COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD NO. 1962/180

QUEEN VICTORIA HOSPITAL SITE SEISMIC SURVEY, LAUNCESTON, TASMANIA 1961

by

E.J. POLAK

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SUMMARY

A seismic refraction survey was made around the site of a proposed new hospital in Launceston, Tasmania. Depths were determined to unweathered dolerite bedrock, and a contour plan of the unweathered bedrock was prepared.

1. INTRODUCTION

The Health Department of Tasmania proposes to construct a new hospital on Windmill Hill in Launceston. The hospital site adjoins the existing Queen Victoria Hospital.

In preparation of the plans for the hospital the possibility of slip of the ground was considered, and the Soil Mechanics Section of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) was asked to include the site in its investigation of the problems of the Lawrence Vale slip area. CSIRO requested the Bureau of Mineral Resources to help with the investigation. The main problem was the determination of faults in the dolerite bedrock, and the form of the bedrock surface, on the hospital site.

A survey was made between 24th January and 10th February 1961. The party consisted of E.J. Polak (party leader), D.J. Harwood (geophysicist), and J.P. Pigott (geophysical assistant).

2. GEOLOGY

Information on the geology of the area was collected and given in a personal communication by E.D. Gill of the National Museum of Victoria. The hospital site is located on a hill which is believed to consist of sand, silt, and clay of the Miocene Launceston Series, overlying dolerite.

The area is surrounded and crossed by faults, of which two, the Punchbowl Fault and the Cornwall Fault, are indicated roughly on Plate 1.

3. METHODS AND EQUIPMENT

Methods

The seismic refraction method is the one best suited to work of this nature. The method is described in a Record on the Railton limestone quarries (Polak, 1962).

Three different seismic methods were used on this survey:

Method of differences. This method is described by Heiland (1946, page 548). For this method to be used, shots must be fired from each end of a spread of geophones. In this survey the geophones were at 50-ft intervals for the 'normal' spreads. To obtain extra information about near-surface velocities, short 'weathering' spreads were used, with geophones spaced at 10-ft intervals.

The method of differences was used on Traverse R and part of Traverse B.

This method gives more accurate results than the other two. However it was not possible to use it for most of the traverses because of the difficulty of locating shot-points in a built-up area.

Step-out time method. Where it is possible to shoot at only one end of a normal spread, the step-out time method may be used.

The first arrival times are corrected for the time that it takes for the seismic wave to travel from the shot-point to the geophone along the main refractor. The remaining travel time for each geophone represents the time taken for the wave to travel from the main refractor to the surface. If the depth to the main refractor is known at any one geophone, either from drilling information or from depths calculated by the method of differences, then the depth to the refractor at the other geophones can be calculated on the assumption that the depth is proportional to the travel time between the main refractor and the surface.

The accuracy of the step-out time method depends on the accuracy of the two assumptions made, which are that the velocity of the main refractor is constant and known, and that the average velocity between the main refractor and the surface remains the same throughout the spread.

This method was used on parts of Traverses A, C, D, E, and J.

Broadside method. Where it is not possible to shoot at either end of the spread, shots may be fired from the side of the spread; this is known as the broadside method.

As in the step-out time method, the first-arrival times are corrected for the time taken to travel to the geophone along the main refractor. The depth to the refractor at each geophone is calculated from the known depth at one geophone, as with the step-out time method. The same assumptions are made as with the step-out time method.

This method was used on parts of Traverses B, C, H, L, F, and J.

Equipment

A Midwestern 12-channel seismic refraction/reflection seismograph was used for this survey, with Midwestern geophones of natural frequency 6 c/s.

4. RESULTS

Velocities

There are three groups of velocities which were measured in this survey :

Material	Velocity (ft/sec)
Soil	1000
Sand, silt, and clay of Miocene Launceston Series	2300 to 5000
Dolerite	17,000

No intermediate velocities between 5000 and 17,000 ft/sec were recorded. In this Record the dolerite is considered as bedrock and the lower-velocity material (1000 to 5000 ft/sec) as overburden.

