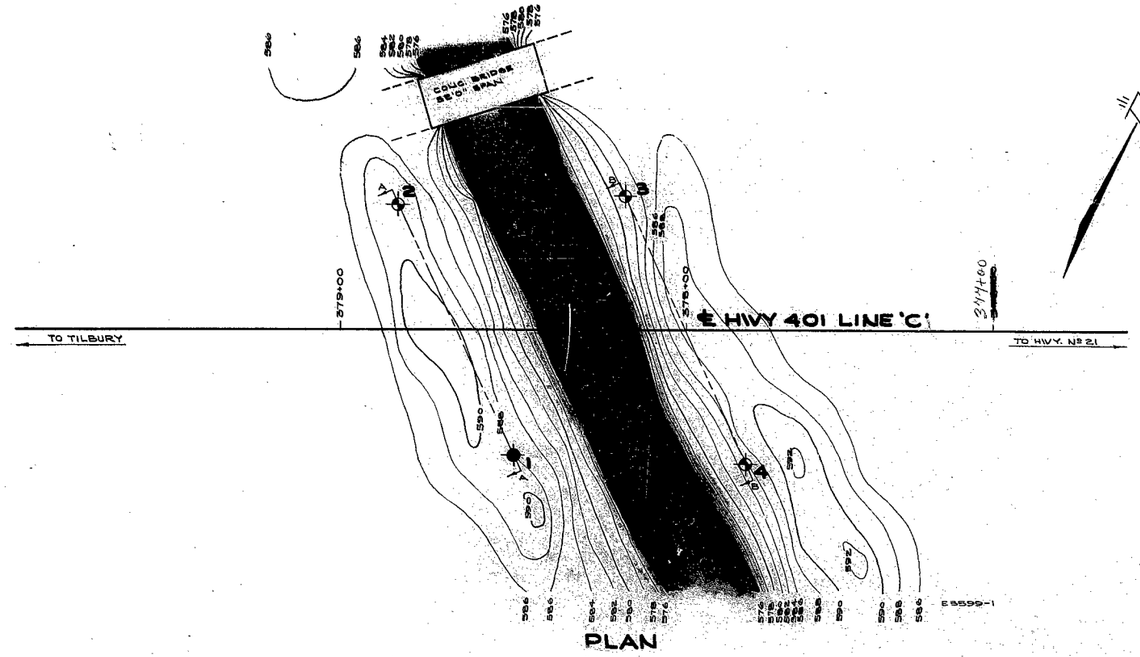
W.P. 11-59

HWY. 401

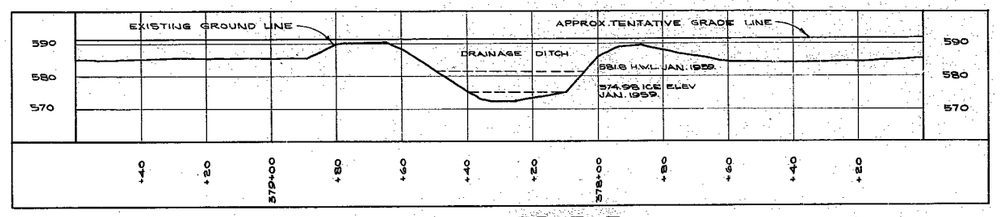
SOUTH OF

CHATHAM

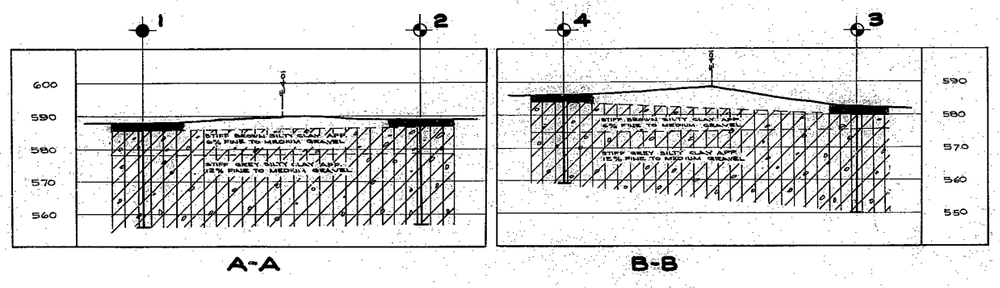
40J8-4



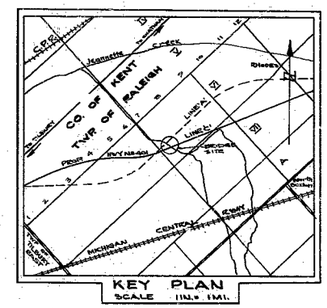

PLAN




PROFILE




A-A B-B




KEY PLAN
SCALE 1 1/2" = 1 MI.

