LENGTH OF FOUNDATION |
| D | DEPTH OF FOUNDATION BENEATH GROUND |
| N | DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY. DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY |
| $k_s$ | MODULUS OF SUBGRADE REACTION |

## SLOPES

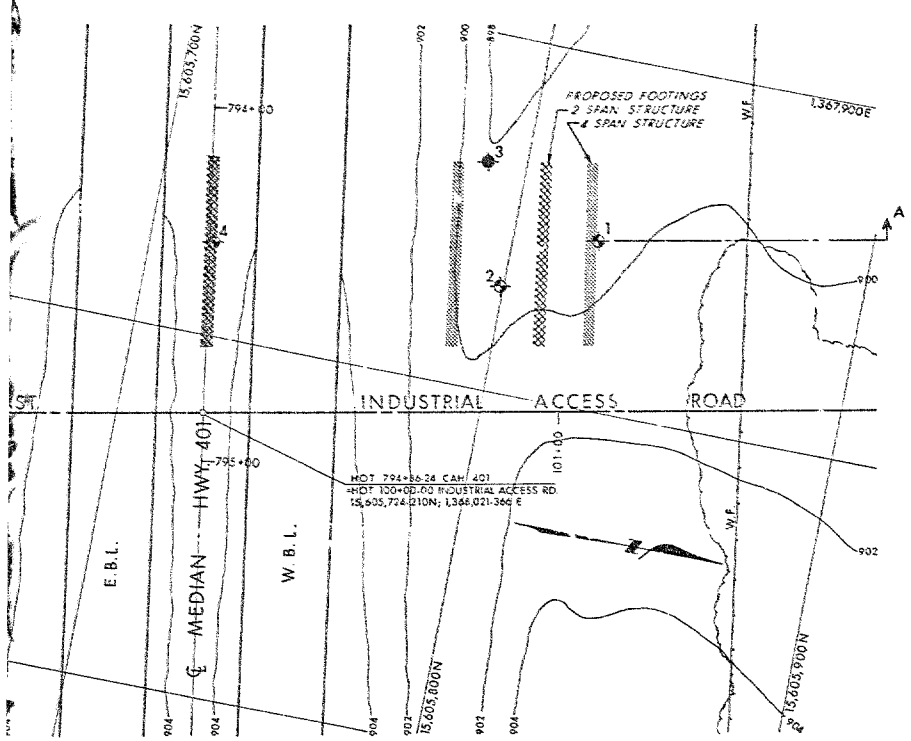
| | |
|---|---|
| H | VERTICAL HEIGHT OF SLOPE |
| D | DEPTH BELOW TOE OF SLOPE TO HARD STRATUM |
| $\beta$ | ANGLE OF SLOPE TO HORIZONTAL |




PLAN
SCALE
20 10 0 20 40FT.



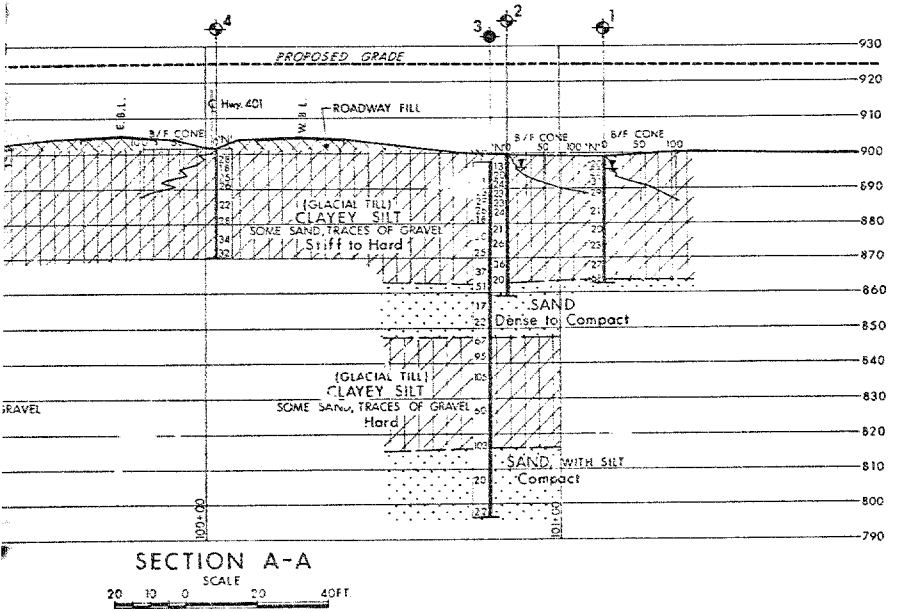

SECTION A-A
SCALE
20 10 0 20 40FT.




PLAN

SCALE

20 10 0 20 40FT.




SECTION A-A

SCALE

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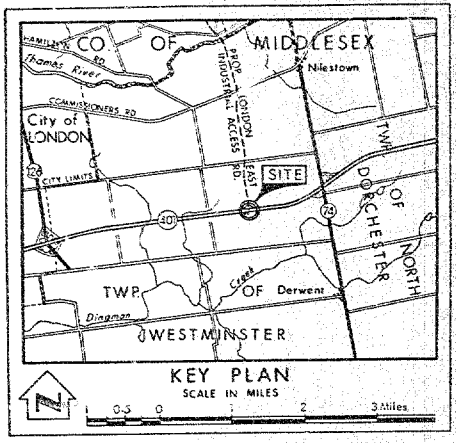



## LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. Nov. 1974 Water Levels in B.H. 3, 4 and 7 not established.

| NO. | ELEVATION | CO-ORDINATES NORTH | CO-ORDINATES EAST |
|---|---|---|---|
| 1 | 899.0 | 15,605,824 | 1,367,952 |
| 2 | 899.2 | 15,605,799 | 1,367,970 |
| 3 | 897.9 | 15,605,789 | 1,367,936 |
| 4 | 901.7 | 15,605,718 | 1,367,974 |
| 5 | 900.1 | 15,605,644 | 1,367,970 |
| 6 | 901.2 | 15,605,655 | 1,368,002 |
| 7 | 902.6 | 15,605,610 | 1,367,995 |

NOTE: FOR CONTRACT DOCUMENT
The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the LONDON District Office.

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

| REVISIONS | DATE | BY | DESCRIPTION |
|---|---|---|---|
| | | | |

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE

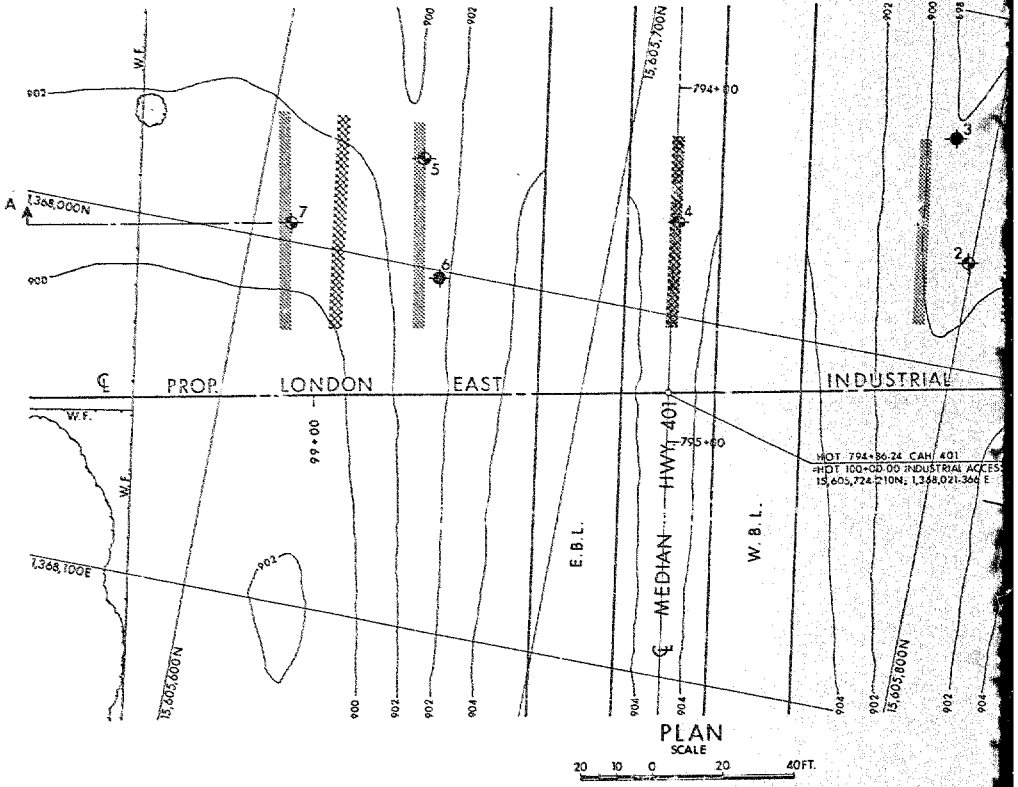
# HIGHWAY 401
## LONDON EAST INDUSTRIAL ACCESS ROAD

