

G.I.-30 SEPT. 1976

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 413-4

DIST. 18 REGION NORTHWESTERN

W.P. No. 162-67-01

CONT. No. 74-162

W. O. No. 70-F-38

STR. SITE No. \_\_\_\_\_

HWY. No. 546

LOCATION HWY. 546-IRON BRIDGE

NORTHERLY

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 1

REMARKS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



Ministry of  
Transportation and  
Communications  
Ontario  
162-67-01,03

PRIORITY DEVELOPMENT BRANCH  
PROGRAM STATUS REPORT  
PERSONAL & CONFIDENTIAL

W.P. & 17-72-01 DIST. 18 HWY. 546 TYPE OF WORK see below  
DESCRIPTION From 0.4 mi. N. of Hwy 17 at Iron Bridge N'ly to Sec. Hwy 554,  
6.5 mi. incl. Iron Bridge patrol yard.  
PRESENT PROGRAM YEAR 1976 DATE INITIATED Oct. 4/74

The following group of projects has been advanced to the 1974 program.

| WP No.     | Group No. | Type of Work | Description   |
|------------|-----------|--------------|---|
| 162-67-010 | 162-67-01 | G.D., G.B.   | From 0.4 mi. N. of Hwy. 17 at Iron Bridge N'ly to Sec. Hwy. 554, 6.5 mi. Est. value \$1,322,000 |
| 162-67-030 | 162-67-01 | P & S.T.     | As above Under sundry Est. value \$90,000   |
| 17-72-010  | 162-67-01 | Pat. Yd.     | G.D. & G.B. of Iron Bridge patrol yard, 1.5 mi. N. of Hwy. 17 Est. value \$50,000               |
|            |           |              | GROUP TOTAL: \$1,462,000  |



REMARKS:

415.4  
GROCES No.

All dates with the exception of Node #39 are actual dates.

NGM/mile

PRE-CONTRACT ENGINEERING SCHEDULE

|                               |            |                               |            |
|-------------------------------|------------|-------------------------------|------------|
| 1. STATUS REPORT              | Oct. 4/74  | 21. STRUCT. QUANT'S COMPLETE  | n/a        |
| 2. FEASIBILITY STUDY REPORT   | n/a        | 22. STR. PLANS & D4 TO S.D.O. | n/a        |
| 3. TRAFFIC ISSUED             | n/a        | 23. N.W.P.A. APPL'N SUBM'D.   | n/a        |
| 4. PRE-DESIGN PHOTOGRAMMETRY  | n/a        | 24. N.W.P.A. APPROVAL REC'D.  | n/a        |
| 5. DRAINAGE STUDY ISSUED      | n/a        | 25. SOILS DESIGN REPORT       | Dec. 1/71  |
| 6. DESIGN CRITERIA            | Mar. 12/70 | 26. 40' TO 1" PLANS ISSUED    | n/a        |
| 7. TITLE SEARCH REQUEST       | Jan. 16/70 | 27. CO-ORDINATED ALIGNMENT    | n/a        |
| 8. PRE-DESIGN REPORT          | Jun. 25/70 | 28. STRUCTURE SITE GEOMETRICS | n/a        |
| 9. FINAL ALIGNMENT REQUEST    | Jan. 23/70 | 29. INTERSECTION DESIGN COMP. | n/a        |
| 10. DESIGN X-SECTIONS REQ'T.  | Jan. 23/70 | 30. FINAL PROPERTY REQUEST    | Feb. 9/72  |
| 11. DESIGN X-SECTIONS ISSUED  | Jan. 12/72 | 31. R.T.C. APPL'N SUBM'D.     | n/a        |
| 12. PLANS & PROF. TO S.D.O.   | Oct. 18/71 | 32. R.T.C. APPROVAL REC'D.    | n/a        |
| 13. PLANS & PROF. ISSUED      | Oct. 18/71 | 33. DETAIL DESIGN REPORT      | Apr. 10/72 |
| 14. E & G PLANS ISSUED        | n/a        | 34. ILLUMINATION DESIGN COMP. | n/a        |
| 15. ENG. & TITLE RECORDS      | n/a        | 35. SYSTEMS DESIGN CONSULTS.  | n/a        |
| 16. FOUNDATION REPORT REQ'D.  | n/a        | 36. PERCENT COMPLETE S.D.O.   | 080        |
| 17. FOUNDATION REPORT ISSUED  | Sep. 4/70  | 37. STRUCT. DESIGN CONSULTS.  | n/a        |
| 18. STRUCT. PLANNING REPORT   | n/a        | 38. PERCENT COMP. STR. DESIGN | n/a        |
| 19. PRELIM. STRUCTURE PLANS   | n/a        | 39. DOCUMENTS IN SCRUTINY     | Oct. 18/74 |
| 20. STRUCTURE DESIGN COMPLETE | n/a NO     | 40. PROPERTY CLEARANCE        | Jun. 5/73  |

PROGRAM STUDIES ENGINEER

REGIONAL DIRECTOR

SCHEDULING ENGINEER

DATE

DATE

DATE

|         |           |                                |             |
|---------|-----------|--------------------------------|-------------|
| 70-F-38 | 162-67-01 | HWY. 546-IRON BRIDGE NORTHERLY | 41J-4       |
| W.O.    | W.P.      | LOCATION                       | GEOCRES NO. |

• DATA ON FILE IN SOIL MECHANICS SECTION

REFER TO: ~~W.P. FILE~~ CONT. 74-162

REMARKS

**GEOCRES** INDEXING CARD FOR REPORTS NOT MICROFILMED

GI-20 AUG. 74

SUPER IMPOSED DOCUMENT MAY  
APPEAR AS MULTI-FEED ON FILM.

## MEMORANDUM

To: Mr. H. W. Murrell,  
Regional Road Design Dept.,  
Regional Office,  
THUNDER BAY, Ontario.

From: Foundation Section,  
Materials & Testing Office,  
Room 107, Lab. Bldg.

