COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD NO. 1962/179

GOOGONG DAM SITES, SEISMIC REFRACTION SURVEY, NSW 1962

by

M. Kirton and W.A. Wiebenga

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ILLUSTRATIONS

SUMMARY

This Record describes a geophysical survey of the Googong Saddle dam site, and an extension to the main dam site survey on the Queanbeyan River, NSW. The previous survey of the main dam site is described in Bureau of Mineral Resources Record No. 1962/58.

1. INTRODUCTION

Following the geophysical survey of the Googong dam site on the Queanbeyan River, NSW, in 1961 (Wiebenga and Kirton, 1962), further work on this site was requested by the Geological Branch of the Bureau of Mineral Resources, on behalf of the Department of Works, Canberra. The additional work comprised 750 ft of traverse to give more information on possible shear zones revealed by the 1961 survey, and 1000 ft of traverse to cover the proposed spillway area. In addition, 2250 ft of traverse was requested on the site of a saddle dam which will be required to close off a saddle in the hills upstream from the main site.

Referring to the Canberra sheet of the Australian one-mile map series, the co-ordinates of the dam site and of the saddle dam site are 278257 and 281263 respectively.

The survey was made between 13th April and 2nd May 1962 by M. Kirton (party leader), J.E.F. Gardener (geophysicist) and J.P. Pigott (geophysical assistant). The Department of the Interior provided the topographic survey of the traverses. The seismic computations were done by W.A. Wiebenga and M. Kirton.

2. METHODS

The seismic refraction technique known as the 'method of differences' (Dyson and Wiebenga, 1957) was used. The instrument used was a Midwestern 12-channel seismograph, with geophones of natural frequency 20 c/s. The geophone spacing was 25 ft or 50 ft for normal spreads and 10 ft for detailed spreads.

Measurements of vertical magnetic intensity were made with a Watts variometer along a traverse over part of the saddle dam site.

3. SADDLE DAM SITE

Geology

The geology of this site is described in an unpublished paper entitled 'Googong Dam Site, Saddle Area' by G.M. Burton of the Geological Branch, Bureau of Mineral Resources.

The saddle has been formed in a sequence of slate and dacitic tuff, which dips north-east at about 80 degrees. These sediments and volcanics are probably of Middle Silurian age and are lithologically similar to the rocks immediately upstream from the Googong Fault at the dam site.

The slate in the saddle area has been intruded by a biotite granite of probably late Silurian age. The granite resembles that which is exposed in the left bank of the dam site. It appears to have intruded and replaced a sequence of limestone beds.

In the sediments and volcanics there is a strong cleavage striking at about 170 degrees and dipping east at about 70 degrees. The grahite is not cleaved but is strongly jointed.

The boundary between slate and dacitic tuff appears to be gradational. It was tentatively positioned through seismic stations SA 450 and SB 450. The boundary between slate and granite was roughly positioned through SA 150 and SB 100.

Results

Plate 1 shows the locality plan, the layout of the traverses and some geological information.

Plate 2 shows the seismic cross-sections along the traverses, with depths to bedrock and longitudinal seismic velocities, and the vertical magnetic intensity profile along Traverse SB. The ordinate of this profile was selected so that an increase in vertical intensity corresponds to an increase in magnetic material in the rock.

Table 1 gives the probable interpretation of the measured seismic velocities in terms of rock type.

TABLE 1

Longitudinal seismic velocity (ft/sec)	Geological formation
1000 to 1200	Soil
3000 to 4000	Very weathered and decomposed rock, very jointed rock with open joints.
5000 to 7000	Weathered and jointed rock with joints partially closed or cemented.
10,000 to 11,000	Slightly weathered or slightly jointed slate bedrock.
14,000	Dacitic tuff bedrock

The 10,000-ft/sec and the 14,000-ft/sec layers were the deepest refractors recorded and so are classified as bedrock.

Between stations SA 00 and SA 300, and stations SB 00 and SB 350, the bedrock in which the velocity is 10,000 to 10,500 ft/sec corresponds to slate. Between stations SA 450 and SA 1000, and stations SB 450 and SB 750 the bedrock in which the velocity is 14,000 ft/sec corresponds to dacitic tuff. Between stations SA 350 and SA 450, and between SB 350 and SB 450, the data are insufficient to give a precise value of bedrock velocity. It is about 5000 ft/sec, which corresponds to fractured or deeply weathered rock. This places the contact in the vicinity of station 400 on both lines. Consequently Traverse SC is on the contact, and depth measurements made along it are not reliable. The anomaly on the magnetic profile along Traverse SB also indicates a zone of deeper weathering associated with a contact between stations 350 and 450.

The results gave no indication of higher velocities that would be expected for granite on the eastern ends of Traverses SA and SB. Hence the slate/granite contact is presumably east of stations SA 00 and SB 00.

Conclusions

The survey indicates that the dacite/slate contact is about 70 ft wide and in this region the rock is deeply weathered or fractured or both. There could be a high rate of water seepage along it.

The overburden velocity of 5000 to 7000 ft/sec indicates considerable weathering and jointing which could also allow a high rate of seepage. Some grouting or the sinking of an impervious barrier might be required if the dam is built on this layer.

The slate bedrock velocity of 10,000 ft/sec, measured roughly normally to the strike, is rather low and may indicate open cleavage planes.

The dacitic tuff bedrock appears to be sound and unweathered and would form a strong and impervious dam foundation.

It is recommended that the region of the contact, the slate bedrock, and the overburden be investigated further by drilling and water-pressure testing.

4. EXTENSION OF MAIN DAM SITE SURVEY

Geology

The geology of this area is briefly described by Wiebenga and Kirton (1962).

Results

Plate 3 shows the locality plan and the layout of the traverses. Plate 4 shows the seismic cross-sections along the traverses, with depths to bedrock and longitudinal seismic velocities.