**LEGEND**

| | |
|---|---|
| BORE HOLE | ● |
| PENETRATION HOLE | ⊕ |
| BORE & PENETRATION HOLE | ◉ |

| HOLE NO. | ELEVATION | STATION | DISTANCE FROM ℄ |
|---|---|---|---|
| 1 | 588.0' | 378+47 | 58' LT. |
| 2 | 589.0' | 378+82 | 58' LT. |
| 3 | 582.0' | 378+13 | 41' RT. |
| 4 | 586.0' | 377+76 | 41' RT. |

- NOTE -

THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BETWEEN BORE HOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE AND MAY BE SUBJECT TO CONSIDERABLE ERROR.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

# DRAINAGE DITCH PROPOSED CROSSING

SHOWING POSITIONS & ELEVATIONS OF HOLES

HWY. 401 DISTRICT 1 COUNTY KENT
TOWNSHIP RALEIGH LOT 7 CON. VI
LOCATION APP. 3 MI. S. OF CHATHAM

| | | |
|---|---|---|
| DRAWN BY: T.MELLORS | CHECKED BY: | W.P. 11-59. |
| DATE APR. 29/59. | APPROVED BY: | DRAWING NO. F59-6A. |
| SCALE 1" = 20' | | |

40J8-4
GEOCRES No.

# FOUNDATION REPORT

on

Hwy. 401, Line 'C' and
Drainage Ditch Crossing,
Lot 7, Con. VI, Twp. of
Raleigh - Approximately
3 Miles South of Chatham.

---

Site Plan No. E 3599-1
Chainage: Sta. 375+25

Distribution:

Mr. A. M. Toye,
Bridge Engineer. (2)

Mr. R. A. Tregaskes,
Construction Engineer. (1)

Mr. D. G. Ramsay,
Design Engineer. (2)

Mr. G. U. Howell,
District Engineer,
Chatham, Ontario. (1)

Mr. J. Roy,
Regional Soils Engr.,
London Regional Office. (1)

Dr. A. Harrow,
Department of Mines. (1)

Foundation Section. (1)

File. (1)

cc: Foundations Office

Mr. A. M. Toye,
Bridge Engineer.

May 8, 1959.

Re: FOUNDATION REPORT -
Hwy. 401, Line 'C' & Drainage
Ditch Crossing, Twp. of Raleigh -
W.P. 11-59 -- District #1.

Materials & Research Section.

Attention: Mr. J. McCombie.

Enclosed herewith is our Foundation Report showing the subsoil conditions at the above noted site. Reference to the contents of the report shows that the site is covered by stiff silty clay underlain by deep deposits of soft to medium silty clay.

For your convenience, recommendations pertinent to the foundation design are summarized as follows:-

1. Subsoil conditions are such that at elevation 574' or below in the stiff silty clay, for footings typically 7' to 10' wide, a safe footing pressure of 2 1/2 t.s.f. can be used for spread footing design. In order to avoid undesirable undermining of the footings due to stream erosion and scour action and to allow for future deepening of the channel, it is recommended that footings be founded at Elev. 564' or below.

2. Long-term settlements resulting from abutment loading have been estimated as of the order of 4 inches. For a single-span structure, the resultant differential settlements are considered tolerable.

3. No excessive seepage problems with respect to footing excavations are anticipated.

4. The proposed grade line does not present any approach fill stability problems. Bank slopes on the upstream side of the structure should be protected by rip-rap.

If you require any clarification of data and recommendations contained in the report, please contact our office.

Yours very truly,

L. E. Soderman,
MUNICIPAL SOILS & FOUNDATION ENGINEER

A. Loh,
FOUNDATION ENGR.

Encl.

cc: Messrs. A. Toye
H. Tregaskes
D. Ramsay
C. Howell
J. Foy
Dr. J. Marrow
Foundation Office - File

## INTRODUCTION:

Presented in this report are the results of a subsoil investigation carried out at a structure location approximately 3 miles South of Chatham where proposed Hwy. 401 Line 'C' crosses the drainage ditch in Lot 7, Con. VI, Township of Raleigh - (Sta. 378+25, Site Plan No. S 3599-1). This report contains the results of field and laboratory findings and recommendations for the foundation of the proposed structure.

