

ENG. GEOLOGY SECTION

DEPARTMENT OF MINES
SOUTH AUSTRALIA



GEOLOGICAL SURVEY
ENGINEERING DIVISION

BRIDGES FOR RAILWAY/ROAD GRADE SEPARATION - ASCOT PARK
Railway Reserve, Hd. Adelaide

FOUNDATION INVESTIGATIONS

FEASIBILITY STAGE

Client: South Australian Railways

by

B.J. MORRIS
GEOLOGIST
ENGINEERING GEOLOGY SECTION

Rept. Bk. No. 71/38
G.S. No. 4618
D.M. No. 1115/70

16th March, 1971

70-29

71/38

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FIGURES

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1	Proposed Railway/Road Grade Separation Ascot Park, Location of drill Holes	71-179 Ha6

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Railway Reserve, Hd. Adelaide

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SUMMARY AND CONCLUSIONS

Four cable-tool holes (each about 60 feet deep) on the site of the proposed railway bridges and road excavations at Ascot Park, passed through a horizontal succession of sediments consisting of 5 to 7 ft. of top soil (mainly stiff to very stiff **CLAY SOIL** of low to high plasticity*, plus a compact **SILT SOIL** of low to high plasticity), overlying the Hindmarsh Clay which consists of stiff to very stiff **CLAY SOIL**, medium to high plasticity, with lenticular layers, 3 to 6 ft. thick, of medium dense **SAND** and **GRAVEL**.

The regional groundwater as measured during the summer months stands at about 12 to 14 ft. below ground surface.

There does not appear to be any consistent horizon on which piles or piers could be founded, however, it is considered that friction piles would find refusal in the stronger clays and dense sand horizons below a depth of 20 ft. A programme of test piles may be necessary to determine actual depths of refusal.

* These terms defined in Appendix.

Excavations could be easily carried out by earth moving equipment using near vertical batters, provided that adequate braced retaining walls are installed for immediate support. In excavations above the ground water table only local inflows from near surface perched water are likely to be encountered. These flows should be small and dry up rapidly unless connected to a leaking service line. Below the ground water table inflows would occur from the sand and gravel horizons. It should be possible to handle these inflows during construction by a system of local drains in the excavation, or by well points installed outside the excavation.

INTRODUCTION

In a letter dated 10th September, 1970, the South Australian Railways asked the Department of Mines to determine soil characteristics at the locations of two proposed railway bridges at the Marion Road-Daws Road level crossing, Ascot Park, in order to decide on foundation details for the railway bridges and excavation conditions for road cuttings.

Four trial cable-tool drill holes were proposed, two at each road crossing (Fig. 1) with depths of the holes to be from 40 ft. to 60 ft. depending on the type of material encountered.

Hole CH.1 was drilled from the 10 to 15 of December, 1970, to a depth of 61.5 ft.

Hole CH.2 was drilled from the 15 to 16 of December, 1970, to a depth of 61.6 ft.

Hole CH.3 was drilled from the 14 to 19 of January, 1971, to a depth of 60 ft.

Hole CH.4 was drilled from the 25 of January to 12 of

February, 1971, to a depth of 51.5 ft.

Holes CH.1 and CH.2 were cored throughout, using open-end tubes, with a sealed tube sample taken every 10ft. or at a change of lithology. Continuous sealed tubes were taken to a depth of 30 ft. in holes CH.3 and CH.4, for testing at the Soils Laboratory of the Engineering and Water Supply Department. Standard penetration tests were carried out every 10 ft. and immediately sandy material was encountered, thence every 5 ft. in sandy material.

REGIONAL GEOLOGY

According to the Adelaide geological sheet, (Thomson, 1969) the proposed bridges are situated on the southern end of the Para Fault Block, which is one of a number of elongate, faulted crustal blocks that make up the Mt. Lofty Ranges. The surface exposures in the area are designated Pleistocene to Recent alluvial clays and sand.

SITE GEOLOGY

Topography and Geology

The site is flat and grass covered with no outcrop. The drill holes are located on grassy areas between the railway line and sealed roads. Geological observations are limited to the drill cores which were logged as shown in Appendix A, and then summarized for Table 1.

The sequence of strata (The Hindmarsh Clay) below the top soil is essentially horizontal, and consists of sediments laid down under lacustrine to fluvial conditions.

Groundwater

Water was cut between 20 ft. and 30 ft. depth in sandy layers of the Hindmarsh Clay in three of the four holes. The static water is 12 ft. below the surface in holes CH.1 and CH.2 and 14 ft. below the surface in holes CH.3 and CH.4.

DISCUSSION

The topsoil appears to be expansive in nature with significant volume changes accompanying changes in moisture content.

The clays of the Hindmarsh Clay are generally strong soils (very stiff) at a moisture content less than plastic limit. However, in some areas the moisture content increases markedly and the clays are much weaker (soft to firm). This occurs close to the ground surface in hole CH.2 (from 10 to 12 ft. depth) and at depth in hole CH.3 (from 45 to 55 ft. depth).

It is not possible to determine the density of the gravel horizons, however, alluvial deposits of this type are generally formed as gravel sized fragments in a dense sand matrix. The gravel fragments are fresh strong rocks (quartzites, slates, quartz).

The various sand and gravel horizons are likely to be lenticular in nature and although there appears to be correlation between some beds in adjacent holes, i.e. between holes CH.1 and CH.3 and between holes CH.2 and CH.4, it is very doubtful whether these beds could be correlated between distant holes.

16.3.1971
BJM:MK



B.J. MORRIS
GEOLOGIST
ENGINEERING GEOLOGY SECTION

TABLE 1

Hole	Depth in ft.	Thickness (feet)	Stratigraphic unit	Lithology	Engineering Properties		
					Description	Consistency etc.	Moisture Content
CH.1 CH.2 CH.3 CH.4	0 to 11 0 to 7 0 to 3 0 to 5	11 7 3 5	Soil Cover	Clay and silt with modern soil profile, calcareous in places, also some sand and gravel patches.	CLAY SOIL low to medium (CL) and high (CH) plasticity with red brown colour and SILT SOIL low plasticity (ML) to high plasticity (MH).	Clay is hard to stiff. Silt is moderately compact to compact.	Clay is less than plastic limit. Silt is less than plastic limit.
CH.1 CH.2 CH.3 CH.4	11 to 32 7 to 22 3 to 19 5 to 30	21 15 16 25	Hindmarsh Clay	Clay with minor silt fines and calcareous nodules up to 2cms. in size.	CLAY SOIL, high plasticity (CH) with up to 20% lime nodules. Soil is reddish brown-grey colour.	Clay is stiff to very stiff.	Clay is less than or equal to plastic limit.
CH.1 CH.2 CH.3 CH.4	32 to 61.5 22 to 61.6 19 to 60 30 to 51.5	29.5 39.6 41 21.5	Hindmarsh Clay	Clay with quartz and mica sand to 0.5mm., and quartzite gravels to 10cms.	Mainly CLAY SOIL high plasticity (CH); with SAND (SC) excess clayey fines, and GRAVEL (GP) with sand and clay fines. Sand and gravel layers are from 3 to 6 ft. thick.	Clay is firm to very stiff and sand is medium dense to dense and gravel is medium dense.	Clay is less than or equal to plastic limit and greater than plastic limit near bottom of holes. Sand is wet to saturated. Gravel is wet to saturated.

REFERENCES

THOMSON, B.P., 1969. Adelaide sheet, Geol. Atlas of S.Aust.
1:250,000 series, Geol. Surv. S.Aust.

APPENDIX A

**Logs of cable-tool holes CH.1, CH.2, CH.3, CH.4,
and explanatory notes.**

PROJECT ASCOT PARK

LOG OF CABLE TOOL HOLE

HOLE CH 1

RAILWAY BRIDGES

SECTION RAILWAY RESERVE

SERIAL No.

FEATURE DAW'S ROAD BRIDGE

HUNDRED ADELAIDE

R.L. Surface 11 FT.

LOCATION: Adjacent to tracks, NE. corner of bridge CO-ORDS

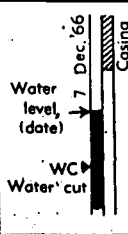
R.L. Collar 11 FT.

Datum 11 FT.

