COMMONWEALTH OF AUSTRALIA
DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

RECORDS 1956, No. 34

GEOPHYSICAL INVESTIGATION OF THE NIVE RIVER DAM SITE, WAYATINAH "A" POWER DEVELOPMENT SCHEME, TASMANIA

by

W. A. WIEBENGA, D. F. DYSON & L. V. HAWKINS

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ABSTRACT

Results are given of a combined resistivity and seismic refraction survey made at the request of the Hydro-Electric Commission of Tasmania, to locate a possible dam site on the Nive River. The dam is part of the Wayatinah "A" Power Development Scheme.

The main requisite for such a site is that depth to rock suitable for foundations (at this site unweathered dolerite) should be as small as possible. Results indicated that the thickness of the weathered dolerite has a considerable range and revealed the presence of several zones of fracturing. The results indicated two possible sites, where the weathered dolerite is comparatively thin.

1. INTRODUCTION.

The Nive River dam is part of the Tasmanian Hydro-Electric Commission's Wayatinah "A" Power Development Scheme. The dam site (see Plate 1) must be situated between the Tarraleah Power Station and the level of the proposed tunnel to feed the Wayatinah Power Station.

Diamond drilling tests at Wilson's Creek showed the dolerite to be deeply weathered, and revealed a fault zone along the river bed. Such weathering and faulting would cause difficulties in water diversion, thus further restricting possible dam sites upstream from this point.

The Bureau of Mineral Resources, Geology and Geophysics was asked by the Hydro-Electric Commission to undertake a geophysical survey with the object of finding a suitable dam site within three-quarters of a mile downstream from Wilson's Creek.

The slopes of the sides of the Nive River valley are steep and long, and access to the south-west bank is difficult. As all equipment had to be transported by hand, and the survey was made during inclement mid-winter weather, progress was very slow.

The geophysical survey was carried out during the period May to August, 1954 by a party comprising D. F. Dyson (party leader), L. V. Hawkins (geophysicist) and four to six field assistants supplied by the Hydro-Electric Commission. The Survey Section of the Commission carried out the topographical survey work as directed by the geophysical party.

2. GEOLOGY.

The country rock in the area consists of dolerite which is considerably faulted and sheared. The direction of the main faults and shears is evident from the physiographic pattern, which indicates three main directions of shearing at approximate bearings of 280°, 325° and 0° to 15°. The Nive River follows one or other of the main shear zones.

The slopes of the sides of the valley are steep and range from 25° to 45°. The sides of the valley are mostly covered by dolerite boulders and scree; the thickness of this surface layer varies from place to place. The dolerite is weathered near the surface and the main factors in determining the choice of the dam site are the thickness of weathering and the presence of shear zones.

3. METHODS.

(a) General.

It was originally intended to make a reconnaissance resistivity survey along both banks, and from the results of this to select possible dam sites over which detailed and more definite seismic surveys could be made. Electrode contacts on the south-west bank were so bad, however, that reliable resistivity measurements along this bank were impossible and a seismic refraction survey was made along the whole bank. Resistivity work was completed along the whole north-east bank, and three possible dam sites suggested by the resistivity results were further investigated by the seismic method.

(b) Resistivity survey.

The equipment used was the "Megger" earth tester. The method of continuous profiling, with constant electrode spacing, was employed. Two sets of readings were taken along the upper traverses (K,P and M), with electrode spacings of 40 feet and 80 feet, and one set along the lower traverse (L, Q, R and N) using 40-foot spacing (Plates 2 and 3). Readings were at intervals of 40 feet.

(c) Seismic refraction survey.

A "Century" 12-channel portable refraction equipment, model 506, was used in the seismic survey.

The technique used was the "reciprocal method" (or "method of differences"). This is fully described by Heiland (1946, p. 548) and Edge and Laby (1931, p. 339).

The following types of geophone spread were used:-

(i) Weathering spreads, with a geophone interval of 10 feet, at about 800-foot intervals along the traverses. Shot distances were 10 feet, 50 feet, and in excess of 50 feet from the geophone spread. The data obtained from the weathering spreads were used to determine the thickness and velocity of the soil and the velocity of the material overlying the unweathered dolerite.

(ii) Normal spreads with a geophone interval of 40 feet. Shot distances were 40 feet, and of the order of 200 feet.

4. RESULTS.

(a) Resistivity survey (Plate 3).

The resistivity profiles along the north-east bank showed the following three locations where relatively high resistivity values indicate minimum depth to fresh dolerite:-

Traverses K, P and M	(i)	Stations 905-872
	(ii)	" 862-850
	(iii)	" 801-777
Traverses L, Q, R and N	(i)	Stations 625-649
	(ii)	Near Station 702
	(iii)	Stations 725-738

These locations were selected for further investigation by detailed seismic refraction work.

(b) Seismic survey.

The interpretation of the seismic data is shown by the sections on Plates 4 and 5. Table 1 below gives the correlation between the seismic velocities recorded and rock types identified.

