

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 41K-32

W.P. No. 902-69-05

CONT. No. 71-520

W. O. No. 72-11074

STR. SITE No. N/A

HWY. No. 638 DIST 18

LOCATION ECHO BAY PATROL
YARD, 1.0 mi S of ECHO
BAY

=====
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS: SEE ALSO 41K-2 for
ORIGINAL FOUNDATION
INVESTIGATION

Mr. F. J. Mauro,
Regional Inspector,
Special Services,
Thunder Bay.

Materials and Testing,
Northwestern Region.

41K-32

GEOCRE No.

April 20, 1970.

Echo Bay Patrol Yard
Site No. 18-03-211

63-F-25

Proposed Patrol Garage Foundation

As per your memorandum dated April 15, 1970, Mr. M. Devata, Supervising Foundation Engineer, has been contacted and the following briefly outlines the comments discussed in relation to the foundation for the proposed six bay patrol garage.

Support in the type of soil under consideration is uncertain with a floating slab or raft foundation. Unevenly distributed dead loads possibly combined with the detrimental effects of live loads of variable duration as well as unequal bearing strengths could promote differential settlement and subsequent failure of the building. The type of footing recommended by Foundations will provide a more stable structure and be at the same time more economical.

Your office was contacted by telephone April 16, 1970, and plans are in progress to have the four corners of the garage staked out by April 22, 1970 for additional boreholes. This information will be forwarded to those concerned as quickly as possible.

If you have any more queries concerning the recommended foundation type, please contact the Foundations Office for further comment.

C. M. Smith,
Project Soils Engineer,

For:

R. Morgenroth,
REGIONAL MATERIALS ENGINEER.

CMS/mh

c.c.: M. Devata
F. Norman

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

71-520
72-11074

TO: Mr. A. G. Stermac,
Principal Foundations Engineer,
Foundations Office,
Downsview.

FROM: Materials and Testing,
Northwestern Region.

ATTENTION: Mr. M. Devata,
Supervising Foundations Engineer.

DATE: June 9, 1972.

OUR FILE REF.

IN REPLY TO

SUBJECT:

Work Project 902-69-05
Echo Bay Patrol Yard - District 18

Attached please find a recent memorandum from Mr. R. D. Gunter, dated February 16, 1972, concerning the proposed sand pad development in the Echo Bay patrol yard. On February 24 and 25, 1972, five additional boreholes were drilled behind the existing garage; copies of the borehole logs are also enclosed. These results, together with previous investigations, show variations in the thickness of the varved clay layer throughout the patrol yard site. Because of this variation, it may be possible to locate the proposed sand dome in a more favourable part of the yard in order that the stockpile height can be increased.

It is our understanding that the Municipal Division has requested an investigation at Kars Creek on the Goulais Mission Road (70-61-007). While your crew is in the area, we would like further work done at the patrol yard site. It is hoped that through additional borings your Section can recommend the best stockpile location with a revised height limitation. Contract 71-164 is in progress on Highway 638 and an early recommendation would mean the sand pad preparation could be done by the contractor on that job. The latest site plan of the patrol yard is enclosed.

Should any further information be required, please contact this office.

RBA/le
Attach. (3)

R. B. Adamson
R. B. ADAMSON,
PROJECT SOILS ENGINEER,

For:
R. MORGENROTH,
REGIONAL MATERIALS ENGINEER.

c.c.: Messrs. G. R. Browning,
G. Jordan,
F. Mauro,
A. Rutka,
G. Wrong;
Manager, Engineering Services.

100-11074-11074
DO NOT RECALL THIS

MEMORANDUM

41 K - 32

TO: Mr. R. Morgenroth, (2)
Regional Materials Engineer,
Northwestern Region,
Thunder Bay, Ontario.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION:

DATE: October 13, 1972.

OUR FILE REF.

