

DOCUMENT MICROFILMING IDENTIFICATION.

GEOCRE'S No. 4038-39

DIST. 1 REGION Southwestern

W.P. No. 81-59

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

HWY. No. 401

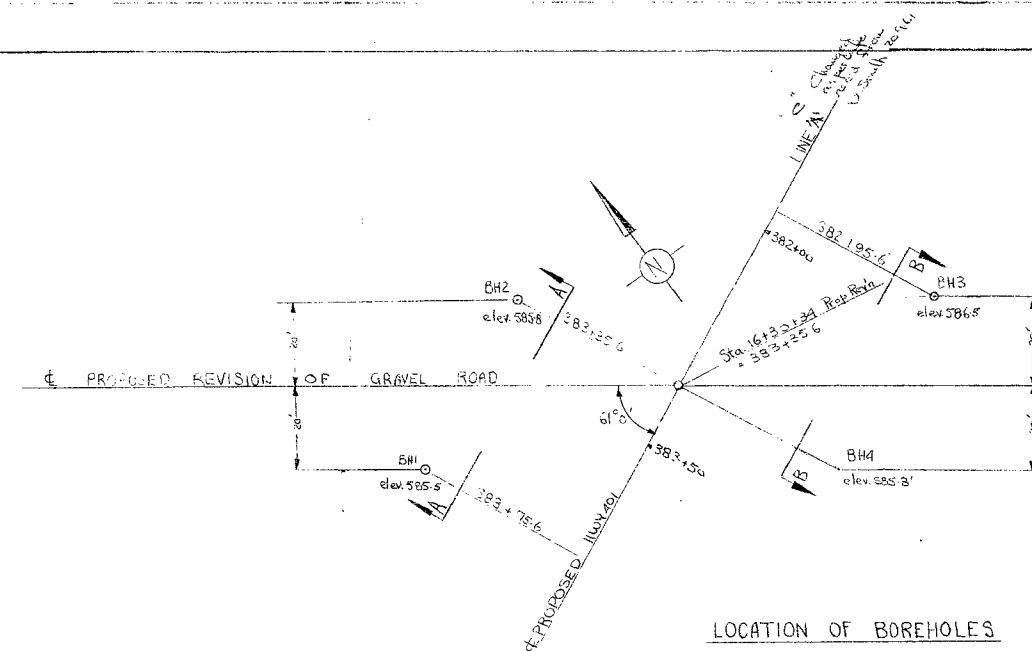
LOCATION LOT 6 & 7, CONG. HWY 401

RALEIGH TWP.

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 1

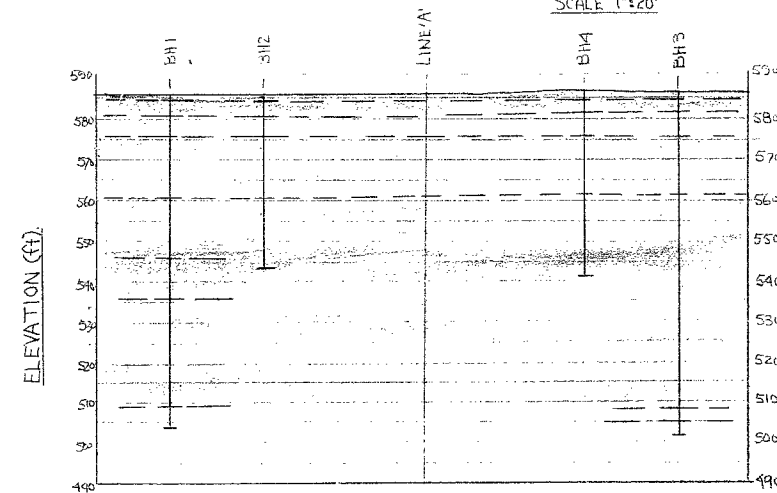
REMARKS: 10 DOCUMENTS TO BE

UNFOLDED BEFORE MICROFILM.



LOCATION OF BOREHOLES

SCALE 1"=20'



SUBSURFACE PROFILE ALONG CL OF PROPOSED REV'N OF GR. RD.

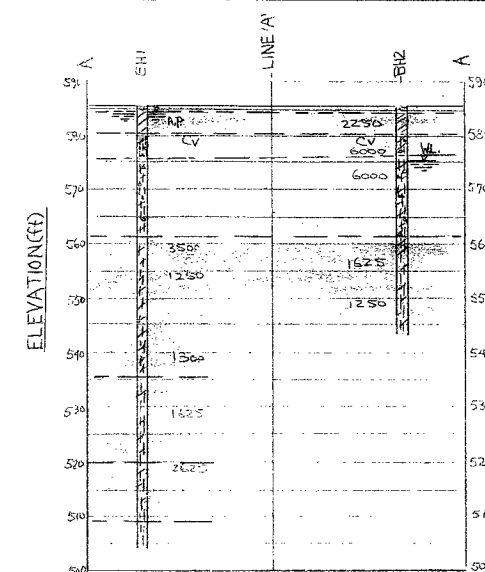
SCALE 1"=20'

LEGEND

- WL - Free water table level
- APL - Steadied Artesian water level
- W* - Possible perched water table - see logs for BH
- BH - Bore hole
- GR RD - Gravel road
- CL - Construction line
- ELEVATION - Geodetic datum
- Cv - In situ vane shear strength

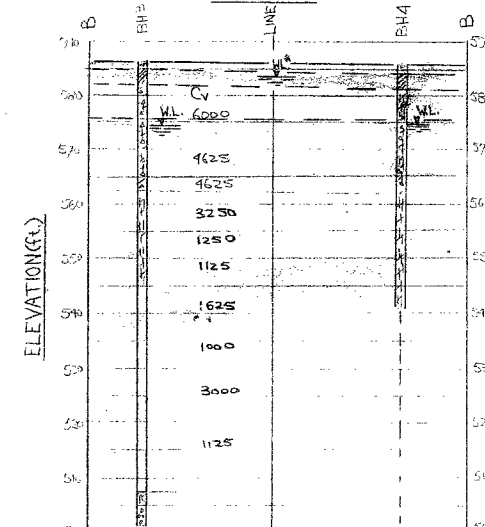
SOIL LEGEND:

- Clayey topsoil: dark brown, clayey, organic
- Stiff grey clay: some silt, clay, organic material
- Med dense glacial till: grey, sandizing to brown, predom. silt some clay, some coarse sand, some gravel (predom. black shale).
- Stiff grey silty clay, some sand, some fine gravel
- Med. dense grey clayey silt, some fine sand, trace med. gravel
- Med. dense grey silt, almost pure, trace of clay
- Med. dense, grey, fine silty sand, some clay, some silt
- Dense gravelly grey till, some gravel sand.



