Rept. Bk. 66/138
G.S. 3999

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
ENGINEERING DIVISION

SATELLITE TRACKING STATION - CEDUNA

GEOLOGICAL INVESTIGATIONS - PROGRESS REPORT NO. L

FEASIBILITY/DESIGN STAGE

Out of Hundreds, Co. Way

Client: The Overseas Telecommunicatins Commission (Australia)

by

W.R.P. Boucaut
Senior Geologist
Engineering Geology Section

and

I.S. Rowan
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Exploration Geophysics Section

DM.454/68

21st May, 1968

66/138

DEPARTMENT OF MINES
SOUTH AUSTRALIA

RB 66/138

SATELLITE TRACKING STATION - CEDUNA

GEOLOGICAL INVESTIGATIONS - PROGRESS REPORT No.1

FEASIBILITY/DESIGN STAGE

Out of Hundreds, Co. Way

Client: The Overseas Telecommunications Commission (Australia)

by

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CONTENTS

FIGURES

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D.M. No. 454/68

22nd May, 1968

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rep. Bk. No. 66/138
G.S. No. 3999
D.M. No. 454/68

SATELLITE TRACKING STATION - CEDUNA

GEOLOGICAL INVESTIGATIONS - PROGRESS REPORT NO. 1

FEASIBILITY/DESIGN STAGE

Out of Hundreds, Co. Way

Client: The Overseas Telecommunications Commission (Australia)

INTRODUCTION

A request to investigate foundation conditions for a proposed Satellite Tracking Station about 19 miles northeast of Ceduna was received in a letter dated 5th April, 1968 from The Overseas Telecommunications Commission.

The main structure, as yet undefined, may occupy an area of about 60 ft. diameter and will support a solid dish of about 100ft. diameter, capable of rotation in any direction.

Various single story buildings are to be erected over an area of about 200 ft. by 100 ft. immediately south of the main structure.

Investigations carried out at the site have included

- .....an inspection of the area with officers of the Commission to determine possible sites for the station
- .....a seismic refraction survey (Figs. 1 to 4)
- .....four diamond drill holes (DH 1 to 4) totalling 106 ft. (Appendix A)
- .....three test pits, 5 to 5.5 ft. deep, (Appendix B)

SITE GEOLOGY

Topography

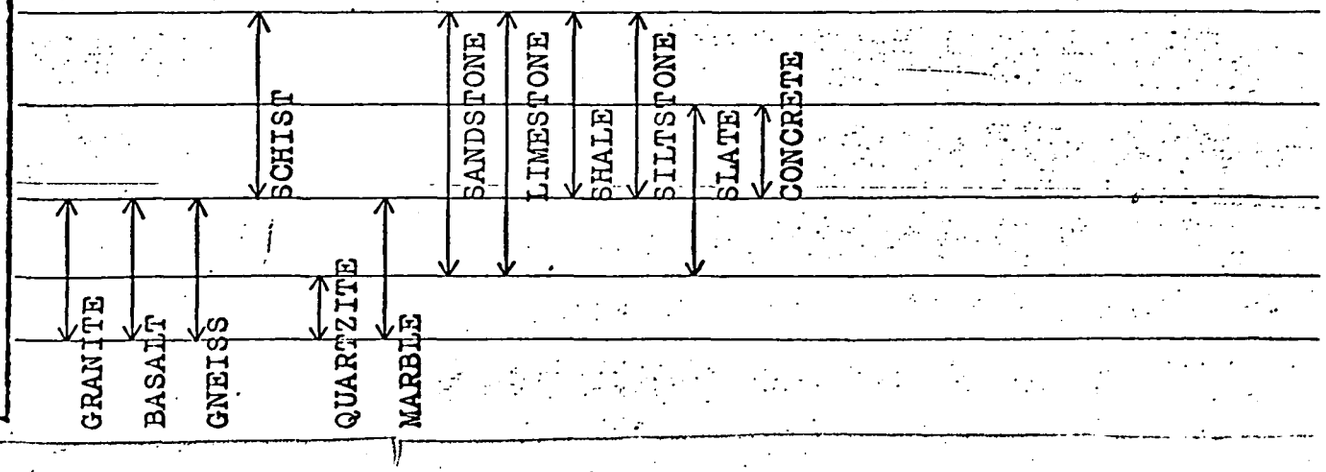
The site is in an area of northwest-southeast trending gently rolling sand dunes. They are up to 50 ft. high and from a few hundred feet to 0.5 miles apart with flat ground between. The site chosen

TABLE 1

CLASSIFICATION OF CLAY SOILS AND ROCK SUBSTANCES
BY UNCONFINED COMPRESSIVE STRENGTH.

	TERM	ABBREVIATION	UNCONFINED COMPRESSIVE STRENGTH (Kg/sq.cm)
SOIL PROPERTIES Disintegrates, or can be remolded, in water.	Very soft (clay)	VS	less than 0.25
	Soft "	S	0.25 - 0.5
	Medium "	M	0.5 - 1.0
	Stiff "	St	1.0 - 2.0
	Very Stiff "	V.St	2.0 - 4.0
	Extremely stiff clay	E.St	greater than 4.0
	Boundary Zone Substances		
ROCK PROPERTIES Do not disintegrate, cannot be remolded, in water.	Very weak (rock)	VWR	less than 70
	Weak "	WR	70 - 200
	Medium Strong "	MSR	200 - 700
	Strong "	SR	700 - 1800
	Very strong "	VSR	greater than 1800

Range of strengths of some Common Rock Substances, in the Fresh State



for the Station is on the broad, nearly flat crest of one of these dunes.

The dunes are normally covered by dense low scrub, but in the chosen area the scrub has been removed and cereal crops planted.

Soil Types

The ground surface over much of the site is covered by a red brown (limy) sand, mainly fine grained, calcareous and containing numerous rounded to subangular calcrete gravel fragments 0.1 to 0.5ft. in diameter. The test pits constructed on the site indicate that this material is about 0.5ft. thick and has been disturbed by cultivation. It overlies a layer of calcrete about 0.5ft. thick. This is a nodular material consisting of "cores" of sandy limestone surrounded by "shells" composed of concentric layers of laminar limestone. Several "shells", representing different generations of calcrete formation may often be recognized. Calcrete is probably formed by the precipitation of calcium carbonate in soil. The calcrete fragments have the properties of a strong rock (Table 1) but the mass usually tends to be composed of discreet strong nodules in a matrix of weak lime-sand. The horizon varies in composition laterally, and in places may be completely absent (Pit 3).

Underlying the calcrete is a further layer of red brown limy sand, with some calcrete gravel fragments. This material extends to depths of 5.5ft. below ground surface in Pits 2 and 3, and to 5.0ft. in Pit 1. A further calcrete horizon was exposed in the floor of Pit 1 at a depth of 5ft.

The soil and calcrete horizons were penetrated by holes DH2 to 4 to depths of 9 to 11ft. Most of the soil was washed away in the drilling water and only fragments of calcrete were recovered.

