DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

CLOSED FILE!

RESTRICTION MAY BE LIFTED.

REPT.BK.NO.82/48
REFRACTION SEISMIC INVESTIGATIONS AT CAPE JERVIS

DEPT. MARINE & HARBORS

GEOLOGICAL SURVEY

by

B.J. TAYLOR

16th July, 1982

DME.30/82

CONTENTS

PLANS

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Rept.Bk. No.82/48
DME No.30/82
Disk No.59

ABSTRACT

At the request of the Department of Marine and Harbors, experimental seismic work was carried out at Cape Jervis. This was done to delineate an infilled glacial valley which is being considered for development as a safe harbor.

Both conventional in-line shallow refraction and broadside shooting were used to obtain a complete profile of the valley. Test excavation and further in-line seismic work is recommended.

INTRODUCTION

Department of Marine and Harbors is undertaking preliminary designs for a safe harbor at Cape Jervis and requested that refraction seismic work be carried out to define the edges and floor of the glacial valley, as described in Boucaut (1971). The jetty and boat launching area now in use is situated in this valley.

Initially, two shallow refraction spreads (spreads 1 & 2) were sited as shown in Figure 2. Half of each spread consisted of 12 waterproof geophones and cable, the other half of land geophones and cable. As the waterproofed detectors were the only ones available, it was not possible to straddle the valley with spread 1. However, it was considered that the information obtained would delineate the eastern edge and the floor of the valley.

Spread 2 was sited along the major axis of the valley, again with half the spread in the water and the other half on land.

Spread 1 showed the eastern edge of the valley, the depth and configuration of the two horizons of weathered material contained in the valley and the bedrock configuration. Velocities of these three layers and near-surface material were calculated from the spread data. Spread 2 showed the slope of the floor of the valley and the velocities of the rocks when measured along the valley.

In order to obtain more information on configuration of the valley, further work was carried out. This consisted of an extension to the west of spread 1 (spread 3) to intersect the western side of the valley and some broadside shooting to delineate the floor of the valley. The broadside configuration was adopted because of the restricted area of operation and because it was considerably cheaper than in-line shooting with long-distance offset shots.

METHODS USED

In-line refraction spread

Spread 1 and 2 consisted of 24 geophones placed 5 m apart and spread 3 of 12 geophones 5 m apart. Shots were detonated at the centre, each end, halfway between the centre and each end and approximately 50 m off each end. The time taken for the first arrival of energy at each geophone from the instant of detonation for each shot was measured and plotted as a time-distance curve. These graphs were then analysed to obtain the depths to the various rock types and their seismic velocities using the reciprocal method as reviewed by Hawkins (1961).

Broadside Configuration.

This consisted of two spreads B (1-12) and C (1-12) of 12 geophones each with 5 m spacing parallel to one another and 100 m apart. The two spreads were located within the confines of the valley and normal to the major axis of the valley. Spread B (1-12) was sited as near as practical to refraction spread 1.

As can be seen in Figure 2, shotpoints AA, AB, AC, AD and AE were sited in a line parallel to spreads B and C. The distance from the shotpoints to spread B was designed so that the first arrivals of energy at geophones 1-12 were refracted from the high velocity bedrock. The configuration of shotpoints CA, CB, CC and CD and spread B was similarly devised.

By selecting travel paths from shotpoints on line A and spread C to geophones on spread B so that they form a straight line and obtaining a reciprocal time from coincident travel paths from a shotpoint on line A to a shotpoint on spread C, time-depths to the high velocity layer below each geophone were obtained. Appropriate depth conversion factors were obtained from the in-line method to convert the 'time-depths' to depths.

RESULTS

Figure 3 shows the seismic cross-section below spread 2 and also a composite seismic cross-section below spreads 1 & 3. The upper 10-15 m has been interpreted from the in-line method and the rest below 10-15 m from the broadside configuration.

The seismic cross-sections indicate layers with the following velocity ranges:

650 m/s - 1500 m/s	This layer consists of highly weathered rock and surface sand (650 m/s when dry and up to 1500 m/s saturated).
2250 m/s - 2300 m/s	Is interpreted as arising from weathered shale and sandstone valley fill.
2500 m/s	This layer is considered to be less weathered valley infill.