GEOLOGICAL NOTES AND CLASSIFICATION	R.L. (FEET) DEPTH	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966	WATER LEVEL	C.B.I.R. CURVE	MOISTURE CONTENT	Consistency	Compact. Density	FIELD TEST DATA		
										BLOWS PER FOOT	SOILTEST P.T.R. METER Units *	
										20	40 60 80	1 2 3 4
<p>MODERN SOIL PROFILE</p> <p>PLEISTOCENE TO RECENT HINDMARSH FORMATION</p> <p>Mottled clays, sandy clays with sand and gravel lenses.</p>	0		ML	SILT SOIL, low plasticity, clayey. Dark brown to grey. Calcareous. Lime pockets.	11 DEC 70	T.W.C.	V.St.	H	V.St.	18 Blows	NA	4.5
	10		CH	CLAY SOIL, high plasticity, very silty - calcareous. Occasional sand grains. Root tubes up to 1mm. Light brown.								
	20		CH	CLAY SOIL, high plasticity, silty. Mottled grey-yellow brown.								
	30		SC/CH	SAND, excess clay fines grades to high plasticity clay-sandy.								
	40		CH	Silt in pockets up to 5mm. Angular gravel fragments up to 1cm.								
	50		CH	CLAY SOIL, high plasticity, silty and with a few sandy bands. Mottled grey to yellow brown. Non-calcareous. Silty. Soft band.								
60			End of hole 61.5 ft.							12 Blows		4.5

TYPE OF SAMPLE

A shoe (SA)	
D " (SD)	
E " (SE)	
G " (SG)	
Sealed Tube - A Shoe - SAL	
Standard Penetration Test - SPT	



CONSISTENCY (Clays)

VS. - Very Soft	Ls - Loose
S - Soft	MC - Moderately Compact
F - Firm	C - Compact
St. - Stiff	VC - Very Compact
V. St. - Very Stiff	H. - Hard

COMPACTNESS (Silt)

VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

RELATIVE DENSITY (Sands)

H - Humid
D - Damp
M - Moist
W - Wet
S - Saturated
LL - Liquid Limit
PL - Plastic Limit

MOISTURE CONTENT

H - Humid
D - Damp
M - Moist
W - Wet
S - Saturated
LL - Liquid Limit
PL - Plastic Limit

ENGINEERING GEOLOGY SECTION

DRILL No. 24	LOGGED BY H. DIXON
TYPE DM 500	DATE 22 DEC 70
DRILLER A. STURAK	TRACED JMB
START 10 DEC 70	CHECKED L.V.W.
FINISH 11 DEC 70	
SHEET 1 OF 1	DRG No. S9115 Ha6

* These values refer to clay soils only and provide an indication of their consistency.

LOG OF CABLE TOOL HOLE

PROJECT ASCOT PARK RAILWAY BRIDGES

SECTION RAILWAY RESERVE

FEATURE MARION ROAD BRIDGE

HUNDREDADELAIDE

LOCATION Adjacent to tracks, W side level crossing, CO-ORDS

HOLE CH 2

SERIAL No.

R.L. Surface 1 FT.

R.L. Collar 1 FT.

Datum 1

GEOLOGICAL NOTES AND CLASSIFICATION	R.L. (FEET) DEPTH	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966	WATER LEVEL	MOISTURE CONTENT	Consistency	FIELD TEST DATA	
								BLOWS PER FOOT	SOIL TEST P. TR. METER Units * 1 2 3 4
<p>PLEISTOCENE TO RECENT HINDMARSH FORMATION</p> <p>Mottled clays, sandy clays with sand and gravel lenses.</p> <p>Silt is mica and limonite or manganese oxide patches up to 3mm.</p> <p>Sand and gravel is angular quartz and rock fragments. Gravel band →</p> <p>Silt is chalky lime disseminated and in pockets up to 2cm.</p> <p>Gravels are angular calccrete.</p> <p>Sand is fine quartz. Silt is mica?</p> <p>Sand is subrounded to angular quartz, Gravel is angular rock fragments</p>	0		CL	CLAY SOIL, silty, low plasticity. Few angular gravels up to 4cm.					
	0		ML	SILT SOIL, low plasticity - black.					
	0		CH	CLAY SOIL, high plasticity, red brown. Root tubes up to 1mm.					
	10		CH	CLAY SOIL - high plasticity. Dark red brown with minor light brown streaks. Minor silt. Root tubes open up to 2mm.				5 BLOWS	
	20		CH	CLAY SOIL, high plasticity, sandy, to SAND, excess clay fines				3 BLOWS	
	20		SC	SAND, excess clay fines, dark red brown. Grains 0.5 to 1mm. Bands of gravel up to 4cm.					
	30		CH	CLAY SOIL, high plasticity, silty Grey with red brown mottling.				21 BLOWS	
	40		CH	Few gravels up to 1.5cm. Calcareous. Joints dip 40°-50° - polished.				24 BLOWS	
	50		CH	CLAY SOIL, high plasticity, silty, some fine sand. Minor sand. Light grey - red brown mottling.				12 BLOWS	
	60		SC	SAND, excess clay fines, sand grains mainly 0.5-1mm. Red brown light grey mottled. Gravels to 1cm.				23 BLOWS	
				End of hole 61.6 ft.					

TYPE OF SAMPLE	CONSISTENCY (Clays)	COMPACTNESS (Silt)	RELATIVE DENSITY (Sands)	MOISTURE CONTENT	ENGINEERING GEOLOGY SECTION	
A shoe (SA)	VS. - Very Soft	Ls - Loose	VL - Very Loose	H - Humid	DRILL No. 24	LOGGED BY H. DIXON
D " (SD)	S - Soft	MC - Moderately Compact	L - Loose	D - Damp	TYPE DM 500	DATE 22 DEC 70
E " (SE)	F - Firm	C - Compact	MD - Medium Dense	M - Moist	DRILLER A. STURAK	TRACED J.M.B.
G " (SG)	St. - Stiff	VC - Very Compact	D - Dense	W - Wet	START 13 DEC 70	CHECKED L.V.W.
Sealed Tube - A Shoe - SAL	V. St. - Very Stiff		VD - Very Dense	S - Saturated	FINISH 16 DEC 70	
Standard Penetration Test - SPT	H. - Hard			LL - Liquid Limit		
	* These values refer to clay soils only and provide an indication of their consistency.			PL - Plastic Limit	SHEET 1 OF 1	DRG No. S 9116 Ha 6

LOG OF CABLE TOOL HOLE

PROJECT **ASCOT PARK RAILWAY BRIDGES**
 FEATURE **MARION ROAD BRIDGE**
 LOCATION **Adjacent to track, E. side of level crossing**

SECTION **RAILWAY RESERVE**
 HUNDRED **ADELAIDE**
 CO-ORDS -

HOLE **CH 3**

SERIAL No.

R.L. Surface - FT.
 R.L. Collar - FT.
 Datum -

GEOLOGICAL NOTES AND CLASSIFICATION	R.L. (FEET) DEPTH	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966	WATER LEVEL	MOISTURE CONTENT	Consistency	Compact. Dens ^s	FIELD TEST DATA								
									BLOWS PER FOOT	SOIL TEST PARAMETER Units *							
									20	40	60	80	1	2	3	4	
<p>TOPSOIL</p> <p>Vegetation roots →</p> <p>Numerous tubes to 3mm. diameter, mainly less than 1mm. - decreasing with depth.</p> <p>Percentage lime decreases with depth.</p> <p>Sand is mainly rounded quartz grains, few lime fragments and mica flakes.</p> <p>Gravel is slate, quartzite, quartz.</p> <p>Lime in silt sizes, disseminated and in veins to 1mm, and patches.</p> <p>No lime present ↓</p> <p>→ Becoming sandy</p> <p>Mottled clays, sandy clays - with sand and gravel lenses.</p>			CL	CLAY SOIL, low plasticity, red brown, limy. Few angular gravel fragments to 4 cm.													
			MH	SILT SOIL, high plasticity, black organic, limy.													
		10		CH	CLAY SOIL, high plasticity, red brown to white (limy). Lime in silt sizes and cemented nodules to 1cm size. Granular structure.									9 Blows			NA
		20		SC	SAND, excess clay fines, red brown, mainly coarse grained, up to 1mm.									10 Blows			
		30		GP	GRAVEL, poorly graded, rounded, gravel-sand mixture, to 10cm size in CLAY SOIL, high plasticity, red brown matrix.									18 Blows			
		40		SC	SAND, excess clay fines (CLAY SOIL, high plasticity) - up to 30% clay, red brown.									22 Blows			
		50		CH	CLAY SOIL, high plasticity, limy. Gray to red brown mottled.									12 Blows			
	60		GP	GRAVEL poorly graded rounded gravel-sand mixture to 2cm, in variable clay matrix.									8 Blows			NA	
				End of hole 60 ft.													

WC ↓ 19 Jan 71

WC ↓

WC ↓

WC ↓

WC ↓

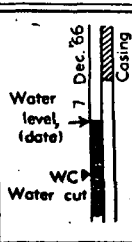
WC ↓

WC ↓

WC ↓

WC ↓

TYPE OF SAMPLE	Water level (date)
A shoe (SA)	7 Dec. 66
D. v (SD)	
E. v (SE)	
G. v (SG)	
Sealed Tube - A Shoe - SAL	
Standard Penetration Test - SPT	



CONSISTENCY (Clays)	COMPACTNESS (Silt)
VS. - Very Soft	LS - Loose
S - Soft	MC - Moderately Compact
F - Firm	C - Compact
St. - Stiff	VC - Very Compact
V. St. - Very Stiff	
H. - Hard	

RELATIVE DENSITY (Sands)	MOISTURE CONTENT
VL - Very Loose	H - Humid
L - Loose	D - Damp
MD - Medium Dense	M - Moist
D - Dense	W - Wet
VD - Very Dense	S - Saturated
	LL - Liquid Limit
	PL - Plastic Limit

* These values refer to clay soils only and provide an indication of their consistency.

