DEPARTMENT OF MINES
SOUTH AUSTRALIA

PROPOSED DAM AT MT. LOFTY BOTANIC GARDENS
SHALLOW REFRACTION SEISMIC SURVEY

by

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Rept.Bk.No.77/54
G.S. No. 5880
DM. No. 650/76

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ABSTRACT

A shallow refraction survey was carried out in the vicinity of a proposed dam site at the Mt. Lofty Botanic Gardens at Piccadilly to measure the thickness of overburden and weathered rock at the site, and so determine foundation requirements and estimate available fill for the dam. Results are shown as seismic sections below a profile of the surface relief.

INTRODUCTION

At the request of the Engineering Geology Section, a shallow refraction seismic survey was carried out in the vicinity of a proposed dam site at the Mt. Lofty Botanic Gardens at Piccadilly (Dwg. S12612). The investigation is being undertaken on behalf of the Public Buildings Department. The aim of the survey was to determine the thickness of weathered rock at the proposed site to assist in assessing foundation conditions and estimating available fill for the dam.

Two seismic traverses across the gully, one near the axis of the dam and another 65 m upstream, were shot to test the foundation for the dam. Two further spreads were shot along the slopes of the gully downstream from the dam site, to test the thickness of material which could be excavated and used as fill for the dam. The work was completed during two days in late January, 1977.

METHOD USED

The refraction seismic method records the response from an array of geophones to an impulse transmitted into the ground, in this case by means of an explosive. Geophones and shot points were placed in a line and the distance between each geophone and the shot point measured. Records were then examined for the first onset of energy at each geophone and travel times of these "first breaks" were plotted against the corresponding geophone distances from the shotpoint as time-distance curves. These curves were then analysed to derive velocities and thicknesses of various rock layers in the ground below the geophone line (Hawkins, 1961).

The recording instrument used consisted of an S.I.E. PT100 amplifier bank and an S.I.E. ERC 6 electrostatic oscillograph, which records information from up to 24 geophones. Standard refraction seismic geophones were used with 5 m spacing between each of the 24 geophones.

Recordings were taken with shot points at each end, in the centre, and 50 m from each end of each spread for the traverses across the gully. Recordings from shots at each end and at the centre only were taken for the two spreads along the slopes of the gully. Dwg. No. S12612 shows a plan of the area with the positions of the seismic spreads and Dwg. No. 77-238 shows interpreted seismic sections.

RESULTS

Traverse along axis of dam (Spreads 1 and 2)

Spreads 1 and 2 were positioned along the axis of the dam with spread 1 along the left bank (west slope) of the valley. The interpreted seismic section shows a thin low velocity (210 m/s to 480 m/s) near-surface layer. Except for the western quarter of

the traverse, this layer has a relatively uniform thickness of between 1 m and 2 m and probably consists of topsoil and red-brown clay as described in the logs of a series of backhoe pits along the axis of the dam. Along the western quarter of the traverse, this near-surface layer has a maximum thickness of 4 m and lies directly on the high velocity deepest layer: here the near-surface layer probably consists of some topsoil and highly weathered bedrock and the deeper layer probably comprises less weathered bedrock.

The intermediate layer along most of the section, with velocities between 600 m/s and 1 280 m/s, has its maximum thickness on the eastern side (up to 12 m) and is assumed to represent bedrock with varying degrees of weathering. The high velocity layer below this (with velocities between 1 330 m/s and 4 000 m/s) is probably associated with less weathered bedrock. The large variations in velocities within this layer can probably be related to lithological changes and differential weathering. The narrow anomalous 1 330 m/s zone below trench 8 in this layer could possibly be due to the crush zone of a minor fault.

For some 10 m on either side of the centre shot point of the traverse, and lying between the low velocity near-surface layer and the intermediate layer, is a thin layer of material less than 2 m thick with a velocity of 730 m/s. This is probably a layer of mottled grey clay with gravel size particles of metasediments as was logged in a backhoe pit in that area.

Traverse upstream from axis of dam (Spread 3)

In this area a relatively uniform near-surface layer less than 2 m thick, with velocities between 210 m/s and 280 m/s, consists of topsoil and red-brown clay. It overlies a second layer less than 2.5 m thick with velocities between 530 m/s and 750 m/s.

