REPT.BK.NO.74/209

SEISMIC REFRACTION INVESTIGATION OF A TANK SITE AT WHYALLA

E. & W.S. Department

R.G. NELSON

Department of Mines
South Australia —

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
EXPLORATION SERVICES DIVISION

SEISMIC REFRACTION INVESTIGATION OF A TANK SITE AT WHYALLA

- E. & W.S. Department -

by

R.G. NELSON
GEOPHYSICIST
GEOPHYSICAL SERVICES SECTION

Rept.Bk.No.74/209
G.S. No. 5523
DM. No. 1130/63

4th November, 1974

CONTENTS

PLANS

Plan No.	Title	Scale
S11064	Seismic refraction survey Tank site - Whyalla Locality Plan.	As shown.
74-940	Seismic refraction survey Tank site - Whyalla Location of traverses.	1:500
74-939	Seismic refraction survey Tank site - Whyalla Seismic sections AA' and BB'	1:500

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No.74/209
G.S. No. 5523
DM. No. 1130/63

SEISMIC REFRACTION INVESTIGATION OF A TANK SITE AT WHYALLA

ABSTRACT

Seismic refraction investigations made at a tank site just north of Whyalla show that rocks within the first three metres or more from the surface have low velocities (700-1 400metres/sec). These low velocities are probably produced by weathering and jointing within the feldspathic sandstones and conglomerates which form bedrock. Within the unweathered bedrock two distinct velocity types were recorded, one of about 1 400 -1 600 metres/sec. and one of about 2 000-2 650 metres/sec. Where encountered in excavation work, the second of these may prove to be unrippable.

INTRODUCTION

The site investigated is near some existing tanks lying just to the north of Whyalla near the Iron Knob railway line and the Iron Knob and Port Augusta roads. The countryside consists of low rounded sandstone hills, covered with saltbush and bluebush, and dissected by minor creeks and gullies.

The purpose of the seismic refraction survey was to obtain information on bedrock conditions which could be used for excavation and foundation planning. The work was carried out on the 20th and 21st of August, 1974 by the author together with R.S. Turner, Senior Technical Officer and C. Moskos, Field Assistant.

GEOLOGY

Sites within the general area were investigated by Stapledon and Robson (1965) who discuss the geology of the area in some detail. For further information refer to their report, from which the following summary of the geological succession is taken.

Unit Name	Age	Description
	Recent-Pleistocene	Alluvial sands and sandy silts, with some talus and creek gravels. Lime-rich soil horizons and hard bands of kunkar limestone occur in many places.
Pandurra Formation	Proterozoic	Feldspathic sandstones, conglomerates and shale, usually red-brown in colour and generally gently dipping to horizontal
----------	Unconformity	----------
Moonabie Formation		Quartzites and feldspathic sandstones mostly steeply dipping.

METHODS & EQUIPMENT USED

A Texas Instrument Co. 7000B recording seismograph system was used to record the response to explosions of 24 geophones arranged in in-line spreads with a distance of 5 metres between geophones. The camera used was a Geospace R1801 electrostatic camera. Paper speed was 50 cms/sec.

On each spread shots were fired:-

(1) at the spread cen tre;

(2) between geophones 6 and 7;

(3) between geophones 18 and 19;

(4) at the ends of the spread;

and (5) as offset shots located 27.5 metres from the ends of the spread.

The use of such multiple-shooting techniques enables particular refraction horizons to be identified more easily as well as giving information on changes within the near surface layers along each spread.

The locations of the seismic traverses are shown on Plan No. 74-940. Along the main traverse (AA') three seismic spreads were laid down. These were centred at chainages of 60 metres, 150 metres and 240 metres respectively along the pegged line. Since each spread was 115 metres long there was consequently some overlap of the spreads. A fourth spread was laid down as a cross-traverse (BB'). This was centred at chainage 150 metres on the pegged line.

Seismic records were timed for the first arrival of energy at each geophone position and the results were plotted as time-distance graphs. Reciprocal analysis as reviewed by Hawkins (1961) was used on the end shots and on the bracketing offset shots to obtain time-depths and estimates of the intrabedrock velocities. These, together with the near-surface velocity measurements taken from the time-distance graphs, were used to obtain the bedrock profile.