Rock Type

About 300ft. southeast of the site chosen on the dune crest, granite outcrops over an area of about 100ft. diameter (Fig.1) The outcrop is generally 8ft. lower in elevation than the crest of the dune.

The granite is medium to coarse grained, and is essentially

composed of quartz and felspar with few micas. It is pink to grey in colour when fresh.

Geological Structures

Although the granite is a strong and compact rock in small samples, the mass has been weakened to varying degrees by geological defects such as joints, and crushed and weathered seams.

Three sets of joints are exposed in the outcrop.

Set. 1 Strike N 105° E, dip 75° N, spaced 5 to 20ft. apart and persistant up to 20ft.

Set 2 Strike N 15° E, dip 80° E, spaced 20 to 30ft. apart, and persistant up to 40ft.

Set 3 Near horizontal.

Joints of Set 1 and Set 2 are mainly tightly closed and strongly cemented. Joints of Set 3 are commonly weakly cemented or uncemented and open to 5mm.

Joints in the granite recovered during drilling had similar dips to those of Sets 1 to 3, but in holes DH 2 to 4 they were spaced less than 0.5ft. and were weakly cemented or uncemented with weathering products and limonite staining on joint faces.

Weathering

Weathering is defined here as disintergration of rock due to the action of surface agencies and associated phenomena. Two distinct types of weathering occur, namely mechanical and chemical.

Mechanical Weathering. This is mechanical failure of the rock due to the opening up of joints near the ground surface, and is believed to be initiated by the redistribution and release of stresses within the rock mass when overburden is removed by erosion.

In rocks which contain few joints of tectonic origin, irregular joints almost parallel to the grouns surface tend to form as part of the mechanical weathering process. Keislinger (Ref. 1) describes these as Bankung or exfoliation joints. They are clearly formed by failure of the rock across its fabric. It is probable that the flat lying joints (Set 3) in outcrop and in

in the drilling cores are of this type.

Chemical Weathering. This is decomposition of the rock material due largely to the action of groundwaters. The rock materials are virtually impermeable, and the groundwater has gained access to the rock mass mainly by percolating along joints or seams. The degrees of chemical weathering are defined according to the physical properties of the weathering products as set out in Table 2.

The granite in outcrop and recovered during drilling of hole DH1 is fresh to slightly weathered. In holes DH2 to 4 the granite immediately below the topsoil is moderately to highly weathered. Holes DH3 and DH4 passed into fresh granite at depths of 21 and 14 ft. below the ground surface respectively but hole DH2 did not pass into fresh granite until 48ft. below the ground surface.

Groundwater

Following periods of rain, water accumulates in holes in the surface of the granite outcrop.

Groundwater was present in Holes DH2 and DH3 at 38ft. and 17ft. respectively, while in Hole DH2, 25ft. deep, no water was measured. The irregularity of the groundwater surface as indicated by these measurements is probably due to disconnected or partly connected bodies of water within the rock mass. This is typical of groundwater in jointed rocks (Ref. 2).

SEISMIC REFRACTION SURVEY

General

A shallow seismic refraction survey was carried out between 2nd and 8th April, 1968, under the direction of Mr. I. Rowan, Exploration Geophysics Section to determine depths to granite in the site area.

The S.I.E.P. 19, 12 channel recording equipment mounted in a Land Rover was used for the survey. Four 900ft. spreads were completed along lines A, B, C and D, and eight more detailed 330ft. spreads were completed along part of lines A and B and

TABLE 2

WEATHERING PRODUCTS OF ROCK MATERIALS

TERM	ABBREVIATION ON DRAWINGS	DESCRIPTION
Fresh	Fr.	The rock shows no discolouration, loss of strength, or any other effect due to weathering.
Slightly Weathered	SW	The rock is slightly discoloured, but not noticeably lower in strength than the fresh rock.
Moderately Weathered	MW	The rock is discoloured and noticeably weakened, but 2 inch diameter drill cores cannot usually be broken up by hand, across the rock fabric.
Highly Weathered	HW	The rock is usually discoloured and weakened to such an extent that 2 inch diameter cores can be broken up readily by hand, across the rock fabric. Wet strength usually much lower than dry strength.
Completely Weathered	CW	The rock is discoloured and is entirely changed to a soil, but the original fabric of the rock is mostly preserved. The properties of the soil depend upon the composition and structure of the parent rock.

along lines E and F (Fig. 1).

Results

The quality of the records was good with the exception of a few isolated cases where the records were marred by crossfeed in the recorder. The seismic interpretation for the various lines are shown on Figs. 2, 3 and 4. As the ground surface levels are not known the depths given are depths below the surface at that particular point.

The seismic velocity through the soil and calcrete varies locally from 1,200ft/sec. to 3,000 ft/sec. The lower velocities probably correspond to the loosely compacted surface material, and the higher velocities probably indicate greater thicknesses of calcrete or perhaps highly weathered granite. Drill holes along line F, where the indicated thickness of this layer was 20 to 25 ft., showed 10ft. of soil and calcrete overlying several feet of highly weathered granite. An average velocity of 2,250ft./sec. for this layer was used in depth calculations.

The seismic velocity through the underlying material was between 16,500 ft/sec. and 19,000 ft./sec. The drill holes along line F showed the material with this siesmic velocity to be fresh granite. The velocity of 14,000ft/sec. recorded on lines E and F may correspond to areas of more weathered granite such as was indicated by hole DH 2. At the intersection of lines E and A a lower velocity (7,000 ft/sec.) was recorded. This may indicate that more highly weathered granite is present, or that, if fresh granite is present, it dips steeply to the west at this point. This may also be the cause of the lack of interpretable records along the western end of line A.

An isopach plan using contours for the thickness of the low seismic velocity layer is shown in Fig. 1. Seemingly anomalous single depth values have been omitted as the contouring is only approximate with this sparse coverage. These results show that north-west of the outcrop depths to the granite are less than south or east where the granite seems to dip away relatively steeply.

DISCUSSION

Antenna Structure

In the fresh state granite is generally a medium strong to very strong rock (Table 1), but its strength decreases with increase in weathering. The change from rock to soil properties is gradational but is placed nominally between the highly and completely weathered states.

It is probable that nearly horizontal Bankung joints, which usually contain soil from infill or from weathering of the adjacent rock, are presistant in the granite over most of the area. The open joint at a depth of 22ft. in hole DH 4 (13ft. below top of granite) is probably a Bankung joint. The core losses at 16 and 31 ft. in hole DH 2 probably represent zones of weaker rock such as weathered zones, possibly associated with Bankung joints, or crushed seams.

General Buildings

The soils as exposed in the pits would not be subject to seasonal shrinkage and swelling movements of any significance and would be well drained.

Bearing capacity is not high due to the limy material present, which becomes soft and loses strength if allowed to become saturated, but experience has shown that for normal domestic type foundations, footings of the following dimensions are usually adequate.