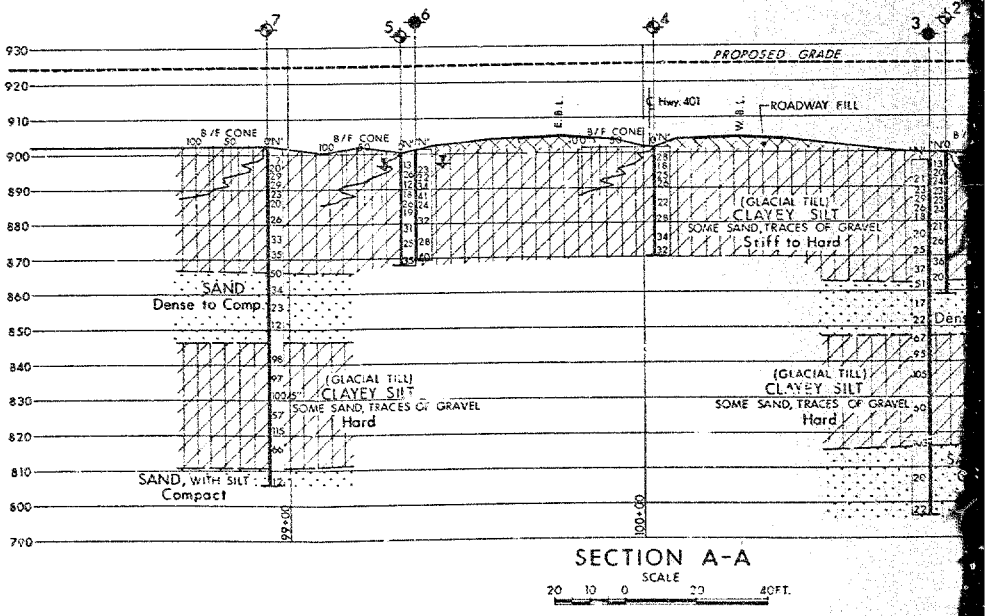
HIGHWAY NO. LOCAL DIST. NO. 2
CO. MIDDLESEX
TWP. WESTMINSTER LOT 5 CON II

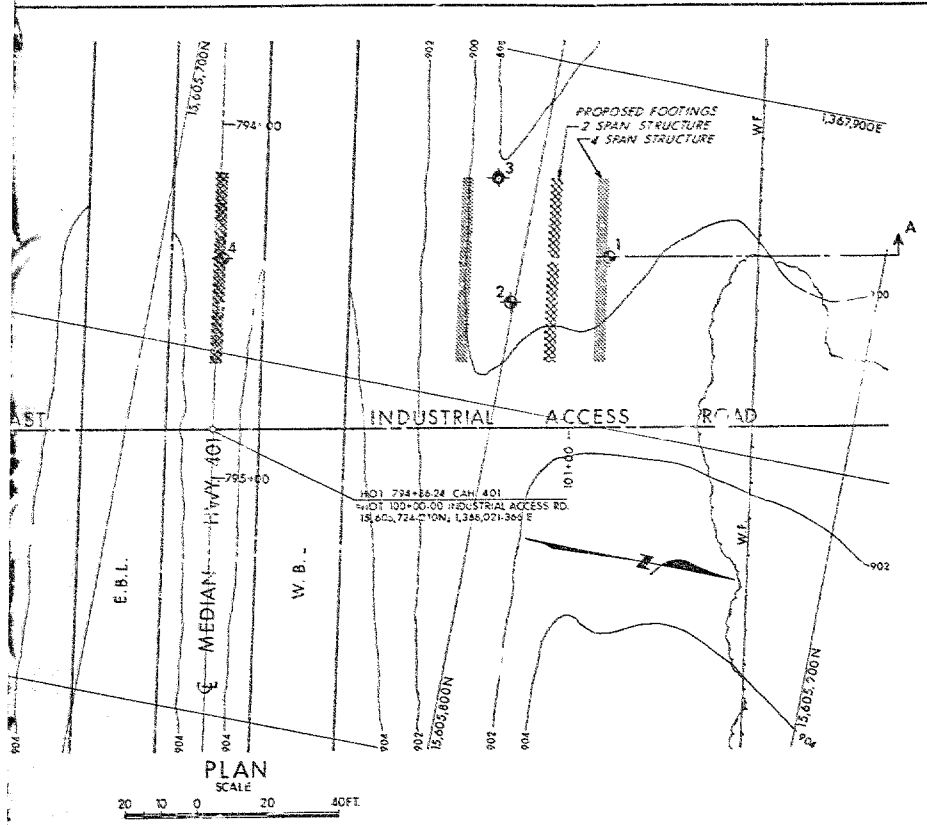
## BORE HOLE LOCATIONS & SOIL STRATA

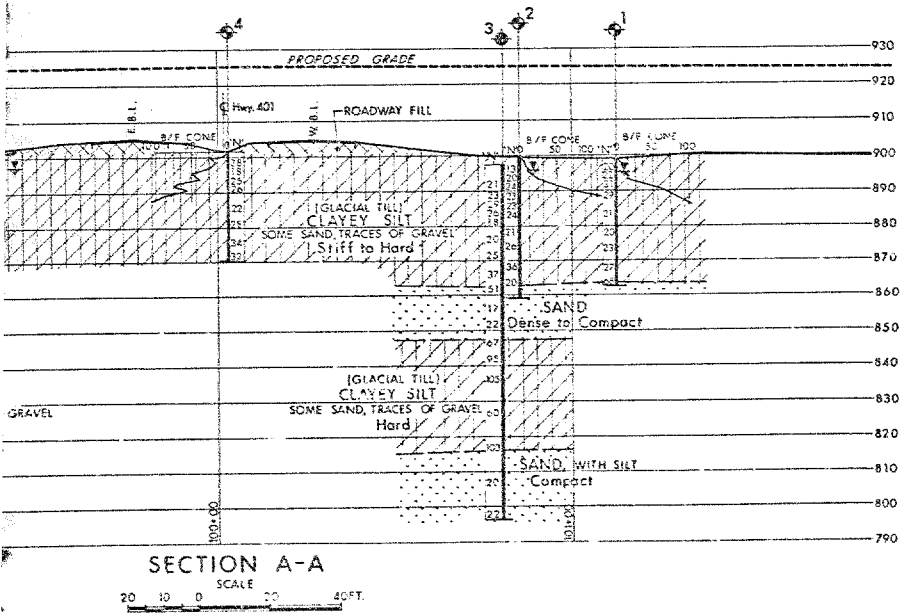
| | | | |
|---|---|---|---|
| SUBMD. P.S. | CHECKED | W.P. NO. 32-73-02 | DRAWING NO. 327302-A |
| DR. IN | CHECKED | W.O. NO. | |
| DATE Dec. 12, 1974 | | SITE NO. 19-515 | BRIDGE DRAWING NO. |
| APPROVED | | CONT. NO. | |

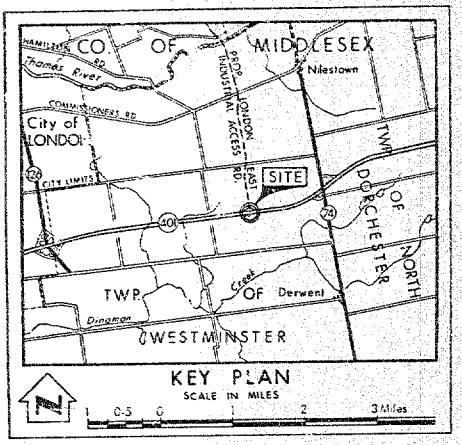
RSF. NO. E-5352-1 June 1974


W.F.
902
900
A
1,368,000N
7
6
5
4
3
2
℄ PROP. LONDON EAST INDUSTRIAL
W.F.
W.F.
99+00
794+80
795+60
15,605,700N
15,605,600N
15,605,800N
1,368,100E
902
900
E.B.L.
W.B.L.
℄ MEDIAN HWY. 401
MOT 794+86.24 CAH 401
MOT 100+00.00 INDUSTRIAL ACCESS
15,605,724.210N; 1,368,021.366 E
PLAN
SCALE
20 10 0 20 40FT.


PROPOSED GRADE
℄ Hwy. 401
E.B.L.
W.B.L.
ROADWAY FILL
B/F CONE
(GLACIAL TILL)
CLAYEY SILT
SOME SAND, TRACES OF GRAVEL
Stiff to Hard
SAND
Dense to Comp.
(GLACIAL TILL)
CLAYEY SILT
SOME SAND, TRACES OF GRAVEL
Hard
SAND, WITH SILT
Compact
930
920
910
900
890
880
870
860
850
840
830
820
810
800
790
99+00
100+00
SECTION A-A
SCALE
20 10 0 20 40FT.




## LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of Field investigation. Nov. 1974. Water Levels in B.H. 3, 4 and 7 not established.

| NO. | ELEVATION | CO-ORDINATES NORTH | CO-ORDINATES EAST |
|---|---|---|---|
| 1 | 899.0 | 15,605,824 | 1,367,952 |
| 2 | 899.2 | 15,605,799 | 1,367,970 |
| 3 | 897.9 | 15,605,789 | 1,367,936 |
| 4 | 901.1 | 15,605,716 | 1,367,974 |
| 5 | 900.1 | 15,605,644 | 1,367,970 |
| 6 | 901.2 | 15,605,655 | 1,368,002 |
| 7 | 902.6 | 15,605,610 | 1,367,995 |

NOTE: FOR CONTRACT DOCUMENT
The complete foundation investigation report for this structure may be examined at the Structural Office and Foundation Office, Downsview, and at the LONDON District Office.

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

| REVISIONS | | | |
|---|---|---|---|
| DATE | BY | DESCRIPTION | |

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE

# HIGHWAY 401
## LONDON EAST INDUSTRIAL ACCESS ROAD

HIGHWAY NO. LOCAL DIST. NO. 2
CO. MIDDLESEX
TWP. WESTMINSTER LOT 5 CON. II

## BORE HOLE LOCATIONS & SOIL STRATA

| | | | |
|---|---|---|---|
| SUBMD P.C. | CHECKED | W.P. NO. 32-73-02 | DRAWING NO. 327302-A |
| DRAWN | CHECKED | W.O. NO. | |
| DATE Dec. 12, 1974 | SITE NO. 19-515 | | BRIDGE DRAWING NO. |
| APPROVED | CONT. NO. | | |

REF. NO. E-5352-1 June 1974

Ministry of Transportation and Communications
Ontario

ENGINEERING SERVICES BRANCH
GEOTECHNICAL OFFICE

# BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 2 CONTRACT NO. 76-36 STRUCTURE W. P. NO. 32-73-02

CONTRACTOR BIRMINGHAM DESIGN LOAD OF PILE 25 TON / PILE

HAMMER DETAILS: TYPE BIRMINGHAM B22S WEIGHT 3000 LBS HEIGHT OF FALL OR ENERGY 9'

