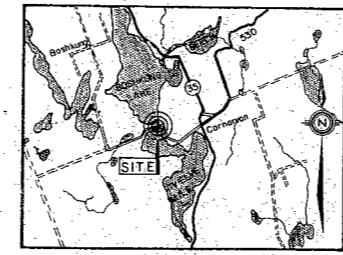
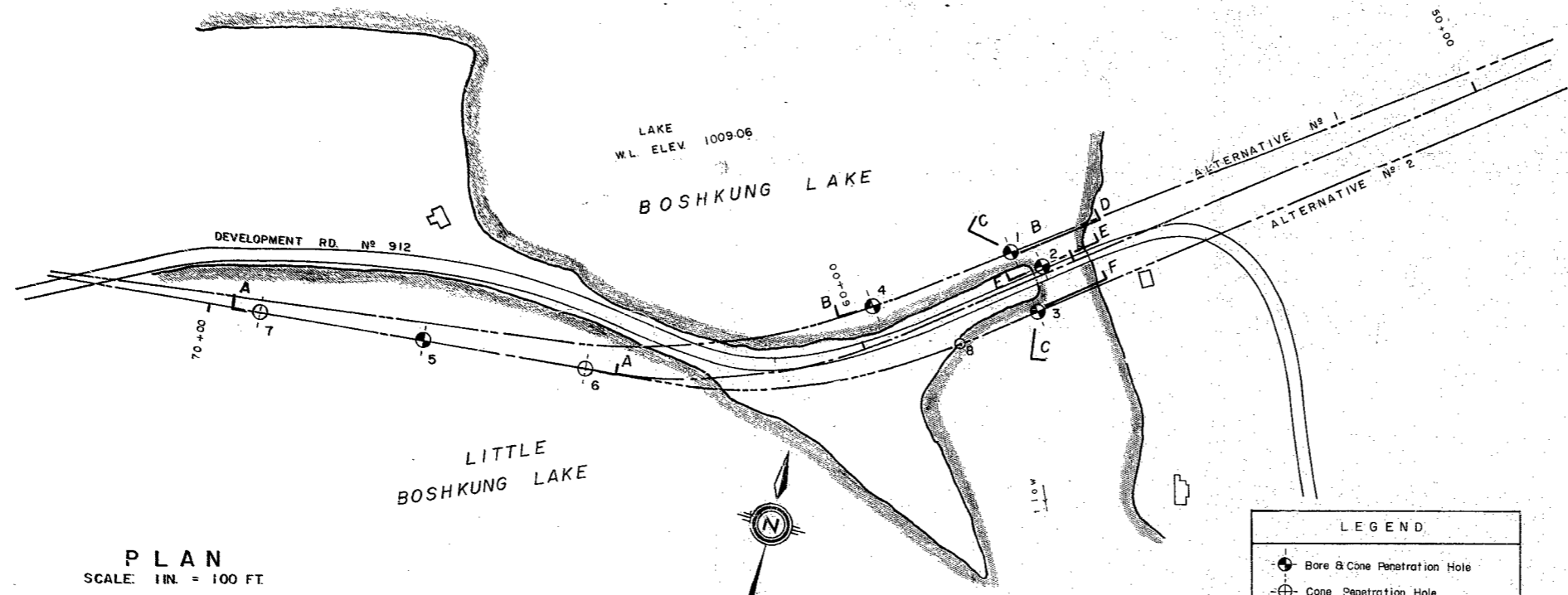
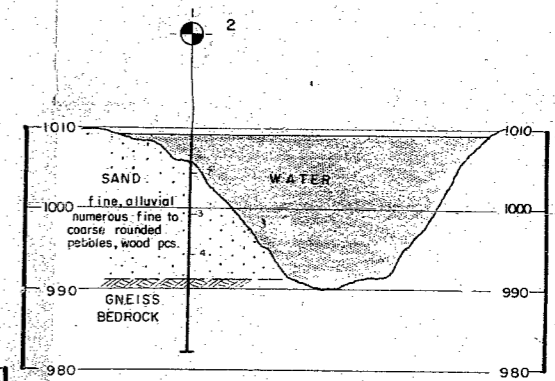
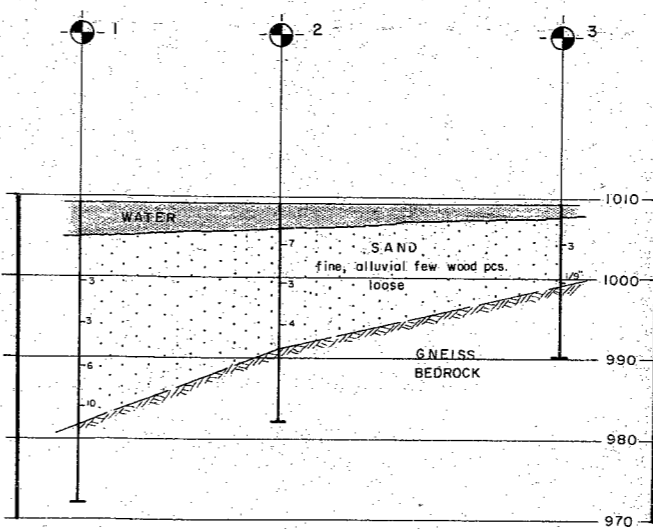