SUBSURFACE SECTION A-A

SCALE 1"=15'



SUBSURFACE SECTION B-B

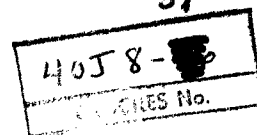
SCALE 1"=15'

4018-39

ONTARIO DEPARTMENT OF HIGHWAYS
MATERIALS & RESEARCH SECTION, DOWNSVIEW

PROPOSED '401' HWY BRIDGE
KENT CO. RALEIGH TWP CONC. VI
REVISION OF GRAVEL ROAD BET'N LOTS 6 & 7
WP 81-59

DOMINION SOIL INVESTIGATION LTD.
88 EGLINTON AVE. E. TORONTO 12
SUP. PL. FEB 19/60 JOB NO. 60-105 ENCL. 12



Department of Highways Ontario
Materials and Research Section
Downsview Ontario

REPORT ON
FOUNDATION INVESTIGATION
PROPOSED CROSSING ON GRAVEL ROAD REVISION
BETWEEN LOTS 6 & 7, CONCESSION VI, AND HIGHWAY 401
RALEIGH TOWNSHIP - KENT COUNTY
W.P. 81-59

Submitted by:
Dominion Soil Investigation Ltd.
88 Eglinton Avenue East
Toronto 12 Ontario

Feb. 26, 1960

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| 6. Foundation Conditions | 4 |
| 7. Conclusions and Recommendations | 6 |

ENGINEERING DATA SHEETS

| | |
|---|----------------------|
| Location of Boreholes | Encl. No. 1 |
| Borehole Logs | Encl. No. 2-11 incl. |
| Subsurface Sections (Pocket at back of Report) | Encl. No. 12 |
| Summary of Laboratory Tests | Encl. No. 13 |

DOMINION SOIL INVESTIGATION LTD.

SOIL MECHANICS • FOUNDATION ENGINEERING

TORONTO 12, ONTARIO

FOUNDATION INVESTIGATION
PROPOSED CROSSING ROAD ALLOWANCE
BETWEEN LOTS 6 & 7, HWY. 401
RALEIGH TOWNSHIP
W.P. 81-59

1. INTRODUCTION:

A foundation investigation for a proposed bridge carrying the county road over Highway 401 between lots 6 & 7, Concession VI in Raleigh Township, Kent County, was authorized by the Materials and Research Section.

This report covers the results of our investigation. An outline is given of the field work done, a discussion of the results of laboratory test, foundation conditions and recommendations on foundations for the proposed bridge and its approaches are included in the report.

2. DESCRIPTION OF SITE AND GEOLOGY OF AREA

The site is located about 8 miles S.W. of Chatham, Ontario where Highway 401, Line "A" and the revised line of gravel road between lots 6 & 7, Concession VI intersect. There are no pronounced features at the site; the area is flat farmland. Deep drainage ditches (along the gravel road and one about 300 ft east of site) are responsible for lowering the free ground water table in the area. Ground water level is at elevation 575 or about 10 ft below the ground surface. A perched water table was also evident with the water level about 1-2 ft below the surface. General ground surface elevation is 585-586.

The area is on the edge of the St. Clair Clay Plain. A 4 ft veneer of stiff grey clay overlies the Wisconsin Till Plain. It was probably produced from the washing of the till plain by post glacial lakes which formed at the lakes of retreating Wisconsin till sheet. According to Chapman and Putnam these clays are deposited only in low lying areas of the till plain. The site is on the southern edge of one of these low areas.

The till sheet is 20-25 ft thick throughout the area. It is oxidized to a depth of 10 ft from the surface. This till has a high clay content with a predominance of coarse sand to medium gravel size black shale particles. Shale particles were

probably picked up from local overriding of clays below the till. The clay content increases with depth. Between elevation 552⁺ and 535⁻ it is classified as a firm silty clay. Below the clay the soil changes to a clayey silt, then a pure silt.

A 5-10 ft layer of coarse gravel and sand overlies bedrock. Underlying bedrock is a fissile black bituminous shale (Kettle Point-Devonian). It occurs about 90 ft below ground level and is also as flat as the present surface topography. From bedrock contour maps obtained by water and gas well drilling it would appear that there is a slight dome in the area.

3. SUBSURFACE EXPLORATION:

Four boreholes were drilled during the period of January 19th to January 26th, 1960. Two boreholes were drilled to a depth of 42 ft and the other two were stopped in the granular strata overlying bedrock. A cone penetration test was attempted but practical refusal was met before reaching a depth of 10 ft.

Disturbed split spoon samples and 2" thin-walled tube samples were recovered. Most of the split spoon samples were sealed for moisture content determination. Insitu vane shear tests were made at regular intervals to a depth of 63 ft.

Artesian pressure conditions were encountered in borehole 1 at elevation 520.5⁺ within the clayey silt or silt strata. The water rose 18 ft above ground level (elevation 603) within the casing. Gas bubbles were noted rising through the wash water. After a period of 2-3 days the water level subsided to elevation 584⁺.

4. LABORATORY SOIL TESTS:

The undisturbed samples were subjected to unconfined compression tests as well as unit weight and moisture content determination. Most of the cohesive soil samples were tested for moisture content and Atterberg limits were obtained for the clay till layer.

Shear strengths, taken as half the unconfined compressive strength, gave values half or less than half of those obtained by insitu vane shear strengths. Page 5 shows the relationship of shear strength (vane and unconfined compression) with depth.

All the samples recovered in the till by thin-walled tubes had to be driven into the soil by gentle taps of the drive hammer. Some disturbance is inevitable which may account for the discrepancy in shear strength results.

Results of laboratory tests are summarized at the back of the Report.

5. GEOLOGICAL FORMATIONS:

The subsoil to the depths drilled may be classified into about seven formations. There is a gradual transition rather than a sharp differentiation between strata of glacial origin. Subsurface sections showing the soil profile are drawn on Enclosure No. 12 found in the Pocket at the back of the Report.