RESULTS

The seismic sections are shown in Plan No. 74-939. It can be seen that near-surface velocities are low (700-1 400 metres/sec.), indicating that rocks to depths of from 3 to 15 metres are probably weathered and jointed to some extent. Jointing is apparent in outcrops of surface rocks, most of the joints being steeply-dipping or vertical. Some chemical weathering of the sandstone was seen in rocks fragmented by the explosions.

The profile of what is taken to be unweathered bedrock varies considerably along the sections. Within this zone there are two distinct velocity types, one of 1 400-1 600 metres/sec. and one of 2 000-2 650 metres/sec. Section AA' shows a central velocity of 1 970 metres/sec. flanked on each side by 1 400 metres/sec. zones, which are themselves flanked by 2 000 metres/sec. zones. The western side of section BB' contains a 2 090 metres/sec. unweathered bedrock zone, while on the east

the velocity is 1 610 metres/sec. It would seem that the two 1 400 metres/sec. zones and the 1 610 metres/sec. zone are interconnected and form one and the same zone.

DISCUSSION

Some geological investigation followed by drilling and or test pits may be necessary to test these results and to clarify the situation.

As far as rippability of the rocks is concerned, it must be remembered that this depends on many conditions, among them being the type of rock, the amount of jointing and the degree of weathering. There is no direct relationship between a rock's seismic (compressional) velocity and its rippability. However, as the charts in Plan No. S9202 show, most sandstones are rippable by a tractor of D9 class to velocities of about 1 800-1 900 metres/sec. This may be used as a guide to likely excavation conditions. Where rock whose velocity is greater than 1 900 metres/sec. is encountered, blasting may be required.