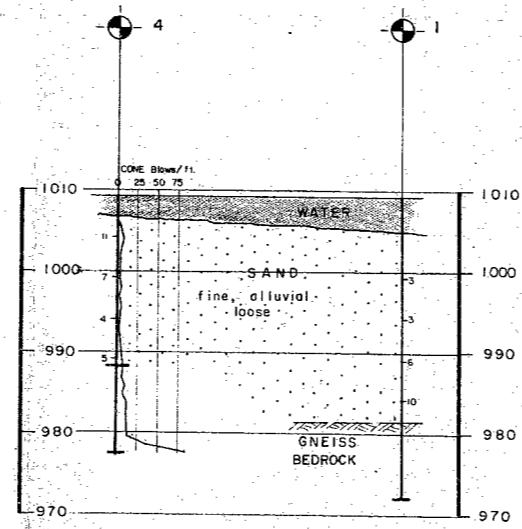
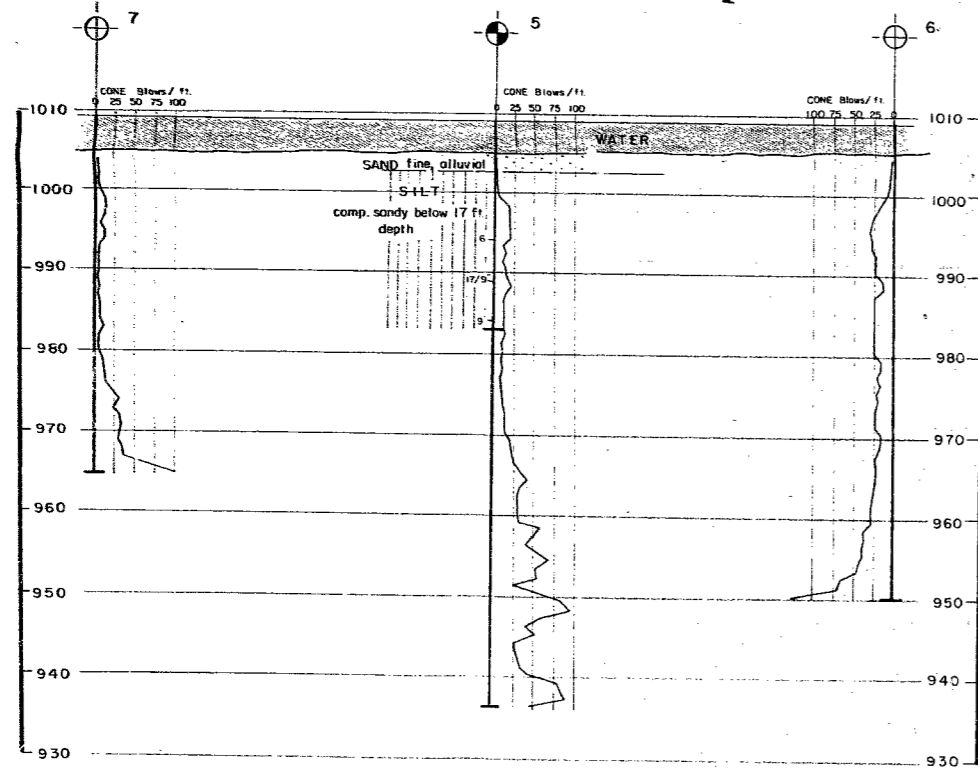
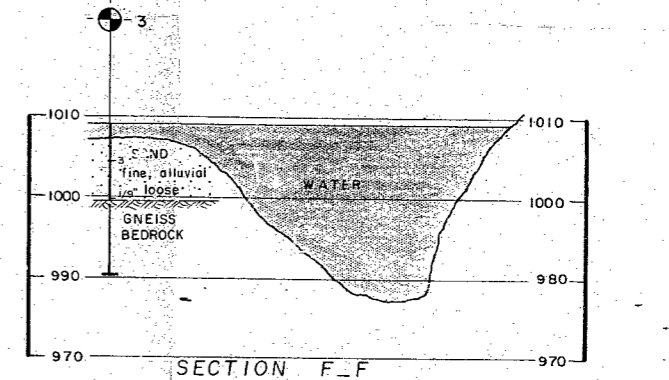
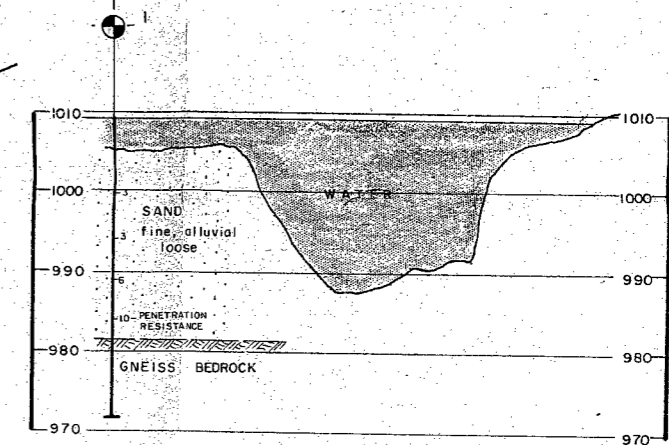