TABLE 1

Rock type	Seismic velocity (ft/sec)	Remarks
Soil or hillside detrital	1,000-1,100	Determined in situ
Weathered dolerite	3,000-4,500	" " "
Fractured dolerite (slightly weathered along fractures)	6,500-7,500	Inferred from previous surveys in the area
Fresh dolerite (fractured to massive)	10,000-18,000	Determined in situ

The soil ranges in thickness from zero at stations 664 on Traverse B and 726-730 on Traverse N to a maximum of 21 feet at station 772 on Traverse N. Along some parts of the seismic sections no soil layer is shown, because the data obtained did not permit the soil thickness to be calculated. In such instances the soil is included in the weathered dolerite, which is represented by a proportionally lower velocity.

On the north-east bank the seismic work outlined in Section 4(a) above showed that not only is the depth to unweathered dolerite irregular, but that the nature of the dolerite varies as indicated by the variation in the seismic velocity. At the upstream end of Traverse K the thickness of the weathered layer has a considerable range, ranging from 8 feet at station 899 to 48 feet at station 895. Along Traverse L the thickness of the weathered material is more uniform but ranges from 7 feet at station 644 to 30 feet at station 630.

Along Traverses P, Q and R, the minimum and maximum thicknesses of overburden are 6 feet at station 708 and 57 feet at station 690 respectively.

Along Traverses M and N, the thickness of weathered material is less than that along the traverses upstream, but the lower average velocities of the unweathered dolerite indicate close jointing or fracturing.

On the south-west bank, along which the seismic work was continuous, the thickness of the weathered layer increases downstream, in some places being more than 100 feet. Over a distance of 400 feet on the upstream part of the river, the depth to unweathered dolerite ranges from 3 feet at station 667 on Traverse B to 39 feet at station 660 on Traverse A.

Fracturing or shearing is indicated by the lower velocities in the unweathered dolerite between stations 529 on Traverse B and 555 on Traverse D. This fracture zone is also evident on Traverse A, downstream from station 483.

Results along Traverses E, F and H, at right angles to the river, confirm the results obtained along the main traverses, namely that the weathered dolerite increases in thickness downstream and that a fracture zone exists near Traverse F.

Because of the adverse conditions under which the seismic survey was made, the overall accuracy of the depth estimates is considered to be not better than ±20 per cent., but this should be adequate for the purpose of indicating those places where the depth to unweathered dolerite is small.

5. CONCLUSIONS.

The survey provided information on the depth to unweathered dolerite and indicated the presence of shear zones along both sides of the river.

Also, in selecting a suitable dam site, the presence of close jointing within the proposed abutments is undesirable. It is considered that the most suitable dam sites indicated by the survey are in the north-western part of the area surveyed, and are shown on Plate 2 by the lines SS' and TT'. Cross-sections along these lines have been drawn from the seismic profiles and are shown on Plate 6. Also shown on Plate 6, for comparison purposes, are cross-sections along XX' and YY' which are located approximately in the centre of the second and third areas where the resistivity survey indicated that further investigation by seismic refraction work was desirable - see Section 4(a) of this report. It is clear from the four cross-sections that the weathered dolerite is much thinner along SS' and TT' than along XX' and YY'.

6. ACKNOWLEDGEMENTS.

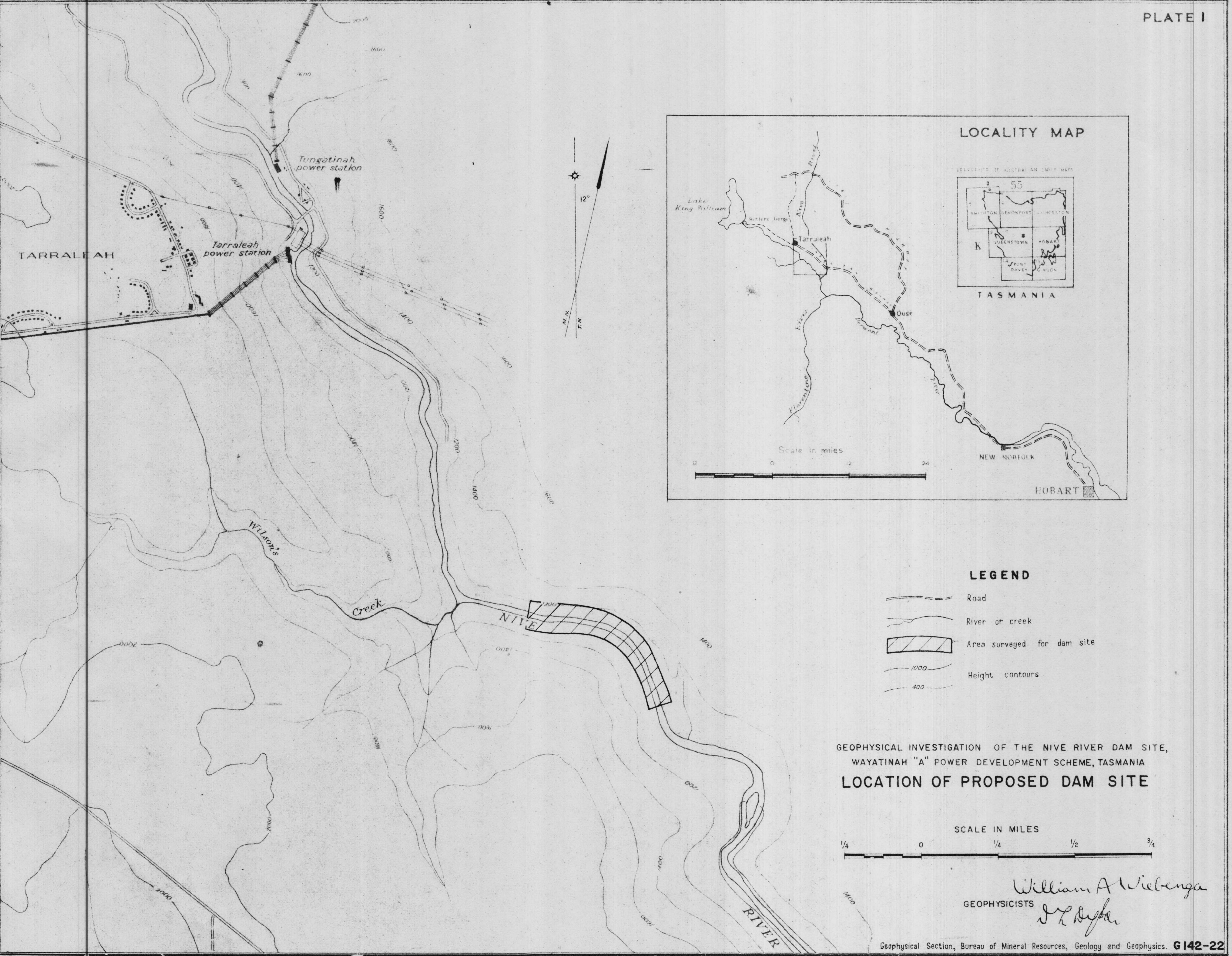
It is desired to acknowledge the ready co-operation of the staff of the Resident Engineer's Office at Wayatinah.