(a) Topsoil:

The top 1.5 ft of soil is dark clay loam having a high organic content.

(b) Stiff Grey Clay:

From elevation 584⁺ to 580.5⁺ is a stiff grey clay containing some silt and traces of sand and organic matter. One moisture content determination in this strata gave a value of 21.8%. Vane shear strengths range from 2200 psf to 3900 psf near the till contact.

(c) Medium Dense Brown and Grey Till:

This is a clay till containing coarse sand and gravel particles of black shale. The top 5-6 ft is oxidized. Moisture contents are in a narrow range from 14.5 to 17.5%. The plasticity index is 12.3%. Wet unit weights are between 134 and 137 pcf at the top and 122-128 pcf at the bottom of the strata. Unconfined compression tests gave shear strengths of 3250 psf at elevation 580 to 4375 at elevation 570. Vane shear strengths exceeded the capacity of the instruments which is 6000 psf between elevation 579 and 572. Thereafter the strength decreased with depth to about 1200 psf at the bottom of the till layer at elevation 552.5⁺. The bottom 9 ft of the till contains more clay and has slightly higher moisture contents.

(d) Firm Grey Silty Clay:

Between elevation 550.5⁺ and 535.5⁺ is a firm grey silty clay with less granular particles than in the till sheet. Moisture contents are about 22%. One unit weight at elevation 550 was 132 pcf.

Vane shear strengths range from 1000 to 1400 psf in this stratum. Compressibility characteristics were not determined for the clay.

(e) Firm Grey Clayey Silt:

Below the clay stratum is a 15 ft layer of clayey silt extending to elevation 520⁺. Moisture contents are about 20% and vane shear strengths start with 1050 psf and increase to about 3000 psf.

(f) Medium Dense Grey Silt:

A grey silt having traces of clay and fine sand underlies the clayey silt. At the contact of the two (elevation 520-) artesian pressure and gas was encountered. Moisture content on one sample was 18.3%. At elevation 507.5 in borehole 3 the silt layer terminated.

(g) Medium Dense Silty Sand and Dense Coarse Gravel:

Below the grey silt a medium dense grey fine silty sand was encountered. It rapidly changed to a dense grey coarse gravel and sand mixture. The borehole was terminated in this layer after attempts to penetrate the strata by jetting were unsuccessful.

Although it was not proved by the borings, it is known from gas wells drilled in the general area that bedrock underlies the coarse granular layer. A local well driller produced boring logs of a water well about 200 ft west of the site which indicated that shale bedrock was encountered at elevation 494.

6. FOUNDATION CONDITIONS:

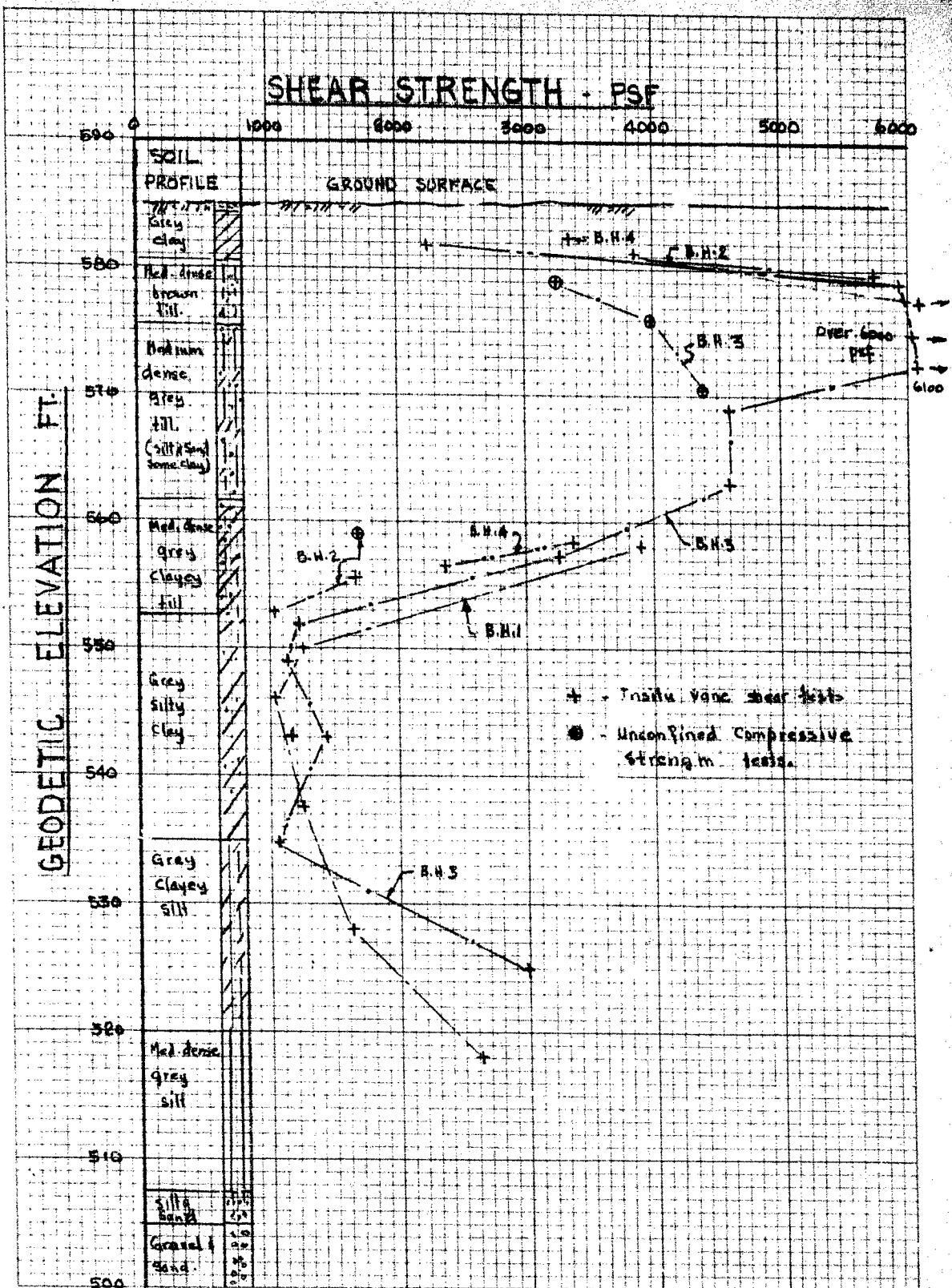
The results of field and laboratory tests indicate that the top 7 ft of till has a very high shear strength and is capable of sustaining heavy bearing pressures. The following page shows the relationship between shear strength and depth. The bridge may be supported on spread footings at a relatively shallow depth.