IN REPLY TO

NOV - 8 1972

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed Sand Dome
At Echo Bay Patrol Yard
District 18 (Sault Ste. Marie)
W.O. 72-11074 -- W.P. 902-69-05
3rd 71-520

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

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

A. G. Stermac

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

AGS/ao
Attach.

cc: A. Argue
G. R. Browning
W. L. Lees
G. A. Wrong
B. J. Giroux
B. A. Singh

Foundations Files ✓
Documents

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FOUNDATION INVESTIGATION REPORT
For

Proposed Sand Dome
At Echo Bay Patrol Yard
District 18 (Sault Ste. Marie)
W.O. 72-11074 -- W.P. 902-69-05

1. INTRODUCTION:

A request for a foundation investigation concerning the proposed sand pad development in the Echo Bay patrol yard was received from Mr. R. Morgenroth, Regional Materials Engineer, in a memorandum dated June 9, 1972.

A field investigation has been carried out by the Foundations Office to determine the subsoil conditions at this site. This report contains the results of this investigation and our recommendations pertaining to the design of the proposed sand pad foundation.

2. SITE CONDITION:

The site for the proposed sand pad is located on Highway 17, one mile south of Echo Bay. The land is flat and poorly drained at this location.

3. FIELD WORK AND LABORATORY WORK:

3.1) General:

The field work consisted of two separate studies, one study at the existing sand pad location and one at an alternate site behind the existing garage. Laboratory work was not carried out for this report because of the availability of information from previous investigations. This information is contained in Foundation Investigation Report 63-F-25 and in

the borelog sheets from an investigation undertaken at this site on February 24 and 25, 1972, by the Materials and Testing Section, Northwestern Region.

3.2) Existing Pad Location:

The field work at this location consisted of four boreholes. These holes involved continuous field vane tests wherever possible. A few disturbed samples were also obtained using a 2-inch O.D. split spoon sampler driven according to the specifications for the Standard Penetration Test. These boreholes were advanced using continuous-flight augering equipment mounted on a bombardier.

3.3) Alternate Location:

The field work at this location consisted of nineteen dynamic cone penetration tests and one sampled borehole placed adjacent to one of these cone tests. This borehole was advanced using continuous-flight augering equipment mounted on a bombardier. One disturbed sample was obtained using a 2-inch O.D. split-spoon sampler driven according to the specifications for the Standard Penetration Test.

The dynamic cone penetration tests were advanced with a driving energy of 350 ft.-lbs. per blow. These tests were performed in a grid pattern, as shown on Drawing 72-11074A, in order to evaluate the thickness of the clay deposit at this location. The results of these cone tests were evaluated with the aid of information from boreholes placed at this site during the earlier investigations previously mentioned.

4. SUBSOIL CONDITIONS:

4.1) Existing Pad Location:

4.1.1) General:

The subsoil at this location is fairly uniform with three prominent soil strata occurring. The upper layer is

a gravelly sand, fill material. This stratum is underlain by a layer of varved clay. Beneath this clay layer, silty sand is found.

The boundaries between various soil types are shown on the Record of Borehole sheets. From ground level downwards the various soil strata are described as follows.

4.1.2) Gravelly Sand:

This stratum was present in all boreholes and varied in thickness from 3.0 to 3.9 feet. A 4-inch thick layer of asphalt was encountered in boreholes 201 and 204 in the upper foot of this stratum. This material is a loose, gravelly sand, fill material.

4.1.3) Varved Clay:

This stratum is a soft clay consisting of alternate red and grey layers. The thickness of this stratum varies from 15.5 feet to 20.9 feet. The field vane tests carried out in this stratum gave shear strengths varying from 320 p.s.f. to 2080 p.s.f. The results of the field vane tests are plotted on the Record of Borehole sheets.

4.1.4) Silty Sand:

Earlier investigations indicate that the silty sand stratum varies in density from compact to very dense. Some gravel may be encountered in this layer.

4.2) Alternate Location:

4.2.1) General:

The subsoil at this location is similar to that at the pad location with some variations in the extent of each stratum. For the one sampled borehole at this location, the boundaries between various soil types are shown on the Record of Borehole sheet. From ground level downward the various soil

strata are described as follows.