Depths from seismic information

Plates 2 and 3 show the position of the bedrock as determined from the seismic results. There are several abrupt changes in the depth to bedrock shown on these traverses. On Traverse R between stations R1 and R6, there is a change of 80 ft in the level of the bedrock. This is probably due to faulting.

On Traverse E the bedrock surface dips uniformly at a low angle from Station E29 to the North Esk River at Station E0. North of Station E0, and beneath the North Esk River, the depth to bedrock increases rapidly. This may be due to faulting.

The same feature was not indicated along Traverse H.

On Traverse C there is a lowering in the level of the bedrock surface of about 40 to 60 ft near Station C40. There is also a small change in the depth to bedrock near Station C62. These changes in elevation may be due to faulting or to erosion features on faults or fractures.

On Traverse A, immediately west of the hospital site, the bedrock surface has no dip in the direction of the traverse from Station A0 to Station A23. South of Station A23 the bedrock depth increases rapidly to Station A30; the increase is about 50 ft. This feature is repeated on Traverse J east of Station J10, on Traverse K east of Station K10, and on Traverse L near Station L10. The feature strikes north as is shown on the contour plan of the bedrock (Plate 4).

Accuracy of results

From a comparison of the depth to bedrock on different traverses at their intersection points, it is found that discrepancies in calculated dolerite levels are less than 15 ft, except at the intersectionsof Traverse A with Traverses J and L. By raising the computed dolerite levels of Traverse A by 50 ft, a consistent picture is obtained in the circuit formed by Traverses A, L, F, and J. The resulting levels are also consistent with the levels of neighbouring traverses, whether tied to the loop or separated by a small gap.

The discrepancy in the level calculated along Traverse A is possibly due to the shot having been fired in a low-velocity zone. The traverse was shot from one end only, so no check is available.

Plate 4 shows a contour plan of the bedrock from seismic data after the adjustment of the level of Traverses A and correcting for small differences between adjacent traverses.

Depths to bedrock may still be in error by 20 percent after adjustment; however, it is believed that the general shape of the dolerite surface as shown on Plate 4 is reasonably accurate.

5. CONCLUSIONS

The highest part of the unweathered dolerite surface is formed by the closed + 10 contour near the intersection of Traverses A and L. There is a deep subsurface gully at the southern end of Traverse A, plunging to the south in the opposite direction to the slope of the terrain. A similar, but smaller, gully is suggested near Station F18.

There are steep dips on the dolerite surface on Traverse R. There is a dip in a westerly direction near the intersection of Traverses E and C.

It is possible that the features shown could be due to erosion as well as faulting, as the dolerite has been exposed to erosion.

6. REFERENCES

HEILAND, C.A. 1946 GEOPHYSICAL PROSPECTING. New York. Prentice-Hall Inc.

POLAK, E.J. 1962 Railton geophysical survey, Tasmania 1959-60. Bur. Min. Resour. Aust. Rec. 1962/181.