ATTENTION:

DATE: September 3, 1970

OUR FILE REF.

IN REPLY TO

SEP - 4 1970

SUBJECT:

## FOUNDATION INVESTIGATION REPORT

For

Highway #546

Station 202+00 to Station 212+00  
District No. 12 (Sault Ste. Marie)  
W.O. 70-11073 - W.P. 162-67-01

*enclosed*

Enclosed please find our complete foundation report for the above mentioned project.

We believe that factual information pertaining to subsoil conditions at the site, and recommendations regarding the design and construction of the proposed fills, contained within the report, should be sufficient for your purposes.

If additional information is required, or should the report require further clarification, please contact this office.

433/4357

Attach.

cc: Murrell, H. W. Murrell (P)  
A. I. Treackles  
A. W. Parren  
A. D. Macoyne  
H. P. Storr  
A. L. L. L. L.  
A. L. L. L.

Foundation Files  
H. W. Murrell

*Alf Stormac*  
A. G. Stormac  
PRINCIPAL FOUNDATION ENGINEER

## TABLE OF CONTENTS

1. INTRODUCTION.
  2. DESCRIPTION OF SITE.
  3. FIELD AND LABORATORY WORK.
  4. SUBSOIL CONDITIONS, DISCUSSION AND RECOMMENDATIONS:
    - 4.1) General.
    - 4.2) SITE #1 - Station 203+00.
    - 4.3) SITE #2 - Station 275+50.
    - 4.4) SITE #3 - Station 294+50.
    - 4.5) SITE #4 - Station 312+00.
  5. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION REPORT  
For  
Highway #546  
Station 202+00 to Station 212+00  
District No. 1<sup>st</sup> (County Sta. Marie)  
U.S. 73-1107 - U.S. 162-67-01

---

1. INTRODUCTION:

A request to carry out a foundation investigation to check the stability of the proposed embankments along Hwy. #546 from Station 202+00 to Station 212+00 was received from Mr. R. Korperoth, Regional Materials Engineer, in a memo dated April 16, 1970. Four locations in all, were to be investigated where the intention was to considerably increase the embankment height.

An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at these sites.

This report contains the results of our field and laboratory investigation, together with our recommendations regarding the stability of the proposed embankments.

2. DESCRIPTION OF SITE:

The section of Hwy. #546 investigated extends from approximate Station 202+00 to 212+00 - i.e., about 1/4 to 6 miles north of Iron bridge.

3. FIELD AND LABORATORY WORK:

The field work at the site consisted of eight sampled coneholes and four dynamic cone penetration tests. All boreholes were advanced using a Barker-Deere-mounted continuous flight auger. However, coneholes 4 & 5 were drilled by washboring method, using the same rig.

3. FIELD AND LABORATORY WORK: (cont'd.) ...

Disturbed samples were obtained using a 2-inch O.D. split- spoon sampler driven according to the specifications of the Standard Penetration Test. Undisturbed samples were obtained by means of 2-inch I.D. Shelby tubes which were pushed into the soil manually or hydraulically. In-situ vane tests were carried out, wherever possible, at a depth of 12 inches below various soil samples.

Dynamic cone penetration tests were carried out adjacent to each borehole and also at one other location. Driving energy to advance the cone was 350 ft.-lbs. per blow.

Samples were visually examined in the field and subsequently in the laboratory. Tests were carried out on selected samples to determine the following physical properties:

1. Grain-Size Distribution
2. Atterberg Limits
3. Natural Moisture Content
4. Bulk Density
5. Unconfined Compressive Strength

The results of field and laboratory tests are summarized on the Record of Borehole sheets, which are contained in the Appendix to the report.

The locations and elevations of boreholes are given on Drawing No. 70-110541, which accompanies this report.

The boreholes were surveyed in the field by the Sault Ste. Marie District Office of the D.H.O.

4. SOIL CONDITIONS, DISCUSSION AND RECOMMENDATIONS:

4.1) General:

It is proposed to reconstruct Hwy. #546, which will involve a considerable grade raise at many places. In all, soil investigations at four sites - where it was thought that

4. SUBSOIL CONDITIONS, DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

4.1) General: (cont'd.) ...

some stability problems may be encountered - were requested by Mr. J. E. Smith, Project Geologic Engineer.

In the following pages, each site has been considered individually and commented upon regarding the stability problems existing there.

4.2) SITE #1 - Station 203+00:

a) Subsoil -

At this point the road runs along the edge of Gladstone Lake and rides a swamp. Boreholes #1, 2 and 7 were put down at this site. Boreholes #1 and 2 were located on either side of the road, and Borehole #7 was put down through the existing gravel pavement. The subsoil consists of 7.0 to 10.5 ft. of very soft muck, followed by 16.5 to 26.0 ft. of very soft to firm clayey silt with some clay layers, followed by a compact to dense sand deposit with varying amounts of gravel and silt. Boreholes #1 and 2 were terminated in the last mentioned deposit. In Borehole #7, the upper 4 ft. consists of fill containing sand with some silt.

The shear strength of the muck, as determined from field vane tests, was about 340 p.s.f., but the unconfined compression tests indicate it to vary from 40 to 120 p.s.f.

The shear strength of the underlying clayey silt stratum, in general, increases with depth and varies between 240 p.s.f. as determined from the field vane tests. However, unconfined compression tests indicate a shear strength between 80 p.s.f. and 160 p.s.f. The Atterberg limit tests on clayey silt layers indicate the following values:

|                       |   |          |
|-----------------------|---|----------|
| Liquid Limit          | : | 20 - 30% |
| Plastic Limit         | : | 14 - 20% |
| Natural Water Content | : | 30 - 40% |



4. SUBSOIL CONDITIONS, DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

4.2) SITE #1 - Station 223+00: (cont'd.) ...

a) Subsoil - (cont'd.) ...