4.2.2) Gravelly Sand:

This stratum is present at all cone test locations except test numbers 101, 102, and 103. At Borehole 110 this stratum is about 1 foot thick and it is estimated that this stratum is no more than two feet thick at any location. This layer is a loose, fill material.

4.2.3) Varved Clay:

This stratum is a soft clay consisting of alternate red and grey layers. Since sampling was not carried out at this location, the exact boundaries of this stratum are not known. At test locations 101, 102, and 103 this layer appears at ground level covered with a thin layer of topsoil. At other test locations it is estimated that this layer is no more than two feet below ground level.

The lower boundary of this layer has been estimated from the results of the cone tests which have been evaluated in the light of information from the borehole at test location 110 and from the results of earlier investigations. The estimated depth of the lower boundary of the clay stratum at the location of each cone test is as follows:

<u>Test No.</u>	<u>Estimated Depth (ft.)</u>
101	6
102	6
103	7
104	12
105	9
106	8
107	5
108	6
109	4
110	5
111	6
112	6
113	7
114	8

<u>Test No.</u>	<u>Estimated Depth (ft.)</u>
115	10
116	9
117	8
118	8
119	7

Field vane shear strengths reported in previous investigations indicate a shear strength varying between 170 p.s.f. and 280 p.s.f. at this location.

4.2.4) Silty Sand:

Earlier investigations indicate that the silty sand stratum varies in density from compact to very dense. The results of cone tests suggests that the upper 2 to 4 feet of this layer is loose to very loose. Some gravel may be encountered in this stratum.

5. GROUNDWATER CONDITIONS:

5.1) Existing Pad Location:

The groundwater level was at a depth of 2 ft. at the time of this investigation.

5.2) Alternate Location:

From Foundation Report 63-F-25 the groundwater level is determined to be about 2 feet below ground level in the early spring of the year. Drainage of the yard appears to be poor at this location with pools of water occurring in some of the drainage ditches in lower lying parts of the yard.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) Existing Pad Location:

6.1.1) General:

Proposal 'A' is to build the proposed sand dome at the existing sand pad location. In the past few years the height of the sand pile has been kept to a maximum height of 20 feet and the initial settlement was observed to be in the order of 2 feet. A stability analysis of this site has been conducted in order to determine the maximum allowable sand pile height.

6.1.2) Sand Pile Stability:

Stability analyses were carried out by means of an electronic computer assuming that failure occurs along a circular arc, immediately after construction. Such computations are based upon shear strength parameters in terms of total stresses.

For these analyses the subsoil was divided into a number of layers of varying size and shape. This division was based entirely on variations in shear strength parameters. The results of field vane tests were used to obtain shear strength parameters for the varved clay stratum which was subdivided into five layers. The parameters for the sand pile material, the existing fill material, and the silty sand stratum were estimates based on experience. The parameters used were as follows:

Soil Type	Undrained Cohesive Strength (p.s.f.)	Angle of Friction	Bulk Density (p.c.f.)
Sand Pile Material	--	*33° or 45°	130
Fill Material	--	*33° or 45°	130
Varved Clay - Layer 1	1,800	--	110
Varved Clay - Layer 2	700	--	110
Varved Clay-- Layer 3	800	--	110
Varved Clay - Layer 4	400	--	110
Varved Clay - Layer 5	850	--	110
Silty Sand	--	35°	125

*An angle of 33° was used for a 1-1/2:1 slope; 45° was used for a 1:1 slope.

The results of the stability analyses indicate that a 24-foot-high sand pile will be stable with 1 horizontal to 1 vertical slopes or with 1.5 horizontal to 1 vertical slopes. It is recommended that the sand pile be kept to a maximum height of 24 feet at this location.

6.2) Alternate Location:

6.2.1) General:

Proposal 'B' is to build the proposed sand dome at a location behind the garage. The proposed site is shown on Drawing 72-11074A in the Appendix of this report.

The advantage of this location is that the soft clay layer is not as thick as at the existing pad location. For this reason it becomes feasible to excavate the clay and replace with a suitable backfill material.