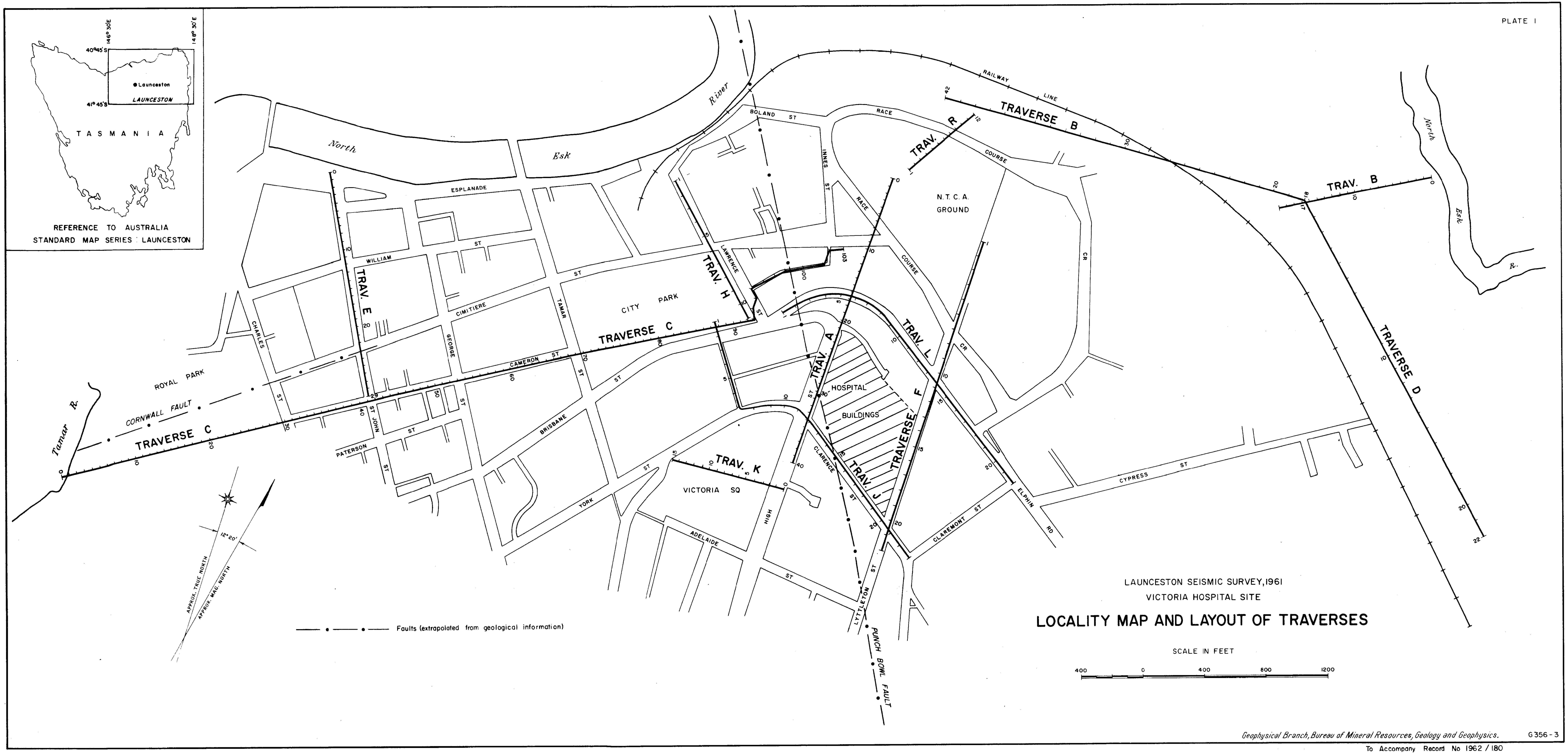