However, it is believed that the shear strength values, as obtained from the field vane, are more indicative of the in situ strength, than the unconfined compression test results.

b) Recommendations:

It is proposed to raise the grade at this site by about 10.0 ft. A stability analysis was carried out in terms of total stresses, assuming that all muck under the proposed embankment will be removed and replaced with granular material. It was found that a 10.0 ft. high embankment with 2:1 side slopes will not be stable. The maximum height of the embankment that can be supported by the underlying subsoil is 6.0 ft. Therefore, it is recommended that, in order to ensure an adequate factor of safety, the grade raise should be restricted to 6.0 ft.

Since the organic material under the existing road consists of a mixture of fill and muck, it will not displace easily under the weight of additional fill. Therefore, it is recommended that it should be machine removed before placing the fill.

4.3) SITE #2 - Station 275+00:

a) Subsoil -

At this site the highway runs along the edge of Puddle Lake. On one side of the existing road is the lake, and on the other side there is a very steep bedrock face. Two boreholes - #2 and #1, were put down at this site. Borehole #1 was at the edge of the existing pavement, and Borehole #2 was away from the road in the swamp. Subsoil at this site consists of 2.0 ft. of sand and gravel fill (found in Borehole #1 only), followed by 2.0 to 25.0 ft. of very soft to firm muck, followed by 2.0 to 6.0 ft. of very soft to soft clayey silt to silty clay, underlain by 1.0 ft. of dense sandy silt (found in Borehole #1 only), followed by a compact to very dense sand and gravel deposit.

4. SUBSOIL CONDITIONS, DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

4.2) SITE #2 - Station 2754.12 - (cont'd.) ...

a) Subsoil - (cont'd.) ...

Shear strength of the silt, as determined from the field vane test in borehole #31, is about 600 p.s.f., while in borehole #3 away from the existing road, it varies from 100 p.s.f. to 200 p.s.f. The unconfined compression tests indicate a shear strength ranging between 40 and 160 p.s.f. Shear strength of the clayey silt to silty clay layer varies between 240 and 360 p.s.f. Two Atterberg Limit determinations carried out on the last mentioned layer, indicated the following results:

|                          |   |          |
|--------------------------|---|----------|
| Liquid Limit             | : | 26 - 35% |
| Plastic Limit            | : | 17 - 18% |
| Natural Moisture Content | : | 30 - 47% |

In addition, a dynamic cone penetration test - Borehole #8 - was run down through the existing pavement. Because of the proximity of the bedrock, it was very difficult to penetrate more than a foot or two. After repeated attempts, one cone was hammered down to 19.0 ft. The high number of blows/ft. indicate the presence of probable boulders.

c) Recommendations -

It is proposed to raise the grade of Hwy. #46 at this location by about 3.0 ft. In addition, the proposed centre-line will be moved towards the rock face and away from the lake and the dump by about 14.0 to 22.0 ft. The higher shear strength of silt in borehole #31 results from the consolidation of it under the weight of the fill already placed. No stability problems are anticipated for 3.0 ft. of additional fill. However, some settlements will occur due to compression of the underlying layer of silt. If the settlements are to be kept to a minimum, then it will be necessary to excavate all organic soil and replace it with suitable granular material.

4. SUBSOIL CONDITIONS, DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

4.4) Site #2 - Station 225+40:

a) Subsoil -

Two boreholes #4 and 5 were put down at this site. The subsoil consists predominantly of 20 - 25 ft. of firm to very stiff clayey silt with some silty clay layers, followed by 1.0 ft. of sandy silt in Borehole #4 and 2.0 ft. of sand with silt and gravel in Borehole #5. No further penetration by means of augering or driving the spoon was possible, indicating probable bedrock at these depths. The shear strength of the clayey silt structure varies from 300 p.s.f. to more than 2,000 p.s.f. The Atterberg Limit tests indicated the following values:

|                       |   |          |
|-----------------------|---|----------|
| Liquid Limit          | : | 25 - 42% |
| Plastic Limit         | : | 17 - 22% |
| Natural Water Content | : | 26 - 42% |

b) Recommendations -

It is proposed to raise the grade at this site by about 14.0 ft. No stability problems are anticipated for a 14-ft. high embankment with 2:1 side slopes.

4.5) Site #4 - Station 317+00:

a) Subsoil -

Only one borehole #6 was put this site. The subsoil consists of 16.0 ft. of stiff to very stiff clayey silt underlain by bedrock. There is a hillock just south of the borehole and exposed bedrock can be seen on its downslope only 100 ft. away from the borehole. The shear strength of the subsoil is in excess of 100 p.s.f. The single Atterberg Limit test indicated the following values:

|                       |   |     |
|-----------------------|---|-----|
| Liquid Limit          | : | 44% |
| Plastic Limit         | : | 24% |
| Natural Water Content | : | 23% |

4. SUBSOIL CONDITIONS, DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

4.c) PIPE  $\frac{1}{2}$ " - Station 312+00: (cont'd.) ...

b) Recommendations -

It is proposed to raise the grade at this location by about 20.0 ft. No stability problems are anticipated for 2:1 side slopes of the embankment.

5. MISCELLANEOUS:

The field work for this project was carried out during the period May 14 to May 21, 1970, under the supervision of Mr. A. Prikach, Project Foundation Engineer, who also prepared this report.

The equipment used was owned and operated by Dominion Soil Investigation Ltd.

This report was reviewed by Mr. K. L. Selby, Supervising Foundation engineer.

September, 1970

APPENDIX I

## FOUNDATION SECTION

|       |           |               |                                     |               |                    |
|-------|-----------|---------------|-------------------------------------|---------------|--------------------|
| JOB   | 70-11038  | LOCATION      | Hwy. 546; Sta. 203 + 63 o/s 22' Lt. | ORIGINATED BY | AP                 |
| W.P.  | 162-67-01 | BORING DATE   | May 21, 1970                        | COMPILED BY   | AP                 |
| DATUM | Geodetic  | BOREHOLE TYPE | Bombardier Flight Auger & Cone      | CHECKED BY    | <i>[Signature]</i> |

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No.2

FOUNDATION SECTION

JOB 70-11038

LOCATION Hwy. 546; Sta. 202 + 93 o/s 17' Rt.