3000 m/s - 3400 m/s	These velocities were measured outside the profile of the valley and are interpreted as being diagnostic of weathered Cambrian greywacke.
3550 m/s - 3750 m/s	This material is probably less weathered greywacke and is considered as being the Permian glacial valley floor.

CONCLUSIONS AND RECOMMENDATIONS

The interpreted shape of the valley has been delineated by the interface between the 2500 m/s and 3750 m/s layers at depth and the interface between the 2300 m/s and 3350 - 3400 m/s layers nearer the surface, as shown on cross-sections below spreads 1 and 2. At the northern end of spread 2, the valley floor is shallower with consequent greater weathering of bedrock and is shown by the 2300 and 3000 m/s interface.

The Department of Mines and Energy has no previous experience with the relationship between seismic velocities of saturated material and dredging or dragline excavation capabilities. However, from the description of core from the drilling on the jetty (Boucaut, 1971), it would appear probable that the weathered valley infill may be excavated using a dragline or dredge. This can only be confirmed by testing. If the dragline or dredge is able to excavate the upper 2 m of valley infill, then it would appear from the seismic cross-sections, that excavation to at least 8 m would be possible with that machine.

If it is envisaged that depth of excavation for a safe harbor within the confines of the valley would be less than 8 m, then it is recommended that two or three seismic traverses be sited along the direction of the valley spaced approximately 15 m apart. Results from these would delineate the interface between the weathered and less weathered valley infill material, which would be adequate for the purpose as the depth to bedrock is greater than 8 m.

By placing the traverses along the direction of the glacial valley, offset shots can be sited in the water, thus obviating the need to drill shot holes on land with the resulting high cost.

BJT:ZV

B.J. TAYLOR

GEOPHYSICIST

REFERENCES

Boucaut, W.R.P., 1971. Ferry berth - Cape Jervis: Marine Res Hd Waitpinga: Report on geological investigations. S. Aust. Dept. Mines report 71/12 (unpublished).