This is probably similar to the layer of grey clay with gravel of the previously mentioned traverse.

The underlying layer, with a velocity range from 800 m/s to 1 390 m/s and a maximum thickness of 12 m, is probably weathered bedrock. The high-velocity bottom layer (1 730 m/s to 5 000 m/s) is probably less weathered bedrock: within this layer a narrow 5 000 m/s zone in the centre of the spread possibly represents a quartz vein or rock which is much stronger than the adjacent rock.

Spreads 4 and 5

These spreads were shot in order to estimate the depth of easily removable material which could be used as fill for the dam. The spreads were positioned as shown in Dwg. No. S12612 and the interpreted sections are shown on Dwg. No. 77-238. Interpretation of the high velocity (less weathered bedrock) - intermediate velocity (weathered bedrock) interface is ambiguous, as the amount of data is inadequate to specify this horizon precisely.

The seismic sections show an interpretation from which a minimum amount of removable material can be estimated. Spread 4 shows a maximum thickness of 10 m of less than 1 060 m/s material in the centre of the spread, and thinning toward each end. Spread 5 shows a maximum thickness of 11 m of less than 1 390 m/s material, which decreases in thickness at the western end.

CONCLUSIONS

Seismic velocities measured in this survey can be grouped into categories indicating four types of material.

They are:

(1)	less than 400 m/s	-	topsoil and red-brown clays
(2)	530 m/s to 930 m/s	-	mottled grey clay with gravel sized particles of metasediments.
(3)	800 m/s to 1 390 m/s	-	weathered bedrock (meta-sediments)
(4)	1 400 m/s to 4 290 m/s	-	less weathered bedrock

It is possible that the narrow section of 5 000 m/s material shown in spread 3 is due to a quartz vein.

