

#60-F-217

W.P.# 100-59

Hwy. #401

E' Cty. Rd.

CORNWALL TWP.

Mr. A. M. Toye,
Bridge Engineer.
Materials & Research Section.

May 3, 1960.

FOUNDATION INVESTIGATION -- by
Associated Geotechnical Services,
Limited.

Attention: Mr. S. McCombie.

Re: Proposed Structure: Hwy. 401 & Cty. Rd.,
Lots 30 & 31, Cornwall Twp., District 9,
W.P. 100-59.


This memo accompanies the report on subsoil conditions at the above site, submitted by Associated Geotechnical Services, Ltd.

Spread footings, founded in the underlying stratum of dense glacial till (Elev. 89.0') have been recommended by the Consultants. For footings founded at this elevation, the safe net allowable bearing pressure is at least 3 tons/sq.ft.

Settlement resulting from the application of this pressure to the underlying till stratum, will be well within tolerable limits.

If we can be of further assistance in connection with this project, please contact our Office.

LGS/MeeF
Attach.


L. G. Soderman,
PRINCIPAL SOILS & FOUNDATIONS ENGINEER

cc: Messrs. A. M. Toye (2)
E. A. Tregaskes
D. G. Ramsay
J. Ford
L. E. Walker
J. E. Gruspier
A. Watt

Foundations Office
Gen. Files. _____

FOUNDATION INVESTIGATION REPORT

Proposed Structure: Hwy. 401 & Cty. Rd.

Lots 30 and 31, Cornwall Township,

W. P. 100-59, District No. 9

60-F-217(C)

DEPARTMENT OF HIGHWAYS OF ONTARIO

Submitted by

Associated Geotechnical Services Limited,
Toronto, Ontario.

April 1960.

TABLE OF CONTENTS

| <u>SECTION</u> | | <u>Page</u> |
|----------------|----------------------------------|-------------|
| 1 | INTRODUCTION..... | 1 |
| 2 | SUMMARY AND RECOMMENDATIONS..... | 2 |
| 3 | DISCUSSION OF PROCEDURES | 3 |
| 4 | DISCUSSION OF SITE | 5 |
| | 4.1 Geographical Location | 5 |
| | 4.2 Geology of Site Area..... | 5 |
| | 4.3 Soil Conditions..... | 5 |
| | 4.4 Water Conditions..... | 7 |
| 5 | DISCUSSION OF FOUNDATIONS..... | 8 |
| | 5.1 General | 8 |
| | 5.2 Spread Footings..... | 8 |
| | 5.3 Piles | 8 |
| | 5.4 Approach Fills..... | 9 |
| 6 | PERSONNEL..... | 10 |

APPENDICES

APPENDIX I

| | | |
|--|-------|--------------|
| Plan of Borehole Locations and Soil Profiles | Fig. | 1 |
| Borehole Logs..... | Figs. | 2 to 5 incl. |
| Probe Logs | Figs. | 6 to 9 incl. |

APPENDIX II

Classification Charts

SECTION 1

INTRODUCTION

The purpose of this report is to present the results of a foundation investigation made in connection with the proposed structure on Highway 401 and the County Road between Lots 30 and 31 in Cornwall Township.

This study was authorized by the A/Materials and Research Engineer, Department of Highways of Ontario, on March 30, 1960.

SECTION 2

SUMMARY AND RECOMMENDATIONS

The overburden at the site consisted primarily of 12 to 14 ft of till-textured medium dense to very dense sand and silt, some gravel overlying limestone bedrock. About 2 ft of stiff clay and 3 ft of sand and gravel overlie the till near ground surface.

The foundations for the structure may be founded on the glacial till at a depth of 6 ft below ground surface with an allowable bearing capacity of 5.5 kips per square foot for a 6 ft wide footing.

If so desired, the structure may be supported on H-piles driven to bedrock.

No stability problems are foreseen with the approach fills.

SECTION 3

DISCUSSION OF PROCEDURES

The borehole locations for this investigation were established by the Field Soils Engineer by chaining from Highway 401 chainage stake 101 + 00 which had been previously established in the field by D.H. O. surveyors. The borehole locations are shown on Figure 1, Appendix I.