R.G. Nelson

RGN:FdeA
4/11/74

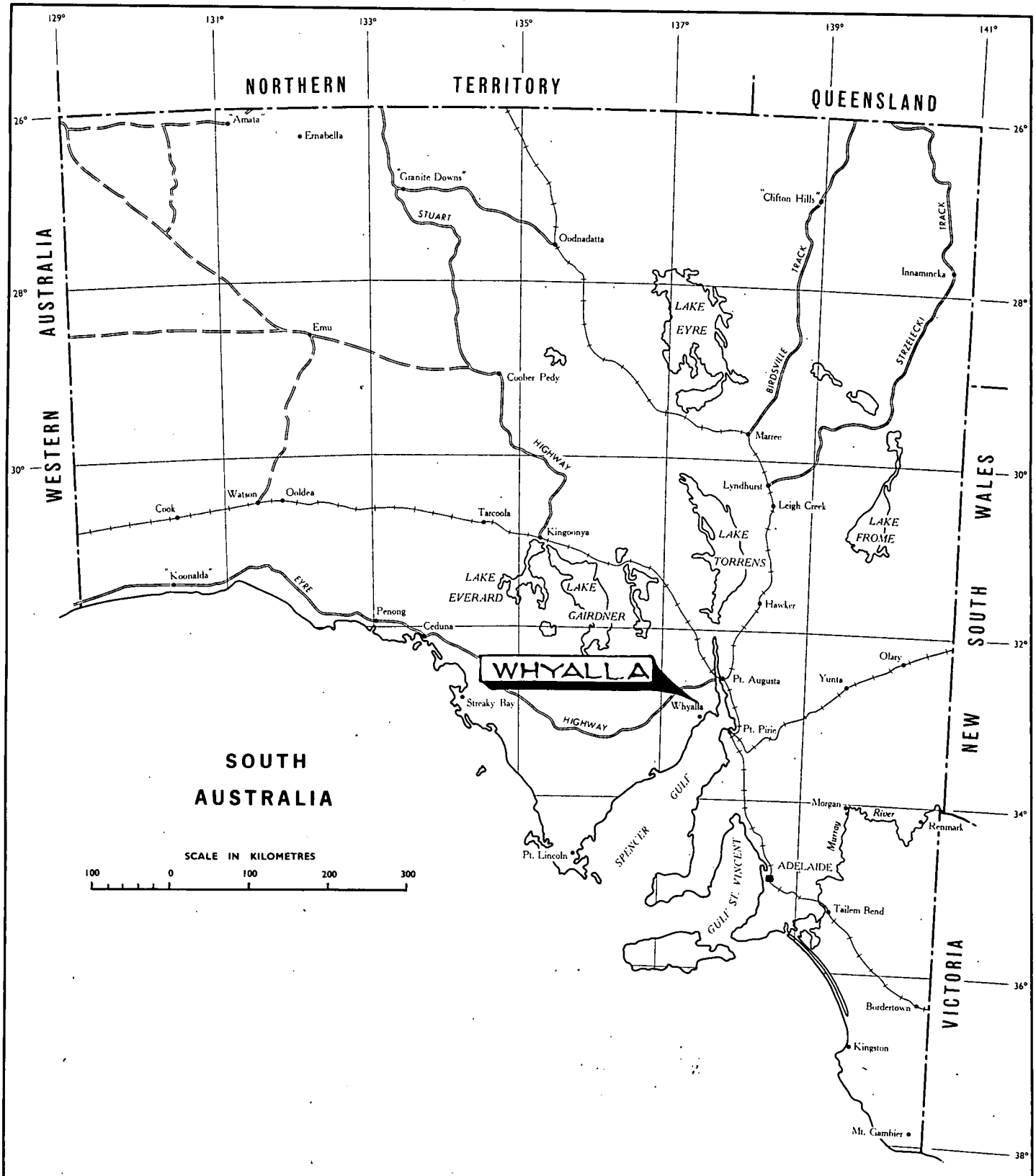
R.G. NELSON
GEOPHYSICIST
for D.M.S

REFERENCES

Hawkins, L.V., 1961. The reciprocal method of routine shallow seismic refraction investigations. Geophysics 26: 806-819.

Stapledon, D.H. and Robson, S., 1965. Examination of five possible sites for water storage near Whyalla. Geological progress report, March, 1965.

S. Australian Dept. Mines unpublished report R.B.60/43.



DEPARTMENT OF MINES — SOUTH AUSTRALIA

Compiled. R.G.N.	TANK SITE-WHYALLA SEISMIC REFRACTION SURVEY LOCALITY PLAN	Date: 31st. Oct. 1974
Drn. R.B. Ckd.		Drg. No. S11064 DK 2