EXTERNAL WALLS : 2 ft. wide by 1ft. deep

INTERNAL WALLS : 1.5ft. wide by 1ft. deep

Concrete raft type foundations also have proved to be satisfactory. Artificial consolidation of the soil by flooding and compaction with a vibrating roller is generally advised before footings are placed.

The following precautions are normally recommended for building constructed on these soils.

...All surplus surface water, downhill drainage, roof run-off etc. be carried well away from the footings in properly constructed drains of adequate capacity. Lawns and gardens should be kept well clear of the foundation area to prevent damage resulting from over-watering.

...A wide concrete, or heavy asphalt paving surround be placed around the building. This is designed to minimise soil moisture variations beneath the footings. If a concrete paving is used, it should be bonded to the footing by means of a bitumastic compound.

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WRPB:RW:OB:CL
22.5.68

REFERENCES

1. KEISLINGER, A. 1960. Residual Stress and Relaxation in Rocks. Proc. Int. Geological Congress, Copenhagen. Session 21 Part XVIII, pp. 270 - 276

2. TERZAGHI, K. 1962 Stability of steep slopes on Hard Unweathered Rock. Geo technique. Vol. 12, No.4 pp. 251 - 270

APPENDIX A

LOGS OF DIAMOND DRILL HOLES AND EXPLANATORY NOTES

APPENDIX A

LOGS OF DIAMOND DRILL HOLES

AND EXPLANATORY NOTES

NOTES ON DRILLING PROCEDURES

Equipment

The core sizes are as follows:-

Symbol	Nominal Diameter of Cores	
	Inches	Centimeters
NXC (NX casing)	2.8	7.2
NMLC	2.0	5.1

The NMLC cores were obtained with "M" type stationery inner tube core barrels fitted with bottom discharge bits. The inner tubes were of the split type, ensuring minimum disturbance of the core during removal from the barrol.

Storing and Marking of Core

Cores are stored in wooden boxes, each compartment of which is designed to contain five feet of core. The internal length of each compartment is actually five feet one inch, to allow for 100 per cent core recovery, when roughness of the ends of the core, and small inaccuracies in measurement when breaking it to fit the box, make it difficult to fit five feet of core in a compartment of exactly that length. The boxes are marked with consecutive compartment numbers at one end, and the drilled depths from the surface in feet at the other.

The cores were boxed in this manner at the drill sites, the core being placed in its appropriate place in the box as soon as it was extracted from the core barrel. The bottom of each lift was marked with paint immediately it was placed in the box, and a corresponding paint mark was made on the side of the core box. The measured depth of the hole in feet from the surface was painted on the side of the core box. Core losses where their position was not known, were assumed to occur at the bottom of each lift. Timber blocks cut to the correct length were used to indicate core not recovered.

The cores were stored in the P.M.G. Works Yard, Ceduna.

NOTES ON DETAILS SHOWN ON LOG SHEETS

At the head of the sheet general details of the hole are given.

The logs are plotted on a scale of 1 inch = 10 feet (1:120). In the column headed "Log", places where core was obtained are shown by stippling, and the traces of joints, and seams are shown diagramatically by means of symbols.

Places where core was lost are shown by blank spaces. The descriptions given on the log sheet refer only to material recovered as core. Core is lost by the material being ground or washed away during the drilling process; it may usually be inferred

that such material is relatively weak. Near the surface this weakness may arise from the unconsolidated nature of soils or weathered rocks. At greater depths the weakness may arise from weathering confined to narrow seams in otherwise fresh rock, or from sheared, crushed or jointed rock. It cannot always be assumed that the material not recovered is weak, since even solid rock core may be ground away and lost during drilling operations.

The core size symbol is shown on the log sheets under the heading "Core Size".

The drilling lifts and the approximate percentage core recovery are shown in the column "lift Core Recovery".

The degree of chemical decomposition or weathering of the rock material recovered is given in the column "Weathering" by means of a histogram-type plot.

The "Fracture Log" column shows the degree of fracturing of the core by means of histogram-type plot. Degree of fracturing means the degree to which the rock has mechanically broken up along geological defects such as joints, or seams.

In the column "Structures", angles shown on joints, bedding or other geological structures are the angles they make with the plane at 90° to the axis of the core.

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. D. H. 1

SERIAL No

PROJECT TRACKING STATION
CEDUNA

FEATURE FOUNDATIONS

LOCATION DINAH ROCK HOLE

SECTION C° WAY

CO-ORDINATES

ANGLE FROM HORIZONTAL 90°

DIRECTION —

R.L. Surface — FT.

R.L. Collar — FT.

Datum —

DESCRIPTION OF CORE	SW WEATH MW ERING HW CW	CORE SIZE, DEPTH R.L. FT.	LOG	FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS % 5 50 10	WATER LEVEL DATE	CASING	DRILL WATER LOSS % 0–100	WATER PRESSURE TESTS LUGEONS 10 20 30 40 80 120
Ironstained GRANITE: Medium to coarse grained, mainly fresh, lightly ironstained in top 2ft., with some decay of felspars.		NX NM LC	+ + +		Joint, near horizontal, irregular, tight, lightly ironstained.		24 Apr '68			Not Tested.
END OF HOLE 5·25ft.										

10 20 30 40 50 60 70 80 90 00

WEATHERING

FR — Fresh
SW — Slightly weathered
MW — Moderately "
HW — Highly "
CW — Completely "

FRACTURE LOG

1 4 16 64 — Natural fractures per foot of core
12 5 ¼ 1/16 — Equivalent diameter in inches

ENGINEERING GEOLOGY SECTION

DRILL No 16
TYPE
DRILLER Ken Rogers
START 9 Apr 68
FINISH 9 Apr 68

LOGGED BY J.A.C.P.
DATE 24 Apr 68
TRACED R.H.
CHECKED W.R.B.

SHEET 1 OF 1 SHTS

2678

P.P. No S50271A MD

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. D. H. 2

SERIAL No

PROJECT TRACKING STATION . CEDUNA

FEATURE . FOUNDATIONS

LOCATION. DINAH. ROCK .HOLE

SECTION . . . . C° WAY

CO-ORDINATES . .

ANGLE FROM HORIZONTAL . 90°

DIRECTION . —

R.L. Surface . — . FT.

R.L. Collar . — . FT.