The field work commenced on January 28, 1959 and was completed on February 7, 1959.

## DESCRIPTION OF THE SITE AND GEOLOGY:

The site and its surrounding area, are generally flat farmlands; the areas on both sides of the drain are presently under cultivation. The drain was originally a branch of Jeannette Creek which has been dredged and widened into a drainage channel. At the time of the investigation the drainage channel and its banks were covered with ice and snow.

Physiographically, the site is located on the St. Clair Clay Plains which were inundated by Glacial Lakes Whittlesey and Warren. According to available geological information, these extensive plains, covering a large area of South-Western Ontario, are covered by deep deposits of clay, underlain by limestone bedrock. At this site, the upper 10 feet of the clay stratum has been subjected to oxidation resulting in its present brownish colour.

cont'd. / 2...

## DESCRIPTION OF FIELD & LABORATORY WORK:

Field work consisted of 4 sampled boreholes, carried out by a skid-mounted coredrill machine adapted for soil sampling. Conventional wash boring procedures were followed and samples were recovered at depths required. 2" I.D. thin walled shelby tube samplers were used in the cohesive subsoil. In addition, a dynamic cone penetration profile was obtained adjacent to Borings 2, 3 & 4.

Upon receipt in the laboratory, samples were visually examined and identified. Routine index tests were performed on selected representative samples. Laboratory test results have been presented in the borehole logs and detailed in tabular form.

The location plan and subsoil profile are presented in Drawing No. F-59-6..

## SUBSOIL CONDITIONS:

Subsoil conditions at this site are similar to all other sites previously investigated in this area. Reference to the borehole logs shows that the site is underlain by a stiff silty clay stratum, the upper zone of which has been subjected to oxidation. According to our boring data in this locality, the stiff silty clay stratum is underlain by a thick stratum of soft to medium silty clay, which extends to a considerable depth over bedrock.

In each of the sampled boreholes, the frozen topsoil was found to be underlain by the stiff silty clay stratum. The upper 10 feet of the clay stratum has been oxidized to its present brownish colour. Below the oxidized zone the colour is predominantly grey. The stiff condition of the clay stratum is believed

cont'd. /3 ...

SUBSOIL CONDITIONS: (cont'd.)

to be the result of desiccation. This stratum was explored to a depth of 32 feet below the existing ground surface (i.e., Elev. 550') to confirm the stiff nature of the clay. In view of the similarity in geological formation as well as subsoil conditions between this site and all other sites in this area previously investigated, it is felt justified to assume that the soft to medium clay stratum would most likely be encountered at some depth below Elev. 550'.

In general, the stiff clay contains 28% silt, 18% sand and 6% to 12% fine to medium gravel throughout. Average unit weight and moisture content were found to be 132 p.c.f. and 18%, respectively. Liquid and plastic limits averaged 28% and 16%. Laboratory shear strength tests show an average of 1300 p.s.f. to be representative for the 32 ft. layer. A plot of shear strength versus depth has been presented and is included in this report under Appendix I. Judging from its moisture content and Atterberg limits, the stiff silty clay appears to be saturated and preconsolidated.

Laboratory and field test results have been summarized in Table No. I and are included in this report under Appendix I.

WATER CONDITIONS:

Water levels in the boreholes recorded during the boring programme, indicate that the ground water table at the site is at approximately Elevations 574' to 581', which corresponds to the seasonal creek water level of the drainage canal. No artesian water conditions or water-bearing sand seams of any significance

cont'd. /4 ...

**WATER CONDITIONS:** (cont'd.) ...

were encountered in the borings. In view of the low permeability of the clay, no seepage problems are anticipated during footing excavations. If seepage does occur, seepage inflow into excavations will be local and of minor quantities, only.

FOUNDATION CONSIDERATIONS:

The stiff silty clay stratum is competent to provide adequate foundation support for the proposed structure. Laboratory and field test results are such that spread footing support can be obtained in the stiff clay at elevation 572' or below. At this elevation or below, for footings of 7' to 10' in width, a bearing pressure of 2 1/2 t.s.f. incorporating a safety factor of 3 can be used for spread footing design. Consideration should be given to founding footings below the stream bed elevation in order to protect them from stream erosion and scour, and to allow for future deepening of the channel. Footings founded at Elev. 564' (approx. 8 ft. below stream bed elevation) are believed to have adequate protection against erosion and scour.