Table 2 gives the probable interpretation of the measured seismic velocities in terms of rock type.

TABLE 2

Longitudinal seismic velocity (ft/sec)	Geological formation
1000 to 2000	Soil or rubble
3000 to 5000	Scree material, or very weathered, jointed rock, with joints open.
5000 to 8000	Weathered to moderately weathered, jointed rock, joints partly open or cemented with weathered minerals.
9000 to 14,000	Moderate to slightly jointed and weathered rock or fractured bedrock in a shear or fault zone.
15,000 to 20,000	Unweathered, very slightly jointed to completely unjointed bedrock.

Rocks in which the velocities range from 9000 to 14,000 ft/sec are classified as bedrock because they are the deepest seismic refractor recorded on some traverses.

Traverse L was required to define a possible shear zone suggested by the 13,000-ft/sec velocity recorded on Traverse J. The 15,000-ft/sec velocity measured along Traverse L proves there is not a shear zone there and suggests that the low velocity along Traverse J is due to slight jointing across the direction of Traverse J.

Traverse M shows a continuation of the high bedrock velocity recorded between J7 and J9, followed by a zone of lower bedrock velocity. This could be a region of heavier weathering, or jointing.

Traverses N and O lie in the area of a proposed spillway. The change in bedrock velocity along Traverse N could correspond to the dacite/granite contact, the continuation of which is not shown on the geological map. The 14,000-ft/sec velocity is associated with dacite in this area, while the 16,000 to 18,000-ft/sec velocity along Traverse O and the northern end of Traverse N probably is associated with a sound unweathered granite. The velocities in the intermediate layers along Traverse O are indicative of weathered granite.

Traverse P on the left bank was surveyed to determine the existence of a possible shear zone running between stations B6 and B7, and C7 and C8. However, the 16,000-ft/sec velocity in the bedrock along this traverse disproves the existence of such a shear zone. The depths to bedrock along this traverse are, in general, less than those at neighbouring points on the other traverses. This suggests that there is a step or cliff in the bedrock surface and that this traverse is along the edge of it.

Conclusions

In general, this survey removed uncertainties raised by the previous survey. However, if the right-hand wall of the dam is to extend to the region M100 to M250, it is recommended that further investigation be carried out here.

5. REFERENCES

WIEBENGA, W.A. and KIRTON, M. 1962 Googong dam site seismic refraction survey, NSW 1961. Bur. Min. Resour. Aust. Rec. 1962/58.

DYSON, D.F., and WIEBENGA, W.A. 1957 Final report on geophysical investigations of underground water, Alice Springs, NT 1956. Bur. Min. Resour. Aust. Rec. 1957/89.

