71/102
4

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1971/102

BUREAU OF MINERAL RESOURCES
LIBRARY
Copy 4
CANBERRA, A.C.T.

HALL GRAVEL QUARRY SEISMIC REFRACTION INVESTIGATION, A.C.T. 1971

by

P.J. Hill

The information contained in this report has been obtained by the Department of National Development as part of the policy of the Commonwealth Government to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology & Geophysics.

BMR
Record
1971/102
c.4

BUREAU OF MINERAL RESOURCES
LIBRARY
Copy 4
CANBERRA, A.C.T.

Record 1971/102

HALL GRAVEL QUARRY SEISMIC REFRACTION INVESTIGATION, A.C.T. 1971

by

P.J. Hill

CONTENTS

ILLUSTRATIONS

SUMMARY

A seismic refraction survey was carried out in the Hall area to locate a suitable site for a road gravel quarrx. The highly weathered volcanic rock in the area, which is a good road gravel material, has a seismic velocity in the range 2600 to 4200 ft/s. Three areas were found which from the seismic results appear suitable as quarry sites; drilling is advised to prove the deposits before quarrying.

1. INTRODUCTION

The Bureau of Mineral Resources, Geology and Geophysics is assisting the Department of Works in a programme to locate deposits of gravel material in the A.C.T. suitable for rural road maintenance and reconstruction. Road gravel is derived from weathered rippable rock and is used in its unprocessed form.

A source of gravel is required in the vicinity of the Gundaroo Road near Mulligans Bridge; as well as meeting present needs, a quarry in this area could provide a supply of gravel for the future metropolitan development northwest of Canberra.

In the selection of a quarry site other factors apart from the quality and size of a deposit (although these are of prime importance) must be considered (Sinclair, 1969): it is desirable to locate the quarry on leasehold or Crown land, and to have it so situated that the workings cannot readily be seen from roads or public areas, that it is accessible from existing roads, and that it is within a few miles of the roadworks.

Officers of the Geological Branch inspected the area and selected a number of areas for closer investigation. To determine the existence and location of gravel material in each area and an idea of its thickness and extend, the Bureau's Engineering Geophysics Group carried out a seismic refraction investigation. It was proposed to follow this up with drilling or augering at the most promising sites. The seismic field work was done in January 1971 by a party consisting of P.J. Hill (geophysicist and party leader), B.H. Dolan (geophysicist), M. Dickson (technical assistant), S. Hall (shooter), and several field assistants.

Plate 1 shows the location of Traverses 2, 3A and 3B, 4A and 4B, and 5 on four prospective sites. Traverse 1, also shown, was located above the face of a disused gravel quarry.

2. GEOLOGY

In the area of Mulligans Bridge on the Gundaroo Road the rock is mainly shale and sandstone, both of which are unsuitable for road construction; the nearest suitable rocks are near Hall, where the Mount Painter Porphyry and Deakin Volcanics formations are to be found (Henderson, 1970). All the sites chosen as possible quarry sites lie within the Deakin Volcanics.

Scattered small bouldery outcrops of hard, slightly weathered rock occur over most of the area and on all the sites investigated a soil cover of half a metre or more would have to be removed to expose gravel.

The disused quarry at the junction of Glebe Road and the Barton Highway shows the type of rock that is required. The face of the quarry is about 6 m (20 feet) high, and apart from the top 60 cm of soil and completely weathered rock, is composed of highly weathered, closely jointed welded tuff. The bottom of the quarry is in moderately weathered welded tuff.

3. METHODS AND EQUIPMENT

Before each area could be assessed in terms of suitable gravel, the range of seismic velocity representative of such material had to be established.

The quarry at the junction of Glebe Road and the Barton Highway served as a source of road gravel in the area until further quarrying would have encroached on the Highway; in fact it was largely because this quarry closed that another gravel source had to be located. To determine the seismic velocity in the highly weathered rock that had been won in the past, a 230-foot spread (Traverse 1) with a 10-foot geophone spacing was laid above the quarry face, parallel to it and about 25 feet away.