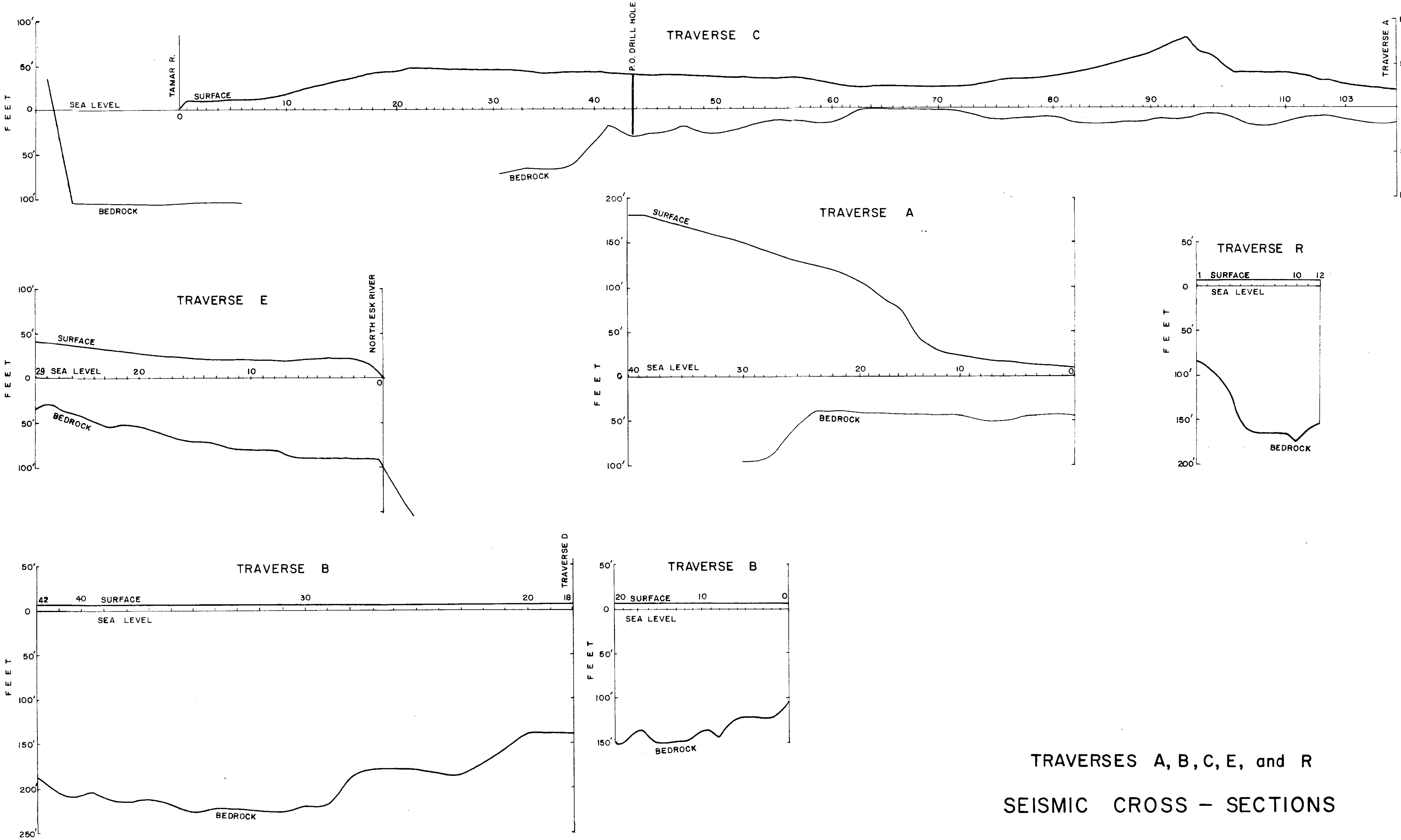


