DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1974/71

HUGHES RESERVOIR SITE INVESTIGATION, DEAKIN, A.C.T.

by

F.N. Michail and P.D. Hohnen

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ILLUSTRATIONS

SUMMARY

Geological mapping and seismic refraction surveys were carried out at the request of the Australian Department of Housing and Construction, to investigate the proposed Hughes reservoir site on the Deakin waste disposal area; the main purpose of the investigations was to determine excavation conditions. The field work and interpretation were carried out by the Engineering Geology and Engineering Geophysics Groups of the Bureau of Mineral Resources, Geology and Geophysics, Canberra.

Bedrock in the area consists mainly of porphyritic rhyodacite, sandstone, and siltstone. The overburden and fill consist of weathered rock, quarry waste, tree logs, and truck bodies.

Overburden and fill of a rippable nature, with seismic velocity ranging from 300 to 1200 m/s, extend at some locations to depths of more than 10 m. The overburden bedrock boundaries were not clearly mappable by seismic refraction techniques owing to the variable nature of the overlying materials and the irregularities of the interface, which gave erroneous apparent intercept times and resulted in discrepancies between depths to refractors at the intersection of traverses. However, the investigation indicates that the rocks would be rippable to the required depth of excavation except on the higher parts of the site where higher-velocity layers were intersected; this higher-velocity material is slightly to moderately weathered sandy siltstone and silty sandstone.

1. INTRODUCTION

A water reservoir for Hughes, A.C.T., is being planned for construction at the Deakin waste disposal area by the Australian Department of Housing and Construction for the National Capital Development Commission. The reservoir will be 40 m in diameter and have a floor level of 632.5 m A.H.D. with a top water level of 642.0 m A.H.D. Excavation to depths of about 10 m will be required in places.

At the request of the Department of Housing and Construction, the Bureau of Mineral Resources, Geology & Geophysics (BMR) carried out geological mapping and a seismic refraction survey, to investigate the proposed reservoir site and to determine the excavation conditions. The location of the seismic traverses is shown on Plate 2. The seismic party consisted of F.N. Michail (Geophysicist and Party Leader), M. Dickson (Technical Assistant), S. Hall (Shooter) and one student. The geological mapping was carried out by P.D. Hohnen (Geologist). The survey was conducted in January 1974. A total of 368 m of traverses was completed.

The seismic results were interpreted by F.N. Michail under the supervision of G.R. Pettifer.

2. GEOLOGY

The geology of the Red Hill area is complex and has been described by Opik (1958).

The greater part of the proposed area of excavation for the reservoir is occupied by a porphyritic rhyodacite (Painter Porphyry) that appears to intrude sedimentary lenses in the Deakin Volcanics. The sedimentary rocks comprise silty sandstone and sandy siltstone which dip almost vertically and strike east in the quarry faces. The silty sandstone consists of well rounded, spherical quartz grains 1 to 2 mm in diameter in a matrix of silt which makes up about 70 percent of the rock. The sandstone is overlain by bleached siltstone and underlain by sandy siltstone which contains load casts of sandstone; these rocks are moderately to slightly weathered in the faces of the quarry and the sandstone is fractured along three predominant joint sets (see map). Jointing in the siltstone and sandy siltstone is less regular, but a prominent set dips north-northwest at 50° (see Plate 3). The sedimentary rocks are intruded in an apparently discordant manner by Painter Porphyry which is highly to completely weathered in exposures in the quarry, though fresh boulders occur in the weathered matrix.

The hillslope within the area of the proposed excavation is underlain by superficial materials that include red earth up to 1.5 m thick, angular talus with fragments up to 30 cm across, fine sandy slopewash, and completely to highly weathered, in situ porphyry.

3. SEISMIC REFRACTION

3.1 Equipment and method

BMR standard engineering refraction equipment consisting of a 24-channel SIE seismograph (Dresser-SIE Inc.) and 14-Hz geophones (Geospace Co.) was used for the survey. Geophone spacing was 4 m on traverses 1, 2, and 3, and 2 m on traverses 4 and 5. Shots were fired at each end of the traverse, at different possible locations along the traverse, and at some offset distance in line with the traverse. The location of the traverses is shown in Plate 2.

The interpretation was carried out using the reciprocal time method (Heiland, 1946). Depths to bedrock were calculated at each geophone position and reproduced as a continuous profile. Depths to different velocity layers were calculated at shot points, but interpolated between them assuming gradual change.

3.2 Results

A number of difficulties were encountered in the interpretation of the seismic results and caused some uncertainty in depth calculations. At the intersection of traverses, discrepancies in velocities and depths are shown. The main difficulty arose from the presence of a former quarry, now filled with waste materials and covering about 25 percent of the area of the proposed reservoir site. The fill consists of tree logs, highly weathered rock, old quarry waste, soil, and truck parts. This caused a horizontal and vertical variation in the composition, thickness, and velocity of the overburden, and introduced uncertainties and errors into the results across the fill area. This, combined with the complexity of the geology of the proposed site, and the variation of the rock type within short distances along the traverse lines, made interpretation difficult. There is evidence of velocity anisotropy over the surveyed area.

