COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

RECORDS
1957, No. 59

SEISMIC REFRACTION SURVEY OF THE MURCHISON RIVER DAM SITE, TASMANIA

by

E.J. POLAK

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ILLUSTRATIONS

ABSTRACT

Details and results are given of a seismic refraction survey carried out by the Bureau of Mineral Resources, on behalf of the Hydro-Electric Commission of Tasmania, to investigate a proposed dam site on the Murchison River, near Tullah, Tasmania. The objects of the survey were to determine the natures of the overburden and bedrock, and the depth to bedrock.

Results indicate that the overburden, consisting of soil and scree, is up to 100 feet thick; the seismic velocity in the overburden ranges from 1,000 to 5,000 ft/sec. The seismic velocity in the bedrock, which consists of rocks of the Owen Conglomerate and Dundas Group, ranges from 8,000 to 18,000 ft/sec. Unfortunately, there are no drill holes which could be used for correlation purposes and for control of the seismic data.

It is estimated that the thickness of the overburden has been calculated with a maximum error of $\pm$ 25 per cent.

1. INTRODUCTION

The Hydro-Electric Commission of Tasmania proposes to erect a dam on the Murchison river about 2 miles above its junction with the Mackintosh river, near the township of Tullah (Plate 1). The dam will be part of the Pieman River scheme. The Murchison power station will use water from the Mackintosh and Murchison rivers.

A possible site for the dam was chosen by the Commission from aerial photo-maps. The site is located between Mt. Farrell and Mt. Little Farrell. The survey described in this report was carried out by the Bureau of Mineral Resources in response to an application from the Commission; the objects of the survey were to determine the natures of the overburden and bedrock and the depth to bedrock at the proposed site.

The survey was made in March, 1957 by a geophysical party consisting of E.J. Polak, geophysicist, and J. Kronenburg, geophysical assistant. The Commission provided additional assistants and carried out the topographical survey of the traverse lines (see Plate 1).

2. GEOLOGY

The geology of the area has been described by Ward (1908) and Bradley (1954, 1956). A detailed geological examination of the site was made by Mather (1957), and his geological map is reproduced on Plate 2 of this report.

The surveyed area is located in a valley with vertical cliffs on both sides. The sides of the valley consist of Owen Conglomerate. The valley is filled with scree, but a few outcrops of Dundas Group rocks are present along the river.

The Dundas Group rocks are of Cambrian age (Opik, 1951), and consist of shale, slates, cherts, schists and graywacke, some of which weather very easily. In the area of the dam site, the bedding planes of the rocks are nearly vertical.

The Owen Conglomerate belongs to the West Coast Conglomerate series and is of Cambro-Ordovician age (Opik, 1951). The conglomerate is wholly quartzose in composition. The pebbles, generally 2 to 4 inches in size, but often larger, consist mainly of reef quartz and quartz schist. The matrix has been altered to quartzite. The rock is strongly resistant to weathering.

The scree consists entirely of blocks of Owen Conglomerate up to 25 feet in size.

A possible fault is indicated on the geological plan.

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3. METHODS AND EQUIPMENT

The seismic refraction method of survey was used. This method depends on the contrast in the velocities of seismic waves through rock formations possessing different elastic properties and densities. The hard, unweathered rocks have higher velocities than their weathered counterparts, and these in turn have higher velocities than soil and unconsolidated deposits.

The method of differences (Heiland, 1946) was used in the present survey and the following types of spread were shot :-

(i) Weathering spreads. These were used to obtain seismic wave velocities in, and the thickness of, the near-surface layers. Geophone interval was 10 ft., and shot points were 5 ft. and 25 ft. from both ends of the spread.

(ii) Normal spreads. The geophone interval was 25 ft. or 50 ft. and shot points were 25 ft. and 250 ft. from both ends of the spread.

Additional velocity tests were carried out in two old mines as follows :-

(a) To determine the seismic velocity in the Owen Conglomerate, shots were recorded in an adit of an old hematite mine near the northern end of traverse C-D (Plate 2).

(b) To determine the seismic velocity in the Dundas Group rocks, shots were recorded in the Old Murchison Mine mid-way between the proposed dam site and Tullah township (Plate 1, inset).

A Century 12-channel portable refraction seismograph, Model 506, was used, with Technical Instruments Co. geophones of natural frequency about 20 cycles per second.

The total length of traverse surveyed was 4300 feet.

4. RESULTS

Table 1 gives the compressional wave velocities for the various rock types at the Murchison river dam site.

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TABLE 1.