Based on the results of unconfined compression tests the safe bearing capacity for spread footings placed at elevation 579.5 to 575⁺ is 8000 psf. Since shear strengths decrease with depth below elevation 570 it is advisable to place the footings as near to elevation 579.5 as possible.

This stiff till sheet is very effective in distributing footing loads. The added pressure due to the structure on the more compressible silty clay strata at elevation 550⁻ (30 ft below footing level) will be small. Subsoil strata are uniform and therefore there should be little or no differential settlement.

There is no stability problem with the construction of approaches at this site.

SHEAR STRENGTH - PSF



7. CONCLUSIONS AND RECOMMENDATIONS:

The subsoil at the site is a highly pre-compressed clay till overlying a firm silty clay, followed by layers of silt and coarse gravel to shale bedrock. A thin veneer of post-glacial grey clay covers the site.

Footings for the proposed structure may be established at or below elevation 579.5. It is recommended that they be placed as near to the top of the till strata as possible with a minimum imbedment in the till of 1.0 ft. For structural reasons it may be necessary to place the footings deeper; however, a safe bearing capacity of 8000 psf may be used.

Differential settlement will be small or negligible. The subsoil is uniform throughout.

The approaches may be constructed in one operation to desired grade with no embankment stability problems predicted.

The free ground water table was at elevation 575[±]. No excavation problems or unwatering of excavations for footings is envisaged.



DOMINION SOIL INVESTIGATION LTD.

A. Kobelak
A. Kobelak, P.Eng.

ENGINEERING DATA SHEETS

Location of Boreholes Encl. No. 1
Borehole Logs Encl. No. 2-11 incl.
Summary of Laboratory Tests Encl. No. 13
Subsurface Sections Encl. No. 12
(Pocket at back of Report)

Order No. 60-105

Enclosure No. 1

Prep. By PL.

To Tillbury

Jeannette's Cd

Hwy 2
CNR

Chatham

Tillbury E. Twp.

conc. VI

Fletcher

Raleigh Twp.

Drainage
Canal

Twp. Line

KEY PLAN

1" = 1.5 mi

To Charing
Cross

RALEIGH TWP

CONC VI

LOT 7

GRAVEL ROAD

DRAINAGE DITCH

PROPOSED

REV'D

BH1
el. 585.9

BH2
el. 585.5

583+75.6

583+55.6

BH4
el. 586.8

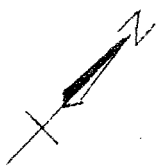
BH3
el. 586.5

302+95.6

70°09'

LINE 'A'

OF GRAVEL ROAD



LOCATION OF BOREHOLES

SCALE 1" = 30'

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 1 - Sheet 1 of 3

Project: 401 Hwy. Bridge

Location: Between Lots 6 & 7, Conc'n. VI, Raleigh Twp., Kent Cty., Ont.

Hole Location: 383+75.6 - 45' Rt. of Line 'A'

Hole Elevation and Datum: 585.5

Field Supervisor: GR & PL Prep.: P.L.

Driller: C.I. Checked:

LEGEND

Shear Strength (C)

Unconfined compression

Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

2" Dia. Cone

Casing

Date: Jan. 22, 60.

LEGEND

Consistency

Natural moisture and

Liquidity Index (LI)