The elevation of each borehole was determined by spirit level from a P. & R. BM which was assumed to have an elevation of 100.0. The description of the P. & R. BM is as follows:-

P. & R. BM - Nail and washer driven vertically
in north root of triple elm located
on the east limit of the County Road
allowance about 50 ft south of the
proposed centreline of Highway 401.

An additional reference elevation was taken at the top of pavement at the intersection of the centrelines of the existing County Road and the proposed Highway 401. The elevation of this point was assumed at 98.2.

A primary drilling program consisting of 4 soil borings and 4 dynamic cone probes was carried out in the vicinity of the proposed structure. Two skid-mounted Boyles screw-feed drilling rigs were used on this project. All boring and sampling operations were completed by an experienced soil sampling crew under the full-time supervision of a qualified Soils Engineer.

SECTION 3 - continued

In general, the soil borings were performed by standard wash boring sequences; however, in order to expedite the advance of the casing into the pebbly till layers, the bottom end of the casing was fitted with a diamond shoe bit and the casing fed into the ground by diamond drilling techniques. Water was used in this method to clean and cool the diamond drill bit as well as to carry the sludge out of the hole during the actual drilling operations.

Attempts were made to obtain soil samples by means of a 2" O.D. standard split-spoon sampler. The standard penetration test using a 140 lb hammer falling 30 inches was recorded for each foot of sampler penetration. All samples were visually examined and classified on the site, then placed in jars and forwarded to the engineering office.

Where the split spoon samples appeared relatively undisturbed, apparent insitu density tests were made by the mercury displacement method. Moisture content determinations were made on appropriate samples. The results of all laboratory tests are given in the Appendices.

Dynamic cone probes were made using a 2" O.D. 60° cone point fastened to the end of an A-rod. The number of blows required by a 140 lb hammer falling 30 inches to drive the cone 12 inches were recorded for each foot of penetration.

SECTION 4

DISCUSSION OF SITE

4.1 Geographical Location

The proposed bridge site is located in the Township of Cornwall, County of Stormont, at the intersection of the County Road between Lots 30 and 31 and the proposed Highway 401.

4.2 Geology of Site Area

The Pleistocene and Recent Geology of the site area are outlined in Paper 51-12 of the Geological Survey of Canada.

The overburden at the site consisted primarily of 12 to 14 ft of glacial till overlying bedrock. About 2 ft of stiff clay and 3 ft of sand and gravel overlie the till.

Limestone bedrock of the Ordovician Period was encountered in all boreholes at a depth of 18 to 20 ft.

4.3 Soil Conditions

The soils at the site are shown in cross section on Figure 1, Appendix I. The soils can be subdivided into three structural types as follows, in order of their occurrence below ground surface:

Stratum 1 - medium dense sand and gravel

Stratum 2 - stiff grey clay

Stratum 3 - medium dense to very dense grey sand and silt, some gravel, till texture.

SECTION 4 - continued

The upper foot or so of soil at the site was found to consist of an organic peat. Below this depth the peat quickly grades into a medium dense brown sand and gravel. The penetration resistance of this soil varied from 12 to 32 blows per foot. Underlying the sand and gravel at a depth of 4-1/2 ft, a stiff to very stiff grey clay was encountered. The clay was found to have a natural moisture content of from 23 to 34 percent and an apparent unit weight of about 120 lb per cft. A vane shear determination was made, in borehole 2 at 7.5 ft, which indicated the shear strength of the clay to be about 3.5 kips per sq ft.

Beneath the clay, a till-textured medium dense to very dense grey sand and silt, some gravel was found. This soil was encountered down to limestone bedrock at a depth of 18 to 20 ft. The penetration resistance for the greatest part of this stratum ranged from 35 to 80 blows per ft, however penetration resistances of 15 and 17 blows per ft were recorded on top of bedrock in boreholes 3 and 4.

Moisture contents varying from 6 to 10 percent were most common in this soil, however, in boreholes 2 and 4, moistures of about 13 percent were recorded overlying bedrock. The apparent unit weight of this stratum was found to be about 150 lb per cft. For the most part, stones of pebble and cobble size were encountered, however, where rocks larger than 6" in diameter were found in the

SECTION 4 - continued

boreholes, their location was noted on the log. For purposes of design, we estimate this soil to have an angle of internal friction of 35° and a unit weight of 150 lb per cft.