7. REFERENCES.

Edge, A.B. & Laby, T.H., 1931 - THE PRINCIPALS AND PRACTICE OF GEOPHYSICAL PROSPECTING. Cambridge University Press, London.

Heiland, C.A., 1946 - GEOPHYSICAL EXPLORATION. Prentice Hall, New York.

PLATE I



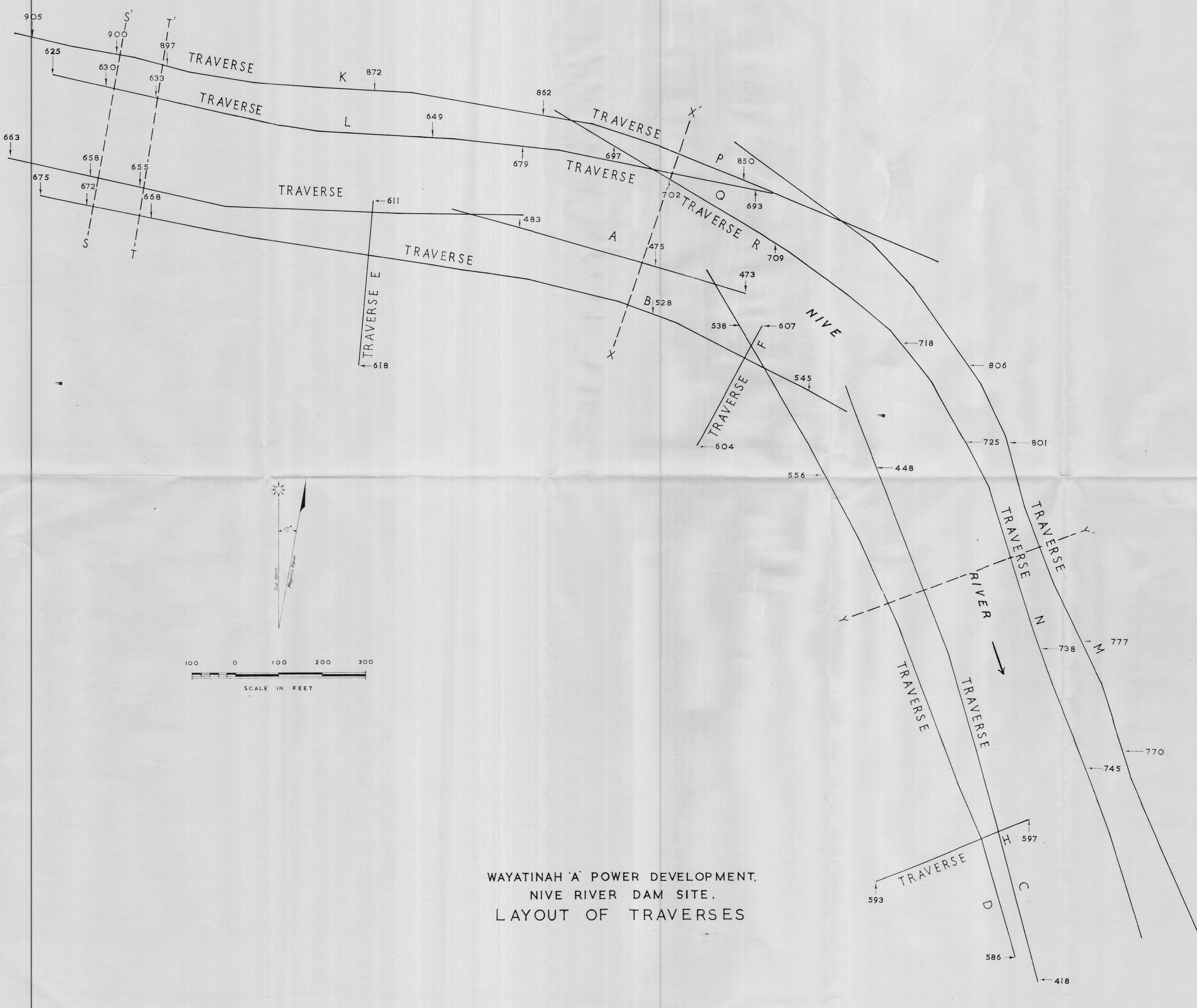
GEOPHYSICAL INVESTIGATION OF THE NIVE RIVER DAM SITE,
WAYATINAH "A" POWER DEVELOPMENT SCHEME, TASMANIA

