

GEOCRES No. 52A-59 / 52A-70

DIST. 19 REGION \_\_\_\_\_

W.P. No. 1503-73-00 , 13-74-01

CONT. No. \_\_\_\_\_

W. O. No. \_\_\_\_\_

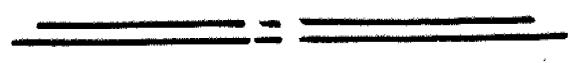
STR. SITE No. \_\_\_\_\_

HWY. No. 595

LOCATION SITCH CREEK & BEAVER

CREEK NEAR HYMERS HWY 595

No of PAGES - \_\_\_\_\_



OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. \_\_\_\_\_

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

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

To: Mr. B.J. McKenna, (2) FROM: Soil Mechanics Section,  
Reg. Structural Planning Geotechnical Office,  
Engineer, West Building, Downsview.  
Northwestern Region,  
ATTENTION: Thunder Bay. DATE: October 3rd, 1974.  
OUR FILE REF. IN REPLY TO **OCT - 9 1974**

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For  
The Proposed New Structures at  
Crossings of Sitch and Beaver  
Creeks, Near Hymers, Hwy. 595,  
District #19, Thunder Bay.  
W.O. 74-11028 W.P. 1503-73-00

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the abovementioned 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.

*M. Devata*

M. Devata,  
Supervising Engineer.

MD/mj  
c.c. E.J. Orr  
B.R. Davis  
W.L. Lees  
R.W. Franks  
B.J. Giroux  
R. Morgenroth  
G.A. Wrong  
P. Lewycky

Files  
Documents

ATTACH\*

52A-59  
GEOCRES No.

52A-70

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FOUNDATION INVESTIGATION REPORT  
For  
The Proposed New Structures at  
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District #19, Thunder Bay.

W.O. 74-11028 W.P. 1503-73-00

1. INTRODUCTION:

A foundation investigation has been carried out at the above-mentioned sites to determine the existing subsoil and groundwater conditions.

A request for this investigation was received in a memorandum from Mr. P.D. Lester, Regional Structural Planning Engineer for the Northwestern Region, dated May 7th, 1974.

There are four locations at which a foundation investigation was carried out. At sites B (48W-124), C (48W-80) and E (48W-122), there are presently Bailey Bridges while at site D (no site number) there is one 7 ft. (2.1 m) diameter and two 3 ft. (0.9 m) steel corrugated pipe culvert. Final details are not yet known, but it is anticipated that the structures at all sites will be replaced by large metal culverts (of the order of 16 ft. diameter) with minimum grade on top.

Plan and profile layouts for this report are approximations only, with the exception of borehole locations and elevations, which have been tied into the proposed "Line A" of Hwy. 595. Systems Design is presently preparing plan and profile layouts, these will be forwarded when available.

This report contains the results of the field and laboratory investigations, together with recommendations for the foundations.

2. SITE DESCRIPTION:

2.1) General.

The sites of the investigation are on Hwy. 595 at crossings of the Sitch and Beaver Creeks, all of which are in the vicinity of the Town of Hymers.

The surrounding area generally has a rolling topography and thick treed vegetation, with the occasional cleared area being utilized as farmland. This area is most abundant with meandering rivers and creeks, which is typical of the whole Northwestern Region.

There are no visible rock outcrops in the immediate area of the work sites. The closest rock outcrops (from observations) are in the area of Kakabeka Falls (approximately 10 miles north of the sites). The bedrock at this location is basically shale, with the occasional granite outcrop.

The field work was carried out in the early part of the summer, during a period (six weeks) of very dry weather, which was preceded by a very wet spring. These extreme conditions have had an effect on the water conditions, i.e. - river widths and depths became noticeably less during the field investigation.

These creeks generally flow at a much greater pace, width and depth in the spring than at the time of the investigations. It was under these spring conditions that caused the previous river crossing structures to fail.

2.2) Site B.