Limestone bedrock was encountered at a depth of approximately 18 to 20 ft in each borehole. This rock was found to be sound and capable of supporting high loads.

4.4 Water Conditions

At the time of this investigation (April, 1960), the ground water table was found to be above the ground surface. This was mostly due to melting snow, however, we would expect the ground water table to remain close to ground surface at all times of the year.

SECTION 5

DISCUSSION OF FOUNDATIONS

5.1 General

At the time of writing this report, plans and profiles for the proposed structure were not available.

5.2 Spread Footings

Considering the use of spread footings for the foundations of this structure, we have assumed that the footings will be placed down to elevation 89 or at least 1 ft into the till-textured soil with a minimum surcharge of 6 ft. In this case, the allowable bearing capacity, with a factor of safety of 3 against shear failure, of a 6 ft wide footing would be 5.5 kips per sq ft and of a 10 ft wide footing would be 7.3 kips per sq ft. Total settlements in this case would not likely exceed one inch, nor differential settlements exceed one-half inch.

It is expected that excavations can be made down to elevation 89 without difficulty.

5.3 Piles

Should design or construction requirements dictate the consideration of a pile supported structure, it would be possible, in our opinion, to drive H-piles through the till-textured soil to bearing on bedrock.

SECTION 5 - continued

5.4 Approach Fills

In our opinion, approach fills with slopes of 1.5 horizontal to 1 vertical may be constructed in the order of 30 ft high without exceeding a reasonable stability safety factor.



SECTION 6PERSONNEL

The site drilling supervision was performed by W. Naumko,
P. Eng.

The writing of this report was the responsibility of
J. Kilgour, P. Eng.

APPENDIX I

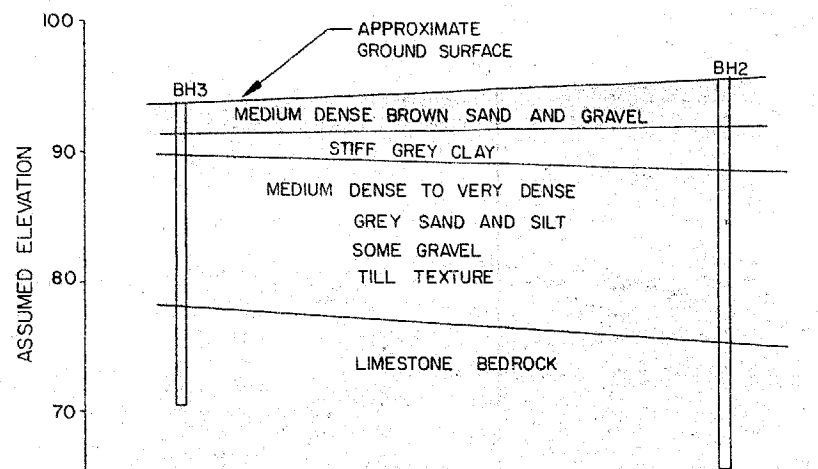
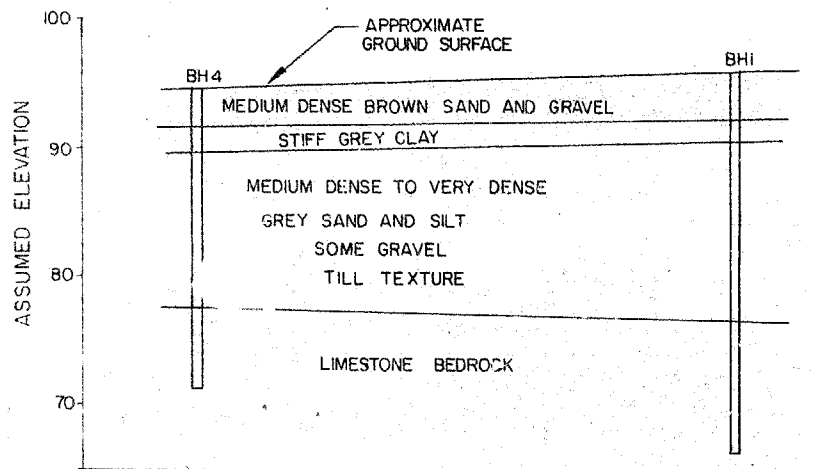
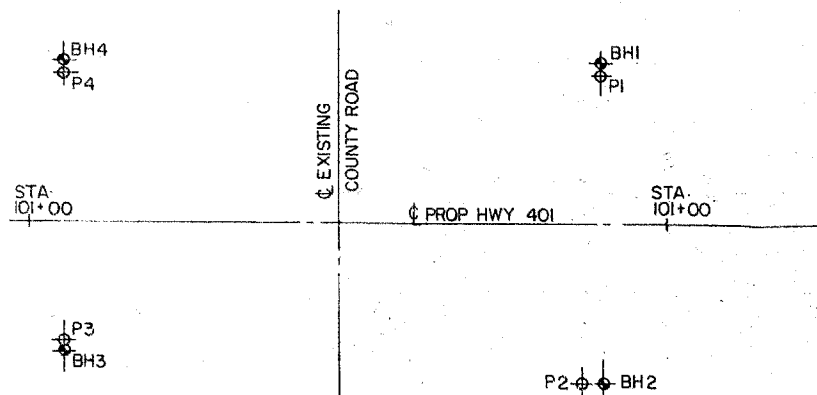
CLIENT Department of Highways of Ontario
 JOB NO. 6011 LOCATION Township of Cornwall
 PROJECT W. P. 100-59
 DATE FIELD INVESTIGATION April, 1960.
 DATE REPORT _____ BY _____ CHKD. _____