PLATE I
REFERENCE TO AUSTRALIA
STANDARD MAP SERIES : LAUNCESTON
TASMANIA
Launceston
LAUNCESTON
TRAVERSE B
TRAV. B
TRAV. R
TRAVERSE C
TRAVERSE D
TRAV. E
TRAVERSE F
TRAV. H
TRAV. A
TRAV. J
TRAV. K
TRAV. L
CORNWALL FAULT
PUNCH BOWL FAULT
ROYAL PARK
CITY PARK
N. T. C. A. GROUND
HOSPITAL BUILDINGS
VICTORIA SQ
North Esk River
Tamar R.
RAILWAY LINE
APPROX. TRUE NORTH
APPROX. MAG. NORTH
12°20'
Faults (extrapolated from geological information)
LAUNCESTON SEISMIC SURVEY, 1961
VICTORIA HOSPITAL SITE
LOCALITY MAP AND LAYOUT OF TRAVERSES
SCALE IN FEET
400 0 400 800 1200
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics.
G356-3
To Accompany Record No 1962 / 180
LAUNCESTON, TAS. 1961

PLATE 2



TRAVERSES A, B, C, E, and R

SEISMIC CROSS - SECTIONS

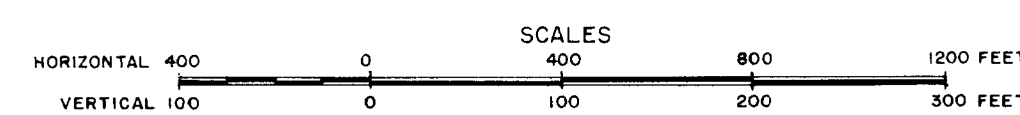


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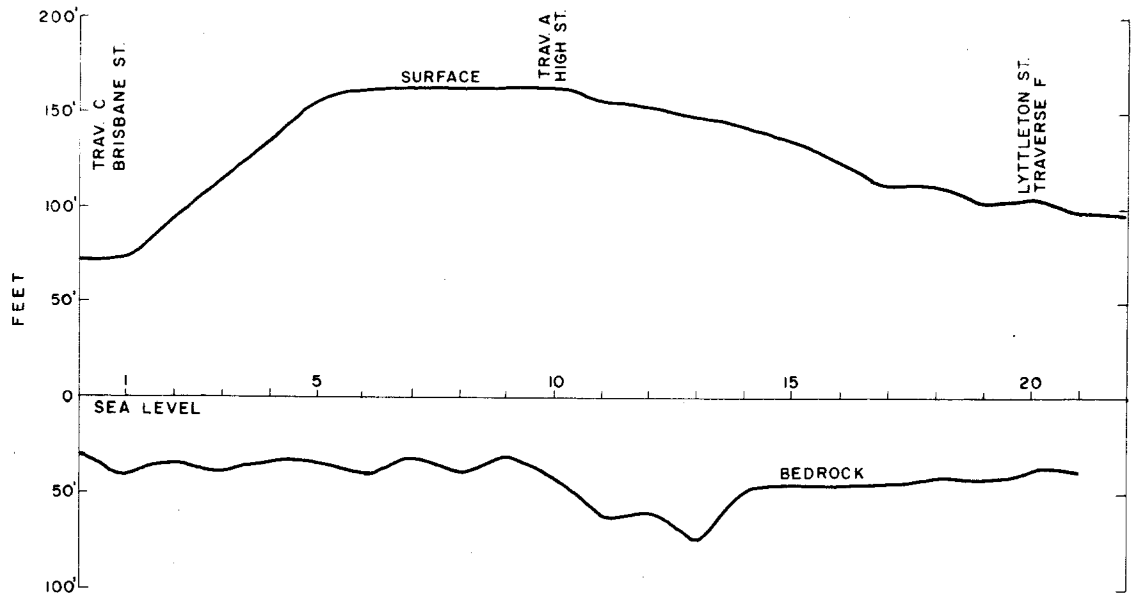
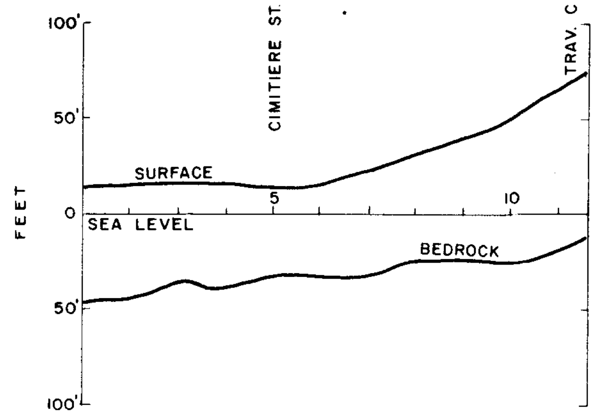
PLATE 3