TYPE OF ANVIL OR CAP _____ WEIGHT OF ANVIL OR CAP 1100 LBS

PILE DETAILS STEEL TUBE PILES 12¾" X 1/4" BATTER: VERTICAL

PILE NO. 32 LOCATION NORTH ABUTMENT DATE DRIVEN AUG 16/76

| TOTAL LENGTH BEING DRIVEN | LENGTH IN GROUND | PENETRATION BLOWS / FT. | TOTAL LENGTH BEING DRIVEN | LENGTH IN GROUND | PENETRATION BLOWS / FT. | TOTAL LENGTH BEING DRIVEN | LENGTH IN GROUND | PENETRATION BLOWS / FT. | TOTAL LENGTH BEING DRIVEN | LENGTH IN GROUND | PENETRATION BLOWS / FT. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 1 | | | 26 | | | 51 | | | 76 | |
| | 2 | | | 27 | | | 52 | | | 77 | |
| | 3 | 6 | | 28 | | | 53 | | | 78 | |
| | 4 | 9 | | 29 | | | 54 | | | 79 | |
| | 5 | 9 | | 30 | | | 55 | | | 80 | |
| | 6 | 10 | | 31 | | | 56 | | | 81 | |
| | 7 | 11 | | 32 | | | 57 | | | 82 | |
| | 8 | 11 | | 33 | | | 58 | | | 83 | |
| | 9 | 14 | | 34 | | | 59 | | | 84 | |
| | 10 | 16 | | 35 | | | 60 | | | 85 | |
| | 11 | 16 | | 36 | | | 61 | | | 86 | |
| | 12 | 16 | | 37 | | | 62 | | | 87 | |
| | 13 | 19 | | 38 | | | 63 | | | 88 | |
| | 14 | 18 | | 39 | | | 64 | | | 89 | |
| | 15 | 19 | | 40 | | | 65 | | | 90 | |
| | 16 | 20 | | 41 | | | 66 | | | 91 | |
| | 17 | 20 | | 42 | | | 67 | | | 92 | |
| | 18 | 22 | | 43 | | | 68 | | | 93 | |
| | 19 | 22 | | 44 | | | 69 | | | 94 | |
| | 20 | 28 | | 45 | | | 70 | | | 95 | |
| | 21 | 26 | | 46 | | | 71 | | | 96 | |
| | 22 | 26 | | 47 | | | 72 | | | 97 | |
| | 23 | 28 | | 48 | | | 73 | | | 98 | |
| | 24 | | | 49 | | | 74 | | | 99 | |
| | 25 | | | 50 | | | 75 | | | 100 | |

| DETAILS FOR FINAL SIX INCHES OF PENETRATION | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| BLOWS PER INCH | 2 | 2 | 2 | 3 | 3 | 4 |
| MEASURED REBOUND IN INCHES | 1/4 | 1/4 | 1/4 | 1/4" | 1/4" | 3/8" |

FINAL LENGTH OF PILE 25'6" FINAL CUT OFF ELEVATION 913.50

REPORT TO BE SENT TO:-

GEOTECHNICAL OFFICE
ATTENTION: PRODUCT & PROCESS IMPROVEMENT SECTION,
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS,
DOWNSVIEW, ONTARIO

SIGNED R J Warner
NAME (PRINT) R J WARNER
DATE AUG 16/76
ATTACH SKETCH OF PILE NUMBERING SYSTEM

GI-9 4-74
OB-MT-285 4-74

Ontario Ministry of Transportation and Communications

ENGINEERING SERVICES BRANCH
GEOTECHNICAL OFFICE

# BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 2 CONTRACT NO. 76-36 STRUCTURE W.P. NO. 32-73-02

CONTRACTOR BURNING HAM DESIGN LOAD OF PILE 25 TON / PILE

HAMMER DETAILS: TYPE BURNING HAMMER B225 WEIGHT 3200 LBS HEIGHT OF FALL OR ENERGY 9'

TYPE OF ANVIL OR CAP _____ WEIGHT OF ANVIL OR CAP 1100 LBS

PILE DETAILS STEEL TUBE PILE 12 3/4" x 1/4" BATTER: VERTICAL

PILE NO. 14 LOCATION SOUTH ABUTMENT DATE DRIVEN AUG 17/76

| TOTAL LENGTH BEING DRIVEN | LENGTH IN GROUND | PENETRATION BLOWS / FT. | TOTAL LENGTH BEING DRIVEN | LENGTH IN GROUND | PENETRATION BLOWS / FT. | TOTAL LENGTH BEING DRIVEN | LENGTH IN GROUND | PENETRATION BLOWS / FT. | TOTAL LENGTH BEING DRIVEN | LENGTH IN GROUND | PENETRATION BLOWS / FT. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 1 | | | 26 | | | 51 | | | 76 | |
| | 2 | | | 27 | | | 52 | | | 77 | |
| | 3 | | | 28 | | | 53 | | | 78 | |
| | 4 | 4 | | 29 | | | 54 | | | 79 | |
| | 5 | 5 | | 30 | | | 55 | | | 80 | |
| | 6 | 5 | | 31 | | | 56 | | | 81 | |
| | 7 | 8 | | 32 | | | 57 | | | 82 | |
| | 8 | 9 | | 33 | | | 58 | | | 83 | |
| | 9 | 10 | | 34 | | | 59 | | | 84 | |
| | 10 | 13 | | 35 | | | 60 | | | 85 | |
| | 11 | 14 | | 36 | | | 61 | | | 86 | |
| | 12 | 14 | | 37 | | | 62 | | | 87 | |
| | 13 | 21 | | 38 | | | 63 | | | 88 | |
| | 14 | 25 | | 39 | | | 64 | | | 89 | |
| | 15 | 24 | | 40 | | | 65 | | | 90 | |
| | 16 | 25 | | 41 | | | 56 | | | 91 | |
| | 17 | 24 | | 42 | | | 67 | | | 92 | |
| | 18 | 24 | | 43 | | | 68 | | | 93 | |
| | 19 | 24 | | 44 | | | 69 | | | 94 | |
| | 20 | 24 | | 45 | | | 70 | | | 95 | |
| | 21 | 22 | | 46 | | | 71 | | | 96 | |
| | 22 | 27 | | 47 | | | 72 | | | 97 | |
| | 23 | | | 48 | | | 73 | | | 98 | |
| | 24 | | | 49 | | | 74 | | | 99 | |
| | 25 | | | 50 | | | 75 | | | 100 | |

| DETAILS FOR FINAL SIX INCHES OF PENETRATION | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| BLOWS PER INCH | 2 | 2 | 3 | 3 | 4 | 4 |
| MEASURED REBOUND IN INCHES | 1/4 | 1/4 | 1/4 | 1/4 | 3/8" | 3/8" |

FINAL LENGTH OF PILE 22' 9" FINAL CUT OFF ELEVATION 913.50

REPORT TO BE SENT TO:-

GEOTECHNICAL OFFICE
ATTENTION: PRODUCT & PROCESS IMPROVEMENT SECTION,
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS,
DOWNSVIEW, ONTARIO

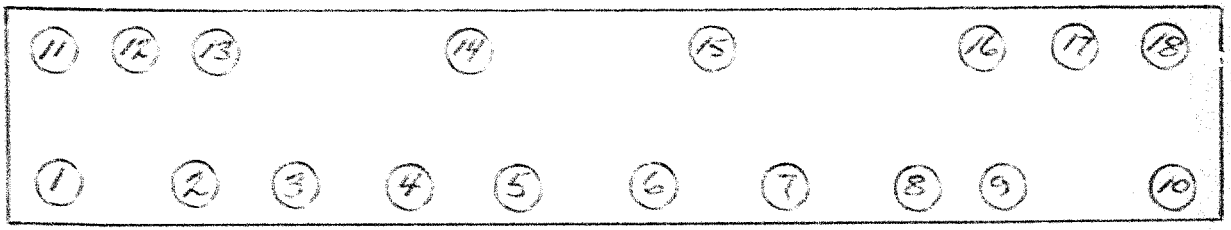
SIGNED R J Wakner
NAME (PRINT) R J WAKNER
DATE AUG 17/76
ATTACH SKETCH OF PILE NUMBERING SYSTEM

01-9 4-74

4-74

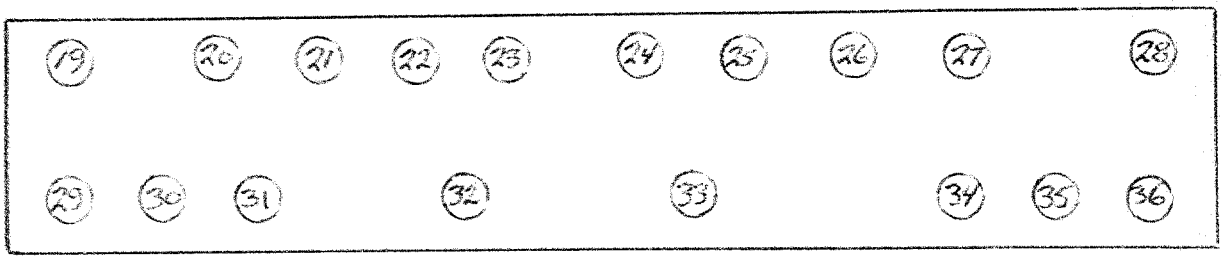
OB-MT-285

SOUTH ABUTMENT

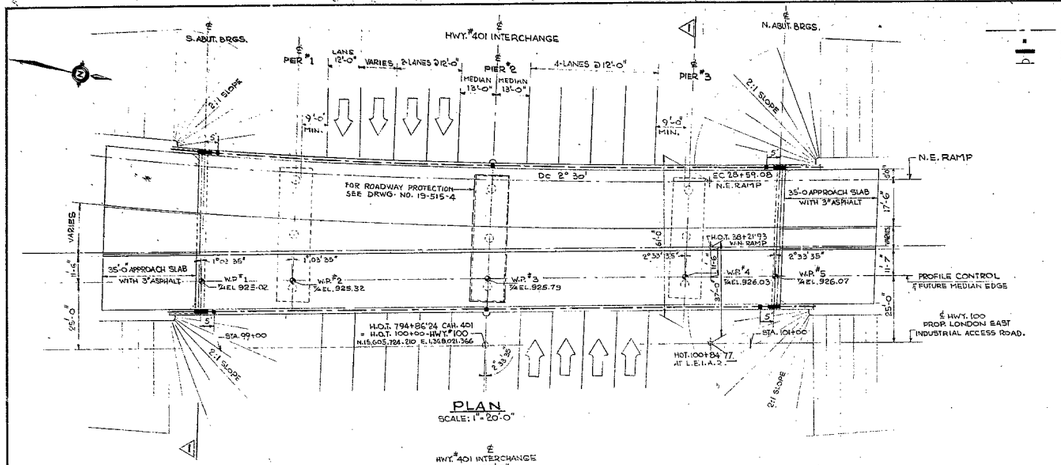



Hwy 401 EAST BOUND

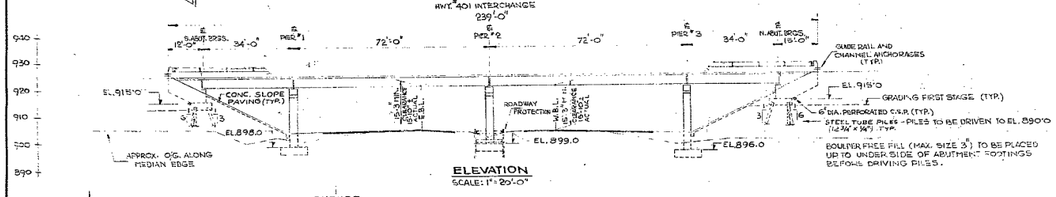
Hwy 401 WEST BOUND



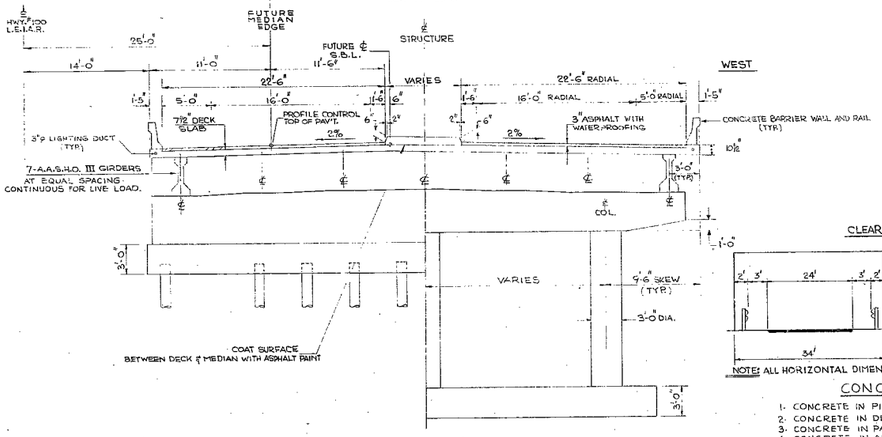

NORTH ABUTMENT




PLAN
SCALE: 1" = 20'-0"

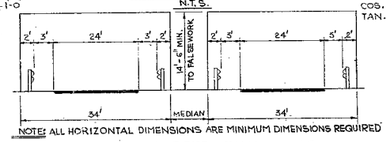



ELEVATION
SCALE: 1" = 20'-0"




SECTION ⚠ N.T.S.