Datum . —

DESCRIPTION OF CORE	SW WEATH MW ERING HW CW	CORE SIZE, DEPTH R.L. FT.	LOG	FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT, CORE LOSS % 5 50 10	WATER LEVEL DATE	CASING	DRILL WATER LOSS % 0-100	WATER PRESSURE TESTS LUGEONS 10 20 30 40 80 120
CALCRETE in BARAGA SOIL: Very strongly calcareous cemented, fine grained sand. NO CORE		NX								
NO CORE										
NO CORE										
		10			Joints dip at 45° to 70°, irregular, ironstained.					
GRANITE: Medium to coarse grained, grains mainly 2 to 5mm. esentially quartz and felspar, few. mica (biotite). When weathered, felspars decay to kaolin and other clay minerals; rock is whitish with yellow-brown staining. When fresh, rock is finely mottled pinkish grey.		NM LC			10 to 15 ft: Joints spaced 5mm to 0·4 ft., dips 0° to 15°, rough, irregular, limonite stained, commonly contains up to 5mm earthy limonite and some yellow-brown clay. Several Joints dip 60°-70°, mainly irregular, ironstained.					Not Tested.
NO CORE										
		20			Joint, dip 70°, smooth, up to 5mm. kaolin coating.					
		30			15 to 36ft. Joints, near horizontal, spaced mainly 0·1 to 0·5ft. rough, irregular, limonite stained and coated, rarely weakly cemented. 36 to 44 ft. Joints spaced mainly 0·7ft, weak limonite cement.					
NO CORE							24 Apr 68			
		BX 40			Joints dip 70 to 85°, one weakly limonite cemented, other contains up to 1mm kaolin. Joint, dip 70-80°, irregular limonite stained and cemented. Joint, irregular, dip 10°, 5 to 20mm MW rock adjacent, iron-stained. Joints, dip 70°, slightly irregular, contain up to 0·5mm. limonite. Joints, dip 20-40°, rough, irregular, limonite stained, weak cement.					
		50			END OF HOLE 51ft.					
		60								
		70								
		80								
		90								
		00								

WEATHERING

FR — Fresh
SW — Slightly weathered
MW — Moderately ″
HW — Highly ″
CW — Completely ″

FRACTURE LOG
1 4 16 64 — Natural fractures per foot of core
12 3 3/4 5/16 — Equivalent diameter in inches

ENGINEERING GEOLOGY SECTION

DRILL No 16
TYPE
DRILLER Van Rooyen
START 10 Apr 68
FINISH 11 Apr 68

LOGGED BY J.A.C.P.
DATE 24 Apr 68
TRACED R.H.
CHECKED WARB

SHEET 1 OF 1 | DRG. No S6579 Dc

P.F. No S5027A MB

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. D.H. 3

SERIAL No

PROJECT TRACKING STATION . CEDUNA

FEATURE . FOUNDATIONS

LOCATION. DINAH ROCK HOLE

SECTION . . . . C° WAY.

CO-ORDINATES .

ANGLE FROM HORIZONTAL . 90°

DIRECTION . —

R.L. Surface . — FT.

R.L. Collar . FT.

Datum . —

DESCRIPTION OF CORE	SW WEATHERING MW HW CW	CORE SIZE. DEPTH R.L. FT.	LOG	FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS. VEINS. SEAMS. SHEARED ZONES. CRUSHED ZONES	LIFT. CORE LOSS % 5 50 10	WATER LEVEL DATE	CASING	DRILL WATER LOSS % 0–100	WATER PRESSURE TESTS LUGEONS 10 20 30 40 80 120
CALCRETE in BAKARA SOIL Very strongly calcareous cemented fine grained sand.	NO CORE NO CORE	NX								
GRANITE Medium to coarse grained grains mainly 2 to 5mm. essentially quartz and felspar, few mica (biotite). When weathered felspar decays to kaolin and other clay minerals, rock is whitish with yellow-brown staining. When fresh, rock is finely mottled, pinkish-grey.		NMLC			11 to 14ft. Joints spaced 5mm to 0·2 ft, near horizontal, irregular, limonite stained, clay & limonite coatings. Joint, dip 70°, slightly rough, regular, up to 1mm. calcareous cement. Joint, limonite stained, and contains earthy, limonite coating. Several Joints, near horizontal limonite stained, irregular, up to 0·2 ft. MW rock adjacent. Joints, tight, limonite cemented.		24 Apr '68			Not Tested
					END OF HOLE 25ft.					

WEATHERING

FR — Fresh
SW — Slightly weathered
MW — Moderately "
HW — Highly "
CW — Completely "

FRACTURE LOG

1 4 16 64 — Natural fractures per foot of core
1/12 1/3 1/4 1/16 — Equivalent diameter in inches

ENGINEERING GEOLOGY SECTION

DRILL No 16
TYPE
DRILLER Van Reeven
START 18 Apr '68
FINISH 17 Apr '68

LOGGED BY J.A.C.R.
DATE 24 Apr 68
TRACED R.H.
CHECKED W.R.B.

SHEET 1 OF 1 | DRG. No S6580 Bc

D.F. No. S5027A MB

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. DH.4

SERIAL No.

PROJECT SATELLITE TRACKING STATION CEDUNA.

FEATURE FOUNDATIONS.

LOCATION DINAH ROCK HOLES.

SECTION . . . Co. WAY.

CO-ORDINATES .

ANGLE FROM HORIZONTAL 90°

DIRECTION

R.L. Surface . . . FT.

R.L. Collar . . . FT.

Datum .

DESCRIPTION OF CORE	WEATHERING SW MW HW CW	CORE SIZE, DEPTH R.L. FT.	LOG	FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT, CORE LOSS % 5 50 10	WATER LEVEL DATE	CASING DRILL WATER LOSS % 0-100	WATER PRESSURE TESTS LUGEONS 10 20 30 40 80 120
No core - soil. (?).		NX							
GRANITE Medium to coarse grained. Grains mainly 2 to 5 m.m. Mainly quartz and felspar-few micas (biotite). When weathered felspars decay to kaolin & rock is whitish to yellow-brown. When fresh rock is finely mottled pinkish-grey.		NM LC			Near horizontal joints spaced 0·1 to 0·6 ft, limonite stained. Joint dip 45°, irregular, rough, clay coated, with patches white clay up to 3 m.m. - calcareous. Few subhorizontal rough joints with little limonite. 3 rough, irregular, subhorizontal joints. Open possibly up to 25 m.m. Calcareous coating.		No water in hole	Hole Cemented	Not Tested.
END OF HOLE 25 Ft.									

10 20 30 40 50 60 70 80 90 100

WEATHERING

FR — Fresh
SW — Slightly weathered
MW — Moderately "
HW — Highly "
CW — Completely "

FRACTURE LOG
1 4 16 64 — Natural fractures per foot of core
12 3 ½ 1/16 — Equivalent diameter in inches

ENGINEERING GEOLOGY SECTION

DRILL No. 18
TYPE
DRILLER Van Rooyen
START 23 Apr '68
FINISH 25 Apr '68

LOGGED BY JAEP/HWD
DATE 24 Apr '68
TRACED J.A.W.
CHECKED L.V.W.

SHEET . OF . DRG. No. S6599

P.F. No. 55027A MB

APPENDIX B

LOGS OF PITS

APPENDIX B

Three test pits up to 5.5 ft. deep were excavated using a truck mounted power auger drill. These were put down in the area of the general buildings to the south of the main antenna structure. Logs of the pits are attached. Their location is shown on Fig. 1.