The site of this investigation is located on Hwy. 595, approximately 0.25 miles (0.4 km) north from the Hwy. 588 intersection (the location of M.T.C. Patrol Yard #13) at the crossing of Sitch Creek. The existing structure at this location is a 70 x 11 ft. (21.3 - 3.4 m) Bailey Bridge, which is founded on spread footings and has approach fills with side slopes of approximately 1½:1. The structure is in good condition. Prior to this existing structure, there was a concrete culvert which was preceded by a wooden bridge. Both of these structures failed due to high water levels in the spring. Along the banks of the creek and under the Bailey Bridge there are

partial remains of the previous structures.

At this location, Sitch Creek varies in width from approximately 5 to 15 feet (1.5 - 4.6 m) and the depth from a few inches to 1.5 ft.

The current of the creek is basically very slow, almost stagnant, except at the narrower, shallow sections, where it flows at a faster pace.

The terrain is generally hilly and the land is mostly undeveloped with a dense forest cover. There are some road cut side slopes of 1:1, these have been eroded due to water runoff (lack of vegetation) and have bulged slightly towards the bottom (a slight slope failure).

#### 2.3) Site C.

The site of this investigation is located approximately 500 ft. (152.4 m) north of Site B on Hwy. 595, also at the crossing of Sitch Creek. The existing structural and site conditions are basically the same as at Site B. The same previous structures also existed, with partial remains at the site.

The river width varies from approximately 5 to 35 feet (1.5 - 10.7 m) and the depth from a few inches to 3 feet, with its current similar to Site B.

#### 2.4) Site D.

The site of this investigation is located approximately 0.25 miles (0.4 km) north of Site D on Hwy. 595, again at the crossing of Sitch Creek. The existing structures at this location consist of one 7 ft. (2.1 m) and two 3 ft. (0.9 m) diameter corrugated steel pipe culverts. The length of the 7 foot diameter C.S.P. is approximately 65 ft. (19.8 m) and that of the 3 ft. diameter is 50 ft. (15.2 m). There is no visual structural damage to any of the pipes except at the ends, which are slightly deformed.

The river width varies from approximately 5 to 25 feet (1.5-7.6 m) and the depth from a few inches to 3 feet, with the current similar to the previous sites.

At the time of the investigation the 7 ft. C.S.P. was approximately 1/3 full and the two 3 pipes were not being utilized due to the present water level conditions.

The land on the north side of the creek is generally very soft and wet, with some swampy areas. However, after talking to a local resident I learned that these conditions were not common at this time of the year. These conditions resulted due to a large amount to rain during the spring.

The area has generally a rolling terrain with the land mostly developed for agricultural uses.

#### 2.5) Site E.

The site of the investigation is located approximately 2 miles (3.2 km) north of the Town of Hymers, on Hwy. 595, at the crossing of Beaver Creek. The existing structure at this location is a 90 x 11 foot (27.4-3.4 m) Bailey Bridge, which is founded on spread footings and has approach fill side slopes of approximately 2:1. The structure is in good condition.

Prior to this existing structure, there was a wooden bridge located approximately 50 ft. (15.2 m) to the west. There are partial remains of the previous bridge at that location.

At this site, Beaver Creek varies in width from approximately 5 to 30 feet (1.5 - 9.1 m) and the depth from a few inches to 2 feet. The current of the creek is similar to that of the previous sites.

The land on the southeast side of the creek is very soft and wet, with some swampy areas; possibly due to high water levels in the spring.

The area has generally a rolling terrain, with the land divided between a dense forest cover and cleared agricultural areas.

3. FIELD AND LABORATORY INVESTIGATIONS:

The field work consisted of twelve sampled boreholes, with dynamic cone tests adjacent to each hole. The boreholes were advanced by a trailer mounted C.M.E. 45, using continuous flight auger, washboring and diamond drilling equipment. Disturbed samples were obtained, using a 2-inch O.D. split-spoon sampler, driven according to specifications for the Standard Penetration Test (350 ft-lbs. per blow).

A 4.5 (1.4 m) rock core sample was obtained at the end of B.H.#8.

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

Grain-size Distribution  
Atterberg Limits  
Natural Moisture Content  
Organic Content

The results of the field and laboratory tests are given in the Record of Borehole Sheets.