CLEARANCE DIAGRAM
N.T.S.




NOTE: ALL HORIZONTAL DIMENSIONS ARE MINIMUM DIMENSIONS REQUIRED

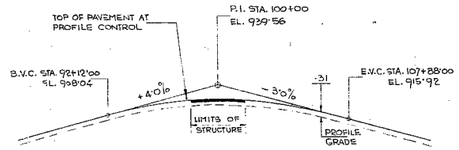
## CONCRETE QUANTITIES

| | | |
|---|---|---|
| 1. CONCRETE IN PIERS, ABUTMENTS AND WINGWALLS | — | 234 CU. YD. |
| 2. CONCRETE IN DECK AND DIAPHRAGMS | — | 413 CU. YD. |
| 3. CONCRETE IN PARAPET WALLS | — | 42 CU. YD. |
| 4. CONCRETE IN APPROACH SLABS | — | 151 CU. YD. |
| 5. CONCRETE IN PILES | — | 27 CU. YD. |
| 6. CONCRETE IN SLOPE PAVING | — | 69 CU. YD. |

## LEGEND

- 3" DIA. ASBESTOS CEMENT TYPE I CONDUIT
- 8" x 8" x 7¼" RIGID P.V.C. JUNCTION BOX
- ASBESTOS CEMENT EXPANSION COUPLING
- POLE BASE (16" B.C.D.)

THESE DETAILS TO BE USED IN CONJUNCTION WITH DRAWING NO 19-515-16

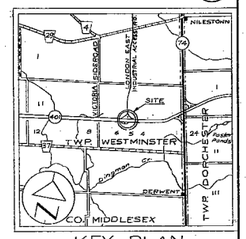



V.C. = 900
L.V.C. = 1576 FT.

PROFILE OF PROPOSED HWY. # 100
(LONDON EAST INDUSTRIAL ACCESS ROAD)
N.T.S.

B.M. 904-03

GEODETIC DATUM
N. & W. IN N.E. ROOT OF 2" ASH
639' Rt. OF STA. 98+74·0




KEY PLAN
0 5M. 0 10MI.

## GENERAL NOTES:

CLASS OF CONCRETE:
A.A.S.H.O. III GIRDERS ---------- 5000 P.S.I.
DECK, BARRIER WALLS AND PIERS ---------- 4000 P.S.I.
PIER FOOTINGS, ABUTMENT FOOTINGS, ABUTMENTS AND APPROACH SLABS ---------- 3000 P.S.I.

CLEAR COVER TO REINFORCING STEEL:
DECK: TOP 2" BTM. 1"
CONCRETE BARRIER WALLS: 1½"
APPROACH SLABS: 2"
REMAINDER: 3"

## CONSTRUCTION NOTES:

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 1/8". NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.

## LIST OF DRAWINGS:



SKEW DATA - 1° 03' 35"
SIN. ·01849458
COS. ·99982896
TAN. ·01849775

SKEW DATA - 2° 33' 35"
SIN. ·04466072
COS. ·99900221
TAN. ·04470532

40 I 14-107
GEOGRES No.

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |

PRINT RECORD

| No. | FOR | DATE |
|---|---|---|
| | | |

FOR REDUCED PLAN
USE SCALE BELOW
10 11 12 13
3 INCHES ON ORIGINAL PLAN

JOSEPH SERSEC — PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

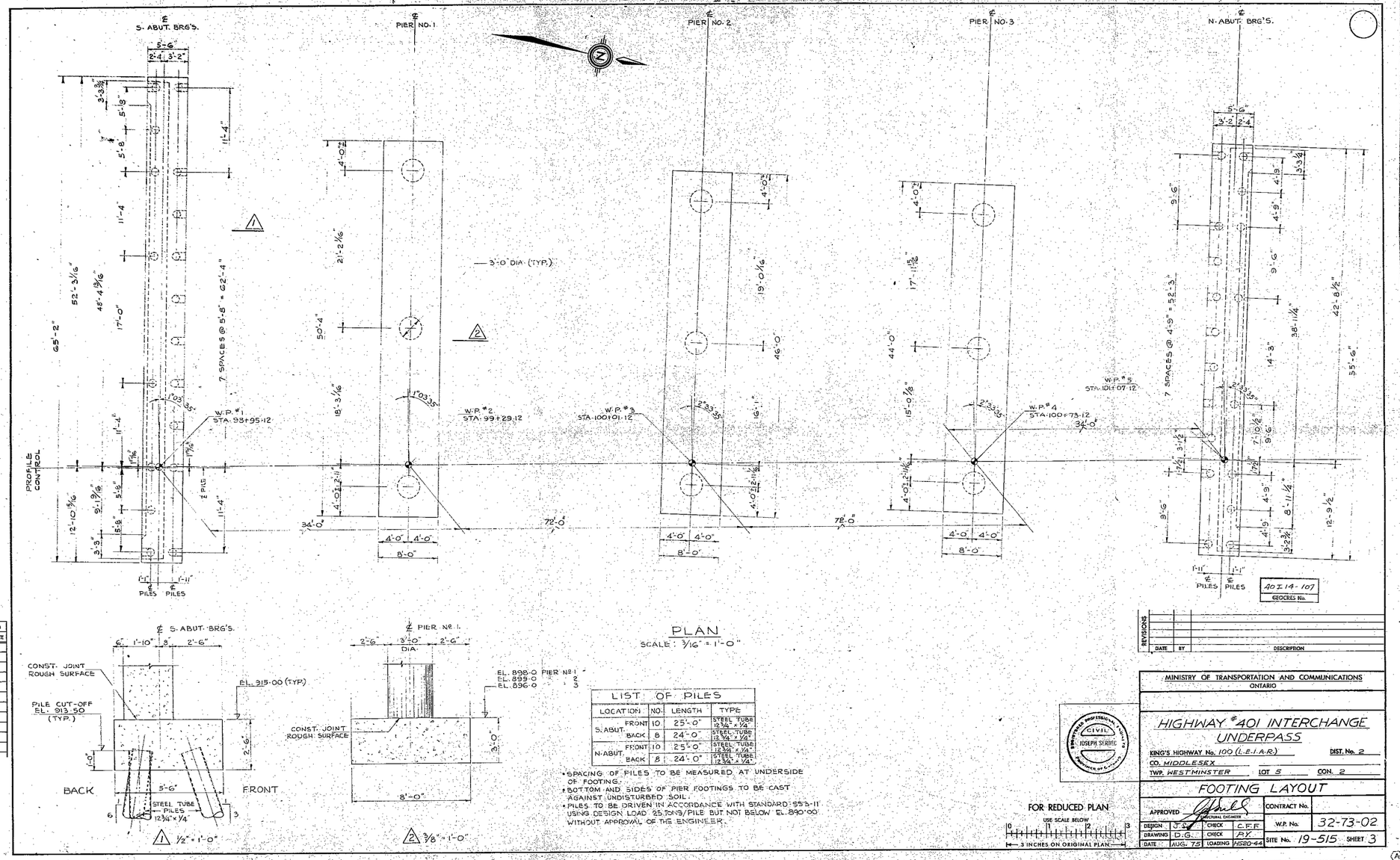
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO

HIGHWAY # 401 INTERCHANGE
UNDERPASS

KING'S HIGHWAY No. 100 (L.E.I.A.R.) DIST. No. 2
CO. MIDDLESEX
TWP. WESTMINSTER LOT 5 CON. 2

GENERAL PLAN

| | | | | | |
|---|---|---|---|---|---|
| APPROVED | | CONTRACT No. | | | |
| DESIGN | J.E. | CHECK | C.F.F. | W.P. No. | 32-73-02 |
| DRAWING | A. | CHECK | J.E. | | |
| DATE | AUG. 1975 | LOADING | MS20-44 | SITE No. | 19-515 SHEET 1 |




PLAN
SCALE: 3/16" = 1'-0"

℄ S. ABUT. BRG'S.