ENGINEERING GEOLOGY SECTION	
DRILL No. 23	LOGGED BY W.R.P. BOUCAUT
TYPE DM 500	DATE 28 JAN 71
DRILLER A. STURAK	TRACED J.M.B.
START 14 JAN 71	CHECKED L.V.W.
FINISH 19 JAN 71	
SHEET 1 OF 1	DRG No. S9154 Na6

PROJECT **ASCOT PARK**

LOG OF CABLE TOOL HOLE

HOLE **CH 4**

RAILWAY BRIDGE

SECTION **RAILWAY RESERVE**

FEATURE **DAWS ROAD BRIDGE**

HUNDRED **ADELAIDE**

LOCATION **Adjacent to tracks, SW corner of bridge**

CO-ORDS

SERIAL No.	
R.L. Surface	FT.
R.L. Collar	FT.
Datum	

GEOLOGICAL NOTES AND CLASSIFICATION	R.L. (FEET) DEPTH	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966	WATER LEVEL	CEILING	MOISTURE CONTENT	CONSISTENCY	COMPACTNESS	FIELD TEST DATA		
										BLOWS PER FOOT	SOILTEST PTR METER UNITS #	
<p><i>Topsoil Gravel and sand is quartz shale, sandstone & numerous plant roots & becoming richer in lime to 5 ft.</i></p> <p><i>Numerous plant tubules & decayed roots up to 1mm. in size. Amount of lime decreasing to none at 22 ft.</i></p> <p><i>Becomes limy again at 25 ft.</i></p> <p><i>Sand is rounded quartz grains and mica flakes & lime particles</i></p> <p><i>Sand is mainly rounded quartz grains & mica flakes up to 0.5mm. Gravel is slate quartzite, quartz & carbon.</i></p> <p><i>Pleistocene to Recent Hindmarsh clay Mottled clays, sandy clays, with sand & gravel lenses.</i></p>	0		CL	CLAY SOIL, low plasticity red brown, limy soil numerous subangular gravel fragments up to 4 cms.								
	0		CH/SC	CLAY SOIL high plasticity, red brown to white, (limy) prismatic structural sand grains up to 0.5 mm.								
	10		CH	CLAY SOIL, high plasticity, reddish green brown, disseminated lime in silt size particles, becoming lighter colored with depth to greyish-brown.							12 Blows	N.A.
	20		CH	Lime is cemented in some nodules up to 2 cm. in diameter. Prismatic structure. Clay has developed mottled red & grey appearance.							16 Blows	N.A.
	30		CH/SC	CLAY SOIL high plasticity with up to 20% fine grained SAND 0.5 mm. in diam.							22 Blows	N.A.
	35		CH	CLAY SOIL high plasticity, some black plant roots up to 2 mm. in size. Red & grey mottling with white limy patches.							24 Blows	N.A.
	40		CH/SC	CLAY SOIL high plasticity with up to 20% SAND grains.							20 Blows	N.A.
	45		SC/CH	SAND excess, clayey fines up to 30% clay.							20 Blows	N.A.
	48		GA/CH	GRAVEL, poorly graded rounded gravel, sand, mixture to 10 cms in size in CLAY SOIL high plasticity matrix.							20 Blows	N.A.
	50		CH	CLAY SOIL, high plasticity. Red grey mottling - some limy patches.							20 Blows	N.A.

End of hole 51.5 ft.

NOTE:- Continuous sealed tubes taken to 30 ft. Samples logged are from shoes only.

<p>TYPE OF SAMPLE</p> <p>A shoe (SA)</p> <p>D " (SD)</p> <p>E " (SE)</p> <p>G " (SG)</p> <p>Sealed Tube - A Shoe -SAL</p> <p>Standard Penetration Test-SPT</p>	<p>Water level (date)</p> <p>7 Dec. '66</p> <p>Water cut</p>	<p>CONSISTENCY (Clays)</p> <p>VS. - Very Soft</p> <p>S - Soft</p> <p>F - Firm</p> <p>St. - Stiff</p> <p>V. St. - Very Stiff</p> <p>H. - Hard</p>	<p>COMPACTNESS (Silt)</p> <p>Ls - Loose</p> <p>MC - Moderately Compact</p> <p>C - Compact</p> <p>VC - Very Compact</p>	<p>RELATIVE DENSITY (Sands)</p> <p>VL - Very Loose</p> <p>L - Loose</p> <p>MD - Medium Dense</p> <p>D - Dense</p> <p>VD - Very Dense</p>	<p>MOISTURE CONTENT</p> <p>H - Humid</p> <p>D - Damp</p> <p>M - Moist</p> <p>W - Wet</p> <p>S - Saturated</p> <p>LL - Liquid Limit</p> <p>PL - Plastic Limit</p>	<p>ENGINEERING GEOLOGY SECTION</p> <p>DRILL No. 23</p> <p>TYPE D.M. 500</p> <p>DRILLER A. Sturak</p> <p>START 25th Jan 71</p> <p>FINISH 12th Feb. 71</p> <p>SHEET 1 OF 1</p>	<p>LOGGED BY B. J. Morris</p> <p>DATE 22nd Feb 71</p> <p>TRACED B. S. G.</p> <p>CHECKED</p> <p>DRG No. S 9168 Ha6</p>
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APPENDIX

LOGS OF CABLE TOOL HOLES AND EXPLANATORY NOTES

NOTES ON DRILLING PROCEDURES

Equipment

The drilling is carried out with a cable tool drilling plant using sampling tubes attached, through a vacuum head, to the sampling tools (Figs. 1 and 2).

Sampling Procedures

S.A. Samples

To obtain, for logging purposes, an almost continuous series of samples, with a relatively small amount of sample disturbance, SA type samples are taken. These are obtained by driving an "S" tube, fitted with a Mark A shoe (Fig. 2), into the material to be sampled.

The assembly is lowered carefully to the bottom of the hole, and the tube driven exactly 1 foot, and the number of blows required for the 1 foot of penetration recorded.

The sample, or core, is extruded from the sampling tube using an hydraulic ram. The extruded core is sealed in a labelled plastic bag and stored in a core box (Fig. 3).

The hole is reamed with a "D" or "E" shoe (Fig. 2) and then the next sample is taken, using the same procedure as above. Thus the hole proceeds by alternate sampling, reaming (and where required, casing) operations, and the samples form a continuous record of the materials penetrated except for a few inches which may be lost between samples during reaming operations.

SA sampling equipment is a composite sampler for simple class sampling. Details are as follows:-

"S" SERIES CUTTING SHOES

MARK	FEATURES	USES
A	Inside clearance 3%. Area Ratio 33%.	Continuous open-tube sampling in strong soils, in which it causes little deformation. Samples extruded and used for logging purposes. Hole is reamed after each sample.
D	Shoe belled out to 4.29/32 in. (just greater than outside dia. of vacuum head)	Continuous open tube sampling where considerable deformation of sample is permissible. Essentially self-reaming.

MARK	FEATURES	USES
E	Shoe belled out to 5 7/16 in. (just less than internal dia. of 6 in casing)	Cleaning hole and reaming out hole.

Sealed Tube (LB) Samples

Sealed tube samples, for laboratory testing, are taken at various intervals during drilling. These are obtained by driving an "L" type sampling tube with a Mark B cutting shoe (Fig. 4) a distance of 1 foot into the material to be sampled.

Before the sample is taken the hole is cleaned out to the depth specified. The hole is not reamed or cased for at least 1 foot from the bottom, however, because these operations can cause considerable disturbance in the soil below. The sampling assembly is lowered carefully to the bottom of the hole, the sampling tube driven exactly 1 foot, and the number of blows recorded.

The sample is sealed in the tube by inserting in each end, plastic seals with rubber sealing rings, and the tube is then labelled and stored in a Laboratory Sample Box.

LB sampling equipment is a composite sampler for obtaining samples with the least possible disturbance. Details are as follows:

Sampler tube -- ASSAB tube cadmium plated
"L" type 4.016 in I.D.
 4.282 in O.D.

Mark B shoe -- ASSAB tube, heat treated, cadmium plated
Area ratio 15%
Inside clearance - ~~nil~~ 0.4%
Outside clearance - nil
Cutting edge angle - 7°

Standard Penetration Test

The Standard Penetration Test (Terzaghi et al 1948) is used to test the in-situ density of sands and to give an indication of the consistency of clays, and compactness of silts. However the test results can be affected by several geological factors such as degree of cementation, and size and shape of grains. These factors should be taken into account in interpretation of results.

The equipment is illustrated in Fig. 5 and consists of a 2in. diameter, sampling spoon (tube) and a hammer of standard weight (140 lbs).