LEGEND
 Borehole
 Dynamic Cone Probe

SCALES
 HORIZONTAL 1" = 40'
 VERTICAL 1" = 10'

ASSOCIATED GEOTECHNICAL SERVICES
 Limited







Plan and Soil Sections







| | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|--|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|--|--|---------|--|--|--|
| CLIENT <u>Department of Highways of Ontario</u> JOB NO. <u>6011</u> LOCATION <u>Township of Cornwall</u> CO-ORDINATES <u>Sta. 102 +80 - 50' L</u> ELEVATION (SURFACE) <u>96.1</u> (COLLAR) <u>96.9</u> DATUM <u>Assumed</u> DATE (STARTED) <u>8/4/60</u> (FINISHED) <u>11/4/60</u> (COMPILED) <u>J.K.</u> RIG. NO. <u>1</u> TYPE <u>Boyles</u> FIELD SUP. <u>W. Naumko</u> | | | | SYMBOLS <div style="display: flex; justify-content: space-around;"> <div> SILT CLAY SAND </div> <div> GRAVEL PEAT FILL </div> </div> <div style="font-size: small;"> * - VANE SHEAR (NATURAL) O - VANE SHEAR (REMOLDED) * - STANDARD PENETRATION </div> | | | | ABBREVIATIONS <div style="display: flex; justify-content: space-between;"> <div style="font-size: x-small;"> SS - SPLIT SPOON ST - SHELBY TUBE TWP. - THIN WALLED PISTON DB - DIAMOND BIT UNDISTURBED DISTURBED BUT REPRESENTATIVE FAIR LOST </div> <div style="font-size: x-small;"> C - CONSOLIDATION TEST M - MECHANICAL ANALYSIS T - TRIAXIAL COMPRESSION K - PERMEABILITY U - UNCONFINED COMP. PCF - POUNDS PER CUBIC FOOT WN - NATURAL WATER CONTENT </div> </div> | | | | ASSOCIATED GEOTECHNICAL SERVICES Limited OFFICE BOREHOLE LOG BOREHOLE NO. 1 | | | | | | | | | | | |
| BORING LOG | | | | FIELD TESTS | | | | SAMPLING | | | | LABORATORY | | | | TESTS | | | | REMARKS | | | |
| SCALE DEPTH ELEV. WATER LOG DESCRIPTION <small>FEET FEET FEET OBSERVATION</small> | | | | SHEAR STRENGTH (TONS PER SQUARE FOOT) STANDARD PENETRATION TEST (BLOWS PER FOOT) 20 40 60 80 | | | | PENETRATION RESISTANCE (BLOWS PER FOOT) SAMPLE NUMBER CONDITION | | | | DEPTH FROM TO TYPE RECOVERY LENGTH REC. DIST. DRIV. FEET FEET | | | | UNIT WEIGHT PCF 130 150 ATTERBERG LIMITS WP X LN OWL 10 20 | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| 1.5 95.4 4.5 92.4 6.0 90.9 10 15 20.9 76.9 25 30.3 66.6 35 40 | | | | Medium dense brown sand and gravel Stiff grey clay Dense to very dense grey sand and silt, some gravel Till texture Limestone bedrock End of borehole | | | | 27 1 16 2 18/6" 87 3 60 4 | | | | 2.0 3.5 SS 6/18 5.3 6.8 SS 12/18 12.0 12.9 SS 1/11 15.0 16.5 SS 7/18 20.9 25.8 DB 53/59 25.8 30.3 DB 51/54 | | | | * | | | | | | | |