#67-F-291M
BOSHKUNG
NARROWS
BRIDGE
MINDEN TWP.



LEGEND			
⊕	Bore & Cone Penetration Hole		
⊙	Cone Penetration Hole		
○	Probe		
No.	ELEVATION	STATION	OFFSET
1	1009.1	57+39	50' Rt.
2	1009.1	57+17	15' Lt.
3	1009.1	57+39	50' Lt.
4	1009.1	59+60	50' Rt.
5	1009.1	66+70	
6	1009.1	64+26	
7	1009.1	69+22	



SCALE: HOR. 1 IN. = 20 FT.
VERT. 1 IN. = 10 FT.

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.

William Trow & Associates Ltd.
FOUNDATION INVESTIGATION
PROPOSED BRIDGE REPLACEMENT
BOSHKUNG NARROWS BRIDGE
TWP. MINDEN ONTARIO
PROJ. 3782 DATE AUG. 1967 DWG. No. 1

SCALE: HOR. 1 IN. = 50 FT.
VERT. 1 IN. = 10 FT.

SCALE: HOR. 1 IN. = 20 FT.
VERT. 1 IN. = 10 FT.

BA. 2725
Site 40-11



TOTTEN, SIMS, HUBICKI AND ASSOCIATES LIMITED
519 DUNDAS STREET WEST
WHITBY, ONTARIO

SOIL INVESTIGATION
BOSHKUNG NARROWS BRIDGE
CARNARVON TO VANKOUGHNET
DEVELOPMENT ROAD

Project: J3782

August, 1967

William Trow Associates Limited

90 Milvan Drive
Weston, Ontario
749-1290

William Trow

Project: J3782

Soil Mechanics
Consultants
W. A. Trow
MSc. MEIC. P. Eng.
K. Peaker
PhD. MEIC. P. Eng.
D. H. Shields
PhD. MEIC. P. Eng.



Associates Ltd.

Totten, Sims, Hubicki, and Associates Limited,
519 Dundas Street West,
Whitby, Ontario.

August 9, 1967

Attention: Mr. R.E. Sims, P.Eng.

Soil Investigation
Boshkung Narrows Bridge
Carnarvon to Vankoughnet
Development Road

Dear Sirs:

We have completed an investigation into the subsoil conditions at the above noted site. The field work was carried out in late July of this year. Our findings and recommendations follow.

1) It is proposed to reconstruct the existing bridge on Boshkung Narrows. We understand that three different alignments are possible for the new highway across the narrows. One of the alignments crosses the existing Bridge with the other alignments to the north and south - See Dwg. 1. In all cases a causeway will be built along the shore of Little Boshkung Lake. A causeway will also be required in Boshkung Lake for the northernmost routing. A three span bridge with spill through abutments is contemplated.



2) The field work consisted of 5 sampled borings and 3 probes driven to refusal. The locations of these are shown on Dwg. 1.

3) The soil encountered at each boring is detailed in the logs, Dwgs. 2 to 6 inclusive. The probes are recorded in Dwgs. 7 to 9 inclusive. The information in these drawings has been used to make up the estimated subsoil profiles of Dwg. 1. Rather than attempt to repeat this information in writing, please refer to these various drawings for an appreciation of the soil conditions.

4) At the west side of the narrows, Boreholes 1, 2 and 3 revealed very loose alluvial sand over rock at shallow depth. A real danger exists that the sand could be eroded away by the current which passes through the narrows, during a period of high water for example. The western pier and/or abutment of any bridge will have to be founded on the rock, either on piles or on a deep pier. Short piles spaced over a large area and driven to refusal, could be made structurally stable in the event that the sand is washed away. However, it may be advisable to socket the piles into the rock to guarantee their stability under all conditions. Socketing the piles will also remove any danger of the tips of the piles slipping down the sloping rock face, either during driving, or afterwards if the sand is eroded. An alternative would be to protect the sand



against scour by means of rip-rapping or sheeting. This may prove feasible for the abutments of a three span bridge in which the west pier would be founded on piles socketed into rock and the west abutment founded on conventional piling. The abutment could be protected against scour. In any event, it seems adviseable to design the piles as unsupported columns.

5) At the east side of the narrows, bedrock is exposed as a steep face rising above the water. The report of our engineering geologist is attached as Appendix A. In essence, the rock is jointed but unweathered. The eastern pier and/or abutment can be founded directly on the rock face provided (a) any loosened blocks of rock are pried off, (b) the footing is dowelled into the rock to, say, a depth of 10 feet and (c) the footing is set back behind a line drawn at 1 horizontal to 4 vertical upwards from the toe of the rock face.

6) The causeways will be founded on fine sand (Hole 4, Boshkung Lake) or on silt (Hole 5, Little Boshkung Lake). Neither of these materials will lead to instability of the embankments. Settlement will be small and will take place mainly during construction.