Rock Type	Seismic Velocity (ft/sec.)	Young's Modulus (c.g.s. units)
Soil	1000	
Scree	2000 to 5000	
Owen Conglomerate	11,000 to 17,000	4.4×10^{11} to 7.2×10^{11}
Dundas Group	8000 to 14,000(?)	

There are no drill holes in the area which could be used for correlation purposes. However, it is believed that the velocity of 8000 to 14,000 ft/sec. corresponds to the velocity in the Dundas Group rocks, as these velocities occur within a strip of ground near the river in which rocks of the Dundas Group crop out.

The velocity in the Dundas Group rocks as measured in the Murchison Mine was 7000 ft/sec. The rock in the mine is sheared and possibly partly weathered.

The velocity in the Owen Conglomerate as measured in the adit near the northern end of traverse C-D is 11,100 ft/sec; on traverse C-D, near the Owen Conglomerate outcrop, it is 11,000 ft/sec., and on other traverses it is up to 17,000 ft/sec.

As the maximum velocity recorded in the Dundas Group is within the range of velocities recorded in the Owen Conglomerate, the boundary between these two formations cannot be accurately indicated.

The relatively low velocities in the Dundas Group may have been caused by shearing or fracturing (suggested by the possible fault indicated on the geological map). Alternatively, the lithology may be such that no high velocities should be expected. On the Mackintosh River dam site (Polak, 1957), the velocity in the Dundas Group ranges from 8000 to 19,000 ft/sec.

Plate 3 shows the interpretation of the seismic results in the form of profiles indicating the thickness of scree and soil (overburden). The surface of the bedrock is uneven, and a section across the river has the form of a broad U-shaped valley with the slope increasing from the centre to the side of the valley.

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It is believed that the error in the computed overburden thickness does not exceed ± 25 per cent. As previously stated, there are no drill holes to check the seismic calculations.

Assuming a density of 2.8 for the Owen Conglomerate and a Poisson's ratio of 0.3 (for low velocities) and 0.1 (for high velocities), (Birch, Schairer and Spicer, 1950), approximate values were computed for Young's Modulus from the seismic velocities and these are indicated in Table 1. It is believed that the error in determined value is less than ± 30 per cent.

5. CONCLUSIONS

The seismic survey provided information on the depth to the bedrock at the Murchison River dam site. The overburden consists of scree and soil. The bedrock consists of Owen Conglomerate and Dundas Group Rocks. It is not possible to delineate the contact between these two formations accurately from seismic observations only.

The existence of the fault shown on the geological map was not definitely confirmed by the seismic results and it is believed that no other geophysical method would indicate conclusively the existence of this fault.

