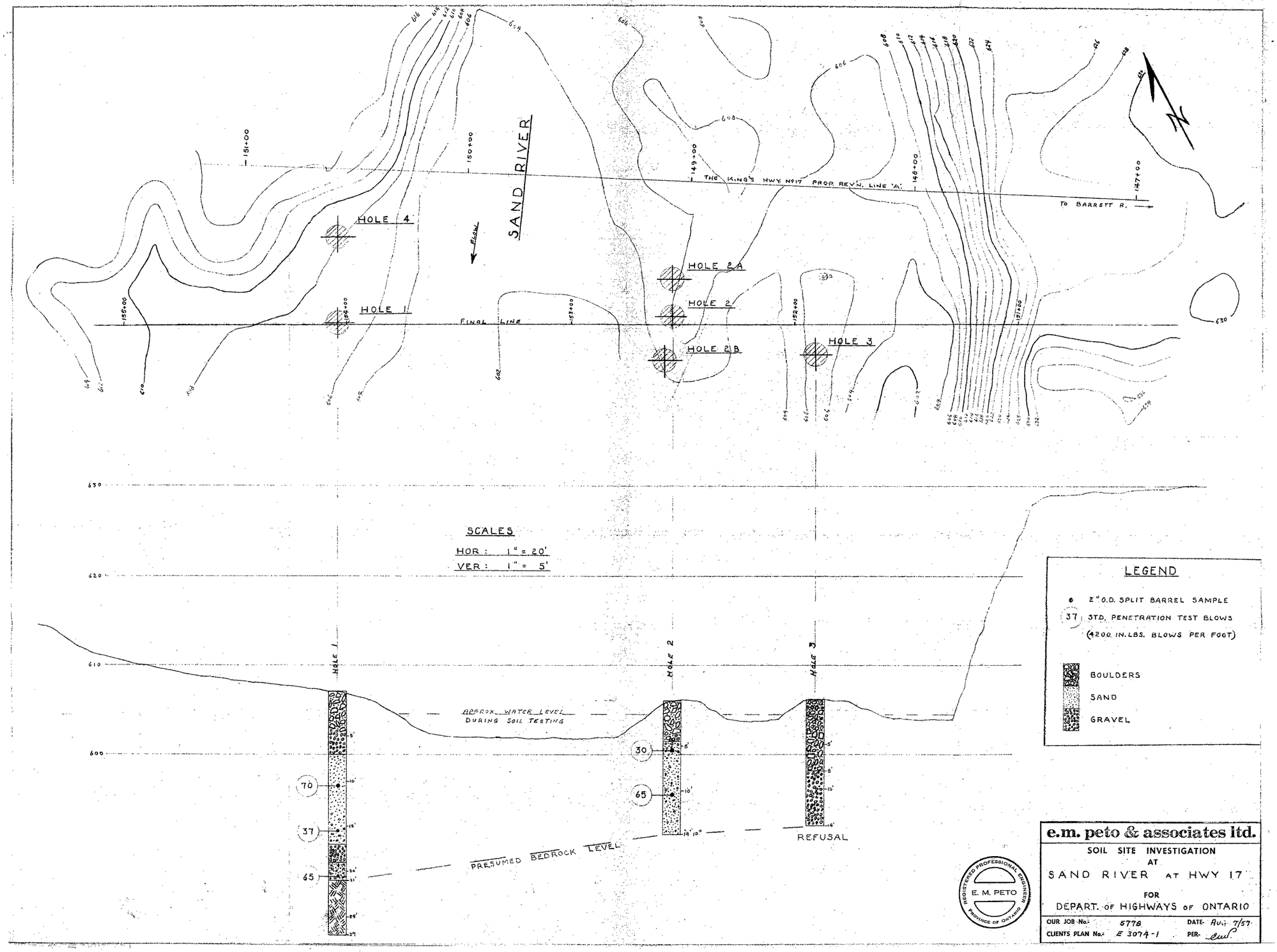
57-F-236C
Hwy. #17
SAND RIVER



e.m. peto & associates ltd.