The seismic velocity sections along traverses 1, 2, 3 and 4 are shown in Plates 5, 6, 7, and 8 respectively. Another traverse was carried out using 2-m geophone spacings but the results were of very poor quality and inconclusive because most of the spread was located over fill material. The results of this spread are not included in the report.

The highest recorded velocity of 2500 to 2900 m/s is defined in this report as bedrock. As far as it was possible to define bedrock depth (Plates 5 and 6), it was found to be below the expected excavation depth of 10 m.

The seismic velocities observed can be classified into three general groups.

300 - 900 m/s:	Soil and fill material; in situ completely weathered rock at higher velocities
1100 -1800 m/s:	Moderately to highly weathered rock
2500 -2900 m/s:	Slightly weathered bedrock

The soil and fill material generally ranges in thickness from about 0.5 to 4.5 m. This layer should be easily ripped during excavation.

The underlying 700 - 900 m/s layer, representing completely weathered bedrock and fill material, was detected over most of the site. This layer should be rippable.

The 1100 - 1800 m/s layer was detected and considered to represent moderately to highly weathered bedrock. The layers with seismic velocity of 1500 to 1800 m/s may have to be blasted in some places (Caterpillar Tractor Co, 1966). Moderately weathered bedrock may be present in thicknesses up to 20 m over the site beneath more extensively weathered rock and fill material.

Bedrock occurs at depths ranging from 10 m to greater than 25 m, and is likely to be encountered at depths less than 10 m over about 20 percent of the area of the proposed excavation.

The interpretation suggests that rippable material will be encountered over about 80 percent of the proposed site except possibly at the following locations where higher seismic velocities were intersected:

1) Traverse 2 between geophone position 15 and 19.
2) Traverse 3 between geophone position 8 and 12.
3) Traverse 4 below the depth of the 700 m/s velocity layer.

4. CONCLUSIONS

General

The practical capability of the seismic refraction method within the fill area was limited in this survey, and the disturbing effects of the heterogeneous anisotropic overburden have made difficult the interpretation of the results. However, conclusions based on geologic mapping of the site are supported generally by the seismic results and this allows reasonably sound predictions of excavation conditions to be made.

Ease of excavation

Between 60 and 80 percent of the area of the proposed excavation (which includes much fill) will be rippable to a depth of at least 4 m below ground surface, and will possibly be rippable to the full depth of the excavation. The area that is underlain by the sandstone and sandy siltstone along the northern margin, however, will only be rippable to a maximum depth of about 1.5 to 2 m.

Slope stability

A batter slope of 2:1 (about 65° from horizontal) should be adequate on the weathered porphyry, and the sedimentary rocks should be stable in vertical cuts because joint orientations are favourable (see Plates 2, and 3). Should existing fill material occur to a depth of more than about 2 m in the walls of the proposed excavation, a bench should be cut at the base of that fill. A bench might also be necessary in *in situ* porphyry if completely weathered material extends to depths greater than 5 m below ground surface.

Bearing strength

Geological inspection indicates that the *in situ* material expected to occur at the base of the proposed reservoir should have adequate bearing strength to support a reservoir. If fill is used in the foundation material, it should be of excavated soil and rock free of refuse material from the now-buried rubbish dump and should be suitably compacted.

5. RECOMMENDATIONS

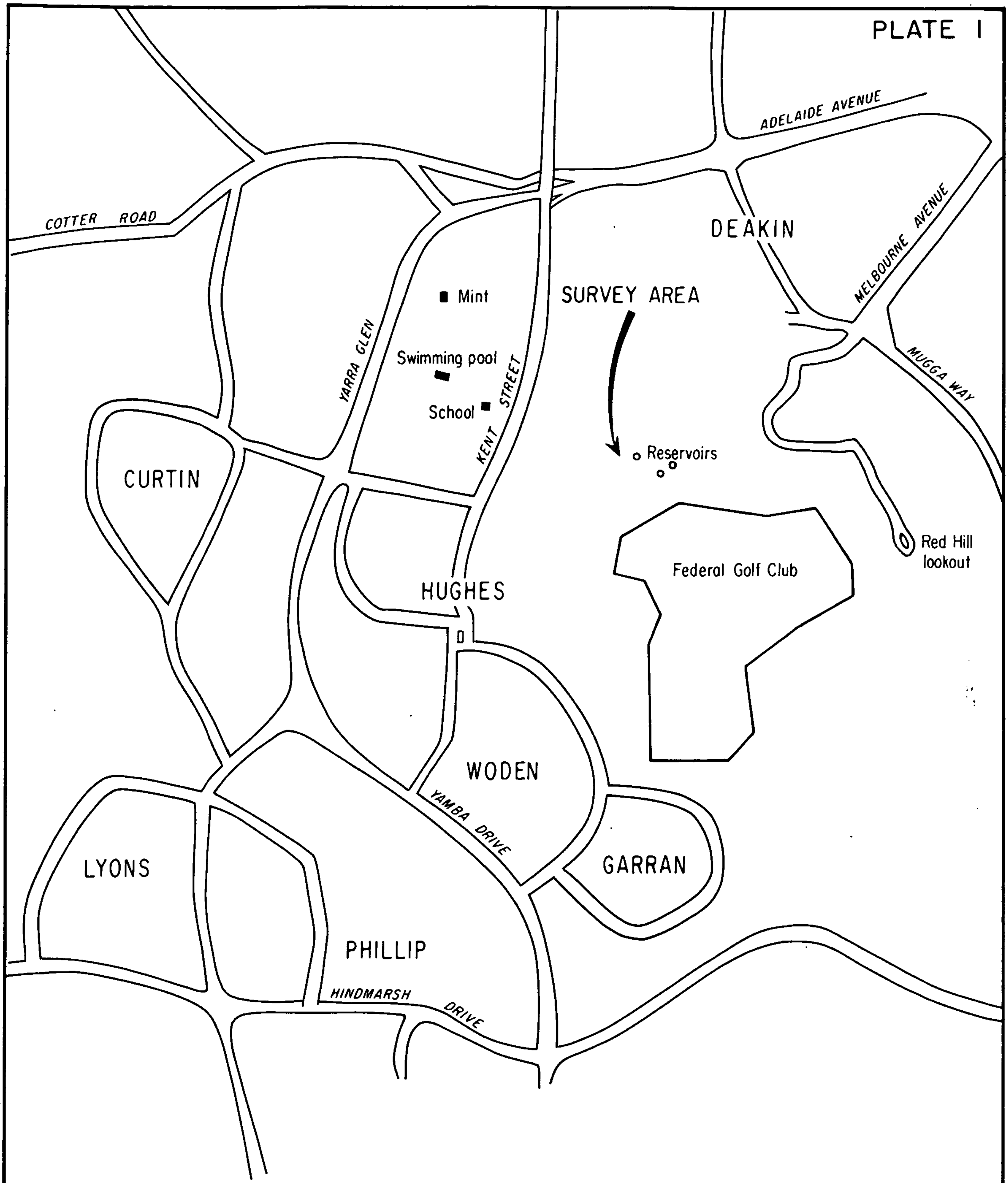
When the excavation is complete, BMR would like to be advised so that geological mapping in detail of the complex geology at the site can be carried out. At this time advice on any problems that have been revealed as a result of excavation, such as stability of batter slopes could be provided.