CONST. JOINT ROUGH SURFACE
PILE CUT-OFF EL. 913.50 (TYP.)
EL. 915.00 (TYP.)
BACK
FRONT
STEEL TUBE PILES 12 3/4" x 1/4"

℄ PIER No. 1

CONST. JOINT ROUGH SURFACE
EL. 898.0 PIER No. 1
EL. 899.0 2
EL. 896.0 3
8'-0"

| LIST OF PILES | | | |
|---|---|---|---|
| LOCATION | NO. | LENGTH | TYPE |
| S. ABUT. FRONT | 10 | 25'-0" | STEEL TUBE 12 3/4" x 1/4" |
| S. ABUT. BACK | 8 | 24'-0" | STEEL TUBE 12 3/4" x 1/4" |
| N. ABUT. FRONT | 10 | 25'-0" | STEEL TUBE 12 3/4" x 1/4" |
| N. ABUT. BACK | 8 | 24'-0" | STEEL TUBE 12 3/4" x 1/4" |

- SPACING OF PILES TO BE MEASURED AT UNDERSIDE OF FOOTING.
- BOTTOM AND SIDES OF PIER FOOTINGS TO BE CAST AGAINST UNDISTURBED SOIL.
- PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD S.S.S.-11 USING DESIGN LOAD 25 TONS/PILE BUT NOT BELOW EL. 890.00 WITHOUT APPROVAL OF THE ENGINEER.

| PRINT RECORD | | |
|---|---|---|
| No. | FOR | DATE |
| | | |

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

PROFESSIONAL ENGINEERS ACT — CIVIL — JOSEPH SERBIS

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| | | |

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO

# HIGHWAY #401 INTERCHANGE UNDERPASS

KING'S HIGHWAY No. 100 (L.E.I.A.R.) DIST. No. 2
CO. MIDDLESEX
TWP. WESTMINSTER LOT 5 CON. 2

## FOOTING LAYOUT

APPROVED _____ STRUCTURAL ENGINEER

| | | | |
|---|---|---|---|
| DESIGN | J.S. | CHECK | C.F.F. |
| DRAWING | D.G. | CHECK | P.Y. |
| DATE | AUG. 73 | LOADING | HS20-44 |

CONTRACT No.
W.P. No. 32-73-02
SITE No. 19-515 SHEET 3

40 I 14-107
GEOCRES No.

# Appendix B

## Explanation of Terms Used in Report
## Record of Borehole Sheets - Boreholes 1 and 2

# EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

| N (BLOWS/0.3m) | 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 |

## 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

| | | |
|---|---|---|
| $m_v$ | $kPa^{-1}$ | COEFFICIENT OF VOLUME CHANGE |
| $C_c$ | 1 | COMPRESSION INDEX |
| $C_s$ | 1 | SWELLING INDEX |
| $C_\alpha$ | 1 | RATE OF SECONDARY CONSOLIDATION |
| $c_v$ | $m^2/s$ | COEFFICIENT OF CONSOLIDATION |
| H | m | DRAINAGE PATH |
| $T_v$ | 1 | TIME FACTOR |
| U | % | DEGREE OF CONSOLIDATION |
| $\sigma'_{vo}$ | 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 |
| $S_t$ | 1 | SENSITIVITY = $\frac{c_u}{\tau_r}$ |

## PHYSICAL PROPERTIES OF SOIL

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

# RECORD OF BOREHOLE No 1

1 OF 3

**METRIC**

W.P. GWP 3033-11-00 LOCATION Veterans Memorial Parkway SE Northing - 4756823, Easting - 416987 ORIGINATED BY JL

DIST London HWY 401 BOREHOLE TYPE 110 mm ID H/S Auger COMPILED BY JL

DATUM Geodetic DATE 21.2.12 - 22.2.12 CHECKED BY EC

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) (10 20 30) | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 275.44 | Ground | | | | | | | | | | |
| 0.00 | 150 mm TOPSOIL | | 1 | SPT | 21 | | 275 | | | | 9 79 (11) Water Ingress @ 1.5 m during drilling. |
| | FILL Brown, moist to wet, compact, consisting of sand with trace gravel. | | | | | | | | | | |
| 273.92 | | | | | | | | | | | |
| 1.52 | | | 2 | SPT | 12 | | 274 | | | | |
| | SILT, ML Brow, wet, compact, trace fine sand. | | | | | | | | | | |
| 272.39 | | | | | | | | | | | |
| 3.05 | | | 3 | SPT | 14 | | 272 | 125 | | 17.4 | 3 30 44 24 (67) |
| | | | 4 | SPT | 21 | | 271 | 200 | | | |
| | Clayey SILT to Silty CLAY, CL-ML to CL Grey, moist, stiff to very stiff, with embedded sand and gravel (TILL). | | | | | | 270 | | | | |
| | | | 5 | SPT | 25 | | 269 | 200 | | | |
| | | | 6 | SPT | 22 | | 268 | 75 | | 21.4 | 5 15 50 31 (81) |
| 267.06 | | | | | | | | | | | |
| 8.38 | | | | | | | 267 | | | | |
| | SILT, ML Grey, wet, compact. | | 7 | SPT | 24 | | 266 | | | | 0 0 93 7 (100) |
| 265.53 | | | | | | | | | | | |
| 9.91 | | | | | | | 265 | | | | |
| | Silty CLAY, CL Grey, moist, hard. | | 8 | SPT | 32 | | | 225 | | 19.1 | 0 0 66 34 (100) |
| 264.01 | | | | | | | 264 | | | | |
| 11.43 | | | | | | | | | | | |
| | | | 9 | SPT | 33 | | 263 | | | | 0 94 (6) Water level measured @ 12.8 m on May 31, 2012 before bailing. |
| | SAND, SP Grey, moist to wet, tr. silt. | | | | | | 262 | | | | |
| | | | 10 | SPT | 22 | | 261 | | | | |

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

# RECORD OF BOREHOLE No 1

2 OF 3

**METRIC**

W.P. GWO-3033-11-00 LOCATION Veterans Memorial Parkway SE Northing - 4756823, Easting - 416987 ORIGINATED BY JL

DIST London HWY 401 BOREHOLE TYPE 110 mm ID H/S Auger COMPILED BY JL

DATUM Geodetic DATE 21.2.12 - 22.2.12 CHECKED BY EC

| ELEV / DEPTH | DESCRIPTION | NUMBER | TYPE | "N" VALUES | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|
| | SAND, SP<br>Grey, moist to wet, tr. silt. *(continued)* | 11 | SPT | 98 | | 1 92 (7)<br>Water level measured @ 16.1 m on June 2, 2012. |
| 258.52 / 16.92 | | | | | | |
| | | 12 | SPT | 91 | 21.1 | 3 31 48 18 (66) |
| | Clayey SILT to Silty CLAY, CL-ML to CL<br>Grey, moist to wet, hard, with embedded sand and gravel (TILL), occassional frequent wet silty sand seams. | 13 | SPT | 95 | | |
| | | 14 | SPT | 46 | 21.7 | 4 24 53 20 (73) |
| | | 15 | SPT | 82 | | |
| 246.48 / 28.96 | Layered SAND & SILT, SM to ML<br>Grey, dense. | | | | | |

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

○ ¹⁵⁰ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

## RECORD OF BOREHOLE No 1 3 OF 3 METRIC

W.P. GWP 3033-11-00 LOCATION Veterans Memorial Parkway SE Northing - 4756823, Easting - 416987 ORIGINATED BY JL

DIST London HWY 401 BOREHOLE TYPE 110 mm ID H/S Auger COMPILED BY JL

DATUM Geodetic DATE 21.2.12 - 22.2.12 CHECKED BY EC

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT w / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (10 20 30) | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | GR SA SI CL |
| | Layered SAND & SILT, SM to ML<br>Grey, dense. *(continued)* | | | | | | 245 | | | | |
| 244.50 | | | 16 | SPT | 31 | | | | | | 0 51 43 7 (49) |
| 30.94 | End of borehole. | | | | | | | | | | |

+ 3, × 3: Numbers refer to Sensitivity

○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

# RECORD OF BOREHOLE No 2

1 OF 3

**METRIC**

W.P. GWP 3033-11-00 LOCATION Veterans Memorial Parkway NW Northing - 4756861, Easting - 416949 ORIGINATED BY JL

DIST London HWY 401 BOREHOLE TYPE 110 mm ID H/S Auger COMPILED BY JL

DATUM Geodetic DATE 23.2.12 - 24.2.12 CHECKED BY EC

| ELEV / DEPTH | DESCRIPTION | NUMBER | TYPE | "N" VALUES | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|
| 274.87 | Ground | | | | | |
| 0.00 / 274.57 | 300 mm TOPSOIL | 1 | SPT | 9 | | 38 40 18 4 (22) |
| 0.30 | Mixed FILL Brown/grey/black, moist to wet, loose to compact, consisting of gravel, sand silt and organics. 150 mm thick buried topsoil at bottom of sampler. | | | | | |
| 273.04 / 1.83 | Buried TOPSOIL | 2 | SPT | 11 | | |
| 272.74 / 2.13 | assumed 300 mm. | | | | | |
| | Brown | 3 | SPT | 16 | 18.5 | 0 10 72 18 (90) |
| | | 4 | SPT | 33 | | |
| | Silty CLAY, CL Moist to wet, stiff to hard, with embedded sand and gravel (TILL), occasional wet silt seams and partings. | 5 | SPT | 15 | 18.2 | 5 18 53 24 (78) |
| | Grey | 6 | SPT | 15 | | |
| | | 7 | SPT | 18 | | Water level measured @ 8.9 m on May 31, 2012 before bailing. |
| 264.20 / 10.67 | SILT, ML Grey, wet, compact, occasional silty clay partings. | 8 | SPT | 28 | | 0 1 87 12 (99) |
| 263.29 / 11.58 | Silty CLAY, CL Grey, moist, hard. | | | | | Water level measured @ 11.5 m on June 2, 2012. |
| 262.37 / 12.50 | | 9 | SPT | 30 | 18.3 | 0 6 44 50 (94) |
| | Silty SAND, SM Grey, wet, compact. | 10 | SPT | 27 | | 0 89 10 1 (11) |

PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100)

SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)

PLASTIC LIMIT $w_P$ NATURAL MOISTURE CONTENT $w$ LIQUID LIMIT $w_L$

WATER CONTENT (%) (10 20 30)

ELEVATION SCALE: 274 273 272 271 270 269 268 267 266 265 264 263 262 261 260

225+ 225+ 75 100 100

GROUND WATER CONDITIONS

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

# RECORD OF BOREHOLE No 2

2 OF 3 **METRIC**

W.P. GWP 3033-11-00 LOCATION Veterans Memorial Parkway NW Northing - 4756861, Easting - 416949 ORIGINATED BY JL

DIST London HWY 401 BOREHOLE TYPE 110 mm ID H/S Auger COMPILED BY JL

DATUM Geodetic DATE 23.2.12 - 24.2.12 CHECKED BY EC

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | PENETR. RESISTANCE STANDARD ● DYN. CONE / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT w / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT $\gamma$ kN/m$^3$ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Silty SAND, SM<br>Grey, wet, compact. *(continued)* | | 11 | SPT | 24 | | 259 | | | | |
| 258.11<br>16.76 | | | | | | | 258 | | | | |
| | | | 12 | SPT | 49 | | 257 | | 225+ | 22.7 | 2 23 56 19 (75) |
| | Silty CLAY, CL<br>Grey, wet, hard, with embedded sand and gravel (TILL), occasional wet sand seams. | | 13 | SPT | 60 | | 256<br>255<br>254<br>253 | | 225+ | | |
| | | | 14 | SPT | 43 | | 252<br>251 | | 225+ | 19.7 | 1 21 62 16 (78) |
| 248.66<br>26.21 | | | | | | | 250<br>249 | | | | |
| | SILT to Sandy SILT, ML<br>Grey, wet, very dense, with occasional silty clay partingsand seams. | | 15 | SPT | 94 | | 248<br>247<br>246 | | | | 0 20 78 2 (80) |
| | | | | | | | 245 | | | | |