Ultimate settlements under the footings, consequent upon application of a 1/2 t.s.f. bearing pressure will be of the order of + inches. This is mainly due to the fact that the stresses caused by the applied load will influence the deep deposits of soft to medium clay for a considerable depth. In view of the relatively uniform soil conditions at the site, little differential settlement need be anticipated of a single-span structure since each abutment will virtually settle the same amount.

cont'd. /5 ...

**FOUNDATION CONSIDERATIONS: (cont'd.) ...**

No excessive seepage problems during excavations and placing of footings are anticipated.

The proposed grade line presents no approach fill stability problems.

CONCLUSIONS & RECOMMENDATIONS:

(1) The site is underlain by stiff silty clay followed by deep deposits of soft to medium silty clay.

(2) Subsoil conditions are such that spread footing support can be obtained in the stiff clay stratum at Elev. 572' or below. At this elevation or below, for footings of 7' to 10' in width, a bearing pressure of 2 1/2 t.s.f. can be used for spread footing design. In order to avoid undesirable undermining of the footings due to stream erosion and scour, and to allow for future deepening of the channel, it is recommended that footings be founded at Elev. 564' or below.

(3) Long-term settlements under the footings as a result of application of 2 1/2 t.s.f. bearing pressure, have been estimated as of the order of 4 inches. For a single-span structure, little differential settlement need be anticipated since each abutment will virtually settle the same amount.

cont'd. /6 ...

**CONCLUSIONS & RECOMMENDATIONS: (cont'd.) ...**

(4) No excessive seepage problems with respect to footing excavations are anticipated.

(5) The proposed grade line does not present any approach fill stability problems. Bank slopes on the upstream side of the structure should be protected by rip-rap.

A. Loh,
FOUNDATION ENGR.

## APPENDIX I.

# SUMMARY OF FIELD & LABORATORY TESTS

JOB [illegible]
W.P 11-59

| HOLE NO. | SAMPLE NO. | SAMPLE DEPTH (FEET) | MATERIAL DESCRIPTION | PENETRATION RESISTANCE (BLOWS/FT.) | MOISTURE CONTENT % | PLASTIC LIMIT % | LIQUID LIMIT % | SHEAR STRENGTH psf | UNIT WEIGHT p.c.f. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | T1 | [illegible] | Stiff brown silty clay. | 25 | 26.5 | 34.4 | 68.5 | 2200 | 118.0 | Approximately 6% fine medium gravel through |
| " | T2 | 6'-8' | " " " | 35 | 17.1 | 19.1 | 31.6 | 5570 | 127.3 | |
| " | T3 | 9'-11' | " " " | 48 | 16.6 | 17.7 | 32.0 | 6150 | 135.2 | |
| " | T4 | 15'-17' | Stiff grey silty clay. | 49 | 21.2 | 15.0 | 27.4 | 2125 | 129.3 | Approximately 12% fine medium gravel through |
| " | T5 | 20'-22' | " " " | 46 | 21.8 | 15.7 | 26.8 | 2220 | 134.0 | |
| " | T6 | 25'-27' | " " " | 33 | 21.6 | 14.3 | 25.8 | 1670 | 129.5 | |
| " | T7 | 30'-32' | " " " | 33 | 19.4 | 16.5 | 27.2 | 2490 | 134.0 | |
| 2 | T1 | [illegible] | Stiff brown silty clay. | 31 | 18.7 | - | - | 4920 | 131.2 | Approximately 6% fine medium gravel through |
| " | T2 | [illegible] | " " | 47 | 15.5 | 18.7 | 33.6 | 8580 | 132.7 | |
| " | T3 | [illegible] | " " | 62 | 14.8 | 16.8 | 29.1 | 6870 | 134.0 | |
| " | T4 | [illegible] | Stiff grey silty clay. | 44 | 17.2 | 16.2 | 28.9 | 2800 | 135.0 | Approximately 12% fine medium gravel through |
| " | T5 | [illegible] | " " | 31 | 17.2 | - | - | - | 132.2 | |
| " | T6 | [illegible] | " " | 26 | 18.1 | 15.9 | 28.0 | 1800 | 131.8 | |
| " | T7 | [illegible] | " " | 28 | 19.2 | - | - | 2420 | 134.1 | |
| 3 | T1 | [illegible] | Stiff brown silty clay. | 17 | 25.0 | 24.7 | 48.5 | 1440 | 122.0 | Approximately 6% fine medium gravel through |
| " | T2 | [illegible] | " " | 50 | 16.8 | - | - | 7220 | 135.6 | |
| " | T3 | [illegible] | " " | 8 | 16.1 | 16.3 | 29.6 | 3270 | 130.0 | |
| " | T4 | [illegible] | Stiff grey silty clay. | 21 | 17.9 | 16.3 | 29.8 | 1720 | 131.2 | Approximately 12% fine medium gravel through |
| " | T5 | [illegible] | " " | 22 | 19.2 | - | - | 420 | 132.0 | |
| " | T6 | [illegible] | " " | 16 | 18.5 | 15.5 | 29.1 | 1015 | 129.4 | |
| " | T7 | [illegible] | " " | 26 | 19.1 | - | - | - | 133.2 | |