6. REFERENCES

CATERPILLAR TRACTOR COMPANY, 1966 - HANDBOOK OF RIPPING (3rd edn.). Peoria, Caterpillar Tractor Co.

HEILAND, C.A., 1946 - GEOPHYSICAL EXPLORATION. N.Y., Prentice-Hall.

OPIK, A.A., 1958 - The geology of the Canberra City district. Bur. Miner. Resour. Aust. Bull. 32.



HUGHES RESERVOIR SITE
GENERAL LOCALITY MAP

To accompany Record No.1974/71

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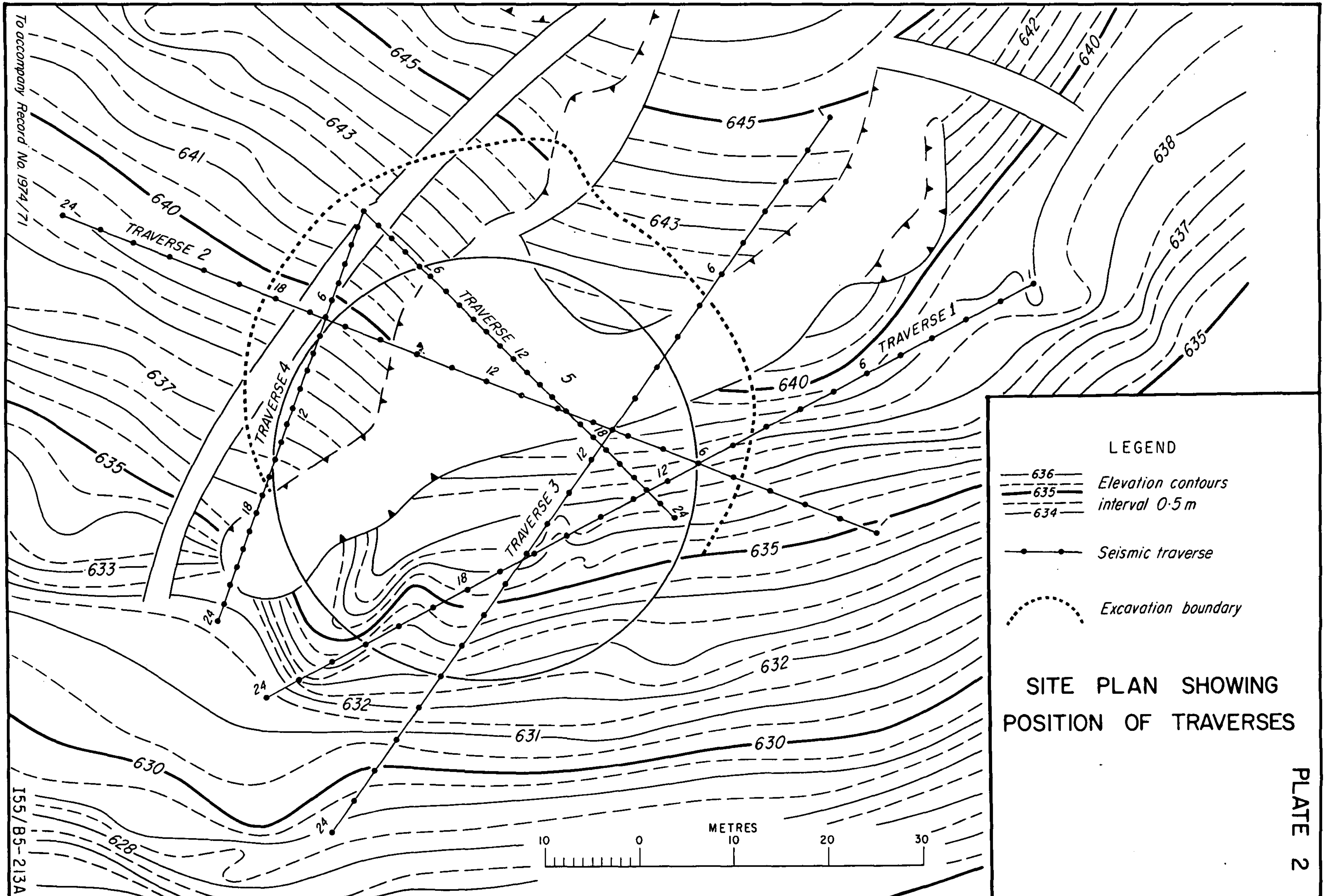