Continued Next Page

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

# RECORD OF BOREHOLE No 2

3 OF 3 **METRIC**

W.P. GWP 3033-11-00 LOCATION Veterans Memorial Parkway NW Northing - 4756861, Easting - 416949 ORIGINATED BY JL

DIST London HWY 401 BOREHOLE TYPE 110 mm ID H/S Auger COMPILED BY JL

DATUM Geodetic DATE 23.2.12 - 24.2.12 CHECKED BY EC

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | PENETR. RESISTANCE STANDARD ● DYN. CONE / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT w / LIQUID LIMIT $w_L$ / WATER CONTENT (%) | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SILT to Sandy SILT, ML<br>Grey, wet, very dense, with occasional silty clay partingsand seams. *(continued)* | | 16 | SPT | 85 | | 244 | | | | |
| | | | | | | | 243 | | | | |
| | | | | | | | 242 | | | | |
| | | | 17 | SPT | 61 | | 241 | | | | 0 55 44 1 (45) |
| 239.82<br>35.05 | | | | | | | 240 | | | | |
| | Clayey SILT to Silty CLAY, CL-ML to CL<br>Grey, moist to wet, hard, with embedded sand and gravel (TILL), occassional frequent wet silty sand seams. | | | | | | 239 | | | | |
| | | | 18 | SPT | 52 | | 238 | 225+ | | 20.5 | 0 8 69 23 (92) |
| | | | | | | | 237 | | | | |
| | | | | | | | 236 | | | | |
| 234.79<br>40.08 | | | 19 | SPT | 84 | | 235 | 225+ | | | |
| 234.13<br>40.74 | Presumed hard Clayey SILT to Silty CLAY TILL.<br>End of borehole. | | | | | | | | | | |

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

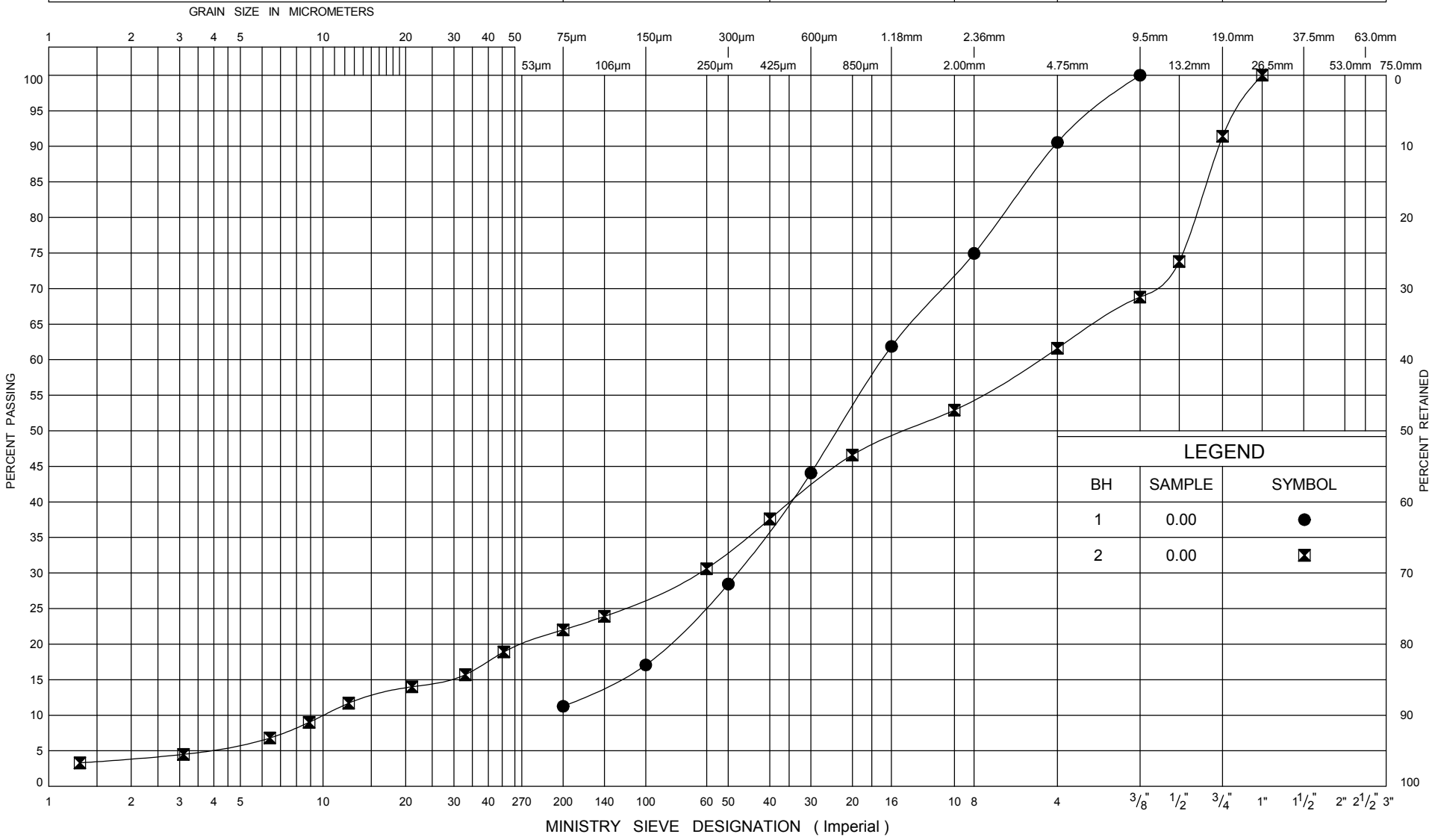
$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

# Appendix C

## Laboratory Test Results

| | |
|---|---|
| Grain Size Distribution | Figures 1, 2, 3, 4 and 6 |
| Plasticity Chart | Figures 5 & 7 |