P.F. No. S5850 994.2

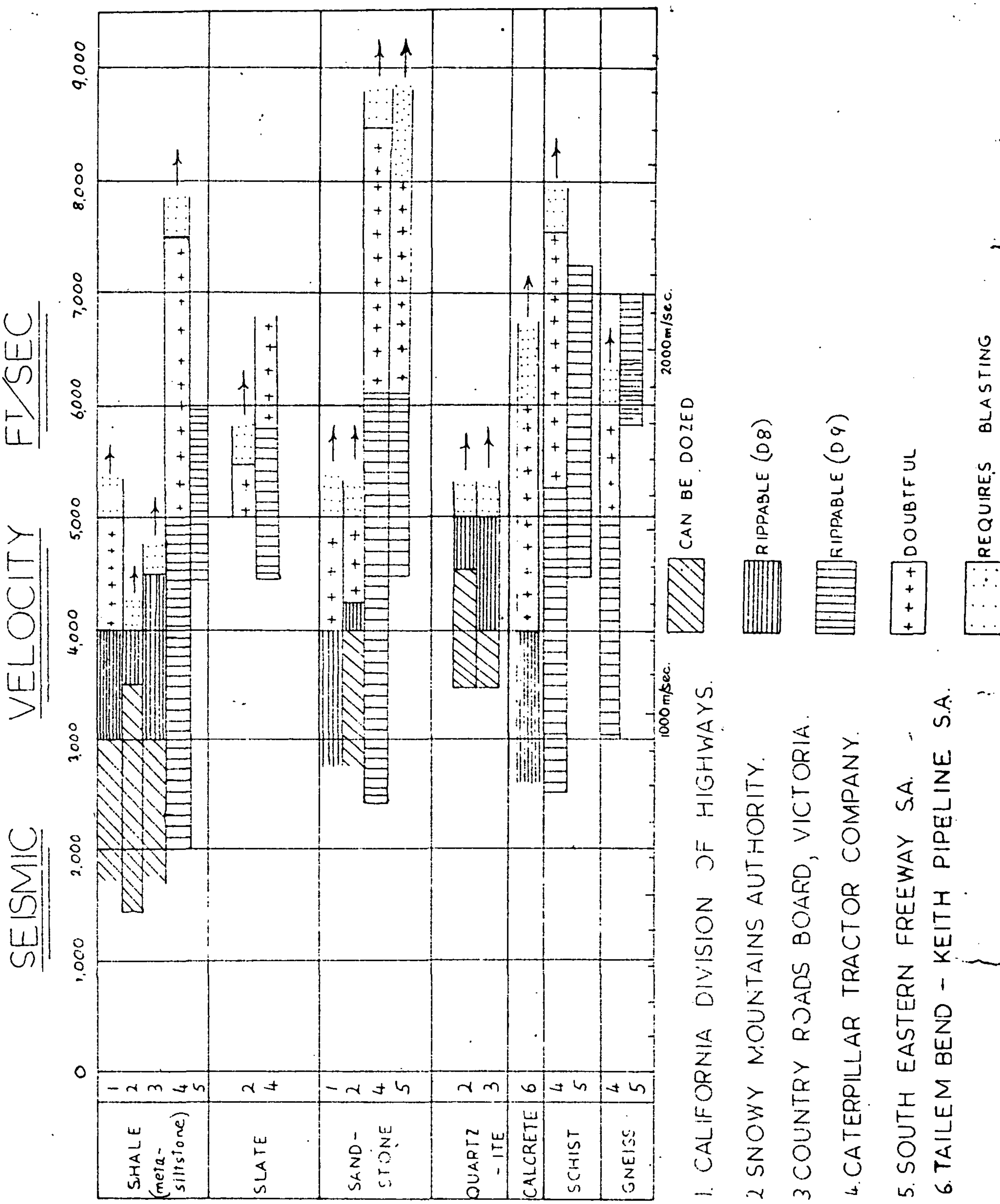
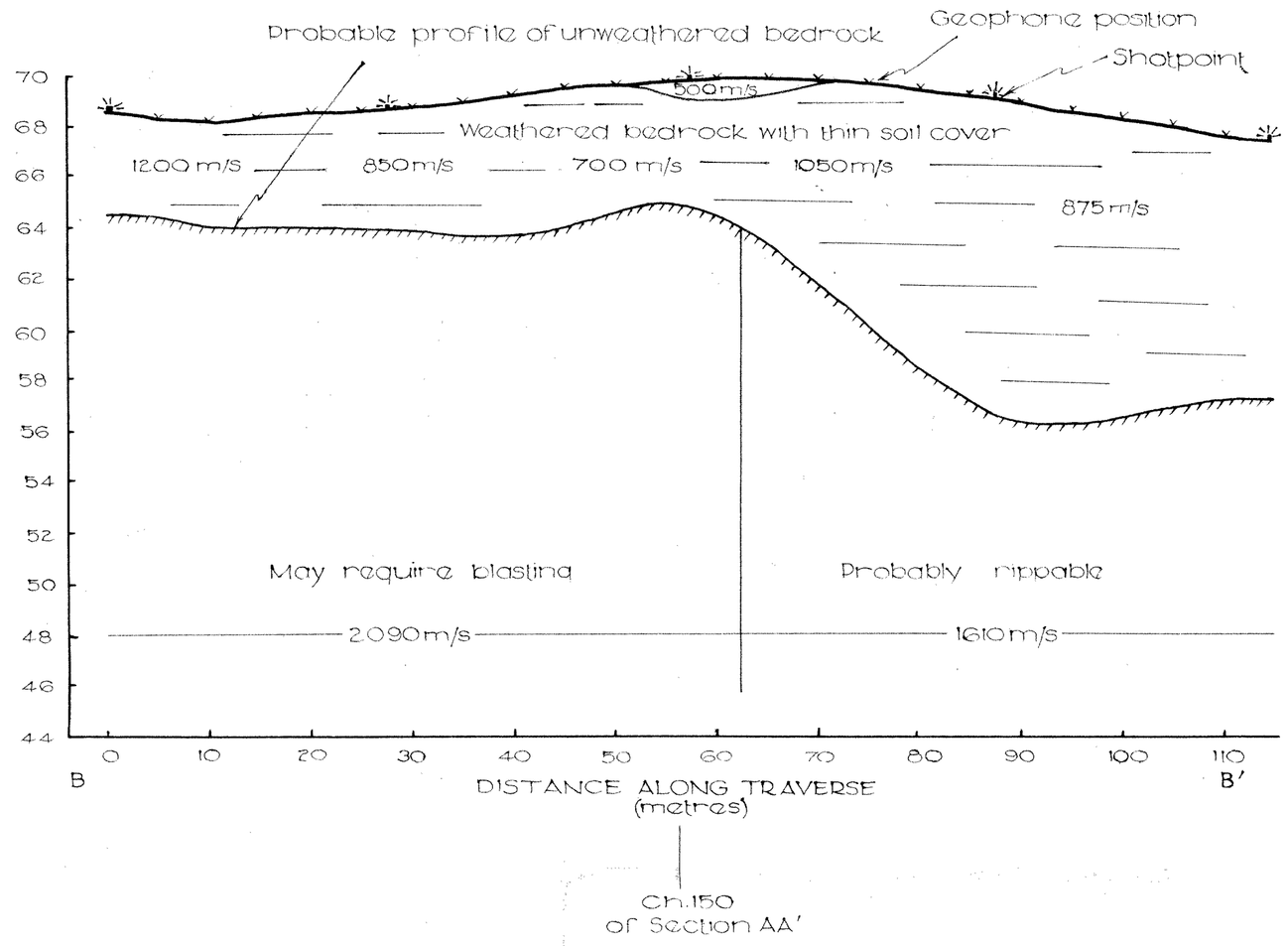