SITE PLAN SHOWING POSITION OF TRAVERSES

PLATE 2

PLATE 3

GEOLOGY OF SITE OF PROPOSED HUGHES RESERVOIR

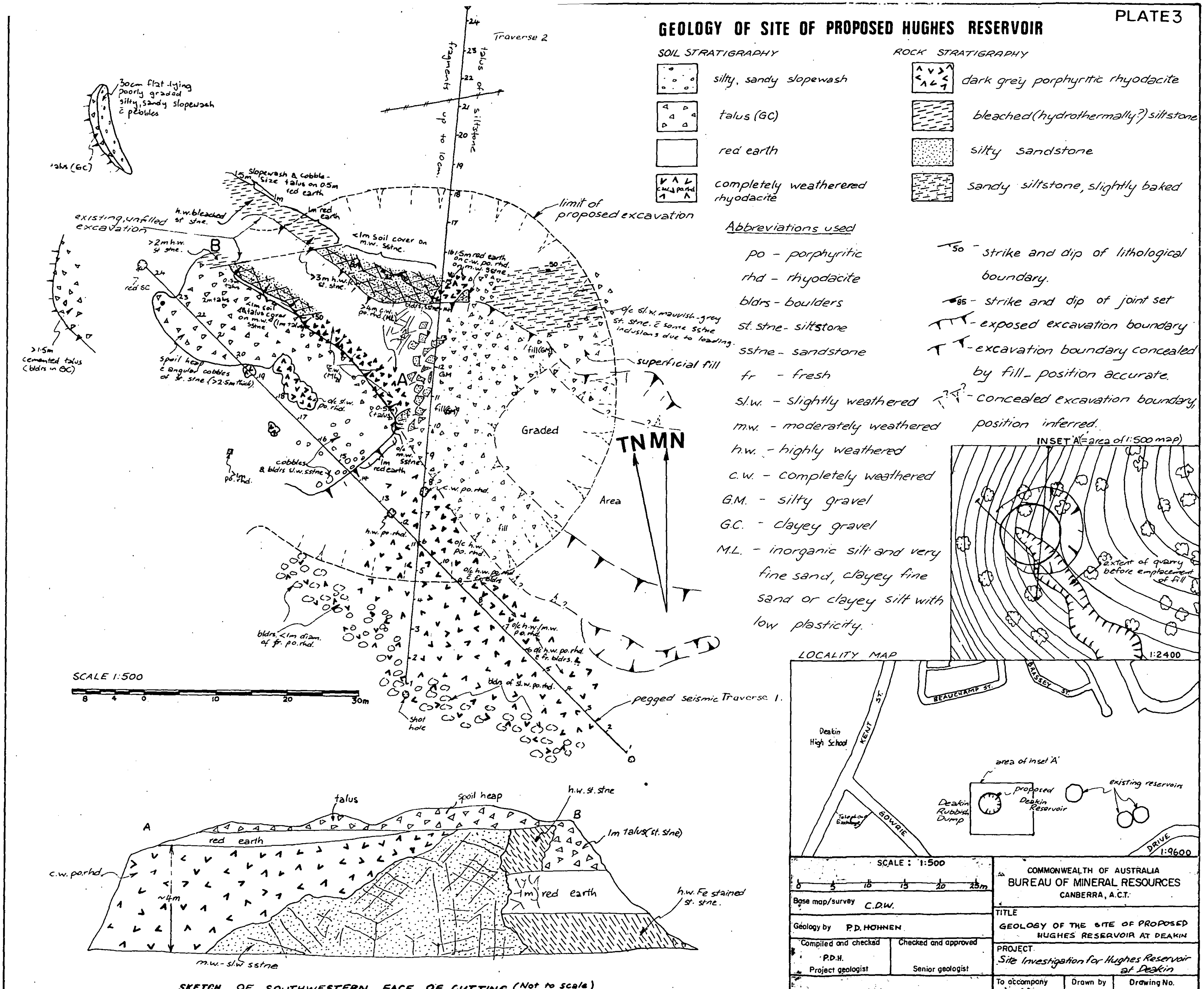
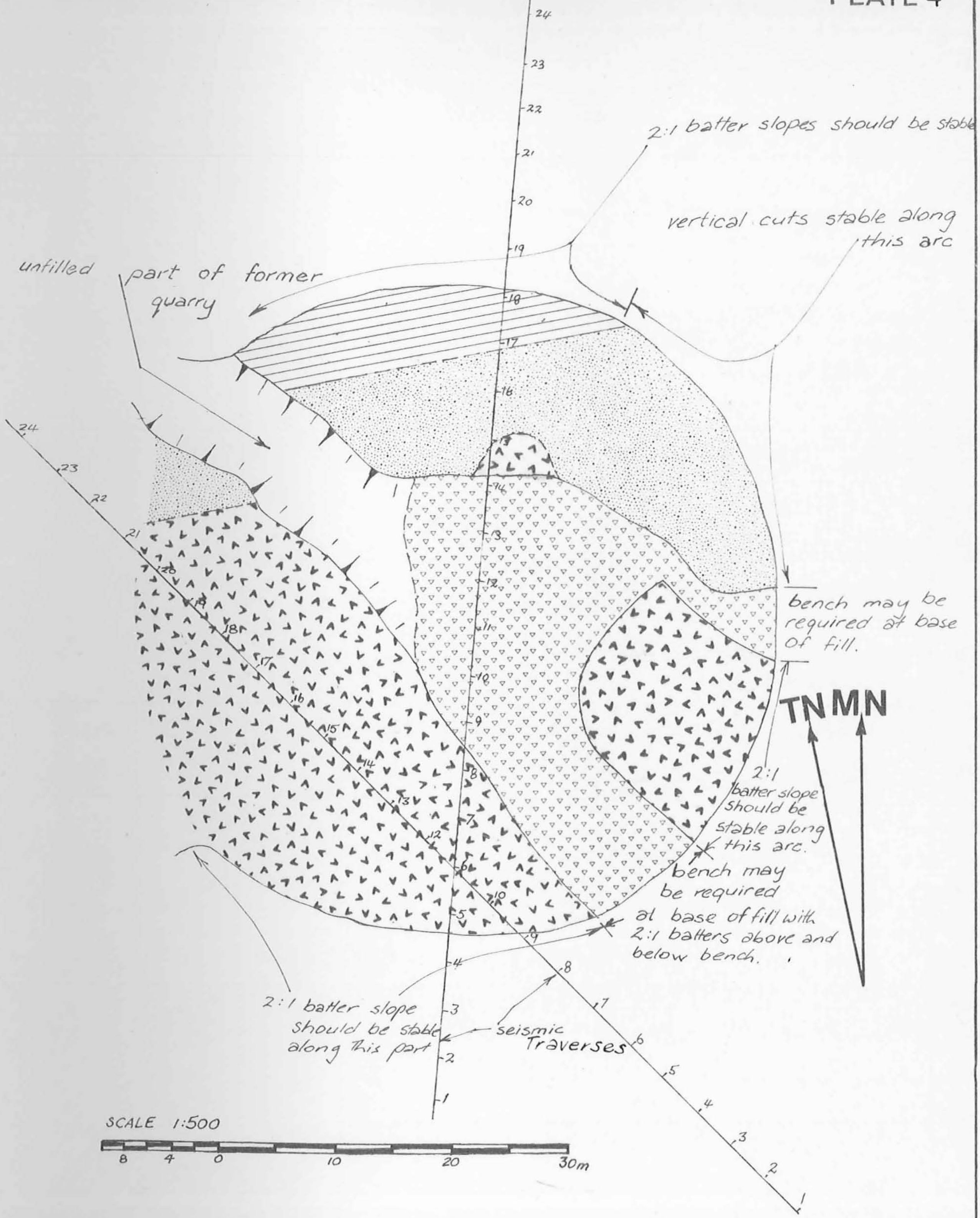


PLATE 4



soil and rock (mostly highly weathered porphyry) that is rippable to at least 4m below ground surface.

predominantly fill (former quarry); some material might foul rippers.

highly and completely weathered siltstone that is rippable to >2m

silty sandstone and sandy siltstone that are not rippable below about 1·5m below ground surface.

COMMONWEALTH OF AUSTRALIA
BUREAU OF MINERAL RESOURCES
CANBERRA, A.C.T.

TITLE
Predicted Excavation Conditions

PROJECT
Site Investigation for Hughes Reservoir at Deakin

To accompany	Drawn by	Drawing No.
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To accompany Record No.1974/71