# UNIFIED SOIL CLASSIFICATION SYSTEM

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## GRAIN SIZE DISTRIBUTION

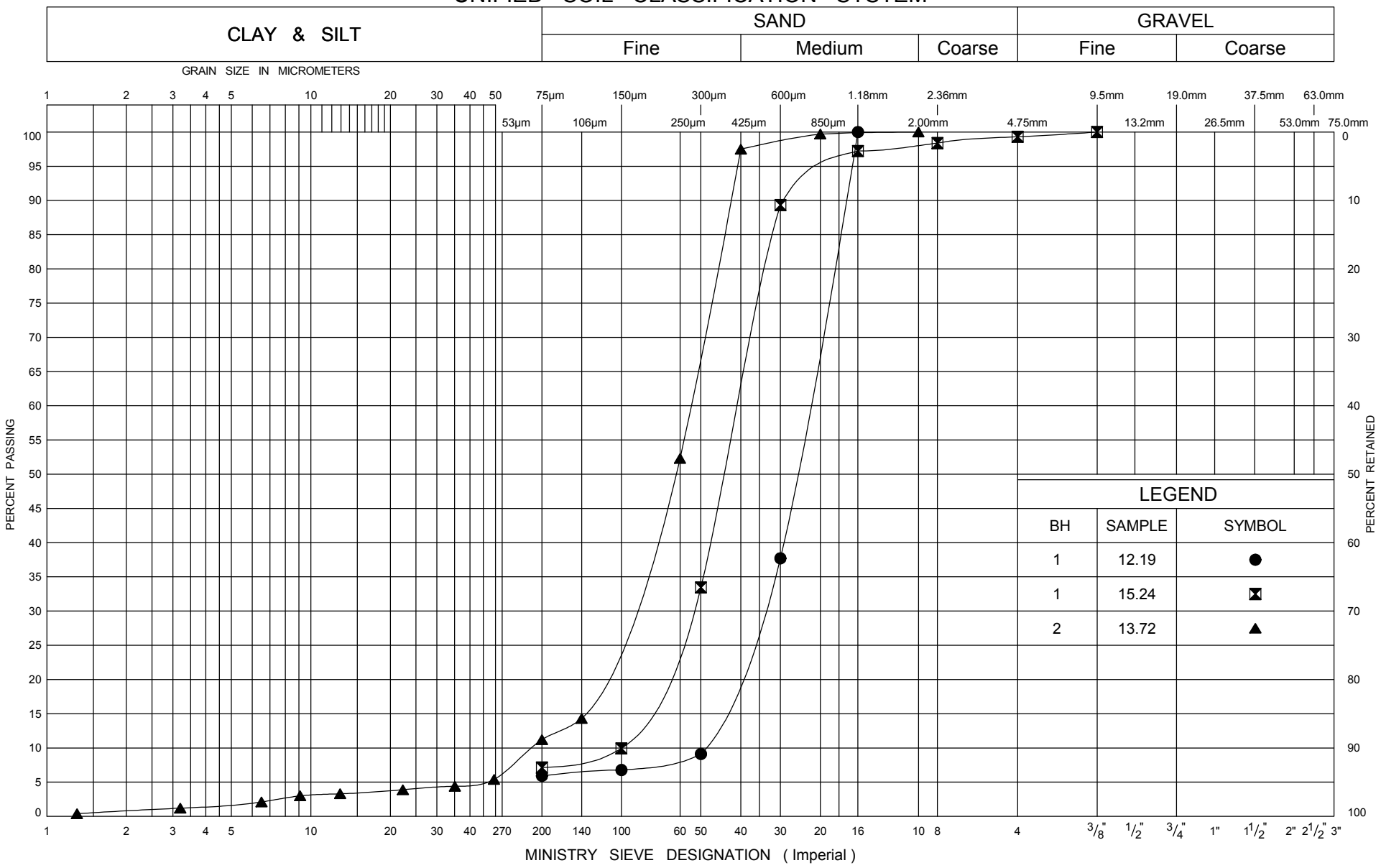
Fill

FIG No 1

GWP 3033-11-00

Veterans Memorial Parkway

# UNIFIED SOIL CLASSIFICATION SYSTEM

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## GRAIN SIZE DISTRIBUTION

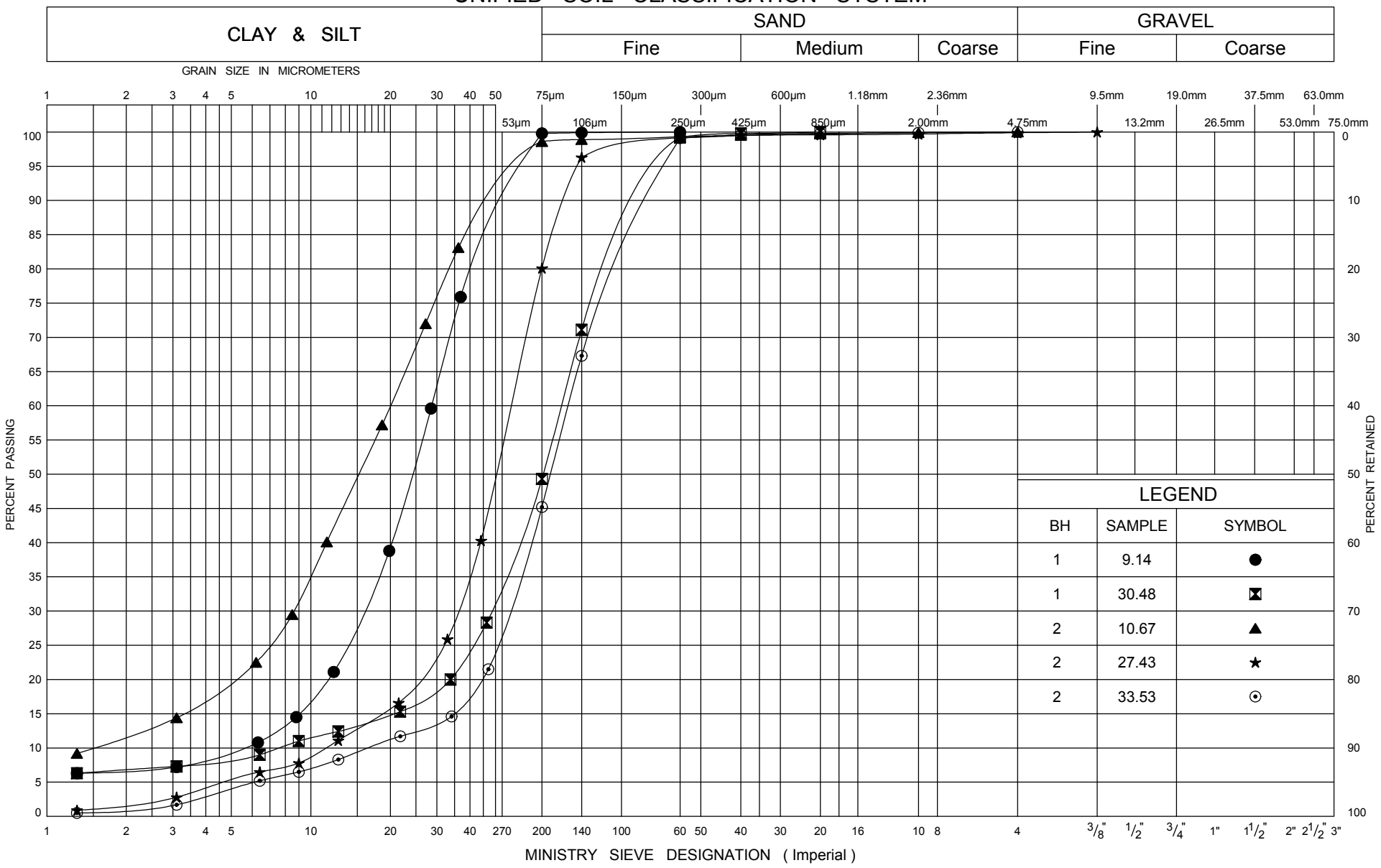
Sand, SP

FIG No 2

GWP 3033-11-00

Veterans Memorial Parkway

# UNIFIED SOIL CLASSIFICATION SYSTEM

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## GRAIN SIZE DISTRIBUTION

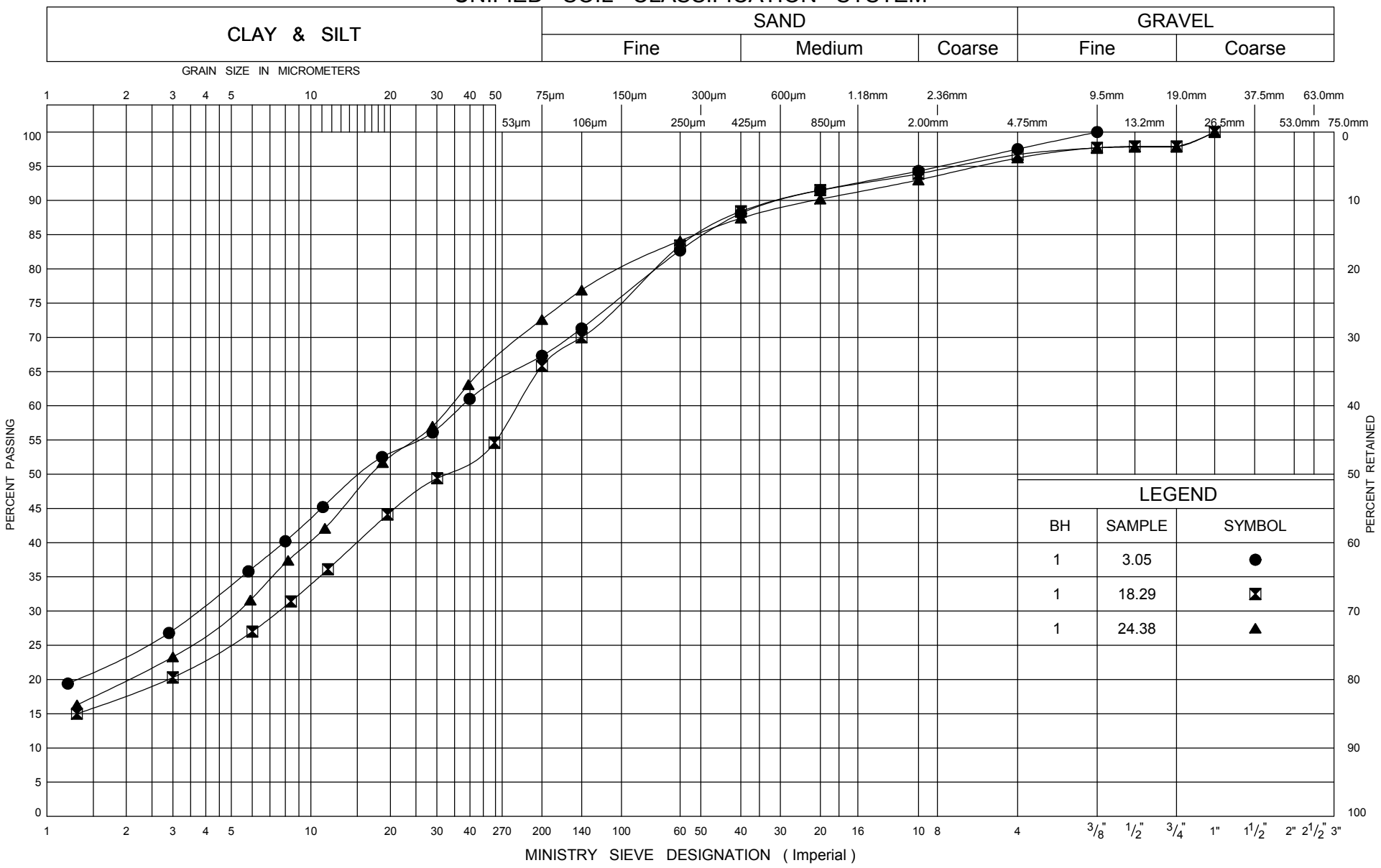
Sand and Silt to Silt, SM-ML to ML

FIG No 3

GWP 3033-11-00

Veterans Memorial Parkway

# UNIFIED SOIL CLASSIFICATION SYSTEM

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## GRAIN SIZE DISTRIBUTION

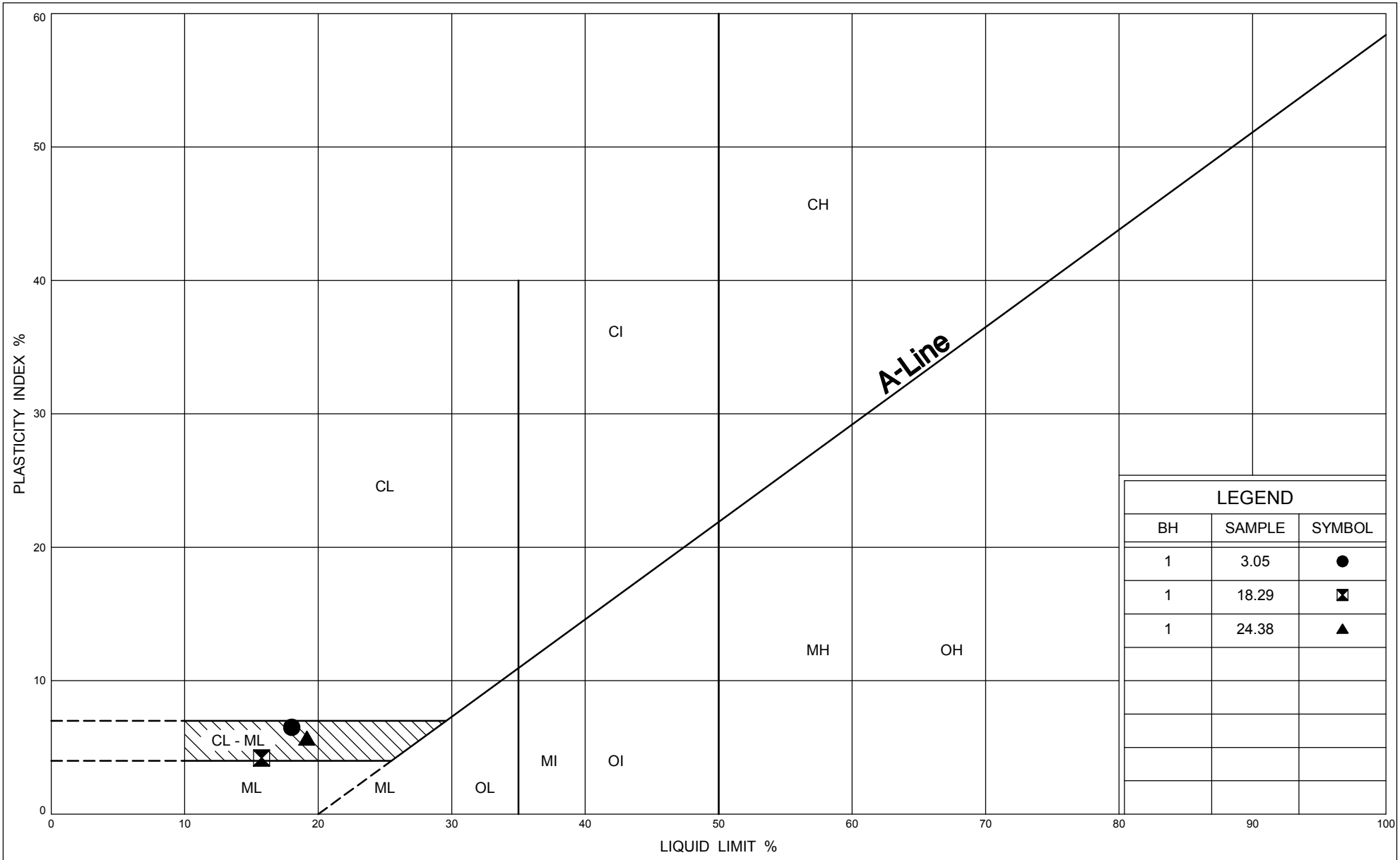
Clayey Silt, CL-ML

FIG No 4

GWP 3033-11-00

Veterans Memorial Parkway

Oct 75, FF - S - 21




| LEGEND | | |
|---|---|---|
| BH | SAMPLE | SYMBOL |
| 1 | 3.05 | ● |
| 1 | 18.29 | ⊠ |
| 1 | 24.38 | ▲ |

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# PLASTICITY CHART

## Clayey Silt, CL-ML

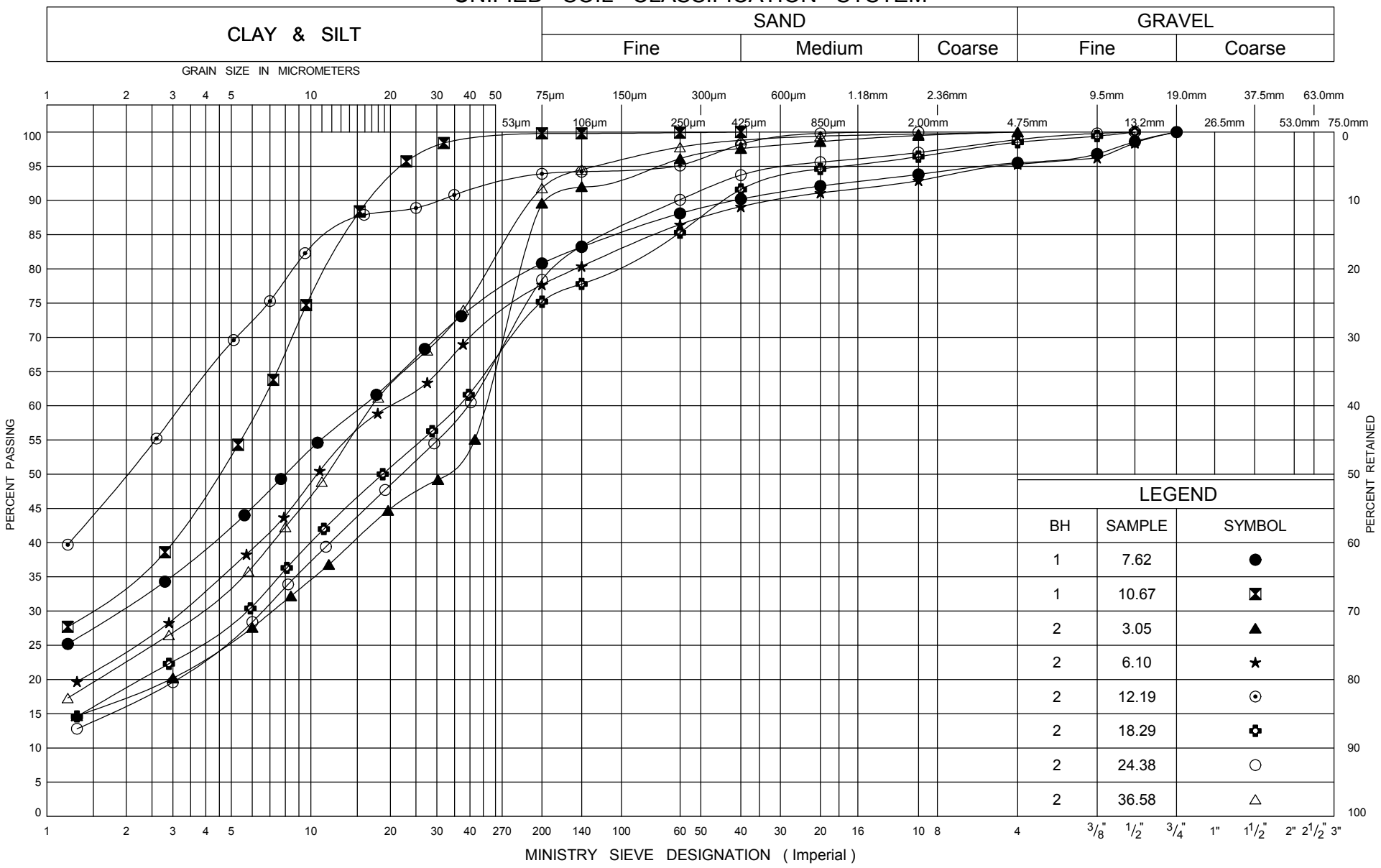
FIG No 5

GWP 3033-11-00

Veterans Memorial Parkway

ONTARIO MOT PLASTICITY CHART LARGE CULVE 12-1-IEG1 VETERANS FOUNDATIONS.GPJ ONTARIO MOT.GDT 28/5/12