BJT:FdeA
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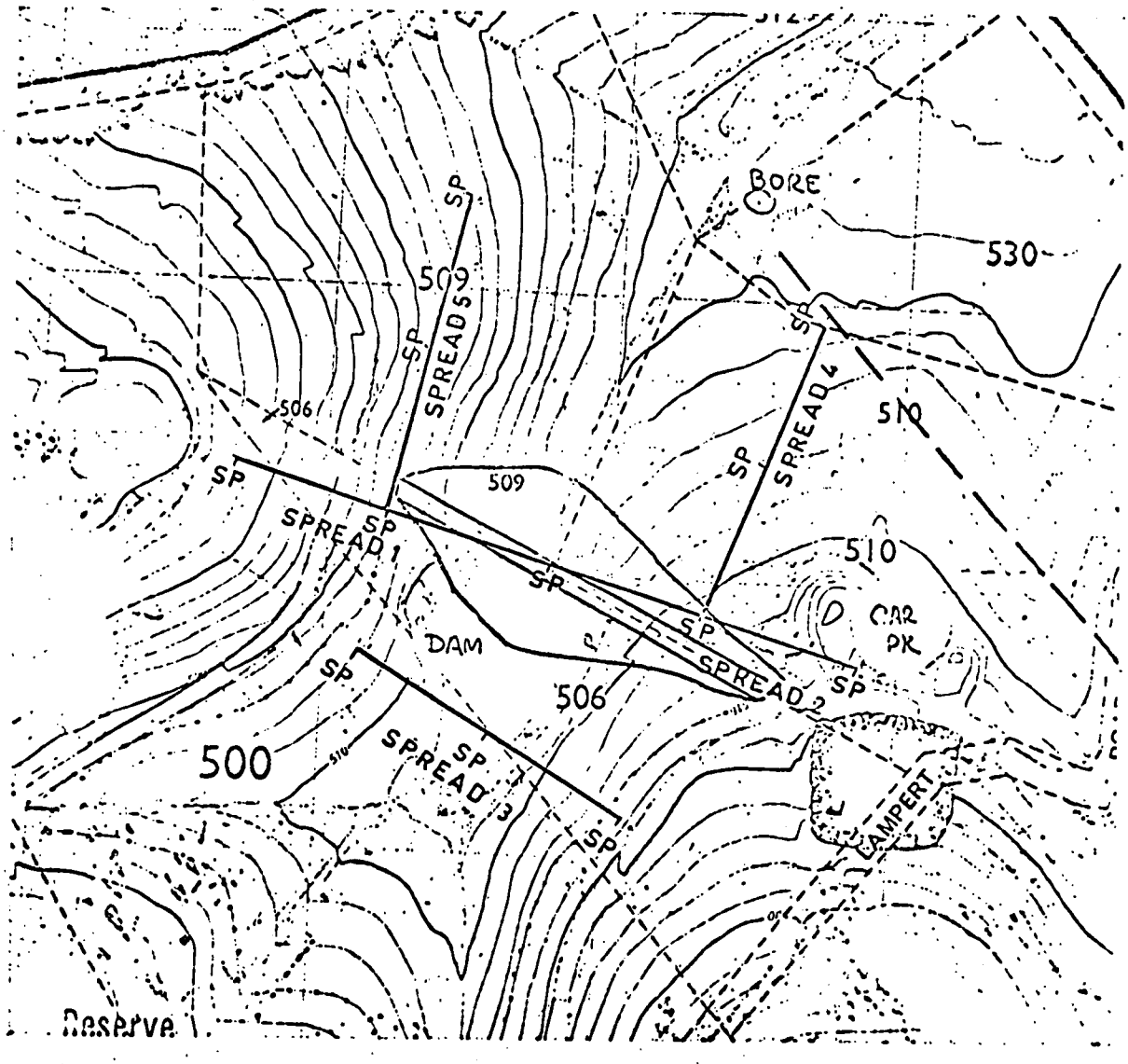
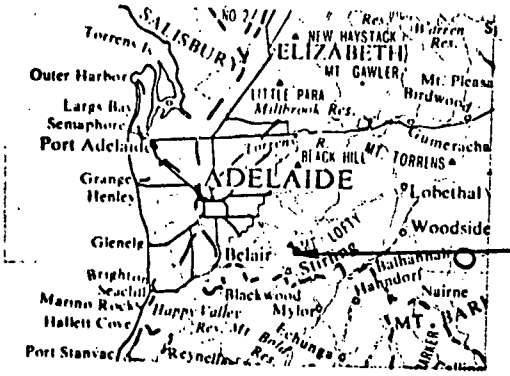
REFERENCE

HAWKINS, L.V., 1961: The reciprocal method of routine shallow refraction investigations, Geophysics, (26), 806-819.