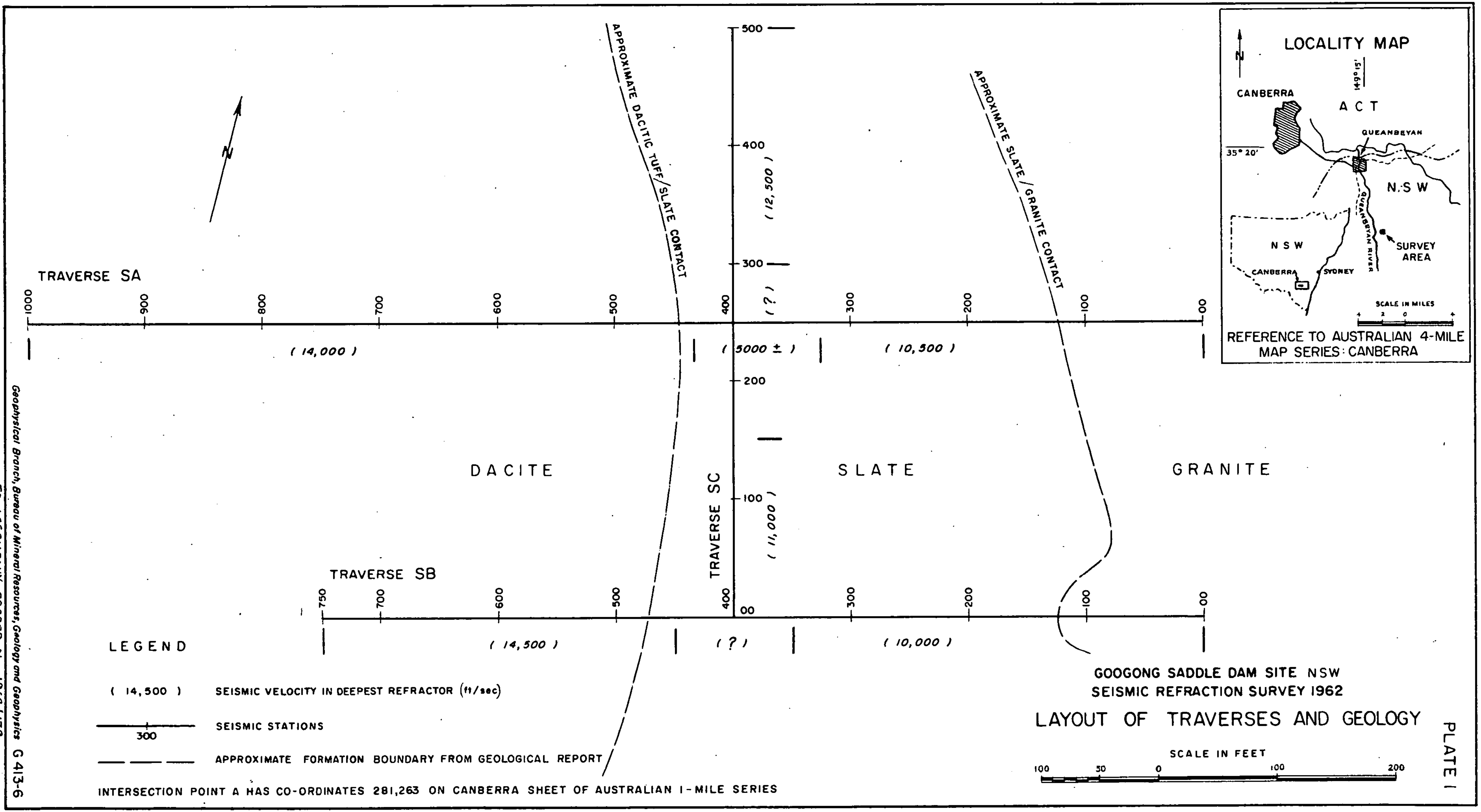
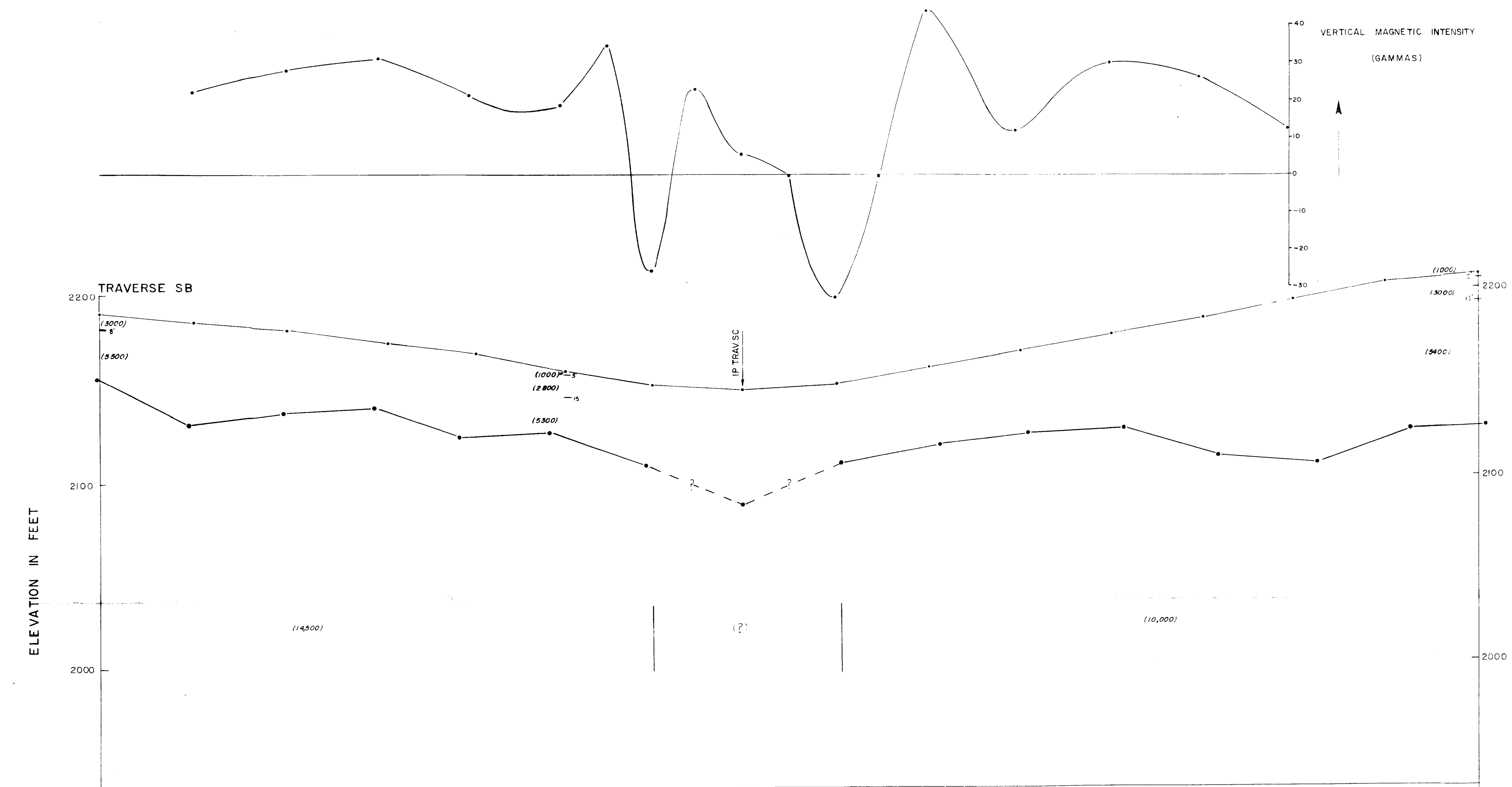
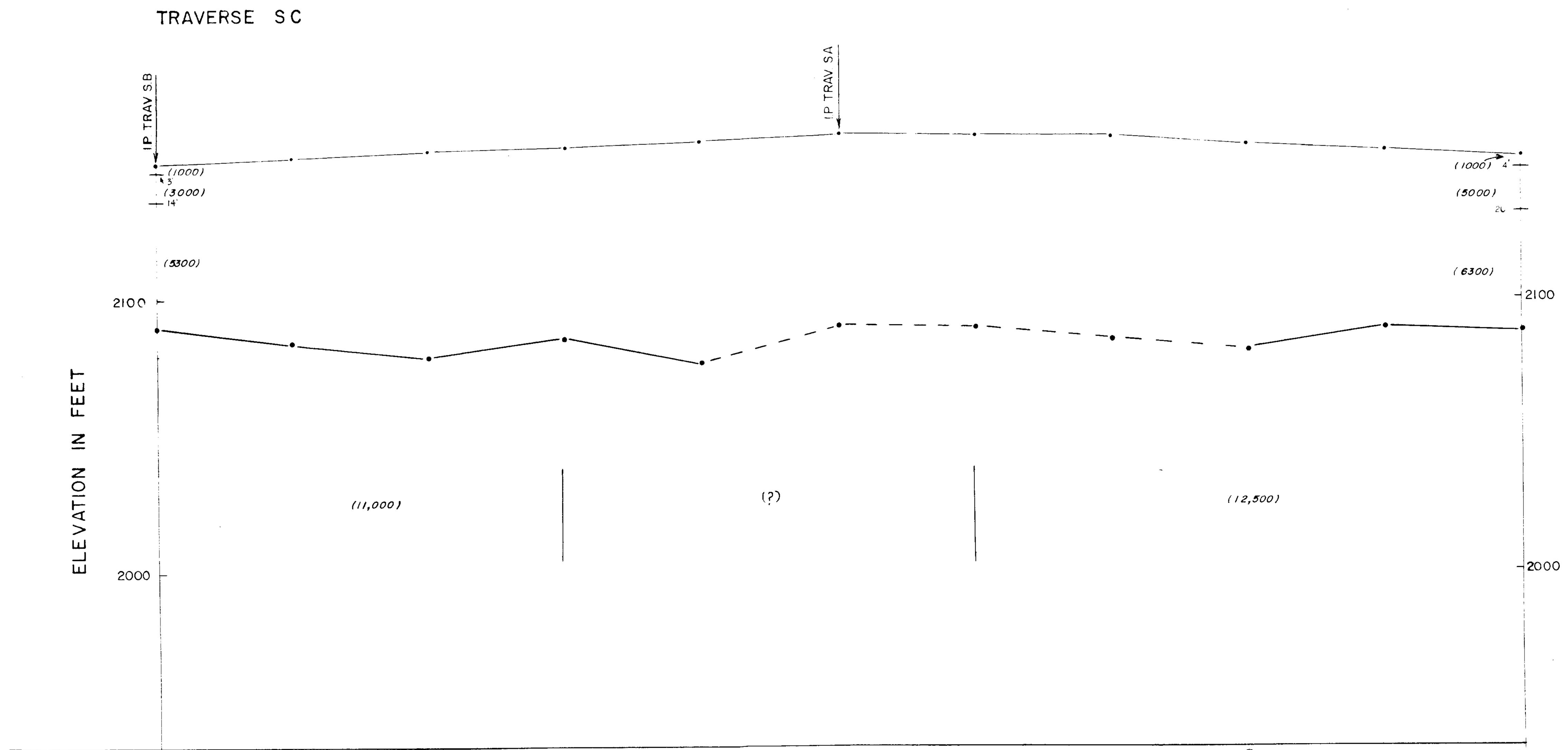