The surveying of the Boreholes was carried out by personnel from the Regional Engineering Surveys Office.

4. SOIL TYPES AND SOIL CONDITIONS:

4.1) General.

The boundaries between different deposits encountered at the sites investigated are shown on the Record of Borehole Sheets, attached to the Appendix. A brief description of the different soil types encountered, are as follows:

4.2) Site B: (B.H.#1, #2 and #3).

4.2.1) Fill Material.

This deposit was intersected in B.H.#1, from the existing roadway level (El. 899.1) to approx. Elev. 888.1. The material in the deposit consists of clayey silt to silty clay with traces of sand, gravel and organics. The consistency is estimated to vary from firm to stiff.

4.2.2) Clayey Silt with Some Sand, Trace of Gravel and Organics.

This stratum was encountered in B.H.'s #2 and #3 and extends from immediately below the topsoil to a depth of 5 ft. (1.5 m). The consistency of the deposit may be described as stiff to very stiff.

4.2.3) Silty Sand to Sandy Silt with Traces of Gravel, Clay and Organics.

This deposit was found to underlie the fill material (B.H.#1) and the clayey silt stratum (B.H.#2 & #3). The upper boundary varies between Elev. 883 and Elev. 888. The thickness ranges from 28 ft. (8.5 m) to 33 ft. (10.1 m).

The overall deposit consists of layers or zones of silts and sands, with traces of gravel, clay and organics. Results of the mechanical analyses are summarized on the Record of Borehole Sheets. Standard Penetration Tests carried out within this deposit gave 'N' values ranging from 10 to 65 blows/foot. The relative density may be described as compact to very dense.

4.2.4) Sand & Gravel with Traces of Silt & Clay.

A very dense sand and gravel with traces of silt and clay stratum was found to underlie the silty sand to sandy silt deposit at elev. 852 and elev. 855 in B.H.'s #2 & #3 respectively. The lower boundary is estimated to be at approx. elev. 849 where refusal to conventional boring methods were reached.

4.3) Site C: (B.H.#4, #5, #6.)

4.3.1) Fill Material.

This stratum was encountered from ground level to a maximum depth of 8 ft. (2.4 m) in all borings.

The material in the deposit consists of firm to very stiff clayey silt with some sand and traces of gravel and organics. The consistency is estimated to range from firm to very stiff.

4.3.2) Sandy Silt to Silty Sand, Traces of Clay and Organics.

Immediately below the fill material a 6 to 11 ft. (1.8 to 3.4 m) thick granular type deposit was intersected at all boring locations. The material in the stratum consists mainly of sand and silt, with traces of clay and organics. Grain-size analyses indicate the presence of gravel sizes in B.H.#4 and #5. The natural moisture content ranges from 18 to 49%. Based on the Standard Penetration Test, the relative density may be described as loose to compact.

Similar material was encountered again in all borings at a lower depth, separated from the upper zone by a layer of sand and gravel. The upper surface of this second sandy silt to silty sand varies between elev. 855 and elev. 875. The lower boundary in B.H.#6 is at elev. 851, where refusal to conventional washboring methods was reached. The relative density varies from loose to very dense. ('N': 8-131 blows/foot).

4.3.3) Sand and Gravel, Some Silt, Traces of Clay and Organics.

This material was observed in all boreholes to underlie the silty sand to sandy silt deposit. The material consists mainly of sand and gravel, in the following average proportions: Gravel: 31%, Sand: 55%, Silt: 10% and Clay: 4%. The natural moisture content was found to range from 5 to 12%. The relative density may be described as compact to dense: The average 'N' value is in order of 32 blows/foot and ranges from 13 to 46 blows/foot.

4.4) Site D: B.H.'s #7, #8, #9 and #10.

4.4.1) Fill Material.

Fill material, consisting of silty sand with some gravel, traces of clay and organics was encountered from the roadway level (elev. 880) to approx. elev. 869, in B.H.#9 only, the relative density varies from compact to dense.

4.4.2) Silty Clay with Some Sand, Traces of Gravel & Organics.