FIG. 2

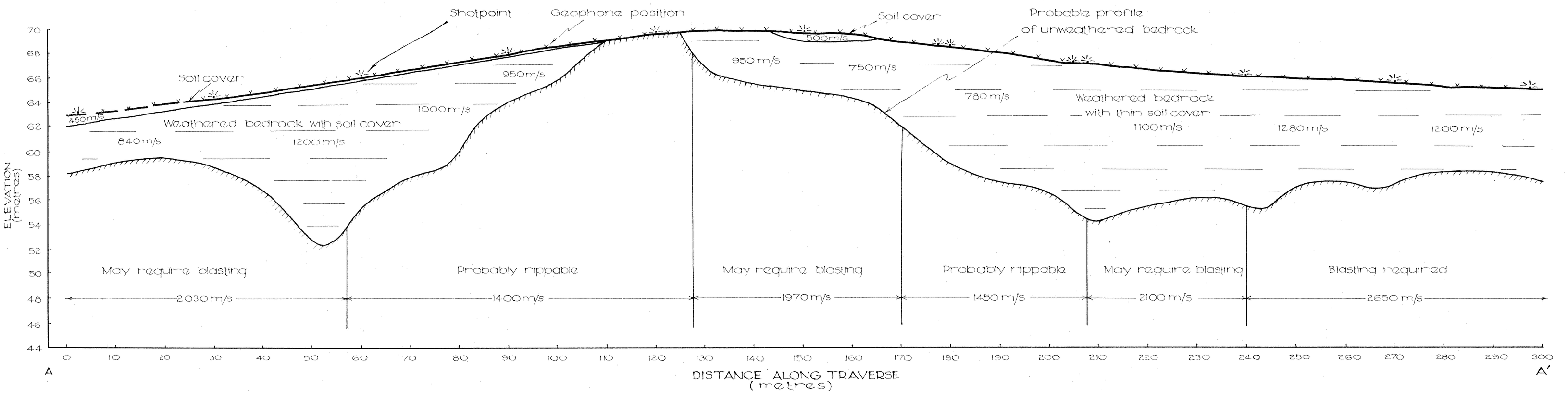
Results of projects 5 & 6 added.	HWD	20 Feb 72
CHANGES	BY	DATE

ENGINEERING GEOLOGY SECTION	**DEPARTMENT OF MINES – SOUTH AUSTRALIA**	Scale: Not to Scale
Compiled: B.J. MORRIS	SEISMIC VELOCITIES AND EXCAVATION EXPERIENCE	Date: 1st April 1971
Drn. B.J.M. Ckd. B.J.M.		Drg. No. S 9202

SECTION BB'



SECTION AA'