LOCALITY MAP
N
149°15'
CANBERRA
A C T
QUEANBEYAN
35° 20'
N.S W
QUEANBEYAN RIVER
SURVEY AREA
N S W
CANBERRA
SYDNEY
SCALE IN MILES
REFERENCE TO AUSTRALIAN 4-MILE MAP SERIES: CANBERRA
APPROXIMATE DACITIC TUFF/SLATE CONTACT
APPROXIMATE SLATE/GRANITE CONTACT
TRAVERSE SA
TRAVERSE SB
TRAVERSE SC
(14,000)
(5000 ±)
(10,500)
(12,500)
(?)
(11,000)
(14,500)
(10,000)
DACITE
SLATE
GRANITE
LEGEND
(14,500) SEISMIC VELOCITY IN DEEPEST REFRACTOR (ft/sec)
SEISMIC STATIONS
APPROXIMATE FORMATION BOUNDARY FROM GEOLOGICAL REPORT
INTERSECTION POINT A HAS CO-ORDINATES 281,263 ON CANBERRA SHEET OF AUSTRALIAN 1-MILE SERIES
GOOGONG SADDLE DAM SITE NSW
SEISMIC REFRACTION SURVEY 1962
LAYOUT OF TRAVERSES AND GEOLOGY
SCALE IN FEET
PLATE I
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G 413-6
TO ACCOMPANY RECORD No. 1962/179

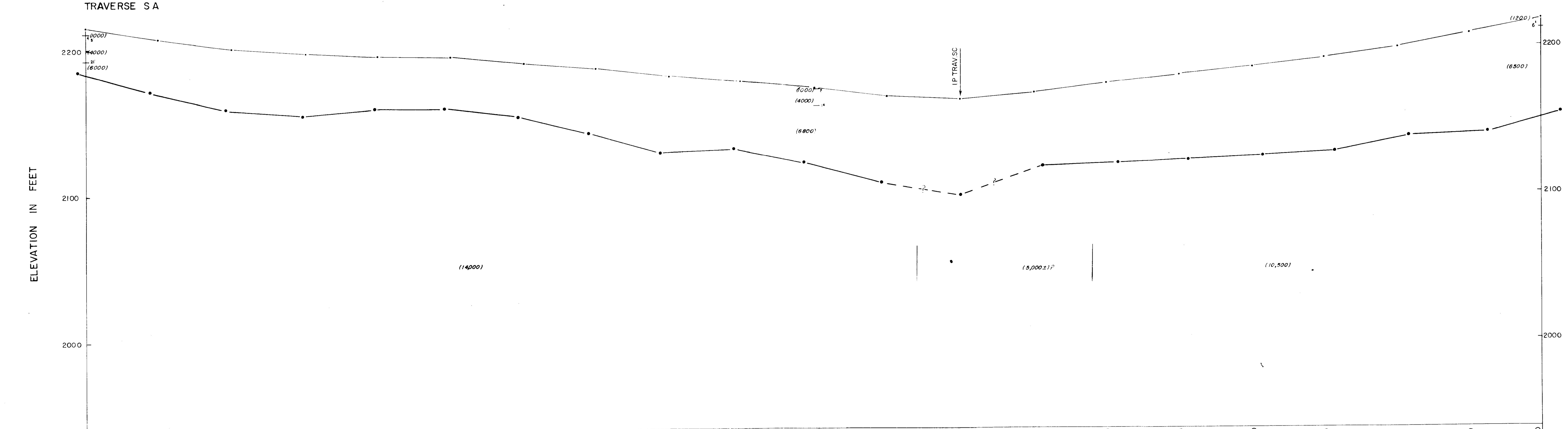
PLATE 2



STATION NUMBER	750	700	650	600	550	500	450	400	350	300	250	200	150	100	50	00
STATION ELEVATION	2191	2187	2183	2177	2171	2161	2152	2150	2152	2160	2169	2177	2185	2195	2205	2208
DEPTH TO BEDROCK	34	55	44	36	46	35	44	62±10	43	41	44	51	74	88	80	62