On all traverses except 1 and 4B two seismic recording trucks were operated, both recording the shots simultaneously. Each truck used identical standard BMR refraction equipment (24-channel SIE seismograph and 20-Hz TIC geophones). With a geophone spacing of 10 feet and overlapping two geophones a coverage of 460 feet was obtained for each 'double' spread. In general shots were fired 5 and 200 feet beyond the ends, about a quarter way along, near the centre and about three-quarter way along each such spread. For Traverse 1 and 4B only one truck was used; in this case a 10-foot geophone spacing gave a spread length of 230 feet and shots were fired 5 and 200 feet beyond the ends and at the centre of each spread.

Depth to the various refractors was calculated by a method similar to the 'reciprocal method' (Hawkins, 1961).

4. RESULTS

The seismic cross-sections along Traverses 1 and 2, 3A and 3B, 4A and 4B, and 5 are shown in Plates 2, 3, 4, and 5 respectively.

Traverse 1

This traverse was situated above the face of the abandoned quarry, a plan of which is shown in Plate 2. From measurements made at points A, B, C, D, and E on the face the following information was obtained.

Point on Face	Depth to Bottom of Quarry	Cover Material
A	15 feet	2 feet soil
B	20	2 feet soil and completely weathered rock
C	22	3 feet soil and completely weathered rock
D	19	½ foot soil and 2½ feet completely weathered rock
E	17	1 foot soil and 1 foot completely weathered rock

Comparing this with the seismic cross-section and remembering that most of the material at the face was worked for gravel, it can be seen that the gravel material has a seismic velocity in the range 2600 to 4200 ft/s, 3800 ft/s being most predominant. The moderately weathered rock at the bottom of the quarry which was not worked due to difficulty in ripping (with a D6 bulldozer) has a velocity from 4600 to 6000 ft/s.

Traverse 2

Low velocity rock (2600 to 3600 ft/s) along the Traverse, mainly from the centre to the southeast end, varies in thickness from about 6 to 18 feet.

Traverses 3A and 3B

The middle of Traverse 3A has a layer of about 4200 ft/s rock averaging about 13 feet in thickness. Its velocity corresponds to the maximum recorded for the gravel material on Traverse 1 and may therefore be a little hard to be suitable for road gravel, but this would have to be checked by drilling. From the centre to the western end of Traverse 3B a 3600 to 3800 ft/s layer is indicated with an average thickness of 10 feet.

Traverses 4A and 4B

This site is characterized by the lower velocities recorded in the southern section of Traverse 4A and along Traverse 4B. This could be the result of faulting, with subsidence in the southern area, of deeper weathering, or possibly of more intense jointing.

In this part of the site at a depth of about 8 feet and below the upper 1000 and 2600 ft/s layers lies an extremely thick layer of rock with velocity of about 4200 to 4300 ft/s. Although this velocity is at the upper limit for suitable road gravel drilling should be carried out to determine the nature of the rock within this layer, for it may extend to depths as great as 50 feet.

Traverse 5

Very little suitable material appears to be present along the Traverse; it is mostly confined to an 8-foot layer of velocity 3400 to 3800 ft/s along the southern part of the Traverse.

Estimate of Quantity

These estimates of gravel material at the most promising sites are approximate only and are based on the assumption that the deposits are disc-shaped, with a thickness corresponding to the average thickness of material which from the seismic results appears suitable, and of a diameter corresponding to the length along the traverse of such material. Although the deposits could extend beyond the ends of the traverses this was not considered in the estimates.

Traverse	Approximate Size of Deposit
2	30,000 cubic yards
3A	30,000 " "
4A and 4B	15,000 " "

5. CONCLUSIONS AND RECOMMENDATIONS

The areas which from the seismic results appear suitable for the location of a road gravel quarry are:

(a) From the centre to the south-east end of Traverse 2.

(b) In the middle of Traverse 3A.

(c) At the southern end of Traverse 4A and along Traverse 4B, particularly the western side.

The deposits at (b) and (c) in which a seismic velocity of about 4200 ft/s was obtained show good potential in terms of size, but may not be easily ripped and could be insufficiently weathered to produce good road gravel, for this velocity was the maximum recorded for the gravel material on Traverse 1 above the abandoned quarry. At (a) the deposit is expected to be quite rippable.

It is recommended that initially drilling be carried out at the three locations to determine the quality of the deposits. Should good gravel material be found to be present at all three, further holes should be drilled to determine the extent of the deposits and at the same time check that the groundwater level is below the bottom of gravel material that is likely to be worked. It should be noted that since (a) and (c) are on hillsides flooding due to groundwater is unlikely and rain water will drain more readily.