6. BIBLIOGRAPHY

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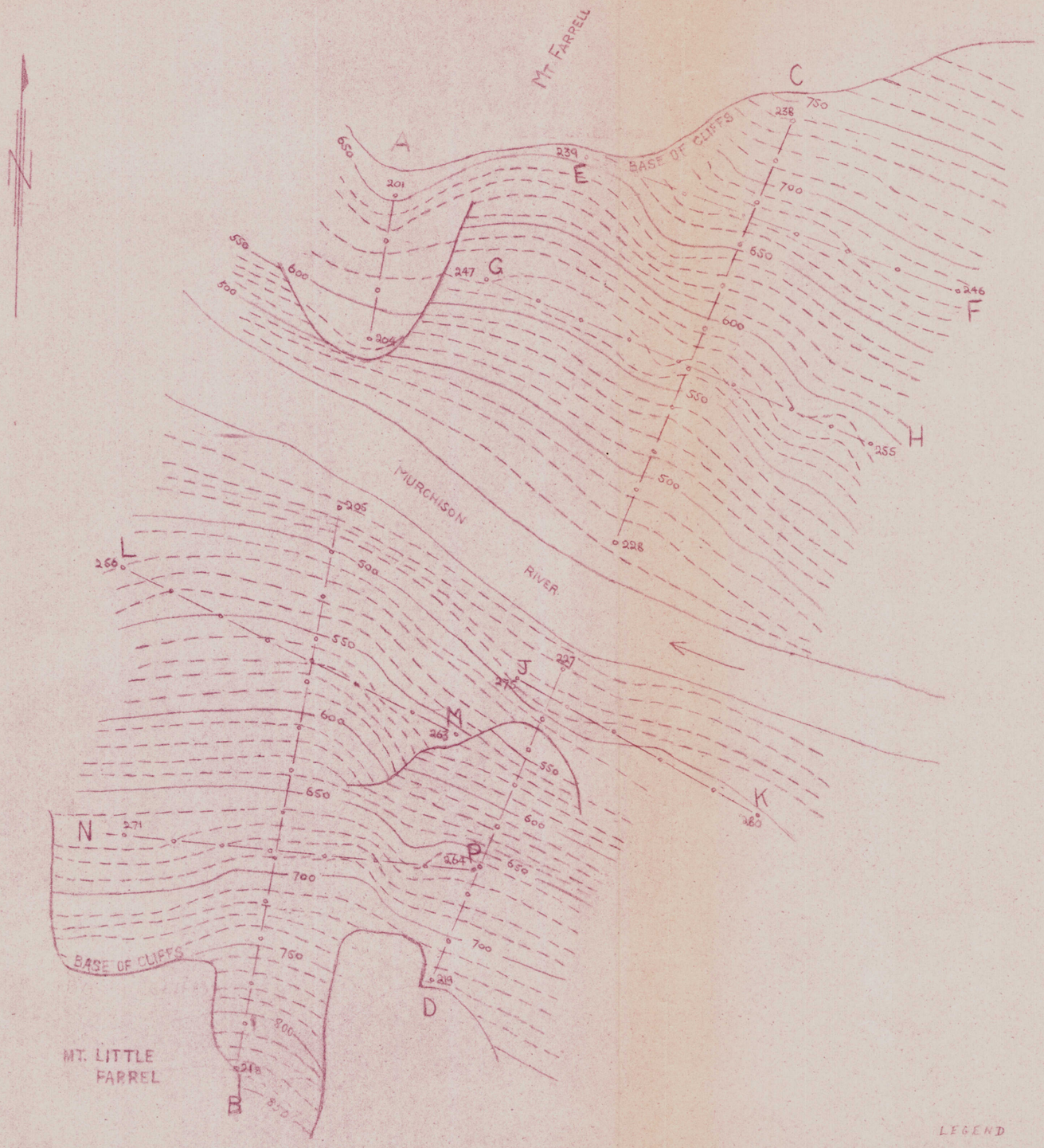
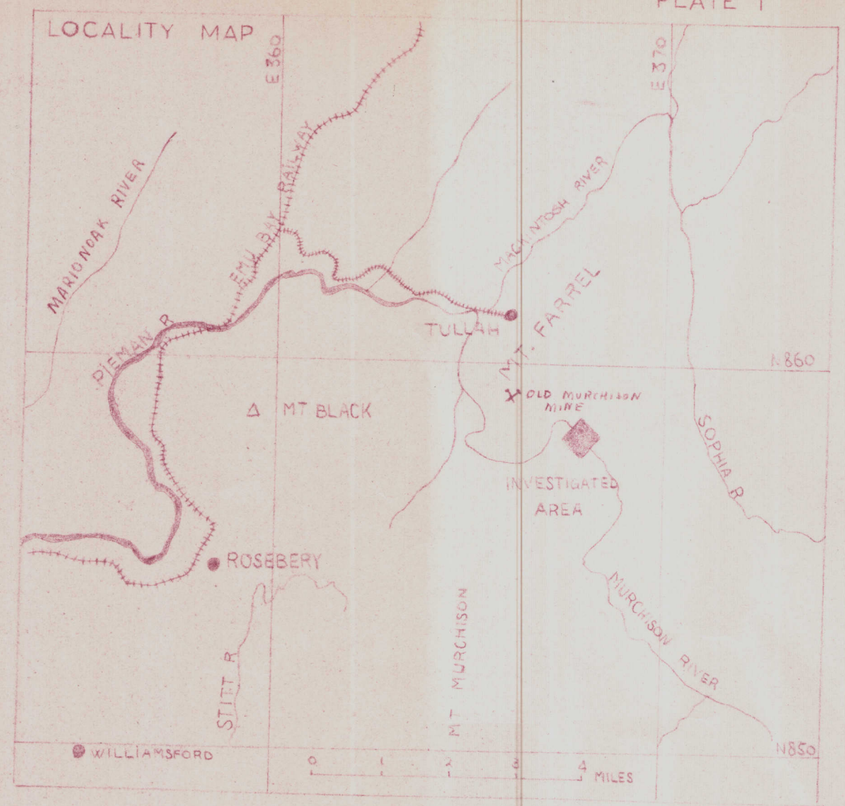
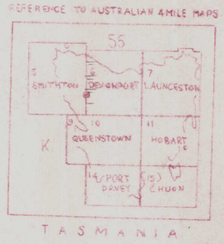
PLATE I