ORIGINATED BY AP

W.P. 162-67-01

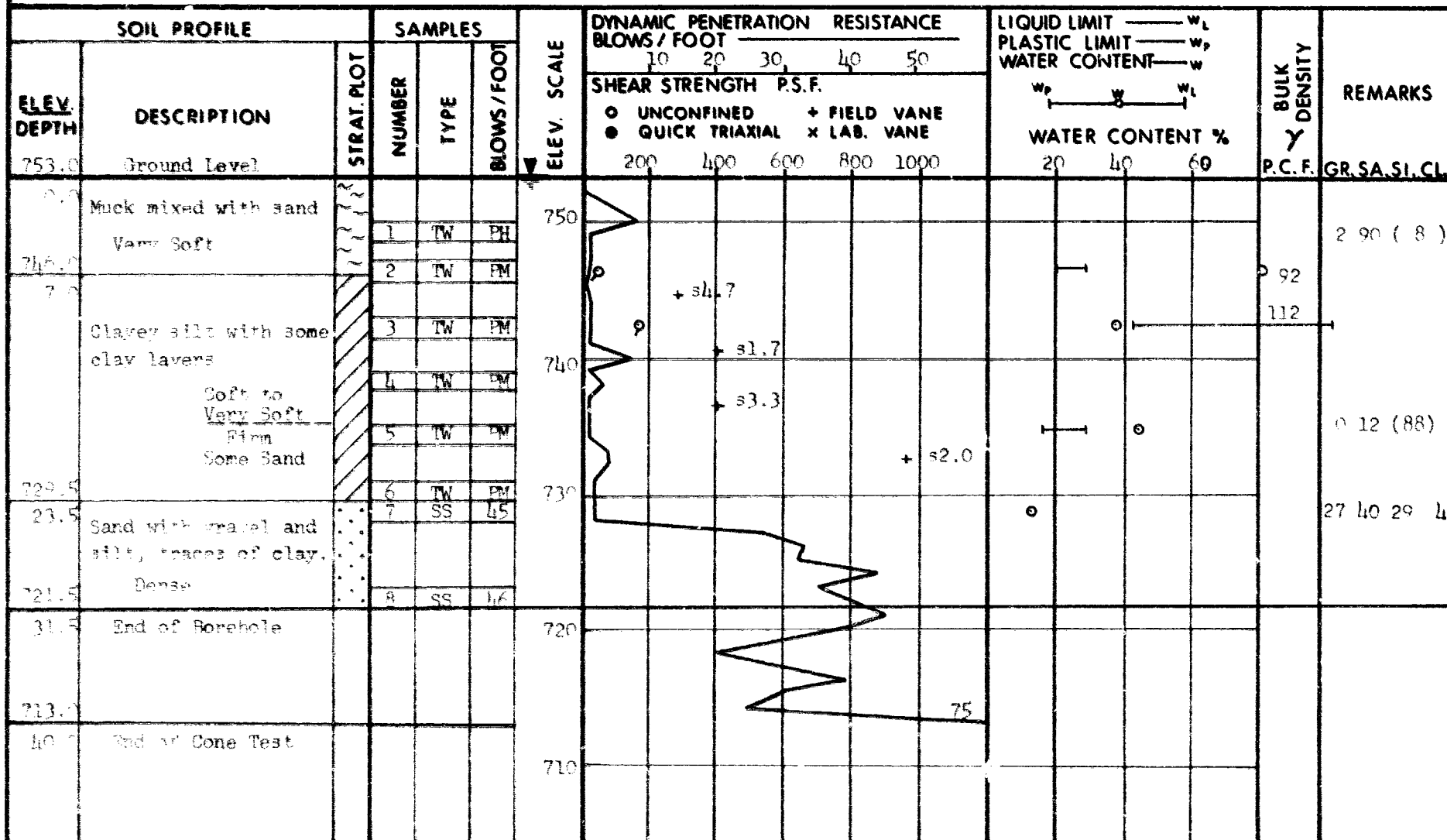
BORING DATE May 20-21, 1970

COMPILED BY AP

DATUM Geodetic

BOREHOLE TYPE Bombardier Flight Auger &amp; Cone

CHECKED BY



DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 70-11038 LOCATION Hwy. 546; Sta. 276 + 60 o/s 50' Lt. ORIGINATED BY AP  
 W.P. 162-62-01 BORING DATE May 19 - 20, 1970 COMPILED BY AP  
 DATUM Geodetic BOREHOLE TYPE Bombardier Flight Auger & Cone CHECKED BY SK