DEPARTMENT OF MINES SOUTH AUSTRALIA

PIT NO 1

LOG OF PIT

PROJECT SATELLITE TRACKING STATION, CEDUNA

LOCATION . DINAH ROCK HOLES . . . . . SECTION . . HUNDRED CO. WAY .

LANDFORM. DUNES

RELIEF GENTLY ROLLING . . . . . Direction of fall.

MICRORELIEF CULTIVATED PADDOCK

DRAINAGE External RAPID . . . . Internal . . . . . Surface Absorption MODERATE

SURFACE VEGETATION Type WHEAT CROP

SAMPLE NUMBER	SOIL/ROCK HORIZON	R.L. (Feet) DEPTH (Feet)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification U.S.B.R. Earth Manual 1st Ed. Rev 1963	OTHER GEOLOGICAL / PEDOLOGICAL DESCRIPTION	SOIL/ROCK STRUCTURE	WATER LEVEL	MOISTURE CONTENT	Consistency Compactness Rel Density	SOILTEST PENETROMETER UNITS * 1 2 3 4
		0		SP	SAND, poorly graded, fine grained, up to 20% silt and clay fines. Mainly 5% GRAVEL, rounded fragments to 0.2ft. size. Sand is quartz and calcareous fragments, gravel is CALCRETE.					LC	
		1		GP	GRAVEL, poorly graded, fragments mainly angular, 0.1 to 0.5ft. size, often cemented into blocks up 1.5ft. across. Contains up to 20% SAND, fine grained, calcareous, between blocks and in pockets. Gravel is CALCRETE						
		2									
		3		SP GW	SAND poorly graded, fine grained, up to 15% silty fines, grades to GRAVEL well graded (approx 40 to 70%) rounded fragments to 0.5ft. size. Generally weakly to strongly cemented near top, becoming less cemented with depth - near 4ft. sand is loose friable. Several patches of weak white earthy lime silt to 1.5ft. diameter. Sand is quartz and calcareous grains, gravel is CALCRETE.		Granular. Calcrete is moderately strong rock.	PIT DRY	H	LC	
		4									
		5		GP	GRAVEL, poorly graded, fragments from 0.3 to 1ft. size. Gravel is CALCRETE (as from 0.5 to 1.0ft. depth).						
		6			BASE OF PIT 5.0ft.						
		7									
		8									

REMARKS

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

CLASSIFICATION		CONSISTENCY (CLAY)	COMPACTNESS (SILT)	RELATIVE DENSITY (SAND)	MOISTURE CONTENT	ENGINEERING GEOLOGY SECTION
Great Soil Group	Water level (date) 7 May 67	VS — Very Soft	Ls — Loose	VL — Very Loose	H — Humid	PLANT
Subgroup		S — Soft	MC — Moderately Compact	L — Loose	D — Damp	TYPE
REFERENCE		F — Firm	C — Compact	MD — Medium Dense	M — Moist	LOGGED J.A.C.P.
Fuller	WC %	St — Stiff	VC — Very Compact	D — Dense	W — Wet	DATE 24.4.68
Map	Water cut	V. St — Very Stiff		VD — Very Dense	S — Saturated	START
		H — Hard			LL — Liquid Limit	FINISH
					PL — Plastic Limit	TRACED
						CHECKED

6109 MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

PIT NO 2

LOG OF PIT

PROJECT SATELLITE TRACKING STATION - CEDUNA

LOCATION . DINAH ROCK HOLES . . . . . SECTION . . ~~HUNDRED~~ CO. WAY

LANDFORM. DUNES

RELIEF GENTLY ROLLING . . . . . Direction of fall. . . . . .

MICRORELIEF CULTIVATED PADDOCK

DRAINAGE Extern RAPID . . . . . Internal . . . . . Surface Absorption MODERATE

SURFACE VEGETATION Type WHEAT CROP

SAMPLE NUMBER	SOIL/ROCK HORIZON	R.L. (Feet) DEPTH (Feet)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification U.S.B.R. Earth Manual 1st Ed. Rev 1963	OTHER GEOLOGICAL / PEDOLOGICAL DESCRIPTION	SOIL/ROCK STRUCTURE	WATER LEVEL	MOISTURE CONTENT	Consistency, Compactness, Rel. Density	SOILTEST PENETROMETER UNITS * 1 2 3 4
		1		SP	SAND, poorly graded, fine grained, up to 20% silt and clay fines. Mainly 5% GRAVEL, rounded fragments to 0.2ft. size. Sand is quartz and calcareous fragments, gravel is CALCRETE.		Granular. Calcrete is moderately strong rock	PIT DRY	H	L(S)	
		2		GP	GRAVEL, poorly graded, fragments mainly angular, 0.1 to 0.5ft. size, often cemented into blocks up 1.5ft. across. Contains up to 20% SAND, fine grained, calcareous, between blocks and in pockets. Gravel is CALCRETE.						
		3		SP/GW	SAND poorly graded fine grained, up to 15% silty fines, grades to GRAVEL well graded (approx. 40 to 70%) rounded fragments to 0.5ft. size. Generally weakly to strongly cemented near top, becoming less cemented with depth - near 4ft. sand is loose, friable. Several patches of weak white earthy lime silt to 1.5ft. diamter. Sand is quartz and calcareous grains, gravel is CALCRETE.						
		4									
		5									
		6			BASE OF PIT 5.5.ft.						
		7									
		8									

REMARKS

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

CLASSIFICATION		CONSISTENCY (CLAY)	COMPACTNESS (SILT)	RELATIVE DENSITY (SAND)	MOISTURE CONTENT	ENGINEERING GEOLOGY SECTION
Great Soil Group	Water level 7 May 67 (date)	VS — Very Soft	Ls — Loose	VL — Very Loose	H — Humid	PLANT
Subgroup	WG > Water cut	S — Soft	MC — Moderately Compact	L — Loose	D — Damp	TYPE
REFERENCE		F — Firm	C — Compact	MD — Medium Dense	M — Moist	START
Fuller		St — Stiff	VC — Very Compact	D — Dense	W — Wet	FINISH
Map		V. St — Very Stiff		VD — Very Dense	S — Saturated	LOGGED J.A.C.P.
Photo		H — Hard			LL — Liquid Limit	DATE 21.1.68
					PL — Plastic Limit	TRACED
						CHECKED

SHEET 1 OF 1. DRG No. 36582 Dc

S 6109 MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

PIT NO 3

LOG OF PIT

PROJECT . SATELLITE TRACKING STATION - CEDUNA

LOCATION . DINAH ROCK HOLES . . . . . ~~SECTION~~ . . ~~HUNDRED~~ CO. WAY . . .

LANDFORM. DUNES . . . . . Direction of fall. . . . . .

RELIEF GENTLY ROLLING . . . . . Surface Absorption MODERATE . . .