If the 4200 ft/s material proves to be unsuitable and the material at (a) satisfactory then additional drilling should be carried out at this location to confirm that the deposit is of sufficient size and to check that it is above the water table before quarrying is begun.

6. REFERENCES

HAWKINS, L.V., 1961 - The reciprocal method of routine shallow seismic refraction investigations. Geophysics, 26(6), 806-19.

HENDERSON, G.A.M., and STRUSZ, D., 1971 - Canberra City, A.C.T.: 1:50,000 geological map and notes. Bur. Miner. Resour. Aust.

SINCLAIR, J., 1969 - QUARRYING, OPENCAST AND ALLUVIAL MINING. London, Elsevier.

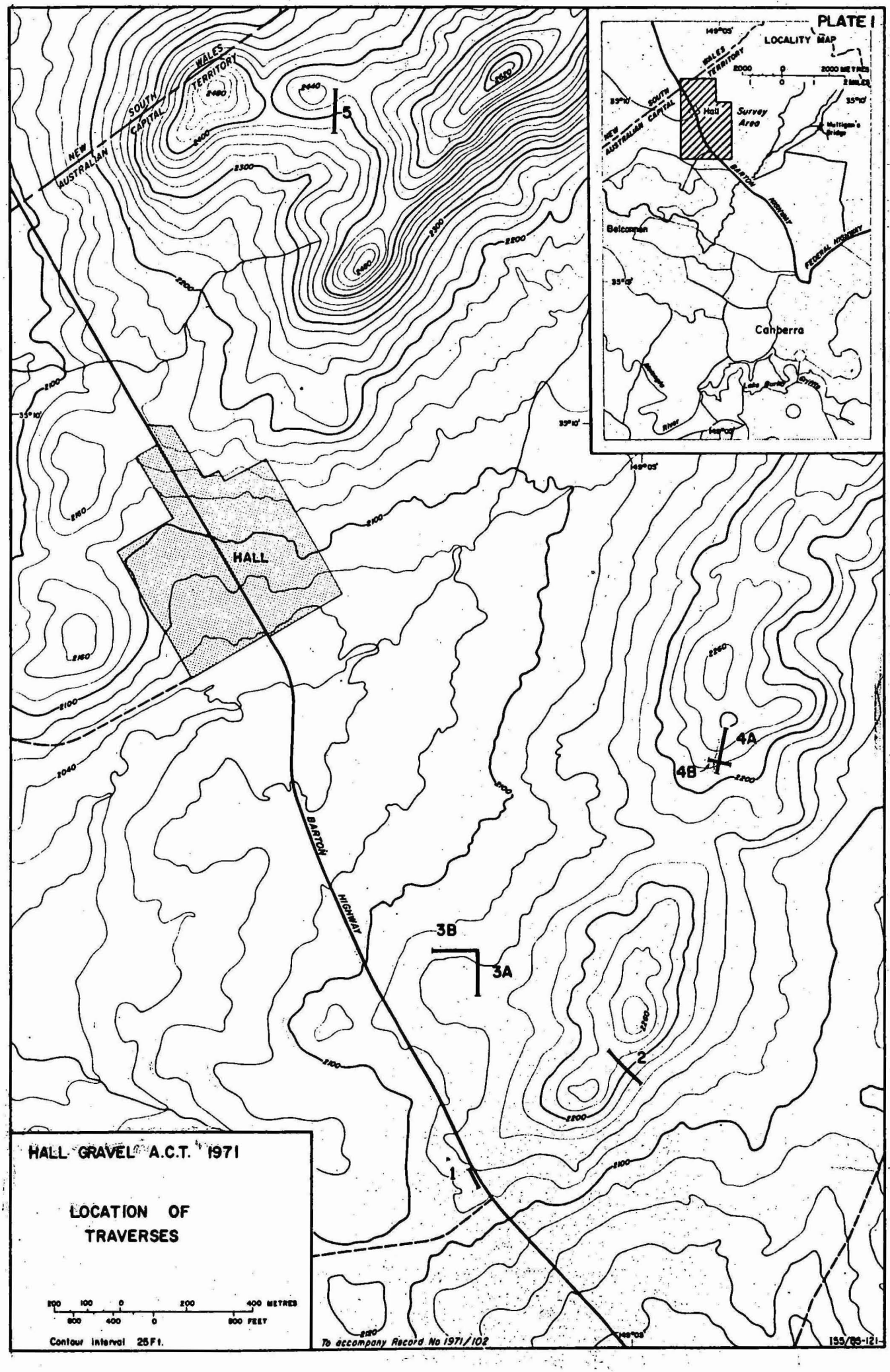
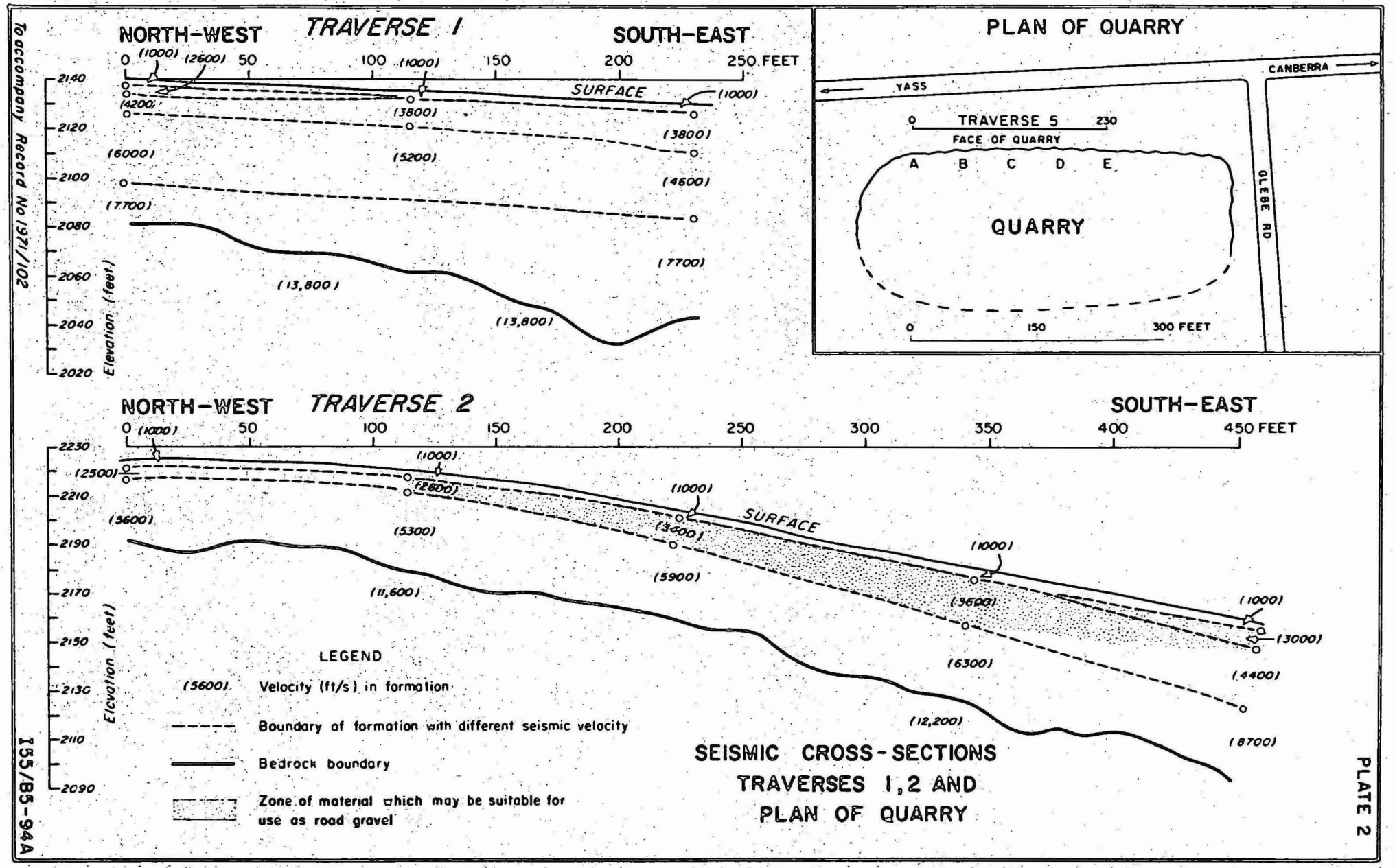
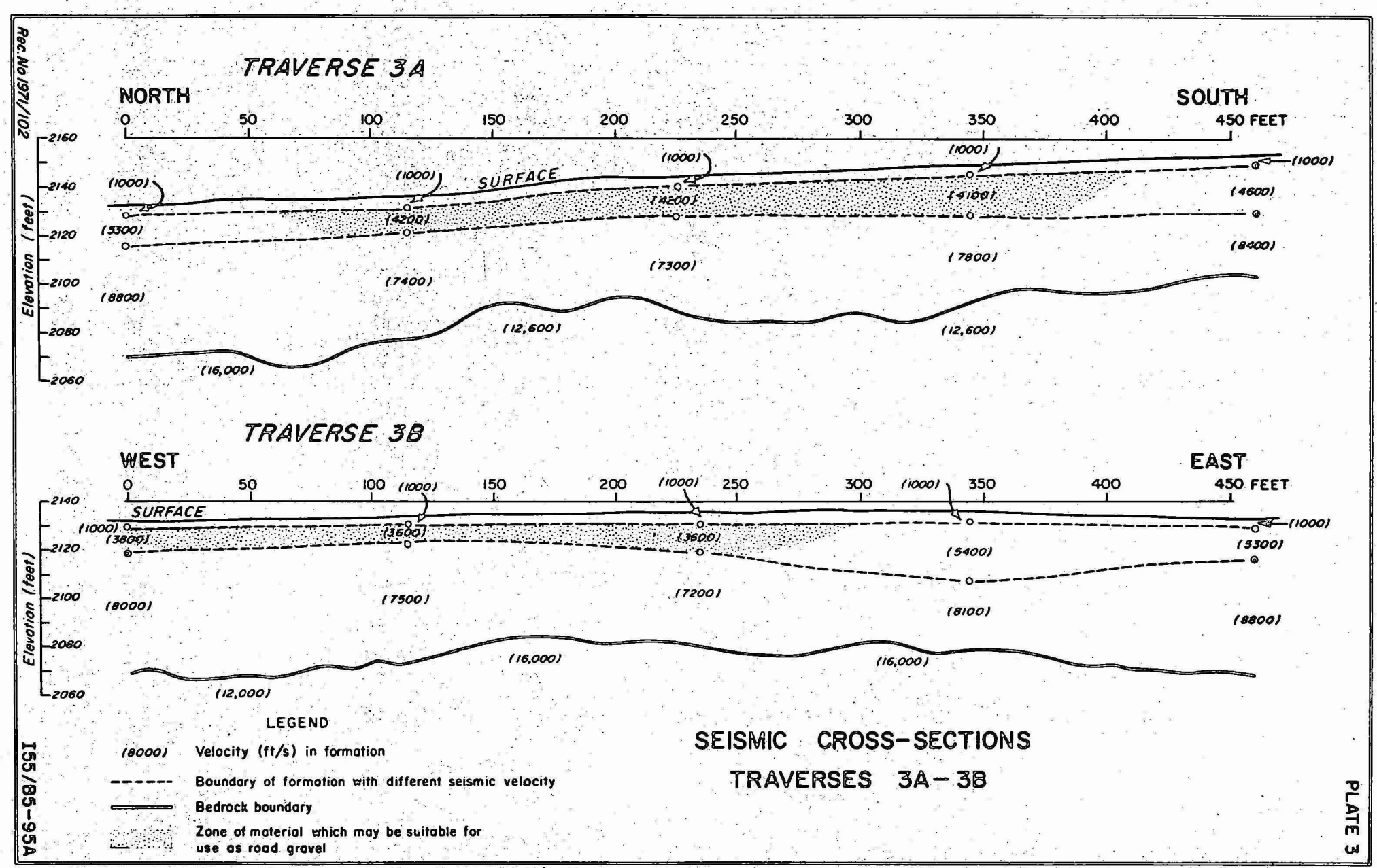