7) If the new bridge follows the existing alignment, then a temporary bridge of the Bailey type may be required. In this case it would be feasible to use large bearing blocks at the west end of



the temporary span and found them directly on the existing causeway or what seems to be an old ferry slip. A bearing value of the order of 1500 psf would seem reasonable for the loose alluvial sand under these conditions.

We trust that the information contained in this brief report is what you require. Should any questions arise or should any portion of the report require enlarging upon or clarification, we would appreciate your call.

Yours very truly,

D.H. Shields, P.Eng.

DHS/gh
Encls.

Dist: - Totten, Sims, Hubicki
and Associates Ltd., (4)



APPENDIX A
CARNARVON PROJECT
GEOLOGISTS REPORT

BEDROCK:

Bedrock at the site consists of banded paragneiss and orthogneiss, of undetermined Precambrian age. The rock is fresh at surface exposures and exhibits a massive joint and fracture pattern, - that is, the joints and fracture planes normal to any rock occur at about 12 inches to 3 feet spacings. All joint faces observed in the exposure along the east bank of the channel are in contact.

The steeply plunging rock face forming the east side of the main channel is joint controlled, and occurs in a series of irregular "strips" and "ledges". The rock itself is fresh and exhibits no discernible weathering. This is also true of the bedrock beneath the alluvial cover to the west of the bridge site.



APPENDIX B

FIELD TECHNICIANS SITE OBSERVATIONS

The east abutment of the bridge rests on bedrock which projects from the surface along the east bank. The bedrock is visible for a distance of serveral hundred feet both north and south of the bridge.

Fifty feet north of the bridge, bedrock projects twenty feet above the water. The rock rises almost vertically from the water.

Fifty feet south of the bridge bedrock projects six to ten feet above the water.

About twenty feet north of the west abutment of the bridge is an existing ferry dock, no longer in use.

It is built of timber cribbing filled with boulders.

At present the ferry dock is about two and one half feet below the surface of the water.

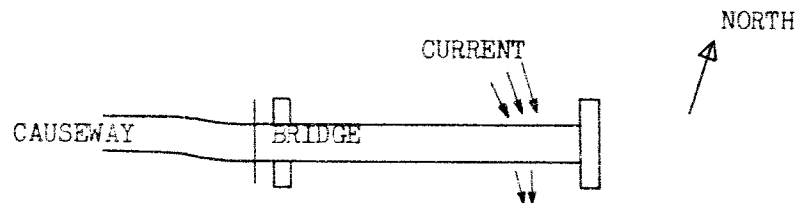


There is a crack in the asphalt roadway on the causeway parallel to and close to the center line of the causeway. It starts close to the west end of the bridge. The crack is up to two inches in width.

The deck of the bridge is 11.6 feet above the water at the east end of the bridge. The water remained at this elevation from July 21 to July 25.

A current runs through the narrows from north to south. By measuring the time taken for a floating object to drift from one side of the bridge to the other, the current was calculated to be from one-half to one mile per hour.

The current flows at an angle to the bridge so that it is strongest at the east end of the bridge.



The causeway averages 40 feet to 50 feet maximum width. It is composed of sand, gravel and boulders. It has an asphalt roadway 20 - 22 feet wide. The causeway slopes down from the bridge. It levels off at 5 to 6 feet above water level. (Shot by levelling instrument at C/L of asphalt roadway).

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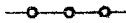
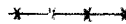

SITE INVESTIGATIONS SOIL MECHANICS CONSULTATION

LEGEND




DRAWING NO 2
PROJECT NO J3782

BOREHOLE NO 1
PROJECT Boshkung Narrows Bridge
LOCATION Carnarvon Vankoughnet Development Road
HOLE LOCATION See Dwg. 1
HOLE ELEVATION 1009.1 feet
DATUM See Dwg. 1

PENETRATION RESISTANCE


2" O.D. SPLIT TUBE 
2" I.D. SHELBY TUBE 
2" DIA CONE 

SHEAR STRENGTH

UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE 
UNCONFINED COMPRESSION 
VANE TEST AND SENSITIVITY (SI) 




NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX

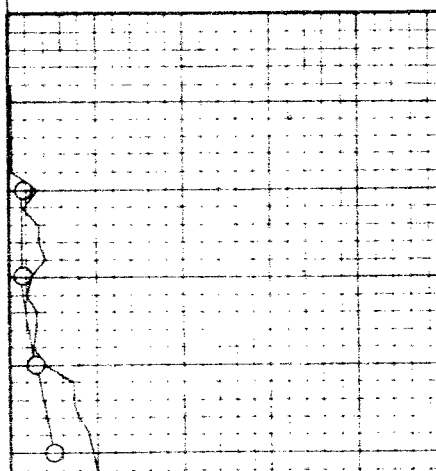
ATTERBERG LIMITS

LIQUID LIMIT 

PLASTIC LIMIT 

SAMPLE TYPE

2" O.D. SPLIT TUBE 
2" I.D. SHELBY TUBE 
3" O.D. SHELBY TUBE 

SYMBOL	SOIL DESCRIPTION	ELEV FEET	DEPTH FEET	PENETRATION RESISTANCE				NATURAL MOISTURE CONTENT AND ATTIERBERG LIMITS % DRY WEIGHT	SAMPLE TYPE AND NO	NATURAL UNIT WEIGHT PCF						
				350 FT. LB BLOWS/FT 60												
				20	40	60	80									
				SHEAR STRENGTH				PSF								
		1009.1	0									1				
	WATER	1005.1														
	SAND-fine, grey, alluvial, loose.		10												2	
			20												3	
															4	
		981.6														
TESTING	GNEISS BEDROCK-100% AX core recovery.		30													
	End of Borehole	971.6														
NOTES	1) Hole cased and advanced by conventional wash boring methods.															