Liquid limit

Plastic limit

Sampling Method

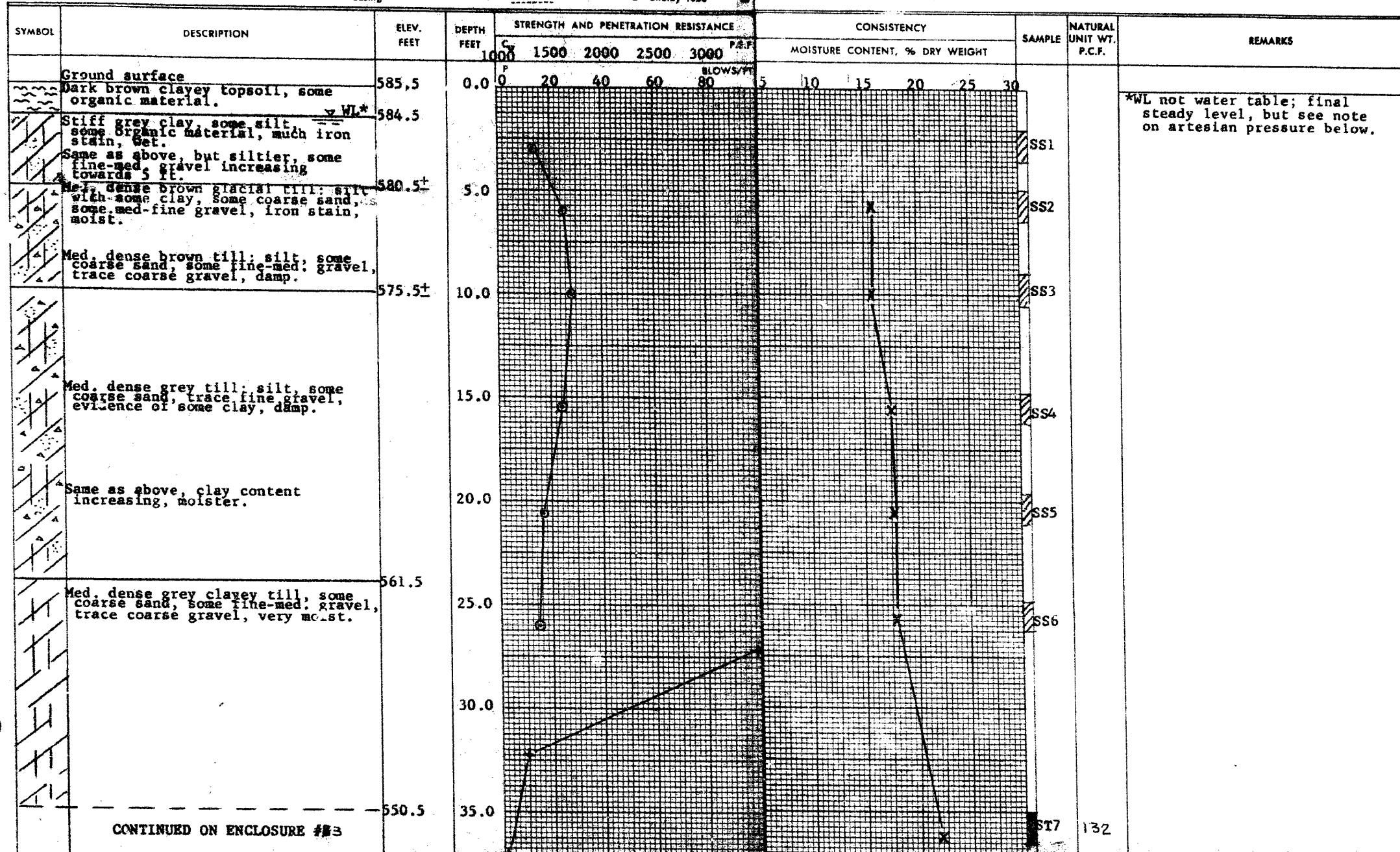
2" Dia. split tube

2" Shelby tube

Sampling Method

2" Dia. split tube

2" Shelby tube



Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole:

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 1 - Sheet 2 of 3

Project: 401 Hwy. Bridge

Location: Between Lots 6 & 7, Conc'n. VI

Location: Raleigh Twp., Kent County, Ont.

Hole Location: 383+75.6 - 45' Rt. of Line "A"

Hole Elevation and Datum: 585.5

Field Supervisor: GR & PL Prep.: P.L.

Driller: C.I. Checked:

LEGEND

Shear Strength (C)

Unconfined compression

Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

2" Dia. Cone

Casing

B

O

Sampling Method

2" Dia. split tube

2" Shelby tube

2" Shelby tube

LEGEND

Consistency

Natural moisture and

Liquidity Index (LI)

Liquid limit

Plastic limit

X

X LI

O

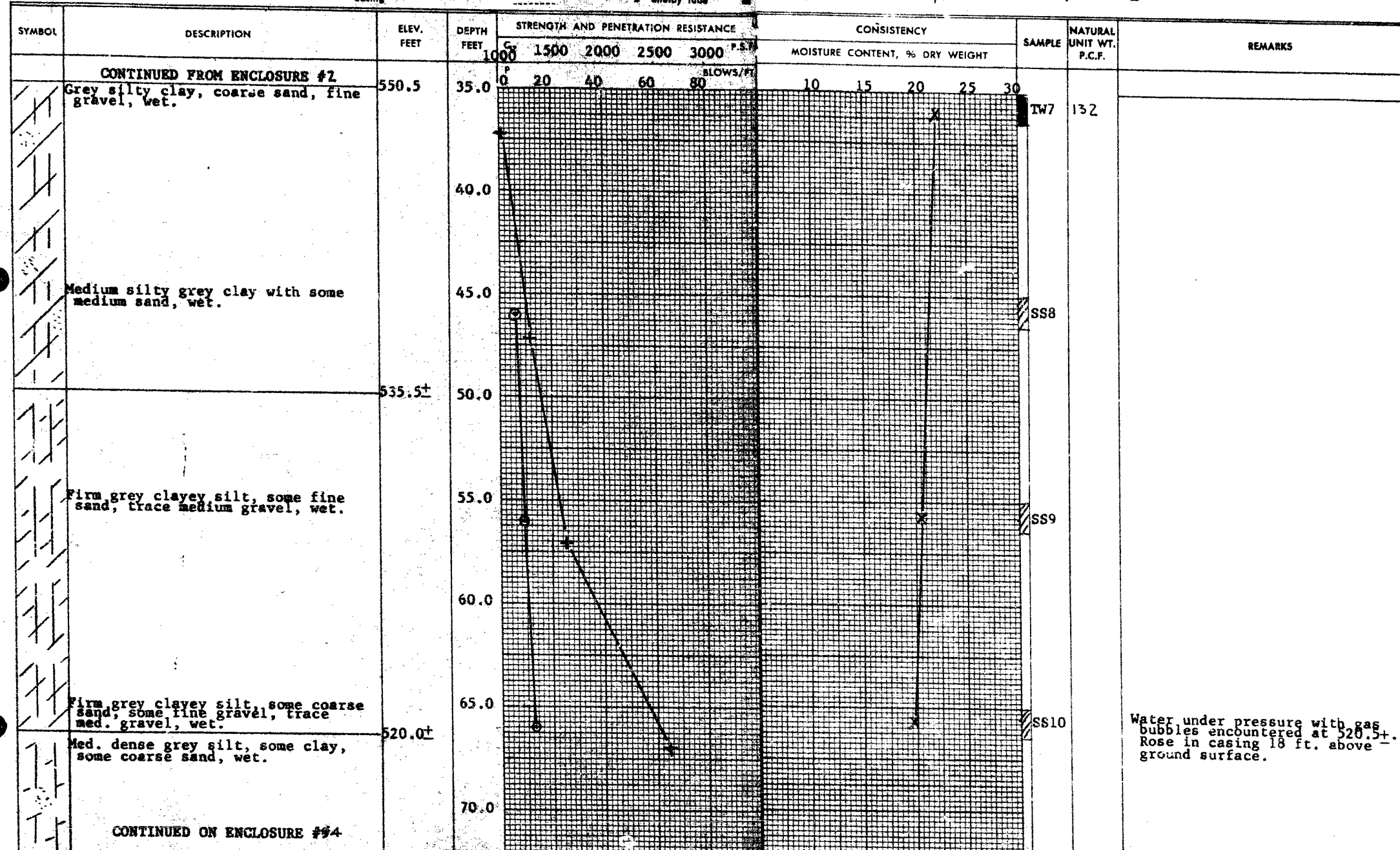
T

Sampling Method

2" Dia. split tube

2" Shelby tube

2" Shelby tube



CONTINUED ON ENCLOSURE #4

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole:

Date: Jan. 22, 1960.