STATION NUMBER	00	50	100	150	200	250	300	350	400	450	500
STATION ELEVATION	2150	2152	2155	2156	2159	2160	2160	2160	2157	2155	2152
DEPTH TO BEDROCK	60	68	75	70	81	70±10	70±15		75	65	64



STATION NUMBER	1000	950	900	850	800	750	700	650	600	550	500	450	400	350	300	250	200	150	100	50	00
STATION ELEVATION	2210	2202	2196	2192	2190	2190	2186	2181	2177	2172	2168	2162	2160	2166	2172	2178	2183	2188	2195	2206	2215
DEPTH TO BEDROCK	31	36	42	43	36	36	37	44	52	46	51	59	66±10	51	56	58	61	64	61	69	64

LEGEND

(7,000) SEISMIC VELOCITY IN ft/sec

I.P. INTERSECTION POINT

UNWEATHERED BEDROCK BOUNDARY

NATURAL SURFACE

GOOGONG SADDLE DAM SITE

VERTICAL MAGNETIC INTENSITY PROFILE ALONG TRAVERSE SB

AND SEISMIC CROSS-SECTIONS ALONG TRAVERSES SA, SB AND SC

HORIZONTAL AND VERTICAL SCALE IN FEET

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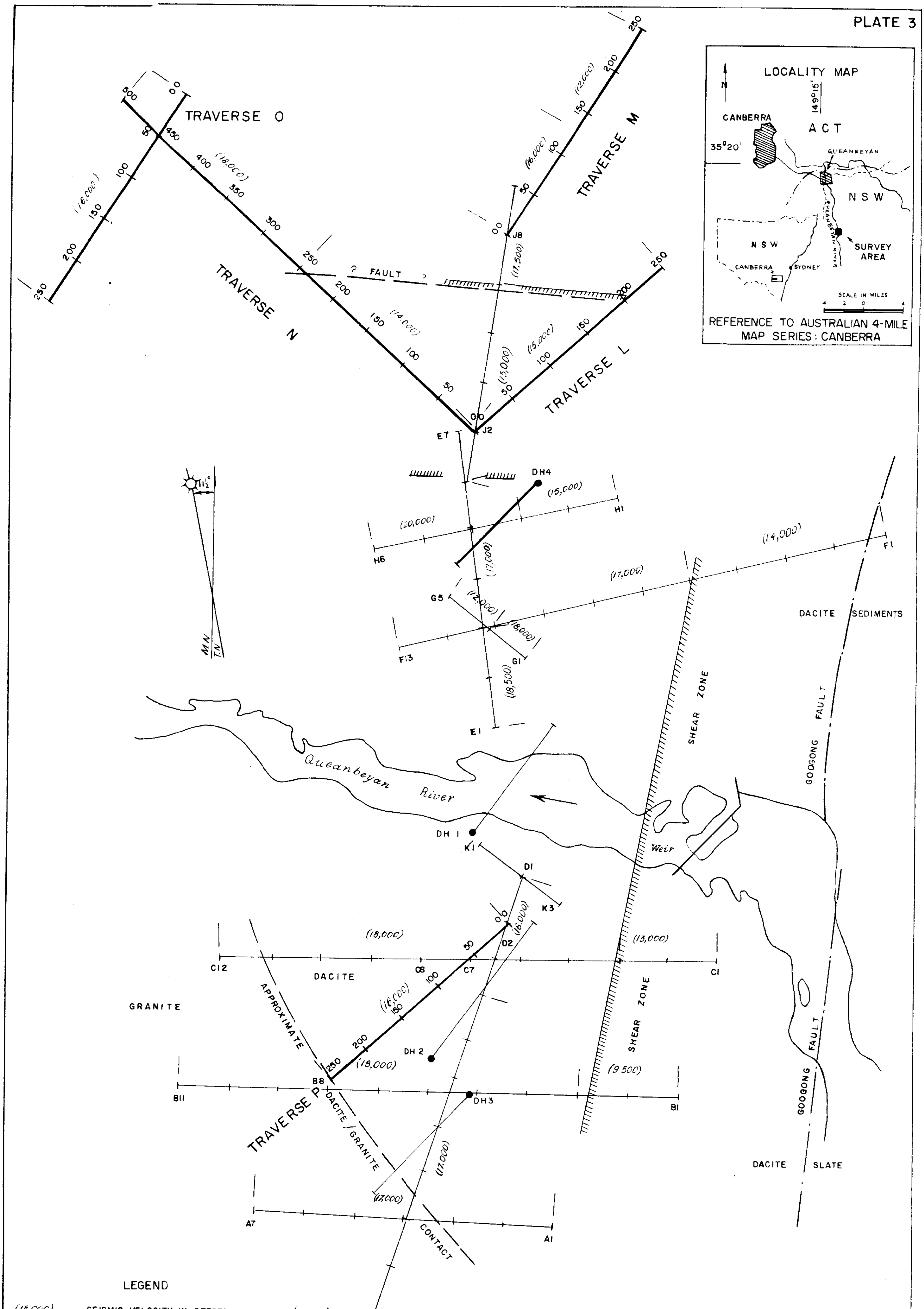
GOOGONG SADDLE DAM SITE N.S.W. 1962