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

WILLIAM TROW ASSOCIATES LTD.

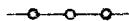
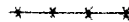

SITE INVESTIGATIONS SOIL MECHANICS CONSULTATION

LEGEND




DRAWING NO 3
PROJECT NO J3782

BOREHOLE NO 2
PROJECT Boshkung Narrows Bridge
LOCATION Carnarvon Vankoughnet Development Road
HOLE LOCATION See Dwg. 1
HOLE ELEVATION 1009.1 feet
DATUM See Dwg. 1

PENETRATION RESISTANCE

2" O.D. SPLIT TUBE 
2" I.D. SHELBY TUBE 
2" DIA. CONE 

SHEAR STRENGTH




UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE 
UNCONFINED COMPRESSION 
VANE TEST AND SENSITIVITY (S) 

NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX

ATTERBERG LIMITS

LIQUID LIMIT 
PLASTIC LIMIT 

SAMPLE TYPE

2" O.D. SPLIT TUBE 
2" I.D. SHELBY TUBE 
3" O.D. SHELBY TUBE 

SYMBOL	SOIL DESCRIPTION	ELEV FEET	DEPTH FEET	PENETRATION RESISTANCE		350 FT. LB BLOWS/FT 80	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT	SAMPLE TYPE AND NO.	NATURAL UNIT WEIGHT PCF
				20	40	60			
		1009.1	0						
	WATER	1006.1							
	SAND-brown, fine, alluvial, loose, numerous fine to coarse rounded pebbles above about 7 feet depth. Many wood pieces throughout down to about 12 feet depth. Becoming mottled brown and grey and fairly clean below about 12 feet depth.		12					1	
								2	
								3	
		981.1	27						
	GNEISS BEDROCK-100% Core Recovery.								
	End of Borehole	972.5							

NOTES: 1) Hole cased and advanced by conventional wash boring methods.

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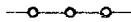

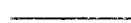




SITE INVESTIGATIONS SOIL MECHANICS CONSULTATION

LEGEND

DRAWING NO. 4
PROJECT NO. J3782


BOREHOLE NO. 3
PROJECT Boshkung Narrows Bridge
LOCATION Carnarvon Vankoughnet Development Road
HOLE LOCATION See Dwg. 1
HOLE ELEVATION 1009.1 feet
LATUM See Dwg. 1


PENETRATION RESISTANCE

2" O.D. SPLIT TUBE 
2" I.D. SHELBY TUBE 
2" DIA. CONE 
SHEAR STRENGTH 
UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE 
UNCONFINED COMPRESSION 
VANE TEST AND SENSITIVITY (SV) 




NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX


ATTERBERG LIMITS

LIQUID LIMIT 

PLASTIC LIMIT 

SAMPLE TYPE

2" O.D. SPLIT TUBE 
2" I.D. SHELBY TUBE 
3" O.D. SHELBY TUBE 

SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FEET	PENETRATION RESISTANCE 350 FT. LB BLOWS/FT 80			NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT			SAMPLE TYPE AND NO.	NATURAL UNIT WEIGHT P.C.F.
				Q	q	q _u	w	LL	PL		
		1009.1	0								
	WATER	1007.4									
	SAND-fine, brown, alluvial, loose, few wood pieces.									1	
										2	
	GNEISS BEDROCK - 100% AX Core Recovery.	999.3	10								
	End of Borehole	980.3	20								

NOTES: 1) Hole cased and advanced by
conventional wash boring methods.

SOIL INVESTIGATIONS SOIL MECHANICS CONSULTATION

LEGEND

PENETRATION RESISTANCE

SHEAR STRENGTH

NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX

ATTERBERG LIMITS

LIQUID LIMIT

PLASTIC LIMIT

SAMPLE TYPE

2 O D SPLIT TUBE

2" I.D. SHELBY TUBE

3" O D SHELBY TUBE.

SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FEET	PENETRATION RESISTANCE	350 FT. LB BLOWS/FT	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS		SAMPLE TYPE AND NO.	NATURAL UNIT WEIGHT pcf
						%	W		
		1009.1	0						
		1006.6							
	WATER								
	SAND-fine, brown, alluvial, loose, grey silt seam from 5 to 7 feet depth. Sand becoming grey below 7 feet depth.								
	End of Borehole	988.1							
NOTES:	1) Hole cased and advanced by conventional wash boring methods.								