LEGEND

Shear Strength (C)

Unconfined compression
A¹ Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

2" Dia. Cone

Casing

Sampling Method
2" Dia. split tube
2" Shelby tube

LEGEND

Consistency

Natural moisture and
Liquidity Index (LI)
Liquid limit
Plastic limit

Sampling Method

2" Dia. split tube

2" Shelby tube

| SYMBOL | DESCRIPTION | ELEV. FEET | DEPTH FEET | STRENGTH AND PENETRATION RESISTANCE | | | | | | CONSISTENCY | | SAMPLE | NATURAL UNIT WT. P.C.F. | REMARKS |
|--------|-----------------------------------|---------------|---------------|-------------------------------------|------|------|------|------|--------|--------------------------------|--|--------|-------------------------------|---------|
| | | | | C 1000 | 1500 | 2000 | 2500 | 3000 | P.S.P. | MOISTURE CONTENT, % DRY WEIGHT | | | | |
| | CONTINUED FROM ENCLOSURE #8 | 515.5 | 70.0 | | | | | | | | | | | |
| | Same as above, but changing. | 509.2 | 75.0 | | | | | | | | | | | |
| | Dense grey almost pure silt, wet. | 504.0 | 80.0 | | | | | | | | | | | |
| | END OF B.H. | | 85.0 | | | | | | | | | | | |
| | | | 90.0 | | | | | | | | | | | |

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 2 - Sheet 1 of 2.

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole:

Project: Hwy. 401 Bridge

Location: Between Lots 6 & 7, Conc'n. VI,
Raleigh Twp., Kent Cty., Ont.

Hole Location: 383+35.6 - 45' R. of Line 'A'

Hole Elevation and Datum: 585.8

Field Supervisor: GR & PL Prep.: P.L.

Driller: C.I. Checked:

LEGEND

Shear Strength (C)

Unconfined compression
Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

2" Dia. Cone

Casing



Date: Jan. 20, 60.

LEGEND

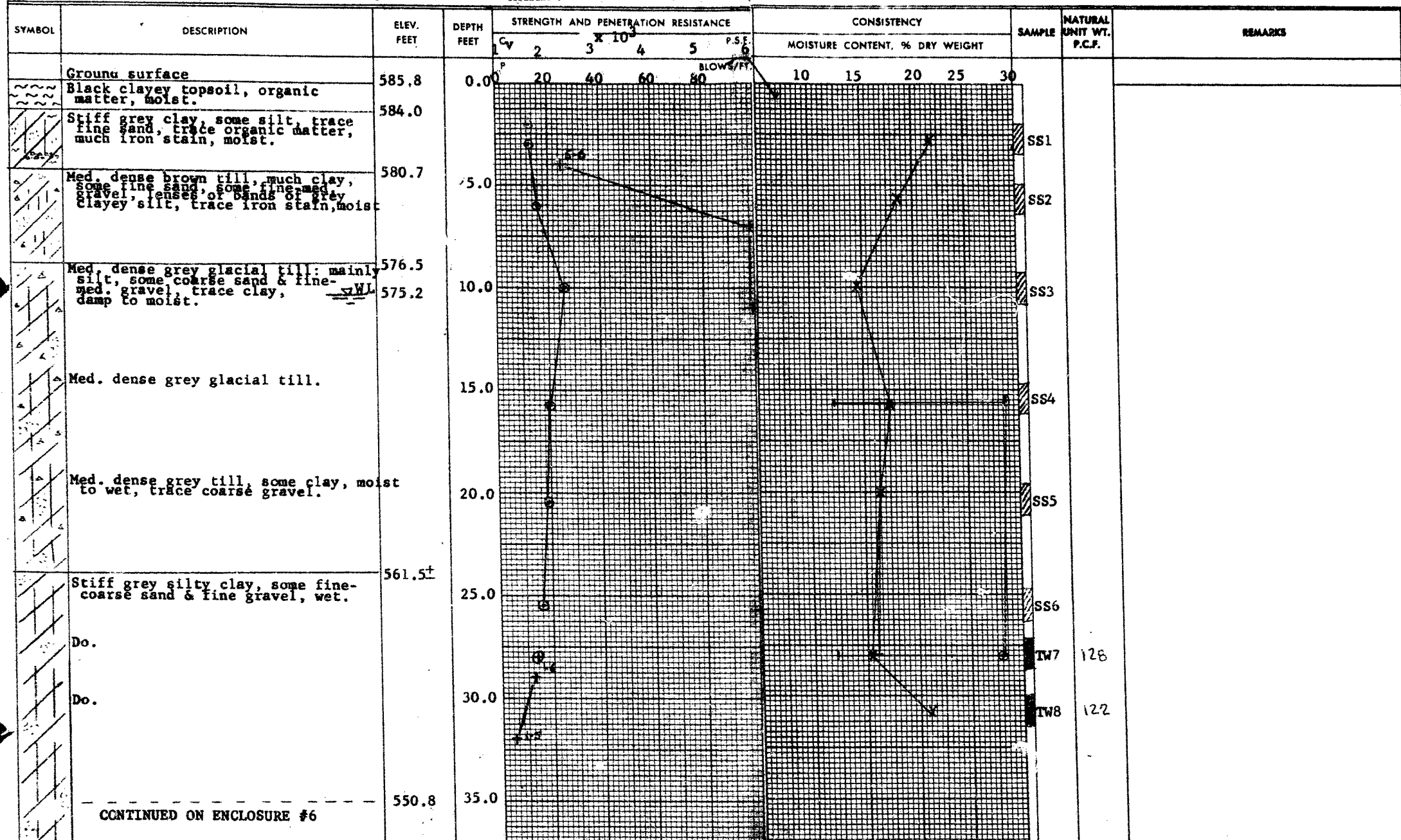
Consistency

Natural moisture and
Liquidity Index (LI)
Liquid limit
Plastic limit

Sampling Method

2" Dia. split tube

2" Shelby tube



Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 2 - Sheet 2 of 2

Engineering Data Sheet for Borehole:

Project: Hwy. 401 Bridge

Location: Between Lots 6 & 7, Conc'n. VI,
Raleigh Twp., Kent Cty., Ont.

Hole Location: 383+35.6 - 45' R. of Line

Hole Elevation and Datum: 585.8

Field Supervisor: GR & PL Prep.: P.L.