SOIL SITE INVESTIGATION
AT
SAND RIVER AT HWY 17
FOR
DEPART. OF HIGHWAYS OF ONTARIO

OUR JOB No.:	5778	DATE:	Aug. 7/57
CLIENTS PLAN No.:	E 3074-1	PER:	EMP

AN INDEPENDENT ORGANIZATION PROVIDING A COMPLETE SOIL ENGINEERING & INVESTIGATION SERVICE

e. m. peto associates ltd.

YOUR REFERENCE:-

OUR REFERENCE:- 5778

859 roselawn avenue,
TORONTO, ONTARIO.
RUssell 1 - 4955.

August 9th, 1957.

Department of Highways of Ontario,
Bridge Office,
280 Davenport Road,
Toronto, Ontario.

Attention: Mr. S. McCombie, P. Eng.

Re: Soil Site Investigation Report,
Sand River Bridge - Highway 17.

Dear Sir:

We enclose herewith the usual four (4) copies of our soil site investigation report for the above mentioned project.

We trust that this report is complete and to your satisfaction. Should your design office or the Consulting Engineer responsible for the bridge design wish to consult with us further with regard to the results and their application to the proposed design, we shall be most pleased to be of further service.

Yours very truly,

E. M. PETO ASSOCIATES LTD.,

E.M.P:sb

E. M. Peto, P. Eng.

e. m. peto associates ltd., 850 roselawn avenue, Toronto 10, Ontario

Job No. 5778 **Client's Ref. No.** **Date** August 8th, 1957

57-F-236C

Report on

SOIL SITE INVESTIGATION

at

HIGHWAY 17 BRIDGE - SAND RIVER

for

DEPARTMENT OF HIGHWAYS OF ONTARIO

TERMS OF REFERENCE:

It was originally proposed that approximately 6 test holes would be performed at locations as indicated on the Client's marked site plan number E-3074-1. The test holes were to be driven to refusal or to prove bedrock, or to sufficient depth to establish a satisfactory bearing stratum for the bridge structure.

The report was also to indicate if any construction difficulties might be encountered on this site.

METHOD OF OPERATIONS:

Our number 3 unit, a skid-mounted Sullivan "12" diamond drill unit was moved to the site by rail, truck and barge from the Michipicoten area during the period from June 14th to June 17th. Due to the considerable difficulties encountered in moving the machines and equipment on this site, and due to the late receipt of the original site plan, the test holes were relocated to some extent on the ground.

The actual test hole locations on the ground were supplied by D.H.O. staff personnel with the assistance of our field manager. The ground elevations at each location were also supplied by the D. H.O.

METHOD OF OPERATIONS: (Cont'd)

Each test hole was performed by driving and cleaning BX drill casing, sampling ahead of the casing with a 2" O.D. split barrel sampler. The standard penetration test results were recorded when sampling, these being the number of blows of a 140 lbs. hammer falling 30" required to drive the sampling tube a distance of one foot. No Shelby tube samples were recovered at this site. A diamond drill core recovery was made at one test hole where refusal was encountered in order to prove bedrock.

OBSERVATIONS:

General Site Conditions:

This proposed bridge crossing is located near the mouth of the Sand River some 500 ft. North-East of the shore line of Lake Superior. The crossing is also located only several hundred feet ± downstream from a water-fall.

The site itself is completely boulder strewn for an area extending immediately below the water-fall to within approximately 100 ft. South or below the proposed bridge site. The boulders are grey or reddish granite which is native to the bedrock in this area. It is quite apparent that these boulders are water borne, having been deposited by fast flowing water to approximately the lowest limit of the river mouth.

The surface is so heavily infested with these boulders that movement of the drilling machine and equipment on this site was extremely difficult. In some places, it was impossible even to drive the AX drill rod without encountering boulder refusal within a few feet of surface. It was only with considereble difficulty that the test holes were driven through the stratum of boulder deposits.

Soil Conditions:

The general results are shown on the borehole logs attached at the rear of this report. The site plan at the rear of the report gives the relative locations of each test hole. Along with the site plan, we have prepared a profile to an exaggerated vertical scale along the proposed bridge centre line. We have indicated cross sections of test holes 1, 2 and 3 on this profile to illustrate the refusal stratum which was cored at test hole number 1 and which was presumed to be bedrock at test holes 2 and 3. We wish to point out that the borehole logs show the

OBSERVATIONS:

Soil Conditions; (Cont'd)

elevation figures as supplied by the D.H.O. staff on site. The contours and profiles on the site plan show elevations approximately 14 ft. higher than those supplied by the field staff and these elevations had been taken from the original site plan supplied by your head office. There does not appear to be any appreciable discrepancy between the site plan contours as shown and the existing ground contours as observed in the field.