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

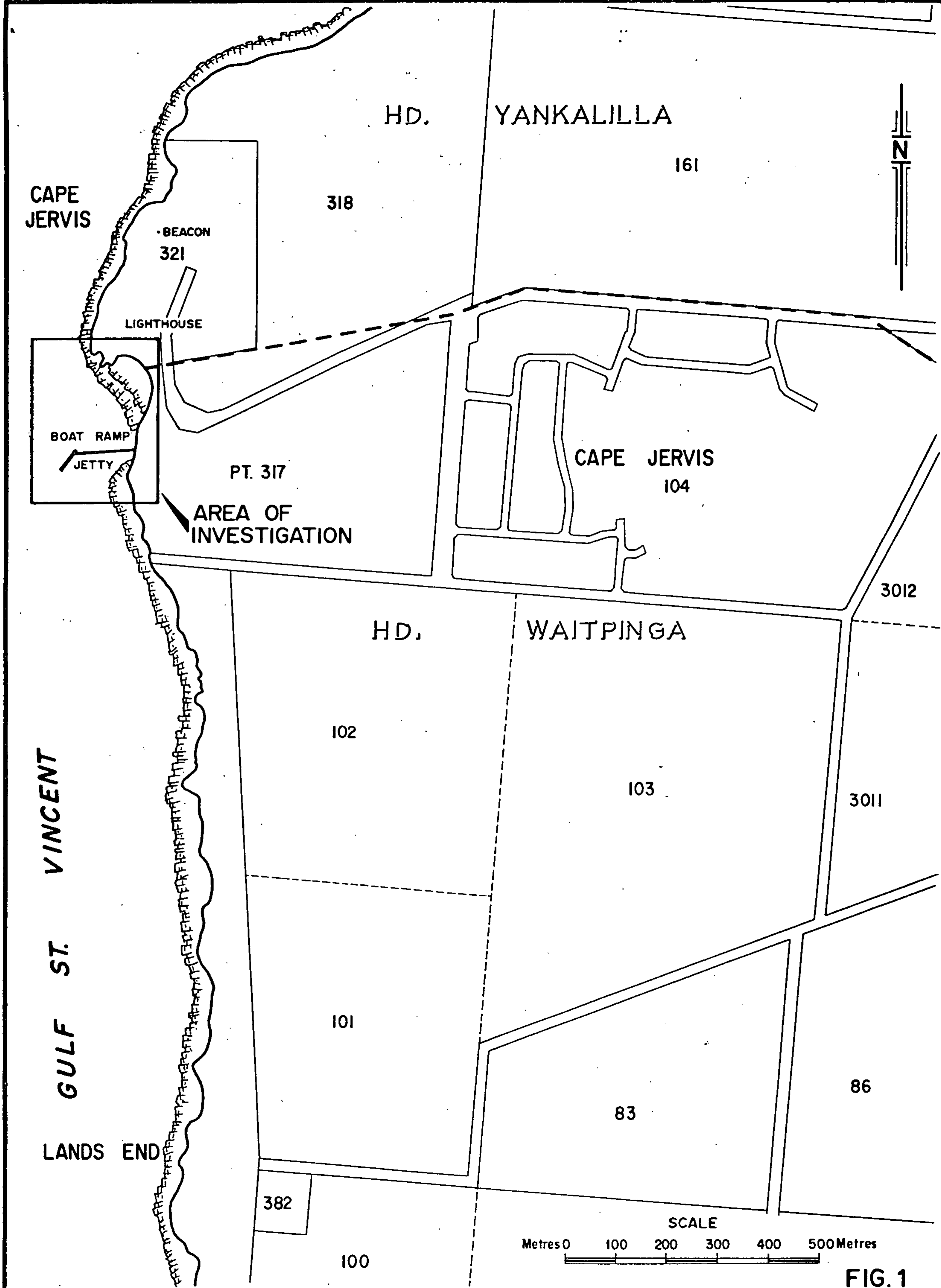


FIG. 1

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED B.T.	C.D.O	10·8·82 DATE
CAPE JERVIS SEISMIC SURVEY	DRAWN S.R.	SCALE 1:10 000	
LOCALITY PLAN	DATE 27/4/82	PLAN NUMBER	
	CHECKED	S16175	