# UNIFIED SOIL CLASSIFICATION SYSTEM

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## GRAIN SIZE DISTRIBUTION

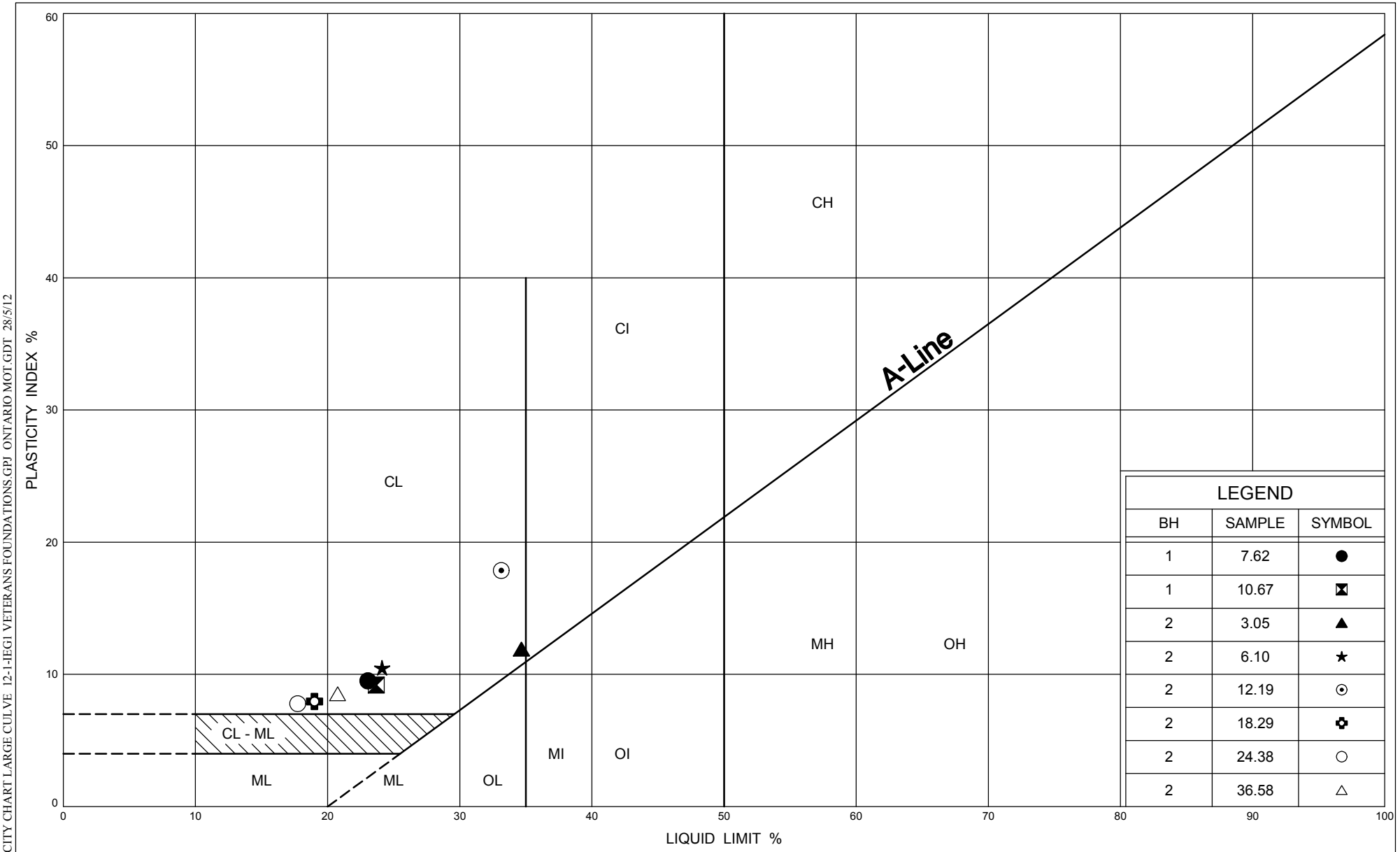
Silty Clay, CL

FIG No 6

GWP 3033-11-00

Veterans Memorial Parkway

Oct 75, FF - S - 21




| LEGEND | | |
|---|---|---|
| BH | SAMPLE | SYMBOL |
| 1 | 7.62 | ● |
| 1 | 10.67 | ⊠ |
| 2 | 3.05 | ▲ |
| 2 | 6.10 | ★ |
| 2 | 12.19 | ⊙ |
| 2 | 18.29 | ✿ |
| 2 | 24.38 | ○ |
| 2 | 36.58 | △ |

Ministry of Transportation
Ontario

# PLASTICITY CHART

## Silty Clay, CL

FIG No 7

GWP 3033-11-00

Veterans Memorial Parkway

ONTARIO MOT PLASTICITY CHART LARGE CULVE 12-1-IEG1 VETERANS FOUNDATIONS.GPJ ONTARIO MOT.GDT 28/5/12

# Appendix D

## Limitations of Report

# APPENDIX D

## LIMITATIONS OF REPORT

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

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

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

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

This report does not reflect the environmental issues or concerns unless otherwise stated in the report.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, IEG recommends that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

# Appendix E

## Site Photographs


**Aerial view of the existing Highway 401 Interchange @ VMP**


**West Elevation of VMP Structure**


**East Elevation of VMP Structure**


**VMP Looking South**


**VMP Looking North**