PLATE I
LOCALITY MAP
Survey Area
Hall
Belconnen
Canberra
NEW SOUTH WALES
AUSTRALIAN CAPITAL TERRITORY
BARTON HIGHWAY
FEDERAL HIGHWAY
HALL
BARTON HIGHWAY
1
2
3A
3B
4A
4B
5
HALL GRAVEL A.C.T. 1971
LOCATION OF TRAVERSES
200 100 0 200 400 METRES
600 400 0 800 FEET
Contour Interval 25 Ft.
To accompany Record No 1971/102
155/65-121


To accompany Record No 1971/102
NORTH-WEST
TRAVERSE 1
SOUTH-EAST
0 (1000) (2600) 50 100 (1000) 150 200 250 FEET
SURFACE
(4200)
(3800)
(1000)
(3800)
(6000)
(5200)
(4600)
(7700)
(7700)
(13,800)
(13,800)
2140
2120
2100
2080
2060
2040
2020
Elevation (feet)
PLAN OF QUARRY
CANBERRA
YASS
0 TRAVERSE 5 230
FACE OF QUARRY
A B C D E
QUARRY
GLEBE RD
0 150 300 FEET
NORTH-WEST
TRAVERSE 2
SOUTH-EAST
0 (1000) 50 100 150 200 250 300 350 400 450 FEET
(1000)
(2500)
(2600)
(1000)
SURFACE
(1000)
(5600)
(5300)
(3400)
(5900)
(11,600)
(3600)
(1000)
(1000)
(3000)
(4400)
(6300)
(12,200)
(8700)
2230
2210
2190
2170
2150
2130
2110
2090
Elevation (feet)
LEGEND
(5600) Velocity (ft/s) in formation
Boundary of formation with different seismic velocity
Bedrock boundary
Zone of material which may be suitable for use as road gravel
SEISMIC CROSS-SECTIONS
TRAVERSES 1, 2 AND
PLAN OF QUARRY
PLATE 2
155/85-94A

Rec. No 1971/102



LEGEND

(8000) Velocity (ft/s) in formation

Boundary of formation with different seismic velocity

Bedrock boundary

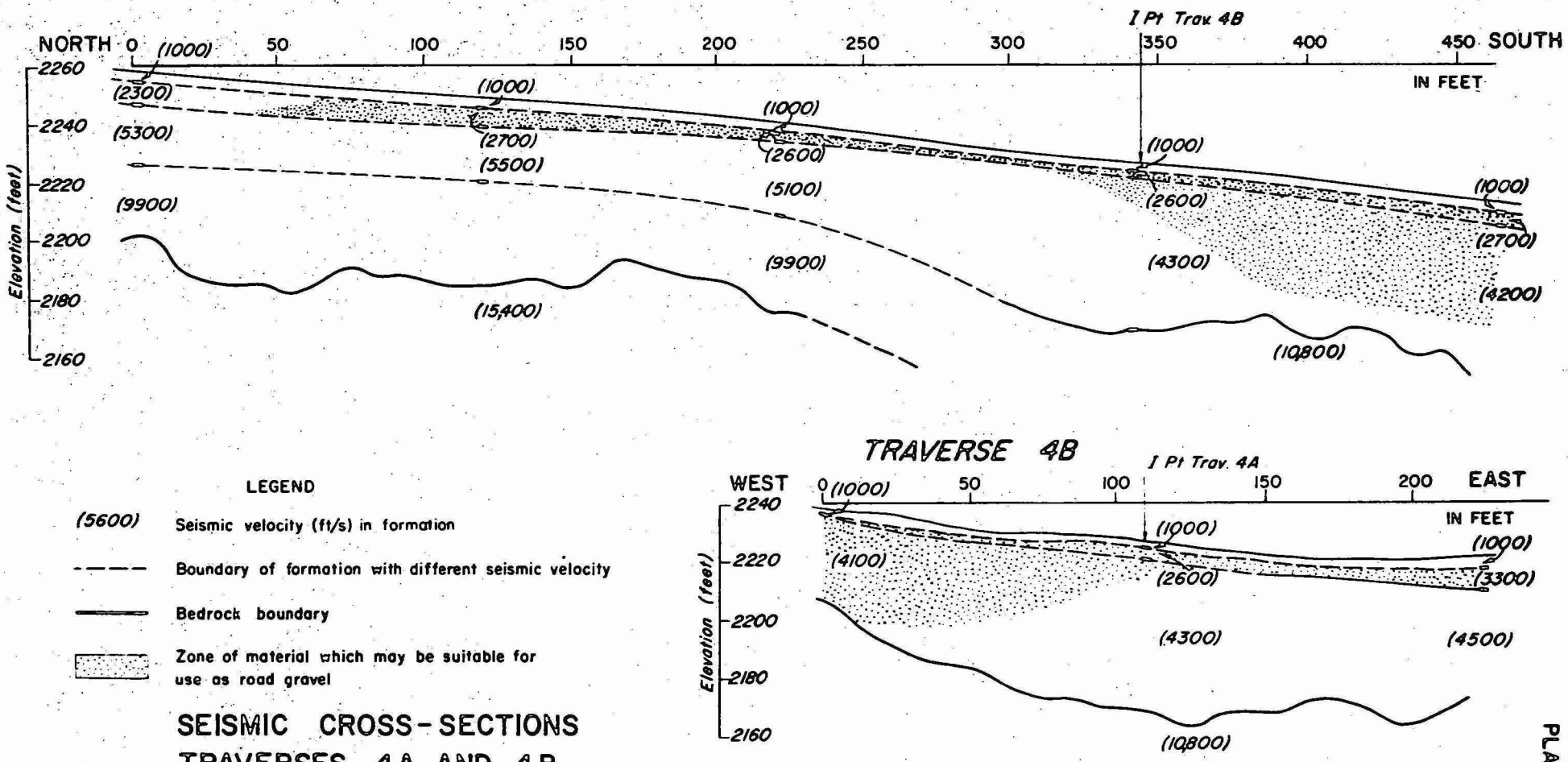
Zone of material which may be suitable for use as road gravel