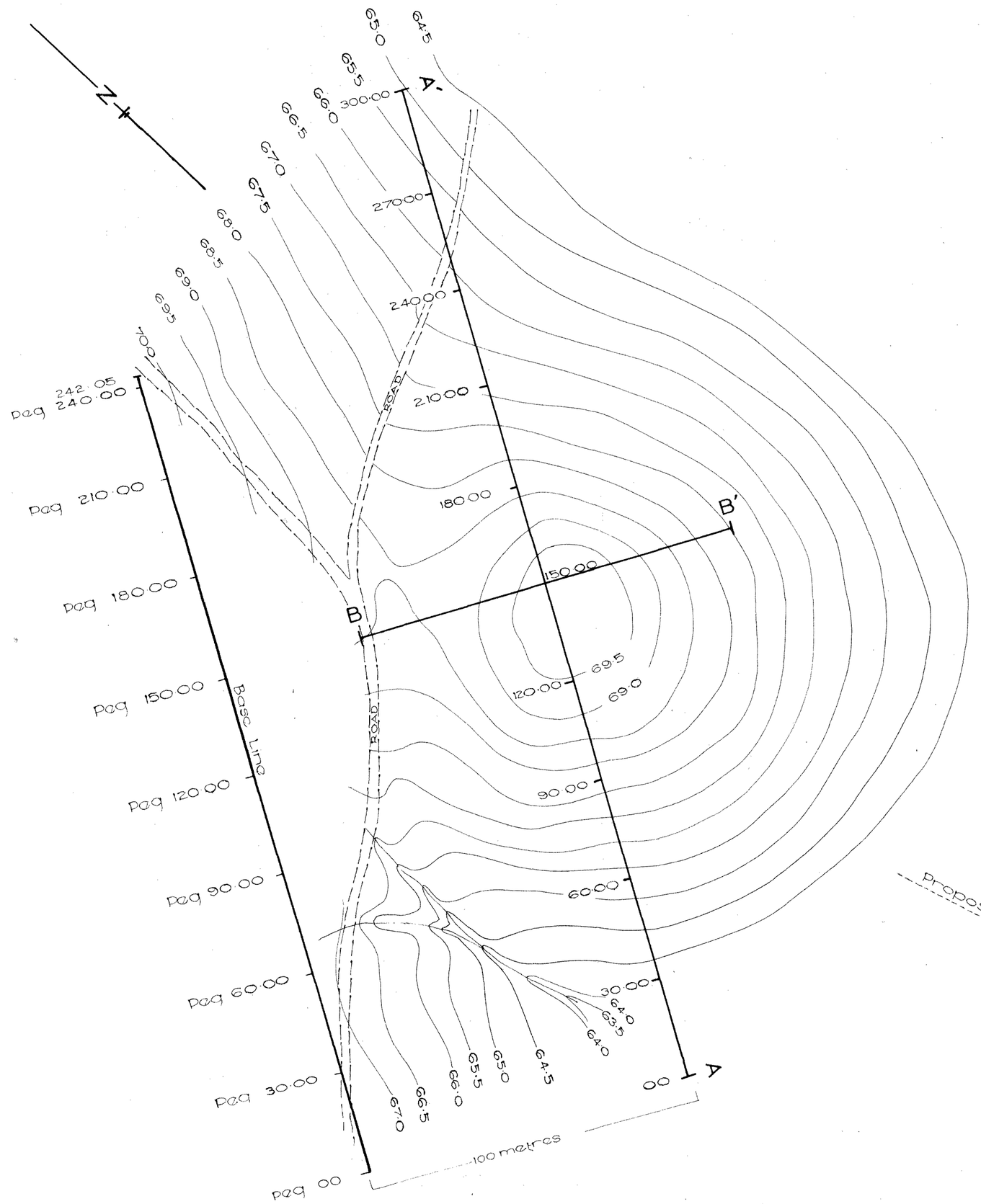


NOTE: The division of bedrock into velocity zones, refers only to the bedrock refractor surface as the seismic data furnishes no information on bedding planes within bedrock

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SEISMIC REFRACTION SURVEY
TANK SITE—WHYALLA
SEISMIC SECTIONS AA' & BB'