REFERENCE TO AUSTRALIAN AMILE MAPS



LEGEND

SURFACE CONTOURS

GEOPHYSICAL TRAVERSE

E. J. Polak
GEOPHYSICIST

SEISMIC REFRACTION SURVEY
OF THE
MURCHISON RIVER DAM SITE, TASMANIA
TOPOGRAPHICAL CONTOURS
AND
GEOPHYSICAL TRAVERSES

SCALE IN FEET
100 0 100 200 300

Bureau of Mineral Resources, Geology and Geophysics G271-1

PLATE 2

N

LEGEND

SCREE

OWEN CONGLOMERATE

DUNDAS GROUP ROCKS

GEOLOGY AFTER R.P. MATHER H.E.C. GEOLOGIST

E.J. Polak
GEOPHYSICIST

SEISMIC REFRACTION SURVEY OF THE MURCHISON RIVER DAM SITE, TASMANIA

GEOLOGICAL MAP

SCALE IN FEET

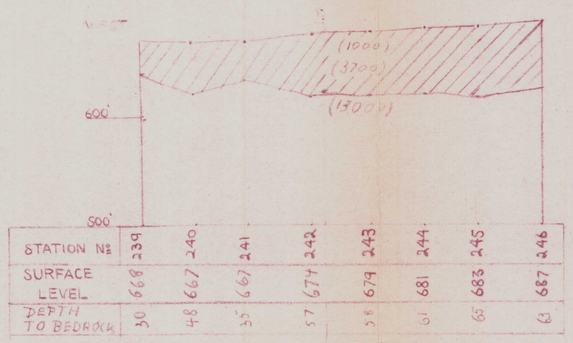
0 100 200 300

G277-2

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

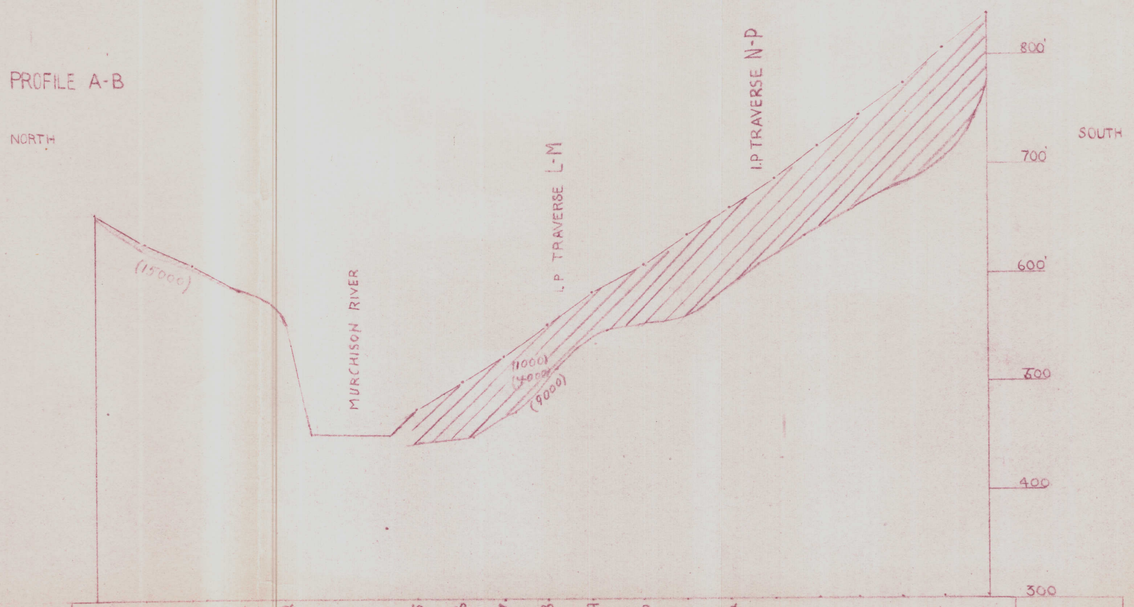
PLATE 3

PROFILE E-F



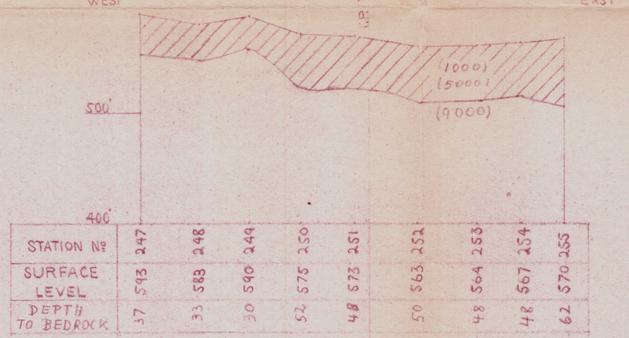
STATION №	239	240	241	242	243	244	245	246
SURFACE LEVEL	668	667	667	674	674	681	683	687
DEPTH TO BEDROCK	30	48	35	57	38	61	65	63