A thin zone of silty clay with some sand, traces of gravel and organics was observed at ground level in all borings with the exception of B.H.#9. The depth is about 5 ft. (1.5 m). The consistency is estimated to range from soft to stiff.

4.4.3) Silty Sand to Sandy Silt, Some Gravel, Traces of Clay and Organics.

This stratum was found to underlie the fill material (B.H.#9) or the silty clay deposit in all boreholes and extends to the full depth of exploration in B.H.'s #9 and #10. The lower boundary in B.H.#7 & #8 was found to be at elev. 851 and elev. 846 respectively. The chief components, as determined by grain-size distribution tests, are sand and silt with some gravel, traces of clay and organics. Occasional layers of sand and gravel, were also observed within this deposit. 'N' values obtained during the field investigation gave a range of 5 to 188 blows/foot. The relative density may be described as loose to very dense. The average natural moisture content was found to be in the order of 21%.

4.4.4) Sand and Gravel, Some Silt, Traces of Clay:

This deposit was encountered in B.H.#7 only at elev. 851 and extends to a depth of about 6.5 ft. (2.0 m). The lower boundary was not determined since the boring was terminated in this zone. The material was found to be sand and gravel, with some silt and traces of clay. Standard Penetration Tests carried out in this zone, indicated a very dense relative density.

4.4.5) Bedrock:

Bedrock was proved in B.H.#8, at elev. 846, by obtaining BX size rock core sample. A description of the rock core made by Mr. B.K. Glassford, Geotechnical Office Geologist, is as follows:

'Graywacke, hard, fine texture, altered with metamorphism, inclusion of calcite, hermatite, marcasite, quartz crystals and graphite, moderately fractured.'

4.5) Site E: (B.H.'s #11 & #12)

4.5.1) Sandy Silt to Silty Sand, Some Gravel, Traces of Clay and Organics.

This deposit was encountered at both boring locations and found to extend from ground level to a maximum depth of 28 ft. (8.5 m). The material in the stratum consists mainly of varying proportions of sand and silt with some gravel, traces of clay and organics. The natural moisture content ranges from 14% to 39%. Standard Penetration Tests carried out within this zone gave 'N' values ranging from 2 to in excess of 100 blows/foot. The relative density may be described as very loose to very dense.

4.5.2) Sand & Gravel with Some Silt and Clay.

A very dense deposit of sand and gravel with some silt and clay was found to underlie the sandy silt to silty sand stratum in B.H.#12, between elev. 941.6 and elev. 937.6.

4.5.3) Clayey Silt, Traces of Gravel.

The sand and gravel zone is underlain by a hard, clayey silt with traces of gravel in B.H.#12. The boring was terminated within this deposit at elev. 934.1.

5. GROUNDWATER CONDITIONS:

The groundwater conditions across the sites were observed by taking readings in the open boreholes during the period of the field investigation. (June and July, 1974.) The results of the readings are shown on the Record of Borehole Sheets.

The observations indicate that the groundwater was located between the following elevations:

Site B:

Elev. 874.1 - Elev. 883.1

Corresponding to levels ranging from 16.5' to 5' (5.0 to 1.5 m) below groundlevel.

Creek water level: elev. 885±

Site C:

Elev. 872.5 - Elev. 876.3

Corresponding to levels from 16.5 to 4.5 ft. (5.0 to 1.4 m) below groundlevel.

Creek water level: elev. 876±

Site D:

Elev. 869.5 - Elev. 873.7

Corresponding to levels from 11 to 3.5 ft. (3.4 to 1.1 m) below groundlevel.

Creek water level: elev. 873±.

Site E:

Elev. 961.2

Corresponding to level approx. 5 ft. (1.5 m) below groundlevel.

Beaver Creek water level: elev. 963±.

6. DISCUSSION AND RECOMMENDATIONS:

The proposals at sites B, C and E are to replace the existing Bailey Bridges with large corrugated steel pipe culverts (in the order of 16 ft. diameter), and, at site D to replace the 7 ft. and two 3 ft. diameter pipes with a large metal culvert. The locations of the culverts will be determined by the new centreline of the roadway, all locations will be within the vicinity of the existing structure.