PLATE 3



LEGEND

(18,000)	SEISMIC VELOCITY IN DEEPEST REFRACTOR (ft /sec)
50	SEISMIC STATION ON EXTENSION SURVEY
DH1	INCLINED DRILL HOLE
	SHEAR ZONE BOUNDARY
	FAULT FROM GEOLOGICAL REPORT
J2	SEISMIC STATION ON ORIGINAL SURVEY

EXTENSION TO GOOGONG DAM SITE

SEISMIC REFRACTION SURVEY N S W 1962

LAYOUT OF TRAVERSES AND GEOLOGY

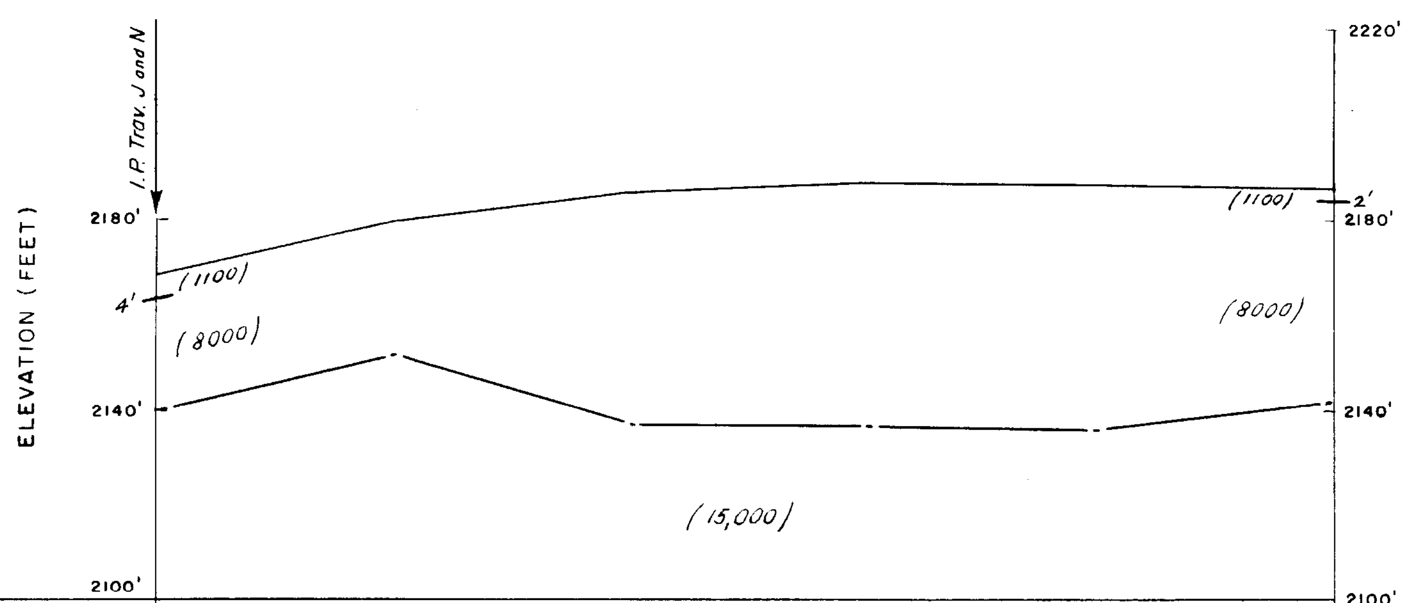
SCALE IN FEET

100 0 100 200 300

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS G413-7