LOCATION OF PROPOSED DAM SITE

GEOPHYSICISTS William A Wiebenga
D L Dyson

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics. G142-22

PLATE 2



WAYATINAH 'A' POWER DEVELOPMENT.
NIVE RIVER DAM SITE.
LAYOUT OF TRAVERSES

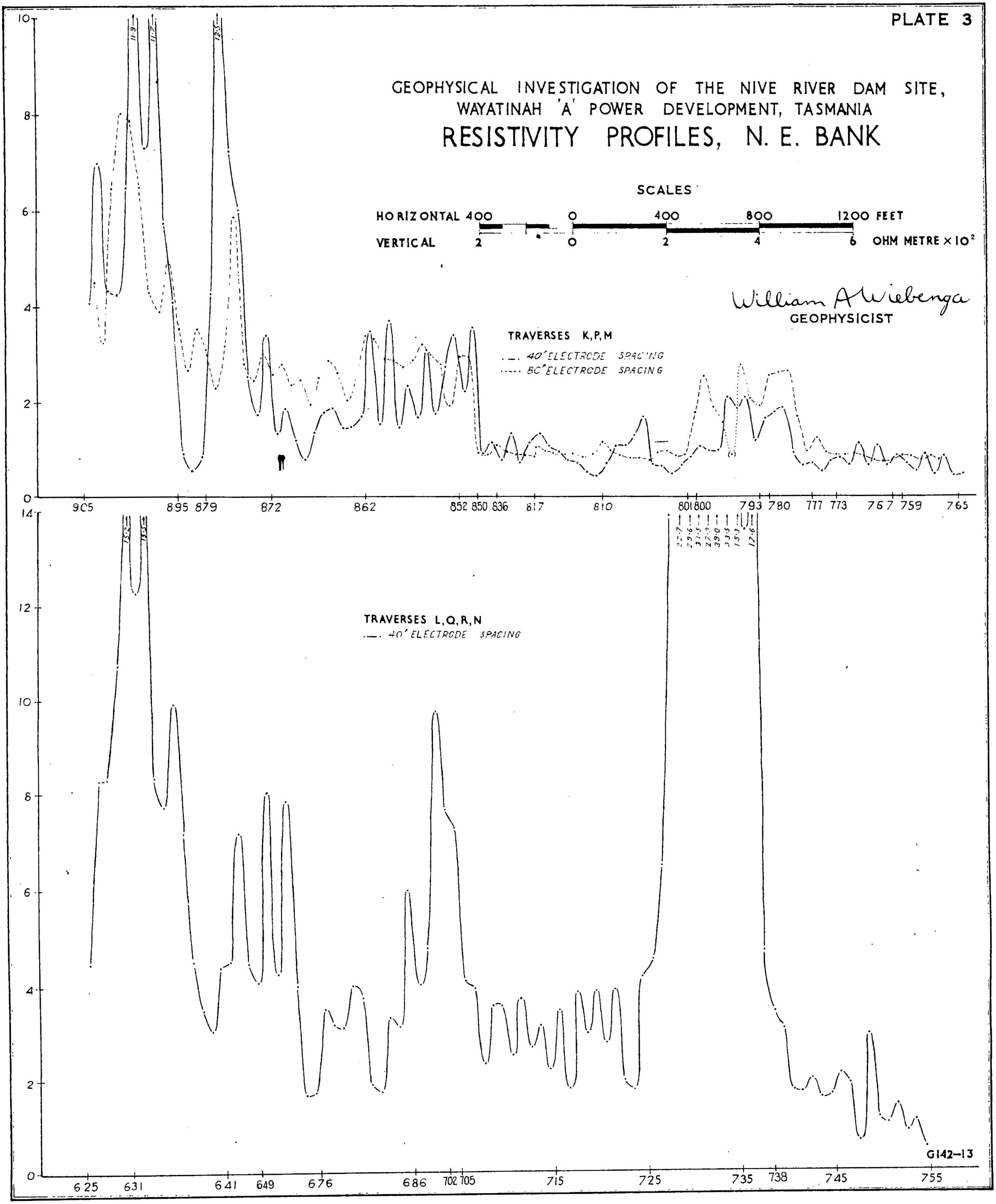
Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics

G 142-20

PLATE 3

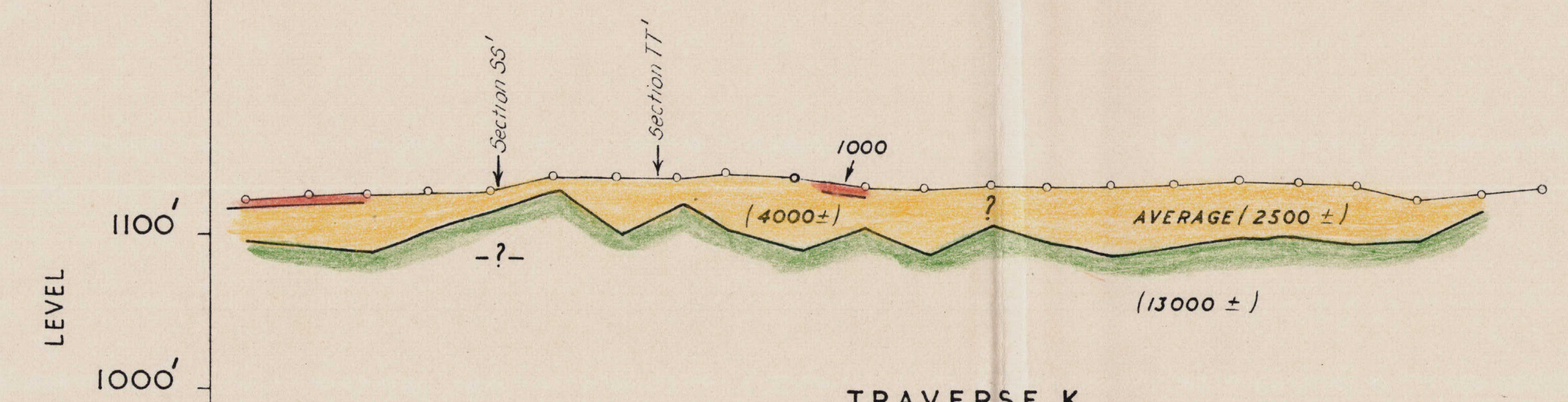
GEOPHYSICAL INVESTIGATION OF THE NIVE RIVER DAM SITE, WAYATINAH 'A' POWER DEVELOPMENT, TASMANIA

RESISTIVITY PROFILES, N. E. BANK



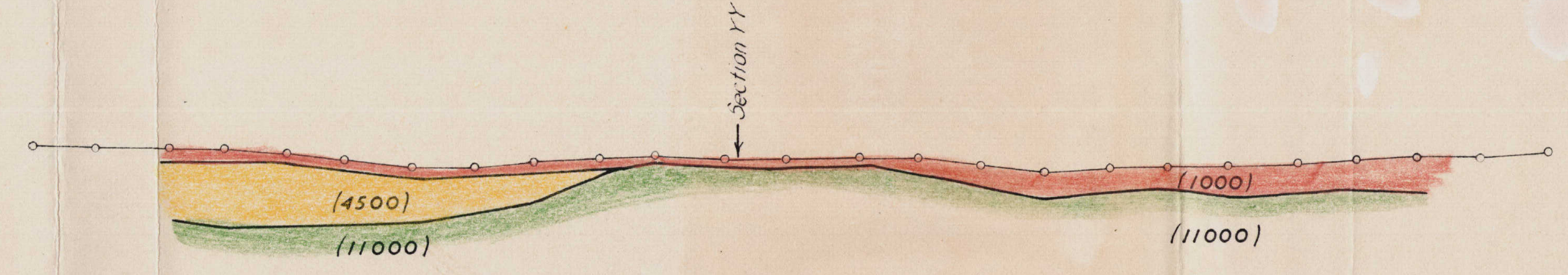
G142–13

PLATE 4



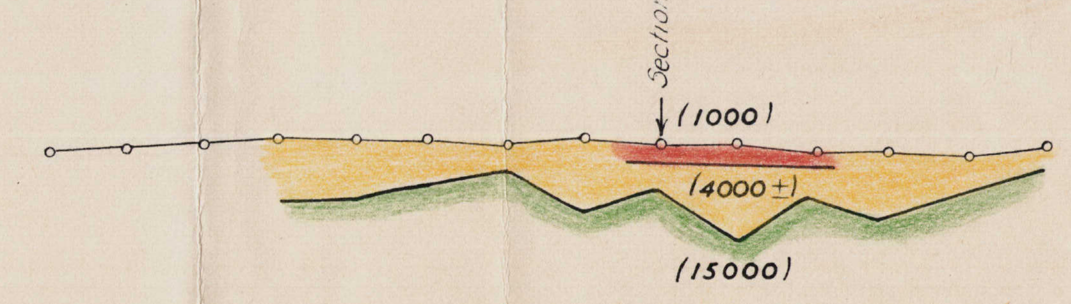
TRAVERSE K

STATION NUMBER	904	903	902	901	900	899	898	897	896	895	894	893	879	878	877	876	875	874	873	872	871	870
THICKNESS SURFACE LAYER	5½										4½											
THICKNESS OVER-BURDEN	29	36		23	15	8	36	17	38	48	25	43	25	38	46	39	39	35	39	29	11	