Driller: C. I. Checked:

LEGEND

Shear Strength (C)

Unconfined compression

A' Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

2" Dia. Cone

Casing

Date: Jan. 26, 1960.

LEGEND

Consistency

Natural moisture and

Liquidity Index (LI)

Liquid limit

Plastic limit

Sampling Method

2" Dia. split tube

2" Shelby tube

Sampling Method

2" Dia. split tube

2" Shelby tube

[illegible]

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 3 - Sheet 1 of 3

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole:

Project: 401 Hwy. Bridge
 Location: Between Lots 6 & 7, Conc'n. VI,
 Raleigh Twp., Kent Cty., Ont.
 Hole Location: Sta. 382+95.6 - 45' Lft. of
 Hole Elevation and Datum: 586.5 Line A
 Field Supervisor: GR & PL Prep.: P.L.
 Driller: C.I. Checked:

LEGEND

Shear Strength (C)
 Unconfined compression
 Vane test and sensitivity (S)
 Penetration Resistance (P)
 2" Split tube
 2" Dia. Cone
 Casing

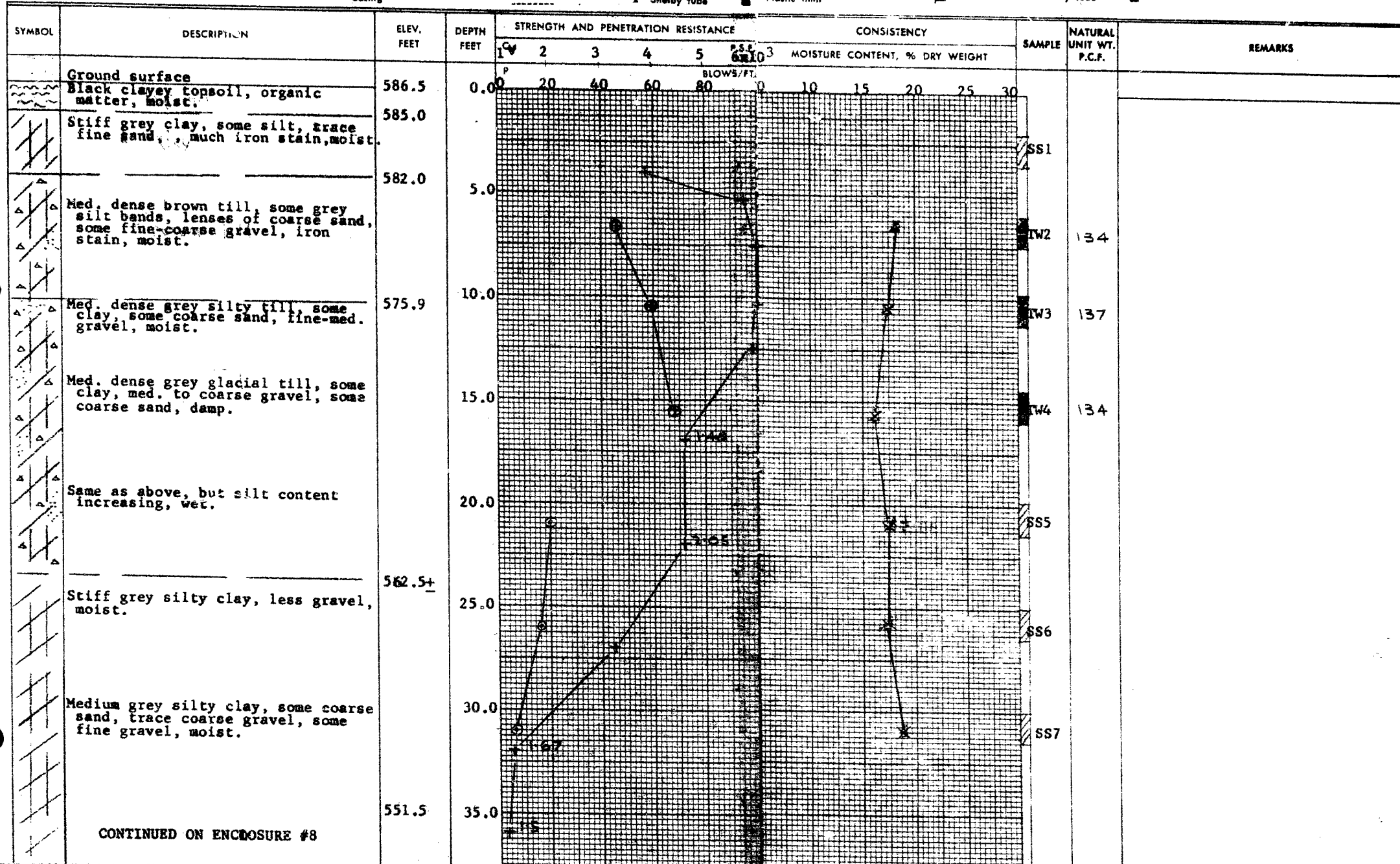
Date: Jan. 26, 60.

LEGEND

Consistency
 Natural moisture and
 Liquidity Index (LI)
 Liquid limit
 Plastic limit

Sampling Method

2" Dia. split tube
 2" Shelby tube



Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 3 - Sheet 2 of 3

Date: Jan. 26, 60.

Project: 401 Hwy. Bridge

Location: Between Lots 6 & 7, Conc'n. VI,
Raleigh Twp., Kent Cty., Ont.

Hole Location: Sta. 382+95.6 - 45' Lft. of

Hole Elevation and Datum: 586.5

Field Supervisor: GR & PL Prep.: P.L.

Driller: C.I. Checked:

LEGEND

Shear Strength (C)

Unconfined compression

Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

2" Dia. Cons

Casing

Sampling Method

2" Dia. split tube

2" Shelby tube

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole:

LEGEND

Consistency

Natural moisture and

Liquidity

Liquid Limit

Plastic limit

—

11

2

1

1

Sampling Method

2" Dia. split tube

off on "A"

2" Shelby tube

[illegible]

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole:

Date: Jan. 26, 60.

LEGEND

Shear Strength (C)

Unconfined compression

Vane test and sensitivity

Penetration Resistance (P

2" Split tube

LEGEND

Consistency

Natural moisture and

Liquidity Index (LI)

Liquid limit

Sampling Method

2" Dia. split tube

3" SL-14-14-14

[illegible]

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 4 - Sheet 1 of 2

Project: 401 Hwy. Bridge

Location: Between Lots 6 & 7, Conc'n. W. Raleigh Twp., Kent Co., Ont.