With the equipment assembled as in Fig. 5 the hammer is allowed to fall on to the drill rods until the sampling shoe has penetrated 6 in. into the soil. The Standard Penetration Test is the number of blows (N) required to produce the next foot of penetration.

NOTES ON DRILL LOG SHEETS

The logs are plotted on a standard cable-tool log form.

Near the centre of the form a graphic log of the materials encountered is shown.

In the column to the right of the graphic log, the soils are classified and described according to the Unified Soil Classification (U.S. Dept. of Interior, Bureau of Reclamation 1966) as shown on Figure 6.

To the left of the graphic log is a geological description of the materials sampled. This includes:-

.....Geological age	}	Printed vertically
.....Soil unit name		
.....Type of material		
.....Mineral composition		
.....Grain shape		
.....Cementation		
.....Organic materials		

Water levels are indicated by a small arrow with the date at which the observation was made.

In the blows per foot column, a continuous histogram is made of the number of blows required to drive the sampling tube through each foot of material. A hatching code is used to distinguish various types of sample. This code is reproduced at the bottom of each log sheet.

In the column on the far right of the log sheet, readings of unconfined compressive strength (q_u) made with a Soiltest Penetrometer, are recorded. The readings are plotted as a histogram. The Soiltest Penetrometer only gives true values of q_u when used in clays in which $\phi = 0$.

REFERENCES

TERZAGHI, K. and PECK, R.B., 1948. Soil Mechanics in Engineering Practice. John Wiley and Sons.

UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION, 1966. Earth Manual, 2nd Edition.

DESCRIPTIVE TERMS

1. CLAY SOILS

CONSISTENCY

CONSISTENCY	SYMBOL	UNCONFINED COMPRESSIVE STRENGTH (kg/sq. cm)	FIELD TEST	N
Very Soft	V.S.	less than 0.25	Easily penetrated several inches by fist.	2
Soft	S	0.25 to 0.5	Easily penetrated several inches by thumb.	2 to 4
Firm	F	0.5 to 1.0	Can be penetrated several inches by thumb with moderate effort.	4 to 8
Stiff	St	1.0 to 2.0	Readily indented by the thumb but penetrated only with great effort	8 to 15
Very Stiff	V.St.	2.0 to 4.0	Readily indented by thumb nail.	15 to 30
Hard (Extremely stiff)	H	over 4.0	Indented with difficulty by thumb nail.	30 and over

Based partly on Terzaghi, K. and Peck, R.B. 1966. Soil Mechanics in Engineering Practice, Wiley - New York.

MOISTURE CONTENT

Abbreviation	Meaning
MC ≈ LL	Moisture Content near liquid limit.
MC < LL	" " less than liquid limit.
MC > PL	" " greater than plastic limit.
MC ≈ PL	" " near " "
MC ≤ PL	" " less or equal to plastic limit.
MC < PL	" " less than " "
MC << PL	" " much less than " "

2. SILT SOILS

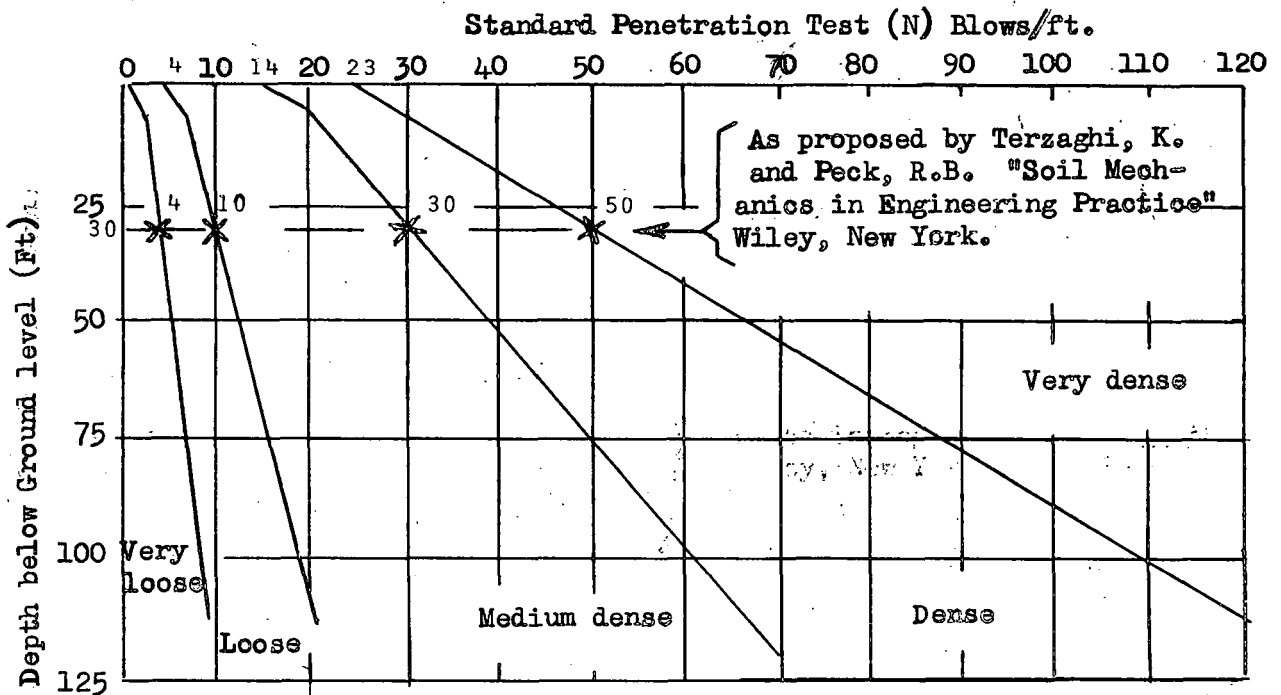
COMPACTNESS	SYMBOL	N
Loose	LS	0 to 8
Moderately compact	MC	8 to 15
Compact	C	15 to 30
Very Compact	VC	greater than 30

3. SANDS

CLASSIFICATION OF SANDS BY STANDARD PENETRATION TEST

The relative density of granular soils has been judged from the results of Standard Penetration Tests carried out by the procedure described by Terzaghi and Peck (1948) bearing in mind the limitations of the method as discussed by Gibbs and Holtz (1957). At all times the water in the drill hole was kept at the level of surrounding groundwater.