6.2.2) Clay Excavation:

The estimated depths to the bottom of the clay stratum are given in Section 4.2.3 of this report. The minimum depth is 4 feet at cone test 109.

Because the groundwater level exists at a depth of 2 feet below ground level, a blow up of the silty sand material in the bottom of the excavation may occur if the clay is completely excavated. Because of the very soft nature of this clay deposit, partial excavation of the clay to prevent boiling of the silty sand stratum will result in stability problems. Only total excavation of the clay stratum is feasible.

It is recommended that the clay be completely excavated and replaced with suitable granular material. Water should be allowed to flow into the excavation in order to prevent blow up of the bottom of the excavation. The sand pile can then be placed to whatever height is required with no stability problems.

The depth of the bottom of the clay stratum is shown on Drawing 72-11074A and listed in Section 4.2.3 of this report.

The depth varies from about 4 feet at cone test No. 109 to about 10 feet at the south-east corner of the proposed pile location. The depth is about 6 feet at most points across this proposed area.

7. MISCELLANEOUS:

The field work for this project was carried out during the period of July 24 - 28, 1972, under the supervision of Mr. E. A. Wood, Project Foundations Engineer. The equipment was owned and operated by Canadian Longyear Ltd.

This report was written by Mr. E. A. Wood and reviewed by Mr. K. G. Selby, Supervising Foundations Engineer.

EAWood

E. A. Wood

K. G. Selby

K. G. Selby, P. Eng.

EAW/ao

Oct. 2, 1972.

APPENDIX I

DESIGN SERVICES BRANCH

FOUNDATION OFFICE

RECORD OF BOREHOLE Nº 101

JOB 72-11074

LOCATION 10' W. by 10' S. of NE corner of yard

ORIGINATED BY EW

W.P. 902-69-05

BORING DATE July 26, 1972

COMPILED BY EW

DATUM Geodetic

BOREHOLE TYPE Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYN. MIC. PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
604.9	Ground Level									
0.0						600				
593.9										
11.0	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATION OFFICE

RECORD OF BOREHOLE NO 102

JOB 72-11074 LOCATION 10' W. by 50' S. of NE corner of yard
 W.P. 902-69-05 BORING DATE July 26, 1972
 DATUM Geodetic BOREHOLE TYPE Cone Test

ORIGINATED BY EW
 COMPILED BY EW
 CHECKED BY JL

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT					
604.6	Ground Level									
0.0						600				
593.6										
11.0	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATION OFFICE

RECORD OF BOREHOLE NO 103

JOB 72-11074

LOCATION 20' W. by 90' S. of NE Corner of yard

ORIGINATED BY EW

W.P. 902-69-05


BORING DATE July 26, 1972

COMPILED BY EW

DATUM Geodetic

BOREHOLE TYPE Cone Test

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
603.2	Ground Level									
0.0						600				
590.2										
13.0	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATION OFFICE

RECORD OF BOREHOLE NO 104

JOB 72-11074 LOCATION 20' W. by 130' S. of NE corner of yard
 W.P. 902-69-05 BORING DATE July 26, 1972
 DATUM Geodetic BOREHOLE TYPE Cone Test

ORIGINATED BY EW
 COMPILED BY EW
 CHECKED BY JT.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w w_p — w — w_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
604.0	Ground Level									
0.0						600				
588.0						590				
16.0	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATION OFFICE

RECORD OF BOREHOLE NO 105

JOB 72-11074 LOCATION 80' W. by 170' S. of NE corner of yard ORIGINATED BY EW
 W.P. 902-69-05 BORING DATE July 26, 1972 COMPILED BY EW
 DATUM Geodetic BOREHOLE TYPE Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
604.1	Ground Level									
0.0						600				
587.1						590				
17.0	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATION OFFICE

RECORD OF BOREHOLE N^o 106

JOB 72-11074

LOCATION 80' W. by 130' S. of NE corner of yard

ORIGINATED BY EW

W.P. 902-69-05

BORING DATE July 26, 1972

COMPILED BY EW

DATUM Geodetic

BOREHOLE TYPE Cone Test

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w w_p — w — w_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
603.2	Ground Level									
0.0										
586.4										
16.8	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATION OFFICE