Hole Location: 383+35.8 - 45' E. of Line

Hole Elevation and Datum: 585.8

Field Supervisor: GR & PE Prep.: PL

Driller: G.I. Checked:

LEGEND

Shear Strength (C)

Unconfined compression

Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

2" Dia. Cone

Casing

Date: Jan. 23, 60.

Sampling Method

2" Dia. split tube

2" Shelby tube

LEGEND

Consistency

Natural moisture and

Liquidity Index (LI)

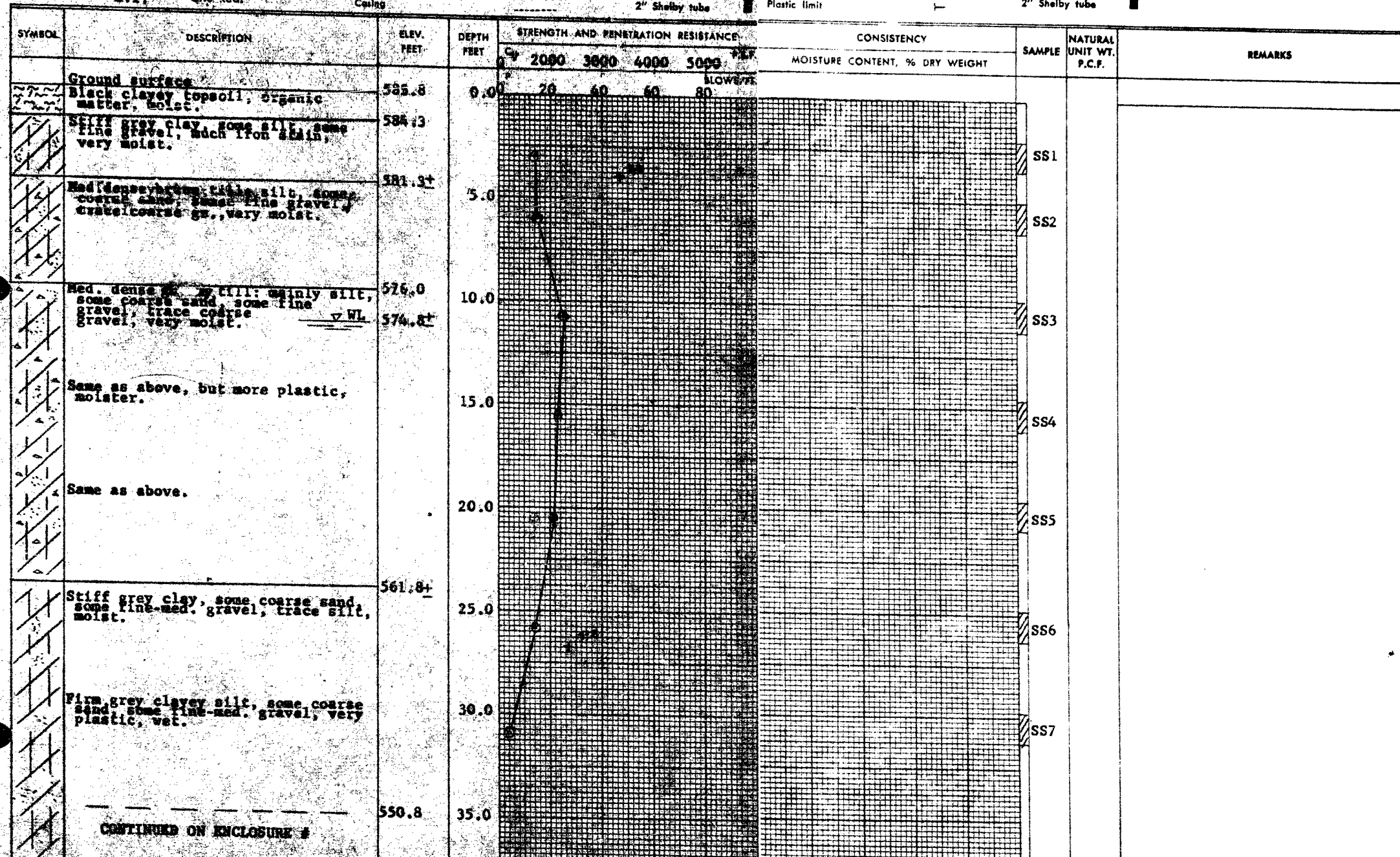
Liquid limit

Plastic limit

Sampling Method

2" Dia. split tube

2" Shelby tube



Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole:

Casing

Sampling Method
2" Dia. split tube
2" Shelby tube

[illegible]

SUMMARY OF LABORATORY TESTS

| Borehole & Sample No. | Moisture Content % | Unit Weight pcf | qu psf | Liquid Limit % | Plastic Limit % | P.I. |
|--------------------------|--------------------------|-----------------------|-----------|----------------------|-----------------------|------|
| BH#1 - S#2 | 15.9 | | | | | |
| 3 | 15.7 | | | | | |
| 4 | 17.0 | | | | | |
| 5 | 17.2 | | | | | |
| 6 | 17.3 | | | | | |
| 7 | 22.1 | 132 | | | | |
| 9 | 20.5 | | | | | |
| 10 | 19.6 | | | | | |
| BH#2 - S#1 | 21.8 | | | | | |
| 2 | 18.5 | | | | | |
| 3 | 14.4 | 137 | | | | |
| 4A | 17.3 | | | 28.8 | 16.5 | 12.3 |
| 4B | 17.6 | | | | | |
| 5 | 16.4 | | | | | |
| 7 | 15.2 | 128 | 3,367 | 28.1 | 16.0 | 12.1 |
| 8 | 21.0 | 122 | | | | |
| BH#3 - S#2A | 18.3 | 134 | 6,500 | | | |
| 3A | 17.4 | 137 | 7,960 | | | |
| 4A | 16.1 | 134 | 8,750 | | | |
| 5 | 17.7 | | | | | |
| 6 | 17.6 | | | | | |
| 7 | 18.7 | | | | | |
| 8 | 22.3 | | | | | |
| 9 | 18.3 | | | | | |