A rise in grade will be necessary to provide adequate cover for 16 ft. dia. culverts.

In order to ensure the stability of the C.S.P. culvert and its accompanying embankment, it is recommended that any encountered soft, surficial organic deposit be removed to its entire extent (vertical and horizontal) within the plan limits of the embankment and culvert. If earth fill is used, 2:1 slopes are recommended.

Due to the nature of the subsoil, the settlements will be elastic and negligible.

Bedding and backfilling for the proposed corrugated steel pipe culverts should be carried out in accordance with current M.T.C. standards.

Appropriate measures will be necessary to prevent infiltration and washing out by water of the backfill and bedding.

A dewatering scheme or stream diversion will be required to place the bedding in the dry.

7. MISCELLANEOUS:

The field work was carried out from June 18 to June 28 and from July 16 to July 19, 1974.

The equipment used was owned and operated by Dominion Soil Investigation Limited (Thunder Bay) under the supervision of Mr. P. Christensen, Student Technician who also prepared this report. The report was reviewed by Mr. M. Devata, Supervising Engineer.



*P. Christensen*  
P. Christensen,  
for Student Technician.

*M. Devata*  
M. Devata, P. Eng.,  
Supervising Engineer.

MD/PC/mj

October, 1974.

APPENDIX I

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1

JOB 74-11028 LOCATION Site 'B' Sta. 244 + 17 10.5' Rt. ORIGINATED BY PC  
 W.P. 1503-73-00 BORING DATE June 18, 1974 COMPILED BY PC  
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY PC

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W	BULK DENSITY γ	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE						BLOWS/FOOT
899.1	Ground Level									
0.0	Clayey silt to silty clay, with traces of sand, gravel and organics.		1	SS	9					
	Firm to Stiff		2	SS	12					
888.1	Fill Brown		3	SS	7					
11.0	Sandy silt with a trace of <u>Brown</u> clay, <u>Grey</u> gravel & organics.		4	SS	16				1.12%	0 3 ( 97 )
			5	SS	10				1.19%	0 7 88 5
			6	SS	14				1.07%	0 15 84 1
876.6	Compact		7	SS	30					
22.5	End of Borehole					120/10'				
					870					

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO 2

FOUNDATIONS OFFICE

JOB 74-11028

LOCATION Site 'B' Sta. 245 + 13 28' Rt.

ORIGINATED BY PC

W.P. 1503-73-00

BORING DATE June 19, 1974

COMPILED BY PC

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			BULK DENSITY $\gamma$	REMARKS				
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	SHEAR STRENGTH P.S.F. $W_p \quad W \quad W_L$				P.C.F.	GR.	SA.	SI.
890.4	Ground Level																		
0.0	Clayey silt with some sand, trace of gravel & organics. V. Stiff Brown		1	SS	24														
885.4			2	SS	26														
5.0	Silty sand to Greyish Brown Black sandy silt with a trace of clay and organics.		3	SS	12	880													0 13 86 1
			4	SS	31														0 52 46 2
			5	SS	47														$\nabla$ 874.1
			6	SS	30	870													
			7	SS	39														
	Compact to Dense		8	SS	48														0 88 (12)
			9	SS	50	860													
			10	SS	42														
852.4	sand & gravel with a trace of silt & clay.																		
38.0	Very Dense Black		11	SS	70	850													37 56 ( 7)
848.9																			
41.5	End of Borehole																		
						840													

OFFICE REPORT ON EXPLORATION



DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 4

JOB 74-11028 LOCATION Site 'C' Sta. 250 + 59 4.5' Rt.  
 W.P. 1503-73-00 BORING DATE June 19, 1974  
 DATUM Geodetic BOREHOLE TYPE Auger