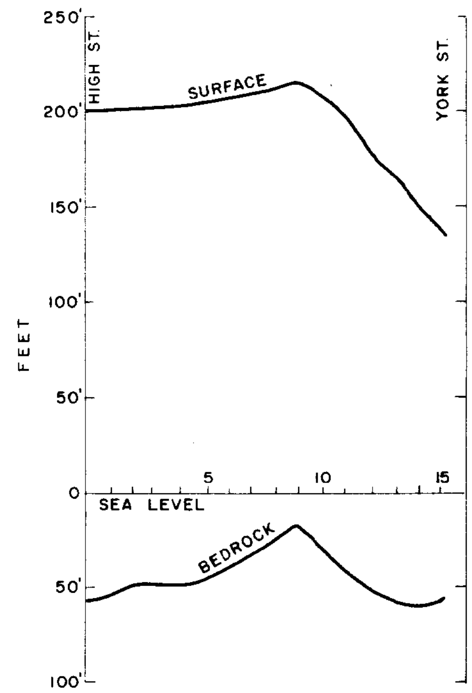
TRAVERSE J



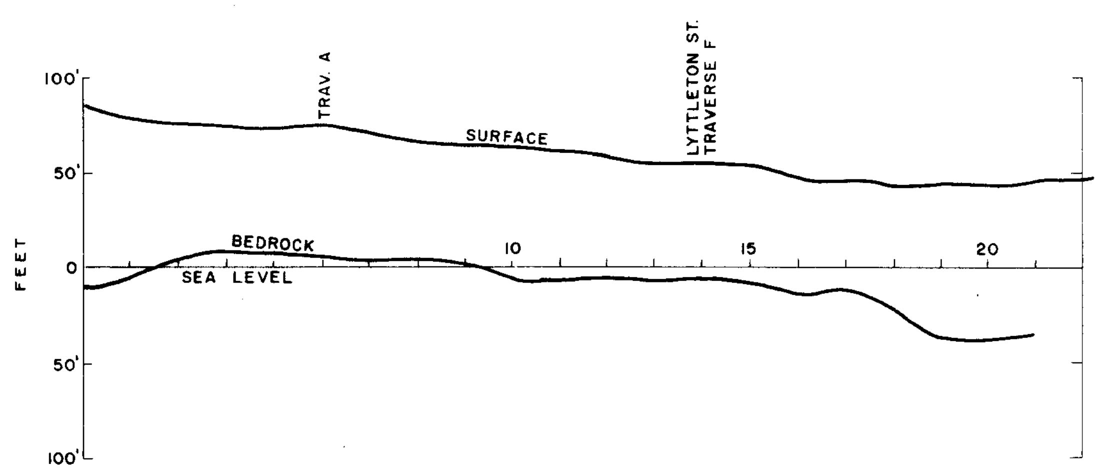
TRAVERSE H



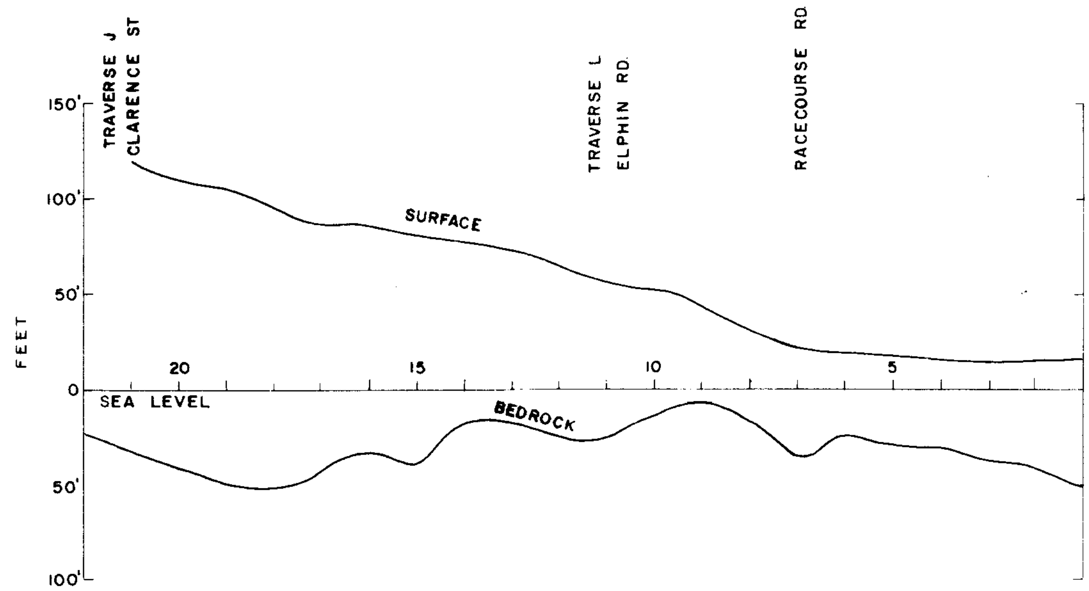
TRAVERSE K



TRAVERSE L



TRAVERSE F



TRAVERSES F, H, J, K, and L