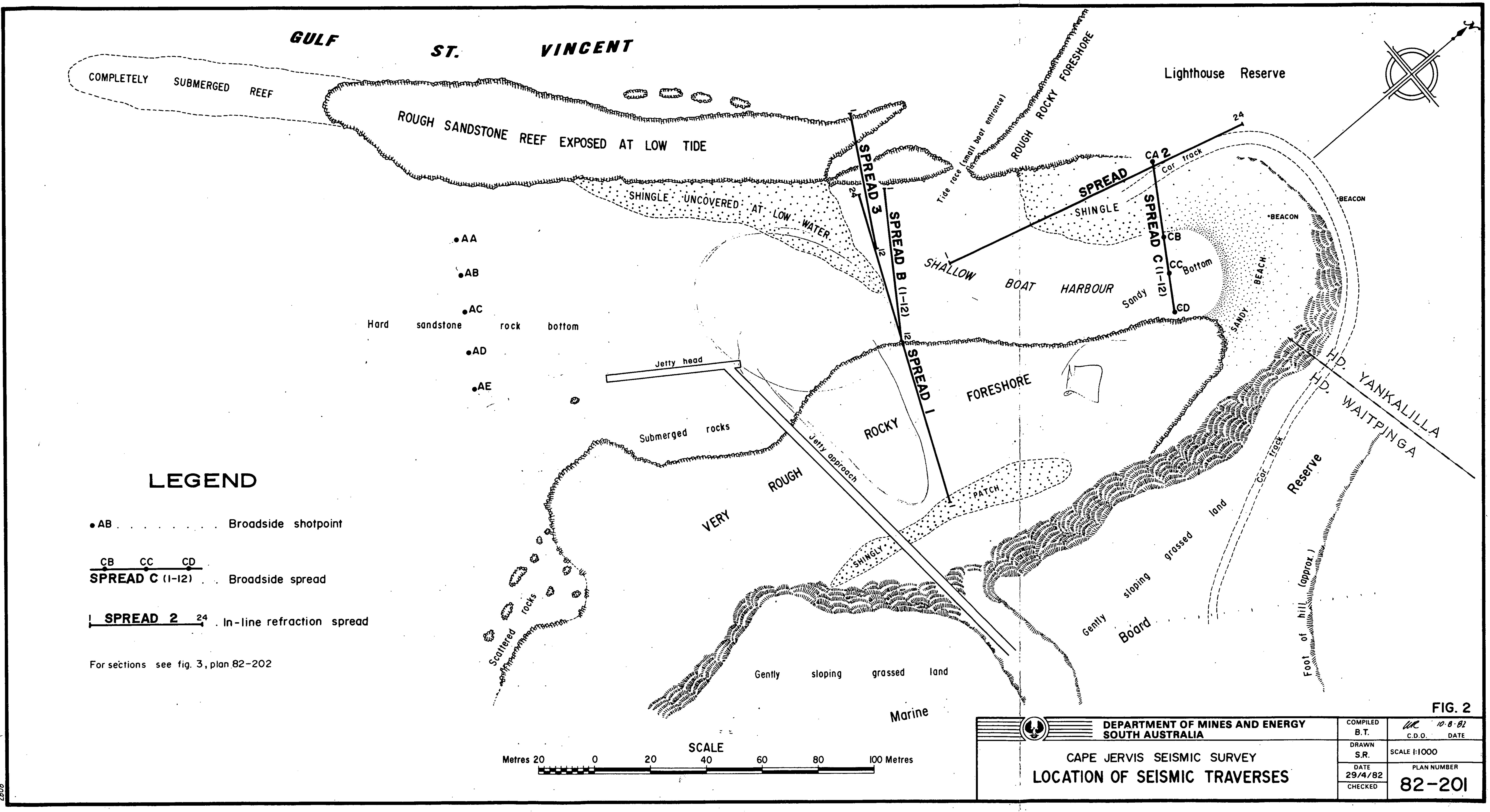
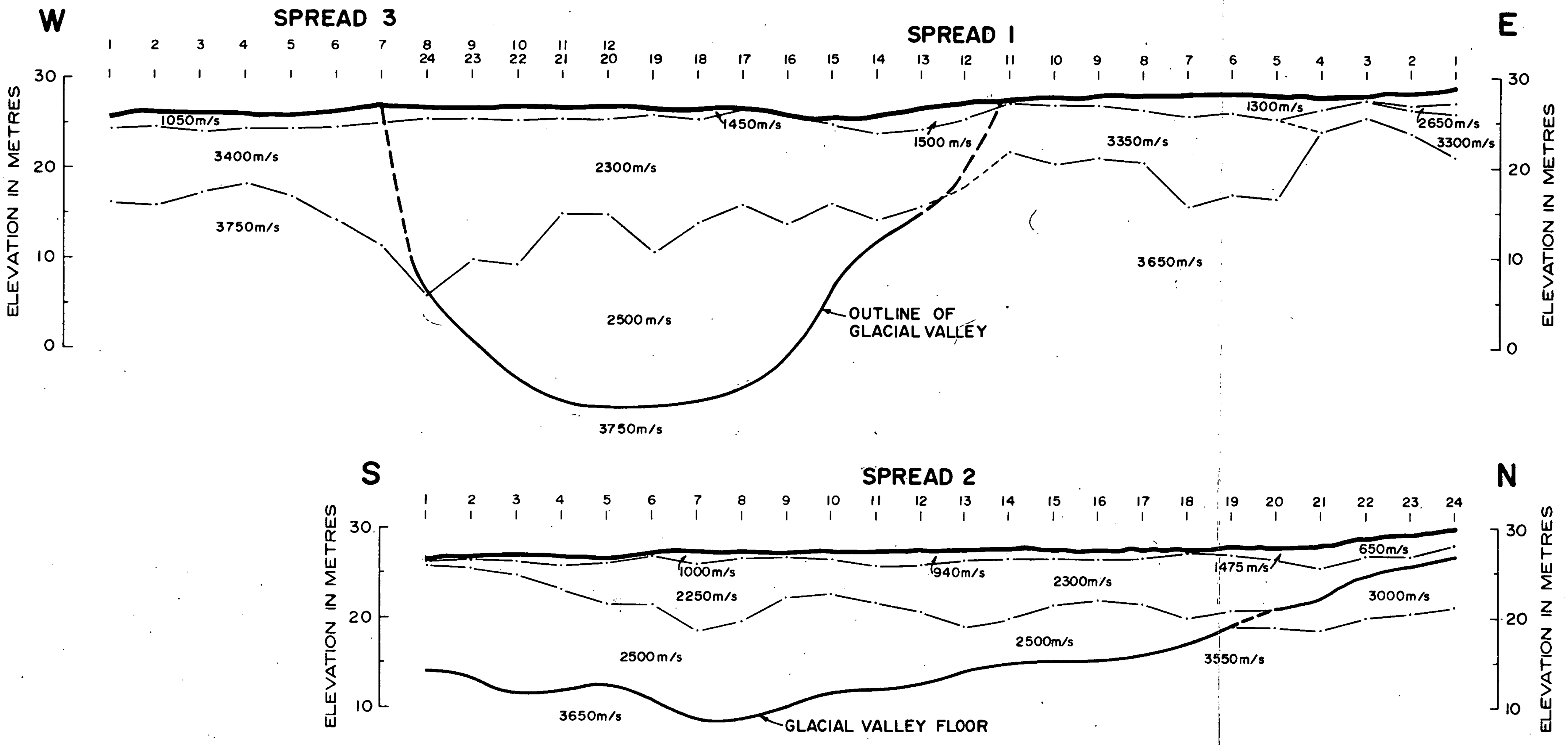