RECORD OF BOREHOLE NO 107

JOB 72-11074 LOCATION 80' W. by 90' S. of NE corner of yard
 W.P. 902-69-05 BORING DATE July 26, 1972
 DATUM Geodetic BOREHOLE TYPE Cone Test

ORIGINATED BY EW
 COMPILED BY EW
 CHECKED BY JL

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
602.9	Ground Level					600				
0.0										
590.9										
12.0	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE N^o108

JOB 72-11074

LOCATION 80' W. by 50' S. of NE corner of yard

ORIGINATED BY EW

W.P. 902-69-05

BORING DATE July 26, 1972

COMPILED BY EW

DATUM Geodetic

BOREHOLE TYPE Cone Test

CHECKED BY J.H.

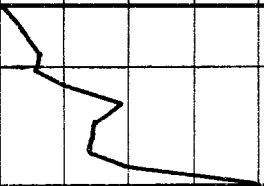
SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W W _P — W — W _L WATER CONTENT %	BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT						
604.3	Ground Level										
0.0						600					
594.5											
9.8	End of Cone Test										

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 109

JOB 72-11074LOCATION 80' W. by 10' S. of NE corner of yardORIGINATED BY EWW.P. 902-69-05BORING DATE July 26, 1972COMPILED BY EWDATUM GeodeticBOREHOLE TYPE Cone TestCHECKED BY JH

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
603.7	Ground Level									
0.0						600				
592.7										
11.0	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 110

JOB 72-11074 LOCATION 140' W. by 10' S. of NE corner of yard ORIGINATED BY EW
 W.P. 902-69-05 BORING DATE July 28, 1972 COMPILED BY EW
 DATUM Geodetic BOREHOLE TYPE Augered Hole & Cone Test CHECKED BY EW


SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W Wp — W — WL WATER CONTENT %	BULK DENSITY Y P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT					
602.8	Ground Level									
601.8	Sandy gravel. Fill water.									
1.0	Varved clay, grey and red layers. Soft					600				
597.8										
596.3	Clayey sand with some gravel.		1	SS	2					
6.5	End of Borehole									
588.3						590				
14.5	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE N^o 111

JOB 72-11074 LOCATION 140' W. by 50' S. of NE corner of yard ORIGINATED BY EW
 W.P. 902-69-05 BORING DATE July 28, 1972 COMPILED BY EW
 DATUM Geodetic BOREHOLE TYPE Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
604.2	Ground Level									
0.0						600				
688.7										
15.5	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE N^o112

JOB 72-11074 LOCATION 140' W. by 90' S. of NE corner of yard ORIGINATED BY EW
 W.P. 902-69-05 BORING DATE July 28, 1972 COMPILED BY EW
 DATUM Geodetic BOREHOLE TYPE Cone Test CHECKED BY JL

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT W_L	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT 20 40 60 80 100	PLASTIC LIMIT W_P		
603.0	Ground Level						SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W_P — W — W_L WATER CONTENT %	γ	GR.SA.SI.CL.
0.0						600				
589.0						590				
14.0	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 113

JOB 72-11074 LOCATION 140' W. by 130' S. of NE corner of yard
 W.P. 902-69-05 BORING DATE July 28, 1972
 DATUM Geodetic BOREHOLE TYPE Cone Test

ORIGINATED BY EW
 COMPILED BY EW
 CHECKED BY JG

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT % W_P W W_L	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT							
603.7	Ground Level											
0.0												
686.7												
17.0	End of Cone Test											

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 114

JOB 72-11074 LOCATION 140' W. by 170' S of NE Corner of yard
 W.P. 902-69-05 BORING DATE July 28, 1972
 DATUM Geodetic BOREHOLE TYPE Cone Test

ORIGINATED BY EW
 COMPILED BY EW
 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
603.9	Ground Level									GR.SA.SI.CL.
0.0						600				
584.9						590				
19.0	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 115