ORIGINATED BY PC  
 COMPILED BY PC  
 CHECKED BY M.J.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	$W_P$	$W$	$W_L$		
888.8	Ground Level															
0.0	Clayey silt with some sand, traces of gravel & organics. Fill, Stiff Brown		1	SS	9							0				
883.8																
5.0	Sandy silt, traces of clay, gravel & orgs. Loose to Compact Brown		2	SS	13	880						HO			1.91% org.	
877.8																
11.0	Sand & gravel with si. Traces of clay & orgs. Compact Brown		3	SS	4							0			1.94% org.	
874.8																
14.0	Sandy silt, traces of clay & organics. Loose to Compact Black		4	SS	13							0				
872.5																
14.0			5	SS	8	870						HO				
866.3																
14.0			6	SS	13							0			1.07% org.	
866.3																
22.5	End of Borehole		7	SS	21							0			0 22 77 1	
						860										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 5

JOB 74-11028 LOCATION Site 'C' Sta. 249 + 80 20' Rt. ORIGINATED BY PC  
 W.P. 1503-73-00 BORING DATE July 16, 1974 COMPILED BY PC  
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY H.S.

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					WATER CONTENT $W_p$			
						20	40	60	80	100	WATER CONTENT %				
						SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						○ UNCONFINED + FIELD VANE					20 40 60				
						● QUICK TRIAXIAL x LAB VANE									
883.8	Ground Level														
0.0	Clayey silt with some sand & a trace of gravel & organics		1	SS	8										
875.8	Firm Fill Brown		2	SS	6									2.11% org.	▼ 876.3
8.0	Sandy silt to silty sand with some gravel, traces of clay & organics.		3	SS	9										19 21 53 7
			4	SS	8										
866.8	Loose. Brown to Black		5	SS	8										7 47 45 1
17.0	Sand & gravel, traces of silt, clay and organics.		6	SS	30										11 79 (10)
	Compact to Dense		7	SS	35										38 54 ( 8 )
	Black		8	SS	21									1.83% org.	
854.8	Silty sand with a tr. of grav. Compact Black		9	SS	17										
31.5	End of Borehole														
										120/0"					

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO 6

FOUNDATIONS OFFICE

JOB 74-11028 LOCATION Site 'C' Sta. 250 + 43 42' Tr.  
 W.P. 1503-73-00 BORING DATE June 27, 1974  
 DATUM Geodetic BOREHOLE TYPE Washboring

ORIGINATED BY PC  
 COMPILED BY PC  
 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 — $w_p$		
							SHEAR STRENGTH P.S.F.				$w_p$ — $w$ — $w_L$ 20 40 60				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT % 20 40 60			$\gamma$ P.C.F. GR. SA. SI. CL.	
880.1	Ground Level					880									
0.0	Clayey silt with some sand & a trace of gravel & organics.		1	SS	26										▼ 875.6
874.1	Very Stiff Fill														
6.0	Sandy silt, traces of clay & organics.		2	SS	7									1.32% org.	0 18 79 3
	Loose to Compact		3	SS	13	870								0.93% org.	0 19 77 4
	Black		4	SS	18										
863.1			5	SS	25										
17.0	Sand, gravel, traces of clay & silt.		6	SS	46	860									38 53 ( 9 )
	Dense Black		7	SS	46										
856.1															
24.0	Silty sand with some gravel & trace of clay		8	SS	131										14 44 38 4
851.1	Very Dense. Black														
29.0	End of Borehole Probably Bedrock					850									

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 7

JOB 74-11028

LOCATION Site 'D' Sta. 261 + 82 42' Rt.

ORIGINATED BY PC

W.P. 1503-73-00

BORING DATE June 21, 1974

COMPILED BY PC

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT % $w_p$ — $w$ — $w_L$	
871.6	Ground Level																	
0.0	Silty clay with some sand, traces of gravel & organics.					870												
866.6	Firm Brown		1	SS	4													Orgs. 1.65%
5.0	Silty sand to sandy silt, traces of clay gravel and organics.		2	SS	19													1.20%
			3	SS	25													0.92%
			4	SS	31													0.74%
	Compact to Dense		5	SS	28													
851.6	Greyish Brown to Black		6	SS	31													0 36 59 5
20.0	Sand & gravel, some silt & trace of clay.		7	SS	100		850											0 3 92 5
845.1	Very Dense. Black	8	SS	179		840											19 53 23 5	
26.5	End of Borehole																62 30 ( 8 )	