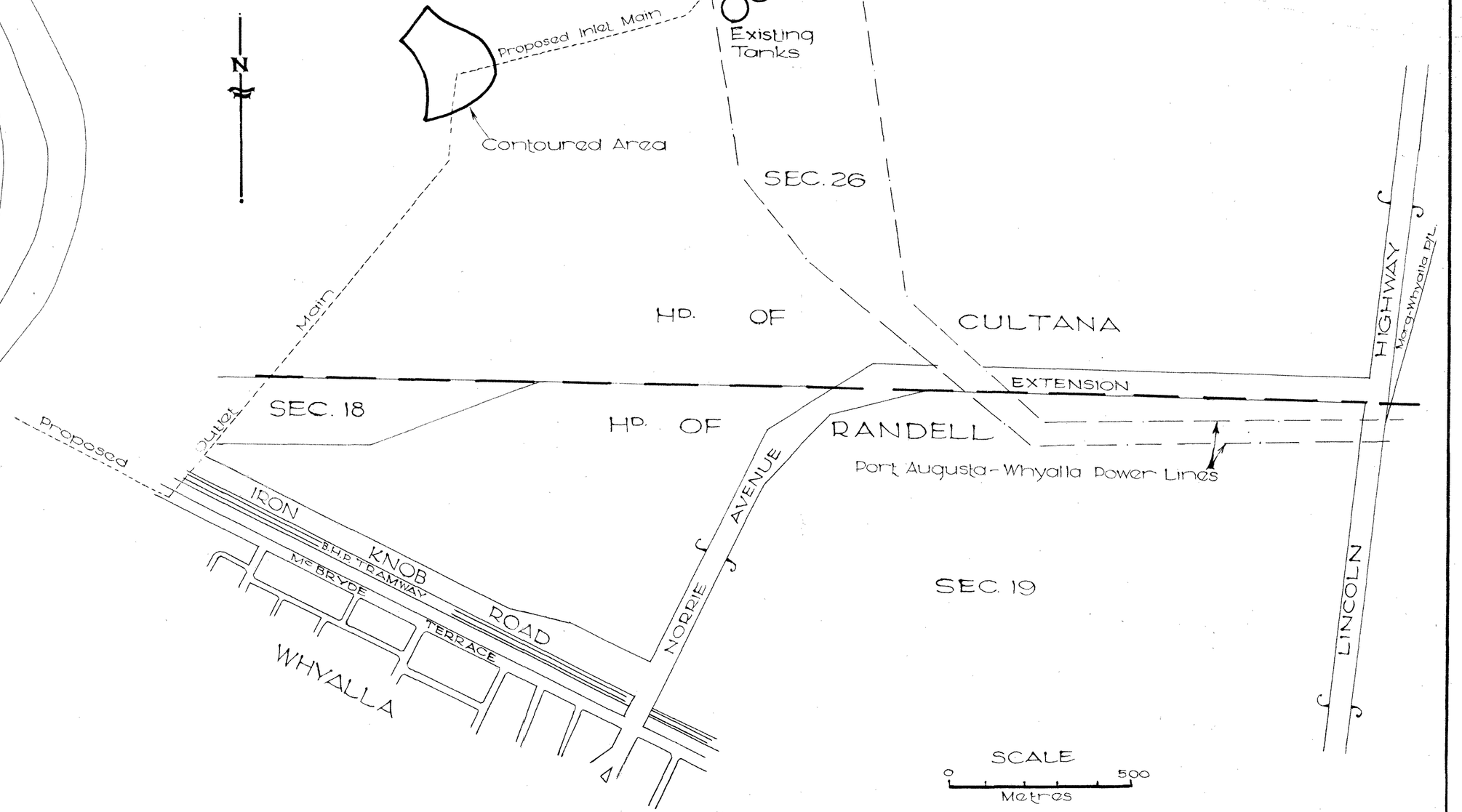
GEOPHYSICAL SERVICES	GEOLOGIST	Drn. R.G.N.	SCALE: 1:500(H); 1:200(V)
		Tcd. R. B.	74-939
		Ckd. A.F.	Dk 2
Director of Mines		Exd.	DATE: 28th Oct 1974



NB: Contour levels in metres

SCALE
0 50
Metres

LOCALITY PLAN



DEPARTMENT OF MINES — SOUTH AUSTRALIA

TANK SITE–WHYALLA
SEISMIC REFRACTION SURVEY
LOCATION OF TRAVERSES

GEOPHYSICAL SERVICES	GEOLOGIST	Drn. R.G.N	SCALE L/P; 1:10000 C/P; 1:1000
		Tcd. R.B.	74 – 940 Dk 2
Director of Mines		Ckd. A.F.	
		Exd.	DATE: 29th Oct. 1974