JOB 72-11074 LOCATION 200' W. by 170' S. of NE corner of yard
 W.P. 902-69-05 BORING DATE July 28, 1972
 DATUM Geodetic BOREHOLE TYPE Cone Test

ORIGINATED BY EW
 COMPILED BY EW
 CHECKED BY JS

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	BULK DENSITY γ P.C.F. GR.SA.SI.CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
603.7	Ground Level									
0.0										
585.2										
18.5	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE N^o 116

JOB 72-11074 LOCATION 200' W. by 130' S of NE corner of yard ORIGINATED BY EW
W.P. 902-69-05 BORING DATE July 28, 1972 COMPILED BY EW
DATUM Geodetic BOREHOLE TYPE Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT W_L		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.				PLASTIC LIMIT W_P	WATER CONTENT W		
603.8	Ground Level						20	40	60	80	100				
0.0						600									
585.8						590									
18.0	End of Cone Test														

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 117

JOB 72-11074

LOCATION 200' W. by 90' S. of NE corner of yard

ORIGINATED BY EW

W.P. 902-69-05

BORING DATE July 28, 1972

COMPILED BY EW

DATUM Geodetic

BOREHOLE TYPE Cone Test

CHECKED BY *EW*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
603.5	Ground Level									
0.0										
583.7										
19.8	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 118

JOB 72-11074 LOCATION 200' W. by 50' S. of NE corner of yard
W.P. 902-69-05 BORING DATE July 28, 1972
DATUM Geodetic BOREHOLE TYPE Cone Test

ORIGINATED BY EW
COMPILED BY EW
CHECKED BY Jes

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT — W _L PLASTIC LIMIT — W _p WATER CONTENT — W W _p — W — W _L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
603.2	Ground Level									
0.0						600				
						590				
582.2										
21.0	End of Cone Test									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 119

JOB 72-11074

LOCATION 200' W. by 10' S. of NE corner of yard

ORIGINATED BY EW

W.P. 902-69-05

BORING DATE July 28, 1972

COMPILED BY EW

DATUM Geodetic

BOREHOLE TYPE Cone Test

CHECKED BY *[Signature]*




SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — W_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT 20 40 60 80 100					PLASTIC LIMIT — W_p WATER CONTENT — W W_p — W — W_L				
603.1	Ground Level						SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT %			γ	P.C.F. GR. SA. SI. CL.
0.0						600										
590.7																
12.4	End of Cone Test															

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE N^o201

JOB 72-11074 LOCATION 52' W. by 48' N. of SW corner of most westerly salt shed ORIGINATED BY EW
 W.P. 902-69-05 BORING DATE July 27, 1972 COMPILED BY EW
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY J.F.






SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20 40 60 80 100					w_p w w_L				
							SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
						400 800 1200 1600 2000										
604.6	Ground Level															
601.5	Asphalt Gravel with sand Fill material		1	SS	11	600										
3.1	Varved clay grey and red layers soft															
581.8																
22.8	Silty sand with gravel		2	SS	14		580									
577.1	Compact															
27.5	End of Borehole															

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 202

JOB 72-11074 LOCATION 100' N. by 2'E. of SW corner of most westerly salt shed ORIGINATED BY EW
W.P. 902-69-05 BORING DATE July 27, 1972 COMPILED BY EW
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY gt

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT						LIQUID LIMIT ——— W_L PLASTIC LIMIT ——— W_p WATER CONTENT ——— W W_p ——— W ——— W_L WATER CONTENT % γ P.C.F.			REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000									
603.8	Ground Level															
0.0	Sand with some gravel					600										
600.8	Loose. Fill material		1	SS	6											
3.0	Varved clay grey and red layers Soft															
585.3						590										
583.8	Silty sand															
20.0	End of Borehole															

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 203

JOB 72-11074

LOCATION 70' N. by 110' W. of SW corner of most westerly salt shed

ORIGINATED BY EW

W.P. 902-69-05



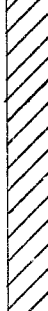

BORING DATE July 27, 1972

COMPILED BY EW

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY JS









SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w w_p — w — w_L WATER CONTENT %				BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000										
605.4	Ground Level																
0.0	Gravelly sand																
602.1	Fill material																
3.3	Varved clay grey and red layers Soft					600											
						590											
581.2																	
24.2																	
578.9	Silty sand					580											
26.5	End of Borehole																
		</															