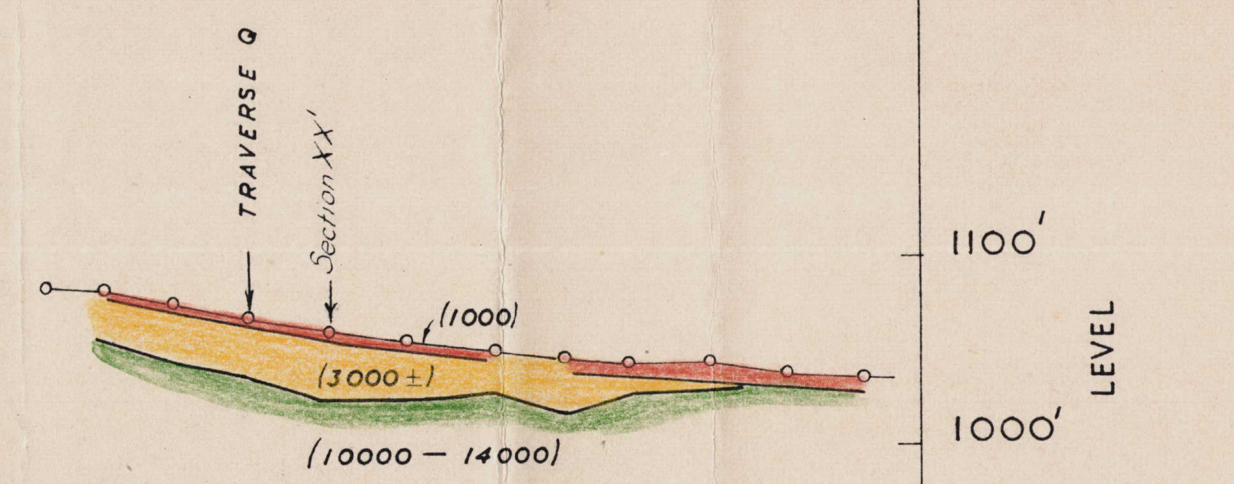
TRAVERSE M

STATION NUMBER	806	805	804	803	802	801	800	799	798	797	796	795	794	793	780	779	778	777	776	775	774	773	772	771	770
THICKNESS SURFACE LAYER			7							7½	2	6	7	5	10	13	15	13	13	17	17	18	21		
THICKNESS OVER-BURDEN			46	51	46	44	36	29	27																



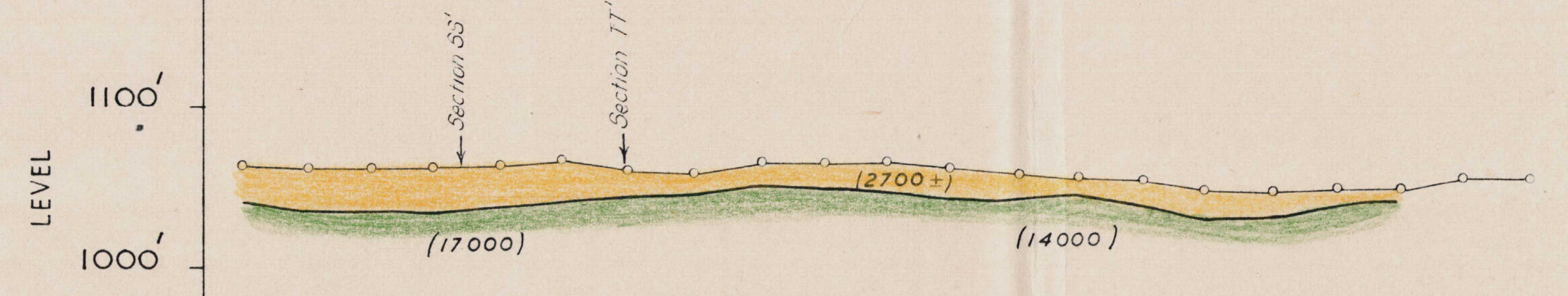
TRAVERSE P

STATION NUMBER	862	861	860	859	858	857	856	855	854	853	852	851	850	849
THICKNESS SURFACE LAYER									7	7	7	7		
THICKNESS OVER-BURDEN				34	32	20	12	38	24	48	24	36	18	12?



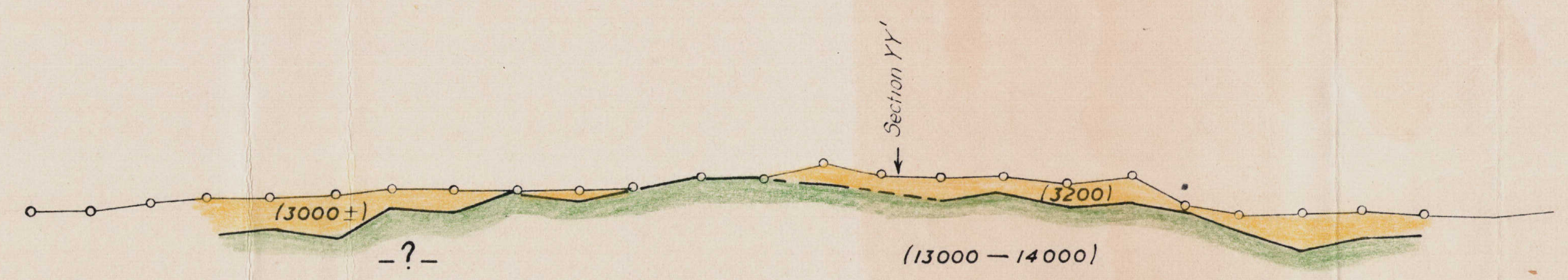
TRAVERSE R

STATION NUMBER	697	696	695	687	702	703	704	705	706	707	708	709
THICKNESS SURFACE LAYER	3			6								7½
THICKNESS OVER-BURDEN	25	21	33	38	30		23	29	15	14	6	7½