SEISMIC CROSS-SECTIONS
TRAVERSES 3A–3B

I55/85-95A

PLATE 3

To accompany Record No 1971/102



LEGEND

(5600) Seismic velocity (ft/s) in formation

Boundary of formation with different seismic velocity

Bedrock boundary

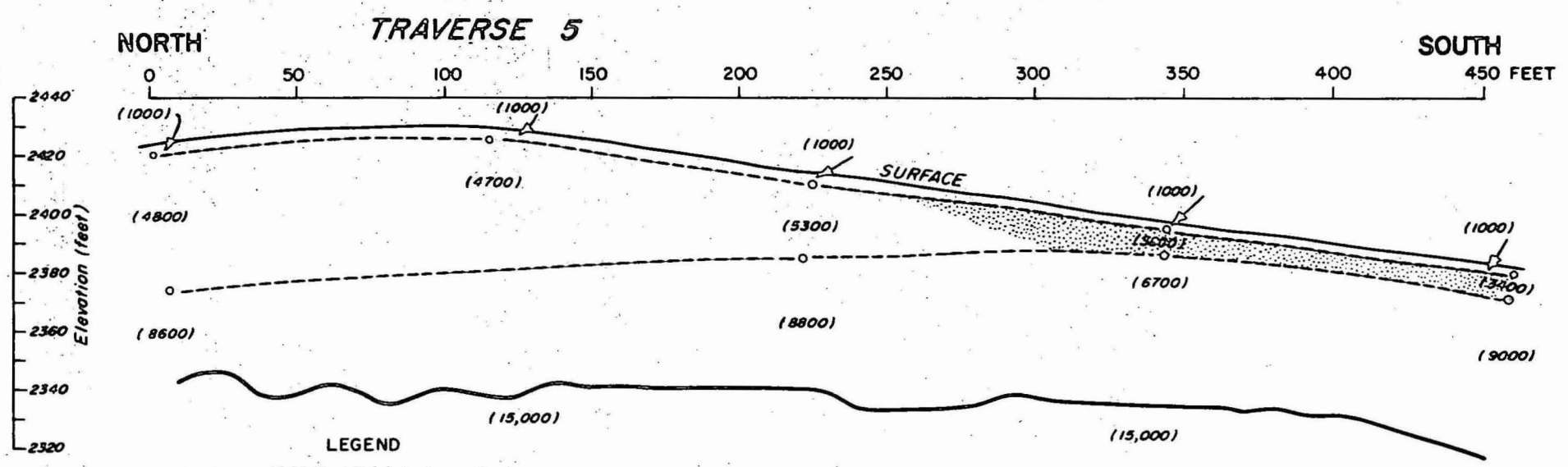
Zone of material which may be suitable for use as road gravel

SEISMIC CROSS-SECTIONS TRAVERSES 4A, AND 4B

PLATE 4

155/85-120A

To accompany Record No 1971/102



LEGEND

(8600) Velocity (ft/s) in formation

Boundary of formation with different seismic velocity

Bedrock boundary

Zone of material which may be suitable for use as road gravel

SEISMIC CROSS-SECTION
TRAVERSE 5

I55/B5-96A

PLATE 5