| SOIL PROFILE |   |             | SAMPLES |      |              | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE                            |     |     |     |      | LIQUID LIMIT — $w_L$<br>PLASTIC LIMIT — $w_p$<br>WATER CONTENT — $w$ |    |    | BULK DENSITY<br>$\gamma$<br>P.C.F. | REMARKS |
|--------------|---|-------------|---------|------|--------------|-------------|---|-----|-----|-----|------|--|----|----|------------------------------------|---------|
| ELEV. DEPTH  | DESCRIPTION                                   | STRAT. PLOT | NUMBER  | TYPE | BLOWS / FOOT |             | BLOWS / FOOT  |     |     |     |      | WATER CONTENT %  |    |    |                                    |         |
|              |   |             |         |      |              |             | 10  | 20  | 30  | 40  | 50   | 20   | 40 | 60 |                                    |         |
| 813.5        | Ground Level                                  |             |         |      |              |             | SHEAR STRENGTH P.S.F.                                     |     |     |     |      |  |    |    |                                    |         |
|              |   |             |         |      |              |             | ○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB. VANE |     |     |     |      |  |    |    |                                    |         |
|              |   |             |         |      |              |             | 200   | 400 | 600 | 800 | 1000 |  |    |    |                                    |         |
| 810          |   |             | 1       | TW   | PM           |             |   |     |     |     |      |  |    |    |                                    |         |
|              | Muck  |             | 2       | TW   | PM           |             |   |     |     |     |      |  |    |    |                                    |         |
|              | Very Soft                                     |             | 3       | TW   | PM           |             |   |     |     |     |      |  |    |    |                                    |         |
|              |   |             | 4       | TW   | PM           |             |   |     |     |     |      |  |    |    |                                    |         |
| 799.5        |   |             |         |      |              |             |   |     |     |     |      |  |    |    |                                    |         |
| 25.0         | Clayey silt to silty clay                     |             | 5       | TW   | PM           |             |   |     |     |     |      |  |    |    |                                    |         |
| 792.5        | Soft  |             | 6       | TW   | PM           |             |   |     |     |     |      |  |    |    |                                    |         |
| 31.0         |   |             |         |      |              |             |   |     |     |     |      |  |    |    |                                    |         |
|              | Sand with some gravel, traces of silt & clay. |             | 7       | SS   | 15           |             |   |     |     |     |      |  |    |    |                                    |         |
|              | Compact to Very Dense                         |             | 8       | SS   | 12           |             |   |     |     |     |      |  |    |    |                                    |         |
| 768.0        |   |             | 9       | SS   | 21 1/2       |             |   |     |     |     |      |  |    |    |                                    |         |
| 45.5         | End of Borehole                               |             |         |      |              |             |   |     |     |     |      |  |    |    |                                    |         |

810  
+ s2.0  
800  
+ s1.3  
790  
+ s1.6  
+ s1.7  
+ s3.0  
780  
770  
80  
100.6  
bouncing

106  
28.64 ( 8)





DEPARTMENT OF HIGHWAYS- ONTARIO

## RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

M.A. &amp; TESTING OFFICE

JOB 70-11038

LOCATION Hwy. 546; Sta. 293 + 77 o/s 1<sup>st</sup> Rt.

ORIGINATED BY AF

W.P. 162-67-01

BORING DATE May 19, 1970

COMPILED BY AP

DATUM Gendritic

BOREHOLE TYPE Bombardier Flight Auger &amp; Cone

CHECKED BY

| SOIL PROFILE |                                     |                         | SAMPLES |      |            | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE |    |    |    |    | LIQUID LIMIT — $w_L$<br>PLASTIC LIMIT — $w_p$<br>WATER CONTENT — $w$ |  |  | BULK DENSITY<br>$\gamma$<br>P.C.F. | REMARKS |  |
|--------------|-------------------------------------|-------------------------|---------|------|------------|-------------|--------------------------------|----|----|----|----|--|--|--|------------------------------------|---------|--|
| ELEV. DEPTH  | DESCRIPTION                         | STRAT. PLOT             | NUMBER  | TYPE | BLOWS/FOOT |             | BLOWS/FOOT                     | 10 | 20 | 30 | 40 | 50   | WATER CONTENT %<br>$w_p$ — $w$ — $w_L$ |  |                                    |         |  |
| 764.3        | Ground Level                        |                         |         |      |            |             |                                |    |    |    |    |  |  |  |                                    |         |  |
| 0.0          | Clayey Silt                         | [Hatched Pattern]       | 1       | SS   | 13         | 760         |                                |    |    |    |    |  |  |  |                                    |         |  |
|              | Firm to Very Stiff                  |                         | 2       | TW   | PH         |             |                                |    |    |    |    |  |  |  |                                    |         |  |
|              |                                     |                         | 3       | TW   | PH         |             |                                |    |    |    |    |  |  |  |                                    |         |  |
|              |                                     |                         | 4       | SS   | 6          | 750         |                                |    |    |    |    |  |  |  |                                    |         |  |
|              |                                     |                         | 5       | TW   | PH         |             |                                |    |    |    |    |  |  |  |                                    |         |  |
| 743.8        | Sandy Silt, Compact                 |                         | 6       | SS   | 6          |             |                                |    |    |    |    |  |  |  |                                    |         |  |
| 21.5         | End of Borehole<br>Probable Bedrock | [Cross-hatched Pattern] |         |      |            | 740         |                                |    |    |    |    |  |  |  |                                    |         |  |

SHEAR STRENGTH P.S.F.  
 ○ UNCONFINED + FIELD VANE  
 ● QUICK TRIAXIAL x LAB. VANE

DYNAMIC PENETRATION RESISTANCE  
 10 20 30 40 50

WATER CONTENT %  
 20 40 60

GR. SA. SI. CL.  
 1 2 ( 97 )  
 0 2 70 28  
 0 16 ( 84 )

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 5

## FOUNDATION SECTION

**JOB** 70-11038 **LOCATION** Hwy. 546; Sta. 295 + 35 c/s 5' Lt. **ORIGINATED BY** AP  
**W.P.** 162-67-01 **BORING DATE** May 19, 1970 **COMPILED BY** AP  
**DATUM** Geodetic **BOREHOLE TYPE** Bombardier Flight Auger & Cone **CHECKED BY** SK