EFFECT OF OVERBURDEN PRESSURE ON STANDARD PENETRATION TEST

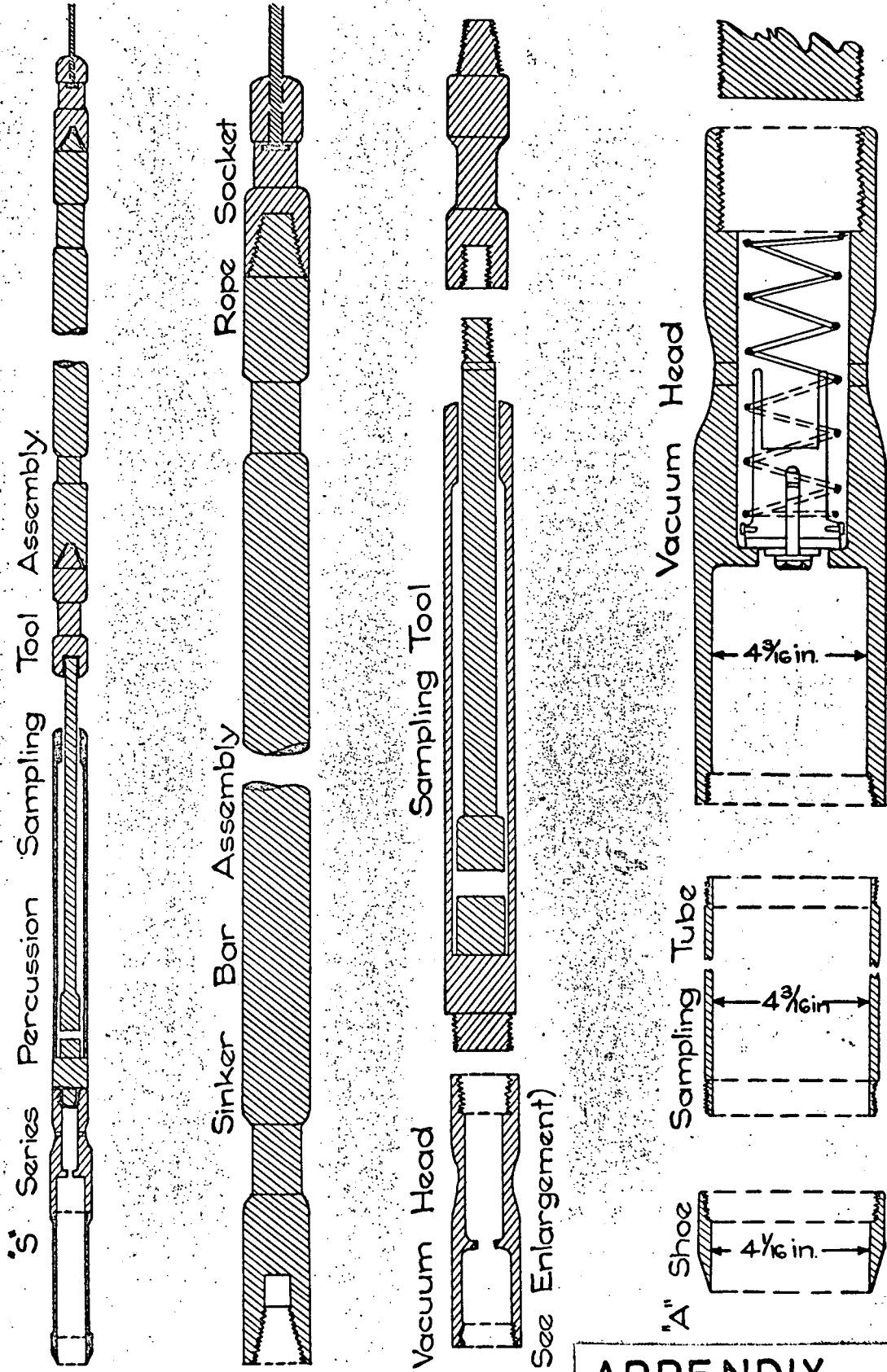


Based on Gibbs, H.J. & Holtz, W.G. (1957) "Research on Determining the Density of Sands by Spoon Penetration Testing" Vol. I Proc. 4th Int. Conf. SM & FE, London.

REFERENCES

TERZAGHI, K., and PECK, 1948. "Soil Mechanics in Engineering Practice". Wiley. New York.

GIBBS, H.T. and HOLTZ, W.G., 1957. Research on Determining the Density of Sands by Spoon Penetration Testing. Proc. 4th Inter. Conf. SM & FE, London, Vol. 9.



APPENDIX FIG. I

DEPARTMENT OF MINES — SOUTH AUSTRALIA

ENGINEERING
GEOLOGY
SECTION

D. W. S. 2
SENIOR GEOLOGIST

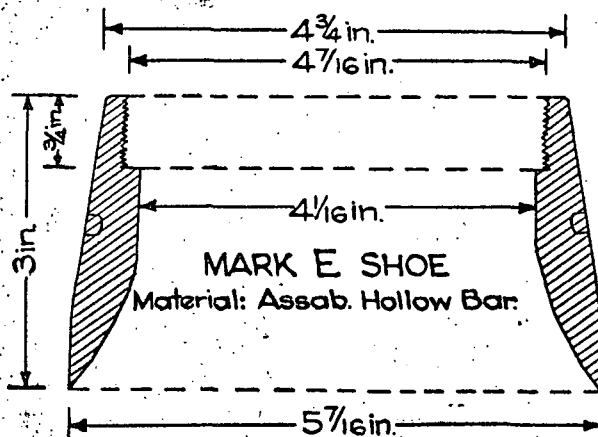
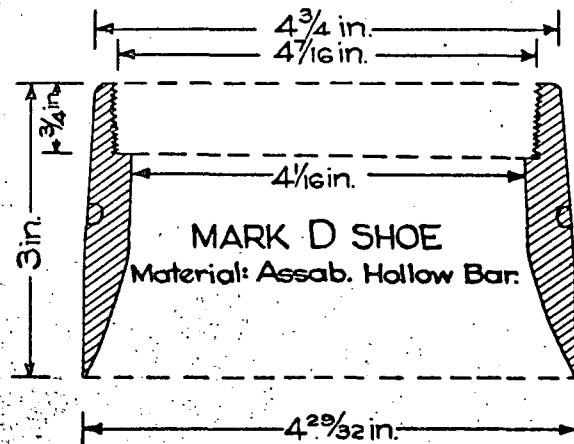
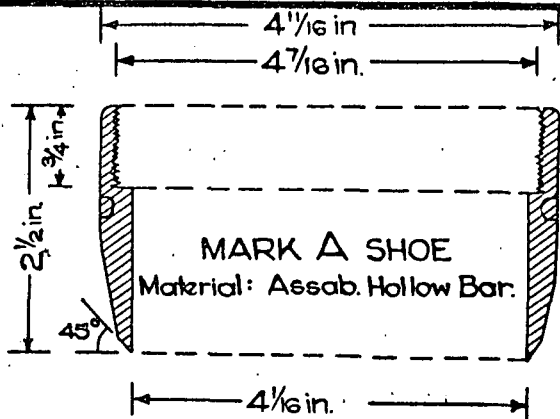
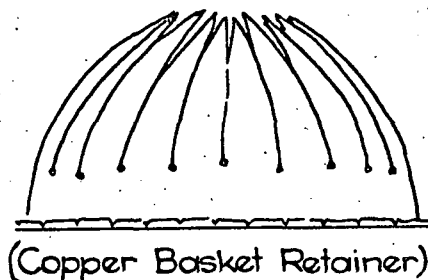
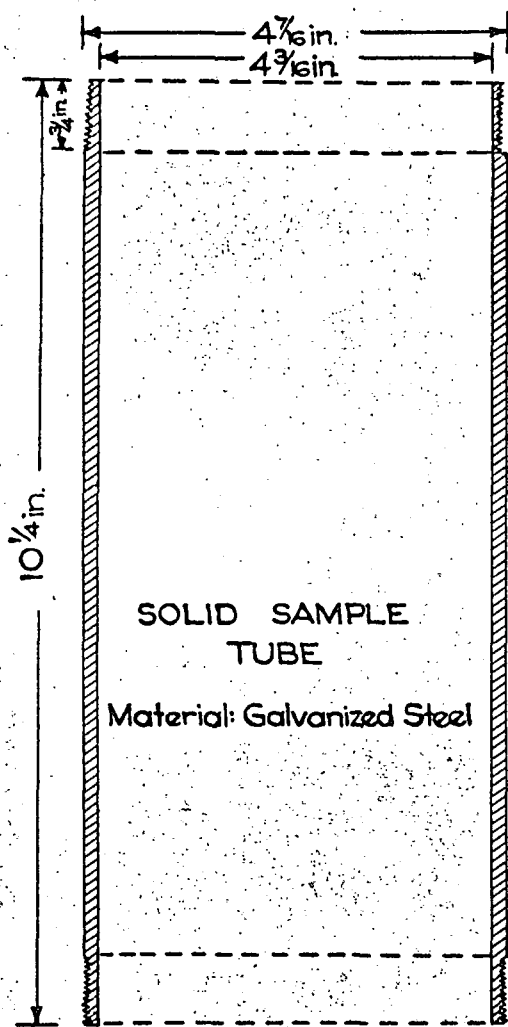
Drn. DHS
Tcd. AMFC
Ckd. LVW
Exd. DA

CABLE-TOOL DRILLING
SAMPLING TOOL ASSEMBLY
WITH 'S' SERIES SHOES

SCALE: NOT TO SCALE

S 4416
MB

DATE: 21 Oct '69



APPENDIX FIG. 2

DEPARTMENT OF MINES — SOUTH AUSTRALIA

ENGINEERING
GEOLOGY
SECTION

Drn D.H.S

Tcd. A.M.E.D

Ckd. L.V.W.