PROFILE A-B



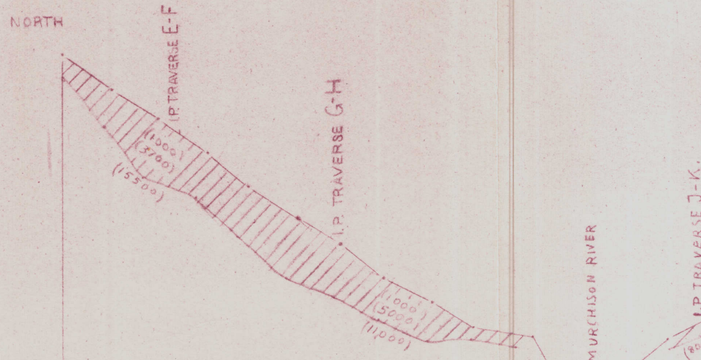
STATION №	201	202	203	204	272	205	206	207	208	209	210	211	212	213	214	215	216	217	218
SURFACE LEVEL	654	624	609	586	563	476	500	524	553	582	609	635	660	688	717	746	776	807	834
DEPTH TO BEDROCK	1	5	2	1		33	52	55	50	42	57		70	72	77	83	90	100	

PROFILE G-H



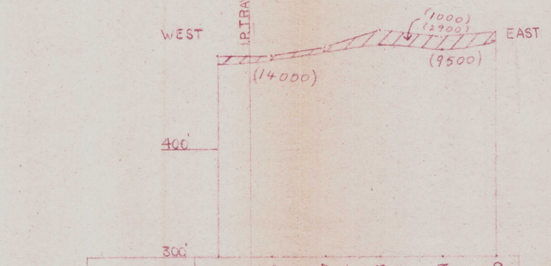
STATION №	247	248	249	250	251	252	253	254	255
SURFACE LEVEL	593	583	590	575	573	563	564	567	570
DEPTH TO BEDROCK	37	33	30	52	48	50	48	48	62

PROFILE C-D



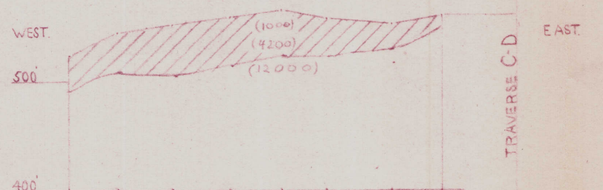
STATION №	238	237	236	235	234	233	232	231	230	229	228	227	226	225	224	223	222	221	220	219
SURFACE LEVEL	744	712	684	654	625	592	569	539	515	492	482	478	506	546	581	612	657	675	702	730
DEPTH TO BEDROCK	23	45	57	57	54	64	50	42	37	12		10	14	20	20	13	12	18	17	16

PROFILE J-K



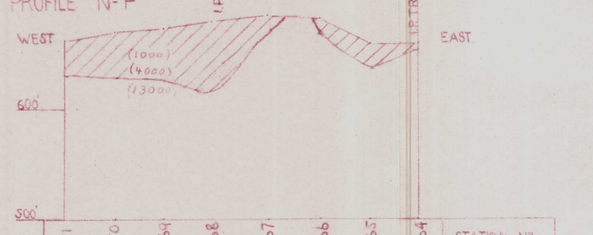
STATION №	275	276	277	278	279	280
SURFACE LEVEL	485	486	492	507	501	505
	7	4	4	13	12	9

PROFILE L-M



STATION №	256	257	258	259	260	261	262	263
SURFACE LEVEL	523	542	551	560	566	558	553	560
DEPTH TO BEDROCK	34	36	45	44	42	35	22	12

PROFILE N-P



STATION №	271	270	269	268	267	266	265	264
SURFACE LEVEL	664	671	675	681	687	683	660	661
DEPTH TO BEDROCK	30	42	47	68	18	15	22	7

LEGEND

OVERBURDEN

BEDROCK

(9000) SEISMIC VELOCITY IN FEET/SEC MEASURED FROM TIME/DISTANCE CURVES

I.P. INTERSECTION POINT

SCALE IN FEET

100 0 100 200 300

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SEISMIC REFRACTION SURVEY OF THE MURCHISON RIVER DAM SITE, TASMANIA

SEISMIC PROFILES

GEOPHYSICAL SECTION, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS. G277-3