| SOIL PROFILE |  |             | SAMPLES |      |              | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE                            | LIQUID LIMIT — $w_L$<br>PLASTIC LIMIT — $w_p$<br>WATER CONTENT — $w$ |     | BULK DENSITY<br>$\gamma$<br>P.C.F. | REMARKS |                 |    |    |  |            |
|--------------|--|-------------|---------|------|--------------|-------------|---|--|-----|------------------------------------|---------|-----------------|----|----|--|------------|
| ELEV. DEPTH  | DESCRIPTION                            | STRAT. PLOT | NUMBER  | TYPE | BLOWS / FOOT |             | SHEAR STRENGTH P.S.F.                                     |  |     |                                    |         | WATER CONTENT % |    |    |  |            |
|              |  |             |         |      |              |             |   |  |     |                                    |         |                 |    |    |  |            |
|              |  |             |         |      |              |             | 10  | 20   | 30  | 40                                 | 50      |                 |    |    |  |            |
|              |  |             |         |      |              |             | ○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB. VANE |  |     |                                    |         |                 |    |    |  |            |
|              |  |             |         |      |              |             | 200   | 400  | 600 | 800                                | 1000    | 20              | 40 | 60 |  |            |
| 759.2        | Ground Level                           |             |         |      |              |             |   |  |     |                                    |         |                 |    |    |  |            |
| 757.7        | some sand                              |             | 1       | SS   | 8            |             |   |  |     |                                    |         |                 |    |    |  | 3 33 53 11 |
|              |  |             | 2       | TW   | PH           |             |   |  |     |                                    |         |                 |    |    |  |            |
|              | Clayey silt                            |             | 3       | SS   | 16           |             | 750   |  |     |                                    |         |                 |    |    |  |            |
|              | Stiff to Very Stiff                    |             | 4       | TW   | PH           |             |   |  |     |                                    |         |                 |    |    |  |            |
|              |  |             | 5       | TW   | PM           |             | 740   |  |     |                                    |         |                 |    |    |  | 112        |
|              |  |             | 6       | TW   | PM           |             |   |  |     |                                    |         |                 |    |    |  |            |
| 734.2        | Band, some silt and gravel, Very Dense |             | 7       | SS   | 77           |             |   |  |     |                                    |         |                 |    |    |  | 19 56 24 1 |
| 27.0         | End of Borehole<br>Probable Bedrock    |             |         |      |              |             | 730   |  |     |                                    |         |                 |    |    |  |            |

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 6

**FOUNDATION SECTION**

|                              |  |                                      |
|------------------------------|--|--------------------------------------|
| <b>JOB</b> <u>70-11038</u>   | <b>LOCATION</b> <u>Hwy. 546, Sta. 311+95 o/s 5' Lt.</u>        | <b>ORIGINATED BY</b> <u>AP</u>       |
| <b>W.P.</b> <u>162-67-01</u> | <b>BORING DATE</b> <u>May 15, 1970</u>                         | <b>COMPILED BY</b> <u>AP</u>         |
| <b>DATUM</b> <u>Geodetic</u> | <b>BOREHOLE TYPE</b> <u>Bombardier Flight Auger &amp; Cone</u> | <b>CHECKED BY</b> <u>[Signature]</u> |

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 7

## FOUNDATION SECTION

**JOB** 70-11038      **LOCATION** Hwy. 546; Sta. 203 + 25 o/s 4' R+.      **ORIGINATED BY** AP  
**W.P.** 162-67-01      **BORING DATE** May 21, 1970      **COMPILED BY** AP  
**DATUM** Geodetic      **BOREHOLE TYPE** Bombardier Flight Auger & Cone      **CHECKED BY** [Signature]

| SOIL PROFILE |   |             | SAMPLES |      |              | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE<br>BLOWS / FOOT            |  | LIQUID LIMIT ——— $w_L$<br>PLASTIC LIMIT ——— $w_p$<br>WATER CONTENT ——— $w$ |  | BULK DENSITY<br>$\gamma$<br>P.C.F. | REMARKS   |
|--------------|---|-------------|---------|------|--------------|-------------|---|--|--|--|------------------------------------|-----------|
| ELEV. DEPTH  | DESCRIPTION   | STRAT. PLOT | NUMBER  | TYPE | BLOWS / FOOT |             | SHEAR STRENGTH P.S.F.                                     |  | WATER CONTENT %  |  |                                    |           |
|              |   |             |         |      |              |             | ○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB. VANE |  |  |  |                                    |           |
| 754.0        | Ground Level  |             |         |      |              |             |   |  |  |  |                                    |           |
| 749.0        | Fill<br>Sand with some silt,<br>traces of gravel and<br>clay. |             | 1       | SS   | 26           | 750         |   |  |  |  |                                    | 3 69 26 2 |
| 747.0        | Muck  |             | 2       | TW   | PM           |             |   |  |  |  | 112                                | 0 6 89 15 |
| 736.0        | Clayey silt, traces<br>of sand.<br><br>Soft                   |             | 3       | TW   | PM           | 740         |   |  |  |  |                                    |           |
|              |   |             | 4       | TW   | PM           |             |   |  |  |  |                                    |           |
| 720.0        | End of Borehole   |             |         |      |              | 730         |   |  |  |  |                                    |           |
| 34.0         | End of Cone Test  |             |         |      |              | 720         |   |  |  |  |                                    |           |

## FOUNDATION SECTION

**CHECKED BY**

| SOIL PROFILE   |                  |             | SAMPLES |      |              | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE<br>BLOWS / FOOT                                     | Liquid Limit ——— $w_L$<br>Plastic Limit ——— $w_p$<br>Water Content ——— $w$ | BULK DENSITY<br>$\gamma$<br>P.C.F. | REMARKS |
|----------------|------------------|-------------|---------|------|--------------|-------------|--|--|------------------------------------|---------|
| ELEV.<br>DEPTH | DESCRIPTION      | STRAT. PLOT | NUMBER  | TYPE | BLOWS / FOOT |             | SHEAR STRENGTH P.S.F.<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB. VANE | WATER CONTENT %<br>$w_p \quad w \quad w_L$                                 |                                    |         |
| 816.2          | Ground Level     |             |         |      |              |             |  |  |                                    |         |
| 0.0            |                  |             |         |      |              |             |  |  |                                    |         |
|                | Probable Bubble  |             |         |      |              | 810         |  |  |                                    |         |
| 797.2          |                  |             |         |      |              | 800         |  |  |                                    |         |
| 19.0           | End of Cone Test |             |         |      |              | 790         |  |  |                                    |         |