BOREHOLE NO. 5
 PROJECT Boshkung Narrows Bridge
 LOCATION Cannaryon Vankoughnet Development Road
 HOLE LOCATION See Dwg. 1
 HOLE ELEVATION 1009.1 feet
 DATUM See Dwg. 1

PENETRATION RESISTANCE

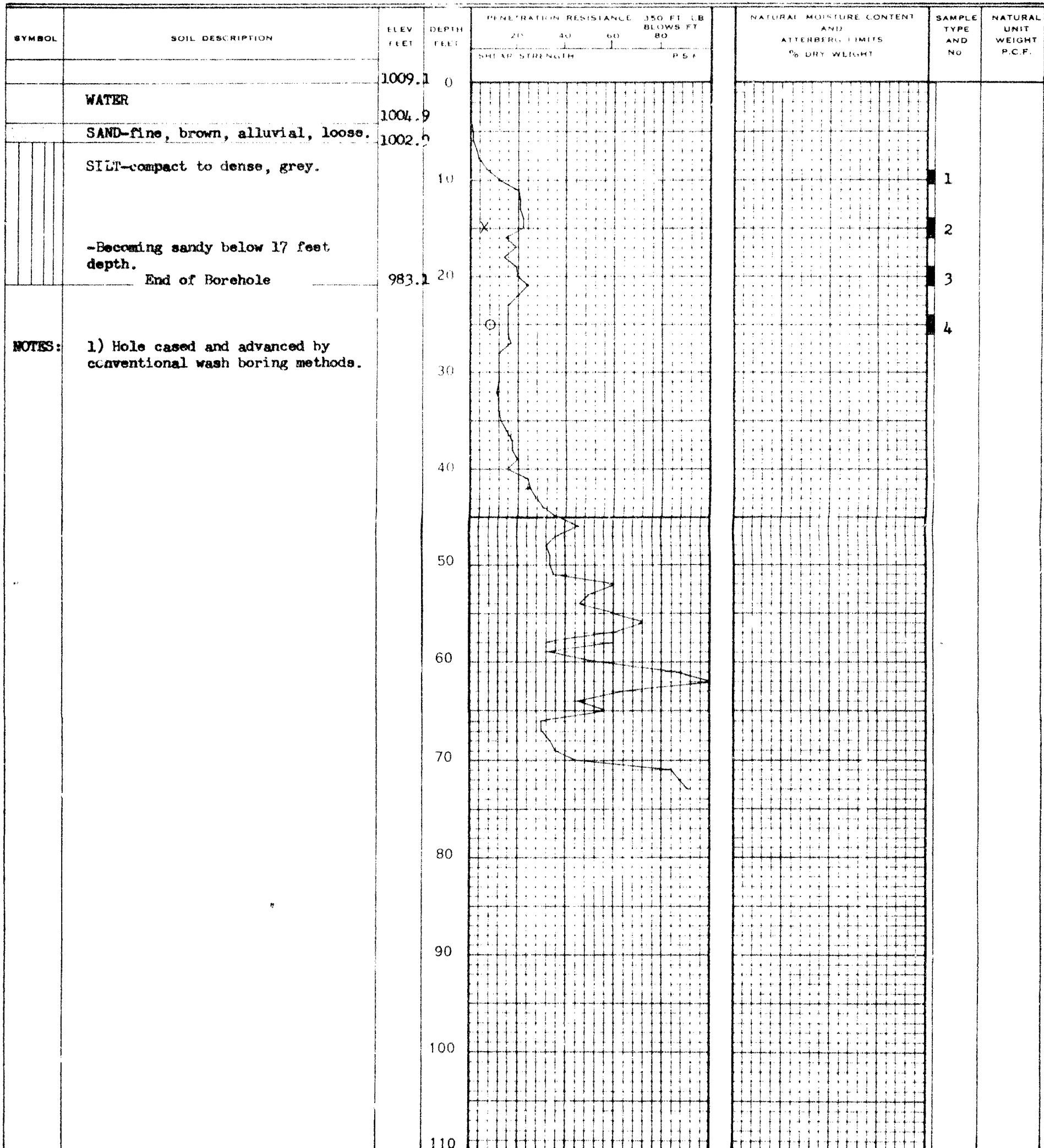
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 2" I.D. SHELBY TUBE —*—*—*—
 2" DIA. CONE —
 SHEAR STRENGTH
 UNDRAINED TRIAXIAL
 AT OTHER BURDEN PRESSURE ⊗
 UNCONFINED COMPRESSION ⊗
 VANE TEST AND SENSITIVITY ⊕

NATURAL MOISTURE CONTENT
AND LIQUIDITY INDEX

ATTERBERG LIMITS

LIQUID LIMIT —○—PLASTIC LIMIT —

SAMPLE TYPE



2" O.D. SPLIT TUBE ▨2" I.D. SHELBY TUBE ■3" O.D. SHELBY TUBE ▩

CONE




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PROJECT Boshkung Narrows BridgeLOCATION Carnarvon Vankoughnet Development RoadHOLE LOCATION See Dwg. 1HOLE ELEVATION 1009.1 feetDATUM See Dwg. 1