MICRORELIEF CULTIVATED PADDOCK . . . . . Internal . . . . . .

DRAINAGE External . RAPID . . . . . .

SURFACE VEGETATION Type WEAT CROP . . . . . .

SAMPLE NUMBER	SOIL/ROCK HORIZON	R.L. (Feet) DEPTH (Feet)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification U.S.B.R. Earth Manual 1st Ed. Rev 1963	OTHER GEOLOGICAL PEDOLOGICAL DESCRIPTION	SOIL/ROCK STRUCTURE	WATER LEVEL	MOISTURE CONTENT	Consistency Compactness Rel. Density	SOILTEST PENETROMETER UNITS * 1 2 3 4
		1		SP	SAND, poorly graded, fine grained-up to 15% silt and clay fines, and 5 to 25% GRAVEL, as rounded fragments, 2 to 20mm diameter. Grey brown, friable. Sand is quartz, calcareous fragments, Gravel is CALCRETE		Granular to poorly cloddy Calcrete is moderately strong rock.	Pit Dry	H L?		
		2		SP/GW	Increased GRAVEL content to 25 to 30% occasionally weakly to moderately cemented into boulders up to 0.6ft. dia.						
		3		SP	Decreasing GRAVEL content to 10 to 20%. Fragments mainly 2 to 5mm. diameter.						
		4									
		5									
		6			BASE OF PIT 5.5ft.						
		7									
		8									

REMARKS

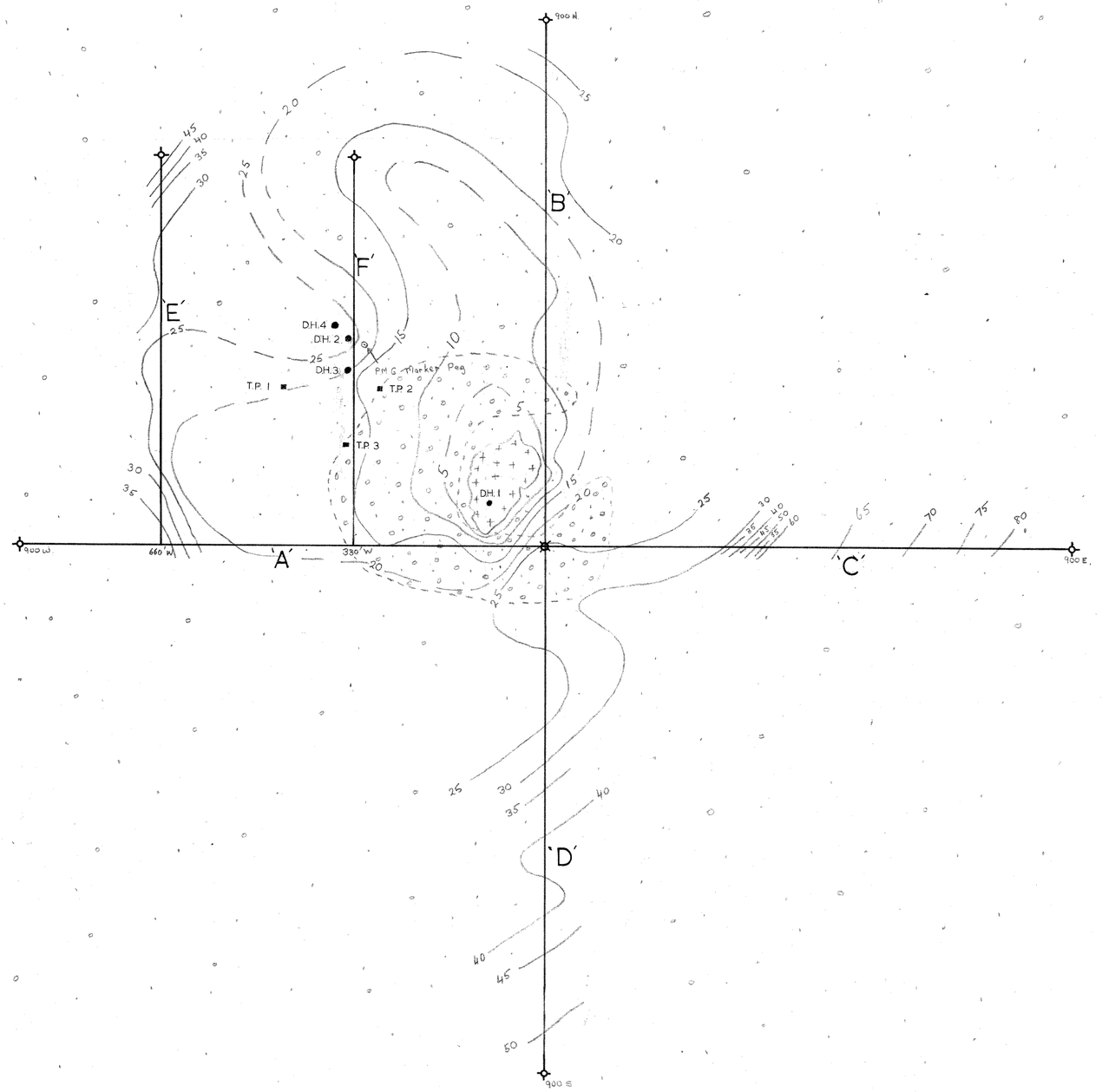
* These values refer to clay soils only and provide an indication of their consistency.

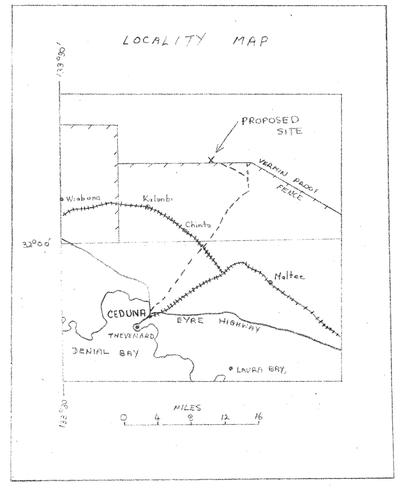
CLASSIFICATION	CONSISTENCY (CLAY)	COMPACTNESS (SILT)	RELATIVE DENSITY (SAND)	MOISTURE CONTENT	ENGINEERING GEOLOGY SECTION
Great Soil Group . . . . . Subgroup . . . . . REFERENCE Fuller . . . . . Mac . . . . . Prescott	VS — Very Soft S — Soft F — Firm St — Stiff V. St — Very Stiff H — Hard	Ls — Loose MC — Moderately Compact C — Compact VC — Very Compact	VL — Very Loose L — Loose MD — Medium Dense D — Dense VD — Very Dense	H — Humid D — Damp M — Moist W — Wet S — Saturated LL — Liquid Limit PL — Plastic Limit	PLANT . . . TYPE . . . START . . . FINISH . . . LOGGED J.A.C.P. DATE . . . TRACED . . . CHECKED . . . SHEET 1 OF 1 DWG. No. S 6583 Dc

Water level (date) 7 Nov 67

W/C > Water cut

S 6109 MB





LEGEND

TOPSOIL, red brown sand, with CALCRETE gravel to 0.5 ft diameter.