Exd. D.S

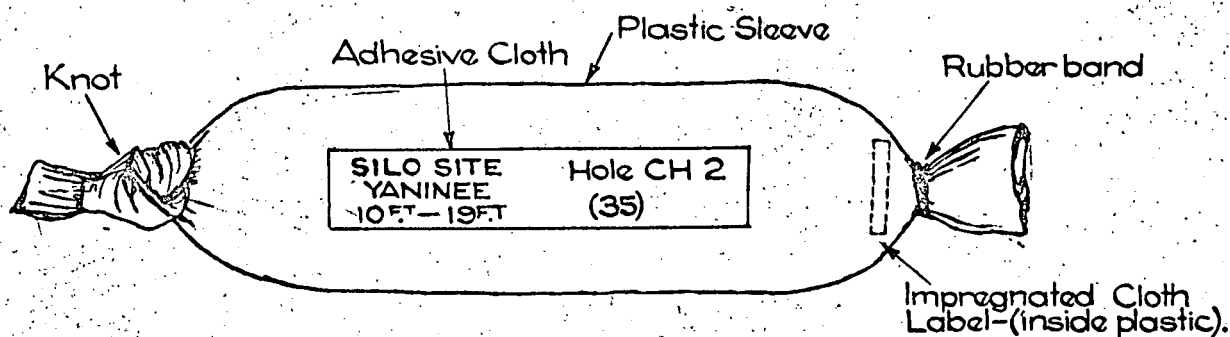
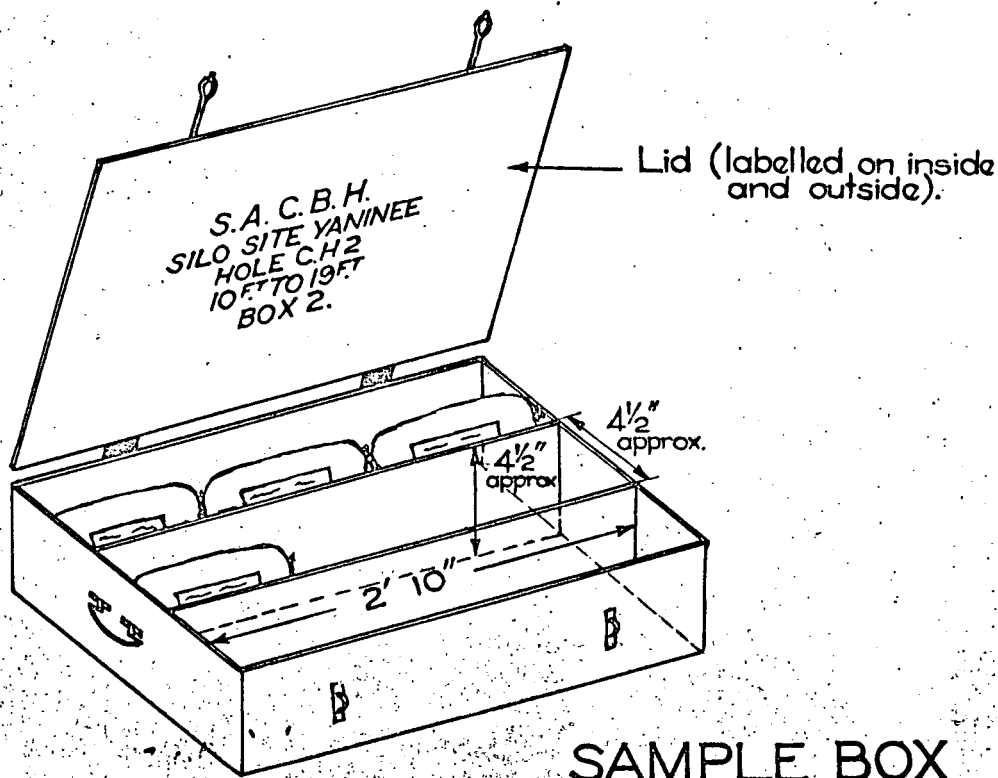
CABLE-TOOL DRILLING
S SERIES SAMPLING
TUBE AND SHOES

SCALE: NOT TO SCALE

S4418
MB

DATE: 21 Oct '69

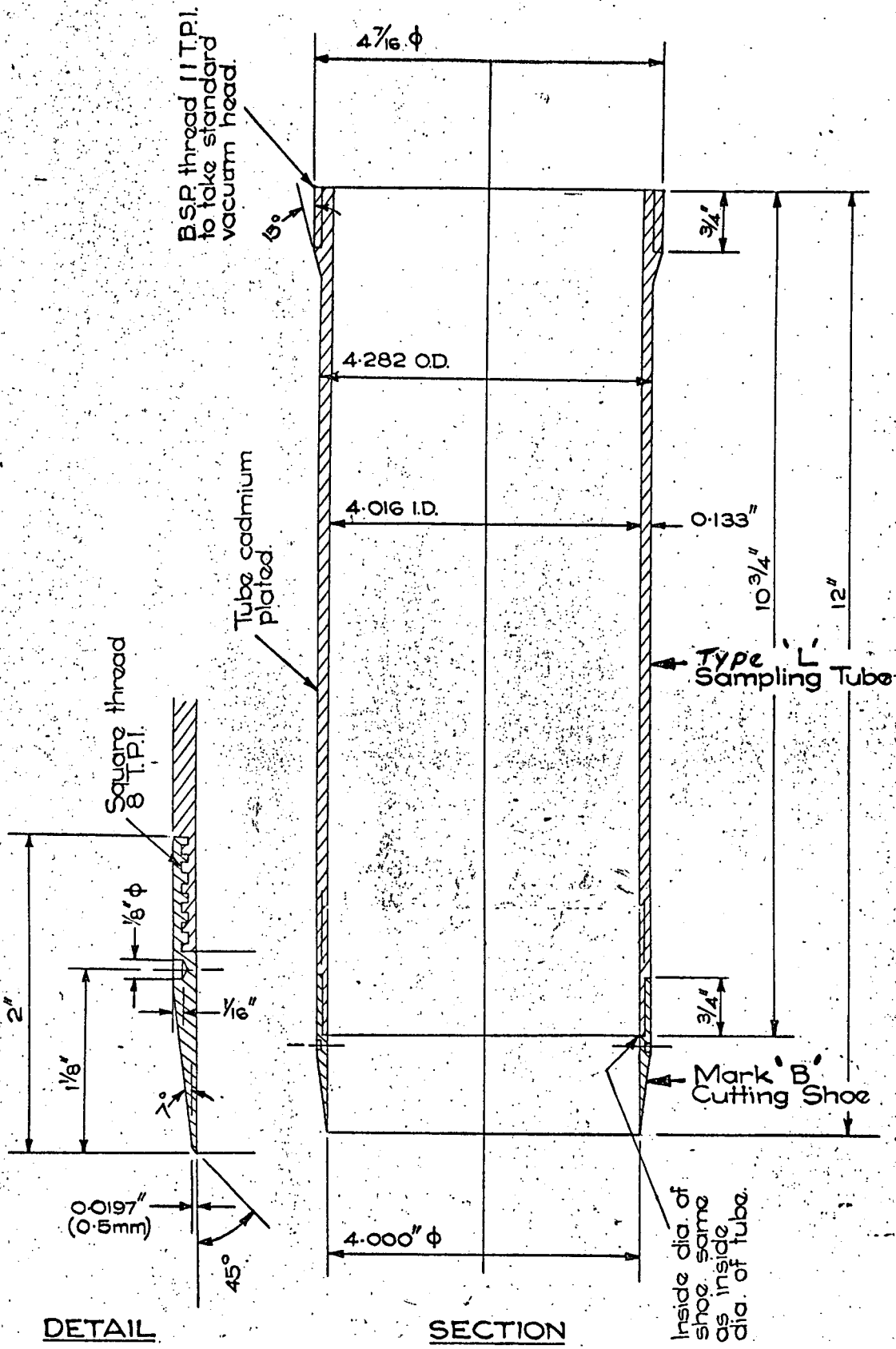
J.W. ...
SENIOR GEOLOGIST



**EXTRUDED SAMPLE
SEALED IN PLASTIC SLEEVE.**

APPENDIX FIG. 3

ENGINEERING DIVISION	DEPARTMENT OF MINES - SOUTH AUSTRALIA	Scale:
Compiled: W.R.P.B		Date: 17 Dec. '69
Drn AM&D. Ckd.	CABLE TOOL DRILLING LABELLING AND BOXING OF EXTRUDED SAMPLES	Drq. No S7580 MD