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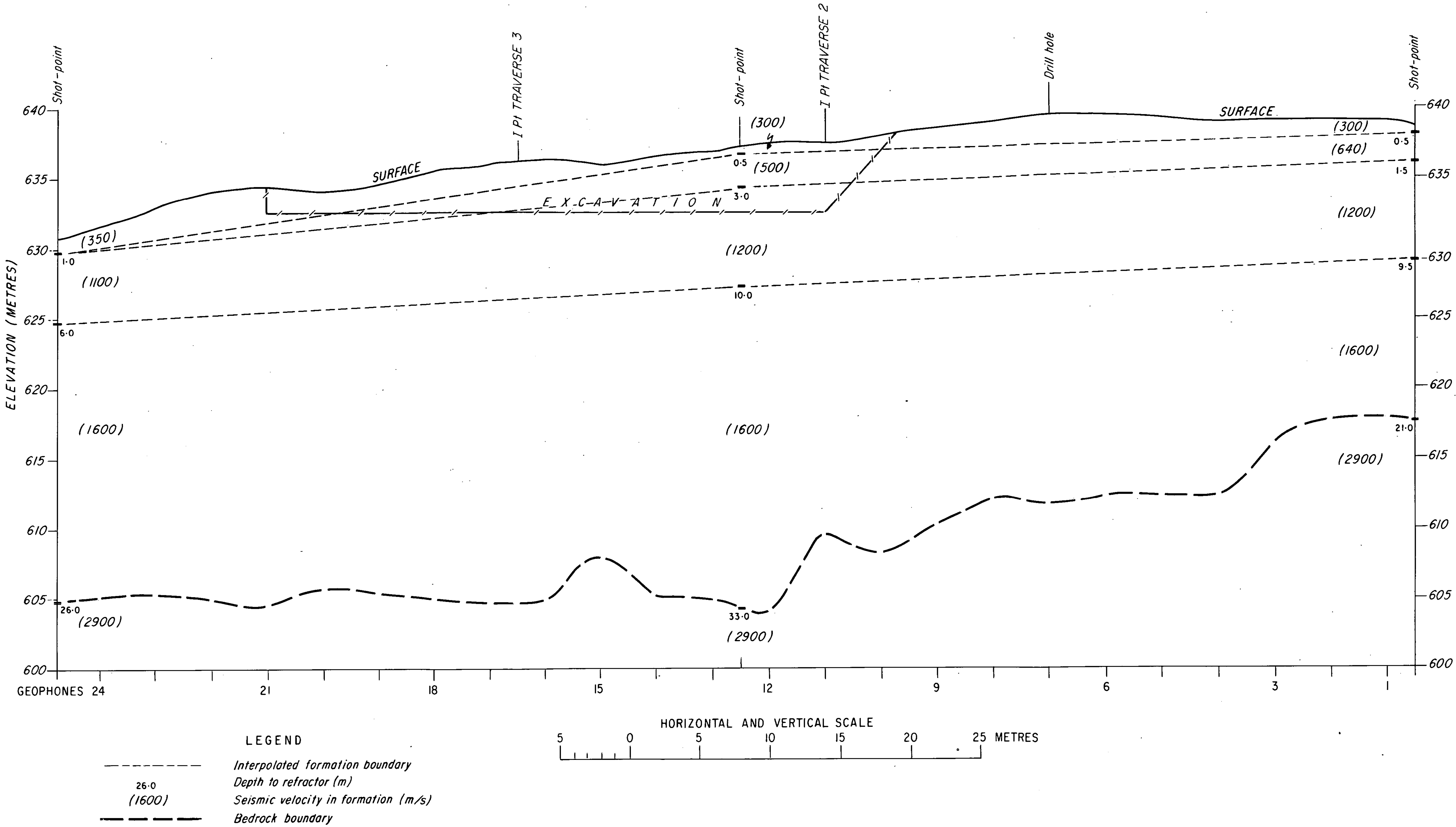
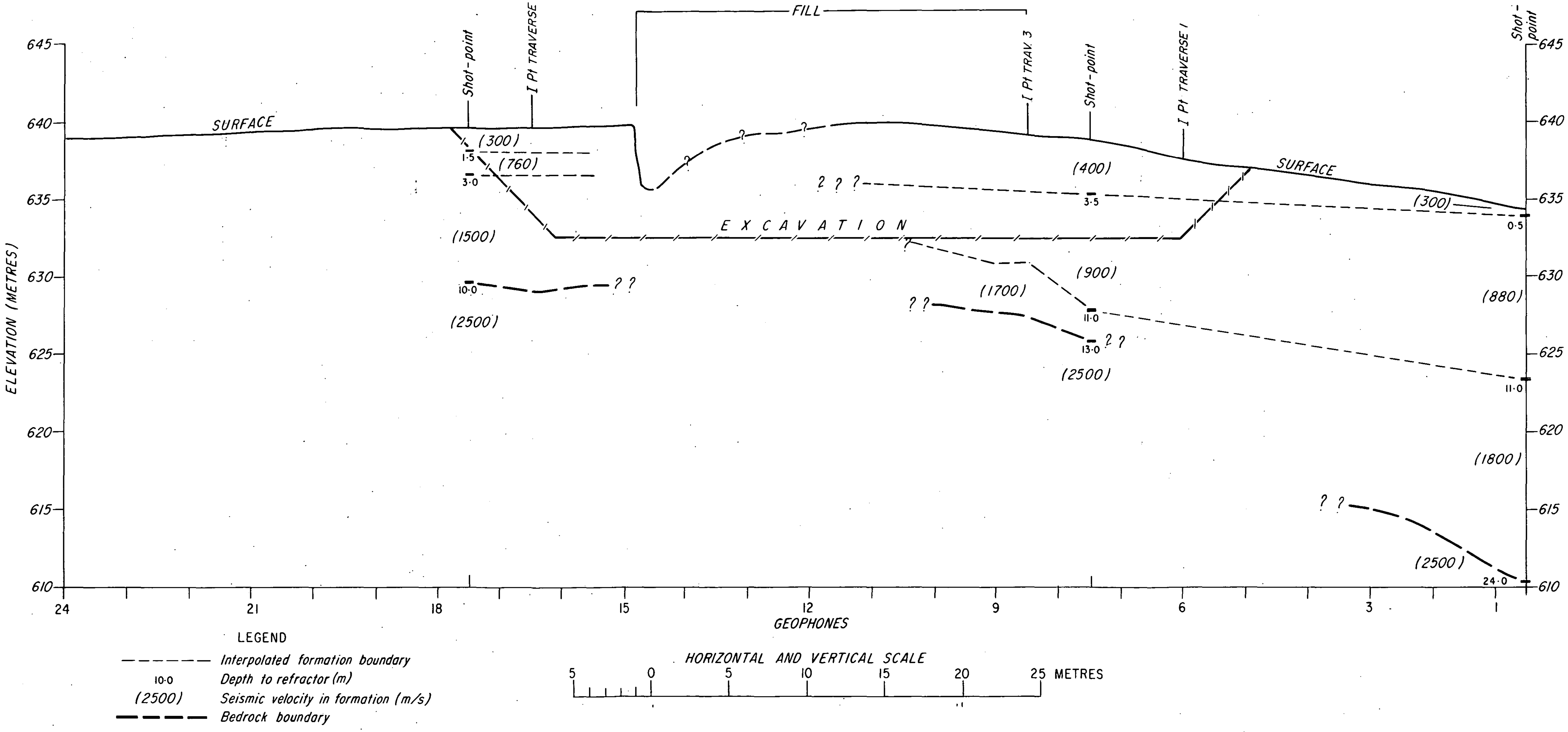
PLATE 5