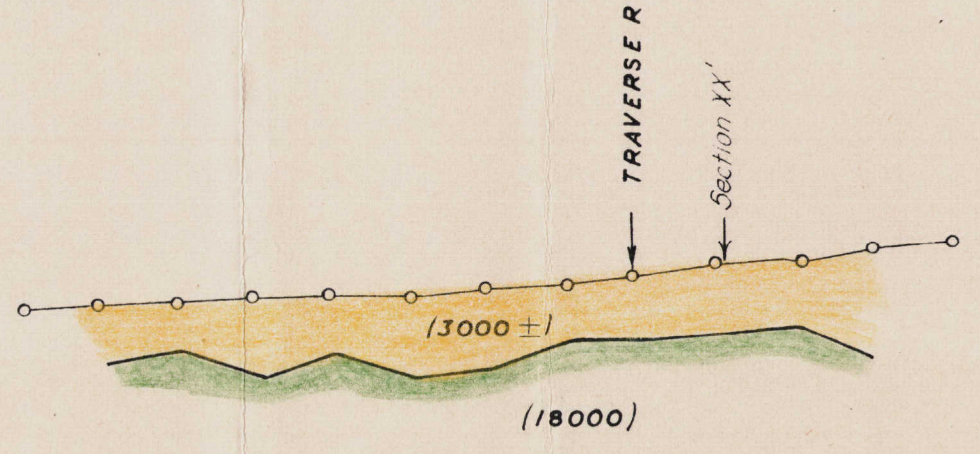
TRAVERSE L

STATION NUMBER	625	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647
THICKNESS SURFACE LAYER									4												
THICKNESS OVER-BURDEN	23	26	28	30	28	27	17	14	14	15	18	19	16	9	15	18	15	7	7		



TRAVERSE N

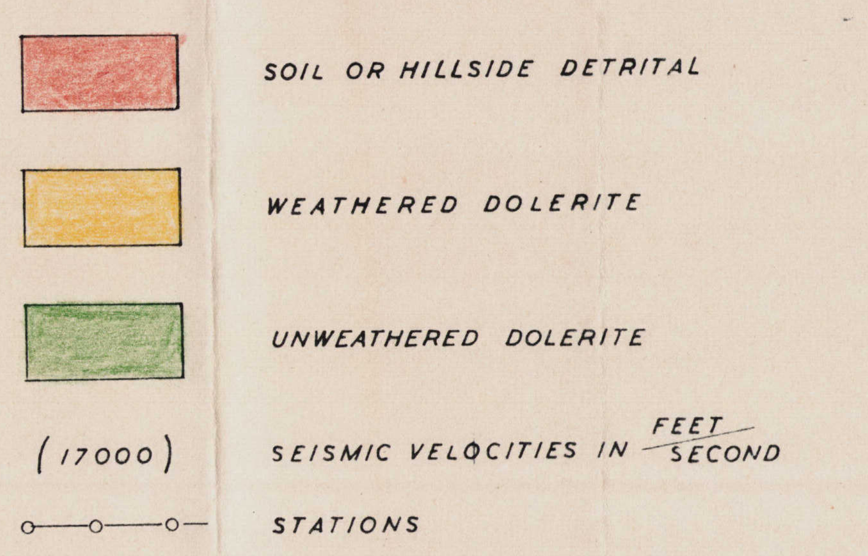
STATION NUMBER	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741
THICKNESS SURFACE LAYER																								
THICKNESS OVER-BURDEN				26	21	29	13	16	0	11	2	0	1	14	1	16	11	16	18	5	14	26	19	13

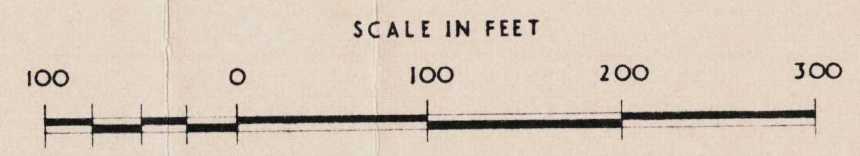


TRAVERSE Q

STATION NUMBER	679	680	681	682	683	684	685	686	687	688	689	690	691
THICKNESS SURFACE LAYER													
THICKNESS OVER-BURDEN	30	24	42	30	42	42	30	33	36	36	57		

LEGEND





WAYATINAH "A" POWER DEVELOPMENT,
NIVE RIVER DAM SITE, N.E. BANK,

SEISMIC SECTIONS

GEOPHYSICISTS

William A Wiebenga

[signature]