OFFICE REPORT ON OIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 8

JOB 74-11028 LOCATION Site 'D; Sta. 261 + 42 30' Lt. ORIGINATED BY PC  
 W.P. 1503-73-00 BORING DATE June 20, 1974 COMPILED BY PC  
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY PC

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — W <sub>L</sub>			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	BLOWS / FOOT				WATER CONTENT — W				
							20	40	60	80	100	W <sub>p</sub>			W
874.1	Ground Level														
0.0	Silty clay with some sand, traces of gravel & organics. Stiff Brown		1	SS	14	870								869.8	
5.0	Silty sand to sandy silt, traces of clay, & organics. Compact to Very Dense Black (occ. layers of sand & gravel)		2	SS	6								1.59% Org.	40 25 33 2	
			3	SS	6										
			4	SS	14	860									
			5	SS	27									0 66 33 1	
			6	SS	16									0 15 81 4	
			7	SS	26	850							1.26% Org.	0 10 88 2	
			8	SS	54										
846.1															
28.0	Bedrock		9	RC	70%										
841.6															
32.5	End of Borehole					840									

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 9

JOB 74-11028 LOCATION Site 'D' Sta. 261 + 50 11' Rt. ORIGINATED BY PC  
 W.P. 1503-73-00 BORING DATE June 20, 1974 COMPILED BY PC  
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		20	40	60	80	100	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT %	GR.	SA.
880.0	Ground Level																	
0.0	Silty sand with some gravel, traces of clay organics. Compact to Dense Fill		1	SS	36													Orgs. 1.47%
			2	SS	16													1.08%
869.0			3	SS	23													3.50%
11.0	Sandy silt, some grav. and clay, traces of organics. Compact to Dense Black		4	SS	21													1.54%
			5	SS	10													1.51%
			6	SS	20													1.42%
			7	SS	20													0.93%
854.5			8	SS	35													1.25%
25.5	End of Borehole																	

OFFICE REPORT ON EXPLORATION





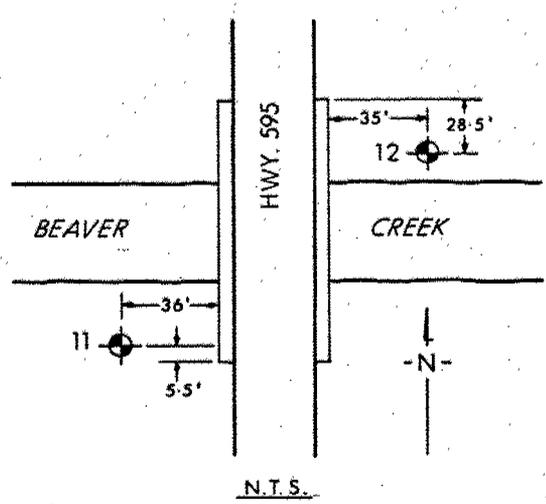
DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 11

JOB 74-11028 LOCATION Site 'E' As Shown Below ORIGINATED BY PC  
 W.P. 1503-73-00 BORING DATE July 17, 1974 COMPILED BY PP & PC  
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			BULK DENSITY $\gamma$	REMARKS				
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	$W_P$	$W$	$W_L$			P.C.F.	GR.	SA.	SI.
966.0	Ground Level																		
0.0	Silty sand to sandy silt, some gravel, traces of clay and organics.  Very Loose to Very Dense  Brown Black	1	SS	3	960													961.2	
		2	SS	12															11 69 18 2
		3	SS	12															0 45 54 1
		4	SS	23															
		5	SS	22		950													0 6 92 2
		6	SS	2															
		7	SS	14															0 73 (27)
		8	SS	170/1"		940													13 43 42 2
938.0	Clayey silt, traces of sand & gravel.  Hard  Black	9	SS	100/4"														1 5 78 16	
28.0		10	SS	100/7"															
		11	SS	190/10"		930													0 0 65 35
		12	SS	100/4"		920													
921.6	End of Borehole Probable Bedrock																		
45.4																			



OFFICE REPORT ON SOIL EXPLORATION