GRANITE

D.H. 1 Diamond Drill Hole No 1

T.P. 1 Test pit No 1

25 Contour showing depth in feet of top of high velocity layer below ground surface

A — A' SEISMIC TRAVERSE A

SCALE
Feet
100 0 100 200

FIG. 1.

DEPARTMENT OF MINES — SOUTH AUSTRALIA			
SATELLITE TRACKING STATION — CEDUNA GEOLOGIAL PLAN AND ISOPACH MAP OF SEISMIC REFRACTION INTERPRETATION			
ENGINEERING GEOLOGY SECTION	W.G.R.B. GEOLOGIST	Drn. W.A.R.D. 25.6.	SCALE: AS SHOWN
		Tcd. N.T.	68-398 Dc.
Director of Mines	W.R.B. Bouceault 1 May 68 SEN. GEOLOGIST	Ckd. W.R.B.	
		Exd.	DATE: 9 MAY 68

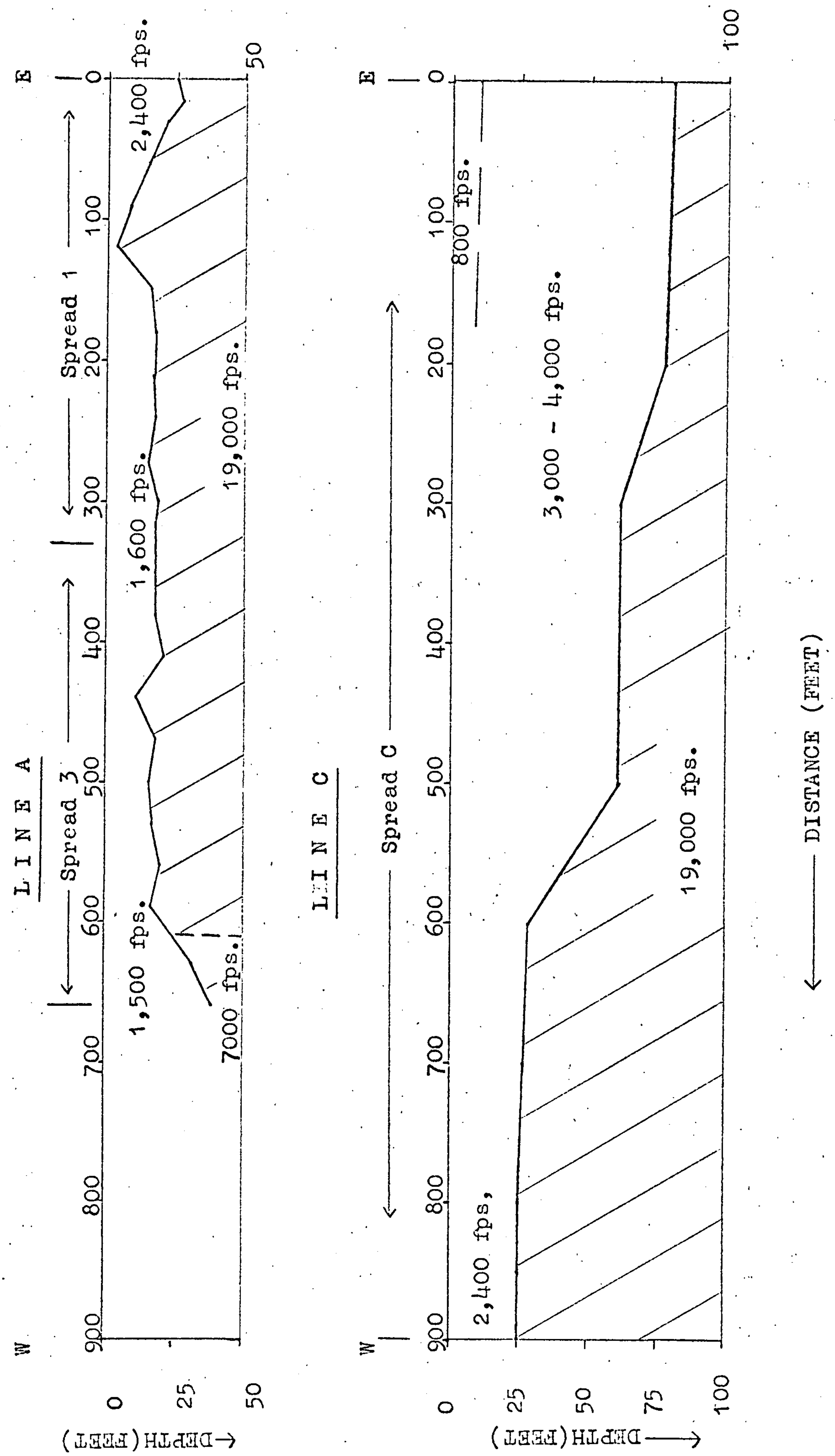


FIG 2

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Geophysicist	Drn. IR	SATELITE TRACKING STATION CEDUNA Results of Seismic Refraction Lines A & C	SCALE: *As Shown.*
	Tcd.		*S6586* *Dc*
O.I.C.	Ckd.		
	Exd.		DATE: *MAY '68*