## ABBREVIATIONS USED IN THIS REPORT

### PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - 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:-

| <u>CONSISTENCY</u> | <u>'N' BLOWS / FT.</u> | <u>c LB. / SQ. FT.</u> | <u>DENSENESS</u> | <u>'N' BLOWS / FT.</u> |
|--------------------|------------------------|------------------------|------------------|------------------------|
| VERY SOFT          | 0 - 2                  | 0 - 250                | VERY LOOSE       | 0 - 4                  |
| SOFT               | 2 - 4                  | 250 - 500              | LOOSE            | 4 - 10                 |
| FIRM               | 4 - 8                  | 500 - 1000             | COMPACT          | 10 - 30                |
| STIFF              | 8 - 15                 | 1000 - 2000            | DENSE            | 30 - 50                |
| VERY STIFF         | 15 - 30                | 2000 - 4000            | VERY DENSE       | > 50                   |
| HARD               | > 30                   | > 4000                 |                  |                        |

### TYPE OF SAMPLE

|     |                       |                               |                   |
|-----|-----------------------|-------------------------------|-------------------|
| S.S | SPLIT SPOON           | T.W                           | THINWALL OPEN     |
| W.S | WASHED SAMPLE         | T.P                           | THINWALL PISTON   |
| S.B | SCRAPER BUCKET SAMPLE | O.S                           | OESTERBERG SAMPLE |
| A.S | AUGER SAMPLE          | F.S                           | FOIL SAMPLE       |
| C.S | CHUNK SAMPLE          | R.C                           | ROCK CORE         |
| S.T | SLOTTED TUBE SAMPLE   |                               |                   |
|     | P.H                   | SAMPLE ADVANCED HYDRAULICALLY |                   |
|     | P.M                   | SAMPLE ADVANCED MANUALLY      |                   |

### SOIL TESTS

|                 |                                 |     |                 |
|-----------------|---------------------------------|-----|-----------------|
| Q <sub>u</sub>  | UNCONFINED COMPRESSION          | L.V | LABORATORY VANE |
| Q               | UNDRAINED TRIAXIAL              | F.V | FIELD VANE      |
| Q <sub>cu</sub> | CONSOLIDATED UNDRAINED TRIAXIAL | C   | CONSOLIDATION   |
| Q <sub>d</sub>  | DRAINED TRIAXIAL                | S   | SENSITIVITY     |

# ABBREVIATIONS 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   |
| 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   |
| $C_\alpha$ | 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  |
| $T_f$      | SHEAR STRENGTH   |
| $c'$       | EFFECTIVE COHESION INTERCEPT   |
| $\phi'$    | EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION                  |
| $c_u$      | APPARENT COHESION  |
| $\phi_u$   | APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION                   |
| $\mu$      | COEFFICIENT OF FRICTION  |
| $S_t$      | SENSITIVITY  |

## GENERAL

|                           |                                   |
|---------------------------|-----------------------------------|
| $\pi$                     | = 3.1416                          |
| e                         | BASE OF NATURAL LOGARITHMS 2.7183 |
| $\log_e a$ OR $\ln a$     | NATURAL LOGARITHM OF a            |
| $\log_{10} a$ OR $\log a$ | LOGARITHM OF a 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  |
| $\bar{\sigma}$ | NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED) |
| $\tau$         | SHEAR STRESS   |
| $\epsilon$     | LINEAR STRAIN  |
| $\gamma$       | SHEAR STRAIN   |
| $\nu$          | POISSON'S RATIO ( $\mu$ IS ALSO USED)                  |
| E              | MODULUS OF LINEAR DEFORMATION (YOUNG'S 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 |
| $K_0$    | COEFFICIENT OF EARTH PRESSURE AT REST   |

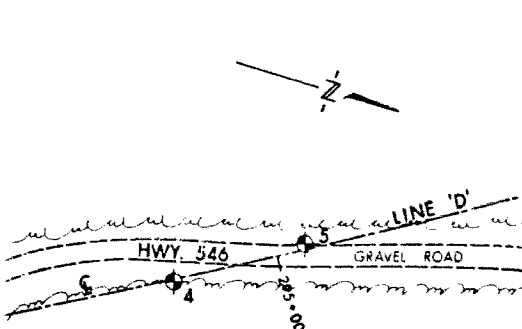
## FOUNDATIONS

|       |  |
|-------|--|
| 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   |

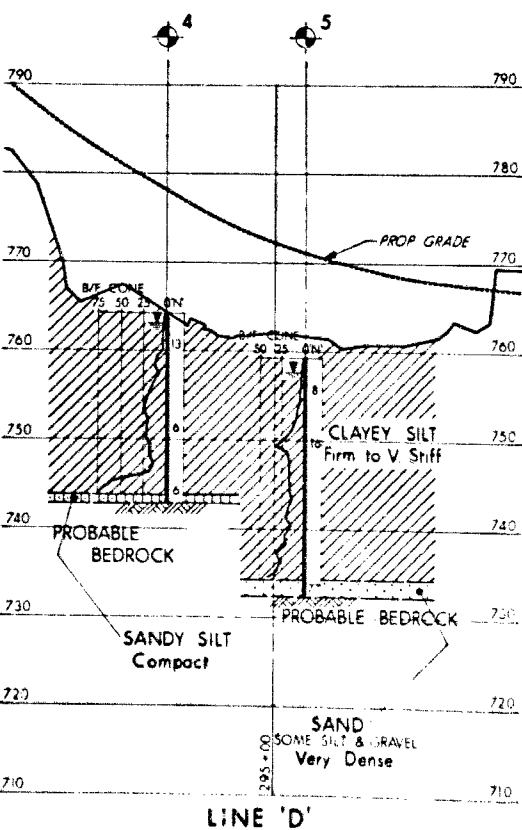
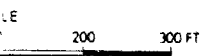
## SLOPES