PENETRATION RESISTANCE

2" O.D. SPLIT TUBE 2" I.D. SHELBY TUBE 2" DIA. CONE 



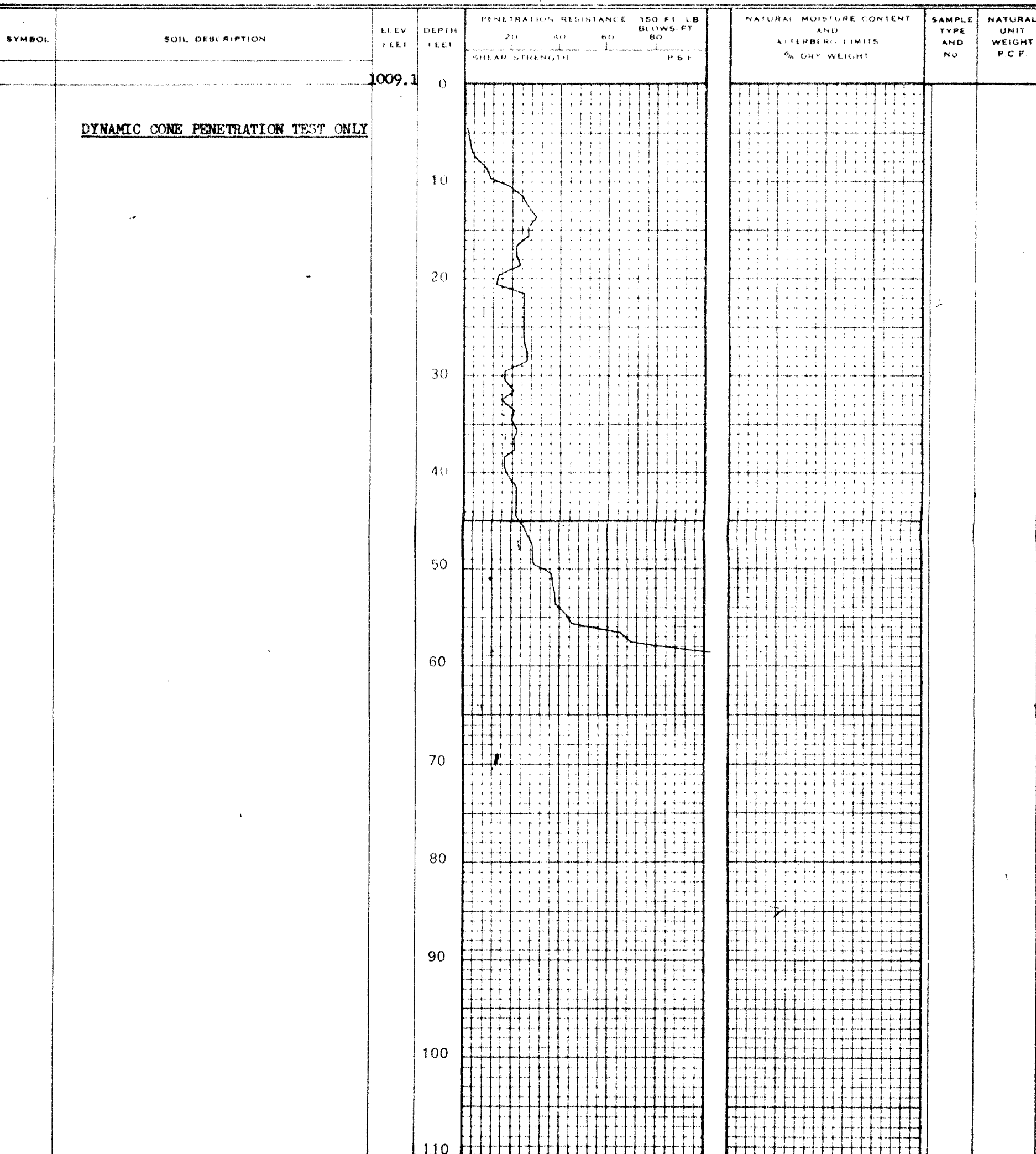

SHEAR STRENGTH

UNDRAINED TRIAXIAL
AT OVERBURDEN PRESSURE UNCONFINED COMPRESSION VANE TEST AND SENSITIVITY (S) NATURAL MOISTURE CONTENT
AND LIQUIDITY INDEX