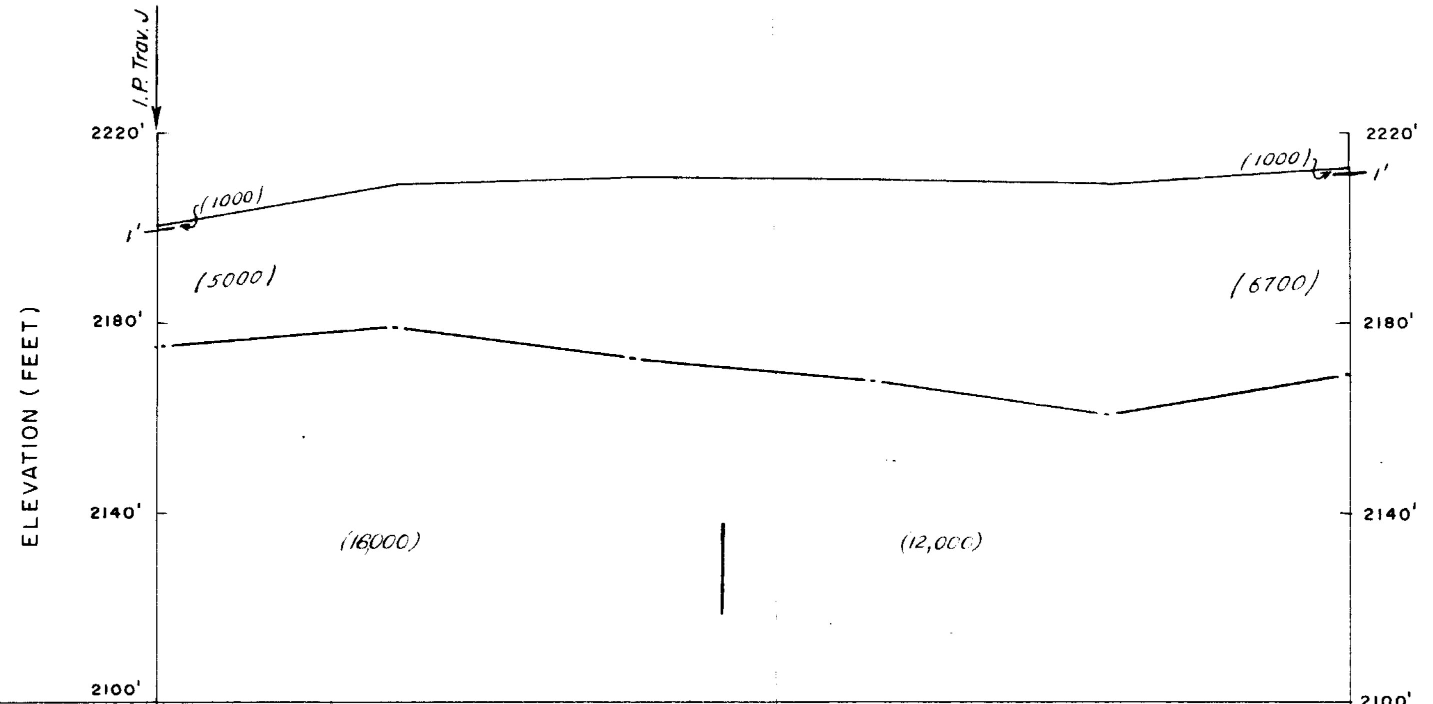
TO ACCOMPANY RECORD No. 1962/79

TRAVERSE L



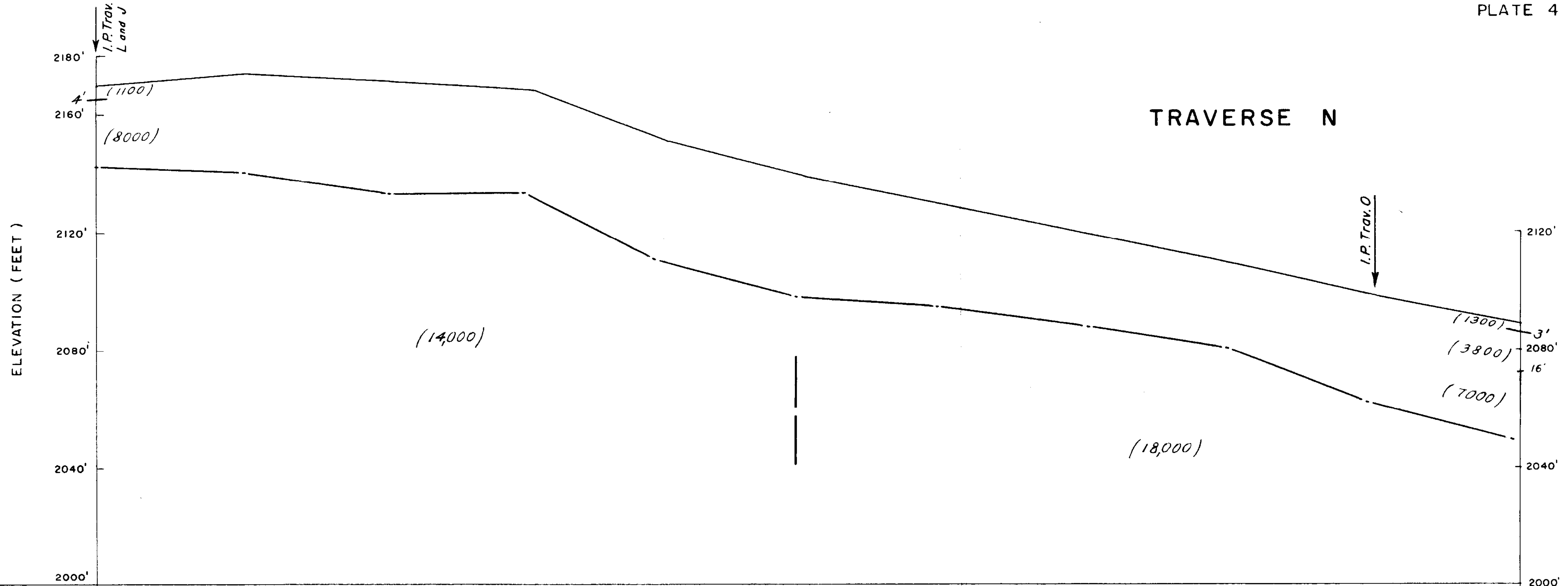
STATION NUMBER	00	50	100	150	200	250
STATION ELEVATION	2168	2178	86	87	87	2186
DEPTH TO BEDROCK	28'	28'	49'	51'	52'	45'

TRAVERSE M



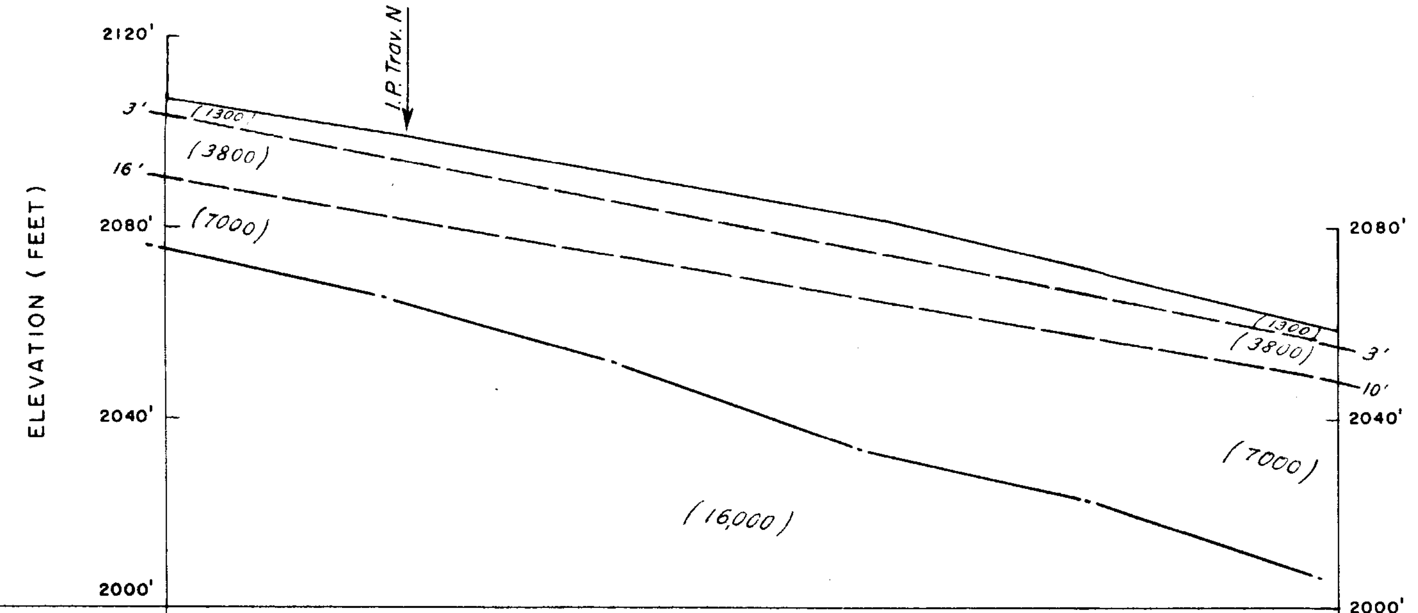
STATION NUMBER	00	50	100	150	200	250
STATION ELEVATION	2200	2208	11	09	09	2211
DEPTH TO BEDROCK	25'	29'	38'	42'	48'	43'