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

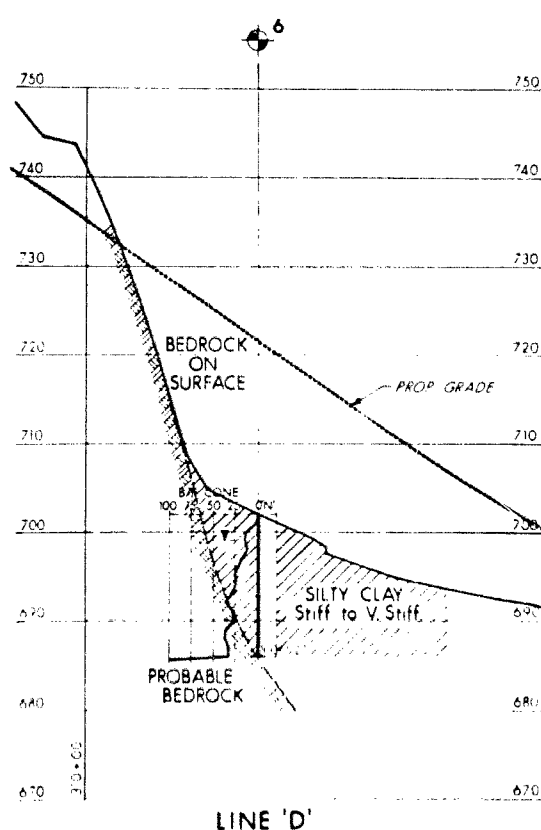
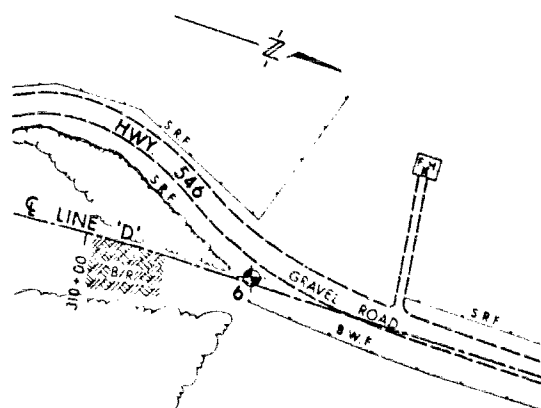
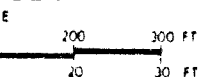




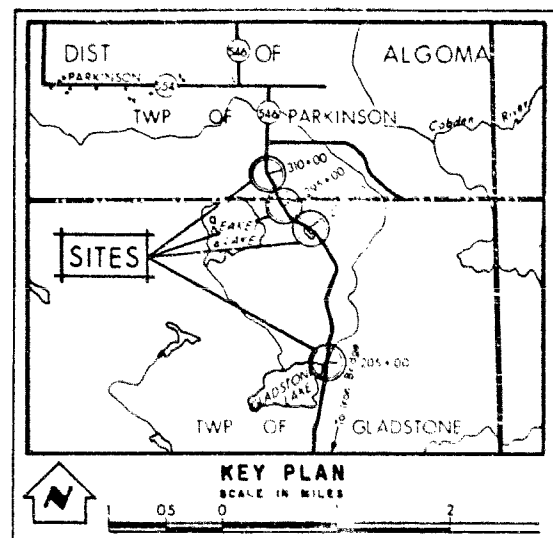
NS



ILES



LINE 'D'



### LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, MAY, 1970

| NO. | ELEVATION | STATION | OFFSET |
|-----|-----------|---------|--------|
| 1   | 753.3     | 203+63  | 22' LT |
| 2   | 753.0     | 202+93  | 17' RT |
| 3   | 813.5     | 276+60  | 50' LT |
| 3A  | 814.5     | 275+50  | 26' LT |
| 4   | 764.3     | 293+77  | 1' RT  |
| 5   | 759.2     | 295+35  | 5' LT  |
| 6   | 701.8     | 311+95  | 3' LT  |
| 7   | 754.0     | 203+25  | 4' RT  |
| 8   | 816.2     | 275+50  | 7' LT  |

### 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.

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

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

EMBANKMENT STABILITY INVESTIGATION

IRON BRIDGE NORTHERLY

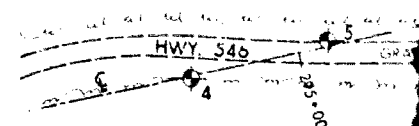
KING'S HIGHWAY NO. 546 LINE 'C' & 'D' DIST. NO. 18

DIST. ALGOMA

TWP. GLADSTONE & PARKINSON

### BORE HOLE LOCATIONS & SOIL STRATA

|           |                     |           |                    |
|-----------|---------------------|-----------|--------------------|
| SUBMITTAL | CHECKED             | W.P. NO.  | W.B.T. DRAWING NO. |
| DRAWN     | CHECKED             | JOB NO.   | 70 - 11038 A       |
| DATE      | JULY 11 1970        | SITE NO.  | BRIDGE DRAWING NO. |
| APPROVED  | <i>A. G. Thomas</i> | CONT. NO. |                    |



SCALE

100 50 0 100 200 300 FT

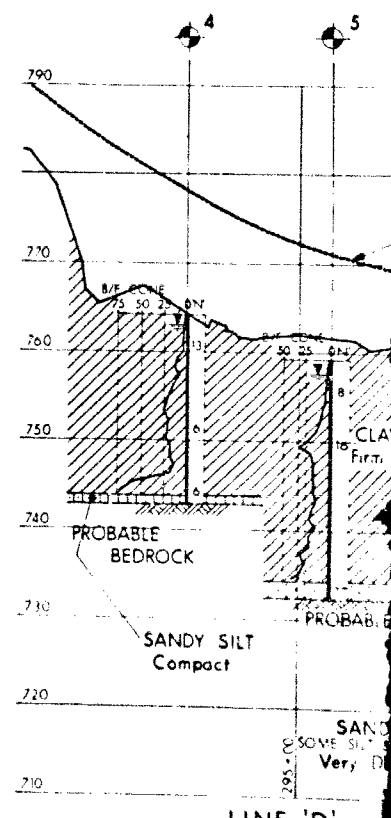


Figure 1 shows a horizontal scale bar with markings for 100, 50, 0, 100, 200, and 300 feet. Below the scale, vertical markings are shown for 10, 5, 0, 10, 20, and 30 feet.

Oversized Drawings

Program Status Report