The site generally is boulder strewn with granite boulders up to 4 ft. diameter or more. The boulder deposit does not appear to be of uniform thickness as is to be expected on a river site located below a water-fall so close to a lake level.

Below the boulder stratum there exists generally a coarse sand or a fine to coarse gravel, changing almost immediately at test hole 1 and 4 to a fine to medium or medium to coarse sand.

At test holes 2, 2A, 2B and 3, all of which were located on small islands located in the water course, the strata below the main boulder depth was almost exclusively a fine to coarse gravel with little sand content. Due to the variable refusal depth at test hole 2 compared with that obtained at test hole 1, two additional test holes were performed adjacent to test hole 2. Boulder refusal was encountered at 7 ft. in test hole 2A, but test hole 2B confirmed the early refusal depth of test hole 2.

There is no reason to believe that the somewhat higher apparent bedrock elevation at test hole 4 as compared with test hole 1 is in error. Test hole 4 is located very much closer to the higher rising ground to the North and West of the bridge site and we presume that bedrock slopes from hole 4 towards hole 1 with a drop of 8 ft. in 40.

Standard penetration tests could not be recorded in all test holes due to boulder interference, as for example at test hole 3, where a boulder was drilled through from 5 ft. to 8 ft. and sampling was continued only by driving an open A-rod to locate bedrock. Where penetration test results were recorded in the sand or fine gravel stratum, the results were all in excess of 30 blows.

OBSERVATIONS:

Water Conditions;

Water seepage levels and final water table levels in every case appear to correspond to the existing river water level at the time that this work was carried out. This is, of course, to be expected on a site of this nature.

RECOMMENDATIONS AND CONCLUSIONS:

1. It is readily apparent that load bearing values provide no problem on this site. Load bearing values of at least 4 tons per sq. ft. can be easily tolerated by the subsoil strata at this bridge site.

2. Due to the presence of the water-fall immediately upstream and the virtually constant level of Lake Superior immediately downstream from this bridge site, it is unlikely that there is a seasonal water level variation ofmore than 4 ft. However, it is also apparent that the stream flows with considerable velocity from time to time, which accounts for the presence of the large boulders on this site. In general, it would appear that the boulder stratum does not exceed a depth of 7 or 8 ft. at the proposed crossing and we therefore believe that scour is unlikely to be a problem below this depth, even though the theoretical maximum scour could be as much as 12 ft.

3. The presence of the somewhat higher approach bank on the South-East side of the river presents some problem in the choice of elevation for the bridge deck. Although the point was raised by our field manager during the field work, the D.H.O. staff did not require test holes on this approach bank, possibly because of prior knowledge of the subsoil conditions within the limiting depth of their proposed approach gradient. It would appear that the most practical solution would be to cut the approach road on the South-East side, depositing the cut material, along with rock fill, and build an embankment over the South-East half of the river. This would reduce the span requirements to something like only 150 ft. without any undue danger to the bridge abutments which could be seated firmly on bedrock. However, the velocity of flow at spring flood along with the new constriction may be such as to cause a dangerous build up of water level upstream from the bridge site, resulting in eventual wash out of the approach to the North-East bridge abutment unless special protection can be provided for the upstream face of this approach bank.

RECOMMENDATIONS AND CONCLUSIONS: (Cont'd)

4. If it should be decided to carry down the footings for the bridge pier or abutments to the apparent bedrock, then considerable difficulty can be anticipated if an attempt is made to drive sheet cut off piling for open caissons. It will be necessary to remove the boulder stratum at the abutment and pier locations as a preliminary to any construction work.

5. There are therefore two construction alternatives;-
   a) to place the abutments on the apparent bedrock level. or
   b) on the sand with loads limited to 4 tons per sq. ft., at or below elevation 585 (in accordance with the datum elevation supplied by D.H.O. staff on site.) and with scour protection for an additional 4 to 5 ft., to approximately elevation 580.