TRAVERSE N



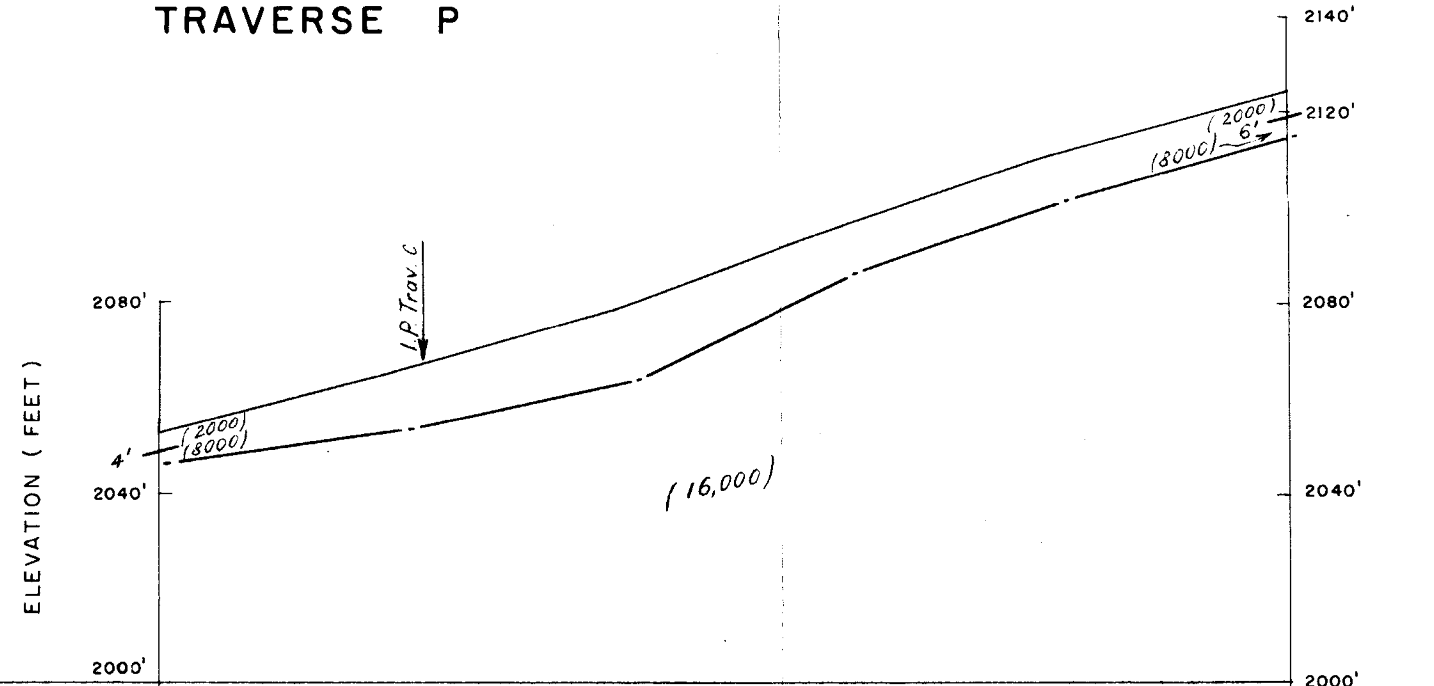
STATION NUMBER	00	50	100	150	200	250	300	350	400	450	500
STATION ELEVATION	2168	72	70	67	49	38	28	18	08	2098	2089
DEPTH TO BEDROCK	28'	34'	38'	35'	40'	41'	34'	31'	29'	36'	39'

TRAVERSE O



STATION NUMBER	00	50	100	150	200	250
STATION ELEVATION	2105	2098	89	80	68	2057
DEPTH TO BEDROCK	31'	34'	39'	48'	47'	52'

TRAVERSE P



STATION NUMBER	00	50	100	150	200	250
STATION ELEVATION	2051	64	77	95	10	2123
DEPTH TO BEDROCK	6'	12'	15'	10'	10'	9'

LEGEND:

(17,000)	SEISMIC VELOCITY IN ft/sec
I.P.	INTERSECTION POINT
———	UNWEATHERED BEDROCK BOUNDARY

EXTENSION TO GOOGONG DAM SITE

SEISMIC CROSS-SECTIONS ALONG TRAVERSES L, M, N, O, AND P

SCALE IN FEET

40 20 0 40 80 120 160

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GOOGONG SADDLE DAM SITE N.S.W. 1962