SECTIONS

SCALES

HORIZONTAL 400 0 400 800 FEET

VERTICAL 100 0 100 200 FEET

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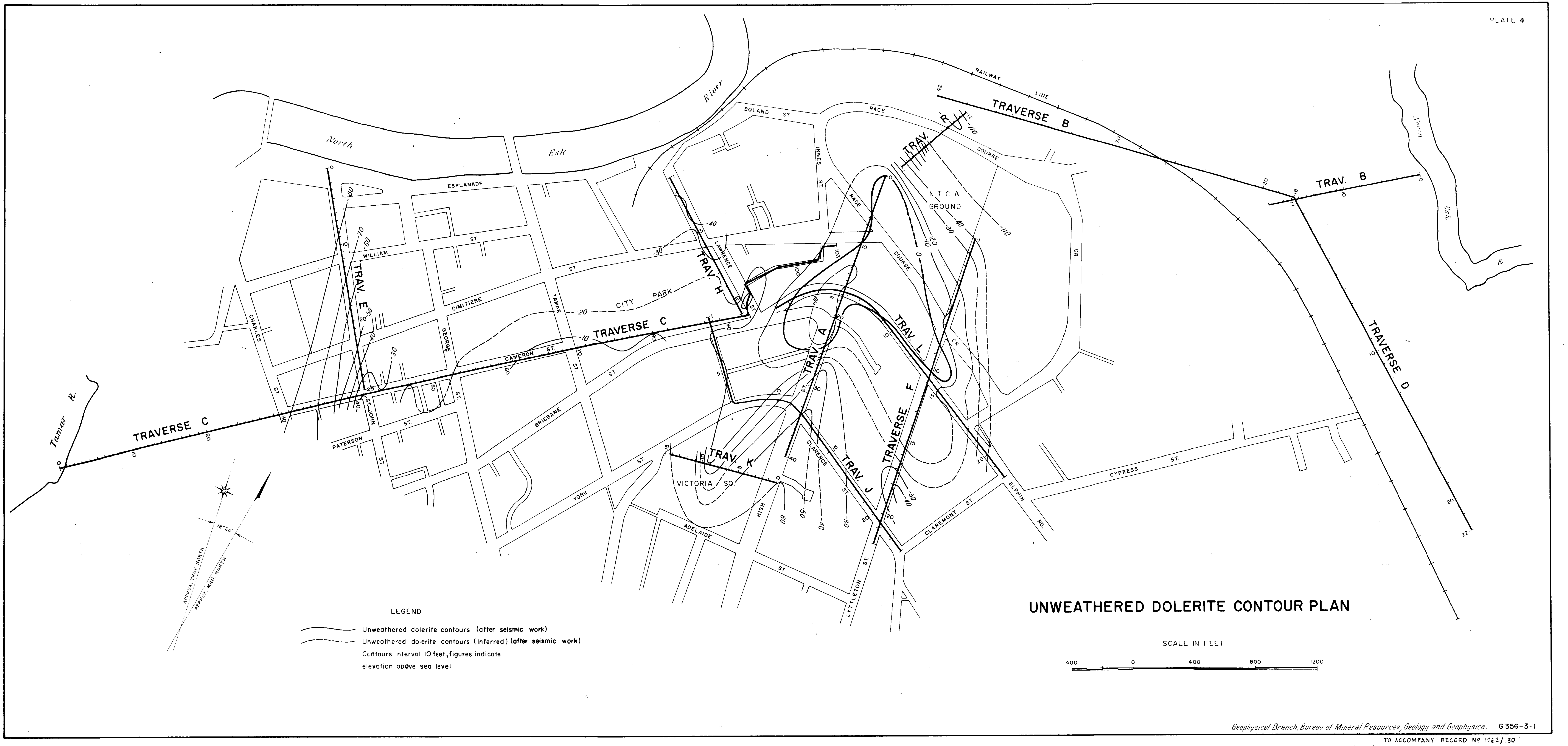

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