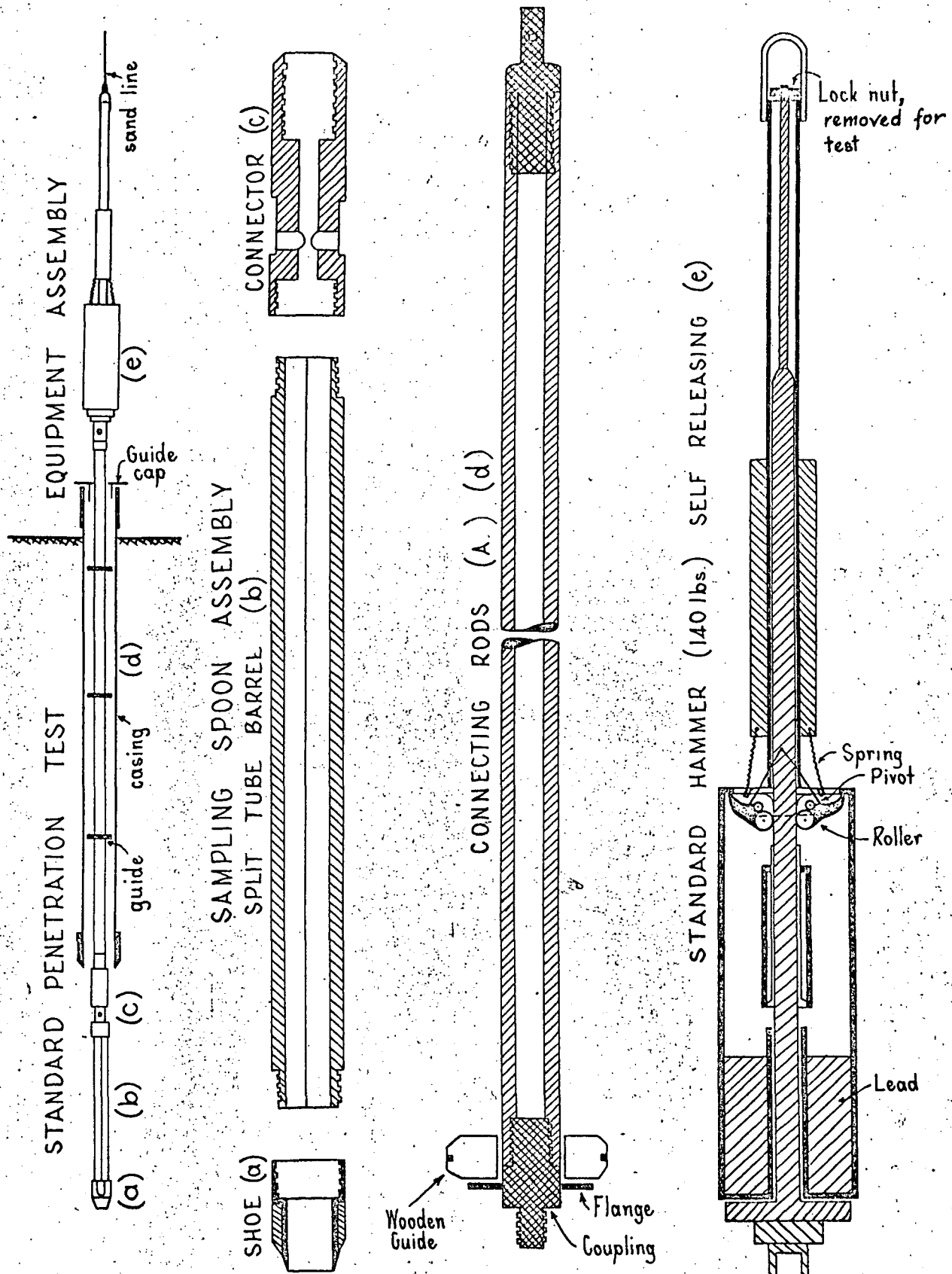


DETAIL

SECTION

APPENDIX . FIG. 4

ENGINEERING DIVISION	DEPARTMENT OF MINES - SOUTH AUSTRALIA	Scale: Half and Full size
Compiled: J. Trudinger	CABLE TOOL DRILLING THIN-WALLED "L" SAMPLE TUBE AND "B" SHOE	Date: 19 Feb '70
Drn. AM&D Ckd. LV.W.		Drg. No 57636 MB.



APPENDIX FIG.5

ENGINEERING DIVISION	
Compiled: W.R.P.B.	
Drn. R.H.	Ckd.

DEPARTMENT OF MINES - SOUTH AUSTRALIA

STANDARD PENETRATION TEST EQUIPMENT

Scale: Not to scale
Date: 22 Dec 1969
Drng. No. S4420 MB

FIELD IDENTIFICATION PROCEDURES
(Excluding particles larger than 0.25 ft. and basing fractions on estimated weights)

GROUP SYMBOL

GROUP NAME
and typical materials

LABORATORY CLASSIFICATION CRITERIA

COARSE GRAINED SOILS
More than 50% of material is larger than No. 200 B.S. sieve size.

GRAVELS More than 50% of the coarse fraction is larger than 2mm. (retained on B.S. 7 sieve)	CLEAN GRAVELS Little or no fines	Wide range in grain size and substantial amounts of all intermediate particle sizes	
	DIRTY GRAVELS Appreciable amount of fines	Predominantly one size, or a range of sizes, with some intermediate sizes missing.	
		Non-plastic fines - for identification see ML below.	
	SANDS More than 50% of the coarse fraction is smaller than 2mm. (passing B.S. 7 sieve)	CLEAN SANDS Little or no fines.	Wide range in grain sizes, and substantial amounts of all intermediate particle sizes
		DIRTY SANDS Appreciable amount of fines	Predominantly one size or a range of sizes, with some intermediate sizes missing.
	Non plastic fines - for identification see M L below		
Plastic fines - for identification see CL below			

GW	GRAVEL, well graded; gravel sand mixtures, little or no fines
GP	GRAVEL, poorly graded; gravel sand mixtures, little or no fines.
GM	GRAVEL, excess silty fines; poorly graded gravel-sand-silt mixtures
GC	GRAVEL, excess clayey fines; poorly graded gravel-sand-clay mixtures
SW	SAND, well graded; well graded sands, gravelly sands, little or no fines.
SP	SAND, poorly graded; poorly graded sands gravelly sands, little or no fines
SM	SAND, excess silty fines; poorly graded sand-silt mixtures
SC	SAND excess clayey fines; poorly graded sand-clay mixtures.

GRAIN SIZE CURVE to be used to identify soil fractions.

Coarse grained soils classified on basis of percentage of fines, as follows

PERCENT OF FINES

Less than 5
More than 12

SANDS
SW, SP
SM, SC

GRAVELS
GW, GP
GM, GC

Borderline cases, use 2 symbols

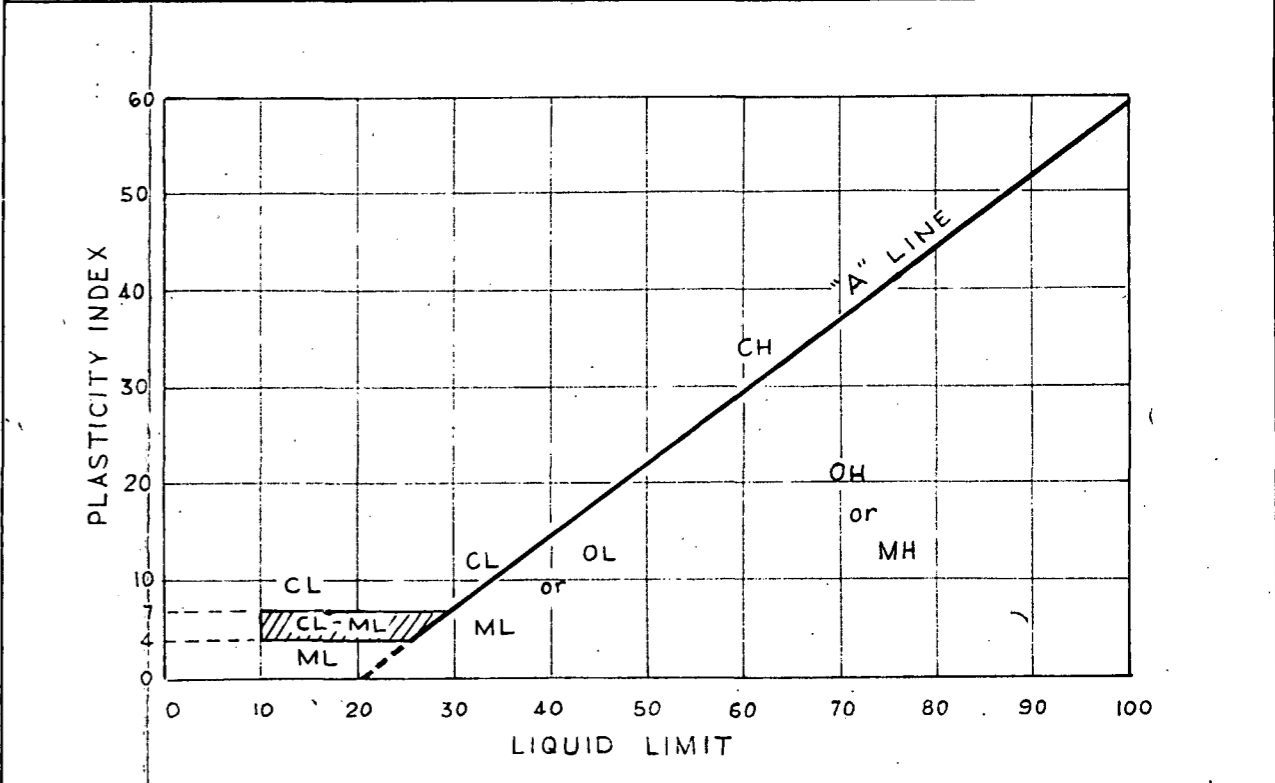
$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4	$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3
Not meeting all gradation requirements for GW	
Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
Atterberg limits above "A" line with PI greater than 7	
$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6	$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3
Not meeting all gradation requirements for SW	
Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
Atterberg limits above "A" line with PI greater than 7	

FINE GRAINED SOILS
More than 50% of material is smaller than No. 200 B.S. sieve size.