6. Despite the relatively consistent refusal elevation and the rock core obtained at test hole 1, it is still possible that there may be a second stratum of very large boulders which we have taken to be bedrock refusal. With this consideration in mind, along with the obvious difficulties of excavation to any great depth in the saturated dense sand and gravel, we believe that alternative "B" in the preceeding paragraph will be the most practical plan for the foundation design.

E. M. PETO ASSOCIATES LTD.,

E. M. Peto, P. Eng.

EMP:sb

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

Job Name: Sand River Bridge Hwy. 17 | Job No.: 5778 | Borehole No.: 1

Client: D.H.O. Bridge Dept. | Casing: BX | Boring Date: June 18th, 1957

Datum: D.H.O. | Compiled By: E.M.P. | Checked By: M.M.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
GROUND SURFACE			0'-0" / 593.0					
BOULDERS UP TO 4' DIA'.			3'-3"				W.T.	W.L. HOLE COMPLETED
FINE GRAVEL UP TO 1/4"	GREY-BROWN		5'-0"		1	W.S.		
			10'-0"					
MEDIUM TO COARSE SAND, WITH RED GRITS	LT. GREY-BROWN	VERY DENSE			2	S.S.	70	WET
			15'-0"					
MEDIUM TO COARSE SAND WITH GRAVEL UP TO 1½" DIA. FINE GRAVEL	LT. GREY-BROWN	DENSE			3	S.S.	37	WET
			20'-0"					
FINE TO MEDIUM SAND WITH GRAVEL UP TO 1" DIA.	GREY	VERY DENSE	572.0		4	S.S.	65	WET
GRANITE		VERY HARD				R.C.		CORE RECOVERY 5'-5" (90%
			25'-0"					
			27'-0"					
			HOLE TERMINATED					

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

Job Name: Sand River Bridge Hwy. 17 | Job No.: 5778 | Borehole No.: 2

Client: D.H.O. Bridge Dept. | Casing: BX | Boring Date: June 22nd, 1957

Datum: D.H.O. | Compiled By: E.M.P. | Checked By: M.M.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
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- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
			0'-0" 592.3					
BOULDERS UP TO 4' DIA.								
FINE SAND			5'-0"					
COARSE SAND AND FINE GRAVEL UP TO ½"	LT. REDDISH BROWN	COMPACT TO DENSE			1 ☒	S S	30	WET (MOSTLY PEA GRAVEL)
			10'-0"					
COARSE SAND AND FINE GRAVEL	GREY-BROWN	VERY DENSE			2 ☒	S S	65	WET (MANY RED GRITS)
			14'-10" 577.5					
BEDROCK OR LARGE BOULDER								REFUSAL

HOLE 2A

			0'-0" 592.7					
BOULDERS			5'-0"					
			7'-0"					BOULDER REFUSAL

HOLE 2B

			0'-0" 589.3					
BOULDERS			5'-0"					
FINE TO COARSE GRAVEL			10'-0"					
			13'-0" 576.3					REFUSAL

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

Job Name: Sand River Bridge Hwy. 17 | Job No.: 5778 | Borehole No.: 3

Client: D.H.O. Bridge Dept. | Casing: BX | Boring Date: June 28th, 1957

Datum: D.H.O. | Compiled By: E.M.P. | Checked By: M.M.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
			0'-0" 592.0					
BOULDERS			5'-0"					CHOPPED AND DROVE CASING TO 5'
								DRILLED THROUGH BOULDER FROM 5' TO 8'. LOST WATER AT 8'
			10'-0"					
FINE TO COARSE GRAVEL								WASHED AHEAD THROUGH BOULDER TO 14'
			14'-0" 578.0					
BOULDER OR BEDROCK			REFUSAL					

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

Job Name: Sand River Bridge - Hwy. 17 | Job No.: 5778 | Borehole No.: 4

Client: D.H.O. Bridge Dept. | Casing: BX | Boring Date: July 1st, 1957

Datum: D.H.O. | Compiled By: E.M.P. | Checked By: M.M.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
			0'-0"					
			594.3					
SAND AND FINE GRAVEL								
COARSE GRAVEL							W.L.	WATER SEEPAGE AT 4'
			5'-0"					
FINE TO MEDIUM SAND	GREY-BROWN		10'-0"					
			14'-3"					
BEDROCK OR BOULDER			580.0					
			REFUSAL					