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 204

JOB 72-11074 LOCATION 29' W. by 5' N. of SW corner of most westerly
W.P. 902-69-05 BORING DATE July 27, 1972 salt shed ORIGINATED BY EW
DATUM Geodetic BOREHOLE TYPE Auger COMPILED BY EW
CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w w_p ——— w ——— w_L WATER CONTENT %			BULK DENSITY γ P. C. F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000										
605.0	Ground Level																
0.0	Gravelly sand with 4" asphalt at depth of 5" to 9". Fill material					600											
601.1																	
3.9																	
	Varved clay																
	grey and red layers																
	Soft					590											
585.0																	
583.5	Silty sand																
21.5	End of Borehole																

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

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	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_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_f	SENSITIVITY

GENERAL

π	= 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
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

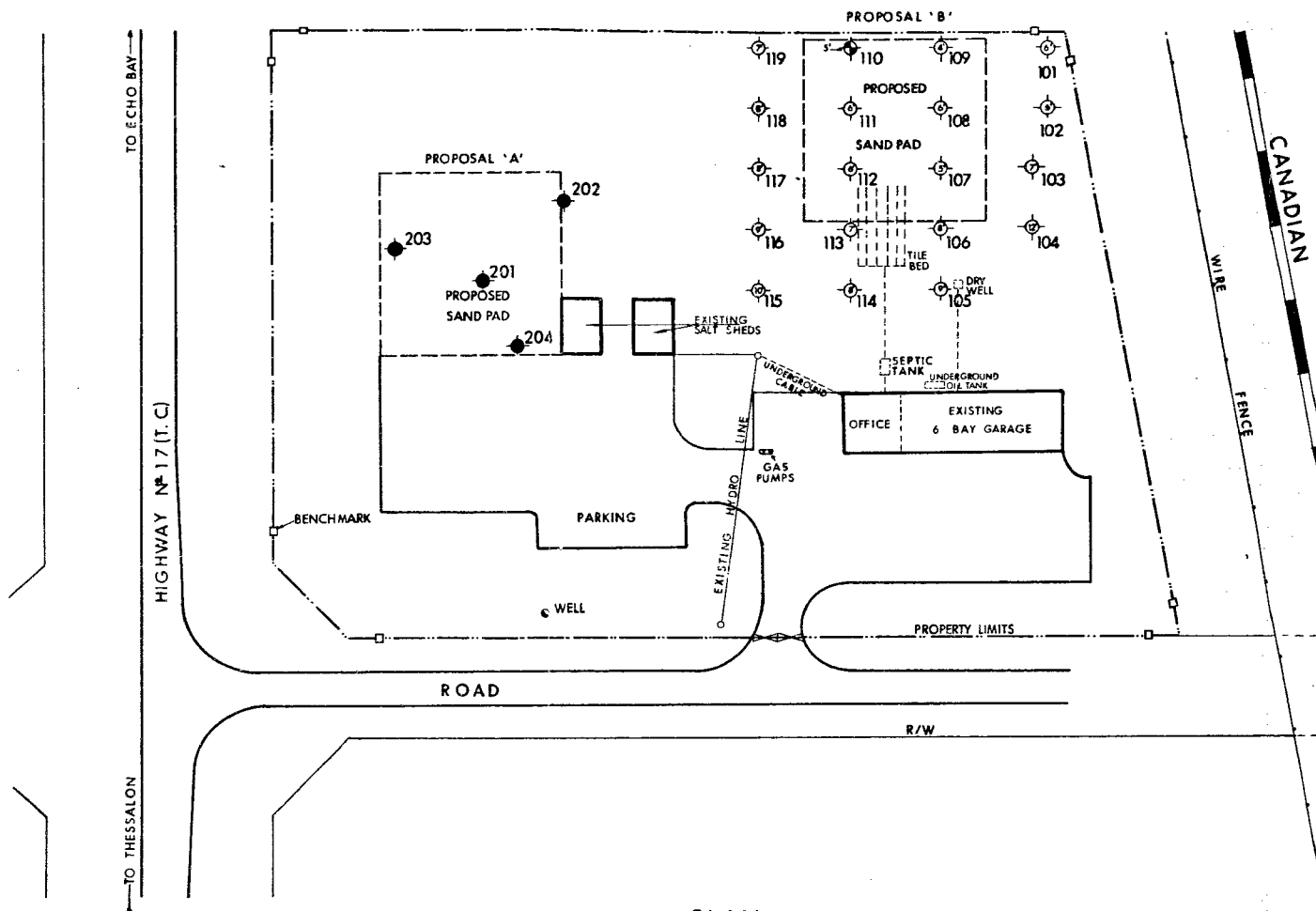
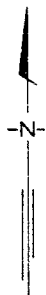
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