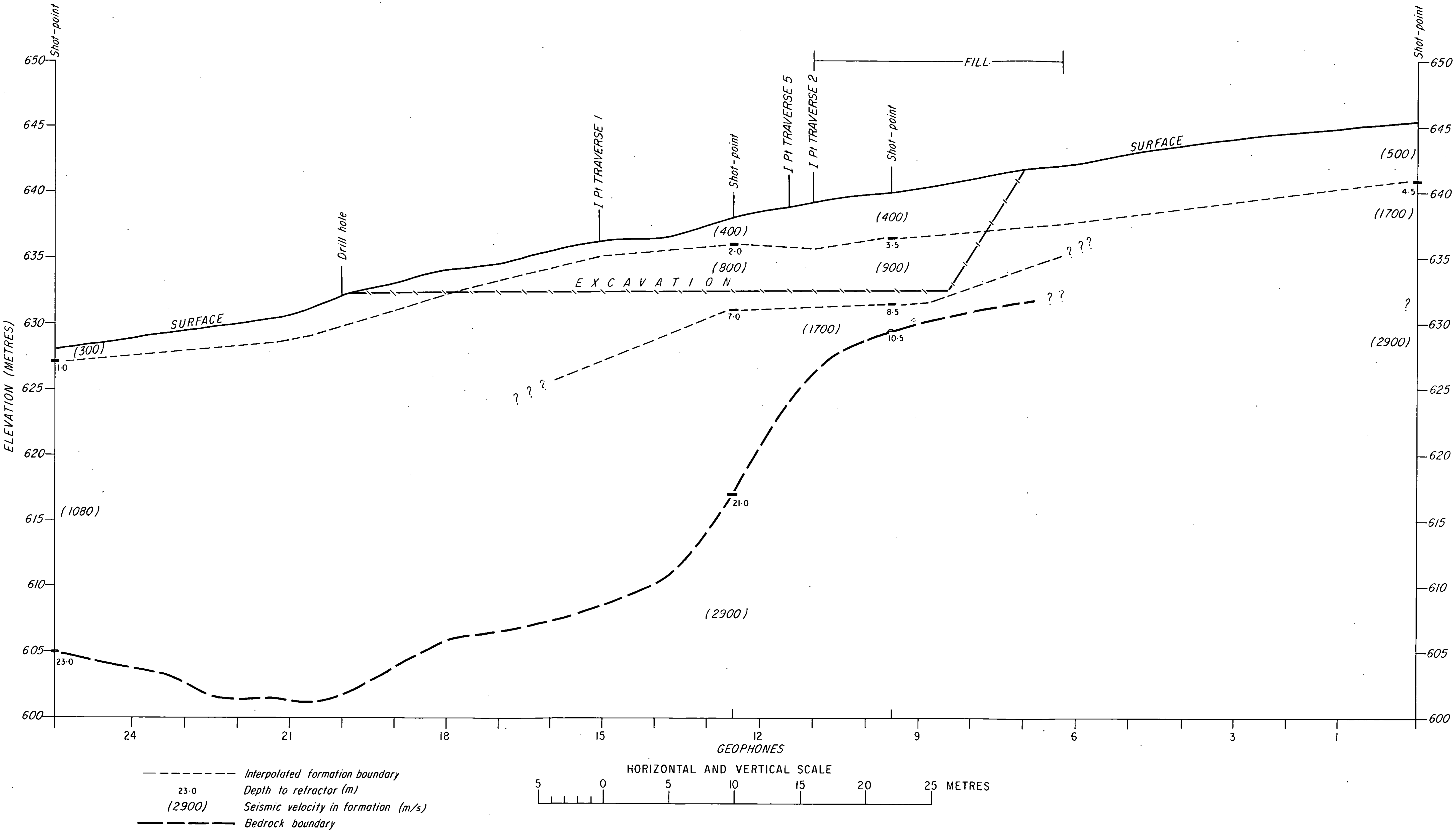


SEISMIC SECTION — TRAVERSE I

PLATE 6



SEISMIC SECTION TRAVERSE 2



HUGHES RESERVOIR SEISMIC SECTION

TRAVERSE 3

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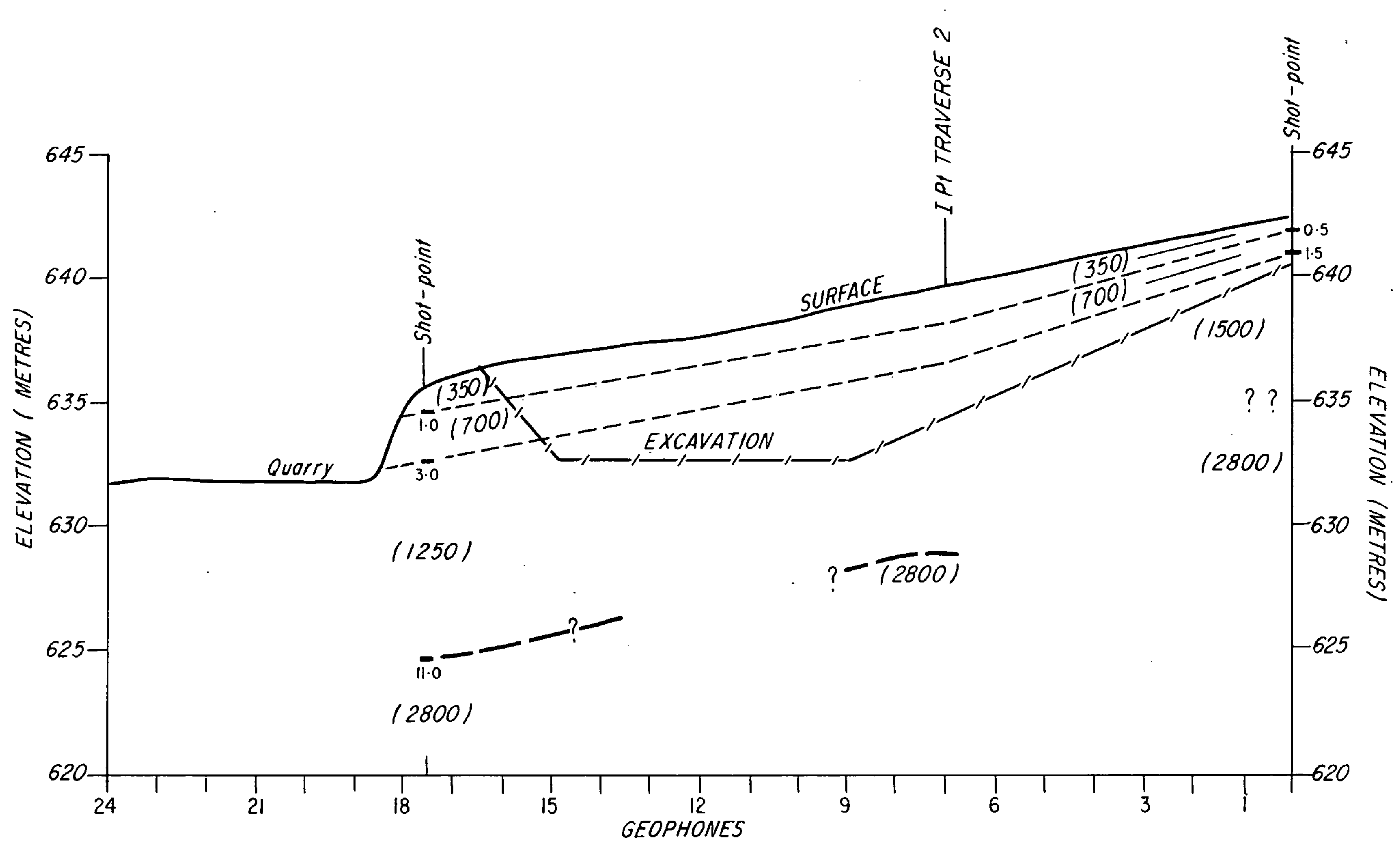
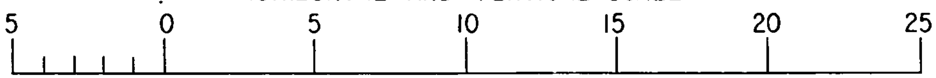


HORIZONTAL AND VERTICAL SCALE



SEISMIC SECTION
TRAVERSE 4

PLATE 8

– – – – Interpolated formation boundary   ▬ ▬ Bedrock boundary

11·0 Depth to refractor   (2800) Seismic velocity in formation (m/s)

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