cont'd. /2 ...

# SUMMARY OF FIELD & LABORATORY TESTS

JOB F-59-6
W.P. 11-59.

| HOLE NO. | SAMPLE NO | SAMPLE DEPTH (FEET) | MATERIAL DESCRIPTION | PENET'N RESIST BLOWS/FT. | MOIST CONT. % | PLASTIC LIMIT % | LIQUID LIMIT % | SHEAR STRENGTH psf | UNIT WEIGHT pcf | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | T1 | 3'-5' | Stiff brown silty clay. | 15 | 23.1 | - | - | - | 126 | Approximately 6% fine to |
| " | T2 | 6'-8' | " " " " | 73 | 16.7 | 18.7 | 32.2 | 6900 | 136.3 | medium gravel throughout. |
| " | T3 | 10'-12' | " " " " | 43 | 16.4 | 16.9 | 28.0 | 3100 | 135.0 | |
| " | T4 | 15'-17' | Stiff grey silty clay. | 59 | 16.9 | 16.6 | 27.8 | 2170 | 131.8 | Approximately 12% fine to |
| " | T5 | 20'-22' | " " " " | 29 | 17.9 | - | - | 2580 | 134.0 | medium gravel throughout. |
| " | T6 | 25'-27' | " " " " | 48 | 18.3 | 16.3 | 27.0 | 1920 | 131.8 | |

T1 - denotes thin walled shelby sample.

Consolidation Characteristics:-

Coefficient of volume compressibility ..... 0.01 sq.ft./ton.
Coefficient of consolidation ..... 0.14 sq.ft./day.

OFFICE REPORT OF SOIL EXPLORATION

# DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS AND RESEARCH SECTION

W.P. 11-59 BORE HOLE NO 1

JOB F-59-6 STATION 378+47 (38'Lt.)

DATUM Geodetic COMPILED BY B.K.

BORING DATE Jan. 28/59 CHECKED BY A.L.

2" DIA SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA CONE
2" SHELBY
CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) O
VANE TEST (C) AND SENSITIVITY (S) +S
NATURAL MOISTURE AND LIQUIDITY INDEX LI X
LIQUID LIMIT
PLASTIC LIMIT

| SYMBOL | DESCRIPTION | ELEV FEET | DEPTH FEET |
|---|---|---|---|
| | Ground Level | 588.0 | |
| | FROZEN TOPSOIL | 586.0 | |
| | Stiff brown silty clay - approx. 6% fine to medium gravel. | | |
| | W.L. ▽ 578.5 | | |
| | Stiff grey silty clay - Approx. 12% fine to medium gravel. | | |
| | | 556.0 | 32.0 |
| | End of Borehole. | | |

STRENGTH AND PENETRATION RESISTANCE
2000 4000 6000 8000
50 100 150 200 BLOWS/FT

CONSISTENCY
MOIST CONTENT % DRY WT
10 20 30

| SAMPLE | NATURAL UNIT WT. P.C.F. |
|---|---|
| TW 1 | 118.0 |
| TW 2 | 127.3 |
| TW 3 | 135.2 |
| TW 4 | 129.3 |
| TW 5 | 134.0 |
| TW 6 | 129.5 |
| TW 7 | 134.0 |

OFFICE REPORT ON SOIL EXPLORATION

# DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS AND RESEARCH SECTION

W.P. 11-59. BORE HOLE NO. 2

JOB F-50-6 STATION 378+82 (38' Rt.)

DATUM Geodetic COMPILED BY B.K.

BORING DATE Feb. 3/59. CHECKED BY A.L.