* Water level was .75 ft above ground surface.

CLIENT Department of Highways of Ontario
 JOB NO. 6011 LOCATION Township of Cornwall
 CO-ORDINATES Sta. 102 + 80 - 50' R
 ELEVATION (SURFACE) 96.0 (COLLAR) 97.0 DATUM Assumed
 DATE (STARTED) 12/4/60 (FINISHED) _____ (COMPILED) J. K.
 RIG. NO. 1 TYPE Boyles FIELD SUP. W. Naumko

SYMBOLS
 SILT
 CLAY
 SAND
 GRAVEL
 PEAT
 FILL
 A - VANE SHEAR (NATURAL)
 O - VANE SHEAR (REMOLDED)
 * - STANDARD PENETRATION

ABBREVIATIONS
 UNDISTURBED
 DISTURBED BUT REPRESENTATIVE
 FAIR
 LOST
 SS - SPLIT SPOON
 ST - SHELBY TUBE
 TWP. - THICK WALLED PISTON
 DB - DIAMOND BIT
 C - CONSOLIDATION TEST
 M - MECHANICAL ANALYSIS
 T - TRIAXIAL COMPRESSION
 K - PERMEABILITY
 U - UNCONFINED COMP.
 PCF - POUNDS PER CUBIC FOOT
 WN - NATURAL WATER CONTENT

ASSOCIATED GEOTECHNICAL SERVICES
 Limited
 OFFICE BOREHOLE LOG
 BOREHOLE NO. 2

| BORING LOG | | | | | FIELD TESTS | | | | | SAMPLING | | | LABORATORY | | | TESTS | | REMARKS | | | |
|---------------|---------------|---------------|----------------------|-----|--|--|------|------|------|--|---------------|-----------|--------------|------------|---|-----------------|---|---------|--|---------------------------------|----|
| SCALE FEET | DEPTH FEET | ELEV. FEET | WATER OBSERVATION | LOG | DESCRIPTION | SHEAR STRENGTH (TONS PER SQUARE FOOT) | | | | PENETRATION RESISTANCE (BLOWS PER FOOT) | SAMPLE NUMBER | CONDITION | DEPTH | | RECOVERY LENGTH REC. DIST. DRIV. | UNIT WEIGHT PCF | | | | | |
| | | | | | | .50 | 1.00 | 1.50 | 2.00 | | | | FROM FEET | TO FEET | | TYPE | ATTERBERG LIMITS | | | | |
| | | | | | | | | | | | | | | | | | STANDARD PENETRATION TEST (BLOWS PER FOOT) | | | | WP |
| | | | | | | 20 | 40 | 60 | 80 | | | | | | | 10 | 20 | | | | |
| | 2.0 | 95.0 | | | Medium dense brown sand and gravel | | | | | 12 | 1 | | 2.0 | 3.5 | SS | 8/18 | | | | * W _N = 30.8% | |
| 5 | 4.5 | 92.5 | | | Very stiff grey clay | | | | | 17 | 2 | | 5.0 | 6.5 | SS | 10/18 | | | | | |
| 10 | 8.0 | 89.0 | | | Dense to very dense grey sand, and silt, some gravel | | | | | 41 | 3 | | 10.0 | 11.5 | SS | 4/18 | | | | | |
| 15 | | | | | Till texture | | | | | 54 | 4 | | 15.1 | 16.6 | SS | 12/18 | | | | | |
| 20 | 21.5 | 75.5 | | | Limestone bedrock | | | | | 78 | 5 | | 20.0 | 21.5 | SS | 10/18 | | | | | |
| 25 | | | | | | | | | | | | | 21.5 | 26.5 | DB | 32/60 | | | | | |
| 30 | 31.5 | 65.5 | | | | | | | | | | | 26.5 | 31.5 | DB | 60/60 | | | | | |
| 35 | | | | | | | | | | | | | | | | | | | | | |
| 40 | | | | | End of borehole | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |

* Water level was 1.0 ft above ground surface

| CLIENT: Department of Highways of Ontario JOB NO. 6011 LOCATION Township of Cornwall | | | | | | SYMBOLS | | FIELD TESTS | | ABBREVIATIONS | | ASSOCIATED GEOTECHNICAL SERVICES Limited | | | |
|---|-------|-------|-------------------|-----|---|---------------------------------------|---|----------------------|-----------|--|---------------|--|----------------------|-------------------|-------|
| CO-ORDINATES: Sta. 101+11 - 40' R | | | | | | CLAY | | STANDARD PENETRATION | | SS - SPLIT SPOON ST - Shelby Tube TWP - THIN WALLED PISTON DB - DIAMOND BIT | | C - CONSOLIDATION TEST M - MECHANICAL ANALYSIS Y - TRIAXIAL COMPRESSION K - PERMEABILITY U - UNCONFINED COMP. PCF - POUNDS PER CUBIC FOOT WN - NATURAL WATER CONTENT | | | |
| ELEVATION (SURFACE) 93.9 (COLLAR) 95.8 DATUM Assumed | | | | | | PEAT | | | | | | OFFICE BOREHOLE LOG | | | |
| DATE (STARTED) 8/4/60 (FINISHED) 11/4/60 (COMPILED) J.K. | | | | | | SAND | | | | | | BOREHOLE NO. 3 | | | |
| RIG NO. 2 TYPE Boyles FIELD SUP. W. Naumko | | | | | | FILL | | | | | | | | | |
| BORING LOG | | | | | | SAMPLING | | | | | | LABORATORY | | | |
| SCALE | DEPTH | ELEV. | WATER OBSERVATION | LOG | DESCRIPTION | SHEAR STRENGTH (TONS PER SQUARE FOOT) | PENETRATION RESISTANCE (BLOWS PER FOOT) | SAMPLE NUMBER | CONDITION | FROM DEPTH FEET | TO DEPTH FEET | TYPE | RECOVERY LENGTH REC. | UNIT WEIGHT PCF | TESTS |
| FEET | FEET | FEET | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 130 150 | |
| | | | | | | | | | | | | | | ATTERRBERG LIMITS | |
| | | | | | | | | | | | | | | WP X 10 WN 20 OWL | |
| | 1.5 | 94.4 | | | Medium dense brown sand and gravel | | 16 | 1 | | 2.0 | 3.5 | SS | 6/18 | | |
| | 4.5 | 91.4 | | | Stiff, grey clay | | 15 | 2 | | 5.0 | 6.5 | SS | 18/18 | | |
| | 5.9 | 89.9 | | | | | | | | | | | | | |
| 10 | | | | | Medium dense to dense grey sand and silt, some gravel, till texture | | 38 | 3 | | 10.0 | 11.5 | SS | 9/18 | | |
| 15 | | | | | | | | | | | | | | | |
| 17.7 | 78.1 | | | | | | 17 | 4 | | 15.4 | 16.9 | SS | 5/18 | | |
| 20 | | | | | Limestone bedrock | | | | | 17.7 | 20.7 | DB | 30/36 | | |
| 25 | | | | | | | | | | 20.7 | 25.7 | DB | 60/60 | | |
| 25.7 | 70.1 | | | | | | | | | | | | | | |
| 30 | | | | | End of borehole | | | | | | | | | | |
| 35 | | | | | | | | | | | | | | | |
| 40 | | | | | | | | | | | | | | | |

* Water level was 0.9 ft above ground surface.