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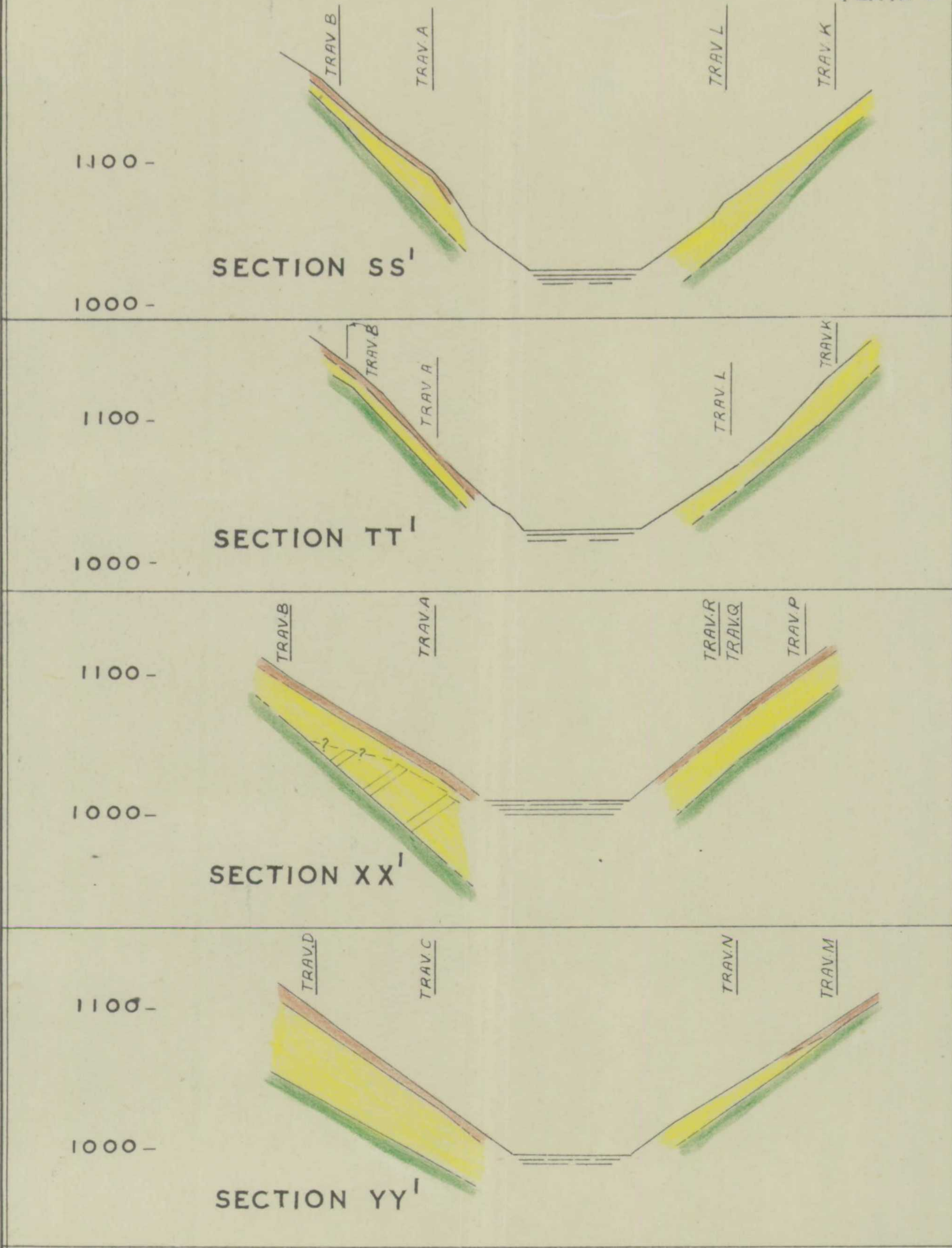
PLATE 5
LEVEL
1100'
1000'
TRAVERSE A
TRAVERSE B
TRAVERSE C
TRAVERSE D
TRAVERSE E
TRAVERSE F
TRAVERSE H
WATER LEVEL
STATION NUMBER
THICKNESS SURFACE LAYER
THICKNESS OVERBURDEN
BETWEEN 10' AND 15'
LEGEND
SOIL AND/OR HILLSIDE DETRITAL
WEATHERED DOLERITE
SHEARED AND FRACTURED DOLERITE
UNWEATHERED DOLERITE
(17000) SEISMIC VELOCITIES IN FEET/SECOND
STATIONS
GEOPHYSICISTS
SCALE IN FEET
100 0 100 200 300 400
WAYATINAH "A" POWER DEVELOPMENT, NIVE RIVER DAM SITE, S.W. BANK
SEISMIC SECTIONS
G 142-5

PLATE 6



Soil or hillside detrital.

Weathered dolerite.

Fractured "

Fresh "

HORIZONTAL SCALE IN FEET

0 100 200

William A Wiebenga

GEOPHYSICIST

WAYATINAH 'A' POWER DEVELOPMENT

NIVE RIVER DAMSITE

CROSS SECTIONS SS', TT', XX', YY'

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