FIELD INVESTIGATION PROCEDURES on fraction smaller than 0.4mm. (passing B.S. 36 sieve)							GROUP SYMBOL	GROUP NAME (and typical materials)
SOIL CAST (wet soil)	SOIL THREAD	SHINE	DILATANCY	ODOUR	DRY STRENGTH			
SILTS AND CLAYS Liquid limit less than 50	Forms fragile cast. Cracks form when kneaded while moist	Thick crumbly thread; easily broken	None to very dull	Distinct	Not significant	None to slight	ML	SILT SOIL, low plasticity; inorganic silts and very fine silty or clayey sands, rock flour.
	Cast may be handled freely without breaking. Can be kneaded moist without cracking. Material adheres to the hand.	Thread can be pointed as fine as a lead pencil, but is fragile.	Moderate	None to slight	Not significant	Moderate	CL	CLAY SOIL, low plasticity; inorganic clays of low to medium plasticity, gravelly clays, sandy clays silty clays, lean clays
	Cast fragile to cohesive material will adhere somewhat to the hand.	Soft, weak thread.	None to Very dull	Slight to distinct	Decayed organic matter	Low	OL	ORGANIC SOIL low plasticity; organic silts and silt clays of low plasticity
SILTS AND CLAYS Liquid limit more than 50	Moderately plastic and cohesive. Material adheres somewhat to the hand	Weak to medium thread. May be crumbly.	Dull	None to slight	Not significant	Moderate Powdered soil feels floury	MH	SILT SOIL, high plasticity; inorganic silts, micaceous or diatomaceous fine sandy or silty soils elastic silts.
	Very plastic and cohesive. Material very sticky to the hand. Greasy to touch.	Vary tough thread. Can be rolled to a pin point.	Very glossy	None	Strong earthy.	High to very high. Cannot be powdered by finger pressure	CH	CLAY SOIL, high plasticity; inorganic clays of high plasticity, fat clays
	Plastic and cohesive. Feels slightly spongy. Greasy to touch.	Weak to medium thread. Often soft and fibrous	Moderate to very glossy	None	Decayed organic matter	Moderate to high. Powdered soil may be fibrous.	OH	ORGANIC SOIL, high plasticity; organic clays of medium to high plasticity.

GRAIN SIZE CURVE to be used to identify soil fractions.

GRAIN SIZE CURVE to be used to identify soil fractions.



PLASTICITY CHART FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

HIGHLY ORGANIC SOILS
Readily identified by colour, odour, spongy feel and frequently by fibrous texture.

Pt

PEATY SOIL; Peat and other highly organic soils.

NOTE : BOUNDARY CLASSIFICATIONS : Soils possessing characteristics of two groups are shown as a combination of two group symbols, e.g. GW - GC, well graded gravel with clay binder.

Based on "The Unified Soil Classification System" APPENDIX
United States Department of the Interior,
Bureau of Reclamation "Earth Manual"
First Edition, Denver COLORADO 1960

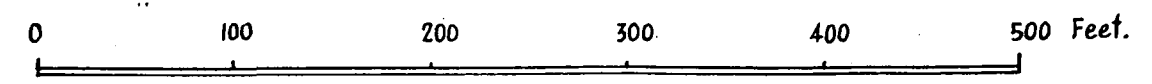
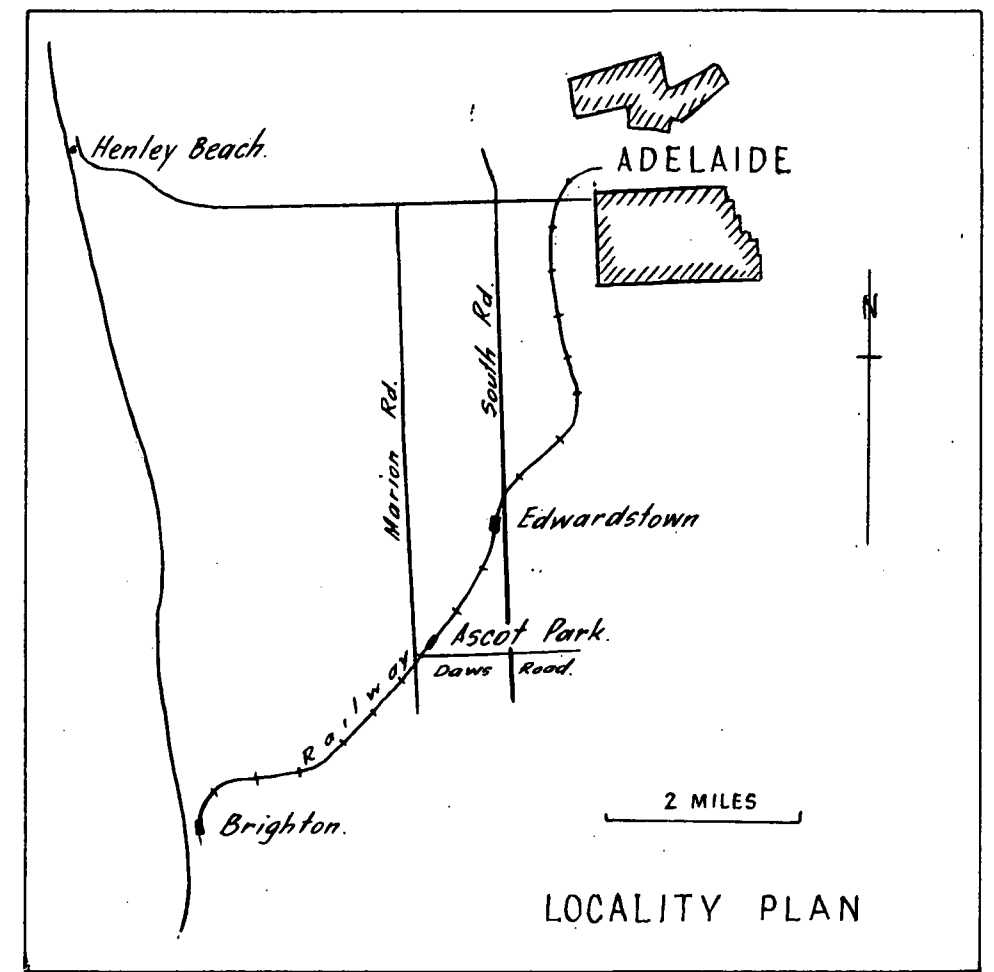
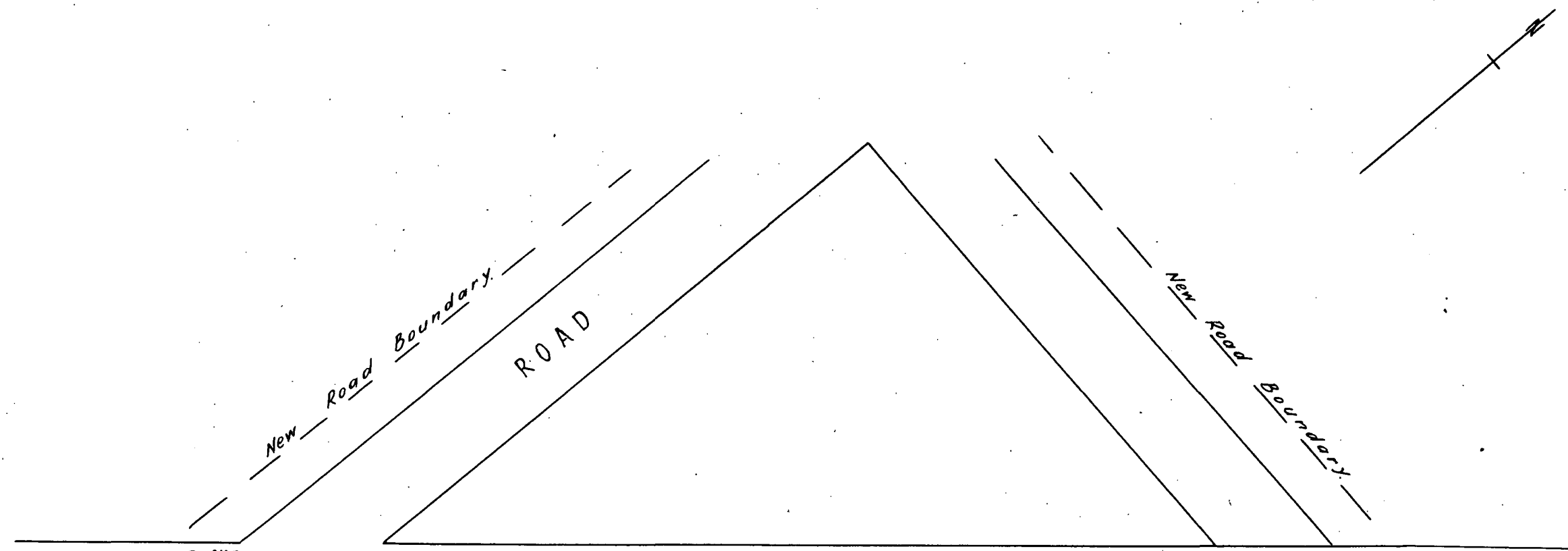


FIG. 1

ENGINEERING GEOLOGY SECTION	DEPARTMENT OF MINES - SOUTH AUSTRALIA	Scale: -
Compiled: <i>W. Boucaut</i>	PROPOSED RAILWAY / ROAD GRADE SEPARATION ASCOT PARK LOCATION OF DRILL HOLES	Date: 24-2-71
Drn. <i>B.S.G.</i> Ckd. <i>W.A.P.B.</i>		Drg. No. 71-179 <i>Ha 6</i>