GULF ST. VINCENT
COMPLETELY SUBMERGED REEF
ROUGH SANDSTONE REEF EXPOSED AT LOW TIDE
SHINGLE UNCOVERED AT LOW WATER
Lighthouse Reserve
ROUGH ROCKY FORESHORE
Tide race (small boat entrance)
SPREAD 3
SPREAD B (1-12)
SPREAD 2
SPREAD C (1-12)
SPREAD 1
SHINGLE
Car track
BEACON
SHALLOW BOAT HARBOUR
Sandy Bottom
SANDY BEACH
AA
AB
AC
AD
AE
CA
CB
CC
CD
Hard sandstone rock bottom
Jetty head
Jetty approach
Submerged rocks
ROCKY FORESHORE
VERY ROUGH
PATCH
SHINGLY
Scattered rocks
HD. YANKALILLA
HD. WAITPINGA
Gently sloping grassed land
Board
Reserve
Foot of hill (approx.)
Gently sloping grassed land
Marine
LEGEND
AB . . . . Broadside shotpoint
CB CC CD SPREAD C (1-12) . . Broadside spread
SPREAD 2 24 . In-line refraction spread
For sections see fig. 3, plan 82-202
SCALE
Metres 20 0 20 40 60 80 100 Metres
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA
CAPE JERVIS SEISMIC SURVEY
LOCATION OF SEISMIC TRAVERSES
COMPILED B.T.
DRAWN S.R.
DATE 29/4/82
CHECKED
C.D.O. 10.8.82 DATE
SCALE 1:1000
PLAN NUMBER 82-201

FIG. 2



LEGEND

SPREAD 2 .... Seismic spread number

12 13 14 15 16 .... Geophone number and position

.... Natural surface

2300m/s .... Seismic velocity in metres per second

.... Refractor interface

2500m/s .... Glacial valley

Seismic sections compiled from Broadside and In-line spreads.

SCALE

Metres 10 0 10 20 30 40 50Metres

Datum: L.W.O.S.T. Pt. Adelaide = 100·8 ft.

For location of sections see fig. 2, plan 82-201.

FIG. 3

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED B.T.	C.D.O. 10·8·82 DATE
CAPE JERVIS SEISMIC SURVEY	DRAWN S.R.	SCALE 1:500
SEISMIC SECTIONS	DATE 5/5/82 CHECKED	PLAN NUMBER 82-202

2808