SEISMIC SPREAD

SP SHOT POINT

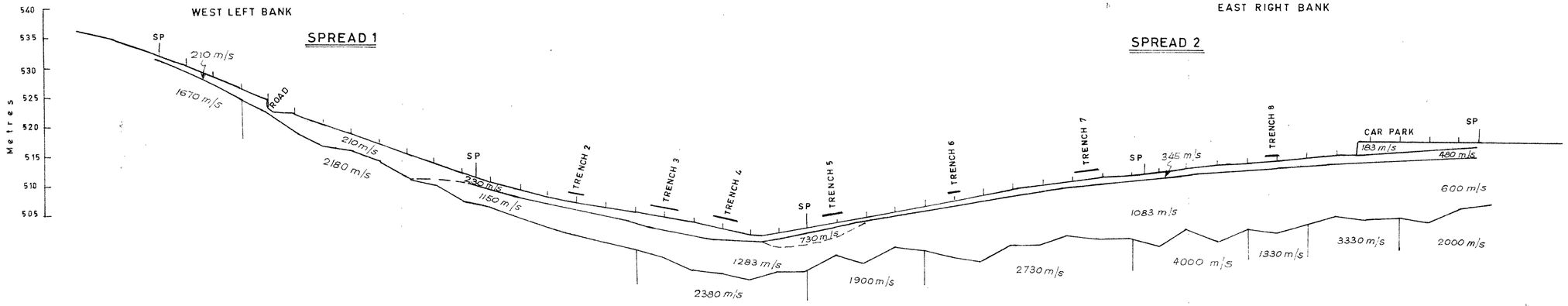


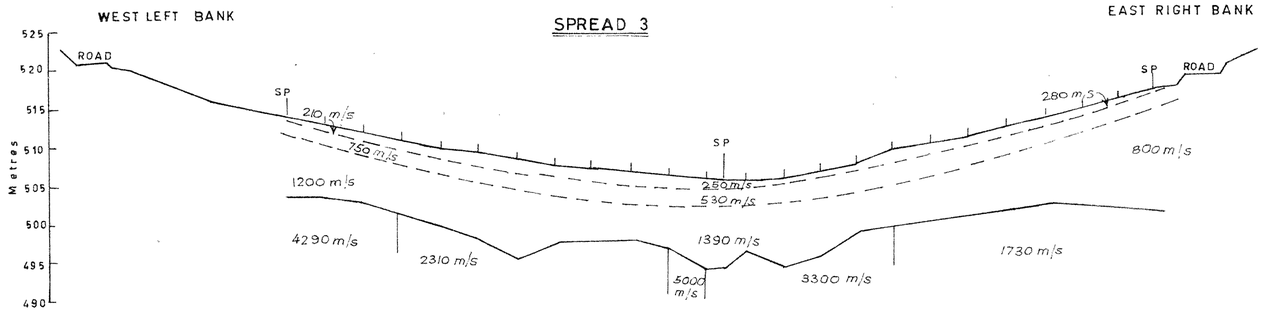
MT LOFTY BOTANIC GARDEN

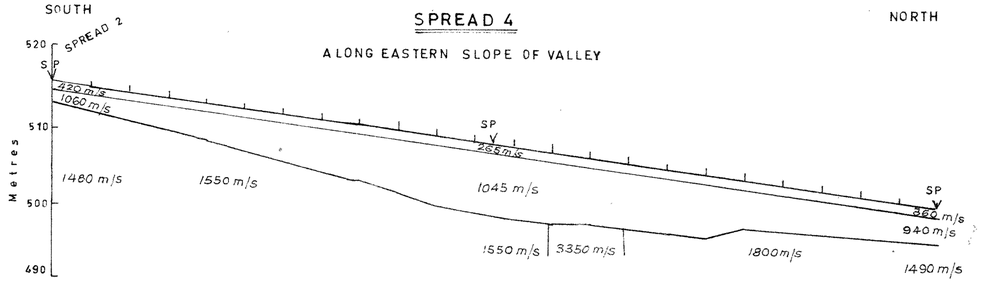
Scale: 1: 1,000.000

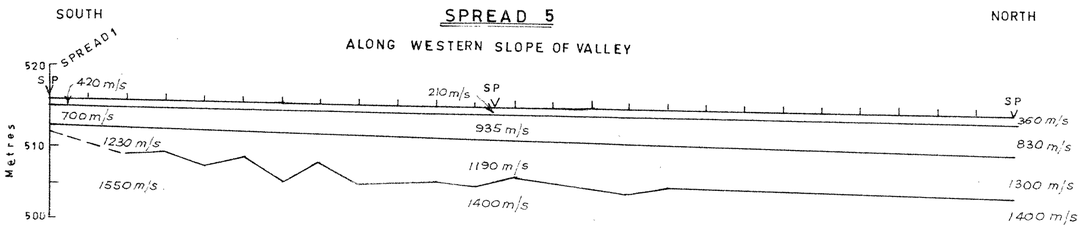
	DEPARTMENT OF MINES-SOUTH AUSTRALIA	Scale: 1: 2500
Compiled: B.J.T.	MT LOFTY BOTANIC GARDEN PROPOSED DAM	Date: 9.3.77
Drn. Ckd.	LOCATION OF SEISMIC SPREADS	Drg.No. S 12612

S12612









DEPARTMENT OF MINES — SOUTH AUSTRALIA

MT LOFTY BOTANIC GARDEN PROPOSED DAM

SEISMIC SECTIONS

		Compiled	Scale: 1 : 500
		B. J. Taylor	Date: 9 . 3 . 77
		Drn.	Drg. No. 77-238
Director of Mines		Ckd.	

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