ATTERBERG LIMITS

LIQUID LIMIT PLASTIC LIMIT 

SAMPLE TYPE

2" O.D. SPLIT TUBE 2" I.D. SHELBY TUBE 3" O.D. SHELBY TUBE 

LEGEND

CONE

~~TEST~~ NO. 7

PROJECT Boshkung Nar DWS Bridge

LOCATION Carnarvon Vankoughnet Development Road

HOLE LOCATION See Dwg. 1

HOLE ELEVATION 1009.1 feet

DATUM See Dwg. 1

PENETRATION RESISTANCE

- 2" O.D. SPLIT TUBE
- 2" I.D. SHELBY TUBE
- 2" DIA. CONE

SHEAR STRENGTH

- UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE
- UNCONFINED COMPRESSION
- VANE TEST AND SENSITIVITY

NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX

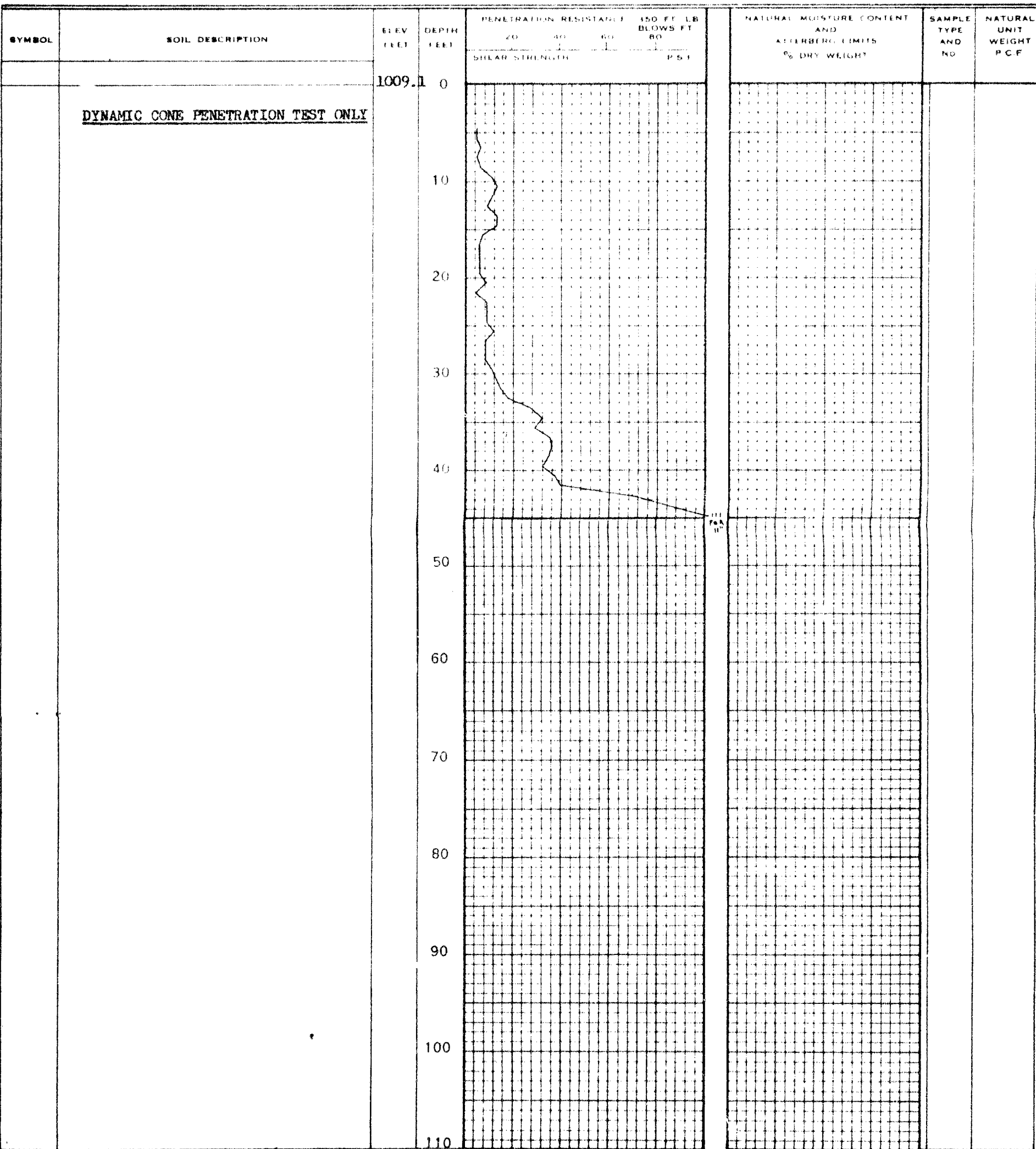
ATTERBERG LIMITS

LIQUID LIMIT

PLASTIC LIMIT

SAMPLE TYPE

- 2" O.D. SPLIT TUBE
- 2" I.D. SHELBY TUBE
- 3" O.D. SHELBY TUBE



SITE INVESTIGATIONS SOIL MECHANICS CONSULTATION

LEGEND

PENETRATION RESISTANCE

SHEAR STRENGTH

NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX

ATTERBERG LIMITS

LIQUID LIMIT

PLASTIC LIMIT

SAMPLE TYPE

2' O D SPLIT TUBE

2 10 SHELBY TUBE

3" O D SHELBY TUBE

SYMBOL	SOIL DESCRIPTION	ELEV.	DEPTH	PENETRATION RESISTANCE				NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS	SAMPLE TYPE AND NO.	NATURAL UNIT WEIGHT P.C.F.
		- FEET -	- FEET -	0-20	20-40	40-60	60-80	% DRY WEIGHT		
		1009.1	0							
	WATER	1006.6								
	SAND—brown, fine to medium.									
	Bouncing Refusal To Wash Rods (Presumed Bedrock)	994.6								
NOTES: 1) Wash rod jetted down to refusal as indicated.										