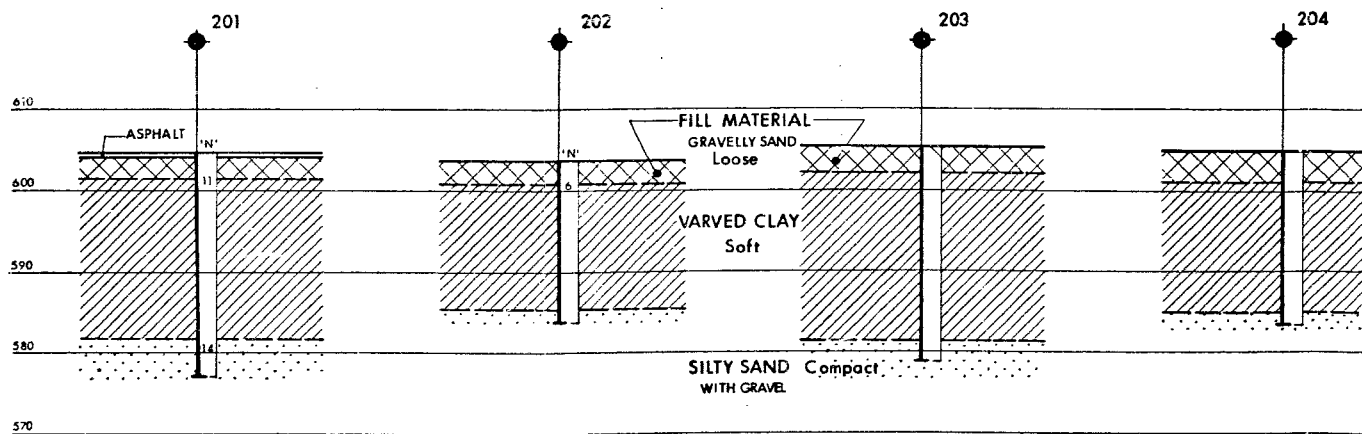
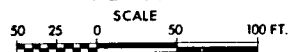
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

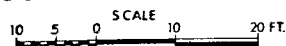
H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL



PLAN



BORE HOLE DETAILS





Memorandum

To: **C. Mirza**
Head, Soil Mechanics Section
Downsview

From: Materials & Testing
Northwestern Region

Attention:

Date: August 20, 1975

Our File Ref.

In Reply to

Subject:

Proposed Sand Dome at Echo Bay Patrol Yard
Sault Ste. Marie District
WP 902-69-05

A Foundation Investigation Report was issued by your office for this project on October 13, 1972. The accompanying plans are for a typical sand dome structure which is proposed at this site (Proposal "A").

Please review the foundation scheme proposed and comment on the adequacy for this site.

/mle
Enc.
c.c. F. Mauro
Central File

H. Meyer
H. Meyer
Project Soils Engineer



Ministry
~~Ministry~~

*Please have your staff
change their terms on this to 1:01.
All material to be filed with Cont-71-520
for now. No prod card needed as now,
Cam.*

Mauro T.