I - 4

[illegible]

DYNAMIC CONE PROBE

No. P1

Location: Sta.: 102 + 76
Offset: 50' L
Elevation: 96.9

| <u>Depth</u> | <u>Blows per ft</u> |
|--------------|---------------------|
| 1 | 7 |
| 2 | 21 |
| 3 | 24 |
| 4 | 14 |
| 5 | 10 |
| 6 | 141 |
| 7 | 49 |
| 8 | 109 |
| 9 | 214 |

DYNAMIC CONE PROBE

No. P2

Location: Sta.: 102 +80
 Offset: 46' R
 Elevation: 97.0

| <u>Depth</u> | <u>Blows per ft</u> |
|--------------|---------------------|
| 1 | Water |
| 2 | 2 |
| 3 | 13 |
| 4 | 24 |
| 5 | 15 |
| 6 | 15 |
| 7 | 20 |
| 8 | 23 |
| 9 | 29 |
| 10 | 45 |
| 11 | 40 |
| 12 | 70 |
| 13 | 67 |
| 14 | 85 |
| 15 | 115 |
| 16 | 98 |
| 17 | 81 |
| 18 | 127 |
| 19 | 124 |
| 20 | 87 |
| 21 | 143 |
| 21.8 | 200 |

DYNAMIC CONE PROBE

No. P3

Location: Sta. : 101 + 11
Offset: 36' R
Elevation: 95.8

| <u>Depth</u> | <u>Blows per ft</u> |
|--------------|---------------------|
| 1 | 4 |
| 2 | 3 |
| 3 | 23 |
| 4 | 18 |
| 5 | 11 |
| 6 | 20 |
| 7 | 32 |
| 8 | 23 |
| 9 | 25 |
| 10 | 36 |
| 11 | 26 |
| 12 | 32 |
| 13 | 65 |
| 14 | 47 |
| 15 | 39 |
| 16 | 44 |
| 16.5 | 23 |

DYNAMIC CONE PROBE

No. P4

Location: Sta.: 101 + 11
Offset: 46' L
Elevation: 95.8

| <u>Depth</u> | <u>Blows per ft</u> |
|--------------|---------------------|
| 1 | Water |
| 2 | 2 |
| 3 | 15 |
| 4 | 31 |
| 5 | 15 |
| 6 | 14 |
| 7 | 34 |
| 8 | 34 |
| 9 | 47 |
| 10 | 28 |
| 11 | 28 |
| 12 | 35 |
| 13 | 39 |
| 14 | 109 |
| 15 | 80 |
| 16 | 51 |
| 17 | 95 |
| 17.1 | 100 |

APPENDIX II

SOIL CLASSIFICATION SYSTEM

The following system was used to describe the various soils encountered at the site as determined by visual field examination and test. It was also used to classify those soils upon which a laboratory grain size determination had been made.

Soil Components

Particle Size

| | |
|----------|--------------------|
| Clay | < .002 mm |
| Silt | > .002 mm < .06 mm |
| Sand | > .06 mm < 2.0 mm |
| Gravel | > 2.0 mm < 2 in. |
| Cobbles | > 2 in. < 6 in. |
| Boulders | > 6 in. |

Descriptive Terms

Range of Proportions

| | |
|-------|------------------|
| and | greater than 40% |
| with | 25% to 40% |
| some | 10% to 25% |
| trace | less than 10% |

Examples

1. Silt (predominant type) with (25% - 40%) sand.
2. Sand and silt (predominant types), some (10% - 25%) gravel, trace (< 10%) clay.

STANDARD PENETRATION CLASSIFICATION

| Relative Density of Sands as determined by Standard Penetration Tests | | |
|--|----------------|-----------------------------|
| N | D _d | Designation on Borehole Log |
| 0 - 4 | 0 - 0.2 | Very Loose |
| 4 - 14 | 0.2 - 0.4 | Loose |
| 10 - 30 | 0.4 - 0.6 | Medium Dense |
| 30 - 50 | 0.6 - 0.8 | Dense |
| Over 50 | 0.8 - 1.0 | Very Dense |

| Shear Strengths of Clays as determined by Standard Penetration Tests | | |
|---|-------------|-----------------------------|
| N | s psf | Designation on Borehole Log |
| 2 | 250 | Very Soft |
| 2 - 4 | 250 - 500 | Soft |
| 4 - 8 | 500 - 1000 | Medium |
| 8 - 15 | 1000 - 2000 | Stiff |
| 15 - 30 | 2000 - 4000 | Very Stiff |
| 30 | 4000 | Hard |