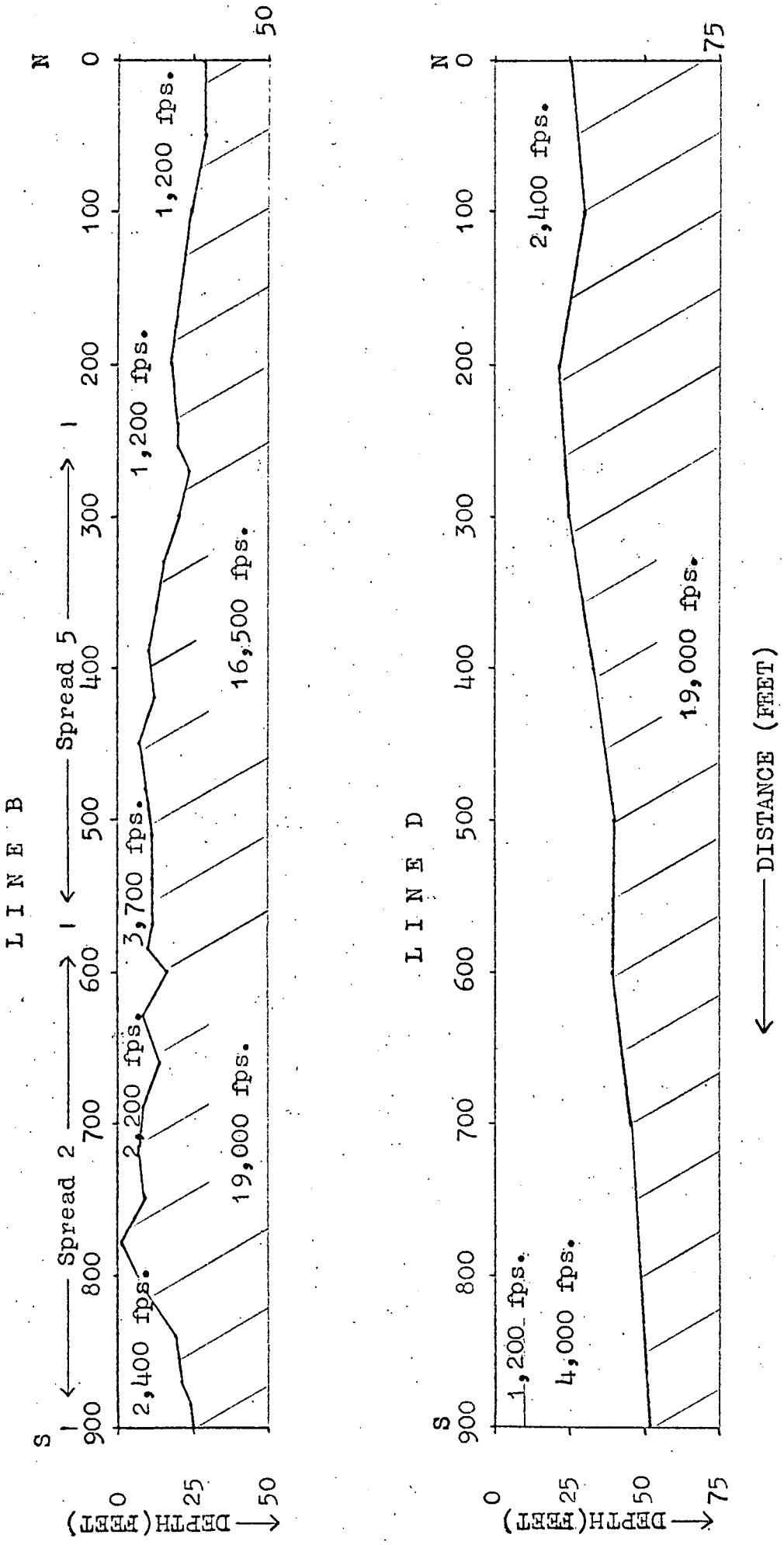


FIG 3

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Geophysicist	Drn. TR	SATELITE TRACKING STATION CEDUNA Results of Seismic Refraction Lines B & D	SCALE: As Shown.
	Tcd.		S6587 Dc
O.I.C.	Ckd.		DATE: MAY '68
	Exd.		

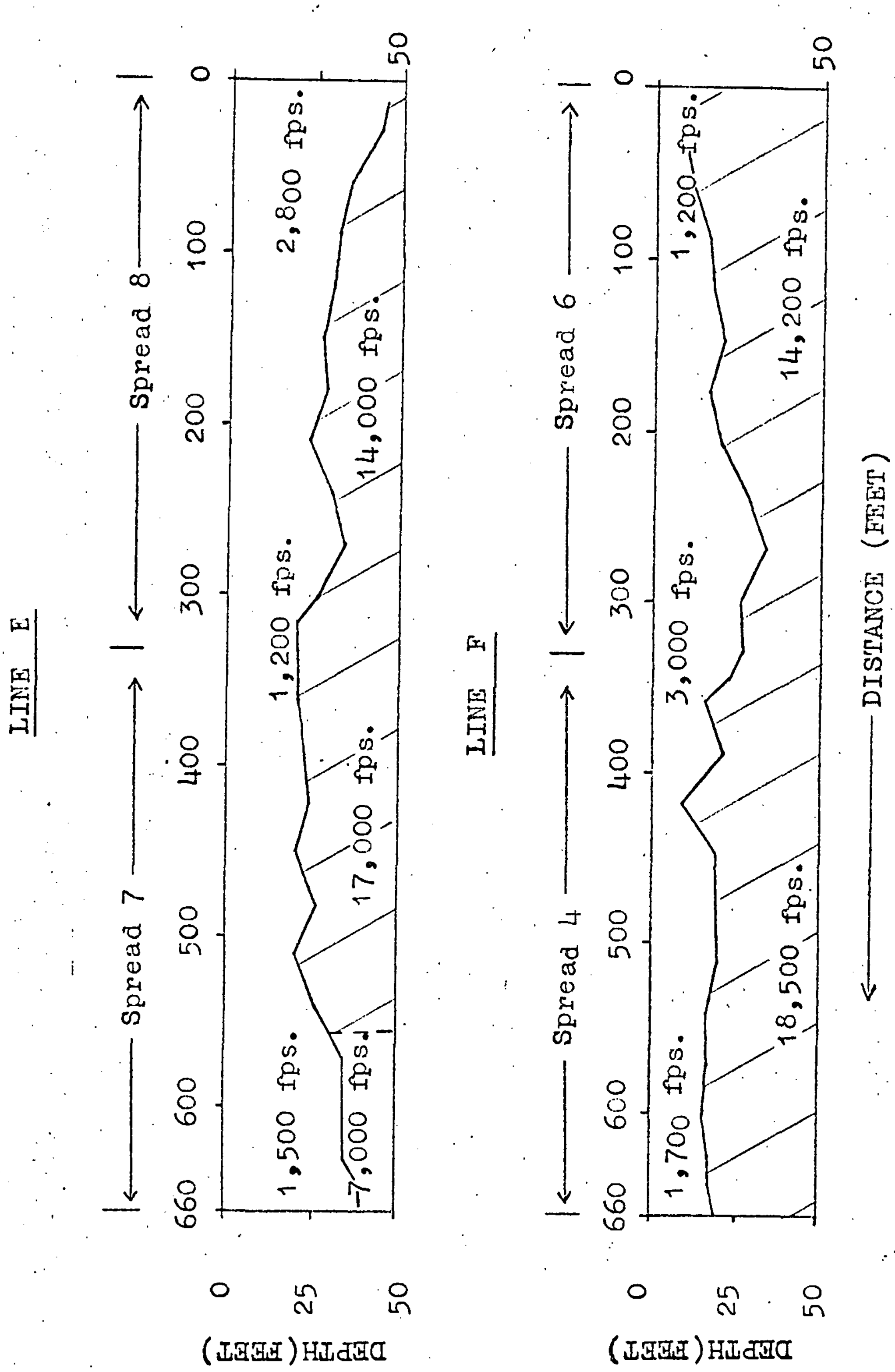


FIG 4

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Geophysicist	Drn. IR	SATELITE TRACKING STATION CEDUNA Results of Seismic Refraction Lines E & F	SCALE: As shown.
	Tcd.		S6588 Dc
	Ckd.		
O.I.C.	Exd.		DATE: MAY 68