2" DIA SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA CONE
2" SHELBY
CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu)
VANE TEST (C) AND SENSITIVITY (S)
NATURAL MOISTURE AND LIQUIDITY INDEX
LIQUID LIMIT
PLASTIC LIMIT

| SYMBOL | DESCRIPTION | ELEV FEET | DEPTH FEET |
|---|---|---|---|
| | Ground Level. | 589.0 | |
| | FILL EMBANKMENT | 582.0 | |
| | Stiff brown silty clay - Approx. 6% fine to medium gravel. W.L. | 580.5 | |
| | | 578.5 | |
| | Stiff grey silty clay - Approx. 12% fine to medium gravel. | | |
| | End of Borehole. | 557.0 | 32.0 |

STRENGTH AND PENETRATION RESISTANCE — p.s.f. 2000 4000 6000 8000 — BLOWS/FT. 50 100 150 200

CONSISTENCY — MOISTURE CONTENT % DRY WT. 10 20 30

| SAMPLE | NATURAL UNIT WT. P.C.F. |
|---|---|
| TW 1 | 131.2 |
| TW 2 | 132.7 |
| TW 3 | 134.0 |
| TW 4 | 135.0 |
| TW 5 | 133.2 |
| TW 6 | 131.8 |
| TW 7 | 134.1 |

OFFICE REPORT ON SOIL EXPLORATION

# DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS AND RESEARCH SECTION

W.P. 11-59 BORE HOLE NO 3

JOB F-59-6. STATION 378+13 (41'Rt.)

DATUM Geodetic COMPILED BY B.K.

BORING DATE Feb. 4/59. CHECKED BY A.L.

2" DIA SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA CONE
2" SHELBY
CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) O
VANE TEST (C) AND SENSITIVITY (S) +S
NATURAL MOISTURE AND LIQUIDITY INDEX W LI
LIQUID LIMIT
PLASTIC LIMIT

| SYMBOL | DESCRIPTION | ELEV FEET | DEPTH FEET |
|---|---|---|---|
| | Ground Level. | 581.0 | |
| | FROZEN TOPSOIL | 580.0 | |
| | Stiff brown silty clay - Approx. 6% fine to med. gravel. | | |
| | W.L. ▽ 575.0 | | |
| | | 571.4 | |
| | Stiff grey silty clay - Approx. 12% fine to medium gravel. | | |
| | | 552.9 | 32.0 |
| | End of Borehole. | | |

STRENGTH AND PENETRATION RESISTANCE
2000 4000 6000 8000
50 100 150 200 BLOWS/FT.
0 10 20 30 40

STOPPED @ 32.0'

CONSISTENCY
MOIST CONTENT % DRY WT
10 20 30

| SAMPLE | NATURAL UNIT WT. P.C.F. |
|---|---|
| TW 1 | 122.0 |
| TW 2 | 135.6 |
| TW 3 | 137.0 |
| TW 4 | 133.2 |
| TW 5 | 132.0 |
| TW 6 | 129.6 |
| TW 7 | 133.8 |

# DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS AND RESEARCH SECTION

W.P. 11-59 BORE HOLE NO. 4

JOB P-59-6 STATION 377+76 (41'Lt.)

DATUM Geodetic COMPILED BY B.K.

BORING DATE Feb. 5/59. CHECKED BY A.L.

2" DIA SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA CONE
2" SHELBY
CASING

LEGEND

UNCONFINED COMPRESSION (Qu)
VANE TEST (C) AND SENSITIVITY (S)
NATURAL MOISTURE AND LIQUIDITY INDEX
LIQUID LIMIT
PLASTIC LIMIT

| SYMBOL | DESCRIPTION | ELEV FEET | DEPTH FEET |
|---|---|---|---|
| | Ground Level | 586.0 | |
| | FROZEN TOPSOIL | 584.0 | |
| | Stiff brown silty clay - Approx. 6% fine to med. gravel. | | |
| | | 575.0 | |
| | Stiff grey silty clay - Approx. 12% fine to medium gravel. | | |
| | | 559.0 | 27.0 |
| | End of Borehole. | | |

STRENGTH AND PENETRATION RESISTANCE

2000 4000 6000 8000 P.S.F.

50 100 150 200 BLOWS/FT.

10 20 30 40

CONSISTENCY

MOIST. CONTENT - % DRY WT.

10 20 30

| SAMPLE | NATURAL UNIT WT. P.C.F. |
|---|---|
| TW 1 | 126.0 |
| TW 2 | 136.3 |
| TW 3 | 135.0 |
| TW 4 | 131.8 |
| TW 5 | 134.0 |
| TW 6 | 131.8 |

W.B. 11-58 JOB # 58-6